COMPONENTS OF SEASONAL SOYBEAN INFESTATION BY *HELIOTHIS ZEA* IN EASTERN VIRGINIA, WITH EMPHASIS ON MULTIVARIATE ANALYSIS OF FIELD SUSCEPTIBILITY

by

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To my husband Walter
and to my parents

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To pursue science is not to disparage the things of the spirit. In fact, to pursue science rightly is to furnish a framework on which the spirit may rise.

Vannevar Bush

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I. INTRODUCTION

Soybeans, Glycine max (Linnaeus) Merrill, have increased in their importance as an agricultural crop in the United States since their introduction in the early 1800's from China. Soybeans, grown primarily for hay until 1941, are now grown for the bean (Probst and Judd 1973). Approximately 95% of the beans harvested in the United States are now extracted for a multitude of products such as livestock and poultry meal, edible fat products, edible protein products, and fermented specialty products (Cowan 1973). In 1971, approximately 30% of the U.S. agricultural exports were in soybean oilseeds, fats and oils (Kromer 1973).

The economic importance of soybeans has increased in both the United States and the world. Production of soybeans, estimated at 5.19×10^8 bushels in 1949, increased to 1.49×10^9 bushels in 1969 (Probst and Judd 1973). The projected production in 1978 is 1.80×10^9 bushels (Bickers 1978). The United States is the foremost producer and exporter of soybeans. In 1973, for example, soybeans from the United States constituted approximately 75% of the world's soybean production (Kromer 1973). Also in that year, approximately 56 million acres in 30 states were in soybeans compared with 41 million acres in 1969 and only 23 million acres in 1959 (Probst and Judd 1973).

This increase in soybean acreage, particularly in monoculture in the South has been accompanied by an increase in crop damage by insects previously of no problem to the originally fewer, smaller scattered soybean fields (Turnipseed 1973). The corn earworm, Heliothis zea (Boddie) (Lepidoptera: Noctuidae) is considered one of the most destructive pod feeding insects of soybeans (Miller 1972, Turnipseed and Kogan 1973). In the more southern states, the corn earworm is considered the single most important insect pest in soybeans (Deitz et al. 1976). H. zea is the major pod feeder taken into account in the soybean scouting surveys conducted in eastern Virginia, where most soybeans are grown.

Due to the increased incidence both of higher numbers of older pests and new species of pests, a need to understand the dynamics of insect populations and plant growth gains in importance. Two wide-area population models on the Heliothis species in soybeans, corn, tobacco, cotton and other hosts were developed for the agroecosystems of North Carolina (Stinner et al. 1977) and Texas (Hartstack et al. 1976). These complex models have been developed over several years and utilize vast amounts of Heliothis-related data (insect developmental time, crop characteristics, etc.) and the expertise of teams of biologists and mathematicians.

The general aim of this study was to increase the understanding of the soybean plant - H. zea dynamics in a more northern, limited geographic region: the coastal plain of eastern Virginia. This region, unlike those in other parts of the country growing soybeans, consists of basically forested areas interspersed with small, approximately 20 acre fields of three basic crops: corn, soybeans, and peanuts. All three of these crops host H. zea. However, corn serves as the host to the second generation larvae, whereas soybeans and peanuts host the third, and largest, generation. Cotton and tobacco, which are equally susceptible host crops, are grown to a greater extent in the more southern soybean growing areas, while tomatoes are grown in the northern regions. In addition to this unique crop complex, the soil is sandy and the terrain relatively flat throughout the soybean-growing region of Virginia. The major problem with corn earworms in this region has been with the third generation larvae, which occurs primarily in soybeans. Unexpected infestations have caused last-minute management problems (e.g., lack of sufficient insecticides and planes for application) and crop damage (W. A. Allen, pers. comm.).

This study's first major objective was to monitor the development of *H. zea* in corn and subsequently in soybeans. This was to be accomplished through three secondary objectives. The first secondary objective required determination of the number of instars present per generation in corn in July and in soybeans from mid-August through September. Second, it was necessary to determine to what extent the reservoir population, that in corn, is related to the density of the following generation in soybeans. The third secondary objective was to determine the timing of moth emergence from corn and of movement to soybeans. Achievement of these three secondary objectives was thought to provide a foundation from which the general magnitude of the regional infestation in soybeans could be predicted, as well as to allow the time of occurrence of the infestation to be anticipated.

The second major objective was to assess which among a complex of biotic and abiotic factors influencing the levels of corn earworm infestations in soybean fields could be used for seasonal predictions of the susceptibility of a specific field. Since the degree of complexity of the corn earworm-plant association is theoretically almost unlimited, the minimum number of variables that would fulfill this second objective was sought. Therefore, the study was approached multi-dimensionally.

To accomplish the second objective, the corn earworm data were analyzed in relation to data of: (a) pupal mortality of the reservoir population; (b) incidence of pathogens, parasites, and predators on the second and third generations of H. zea larvae; and (c) measurements of a variety of other biotic and abiotic factors. The above types of data were considered to be the most likely to yield clues as to differences in larval densities between and within different fields, years, and counties.

The studies presented herein set out to quantify several previously inadequately defined aspects of the corn earworm dynamics in eastern Virginia. Not only is it desirable to determine which factors most influence larval densities in soybeans of eastern Virginia, but it also is desirable to arrive at quantitative results which can be generalized for later use in pest management decisions. Much of the analysis is devoted to the classification of soybean fields according to apparent susceptibility to infestation. Hypotheses are presented concerning why and in what way some fields are actually more susceptible than others. Also, some attention is devoted to the development of an objective estimator for use in short-term predictions of likely corn earworm infestations in soybeans, based on the nature of the reservoir population in corn.

II. LITERATURE REVIEW

A. Systematics and Biology

1. Species Description

The corn earworm, *Heliothis zea* (Boddie) was first described by Fabricius in 1793 as *Bombyx obsoleta*. Since then, the moth has been variously redescribed as: *Noctua armigera* Hübner (1796); *Phaleana zea* Boddie (1850); possibly as *Heliothes* by Glover (1855); *Heliothis pulverosa* Walker (1857); *H. umbrosus* Grote (1862); *H. obsoleta* (Fabricius); *H. armigera* Butler (1882); and *H. zea* (Boddie) (Quaintance and Brues 1905; Hardwick 1965; E. L. Todd, USDA, pers. comm. 1974).

Quaintance and Brues (1905) recognized the *Heliothis* species distribution to be Holarctic. In a monograph, Hardwick (1965) deals with the corn earworm complex and separates the group recognized by Quaintance and Brues and most authors as *Heliothis* spp. from the type species of *Heliothis*. Hardwick's regrouping of type species resulted in the following categories: (a) *Helicoverpa zea*, restricted to the New World; and (b) *Helicoverpa armigera*, the Old World species. However, *Helicoverpa* is not yet generally recognized as the correct generic name of the corn earworm (Dr. E. L. Todd, USDA, pers. comm.).

The common names for *Heliothis zea* include: corn earworm, tomato fruitworm, bollworm, and false tobacco budworm. All these names indicate the particular plant and plant part attacked by the larvae.

Detailed information on the insect's life cycle and biology was given by Quaintance and Brues (1905), Ditman and Cory (1931), Brazzel et al. (1953), Metcalf et al. (1962), and Neunzig (1969). Hardwick (1965) presented descriptions and biologies of representative members of the entire corn earworm complex. Peterson (1971) gave additional larval descriptions. Deitz et al. (1976) gave a general description of the corn earworm biology. The adult moth's exoskeleton was studied in detail by Callahan (1969).

The following morphological description of the corn earworm life stages is adapted from Hardwick (1965) and Neunzig (1969).

The corn earworm egg is hemispherical, approximately 50 mm high, and has a radially-ribbed chorion. The egg is cream-colored shortly after it is deposited and darkens as the larva develops within the egg.

There are 5 to 7 instars which range from a mean of 1.5 mm (neonate larvae) to 42.3 mm (last instar) in length. The first two instars are characterized by dark head capsules and yellowish-green to cream colored bodies with distinct spinulation. The remaining instars are characterized by light brown head capsules that have no distinguishing marks. The thoracic shield is dark brown with white flecks. From the third instar on, H. zea larvae are distinguished from Heliothis virescens (Fabricius) larvae in that the former lack microspines on the chalazae at the alpha setal position on abdominal segments 1, 2, and 8. Dark dorsal stripes on the body are due, in part, to pigmented microspines. The larvae characteristically have longitudinal cream-colored bands on a body that varies from yellowgreen to red-brown. Body color and size differences are attributed to larval host and temperature (Isely 1935). However, Neunzig (1969) determined larval color to be dependent especially upon light and temperature, whereas food and heredity have minimal effect.

The pupa is deep brown, approximately 21.6 mm long and 6.0 mm in diameter at the thorax.

Adults vary in pigmentation; usually however, females have pink-brown to yellow-brown forewings and males have light yellowish-olive forewings. Hindwings of both sexes are white with a broad dark-brown outer marginal band. The mean expanse of the wings is 38.6 mm.

II. A. 2. Behavior and General Development

At 25°C, the corn earworm egg hatches in 80 hours; the larvae develop through the normal six instars in 16.2 days; the period from cessation of feeding to formation of the pupa lasts approximately three days; the mean pupal developmental period to moth emergence is 13.1 days (Hardwick 1965). Adult longevity at 20°C averages 17 days for males and 21.7 days for females (Fye and McAda 1972).

a. Oviposition

Hardwick (1965) reported no mating of female moths until the third and fourth night after emergence, but males mated as early as the second night. The preoviposition period may range from 1 to 8 days (Isely 1935). Fye and McAda (1972) observed that 90% of the eggs had been laid by the time 50% of the adults died. Ten days after emergence, when the temperature was kept at 25°C, 50% of the eggs had been laid. Eight days after emergence when temperatures were kept at

33°C, 56% of the eggs had been laid in 8 days. Moth oviposition has been reported to occur between 7 and 9 p.m. in Arkansas (Phillips and Whitcomb 1962) or all night in Louisiana (Callahan 1958). The egg-laying capacity varies greatly: Hardwick (1965) found moths laid a mean of 1075 ± 565 eggs (i.e., 510 to 1640 eggs); Quaintance and Brues (1905) estimated 415 to 1200 eggs; and Dietman and Cory (1931) estimated between 500 and 3000 eggs.

Eggs are deposited singly wherever moths detect an acceptable surface (Quaintance and Brues 1905). The preferred surface tends to be villose (Callahan 1957). This observation is supported by Lukefahr et al. (1965) who found fewer eggs deposited on glabrous and/or nectariless cotton plants than on those that were hirsute and with nectaries.

The female corn earworm moths usually oviposit near the flowering parts or young terminal plant growth (Hardwick 1965), although eggs can be found on all above-ground parts of flowering and non-flowering hosts (Hardwick 1965; Neunzig 1969). Johnson et al. (1975) found the flowering stage of plants to be preferred over other plant stages.

II. A. 2. b. Larval Feeding Preferences

Upon hatching, larvae usually consume their egg shells (Hardwick 1969). A period of wandering, lasting from 0.5 to 2.5 hours, follows hatching (Ditman and Cory 1931). When the eggs have been laid on silks of corn, the subsequent first or second instars usually enter the ear through the silk channel (Hardwick 1965). Early instars may feed for eight to ten days on silks before reaching kernels

(Barber 1944). If eggs are laid on corn before it silks, the larvae bore through the husk (Ditman and Cory 1931). In soybeans, recently hatched larvae may first feed on foliage, but eventually reach the reproductive plant parts and bore into and feed on the buds, blossoms, and beans (Hardwick 1965; Neunzig 1969).

As a rule, corn earworm larvae principally feed on the fruiting structures of plants (Quaintance and Brues 1905; Graham and Robertson 1970; Johnson et al. 1975). Consistent with this observation, Boyer (1965) and Adkisson et al. (1964) encountered greatest infestation levels of larvae in soybeans and cotton at the time of plant fruiting. Neunzig (1969) found that the majority of larvae on wild hosts in North Carolina were restricted to the seeds and related plant parts but that the larvae also could develop on other plant parts. Morrill and Greene (1973) found the majority of larvae in corn in the ears.

Corn earworm larvae, in addition to feeding on plant reproductive parts, also may feed on other corn earworm larvae. Cannibalism begins when larvae develop into the third or fourth instar (Brazzel et al. 1953; Hardwick 1965).

II. A. 2. c. Pupation

After the cessation of feeding in the ultimate instar, the larvae pupate in the upper portion of V-shaped cells which they burrow in the soil (Quaintance and Brues 1905). In the summer, in cotton fields, pupae usually pupate 1/8 to 1/4 inch (0.32 to 0.64 cm) below the soil surface (slightly lower in sandier soil), and 1 to 2 feet (0.3 to 0.61 m) from the base of the plants (Quaintance and Brues 1905). Quaintance and Brues (1905) also reported average pupation depth in late fall in Texas to be 11.4 cm , with a maximum depth of 17.5 cm. In North Carolina, pupal depths average 2 to 3 inches (5.1 to 7.6 cm), with fewer pupae at 0 to 1 inch (0.0 to 2.5 cm) and 5 to 6 inches (12.7 to 15.5 cm) (Neunzig 1969). In central Virginia Phillips and Barber (1931) found the pupae down to 9 inches (22.9 cm).

II. A. 3. Seasonal Abundance

The abundance of corn earworm larvae is a function of the crop and crop variety (Stinner et al. 1976), and the time of the year, and latitude (Hardwick 1965). Early season build-up in the southern United States in corn is followed by a late season movement of newly eclosed moths to other crops such as cotton, soybeans, tobacco, and late corn (Isely 1935; Barber 1937; Dicke 1939; Snow and Brazzel 1965; Ridgway 1969; Hartstack et al. 1973; Johnson et al. 1975). This movement is dependent, largely, upon crop phenologies (Hartstack et al. 1976).

The generations of corn earworms overlap in mid- and late-season (Ditman and Cory 1931; Phillips and Barber 1940; Neunzig 1969). Because of this overlap, generations were grouped by pre-1940 workers into periods of larval or adult abundance: period I from May through mid-July, and period II from August through October (Quaintance and Brues 1905; Phillips and Barber 1931, 1940).

To delineate more precisely the generations, corn earworm populations have been monitored in several states. In the southern states (e.g., Louisiana and Texas) there are five or more generations of corn earworms per year while in more northern states (e.g., NC) there are fewer generations (Brazzel et al. 1953; Neunzig 1969). In spite of intensive sampling, the separation of populations into generations is sometimes very difficult and only peaks in the population number may be determined (Henry and Adkisson 1965; Graham and Robertson 1970; Cole et al. 1973; Harding 1976). All studies on this separation were in Texas where the corn earworm is active most of the year.

In Maryland, Virginia, and North Carolina, three to four generations are possible. The generations may be distinct, but tend to overlap (Ditman and Cory 1931; Dicke 1939; Neunzig 1969). In this region, the larvae of these generations occur from May through mid-June (first); from mid- to late July through mid-August (second); from mid- to late August through early to late September (third); and the full or partial fourth from September to the killing frost (Ditman and Cory 1931; Dicke 1939; Phillips and Barber 1940; Neunzig 1969).

In Maryland, Virginia, and North Carolina, the larvae occur most abundantly, in the first generation, on whorl-stage corn, wild hosts such as toadflax, legumes and tobacco; in the second generation in corn ears; and in the third and later generations on soybeans, alfalfa, cotton, late corn, tobacco, and wild hosts (Ditman and Cory 1931; Phillips and Barber 1931; Phillips and Barber 1933; Dicke 1939; Neunzig 1969). Even in the states farther south where cotton hosts several generations of corn earworm larvae, the host pattern is similar (Quaintance and Brues 1905; Brazzel et al. 1953; Henry and Adkisson 1965; Graham and Robertson 1970; Roach 1975; Young and Price 1975; Roach and Ray 1976).

II. A. 4. Hosts

Corn, particularly when silking, is the single most preferred host of the corn earworm (Quaintance and Brues 1905; Phillips and Barber 1933; Isely 1935; Brazzel et al. 1953; Johnson et al. 1975). Economic crops make up 22 of the 70 host species tallied by Quaintance and Brues (1905). Host plants of the polyphagous corn earworm primarily belong to the families Graminaceae, Malvaceae, Leguminaceae, and Solanaceae (Neunzig 1969). Among the major crops affected are: corn, soybeans, cotton, tobacco, tomatoes, and alfalfa.

Host lists include: North Carolinian domestic and wild plant hosts, by Neunzig (1969); wild hosts in South Carolina, by Roach (1975); wild hosts in Texas and the time of host susceptibility, by Graham and Robertson (1970); year-round hosts in Louisiana, by Brazzel et al. (1953); crop hosts in Oklahoma, by Young and Price (1975); crop hosts in Florida, by Martin et al. (1976); and crop hosts in Mississippi, by Snow and Brazzel (1965). Reports on specific minor crops and on wild hosts include those of Harding (1976), Lewis and Brazzel (1968), Snow et al. (1966), Gross and Young (1977), and Rivers et al. (1965).

II. B. Factors Influencing Species Abundance

1. Biotic Factors

a. Crop Attractiveness to Adults

The availability of attractive hosts for adult feeding and oviposition is significant in determining the original infestation level in any host (Fye 1974; Stinner et al. 1974; Newsom 1976; Stinner et al. 1976). The most attractive host to H. zea adults is newly silking corn. It provides moisture, an ideal oviposition site, and often, honeydew from aphids on the ear (Ditman and Cory 1931; Isely 1935; Dicke 1939; Phillips and Barber 1940; Hardwick 1965; Neunzig 1969; Miller 1972). Brazzel et al. (1953) hypothesized that the honeydew may attract moths.

Johnson et al. (1975) determined that the moths' first preference for oviposition on any of the major hosts coincides with the plant's flowering. They also determined that corn with tassel and first-week silk were the most attractive stages. The attractiveness of the major crop hosts in flower is not equal and diminishes in the following order: corn, tobacco, soybeans, cotton (Johnson et al. 1975). Freeman et al. (1967) noted, however, an increase in corn earworm populations in soybeans even when attractive corn and cotton were present. In a study restricted to wild hosts, Graham and Robertson (1970) found the corn earworm eggs and larvae most abundant when hosts are at the peak of flowering and fruiting.

Attraction to plant hosts with long internodal spacing is greater than that to the same host that is more compactly growing (Quaintance and Brues 1905; Isely 1935; Adkisson 1958). Well-fertilized crops also create an attractive environment for moths (Adkisson 1958). However, soybean fields with closed canopies prior to the flight of moths seldom have abundant corn earworm larval populations (Deitz et al. 1976).

II. B. 1. b. Diet

Corn earworm development is synchronized with plant growth (Wiseman et al. 1970). Growing and fruiting portions of plants provide nutrients for the proper development of reproductive organs in the imago (Callahan 1962). Adult fecundity is increased or decreased when the chemical balances, such as fatty acids, amino acids, nitrogen and potassium, are changed in the larval diet (Hardwick 1965; Bridges and Phillips 1972; Hagen 1976). Larval weight gain and development time vary depending upon the host and plant parts fed upon (Bennett et al. 1967; Freeman et al. 1967; Pretorius 1976). When highly nutritious foods are provided, larval development is hastened because the number of instars is decreased and weight is increased in each instar (Quaintance and Brues 1905; Wiseman et al. 1970, 1973).

Other factors determine the suitability of food materials. Corn silk extract, for example, elicits a feeding response in fourth instars (Starks et al. 1965), while diapause is increased four-fold when larvae are fed dough-stage corn (Phillips and Newsom 1966).

Resistant lines of corn and soybeans possess physical and chemical barriers which negatively affect corn earworm larval growth. Corn, in particular, may exhibit physical barriers, such as tight husks, silk balling, and long silk channels which larvae must penetrate (Painter and Brunson 1940; Luckman et al. 1964; Starks and McMillian 1967; Straub and Fairchild 1970; Widstrom et al. 1970). In resistant corn varieties, allelochemical products in leaves and silks outside the silk channel, once eaten, may cause larval mortality (Painter and Brunson 1940; Wiseman et al. 1976). In both corn and soybeans, plant tolerance permits significantly more feeding without yield loss (Widstrom and Burton 1970; Clark et al. 1972; Wiseman et al. 1972). Mortality in later instars, additional molts, reduced weight, and longer development time are characteristic of larvae that feed on plants exhibiting larval antibiosis (Walter 1957; Straub et al. 1973; Turnipseed and Sullivan 1976; Goodin 1977; Beland and Hatchett 1977).

Weight of adults and pupae, length of the preoviposition period, and the fecundity of adults also are influenced by larval diet (Brazzel et al. 1953; Gross and Young 1977). Adults live longer and have greater fecundity if they feed than when they do not feed (Quaintance and Brues 1905; Ditman and Cory 1931; Lukefahr and Martin 1964; Hardwick 1965). However, the larval food has a greater influence on fecundity than adult food (Newsom 1972).

II. B. 1. c. Predators

Predators of the corn earworm have been tabulated from various crops by Quaintance and Brues (1905), Phillips and Barber (1931), Dumas et al. (1964), Whitcomb and Bell (1964), Neunzig (1969), and Deitz et al. (1976). There are over 600 predators of Heliothis spp. on cotton (Whitcomb and Bell 1964). The biology, behavior, and seasonal abundance of major predators of the corn earworm were summarized by Quaintance and Brues (1905) and Deitz et al. (1976). Life cycles and behavior on specific predators with respect to their significance on noctuid eggs and larvae, have been studied on Geocoris spp. (Hemiptera: Lygaeidae), Orius spp. (Hemiptera: Anthocoridae), and Chrysopa spp. (Neuroptera: Chrysopidae) (Barber 1936; Tamaki and

Weeks 1972; Barry et al. 1974; Crocket et al. 1975).

The most abundant and/or important anthropod predators of the corn earworm eggs and larvae are: Chrysopa carnea Stephens, Chrysopa spp., Orius insidiosus (Say), Orius spp., Geocoris punctipes (Say), Geocoris spp., Podisus maculiventris (Say) (Hemiptera: Pentatomidae), Nabis roseipennis Reuter (Hemiptera: Nabidae), Nabis spp., Stiretrus anchorago (Fabricius) (Hemiptera:Pentatomidae), Reduviidae (Hemiptera) Coleomegilla maculata (DeGeer) (Coleoptera: Coccinellidae), Coleomegilla spp., Hippodamia convergens (Coleoptera: Coccinellidae), and Araneida. Both Odonata adults (Neal and Whitcomb 1972) and predaceous ants (Whitcomb et al. 1972) feed on corn earworm adults and larvae, respectively. At least 21 species of birds are known to feed on corn earworms, including red-winged blackbirds, blackbirds, grackles, and woodpeckers (Quaintance and Brues 1905; Phillips and Barber 1931; Genung et al. 1976).

Suppression of corn earworm populations and therefore reduction of soybean pod damage had been measured by Barry et al. (1974). Artificially augmented populations of predators cause higher corn earworm mortality than unagumented populations. Releases of Geocoris punctipes and Chrysopa larvae into cotton reduced or eliminated Heliothis virescens larvae (Ridgway et al. 1967; Lingren et al. 1968). Chrysopa carnea, attracted to cotton fields sprayed with sucrose, increased the Chrysopa adult and larval populations which most likely accounted for a reduction in the number of H. zea eggs and larvae and also for the approximately 50% lower damage in comparison to unsprayed fields (Hagen 1976).

Pesticide application on various crops, early in the season, may result in corn earworm resurgence because of the selective mortality on specific predators (Ridgway et al. 1967; Ridgway and Jones 1968; Turnipseed 1972; Hall et al. 1975; Newsom 1976; Walker and Turnipseed 1976). The application of carbaryl, when evaluated against selected predators and corn earworm larvae, resulted in differential mortality; predator survival rates being lowest (Shaw 1977). Similar results were obtained with several other insecticides used to control corn earworm larvae (Anon. 1976). Differences in the mortality of *Geocoris punctipes*, *Orius insidiosus*, *Nabis* spp., and *Chrysopa* spp. between sprayed and unsprayed cotton fields demonstrated variable sensitivity among the predators to the spray. This variable susceptibility may be partially explained by the observations of plant feeding by predators, by Quaintance and Brues (1905), Barber (1936), Dicke and Jarvis (1962), Stinner (1972), and Wiseman et al. (1972).

Predator effectiveness and abundance also vary with the crops' phenology (Barber 1936; Dicke and Jarvis 1962; Bell and Whitcomb 1964; Neunzig 1969; Salas-Aguilar and Ehler 1977). *Orius insidiosus* is the most abundant predator on freshly silking corn. It feeds on corn earworm eggs and young larvae, and on silks and pollen, all of which occur with the freshly silking corn (Quaintance and Brues 1905; Barber 1936; Dicke and Jarvis 1962; Wiseman et al. 1972). Specific predators are present on different parts of the plant foliage, depending upon the time of day (Dumas et al. 1964); temperature variation; microclimatic differences; and social interactions (Aspey 1976). Higher predator numbers correlate with higher temperatures (Crocker et al. 1975) and lower activity is correlated with cloudy and rainy weather (Bishopp 1929).

Predator diversity and abundance vary with adjacent crops (Boyer 1965; Burleigh et al. 1973), geographic locations, and throughout the season within different crops (Phillips and Barber 1933; Bell and Whitcomb 1964; Barry 1973; Tugwell et al. 1973; Carner et al. 1974; Shephard et al. 1974; and Deitz et al. 1976).

Different stages of corn earworm are susceptible to different predators. Most predators feed on corn earworm eggs and/or first through third instar larvae. The efficiency of predators against the various corn earworm stages has also been subject to study. Adult and immature Chrysopa carnea, Geocoris punctipes, Coleomegilla maculata, and Podisus maculiventris were compared under laboratory and field conditions for their effectiveness in consuming Heliothis zea and H. virescens eggs and first, third through sixth instar larvae (Lopez et al. 1976). C. maculata generally was most efficient in consuming eggs and first instars. P. maculiventris was most effective against third instars. Under expanded searching requirements on cotton, G. punctipes was the most effective predator of early instars and C. maculata was the best predator of eggs. Quaintance and Brues (1905) suggested that Orius spp. are probably the most efficient predator of corn earworm eggs on corn silks. Omnivorous predators such as Nabis americoferus Carayon and Geocoris bullatus (Say) are probably more effective at low prey densities than lady-bird beetles, Coccinella transversoguttata Faldermann, which consumes large numbers of prey (Tamaki and Weeks 1972). Tamaki and Weeks (1972) found Nabis alone or in combination with either geocorids or *Coccinella* spp. is superior in reducing populations of small noctuid larvae.

II. B. 1. d. Parasites and Pathogens

Parasites and pathogens can be important regulators of corn earworm populations. Lists on occurrence and/or biology of the major parasites and pathogens of corn earworm eggs, larvae, pupae, and adults were compiled by Bottrell et al. (1968), Lewis and Brazzel (1968), Ridgway and Lingren (1972), Deitz et al. (1976), Harding (1976), Hughes and Rabb (1976), and Smith et al. (1976).

Most important among the parasites are: the Braconidae (Hymenoptera) *Apanteles marginiventris* (Cresson) and *Chelonus texanus* (Cresson); the Ichneumonidae (Hymenoptera) *Sagaritis provancheri* (Dalle Tone) and *Campoletis flavicincta* (Ashmead) (synonym of *C. perdistinctus* (Viereck), (Carlson 1972)); the Trichogrammitidae (Hymenoptera) *Trichogramma* spp.; and the Tachinidae (Diptera) *Archytas marmoratus* (Townsend), *Lespesia archippivora* (Riley), and *Microplitis* spp. The major pathogens include: a fungus, *Nomuraea rileyi* (Farlow) Sampson; a nuclear-polyhedrosis virus (NPV); the bacterium *Bacillus thuringiensis* Berliner; the protozoan *Nosema heliothidis* Lutz and Splendore; and the nematode *Chiromonema heliothidis* Khan, Brooks, and Hirschmann.

Parasites are usually most efficient against given corn earworm stages. Parasitization of corn earworm eggs on corn by *Trichogramma* spp. has ranged to 52% (Graham 1970), and to 90% (Phillips and Barber 1931). Preference by *Trichogramma* spp. for *Heliothis zea* eggs over *Trichoplusia ni* (Hübner) (Lepidoptera: Noctuidae) eggs was shown by by Ashley et al. (1974). *Microplitis croceipes* (Cresson) is most efficient against third instars (Lewis 1970). Turnipseed and Kogan (1976) stated that epizootics caused by *Nomuraea rileyi* probably are the most significant factor in keeping the populations of corn earworm in soybeans below the economic injury level. The potential control of corn earworms with *Bacillus thuringiensis* and NPV were discussed by Dulmage (1972).

The percent parasitism of *Heliothis zea* varies with host plant and season (Bottrell et al. 1968) and with crop variety (Burleigh 1975). There is high larval mortality due to parasites on wild hosts, whereas the parasitism level is negligible in corn (Graham et al. 1972) Corn earworm larvae in corn are seldom parasitized once they reach the protection of the husks, but larvae in soybeans are more susceptible to parasites and pathogens (Smith et al. 1976). Few parasites of *Heliothis* spp. are found on tobacco in North Carolina (Neunzig 1969).

Seasonal variation in parasitism is well documented. The highest proportion of parasitization and disease in *Heliothis* spp. larvae occurs in the early (May through June) and late (August through September) seasons (Burleigh et al. 1973; Deitz et al. 1976; Harding 1976; Hughes and Rabb 1976; Smith et al. 1976). *Nomuraea rileyi* infests greater numbers of corn earworms in the late season (Burleigh 1972, 1975). The protozoan, *Nosema heliothidis* is most abundant in adult corn earworms in the late fall (Deitz et al. 1976).

Parasitization varies with the location of the egg or larva on the plant (Quaintance and Brues 1905; Phillips and Barber 1933; Gonzalez et al. 1970). Maximum parasitization of eggs in corn, for example, occurs when eggs are on the corn leaves and secondly when they are on the silks (Quaintance and Brues 1905). Differential parasitization and disease rates are partially attributed to the openess of the plant host foliage (Lewis and Brazzel 1968; Burleigh 1975). Temperature, humidity, and larval density and available refuge are particularly influential in determining the incidence of pathogens in corn earworm larvae (Allen et al. 1971; Allen and Gonzalez 1975; Newsom 1976).

II. B. 2. Abiotic Factors

There are many abiotic factors which directly or indirectly influence H. zea abundance; the major of these are temperature and precipitation. Greater numbers of generations per year are associated with warmer climates and longer growing seasons (Hardwick 1965). The number of eggs deposited depends upon temperature and adult fecundity (Ditman and Cory 1931; Brazzel et al. 1953). Adult fecundity and longevity decrease at higher temperatures (Fye and McAda 1972). The optimal temperatures for adult fecundity and longevity range from 21.6 to 26.7°C (Isely 1935; Hartstack et al. 1976).

Embryogenesis quickens with an increase in temperature: egg hatch occurs in approximately 86.9 ± 2.1 hours at 75°F (26.7°C) and in approximately 58.7 ± 2.0 hours at 85°F (30.0°C) (Luckmann 1963). In the summer (24-28°C), most eggs hatch in three days (Berger 1963; Ignoffo 1965). Egg hatch requires up to 8 days in cool weather (Ditman and Cory 1931).

Egg deposition is retarded by falling rain. In addition, hard rains cause eggs to be washed from their substrates and larvae to drown (Quaintance and Brues 1905; Gross et al. 1976). Cool, wet weather slows egg and larval development, thus increasing the time of their exposure to predators and therefore increasing the corn earworm mortality (Ditman and Cory 1931).

An interesting relationship between moonlight and oviposition apparently exists: egg deposition is suppressed around the time of full moon (Hartstack et al. 1973). Conversely, illumination by artificial light caused no significant decrease in oviposition in cotton fields (Taft et al. 1972).

Insect growth is a non-linear function of temperature (Stinner et al. 1974), and growth increases at elevated temperatures (Isely 1935; Fye and McAda 1972).

Sudden increases in corn earworm numbers have been observed in soybeans during wet seasons (Neunzig 1969). These increases have been attributed to development of favorable oviposition and feeding sites, as a result of new plant growth promoted by rain and irrigation (Henry and Adkisson 1965). In contrast, severe infestations have also been reported in hot dry seasons (Ditman and Cory 1931).

Heavy rains may result in high pupal mortality due to submersion (Barber and Dicke 1939; Hardwick 1965). Although pupae can float within flooded pupation tunnels, pupal survival is better in well-drained sandy soils than in less well-drained soils (Barber and Dicke 1939). Pupal survival, and therefore moth emergence is higher in dry weather (Phillips and Barber 1929), but soil softened by rain enables moths to emerge more readily from hardened pupal cells (Quaintance and Brues 1905; Brazzel et al. 1953; Neunzig 1969).

Diapause, in effect, removes individuals from the population. Pupal diapause is induced by a combination of cool temperatures and short days (Phillips and Newsom 1966; Roach and Adkisson 1970). Diapause is induced when adults, eggs and larvae are reared at daylengths under 13 hours or under 11 hour days and temperatures of 18.5°C (Adkisson et al. 1972), or under 10 hour days and temperatures of 24°C (Benschoter 1968). Studies by Phillips and Newsom (1966) revealed that high temperatures of 27°C counteract the effect of short photoperiods, and low temperatures of 18°C counteract the effect of long days.

II. C. Sampling Methods

1. Corn

Sample size and sampling frequency necessarily vary according to the stage of development (i.e., adult, egg, etc.) of the corn earworm population to be surveyed. Existing sampling strategies for corn lie in two general categories, as discussed below.

The first category involves surveys made only once within a season; this includes the majority of existing estimates of corn earworm population levels and/or damage in corn. Phillips and Barber (1934) sampled ten ears from ten representative stalks, per field when they compared field damage by corn earworms and field size. They found no definite relationship between field size and the degree of damage. Henry and Adkisson (1965) surveyed the corn earworm population by examining all plants within 20 row feet for each 4 acre unit. Wiseman et al. (1972), in their research on corn tolerance to corn earworms, sampled 15 row feet in five replications with two subplots in a 54 acre farm. Survey for corn earworm population levels in Kansas conducted by Peter and Burkhardt (1961) included over 50 counties with five fields per county and 25 plants examined per field. A sequential sampling procedure was applied by Wolfenbarger and Darroch (1965) to survey potentially damaging population levels of corn earworm in sweet corn. Their sample consisted of 30 or fewer ears: for every ear examined, they moved one space to the right; if the ear examined was sound, they moved also one space into the field, thus progressing through the field, diagonally to the rows.

The second group of sampling strategies, to be found in the more recent literature, involves sampling more than once per season. Thus, in their study of host preference by adult moths, Johnson et al. (1975) sampled weekly for corn earworm eggs, with at least eight random 1.5 meter row sections in 2 - 6 fields in each of two counties. Dively (1974) sampled in an X pattern through fields, twice a season; first samples consisted of ten clustered samples of 50 plants and 100 ears for a population estimate, then later in the season, samples consisted of 100 mature ears sampled for damage estimates. Fields surveyed by Dively averaged 33 acres with a range between 5 and 144 acres.

II. C. 2. Soybeans

The major techniques used to sample soybean insects are: (a) sweeping, standardized for soybeans by Jensen (1976); (b) ground cloth shaking with a 24 x 42 inch sheet, the long dimension of which is stretched between soybean rows (Boyer and Dumas 1963); (c) ground cloth beating (Turnipseed 1974) which involves beating the plants 6 to 8 times over a ground cloth; (d) removal for absolute estimation (Kretzschmar 1948); and (e) suction net, as used in soybeans by Turnipseed (1974). Synoptic examination of the plant in the field is the only effective means of surveying for eggs (Johnson et al. 1975).

Several of these sampling methods have been analyzed for their effectiveness in detecting the various insect species in soybeans. The ground cloth technique has been judged most effective for sampling corn earworm larvae and their predators. Deitz et al. (1976) reported the ground cloth technique to be more reliable than the suction net. Between the suction net, sweep-net and ground cloth techniques compared in soybeans in South Carolina, the ground cloth yielded higher mean numbers and less variability for larvae of <u>Heliothis</u> spp., <u>Geocoris</u> spp. nymphs, <u>Nabis</u> spp. nymphs, and spiders (Shepard et al. 1974). In addition, Turnipseed (1974) determined that the ground cloth technique consistently yielded greater mean numbers and generally lower coefficients of variability for nabids than either the sweep net or vacuum net techniques. Ground cloth beating yielded significantly higher mean numbers of nabids than ground cloth shaking, due possibly to better dislodging power, less lateral dislodging, and/or because nabids could escape less rapidly after the beating technique than after the shaking technique.

Sweep netting was less efficient than the ground cloth method in determining the absolute populations of lepidopterous larvae in soybeans (Hillhouse and Pitre 1974). The detection of *Heliothis zea* and *H. virescens* with the ground cloth technique did not differ significantly from absolute numbers when plants were in the 5-trifoliate stage. The ground cloth also was highly efficient with larger plants because both *Heliothis* species tend to fall when disturbed.

Monitoring of corn earworm populations in soybeans is usually conducted on a weekly basis and with sample sizes that vary with the purpose of the research. The soybean aspect of HELSIM-2, a model of corn earworm populations in North Carolina, is based on weekly samples taken by the beat cloth method throughout the season until the first killing frost (Stinner et al. 1974; Stinner et al. 1976). Deitz et al. (1976) surveyed corn earworm populations in soybeans with the ground cloth, taking four five-row-foot samples per field per week. To make economic decisions regarding control of soybean pests in Virginia, Allen and Roberts (1974) used the shake-cloth method weekly, with ten samples per field. The corn earworm population was surveyed in lima bean fields weekly by the shake cloth by Dively (1974) with six-row-foot sections at ten random sites distributed diagonally through fields ranging in size from 18 to 150 acres.

Because of the disparate spatial distribution of predators within fields, accurate sampling methods are especially important. Studies by Shephard et al. (1974) and Waddill and Shephard (1975) showed dispersal of *Podisus maculiventris* nymphs and geocorid nymphs to be along, rather than across rows. Vertical placement on the plant of predators such as *Geocoris* spp. and *Orius insidiosus* varies with time of day and weather (Dumas et al. 1964; Shephard et al. 1974).

On the other hand, spatial distribution of lepidopteran larvae, in particular, should not present problems when a ground cloth is used (Hillhouse and Pitre 1974).

In addition to quantitative records of corn earworm larvae and their predators, plant characteristics such as phenological state are noted when investigators are concerned with plant dynamics associated with arthropod numbers (Dively 1974; Hillhouse and Pitre 1974; Hartstack et al. 1976; Johnson et al. 1975; Newsom 1976; Stinner 1977). Stinner et al. (1974), Hartstack et al. (1976), and Stinner et al. (1976) incorporated measurements of phenological states in their models of corn earworm populations, HELSIM - 2 and MOTHZV - 2, respectively. Dively (1974) determined that length and maturity of pod, number of corn earworm larvae and time to harvest are important in predicting the maximum damage to lima beans by the corn earworms.

III. TECHNIQUES AND PROCEDURES

A. Data Acquisition

1. Field Studies

a. Field Selection

i. Description of Regions Sampled

Corn and soybean fields were selected in Isle of Wight and Westmoreland Counties, Virginia (Fig. 1). These counties lie in the Southeastern and Eastern Crop Reporting Districts, respectively. These districts produce the majority of corn and soybeans in Virginia. All crop estimates were taken from the US Department of Agriculture, Statistical Reporting Service, Virginia Dept. of Agriculture (1976). Knowledge of relevant physiographic, biotic and agricultural characteristics was considered useful in the analysis of <u>H. zea</u> population dynamics.

Isle of Wight Co., which lies between 36° 40' N and 37° 06' N latitude and 76° 30' W and 76° 55' W longitude, ranges in elevation from sea level to 100 feet (30.5 m.) and is interspersed with streams and swampy areas. In 1974, of the county's approximate 203,072 acres (82,183 hectares), 15% was in woodland pasture and 30% in cropland (U.S. Dept. Commerce, Bureau of Census 1976a). Figure 2 illustrates a typical farm-forest land-use pattern. The major crop acreages in 1974 and 1975 were corn at 25,000 acres (10,118 hectares), peanuts at 16,000 acres (6,475 hectares), soybeans at 12,000 acres (4,856

Figure 1. Location of the two eastern Virginia counties in which the study was conducted.

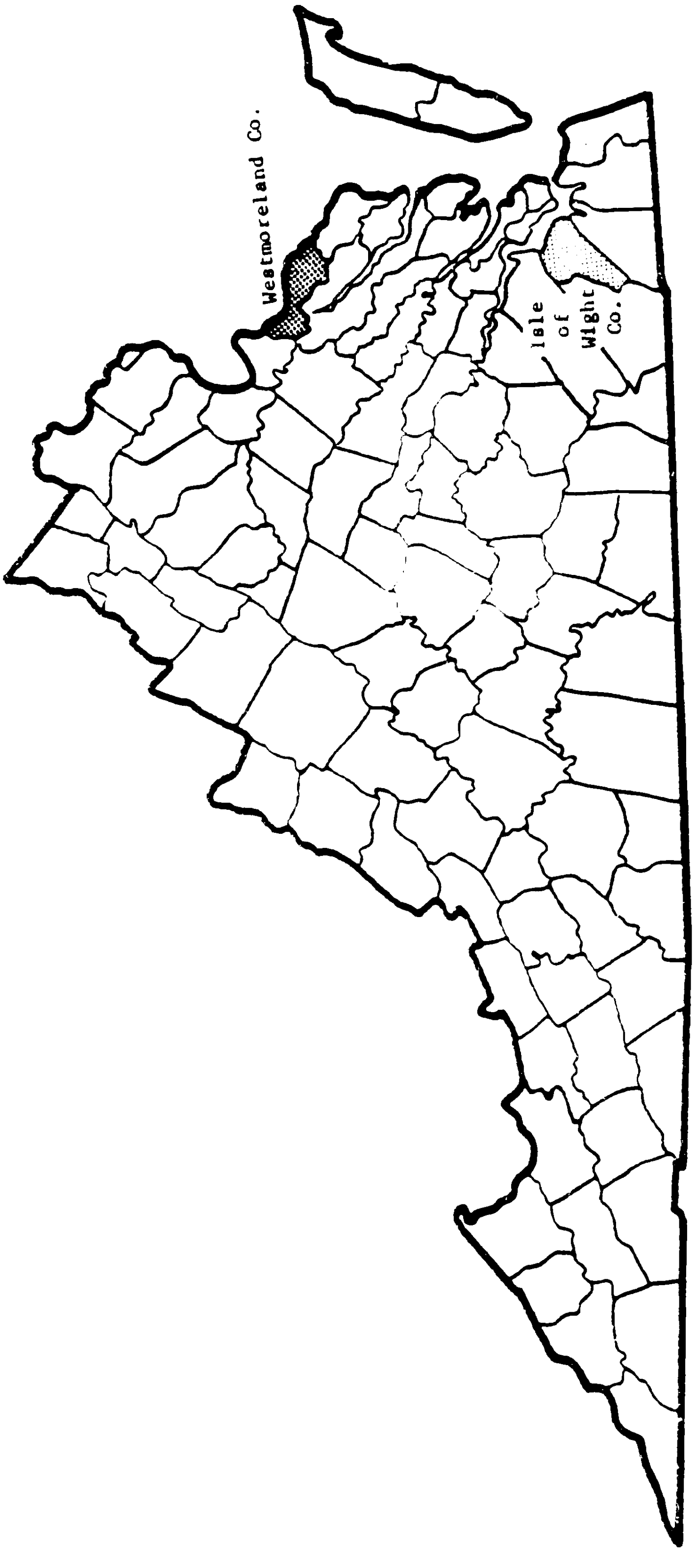
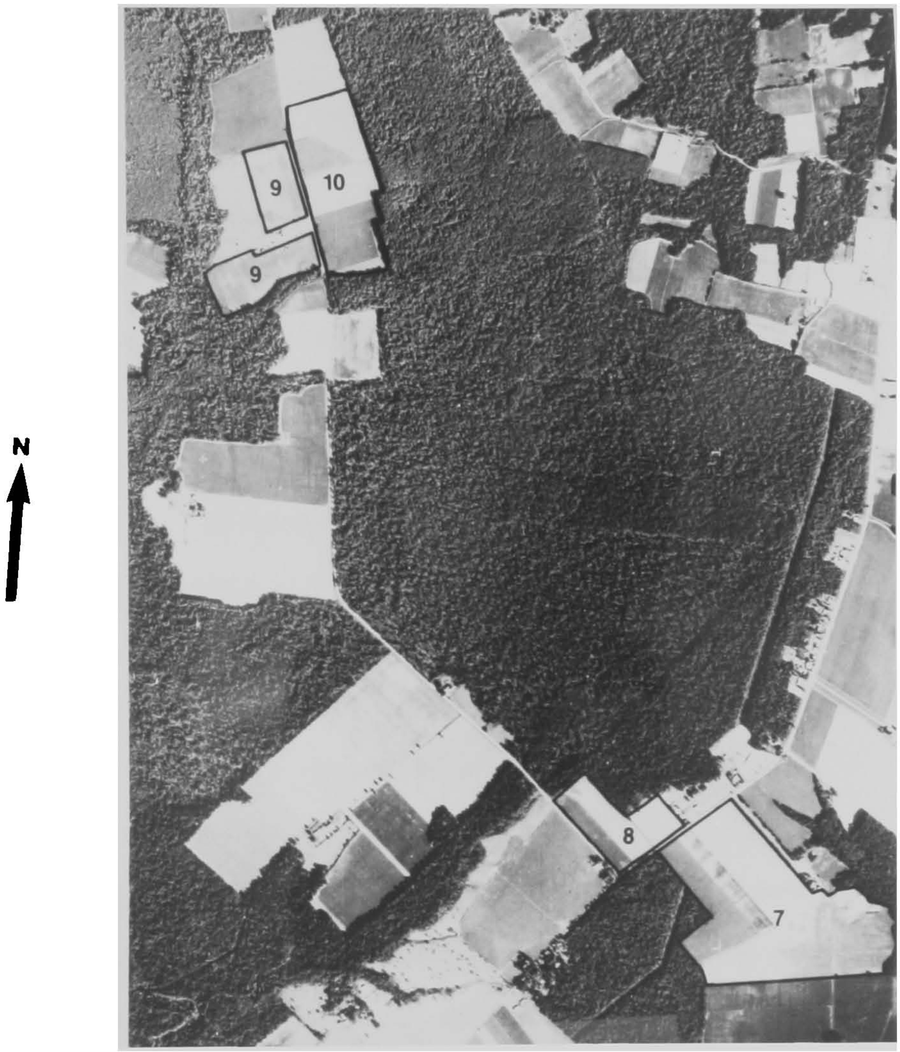

Westmoreland Co.
Isle of Wight Co.

Figure 2. Typical farm-forest land use pattern in Isle of Wight County. Fields outlined indicate field pairs 7 - 8 and 9 - 10. One inch equals 1920 feet (1 cm = 230 m).


N
9
10
9
8
7

hectares), and approximately 2,000 acres (809 hectares) in barley and winter wheat. Hogs, the major livestock, contributed substantially to the county's income (U.S. Dept. Commerce, Bureau of Census 1976a). The soil in Isle of Wight is predominately sandy and lies in the Middle Coastal Plain region of the Coastal Plain Division.

Westmoreland Co., which lies north of Isle of Wight Co., lies between approximately 37° 55' N and 38° 15' N latitude and 76° 36' W and 77° 05' W longitude. The terrain rises from sea level to 100 feet (30.5 m.), but is also separated by wide tidal creeks. Of Westmoreland Co.'s approximately 146,368 acres (59,235 hectares), in 1974, 18% was in woodland and woodland pasture and 26% was in cropland (U.S. Dept. Commerce, Bureau of Census 1976b). The major approximate acreages in 1974 and 1975 were: in soybeans, 16,000 acres (6,475 hectares); barley and winter wheat, 15,000 acres (6,070 hectares); and corn, 13,000 acres (5,261 hectares). Livestock did not contribute substantially to the economy. The predominately sandy soil in Westmoreland Co. is typical of its region, the Chesapeake Bay Region.

III. A. 1. a. ii. General Considerations

The infestations of corn earworms in corn and soybeans usually occur 1 week later in Westmoreland County than in Isle of Wight County (W. A. Allen, pers. comm.). This observation, in conjunction with possible differential influences of climate, soil, etc., upon the agroecosystems in the two counties was thought to justify concurrent surveys in both locations in 1974. In 1975, intensive studies were restricted to Isle of Wight County.

Fields representative of the county were selected, based on uniformity of stand and acreage, and on their proximity to other fields sampled. In all cases, individual corn and soybean fields were paired (adjacent). Studies were conducted on 12 corn and 12 soybean fields in both counties in 1974. During 1975, 16 corn and 16 soybean fields in Isle of Wight Co. were sampled. By pairing corn and soybean fields, the likelihood of at least a local source of second generation corn earworm adults being available for each soybean field was increased. Figs. 3, 4 and 5 illustrate distribution of the 80 fields in the counties.

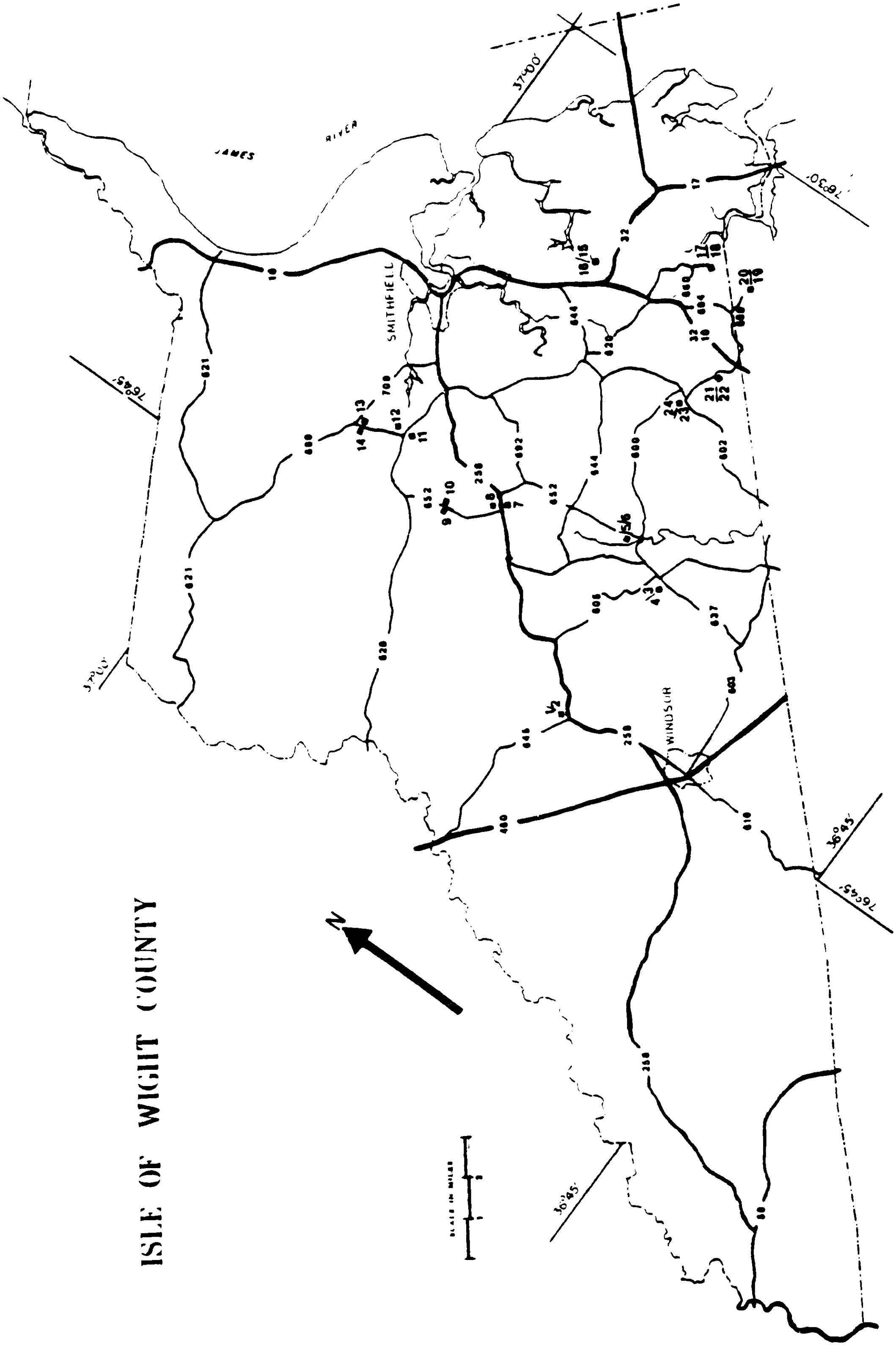
Field acreage in corn averaged 34 and 21 acres (14 and 10 hectares) in Isle of Wight and Westmoreland Counties, respectively, in 1974, and 24 acres (10 hectares) in Isle of Wight Co. in 1975 (Table 1). A field size of 20 acres (8.1 hectares) or more decreased the probability that the same plants would be sampled more than once a season.

III. A. 1. b. Samples in Corn

Sampling in corn began when the majority of corn plants in sample fields commenced silking, since fresh silks are the preferred oviposition site of adult *H. zea* (Isely 1935; Johnson et al. 1975). Each field was surveyed approximately weekly; five times between July 1 and mid-August. This sampling was synchronized with the second generation of *H. zea*; the first and last samples coincided with the extremes of the larval population abundance in corn.

The weekly surveys consisted of ten row samples per field. All samples were taken at least 90 feet from the field borders to reduce

Figure 3. Field locations in Isle of Wight County, Virginia, 1974. Fields are represented by squares. Even and odd numbers accompanying the squares represent soybean and corn fields respectively. Field pairs separated by a hard-top road are represented on the map by separate squares, otherwise a single square is used.



ISLE OF WIGHT COUNTY

Figure 4. Field locations in Westmoreland County, Virginia, 1974. Fields are represented by squares. Even and odd numbers accompanying the squares represent soybean and corn fields respectively. Field pairs separated by a hard-top road are represented on the map by separate squares, otherwise a single square is used.

WESTMORELAND COUNTY

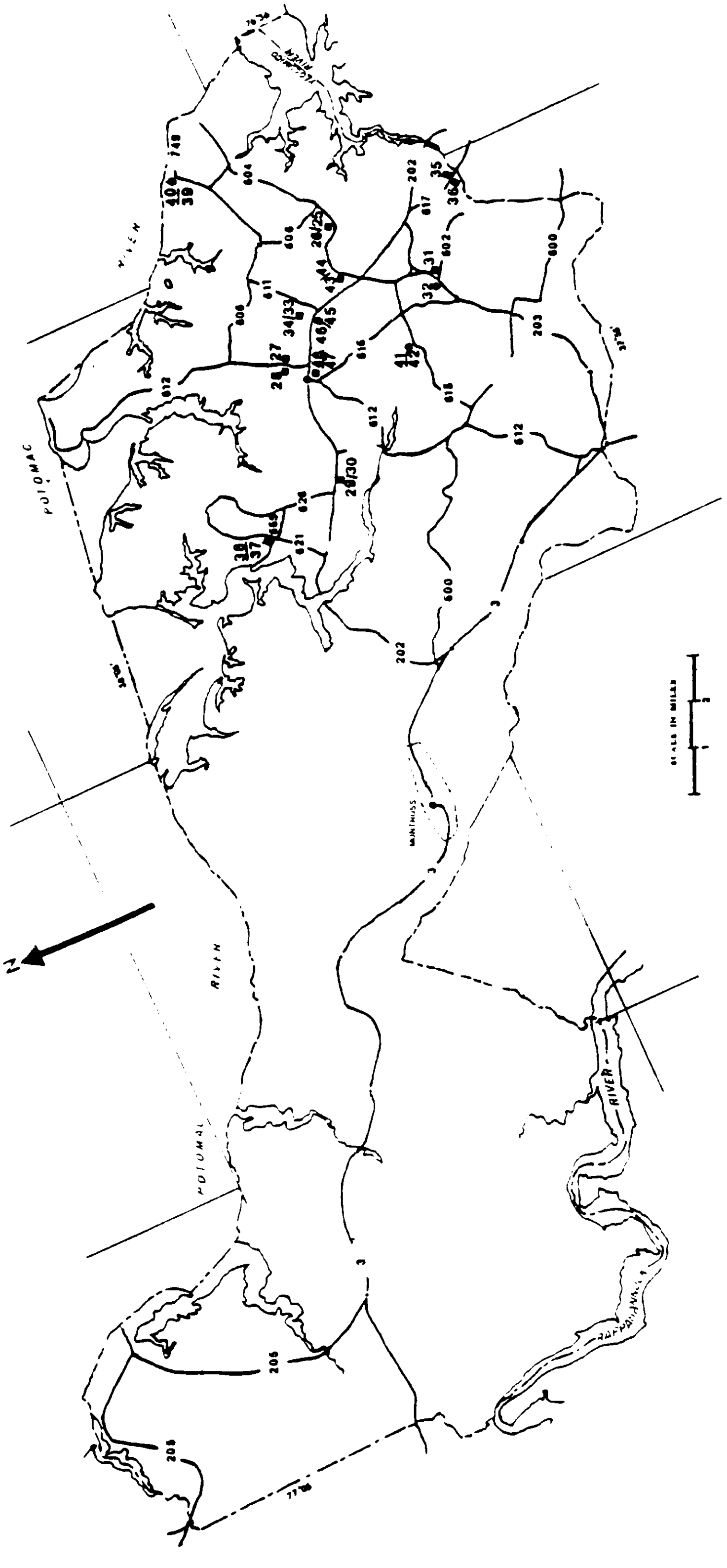
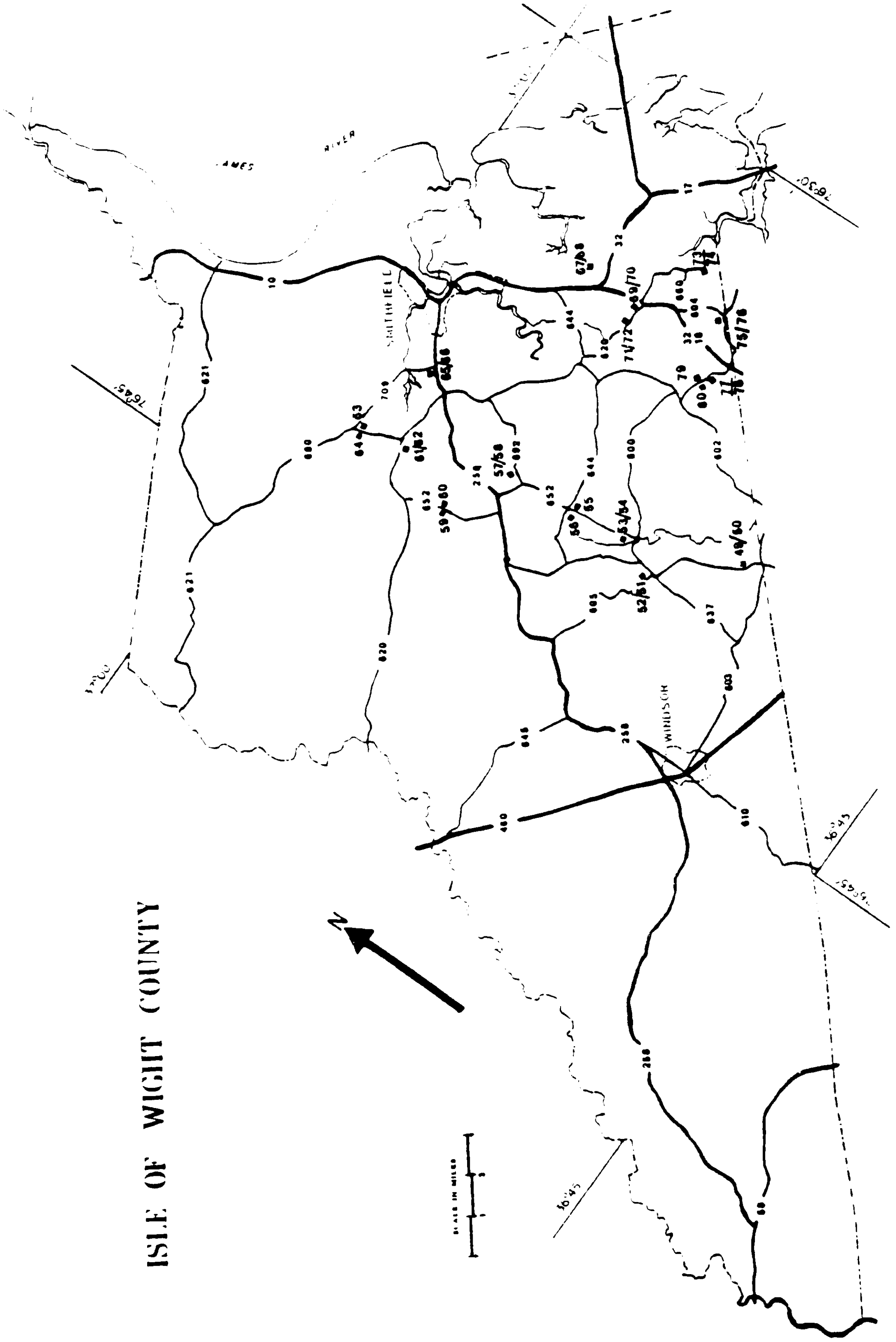


Figure 5. Field locations in Isle of Wight County, Virginia, 1975. Fields are represented by squares. Even and odd numbers accompanying the squares represent soybean and corn fields respectively. Field pairs separated by a hard-top road are represented on the map by separate squares, otherwise a single square is used.



ISLE OF WIGHT COUNTY

Table 1. Field acreage of corn and soybean fields studied.

Year	County	Coded Field [1]	Corn Acres(Hectares)	Soybean Acres(Hectares)
1974	Isle of Wight	1/2	15.9 (6.43)	7.0 (2.83)
		3/4	13.0 (5.26)	7.7 (3.12)
		5/6	20.2 (8.17)	17.9 (7.24)
		7/8	42.8 (17.32)	13.0 (5.26)
		9/10	26.3 (10.64)	32.1 (12.99)
		11/12	93.9 (38.00)	20.0 (8.09)
		13/14	62.7 (25.37)	10.8 (4.37)
		15/16	28.9 (11.70)	31.7 (12.83)
		17/18	11.0 (4.45)	65.1 (26.35)
		19/20	13.0 (5.26)	13.0 (5.26)
		21/22	22.0 (8.90)	18.0 (7.28)
		23/24	58.7 (23.76)	63.8 (25.82)
		Mean and s.d.	34.0 ± 25.7 (13.77 ± 10.40)	25.0 ± 20.1 (10.12 ± 8.14)
1974	Westmoreland	25/26	52.1 (21.08)	28.5 (11.53)
		27/28	22.8 (9.23)	16.1 (6.52)
		29/30	12.5 (5.06)	30.0 (12.14)
		31/32	14.8 (5.99)	22.0 (8.90)
		33/34	33.9 (13.72)	11.4 (4.61)
		35/36	5.5 (2.23)	14.4 (5.83)
		37/38	13.3 (5.38)	15.9 (6.43)
		39/40	34.6 (14.00)	24.0 (9.71)
		41/42	29.5 (11.94)	32.6 (13.19)
		43/44	13.2 (5.34)	32.0 (12.95)
		45/46	16.5 (6.68)	16.8 (6.80)
		47/48	6.6 (2.67)	23.8 (9.63)
		Mean and s.d.	21.3 ± 13.8 (8.61 ± 5.58)	22.3 ± 7.35 (9.02 ± 2.97)

Table 1. (continued)

Year	County	Coded Field [1]	Corn Acres(Hectares)	Soybean Acres(Hectares)
1975	Isle of Wight	49/50	12.0 (4.86)	20.0 (8.09)
		51/52	50.4 (20.40)	37.3 (15.09)
		53/54	23.4 (9.47)	12.6 (5.10)
		55/56	14.4 (5.83)	11.6 (4.69)
		57/58	14.8 (5.99)	12.3 (4.98)
		59/60	12.6 (5.10)	21.0 (8.50)
		61/62	14.4 (5.83)	15.0 (6.07)
		63/64	22.9 (9.27)	10.8 (4.37)
		65/66	11.3 (4.57)	14.9 (6.03)
		67/68	31.7 (12.83)	28.9 (11.70)
		69/70	51.6 (20.88)	17.7 (7.16)
		71/72	15.0 (6.07)	14.0 (5.67)
		73/74	46.4 (18.78)	50.0 (20.23)
		75/76	15.0 (6.07)	70.0 (28.33)
		77/78	15.0 (6.07)	33.0 (13.35)
		79/80	40.0 (16.19)	21.6 (8.74)
		Mean and s.d.	24.4 ± 14.7 (9.89 ± 5.93)	24.4 ± 16.3 (9.88 ± 6.61)

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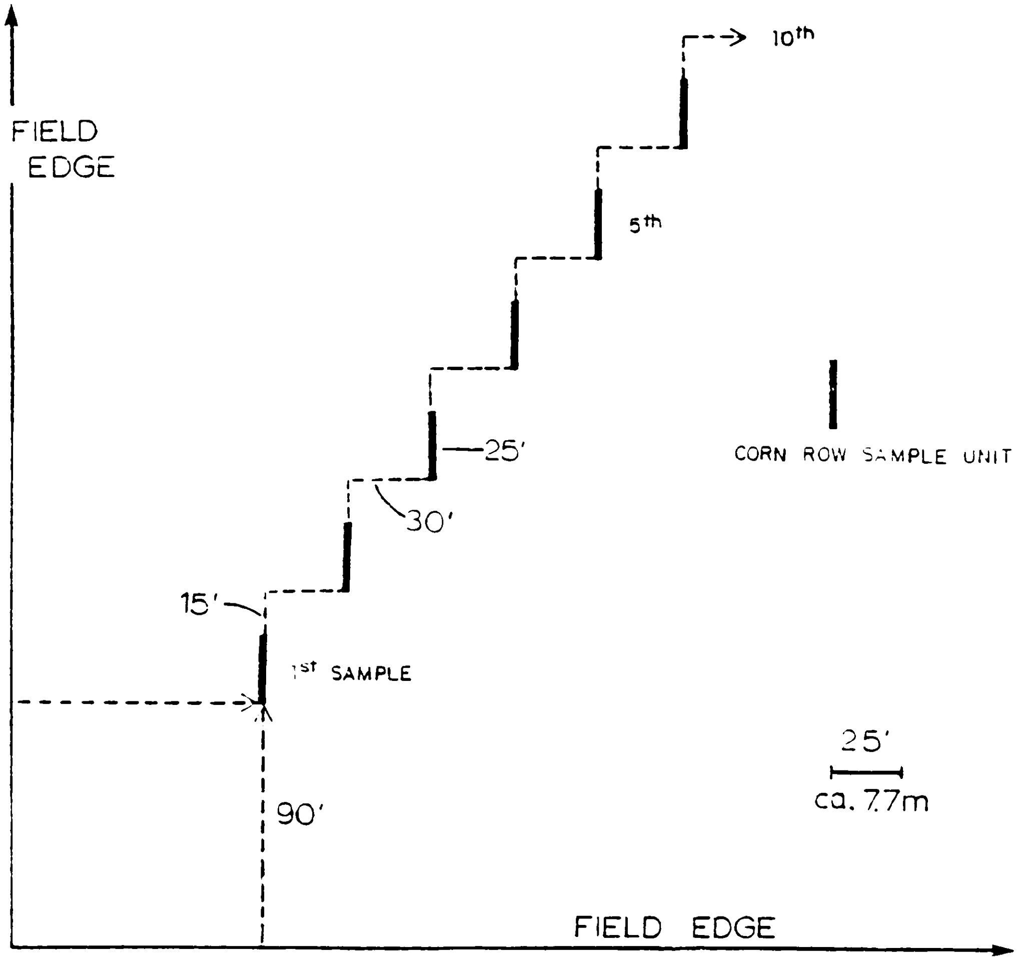
[1] Odd numbered fields are corn fields, even are soybean fields.

the possibility of edge effects (Burleigh et al. 1973; Aspey 1976). Figure 6 illustrates the typical staggered-row sampling pattern within the field.

Sample size was similar to that used by Dively (1974). Sampling was similar in frequency and in plant parts examined to that of Johnson et al. (1975). Each row sample included, per 25 row feet (7.6 m), inspection of: a) all silks for eggs and larvae, b) all ears for larvae, by husk removal, and c) all stalks, by brief visual examination. General crop phenology was recorded (e.g., state of silking, maturity of ears). Records were taken of corn earworm larvae and insect predators observed. In 1975 only, all spiders found on and between corn stalks within the sample row were enumerated. All corn earworm larvae and representatives of each predator encountered, including spiders, were preserved in 80% ethanol for later identification.

The absolute number of eggs on silks was determined in 1974. After the silks had been visually inspected, the silk bundles from all ears in five row feet of all ten row samples in each of 24 fields were cut and returned to the laboratory. These silks were gathered in the first week of sampling, which was during the maximum flight and oviposition activity of the moths. The silk bundles, approximately 1,920 in all, were frozen in the laboratory and later examined for eggs. Egg examination was conducted on thawed silks which were soaked and floating in a dilute hypochlorite solution which aided in the release of eggs from silks (Berger 1963; Patana 1969).

Figure 6. Characteristic staggered-row sampling pattern within corn fields.

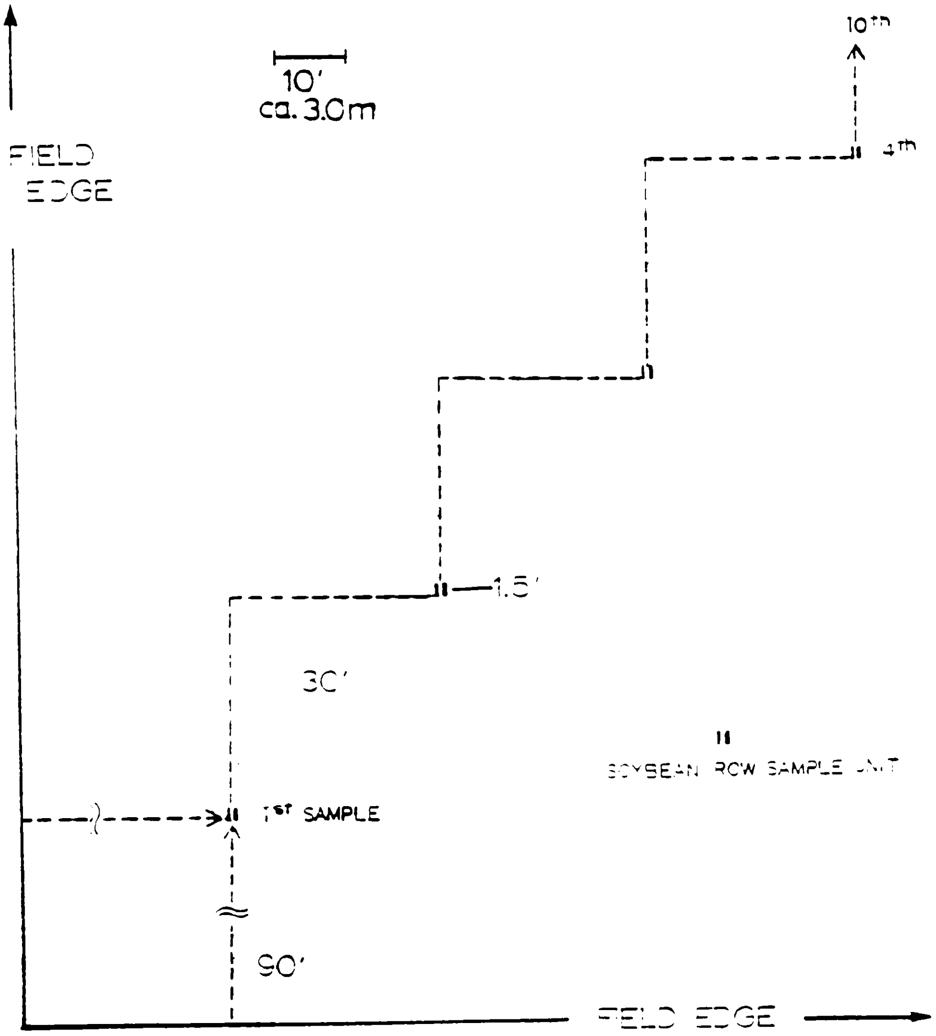

10th
FIELD
EDGE
5th
25'
CORN ROW SAMPLE UNIT
30'
15'
1st SAMPLE
25'
ca. 7.7m
90'
FIELD EDGE

III. A. 1. c. Samples in Soybeans

Sampling for corn earworm in soybeans began in mid-August; this timing corresponded with the completion of the corn earworm generation in corn and with the flight peak of the adults. Each field was sampled at 3 to 7 day intervals until late September, when the most damaging generation in soybeans was completed (Allen and Roberts 1974) The period of soybean pod set and pod fill, which corresponds to the time fields were sampled, is the criterion used by other researchers when corn earworm infestation levels are determined and spraying programs are initiated (Turnipseed et al. 1974). Thus, during the season, there were approximately six sampling periods in soybeans.

The approximately weekly sampling sequences comprised ten row samples per field. A typical sampling pattern with a given field is illustrated in Fig. 7. Each row sample included two types of data: a) quantitative and qualitative assessment of the soybean plants and b) assessment of the relevant arthropod population. Prior to sampling for arthropods, plant height and spacing between row foliage were measured as indicators of vegetative growth and canopy cover. High density cotton and closed canopy soybeans have been correlated with low numbers of corn earworms (Carner et al. 1974; Newsom 1972). For both height and spacing measurements, the decrease in foliage density, represented by a few petioles and leaflets beyond the bulk of the plant, served as the cut-off point for the measurements. Space between row foliage was measured at vertical 1-foot (0.30 m) intervals between soybean rows. In addition to foliage measurements, pod development was monitored through length and width measurements

Figure 7. Characteristic staggered-row sampling pattern within soybean fields.


10th
10'
ca. 3.0m
FIELD EDGE
4th
1.5'
30'
SOYBEAN ROW SAMPLE UNIT
1st SAMPLE
90'
FIELD EDGE

(Fig. 8) taken with a vernier caliper. One pod, representative of the majority of those present, was selected and measured at each of the ten field sampling sites. Measurements of pod width were taken over the center of the second bean forming in the pod (Fig. 8b). In 1975 only, pod height, from pod suture to suture, was measured also.

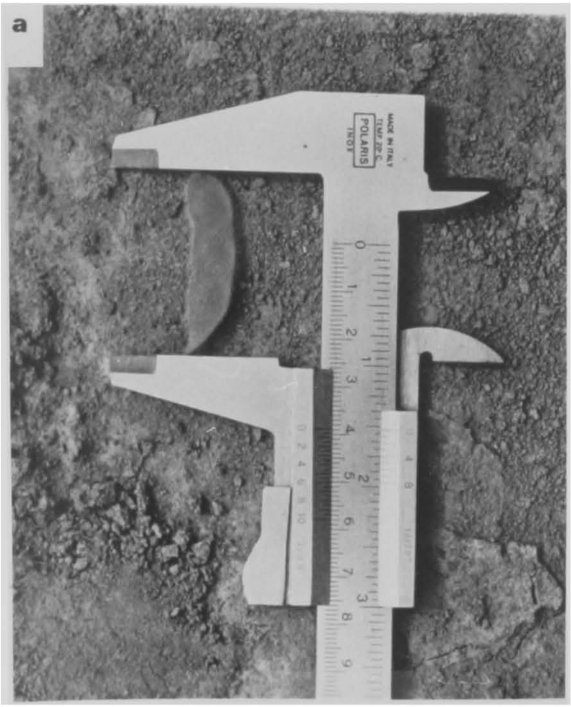
Each arthropod sample was taken by a combination of the shaking and beating techniques, developed by Boyer and Dumas (1963) and Turnipseed (1974) respectively. The sample consisted of 1.5 row feet (0.46 m) sections from two adjacent rows. Plants were bent over the ground cloth and, depending upon the plant size, shaken vigorously five to eight times. The plants were then immediately struck by arm three to six times, one second between strikes. Beating the plant at a point approximately one-third of its height from the ground effectively dislodged larvae on the lower plant parts. The cloth was then examined for larvae and predators. Total time of arthropod sampling, per sample, was approximately 5 minutes.

All corn earworm larvae and predators which fell on the 24 inch (60.9 cm) long ground cloth, spread to the width of the row, were counted. All corn earworms and representatives of predators were preserved in 80% ethanol. Heliothis identifications and instar designations were confirmed in the laboratory. In 1975 only, quantitative records were kept of araneids in the samples. Spiders were later identified in the lab and confirmed by specialists.

III. A. 1. d. Additional Supportive Field Data

Crop planting date, cultivar and maturity group, cultural practices such as row spacing and tillage, and spraying programs were

Figure 8. Measurement of soybean pod dimensions. (a) length, (b) width (in this case, of unexpanded pod).


a
MADE IN ITALY
TEMP 20°C
POLARIS
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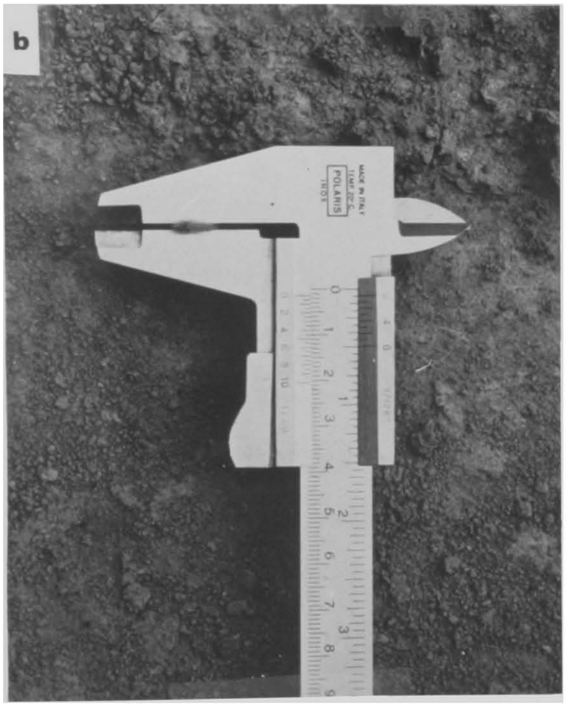
b
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recorded for each field. Additional information included: adjacent crops, previous crop, and soil type. Refer to Table 2 for sources of this seasonal information, which was collected prior to sampling or, as in the case of spraying programs, when they occurred. The necessity of this type of information has been well established (Phillips and Barber 1931; 1934; Brazzel et al. 1953; Dively 1974; Johnson et al. 1975).

Soil samples for each field consisted of ten randomly selected 4- to 6-inch deep samples per field, and were pooled prior to analyses. Samples were taken with a small hand trowel.

III. A. 1. e. Pupal Mortality and Moth Emergence Under Field Conditions

Pupal mortality and time of moth emergence directly affect the size and impact of the emerging moth population (Stinner et al. 1974; Hartstack et al. 1976). These factors have been assessed by a variety of means, including emergence traps placed over soil likely to harbor pupae (Roach and Ray 1976) and cages filled with soil, designed to approximate natural pupation conditions (Quaintance and Brues 1905; Ditman and Cory 1931; Graham and Fife 1972; Gross et al. 1975). The soil cage approach developed for pupal overwintering studies by Graham and Fife (1972) was adopted, with some modifications.

Two corn fields each in Isle of Wight and Westmoreland Cos. (1974) and five corn fields in Isle of Wight Co. (1975) were selected for the studies, which were initiated in early August in 1974 and in late July in 1975.

Table 2. Sources of information for corn earworm related field research in corn and soybeans, eastern Virginia, 1974 and 1975

Information	Source of Information
Acreage	Cooperator [1/]
Planting	Cooperator [1/]
Crop Variety	Cooperator [1/]
Crop Maturity Group	
Previous Crop in Field	Cooperator [1/]
Adjacent Crops	Personal Obs. [2/]
Row Spacing	Cooperator [1/]
Tillage Practice	Cooperator [1/]
Insecticide Application	Cooperator [1/]
Insecticide Applied	Cooperator [1/]
Blacklight Trap Records Suffolk, VA	1974 - Personal Obs. [2/] 1975 - Personal Obs. [2/]
Soil Chemistry	Soil Testing Lab, Agronomy Dept., VPI&SU, Blacksburg, VA [1/]
Soil Texture	Soil Physics Lab, Agronomy Dept., VPI&SU, Blacksburg, VA [1/]

[1/] At outset of research

[2/] As season progressed, during sampling period

Twenty-five cages in rows of five each were placed in each field, at least 90 feet (27.4 m) from field borders. The cage rows were in a staggered stair arrangement (Figs. 6, 7): rows were 30 feet (9.1 m) (i.e., 10 corn rows) apart perpendicularly. Each row began 30 feet (9.1 m) into the field, in front of the previous row. Each row was approximately 13 feet (4.0 m) long.

The cages were adapted from metal egg cans (30 lb. size), 12.50 inches (31.75 cm) high and 9.75 inches (24.76 cm) in diameter. Both ends of the can were removed to allow rainwater drainage and to approximate normal soil moisture conditions by not separating the field soil from the cage soil except at the cage sides. To prevent larval escape by tunneling (Phillips and Barber 1931), the cages were placed in holes to a depth of approximately 10 inches as were those of Graham and Fife (1972), and then filled with soil to ground level. The replaced soil within the cages was firmed to the approximate compactness of the undisturbed soil. Cages within each row were two feet (0.6 m) apart. Fig. 9 shows the cages during and after placement.

One to three days after cage placement, 20 corn earworms in late sixth instar, were removed from corn ears in the field where the cages were placed. One larva was placed in each cage, with the fifth cage in each row serving as a control with no larvae. The control was used to check for larvae which may enter the cage on their own or for pupae which may have been in the soil prior to intentional placement of larvae in the cage. Petroleum jelly was spread on the inner upper inch of each can to prevent larval escape. In 1975, each larva was supplied with lima bean diet so that all could

Figure 9. One set of 5 field cages in corn used for emergence studies of Heliothis zea pupae. (a) during placement into soil, (b) with cheesecloth covers.


a
b

complete feeding, although larvae had been selected which appeared to have completed feeding (prepupal stage larvae). The cages were left uncovered for 1 day in 1974 and for 3 days in 1975 to expose the larvae to predators. After the exposure period, cages were covered with cheesecloth to capture emerged moths.

Larval and pupal mortality, date of emergence, and moth sex were recorded. In addition, pupal cases were retrieved and pupation depth noted. If there was no emergence after 1 month, the soil in the cage was examined for dead or dipausing pupae (Barber 1937; Neunzig 1969).

III. A. 2. Laboratory Studies

Laboratory studies were undertaken to provide supporting data in the following areas: (a) number of instars, under conditions typical of southeastern Virginia, (b) incidence of parasites and pathogens in larvae and pupae, and (c) timing of peak moth emergence.

a. Instar Determination

Because of conflicting information on the number of instars and the size of larval head capsules (Quaintance and Brues 1905; Ditman and Cory 1931; Hardwick 1965; Neunzig 1969), it was necessary to rear larvae for standards for determining the instar of larvae from collections.

In 1975, adults from the larvae collected in corn were kept for rearing. Ten moth pairs were confined in one-gallon (3.8 liter) jars that had a 1-1/2 inch (3.8 cm) layer of moist vermiculite as a base, paper toweling hung down one side, and a cheesecloth lid. By daily spraying water on the cheesecloth lids and keeping the vermiculite moist, a high humidity was maintained. The environmental chamber which held the jars was maintained at 60% ± 20% relative humidity, 78°F ± 2°F (25.6 ± 1.1°C), and at a 12-hour photoperiod (Isely 1935; Berger 1963; Ignoffo 1965; Patana 1969; and Boldt et al. 1975). A seven watt red light illuminated the chamber at all times to permit unobtrusive observation (Hardwick 1965). Honey streaked on the jar wall provided food for the moths.

The egg-laiden cheesecloth and toweling were replaced daily. The cheesecloth was cut into sections and placed in one-ounce plastic cups with the lima bean diet.

Larval hatching and stadia were recorded. When the larvae reached the third and fourth instars, they were placed in separate diet cups to prevent cannibalism. At least 100 specimens of each instar were killed in boiling water and then preserved in 80% ethanol.

III. A. 2. b. Parasites and Pathogens

Because parasite and pathogen attack has an important influence on corn earworm abundance (Fye 1974; Hartstack et al. 1975; Stinner et al. 1974), the incidence of such attack was assessed in the laboratory by rearing _H. zea_ larvae collected from the corn and soybean fields under study.

Larvae in various instars were collected randomly from corn during the last week of July, when the larval population was at its maximum. In soybeans, larvae of various instars were collected randomly in early September, 1974 (5 Sept. in Isle of Wight Co. and 11 Sept. in Westmoreland Co.) and in late August, 1975 (24 Aug. in Isle of Wight Co.). In 1974, 30 larvae were collected from each of two fields of both crops in both counties. In 1975, 30 larvae were collected from each of five fields of both crops in Isle of Wight Co. Fields selected for sampling contained higher corn earworm infestation levels than fields not selected, as determined from previous samples.

At the time of collection, individual larvae were placed in 1-ounce (29.6 cm ^{3}) plastic cups 2/3 filled with lima bean diet (Patana 1969) and capped with cardboard lids. The diet was modified by replacing 30 grams of Gelcarin with 50 grams of agar (Patana 1969). Larvae were reared in environmental chambers as previously described.

One day after collection, all larvae were transferred to new diet cups to reduce incidence of disease and secondary fungal growth due to fecal and other contaminants.

Larval mortality was recorded daily. Larvae and pupae with pathogens were isolated into 4 dram vials and placed in a refrigerator at 40°F (4.4°C) until shipment to an insect pathologist for identification. Parasites were either pinned or preserved in 80% ethanol and later sent to insect taxonomists for identification.

III. A. 2. c. Timing of Peak Moth Emergence

Corn earnworm larvae collected from corn for the parasite and pathogen studies were monitored daily for pupation and subsequent moth emergence. These emergence data were to be compared to observations of pupation and emergence in field cages and with blacklight trap samples.

III. A. 2. d. Processing of Samples

All field collected larvae and predators were examined under a binocular microscope. _H_. _zea_ and _H_. _virescens_ were separated on the basis of microspinules on the chalazae of alpha and beta setae on abdominal segments 1, 2, and 8 (Peterson 1971). *H. zea* instars were distinguished by comparing head capsules of field collected larvae with those of laboratory-reared larvae.

Insect predators were identified to genus and species. Spiders were identified to at least family level using keys by Kaston (1948) and Kaston (1972). Arachnid specialists provided further identification and confirmation.

III. A. 3. Blacklight Trap Data

One 15-watt fluorescent blacklight trap was used in this study as a means of monitoring moth activity. Blacklight trap catches of *Heliothis* spp. were obtained at Tidewater Research and Continuing Education Center, Holland Station, Suffolk, Virginia. The entire light trapping period extended from early June through October, whereas the field sampling period extended from July 1 through late September. Before and after the field sampling period in 1975, and during the entire light trapping period in 1974, the only data obtained were total numbers of *H. zea* captured. In 1974, the sample on the first day after one or more days without data represented the cumulative sample collected during those days. During the field sampling period in 1975, both *H. zea* and *H. virescens* were sexed and counted. Blacklight trap data were not obtainable for Westmoreland Co.

III. A. 4. Climatological Data

Temperature and precipitation were hypothesized to aid in interpreting the magnitude and changes in corn earworm populations.

Daily climatological data utilized for Isle of Wight Co. were recorded at the Tidewater Research and Continuing Education Center, Suffolk. For Westmoreland Co., climatological data were recorded at the Eastern Virginia Research Station, Richmond Co., Warsaw, Virginia (U.S. Dept. of Commerce, National Oceanic and Atmospheric Admin., Environmental Data Service 1974; 1975).

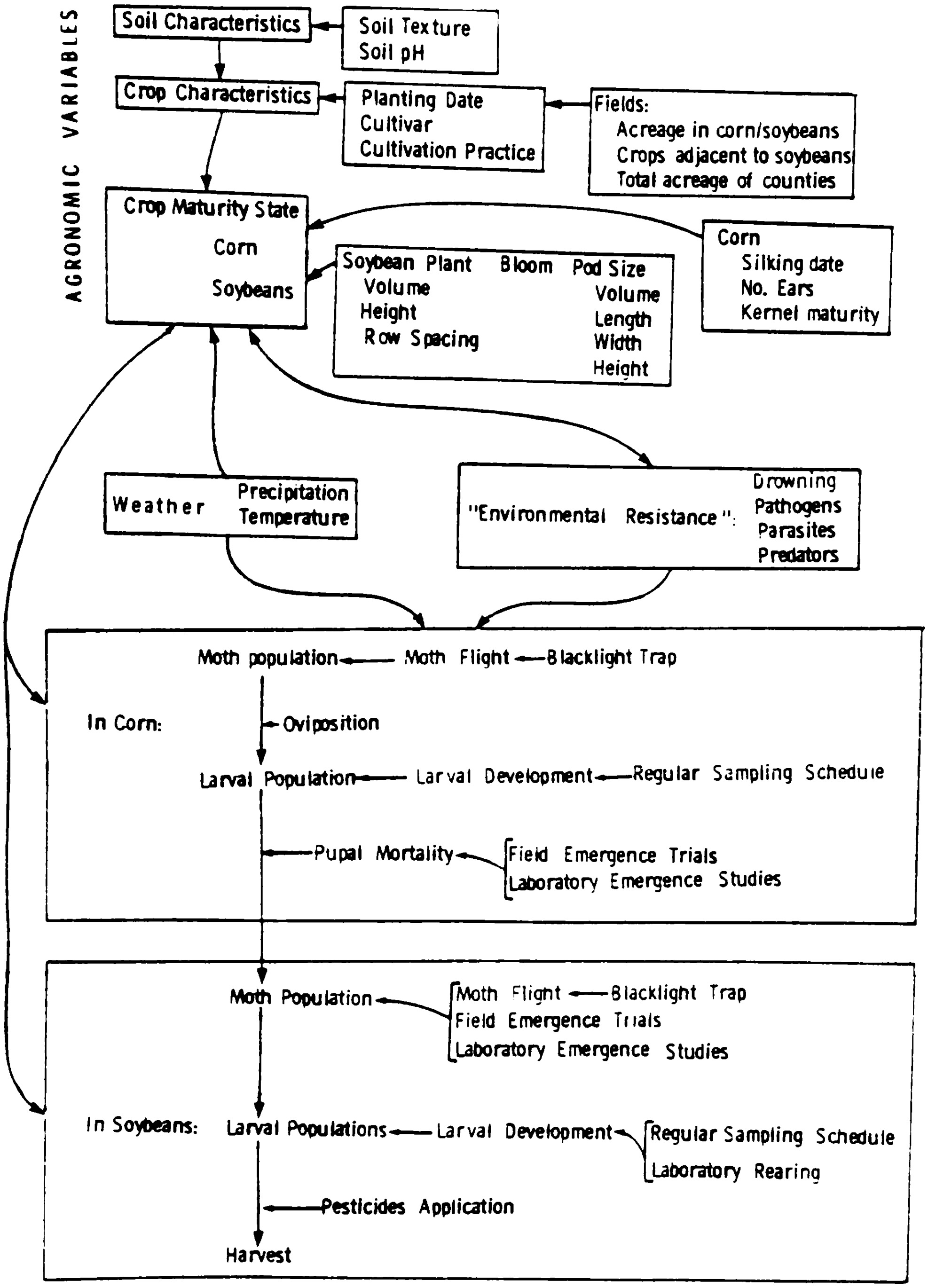
III. B. Approach to Analyses

1. Overview

The incidence of corn earworm larvae in soybeans in eastern Virginia was investigated. Forecasts about the relative magnitude of larval numbers in soybeans were based on recording (a) the build-up of the reservoir population (that generation in corn in July), (b) the timing of moth flight into soybeans, (c) population suppressive factors (environmental resistance), and (d) the soybean field conditions under which the larvae were found. This research followed, in general, the seasonal pest management approach used to deal with insects which are capable of several generations per year and which live in an environment which changes dynamically each year (Polyakov 1976). Divergence from this basic approach is found in the manner in which the component parts of the analysis were handled. Specifically, three types of predictive parameters of population density were derived.

A basic overview of the factors considered in these analyses is presented in Fig. 10. The dynamic nature of the corn earworm population in soybeans made creation of even a simple stochastic model very difficult given current knowledge. The emergence of moths in August

Figure 10. Flow diagram of the data components and steps of data acquisition, in the context of relevant ecological processes examined during the study.


AGRONOMIC VARIABLES
Soil Characteristics
Soil Texture
Soil pH
Crop Characteristics
Planting Date
Cultivar
Cultivation Practice
Fields:
Acreage in corn/soybeans
Crops adjacent to soybeans
Total acreage of counties
Crop Maturity State
Corn
Soybeans
Corn
Silking date
No. Ears
Kernel maturity
Soybean Plant
Volume
Height
Row Spacing
Bloom
Pod Size
Volume
Length
Width
Height
Weather
Precipitation
Temperature
"Environmental Resistance":
Drowning
Pathogens
Parasites
Predators
In Corn:
Moth population
Moth Flight
Blacklight Trap
Oviposition
Larval Population
Larval Development
Regular Sampling Schedule
Pupal Mortality
Field Emergence Trials
Laboratory Emergence Studies
In Soybeans:
Moth Population
Moth Flight
Blacklight Trap
Field Emergence Trials
Laboratory Emergence Studies
Larval Populations
Larval Development
Regular Sampling Schedule
Laboratory Rearing
Pesticides Application
Harvest

and the resultant larval development was not distinct: moth emergence spanned several days and at least three of the six instars were present at one time. A second reason for difficulty in model development was that although larval development in the field could be approximated from extensions of developmental rates reported by other researchers, the magnitude of the population in corn and soybeans varied between and within fields such that a general model of corn earworm numbers was not possible without several more years of research, typically done by a team of researchers, as with the two models of corn earworm populations, namely HELSIM-2 (Stinner et al. 1977b) and MOTHZV-2 (Hartstack et al. 1976). In addition, some values of a stochastic model of the corn earworm population in eastern Virginia are questionable unless, yearly, a trained team of technicians is available to make all of the necessary measurements on at least the variables shown to be important in Fig. 10.

The preliminary analyses were made once the initial computational adjustments and data refinements (Section IV.B) were completed. Incorporated in the preliminary analyses are predictions on the relative magnitude of the reservoir population, determination of time of moth emergence, and information on the various mortality factors on the corn earworm larvae and pupae. This information contributed to an overall understanding of the general population levels detected in soybeans.

The intermediate analyses utilized mortality, predator, and emergence data as independent variables (x) in the regression equations to predict corn earworm numbers (dependent variable y). In addition to these independent variables, temperature, precipitation, and plant morphometrics were incorporated. Regression analyses, when conducted, were considered the best approach to the data with respect to the questions of corn earworm number predictability (M. Lentner, pers. comm.).

Since both dependent and independent variables were not necessarily free from error or normally distributed, the Model II regression analyses criteria were met, and not those of Model I which assume independent variables were measured without error, and values of x and y are independently and normally distributed (Sokal and Rohlf, 1969). The combination of variables in the regression equations was considered insufficient to explain corn earworm numbers if R^2, the coefficient of determination (term of Steele and Torrie, 1960), was less than 0.5 (R^2 = explained SS / Total SS). However, in the course of the selection of regression equations best explaining corn earworm numbers, some equations were rejected in spite of the fact that the total variability explained by the regression equation was 50% or higher (i.e., $R^2 > 0.5$). These cases were based on the knowledge that the particular selection of variables, being purely mathematical, did not make biological sense.

The regression analyses were performed on the dual-processor IBM (International Business Machines) system/370, the computer at VPI and SU. The procedure STEPWISE with the MAXR subroutine was used, in which the maximum R^2 improvement was found at each step in the analysis (Barr et al. 1976).

The results from the regression equations supported the inclusion of soybean morphometrics in distinguishing between densities of corn earworm larvae in the field. However, even though the predictability of corn earworm numbers based on plant characteristics was very high (often $R^2 > 0.8$), the prediction equations varied between fields at each sampling date. No generalization could be made concerning which levels of corn earworms would occur in which fields. This situation was viewed as a function of the type of analyses performed, not the data. Therefore, the data and past analyses and assumptions were reassessed.

In order to make workable models, plant characteristics and other variables were included as independent variables in the regression analyses. However, variables were not all independent. Therefore, corn earworm numbers were viewed with respect to a set of interrelated variables, namely plant morphometrics.

The foregoing made feasible the third stage, multivariate analyses, an approach not possible at the onset of the analyses.

To conduct the multivariate analyses, it was necessary to identify the populations of corn earworm larvae in terms of dependent variables, where the independent variables, field groups or types, were not readily observable. With enhanced familiarity with the fields and data and intuition, it was possible to interpret the corn earworm levels reached in fields in terms of the hyperspace of plant variables. Soybean fields were classified into five ecosystem groups, characterized by plant morphometrics and corn earworm numbers. Since multiple populations were involved, multivariate analysis of variance and stepwise discriminant analysis were the appropriate statistical procedures (Cooley and Lohnes, 1971; Pimentel, 1976).

These analyses are explained in further detail below and in the appropriate sections.

Multivariate analyses of niches and multiple populations are relatively few. However, Conner (1977), Conner and Adkisson (1976), Shugart and Pattern (1972), Riggins et al. (1977), and particularly Green (1971, 1974) have approached the identification of niches through analyses similar to those used here.

III. B. 2. Multivariate Analyses

Multivariate techniques are applied to the analysis of variation between and within multiple groups or populations, each associated with many different variables. The techniques are in part statistical, in part heuristic. That is, they are tools which serve to test formulated hypotheses as well as to help to generate hypotheses about interactions and sources of variation between optimal combinations of variables. Thus, these techniques lead to further discovery concerning the interrelationships of the data. When the statistical analysis is finished, it must be interpreted in biological terms if it is to provide new understanding of the data (Green 1974; Marriott 1974).

The two multiple population statistics used in this study, namely, multivariate analysis of variance (MANOVA) and discriminant analysis, are tests of the predetermined groups that consist of many dependent variables and no observable independent variables. All dependent variates must be considered together because they are dependent among themselves. The dependent variables form a vector which describe each individual or case.

The MANOVA tests were performed with the SAS 76.4 procedure, GLM (Barr et al. 1976). The discriminant analyses were made with the Biomedical Computer Program BMDP7M (Dixon 1975). The group means and variances used in the analysis of the MANOVA are those obtained through the BMDP7M procedure.

III. B. 2. a. MANOVA

MANOVA enables the researcher to test statistically for the differences of group location in multidimensional space. The dependent vector variables are assumed to be normal in this space. Each population is assumed to have the same dispersion or variance-covariance matrix. The latter assumption is an extension of the homogeneity of variance assumption in univariate statistics. If large samples are used, the effect of departures from homogeneous distributions have little effect on the accuracy and validity of the procedure used in testing this assumption (Cooley and Lohnes 1971).

Two hypotheses can be tested in the MANOVA. The first, H_1, is that often-assumed hypothesis, that group populations have a common dispersion. The test of this hypothesis is often skipped: homoscedasticity is assumed to be unlikely to occur. In this work, the test of the first hypothesis was omitted, particularly in light of the large sample size used.

The second null hypothesis, H_2, is that the population centroids (mean vectors) are equal (Cooley and Lohnes 1971). One very useful test in discriminating the equality of population centroids is the Wilks' Lambda (Λ) test. Lambda is defined as $|W|/|T|$, the determinant of the within-group matrix $|W|$ over the determinant of the total-group matrix T . Matrix W is that of the sums of squares and cross-products of deviations of variate measurements from their group centroids, pooled over all groups. The T-matrix consists of the sums of squares and cross-products of deviations of all cases from the grand centroid. Pillai's Trace and the Hotelling-Lawley Trace are two other tests of this hypothesis. All three tests determine a probability level for H_2, and have F-approximation.

Only if the null hypothesis, H_2, is rejected, may the MANOVA tests of the separate variates be interpreted, because these tests are not independent. Inspection of the univariate F-ratios often suggests which of the vector variables contributes most to the discrimination between groups.

III. B. 2. b. Stepwise Discriminant Analysis

When the MANOVA tests are significant (H_2 is rejected), discriminant analyses may be used to classify or diagnose cases or observations. The membership of the cases in fixed groups is examined and/or predicted on the basis of a set of continuous variates measured in the cases. In the current analyses, the continuous variates were observations on soybean plant morphometrics, specifically, measurements of foliage and pods. The fixed groups were based on fields with specific corn earworm densities and plant characteristics. The group aspect, as well as the case measurements are dealt with in Section IV.C.

Discriminant analysis consists of a series of related analyses (refer to Appendix 4 for aid in visualizing this procedure). First, a stepwise procedure is used to obtain the standardized classification or discriminant functions of the groups. The variable that causes the greatest discrimination among groups is entered into the analysis. The F values of all unentered variables are then adjusted to include a new F in terms of the analysis of covariance. For each entered variable, a U statistic or Wilks' Lambda is calculated to test the hypothesis that group centroids are equal. If this test is significant at a predetermined alpha level ($\alpha = 0.05$ in the present analyses), a multiple range test for the above F is run by testing the equality of means between each pair of groups or categories. The entering of variables and the above tests proceed until no more variables with significant F values are available. The results of these tests are progressively better discriminant or classification functions; the ratio of among-group sum of squares matrix to the within-group sum of squares matrix is maximized so that the among-group differences or the group dispersions are minimized.

The discriminant functions represent the distances of each variable from each group centroid. The multigroup discriminant function constants define the location of the group or category to the overall group centroid. However, interpretation of these functions is difficult and seldom analyzed.

The classification matrix is a summary of the table of Mahalanobis' D^2 and posterior probability of each case's classification in its designated and other groups (see Appendix 4 for visualization). The matrix lists the number of "hits and misses" made in classifying.

After classification of cases, the original variable space is transformed so that within-group matrices are reduced to spheres of unit radius. In this discriminate space, the difference between groups is capitalized by orthogonality of axes. In other words, groups in hyperspace are reduced to two axes or more in canonical space, where the distance between groups (categories) and the relationship of individuals to their own space is more easily seen. The location of each canonical function or axis is a reference vector in a dimension of canonical subspace, expressed in terms of structure (canonical) correlation coefficients. The proportion of the total dispersion on each canonical axis is derived by dividing the eigenvalue (or characteristic root) for the first axis by the sum of the eigenvalues. The canonical correlations provide maximum correlation of factors among groups. These correlations indicate how well corresponding cases relate in two or more hyperplanes, i.e., how individual member observations fit various categories. The canonical correlations are very difficult to interpret, and are seldom used. These correlations were not interpreted in the present work.

The coefficients for canonical variables in discriminant space, or eigenvectors, provide maximum differentiation among groups. The bipolar vectors compare the shape, not size of the measured variates. The basis of the discrimination of each canonical axis is the rate of change of the variates in this unit space. Synergistic relationships of the variates are shown in relation to the whole through this canonical space. The orthogonality of the axes becomes more evident when the coefficients for the canonical variables are analyzed.

The analysis of the coefficients for canonical variables is hueristic.

The canonical variables evaluated at group means enables visualization of the group means relative to the first and other axes. Further description of discriminant analysis is provided by Cooley and Lohnes (1971) and Pimentel (1976) from whom this above summary was extracted; Pimentel and Frey (1978) present a recent treatment.

III. C. Preliminary Calculations and Data Refinements

Before any analyses were performed, two types of calculations were made on the existing field data once they were compiled and stored on computer disc packs. First, various soybean plant growth characteristics (such as plant volume) were calculated. These parameters were used both in regression and multivariate analyses. The second calculations consisted of data incremented by fields, through time. These data, utilized primarily in regression analyses, required concatenation and merging of field, blacklight trap, and climatological data for both years and counties. This second set of calculations was placed into three groups according to the types of modifications made: field identification, time incrementations, and climatological and blacklight trap data.

1. Calculated Soybean Plant Morphometrics

a. Pod Volume (PLWV)

A constantly changing variable, pod volume (PLWV), was created from the combination of two variables: pod length (PL), which over time, changed rapidly then slowly; and pod width (PW), which over time, changed slowly then rapidly. A third dimension, pod height (PHT), was measured in 1975 only. Pod height increased rapidly during early pod development, then slowed as it approached about 1 cm. An index to pod volume, representing growth in cubic centimeters, was obtained with the formula: $PLWV = PL * PW * 1.00\ cm$.

This index was used because pod height was not measured in 1974. In addition, the small size of the PHT variable and the similarity between the nature of change in growth in pod height and in pod length supported the decision to omit pod height from the calculation of pod volume.

III. C. 1. b. Minimum Space Between Row Foliage (SPACE)

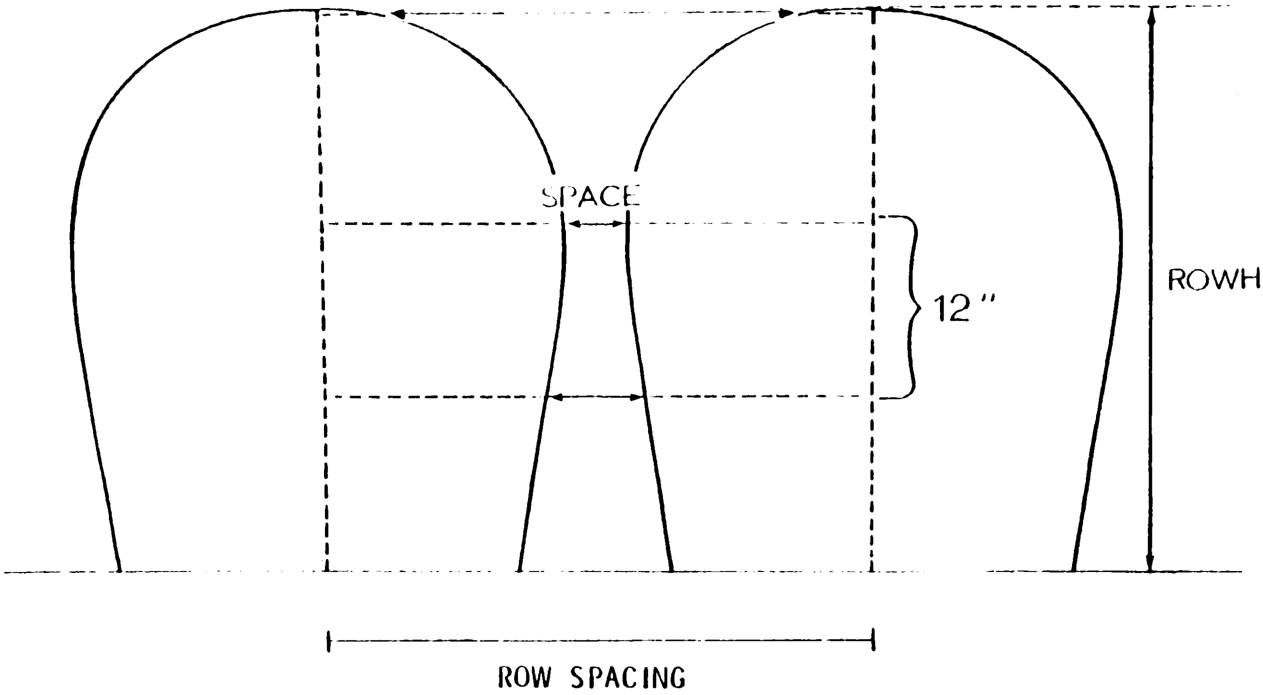
The degree of openness in the soybean canopy was assessed with measurements of the minimum space between row foliage at each sample. The smallest space between rows, measured at 12-inch (30.5 cm) vertical intervals, was recorded as the variable SPACE (Fig. 11). When the total plant height (ROWHT) was under 12 inches (30.5 cm), width measurements were not taken, and plant width was assumed to be approximately equal to 80% of the row height (Dr. T. John Smith, VPI & SU Dept. Agronomy, ret., pers. comm.; pers. obs.). This relationship is expressed as:

$$SPACE = \text{Average row spacing } (AVROWSP) - (0.8 * ROWHT)$$

c. Plant Volume (VOL)

The variable that was considered to best reflect general plant growth was plant volume (VOL) (expressed in cubic inches). One of the three dimensions, length of row (δ) was the same for all samples (36 inches (91.4 cm)). Row length consisted of two adjacent 18-inch (45.7 cm) row sections of foliage. Approximations of the cross-sectional area of plant volume were derived from rectangles and

Figure 11. Row width and plant height measurement, showing the variables SPACE (minimum space between row foliage) and ROWHT (plant (row) height).


SPACE
12"
ROWHT
ROW SPACING

trapezoids delineated at vertical 12-inch intervals (Fig. 12), and based on field measurements. The foliage width at 12-inch intervals equaled the space between row foliage at each interval, subtracted from the average row spacing. The lowest 12-inch, cross-sectional area was based on a rectangle: foliage width at and below 12 inches was treated as if constant. If total row height was less than 12 inches, the previous assumption that foliage width equaled 80% of row height was applied (Fig. 12a). This total plant volume is expressed as:

$$\text{Total Volume} = \text{Volume I}$$

$$\text{Volume I} = (0.8 * h) * \delta$$

where h equals the plant height which is less than 12 inches.

Area intervals above the first 12 inches were approximated with trapezoids, the height of the lower and upper limits of which were measured (Fig. 12c). This total plant volume is represented by:

$$\text{Total Volume} = \text{Volume II} + \text{Volume IV} = \text{Volume V}$$

$$\text{Volume II} = W_1 * 12 \text{ in.} * \delta$$

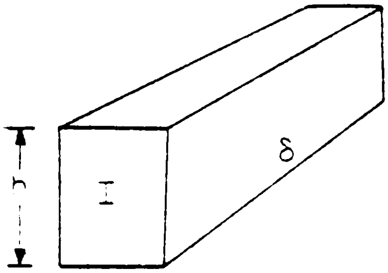
$$\text{Volume IV} = [(W_1 + W_2)/2] * 12 \text{ in.} * \delta$$

$$\text{Volume V} = [(W_3 + W_2)/2] * 12 \text{ in.} * \delta$$

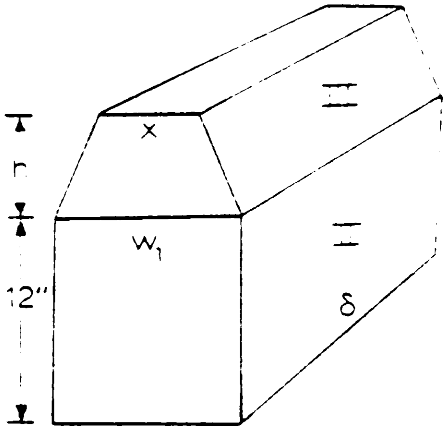
where W_1, W_2, and W_3 are the respective widths at the foot height intervals.

If the interval above the previous 12-inch vertical interval was less than 12 inches high, the ratio of the unmeasured width (x) of the upper limit of the trapezoid, to the trapezoid's height (h), was considered to be proportional to the ratio of the trapezoid's lower base (W_1 in Fig. 12b) to 12 inches (Fig. 12b). This total plant

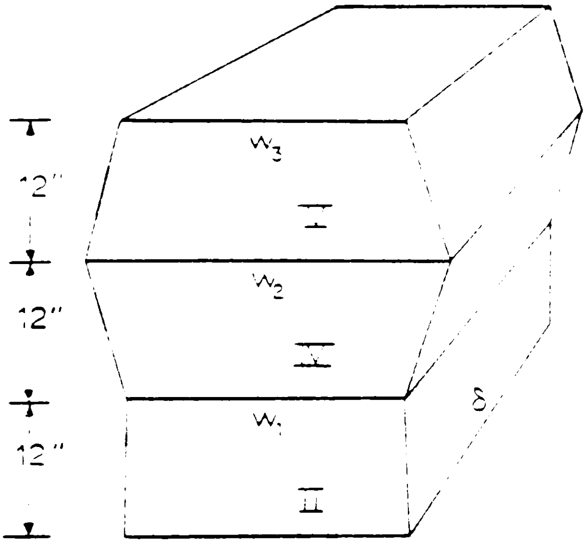
Figure 12. Soybean plant volume derivation. (a) Total plant height less than 12 in.; total volume = Volume I. (b) Total plant height exceeds 12 in., but next increment is less than 12 in.; total volume = Volume II + Volume III. (c) Total plant height is a unit number of feet; total volume = Volume II + Volume IV + Volume V. W_1, W_2, W_3 are the respective widths at the 12-inch height intervals; x is an unknown (calculated) width, h is the measured height not of a unit 12-inch interval; δ is the length of the row sample unit, 36 in.



a.



b.



c.

volume is represented as:

$$\text{Total Volume} = \text{Volume II} + \text{Volume III}$$

$$\text{Volume II} = W_1 * 12 \text{ in.} * \delta$$

$$\text{Volume III} = [(W_1 + x)/2] * h * \delta$$

where h is the measured height, not of a unit 12-inch interval.

The SAS76 statements used to calculate plant volume are given in Appendix Table 1.2.

III. C. 2. Data Incremented by Fields, Through Time

The following subsections incorporate data which required extensive computer programing. Reduced, simplified statements of the more difficult subroutines are presented in Appendix 1.2.

a. Field Identification

In 1974 and 1975, more fields than the number of fields sampled throughout the season were considered during a pre-sampling period. The final number of fields, 24 and 16, for 1974 and 1975, respectively, that were selected for the remainder of the study were originally labeled by nonconsecutive field numbers (FLD). Therefore, to distinguish between corn and soybean fields, years and counties, fields were paired (corn field with adjacent soybean field) and sorted by year, county and FLD number. Soybean fields were assigned even code field numbers (CFLD) from 2 through 80: CFLD 2-24 for Isle of Wight Co., 1974; CFLD 26-48 for Westmoreland Co., 1974; and CFLD 50 - 80 for Isle of Wight Co., 1975. Each corn field was designated by an odd integer one less than its adjacent soybean field. Thus, for example, CFLD 1 and 2, 49 and 50, etc., represent adjacent corn and soybean fields, respectively.

III. C. 2. b. Time Incrementations

Several time increment variables were created to facilitate the monitoring and correlation of events occurring simultaneously and consecutively:

i. Julian Calendar Date (MO, DAY, YR)

The month (MO), day (DAY), and the last two digits of the year (YR) were entered with each entry of field, climatological, and blacklight trap data.

ii. Consecutive Day (TIME)

The Julian calendar date was recorded with all observations and called TIME. Consecutive numbering of the days in the calendar year facilitated data revisions, sorting, and interpretation where sequences of events in time were important.

iii. Consecutive Sampling Period (TTIME)

Each return to a specific field for sampling resulted in a unit increment increase in the variable TTIME. For example, the first and second sampling periods in one field on different dates, were labeled TTIME 1 and TTIME 2, respectively. Each TTIME per field consisted of ten samples within the field. The period between any two sequential TTIMEs included at least 3 to 8 or more days. This unavoidable interval between sampling efforts resulted from the physical requirements of the sampling program: 2 to 4 hours in each of 24 fields in 1974 and 16 fields in 1975, in addition to travel time between fields. In particular, in 1974, 4 hours of travel were required between Westmoreland and Isel of Wight Counties. The number of days between incremental TTIMEs was not constant because (a) the time required to sample fields varied with the time of year and stage of crop development; and (b) within each TTIME, the order of sampling a given field varied with respect to the other fields. Inclement weather, especially thundershowers, and other uncontrollable events necessitated shifts in the sampling schedule. These time-space differences posed significant complications in the analyses (cf. Appendix Table 1.2).

III. C. 2. b. iv. Tagged Field by Consecutive Sampling Time (TTCFLD)

The joining of TTIME and CFLD into one variable, TTCFLD, provided a useful index for TTIME and field combinations. An example of TTCFLD is 364, the union of TTIME 3 and CFLD 64.

v. Post Pulse Day (FLTTIME) and Duration of Moth Flight Pulse (WFLT)

Moth activity was important in timing the emergence of larvae in soybean fields. Levels of corn earworm moth activity were determined by blacklight trap. A pulse was identified when the "capture threshold" was reached; i.e., when the number of moths exceeded background captures. The capture threshold varied relative to the size of samples within each year. The concept of "capture threshold" is covered in more detail in Section IV.A.3, Emergence Timing. The first day of the pulse was labeled FLTTIME 1 or DAY-1.

The width (i.e., duration) of the flight pulse (WFLT) was an indicator of moth flight intensity and therefore of the potential for future infestation of larvae in the county, after the pulse. The width of the pulse was based on the days when a given "capture threshold" was exceeded (see Section IV.A.3).

Since blacklight trap data were not obtained for Westmoreland County, the 1974 data for Isle of Wight County were adjusted to fit the expected pulse dates. Projected moth pulse and width of flight were based on laboratory and field emergence data, covered in detail in Section IV.C.3, Emergence Timing. The FLTTIME of Westmoreland was calculated to be 5 days after that in Isle of Wight Co. in 1974, confirming personal observations of this researcher and those of W. A. Allen (pers. comm.).

III. C. 2. c. Climatological Data and Blacklight Trap Data

The daily climatological data were incorporated with non-daily field data in the following manner. For any specific field, the period of 7 days prior to and including the first sampling data (TTIME 1) was considered representative of weather conditions which may influence the corn earworm and predator populations prior to the first TTIME. The sum of precipitation (SUMPPT), average precipitation (AVPPT), mean maximum and minimum temperatures (AVMXTEMP, AVMNTEMP) for each field's first TTIME were based on these 7 days. These climatological variables for subsequent TTIMEs were calculated from the last sampling date to, and including, the next sampling date for each field. Cumulative precipitation (CUMPPT), began 7 days prior to the first TTIME, as did SUMPPT. But, for each subsequent TTIME, the variable SUMPPT was added to yield a new CUMPPT for each field. Days without rain (DWOR), included the first day after a rain, to and including the sampling date. Samples of the above procedure are presented in Table 3.

Table 3. Sample derivation of field- and time-specific weather data.

Part 1. Hypothetical examples of field data combined with climatological data, prior to preliminary calculations.

Field (CFLD)	Date by Julian Calendar (TIME)	Time Sampled (TTIME)	Daily Precipitation (PPT)
-	211	-	.08
-	212	-	.06
-	213	-	.00
-	214	-	.00
-	215	-	.00
-	216	-	.00
-	217	-	.25
2	218	1	.39
4	218	1	.39
6	219	1	.00
8	220	1	.00
-	221	1	.00
-	222	-	.00
2	223	2	.18
4	224	2	.00
6	225	2	.00
8	225	2	.00

Table 3. (continued)

Part 2. Hypothetical example of field data combined with the climatological data after preliminary calculations have been performed. Refer to text for additional explanations.

Field (CFLD)	Date by Julian Calendar (TIME)	Time Sampled (TTIME)	Sum of Precipitation from One TTIME to Another (SUMPPT)	Days Without Rain (DWOR)	Cumulative Precipitation (CUMPPT)
2	218	1	.70	0	70
2	223	2	.18	0	88
4	218	1	.70	0	70
4	224	2	.18	1	88
6	219	1	.64	1	64
6	225	2	.18	3	82
8	220	1	.64	2	64
8	225	2	.18	2	82

Blacklight trap data were recorded with the field data as follows. Records of total corn earworm numbers (AVCEWNO), male and female corn earworms (in 1975 only, AVMALE and AVFEMALE, respectively), and *Heliothis virescens* moths (AVHHVIR, 1975 only also), were recorded for each field and TTIME in the manner similar to AVPPT.

The incorporation of daily climatological data and blacklight trap data was done in SAS72 (Barr et al. 1972), since programing began prior to SAS76 (Barr et al. 1976) availability. An example of the programing necessary for above calculations is presented in Appendix 1.2.

IV. RESULTS AND DISCUSSION

A. Preliminary Analyses: Supportive Data

1. Instar Determination and Head Capsule Measurements

Study of the dynamics of larval populations in corn and soybeans requires accurate information on larval growth stages. Published data on the number of instars and ranges of head capsule widths for each instar vary substantially with differences in geographic location (Table 4). As pointed out in the literature review, some investigations suggest that a seventh instar is possible (Hardwick 1965; Neunzig 1969). Thus it was necessary to establish the number of instars in eastern Virginia from head capsule measurements of field collected larvae.

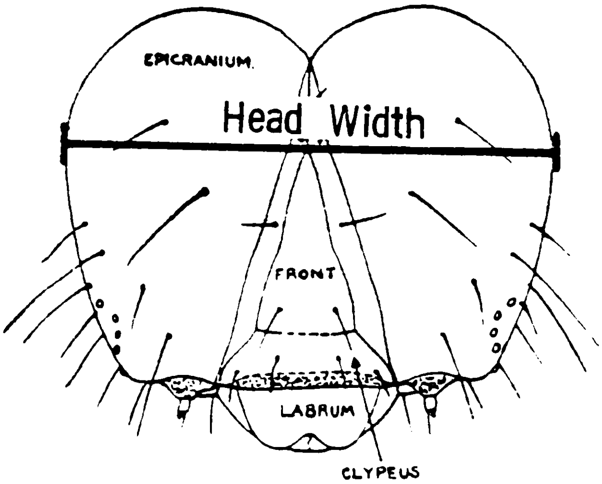
The head capsule widths of all larvae collected in 1974 from corn and soybean fields in Isle of Wight and Westmoreland Counties were measured. In addition, measurements were made of head capsule height (from distal margin of clypeus to top of epicranium in frontal view) and thickness (from postoccipital suture to front of epicranium in lateral view). These measurements were thought to provide potentially additional power in discriminating between instars. The parameters measured are illustrated in Fig. 13.

The head capsule widths were graphed in frequency histograms to determine instar groupings and size ranges (Fig. 14). Six distinct instars were evident. The first and second stage designations are based on the two narrow peaks below 0.55 mm for head capsule width. These designations agree well with the appropriate values reported in

Table 4 . Comparison of *Heliothis zea* larval instar measurements based on head capsule width.

Location	# Instars		Instar Dimensions (mm) 1	2	3	4	5	6	Source
North Carolina	5	Range n =	0.26-0.31 50	0.46-0.59 50	0.89-1.12 50	1.75-2.18 49	2.71-3.22 47	-	Neunzig 1969
Southeastern U.S. (Texas)	6	Range n =	0.26-0.32 50	0.43-0.55 50	0.76-0.90 45	1.30-1.42 42	1.95-2.10 38	3.08-3.84 38	Quaintance and Brues 1905
Southeastern U.S. (Texas)	6	Mean n =	0.3 12	0.49 12	0.80 12	1.33 12	2.03 12	3.95 12	Quaintance and Brues 1905
Ottawa, Canada	6	Mean	0.29	0.47	0.77	1.30	2.12	3.10	Hardwick 1965
Eastern Virginia Field collected 1974	6	Mean ± s.d. Range n =	0.29±0.03 0.25-0.34 14	0.47±0.04 0.39-0.54 48	0.75±0.08 0.60-0.91 116	1.26±0.19 0.93-1.63 200	2.12±0.19 1.65-2.53 234	3.25±0.20 2.55-3.70 218	Present study: field-collected
Eastern Virginia Lab reared 1975	6	Mean ± s.d. Range n =	0.27±0.01 0.25-0.30 60	0.48±0.03 0.43-0.53 60	0.81-0.07 0.65-1.00 60	1.29±0.11 1.07-1.65 60	1.98±0.15 1.50-2.65 60	2.90±0.16 2.55-3.25 60	Present study: 1st generation, lab-reared from egg stage

Figure 13. Corn earworm head capsule dimensions measured for instar determinations. (Fig. modified from Peterson 1971.)


EPICRANIUM
Head Width
FRONT
LABRUM
CLYPEUS

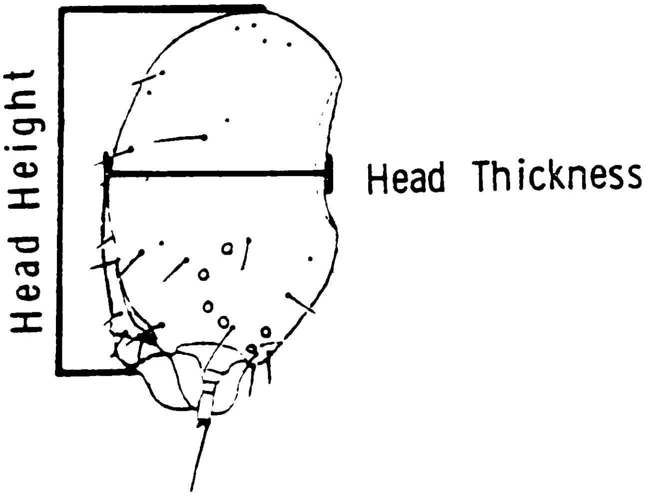
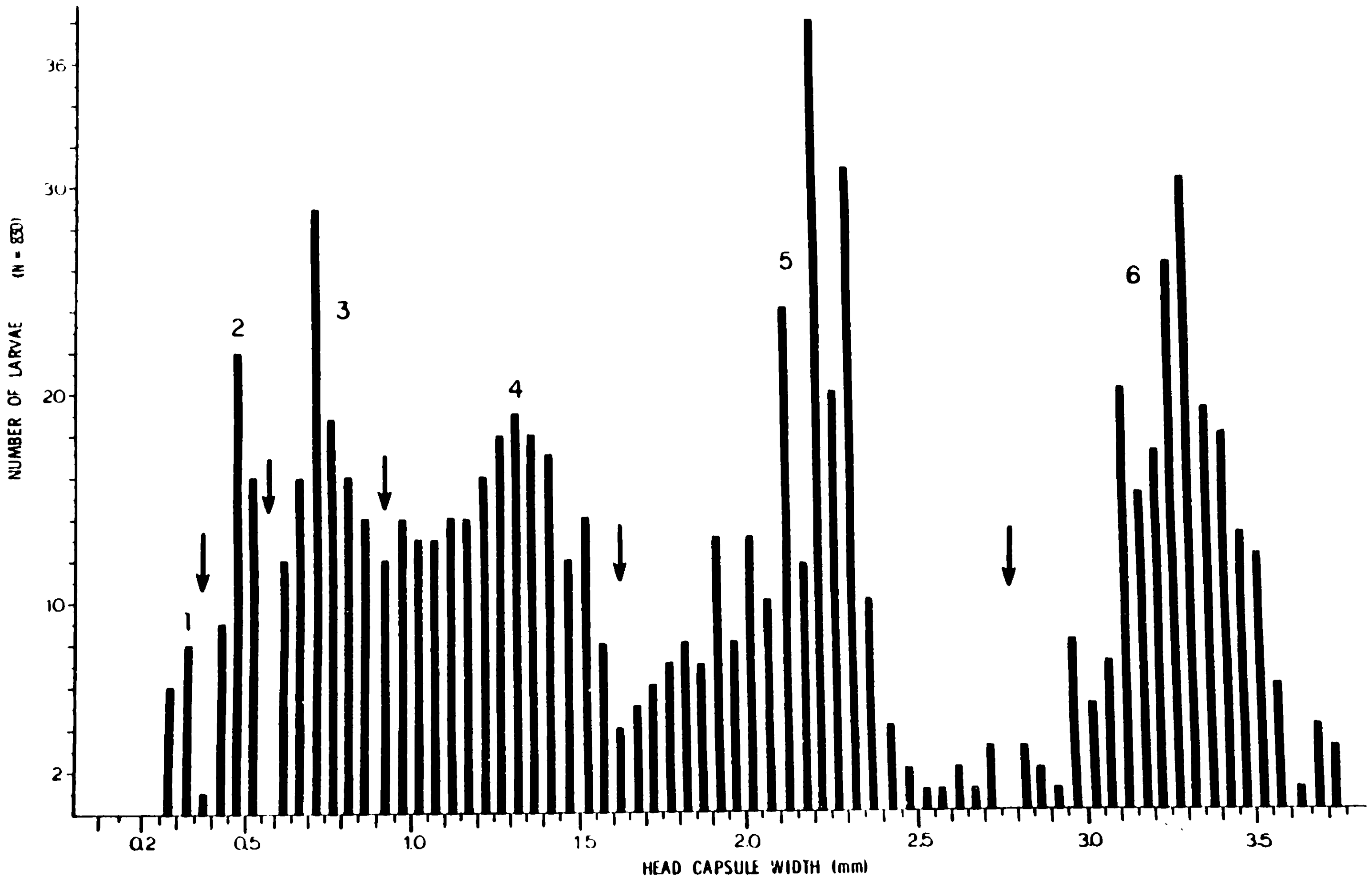

Head Height
Head Thickness

Figure 14. Frequency histogram of *Heliothis zea* head capsule width. Numbers indicate the six instars, and arrows the separation points between instars.


NUMBER OF LARVAE (N = 830)
36
30
20
10
2
1
2
3
4
5
6
0.2
0.5
1.0
1.5
2.0
2.5
3.0
3.5
HEAD CAPSULE WIDTH (mm)

the literature. Head capsule height yields a closely equivalent separation. The two lower peaks in Fig. 14 did not overlap significantly, which suggests that the smallest larvae could be reliably separated into two distinct instars. Head capsule thickness and volume, when identified with the first and second instars, are as discriminating as head capsule width and height (Table 5).

Third instar head capsule width and height did not significantly overlap with those of the second instars. The first two instars also have darker pigmentation of the head capsule than later instars.

The third and fourth instars ranges are not clearly separable, based on head capsule width alone (Table 5). The considerable overlap in widths seems to indicate that Dyar's rule does not apply to Heliothis spp., as was pointed out by Wigglesworth (1972). Surprisingly however, Neunzig (1969) found no overlap between these instars (Table 5). The head capsule widths were separated by a definite trough between 0.89 and 0.94 mm (Fig. 14). The dividing point between these two instars was designated at 0.925 mm. The other head capsule variables were examined to see if they confirmed this demarcation. Head capsule height proved as distinctive as width in separating third and fourth instars, but head capsule thickness provided no clear distinction between these or later instars (Table 5). Head capsule volume, approximated as a ellipsoid, aided in separating the third and fourth instars.

The majority of fifth and sixth instars was readily separable from other instars and from each other on the basis of head capsule width, height, and volume, individually (Figs. 14 and 15, Table 5),

Table 5 . Corn earworm head capsule measurements, based on larvae collected in corn and soybeans in eastern Virginia in the summer of 1974.

Variable	Instar	n	Mean	Standard Deviation	Coefficient of Variation	Minimum Value	Maximum Value
Width	1	13	0.289	0.023	8.01	0.250	0.313
(mm)	2	48	0.471	0.038	8.07	0.388	0.538
	3	116	0.748	0.082	10.96	0.600	0.912
	4	200	1.258	0.187	14.86	0.925	1.625
	5	234	2.122	0.195	9.19	1.650	2.533
	6	218	3.253	0.205	6.30	2.550	3.700
Height[1]	1	13	0.240	0.030	12.50	0.200	0.300
(mm)	2	48	0.401	0.033	8.23	0.350	0.500
	3	116	0.654	0.080	12.23	0.350	0.825
	4	200	1.124	0.179	15.92	0.600	1.575
	5	234	1.884	0.184	9.77	1.350	2.267
	6	218	2.830	0.221	7.81	2.000	3.350
Thickness[2]	1	13	0.129	0.017	13.35	0.100	0.175
(mm)	2	46	0.216	0.028	12.96	0.150	0.300
	3	116	0.343	0.056	16.33	0.175	0.475
	4	200	0.575	0.106	18.43	0.375	0.925
	5	234	0.979	0.126	12.87	0.650	1.400
	6	218	1.533	0.142	9.26	1.067	1.850
Volume[3]	1	13	0.037	0.006	16.07	0.023	0.045
(mm ^{3})	2	48	0.173	0.042	24.28	0.102	0.275
	3	116	0.727	0.247	33.97	0.160	1.438
	4	200	3.637	1.640	45.09	0.895	9.912
	5	234	16.779	4.547	27.10	7.543	27.926
	6	218	59.683	11.270	18.88	23.520	94.706

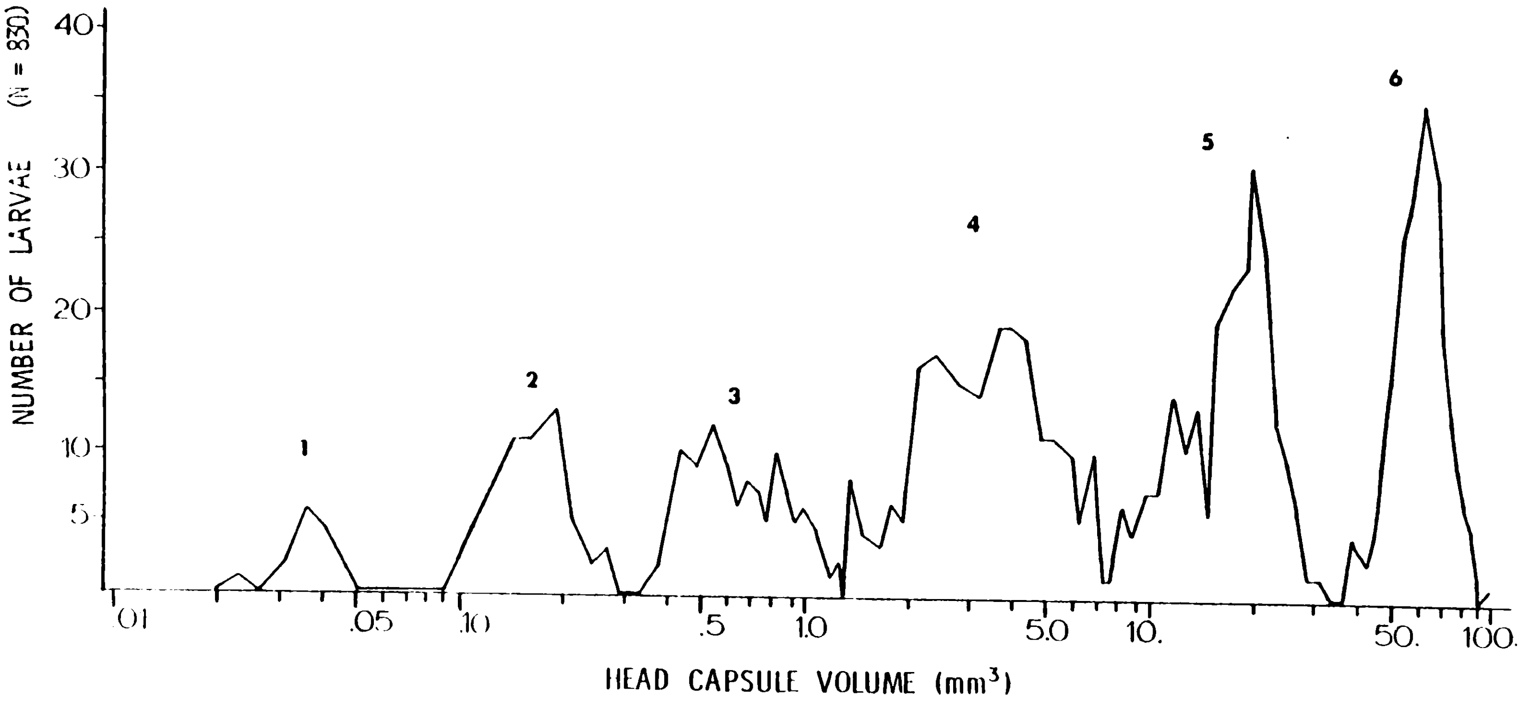
---

[1] Distal end of clypeus to top of epicranium in frontal view.

[2] Post occipital suture to front of epicranium in lateral view.

[3] 4/3 * 3.14 * width * height * thickness

Figure 15. Frequency polygon of <u>Heliothis zea</u> head capsule volume. Numbers indicate the six distinct instars.


NUMBER OF LARVAE (N = 830)
40
30
20
10
5
1
2
3
4
5
6
.01
.05
.10
.5
1.0
5.0
10.
50.
100.
HEAD CAPSULE VOLUME (mm³)

but not on the basis of head capsule thickness (Table 5). Head capsule volume provided the best distinction between third through sixth instars. The overlap in head capsule thickness in fifth and sixth instars may be due to sexual dimorphism, or late-instar specific functional/morphological changes. Investigations into such possibilities are beyond the scope of this research, but definitely lend themselves to discriminant and other analyses.

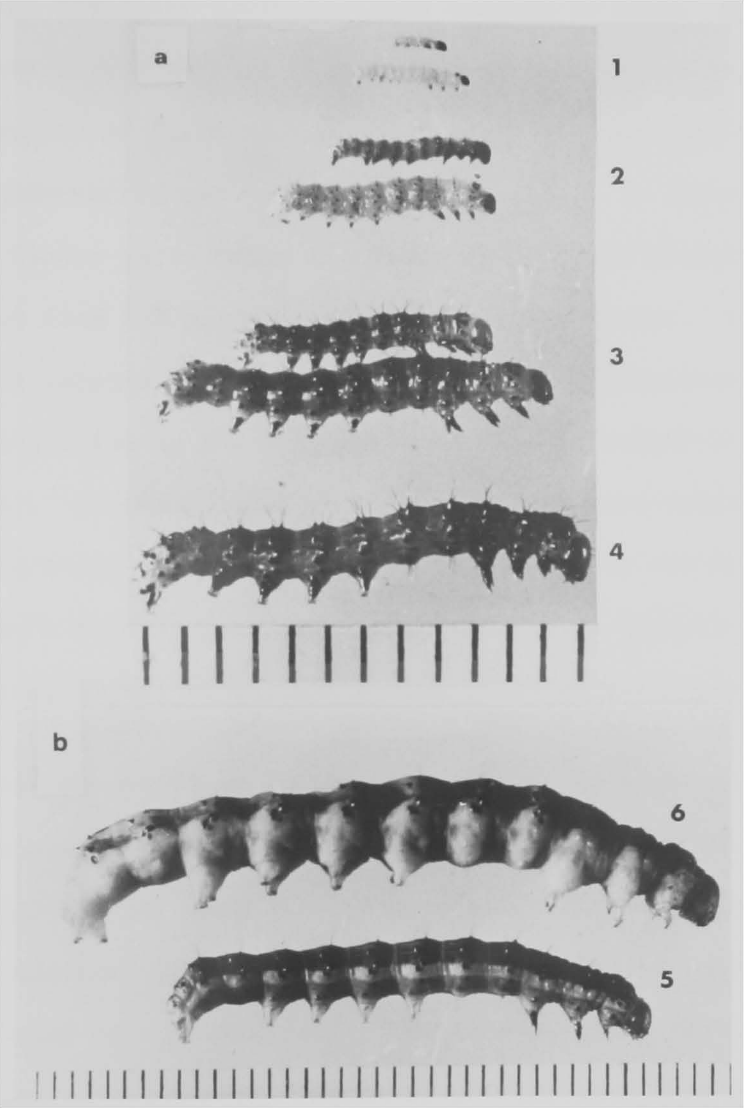
Most larvae fell well within the assigned instar limits, as indicated by the standard deviations of the respective head capsule width means (Table 5). Yet, enough third-through-sixth instar larvae fell into the intermediate ranges between instars to provide for considerable uncertainty, particularly with the critical third and fourth instars (Figs. 14, 15). For example, 18.7% of the combined number of third and fourth instars fell into a 0.20 mm range spanning the designated split between the instars. Therefore, a reference collection was made in 1975 of reared, instar-segregated larvae, for later direct larval comparisons.

First generation laboratory-reared larvae developed through to pupation, in six instars. Head capsule width measurements were made of 60 representatives of each instar (Table 4). The means and ranges in the head capsule widths of the 1975 laboratory-reared larvae and the 1974 field-collected larvae are similar, especially for the first four instars. The laboratory-reared larvae measured showed much less overlap than those from field-collected larvae. However, the means of the last two instars diverge somewhat (about 1 s.d.) between the two groups of larvae. However, it is not unusual for laboratory-reared specimens to be less vigorous than specimens of the same species in nature.

Despite the divergence, the reference collection of lab-reared larvae provided valuable confirmation of the instar ranges established with field larvae. The reference larvae provided discrete intervals which permitted intermediate larvae to be classified more readily. All of the 3,900 larvae field-collected in 1975 were assigned to instars by comparison with the reference larvae. In the relatively few cases in which simple comparison of head capsules did not allow instar designation, other larval characteristics such as spiracle size and shape were compared.

Initially, in 1974, there was a question of one or two instars with head capsule widths less than 0.55 mm. In retrospect, this question deserves discussion. Of the 830 larvae encountered while sampling in 1974, there were only 13 first and 48 second instar larvae which composed only 7.5% of the total. This strongly indicates that they are far less detectable than later instars, even though the earlier instars logically are present in greater numbers. There are several possible reasons for this lower percentage of early instars. First, the short time span of the first two instars and the possibility of overlooking them decreases the probability of capture. Second, in soybeans, young larvae may not be effectively dislodged by the beating-shake cloth technique. Third, the earliest instar larvae probably were overlooked in the time allotted to sampling, because of the small larval size (Fig. 16) and the larval tendency to remain immobile after falling on the cloth. Subsequent to the 1975

Figure 16. Photographs of larvae representing the six Heliothis zea instars. (a) First to fourth instars, from top to bottom: two specimens are shown for each of the first three instars, to indicate the ranges in length which are normally encountered. Note the lighter color of the third instar head capsule in comparison with the first two instars. (b) Fifth and sixth instar larvae, at about one-half the scale of the larvae above. One division represents one millimeter actual size.


a
1
2
3
4
b
6
5

research, the last two reasons were informally investigated.

It was found that the small larvae often did not move until they had remained on the shake cloth for five minutes or more. Also, repeated shakes of the soybean plant appeared to increase the percentage and number of first and second instars detected per site. This latter observation may have been due, in part, to larvae crawling from pods or flower parts after the first shakes, and therefore more easily knocked from the plant in subsequent plant shakes. This suggests that the samples in future studies should be preserved *in toto* for later examination in the lab (although this in itself would have disadvantages). Another clear need, and possibly more reliable and feasible, is a study on the probability of capture of the different instars, using a removal sampling technique such as depletion sampling (Carle and Strub 1978), to which the drop cloth is well suited.

IV. A. 2. Development of an Estimator Based on the Reservoir Population

The purpose of this section is to relate, based on easily obtainable variables, the corn earworm population levels in corn (the reservoir population) to the maximum infestation levels which subsequently develop in soybeans during the same season. An estimator will be formulated which might assist in generating short-term predictions applicable to the corn earworm problem in the corn-soybean ecosystem of eastern Virginia. Further, the object is to discuss the basic considerations and assumptions which must be taken into account in formulating an estimate, and to state those areas in which detailed research is needed before high confidence can be had in the estimates.

Thus, the aim here is not to present a theoretically rigorous, mathematical model for predicting populations--an unrealistic and unproductive goal in itself (Gutierrez et al. 1977). Rather, it is to contribute to the development of strategies for crop-pest management, by selecting measurable variables and determining a set of calculations leading to an estimator.

Corn was sampled for corn earworms from July 1 through mid-August in 1974 and 1975 to obtain the necessary data on the reservoir population that would be attracted to soybeans in the corn earworms' next generation (the third), beginning in early to mid-August. Summaries of the corn earworm numbers and percentages in corn are presented in Tables 6 and 7. The steps taken to arrive at and to assess the estimator follow.

Estimates of the reservoir population were based on data of a single sampling time (TTIME) in corn, because this avoided computational complexities beyond the scope of this work. This TTIME was selected when the total number of corn earworms, as well as percentages of third and fourth instar larvae, combined, were higher than at any of the other TTIMEs. Maximum infestation levels are assumed to be those reached under the pressure of predators and other environmental factors: fields incorporated in these estimates were not sprayed with pesticide prior to infestation by corn earworms. High numbers of corn earworm larvae, relative to other samples in corn, were indicative of the actual corn earworm level in corn: one major peak of total larval numbers, instead of several peaks or one very wide peak, was expected and observed (Table 6). A high percentage of

Table 6. Descriptive statistics of corn earworm instars in corn samples in Virginia, sorted by year, county, and TTIME. IW = Isle of Wight Co., W = Westmoreland Co.; means and standard deviations are based on the "n" indicated.

					Corn Earworm Instar Mean and Standard Deviation													
					One		Two		Three		Four		Five		Six		All Larvae	
YR	CO	TTIME	Dates of Sampling	n[1/]	Mean ±	s.d.	Mean ±	s.d.	Mean ±	s.d.	Mean ±	s.d.	Mean ±	s.d.	Mean ±	s.d.	Mean ±	s.d.
74	IW	1	July 1 - July 2	120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	2	July 8 - July 11	120	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.1	0.3
74	IW	3	July 16 - July 19	120	0.0	0.0	0.0	0.2	0.1	0.3	0.1	0.3	0.1	0.4	0.1	0.3	0.4	0.7
74	IW	4	July 23 - July 26	120	0.0	0.1	0.0	0.3	0.1	0.4	0.2	0.5	0.4	0.9	0.3	0.6	1.0	1.3
74	IW	5	July 31 - Aug. 4	120	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.2	0.1	0.3	0.3	0.5	0.4	0.6
74	IW	6	Aug. 13 - Aug. 15	120	0.0	0.0	0.1	0.4	0.1	0.4	0.1	0.4	0.1	0.5	0.1	0.4	0.4	1.6
74	W	1	July 4 - July 6	120	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
74	W	2	July 12 - July 15	120	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.4	0.0	0.2	0.2	0.5
74	W	3	July 19 - July 21	120	0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.2	0.1	0.3	0.1	0.3	0.3	0.6
74	W	4	July 28 - July 30	120	0.0	0.1	0.0	0.1	0.2	0.4	0.2	0.5	0.3	0.7	0.3	0.6	1.0	1.4
74	W	5	Aug. 6 - Aug. 8	120	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.1	0.3	0.3	0.6	0.4	0.9
74	W	6	Aug. 18 - Aug. 22	120	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.1	0.4	0.1	0.4	0.3	0.8
75	IW	1	July 1 - July 4	160	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
75	IW	2	July 8 - July 16	160	0.5	1.1	0.4	1.2	0.3	0.7	0.1	0.3	0.1	0.3	0.0	0.2	1.4	2.4
75	IW	3	July 16 - July 24	160	1.3	2.5	1.8	3.0	1.8	2.1	1.3	1.7	1.2	2.1	0.5	1.2	7.9	6.9
75	IW	4	July 28 - Aug. 1	160	0.0	0.1	0.1	0.3	0.2	0.4	0.3	0.5	0.8	1.1	1.4	1.5	2.8	2.3
75	IW	5	Aug. 4 - Aug. 10	160	0.0	0.1	0.1	0.3	0.1	0.3	0.2	0.5	0.4	0.8	0.7	1.0	1.4	1.9

[1/] One sample = 25 row feet (7.62 m).

Table 7. Percentages of corn earworm instars in corn samples in Virginia, sorted by year, county, and TTIME.

YR	CO	TTIME	Dates of Sampling	n[1/]	Corn Earworm Instar					
					One	Two	Three	Four	Five	Six
74	IW	1	July 1 - July 2	120	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	2	July 8 - July 11	120	0.0	55.6	0.0	33.3	0.0	11.1
74	IW	3	July 16 - July 19	120	0.0	8.9	17.8	24.4	31.1	17.8
74	IW	4	July 23 - July 26	120	0.8	4.9	12.3	15.6	38.5	27.9
74	IW	5	July 31 - Aug. 4	120	0.0	4.3	2.1	8.5	17.0	68.1
74	IW	6	Aug. 13 - Aug. 15	120	0.0	16.7	24.1	14.8	25.9	18.5
74	W	1	July 4 - July 6	120	0.0	100.0	0.0	0.0	0.0	0.0
74	W	2	July 12 - July 15	120	5.3	5.3	0.0	5.3	63.2	21.1
74	W	3	July 19 - July 21	120	8.3	13.9	11.1	13.9	27.8	25.0
74	W	4	July 28 - July 30	120	0.8	0.8	17.5	20.0	30.0	30.8
74	W	5	Aug. 6 - Aug. 8	120	0.0	0.0	3.9	9.8	19.6	66.7
74	W	6	Aug. 18 - Aug. 22	120	0.0	0.0	11.1	13.9	41.7	33.3
75	IW	1	July 1 - July 4	160	40.0	60.0	0.0	0.0	0.0	0.0
75	IW	2	July 8 - July 16	160	40.4	29.8	18.3	4.1	4.6	2.8
75	IW	3	July 16 - July 24	160	15.8	22.6	23.2	16.0	15.6	6.8
75	IW	4	July 28 - Aug. 1	160	0.5	3.2	5.6	9.5	28.9	52.4
75	IW	5	Aug. 4 - Aug. 10	160	0.9	4.3	6.5	11.7	30.0	46.5

[1/] One sample = 25 row feet (7.62 m)

third and fourth instars, combined, with respect to earlier and later TTIMEs and other instars was typical of the instar composition during this peak (Table 7).

A sampling time with a high percentage of first and second instars was not considered desirable since this percentage indicated that the population was just hatching. This might have yielded incorrect estimates of the reservoir population since many first and second instars, present in higher numbers than other instars, are killed (a) by predators prior to entering the silk channel; (b) by the silk's physical barrier; and, (c) by larger cannibalistic corn earworm larvae, once they are in the ear. Also, detection of early instar larvae is difficult. In addition, sampling for eggs, at the time when larvae would be hatching, did not enhance the estimate of the magnitude of the population when it reached third and fourth instars. Silks were severed in 1974 and examined in the laboratory for eggs and neonate larvae. Fewer corn earworm eggs and neonate larvae were found in the lab than in the field when the silks had been examined prior to removal. This discrepancy was probably due to the number of steps necessary to process the samples in the lab. Through processing, eggs and larvae could have been lost and/or overlooked.

Throughout the sampling period, the maximum percentages and numbers of both fifth and sixth instars were likely to be lower than those of the third and fourth instars because the population size decreased from pupation and larval mortality.

An illustration of the type of TTIME selection process was that used in 1975. A high percentage of early (first and second combined) instar larvae was present at TTIME 3 (Table 7). The number of corn earworm larvae, even without these early instars, far exceeded the total larval numbers at other sampling times. Also, the percentage and total numbers of third and fourth instar larvae (combined) were highest at this sampling time (Table 7). Therefore, the TTIME 3 sample was considered the best representative of the status of the reservoir population.

Once the TTIME in corn was established, an additional criterion for the estimator was established. Two sets of values of the reservoir population, to provide alternative ways of looking at the reservoir population were: (a) the sum of all larvae and (b) the sum of third through sixth instars only. In 1974, the values of a and b were similar. However, the TTIME used in 1975 resulted in greater differences between values a and b and therefore a greater possibility of a population estimate error existed. The use of these two values is discussed and compared below and in Table 3.

All samples provided the basis for the estimates of the reservoir population (Table 8, part 1). These samples were assumed to be representative of all corn fields in the county. There were approximately five times as many larvae per acre in Isle of Wight Co. in 1975 as in 1974, if only third through sixth instars were considered; and seven to eight times as many larvae if all instars were considered. Based on the knowledge that the acreages in corn were similar in Isle of Wight Co. in the 2 years and the numbers were much greater in 1975, more larvae would be expected in soybeans in 1975 than in 1974. This was confirmed by field observations (Appendix Table 2.1).

Table 8. Derivation of "estimator" of potential maximum corn earworm density in soybeans, based on the reservoir population density in eastern Virginia.

Part 1. Reservoir population: larvae in corn.

Year and County	Instars Recorded	TTIME Sample Used	Total # Larvae (L_c)	Sample Space (s)	Total # Samples (n)	Total Area Sampled (s*n)	# Larvae/ Acre ($L_c/(s*n)$) = L_c/A
1974 Isle of Wight	1-6	4	122	3 ft.*25 ft. (one 25-ft. length of row, 3 ft. row spacing)	120	9000 ft.^{2} (0.2066 A)	590
	3-6	"	115		"	"	557
1974 Westmore-land	1-6	4	120	3 ft.*25 ft.	120	9000 ft.^{2} (0.2066 A)	581
	3-6	"	118	"	"	"	571
1975 Isle of Wight	1-6	3	1266	3 ft.*25 ft.	160	12000 ft.^{2} (0.2755 A)	4,595
	3-6	"	780	"	"	"	2,831

Table 8. (continued)

Part 2. County approach to larval density in soybeans. Instars 1-6 recorded.

Year and County	TTIME Sample Used	FLTTIME	Total # Larvae (L_s)	Sample Space (s)	Total # Samples (n)	Total Area Sampled (s*n)	# Larvae/ Acre (L_s/(s*n)) = L_s/A
1974 Isle of Wight	2	7-10	34	3 ft.*3 ft.	120	1080 ft.^{2} (0.0248 A)	1,370
	3	17-22	131	"	"	"	5,282
1974 Westmore-land	2	3-5	6	3 ft.*3 ft.	120	1080 ft.^{2} (0.0248 A)	242
	3	17-20	29	"	"	"	1,169
1975 Isle of Wight	2	10-13	603	3 ft.*3 ft.	160	1440 ft.^{2} (0.0331 A)	18,218
	3	14-18	931	"	"	"	28,127

Table 8. (continued)

Part 3. Specific field approach: soybean fields in each county with maximum numbers of larvae. Instars 1-6 recorded. n = 10. Sample space (s) = 3 ft.*3 ft. Total area sampled (s*n) = 90 ft.^{2} (0.00207 A).

Year and County	TTIME Sample Used	FLTTIME	Coded Field (CFLD)	Total # Larvae (L_{sm})	Maximum # Larvae/Acre ($L_{sm}/(s*n)$) $= L_{sm}/A$
1974 Isle of Wight	2	10	12	7	3,388
	3	19	24	27	13,068
	3	19	18	31	15,004
1974 Westmoreland	2	6	30	4	1,936
	3	19	30	5	2,420
	3	18	40	11	5,324
1975 Isle of Wight	2	10	56	82	39,688
	2	13	80	178	86,152
	3	14	56	234	113,256

Table 8. (continued)

Part 4. Derivation of displacement factor (D) of reservoir population into soybeans.

Year and County	Corn			Acres of Corn in County (A_c)	Acres of Soybeans in County (A_s)	Ratio Acres in Corn/Acres in Soybeans (A_c/A_s)	Displacement Factor $(L_c/A)*(A_c/A_s)$ = D
	Instars Recorded	TTIME Sample Used	# Larvae/ Acre (L_c/A)				
1974 Isle of Wight	1-6	4	590	25,000 A	11,700 A	1.4706	868.4
	3-6	"	557	"	"	"	818.5
1974 Westmoreland	1-6	4	581	13,000 A	15,400 A	0.8442	490.3
	3-6	"	571	"	"	"	482.2
1975 Isle of Wight	1-6	3	4,595	24,600 A	12,000 A	2.0500	9,420.4
	3-6	"	2,831	"	"	"	5,804.0

Table 8. (continued)

Part 5. Derivation of multiplicative factors (X_1 and X_2); magnification of reservoir population from corn to soybean fields.

			Soybeans			Coefficients of Expansion	
Year and County	Instars Recorded in Corn	Displacement Factor (D)	TTIME Sample Used	County Approx. of # Larvae/ Acre (L_s/A)	Maximum # Larvae/ Acre in Specific Fields (L_{sm}/A)	County Approach $((L_s/A)/D) = X_1$	Specific Field Approach $((L_{sm}/A)/D) = X_2$
1974 Isle of Wight	1-6[1]	868.4	2	1,370	3,388 [12:E][2]	1.58	3.90
	3-6	818.5				1.67	4.14
	1-6	868.4	3	5,282	13,068 [24:E]	6.08	15.05
	3-6	818.5				6.45	15.97
	1-6	868.4	3	-	15,004 [18:E]	--	17.28
	3-6	818.5				--	18.33
1974 Westmore-land	1-6[3]	490.3	2	242	1,936 [30:*][4]	0.49	3.95
	3-6	482.2				0.50	4.01
	1-6	490.3	3	1,169	2,420 [30:E]	2.38	4.94
	3-6	482.2				2.42	5.02
	1-6	490.3	3	-	5,324 [40:E]	--	10.86
	3-6	482.2				--	11.04

Table 8. Part 5. (continued)

Year and County	Instars Recorded in Corn	Displacement Factor (D)	Soybeans: TTIME Sample Used	Soybeans: County Approx. of # Larvae/ Acre (L_s/A)	Soybeans: Maximum # Larvae/ Acre in Specific Fields (L_{sm}/A)	Coefficients of Expansion: County Approach ((Ls/A)/D) = X_1	Coefficients of Expansion: Specific Field Approach ((L_{sm}/A)/D) = X_2
1975 Isle of Wight	1-6[5/]	9,420.4	2	18,218	39,688 [56:A]	1.93	4.21
	3-6	5,804.0				3.14	6.84
	1-6	9,420.4	2	--	86,152 [80:A]	--	9.14
	3-6	5,804.0				--	14.84
	1-6	9,420.4	3	28,127	113,256 [56:A]	2.98	12.02
	3-6	5,804.0				4.85	19.51

1/ TTIME = 4

2/ CFLD: field category (See Table 30 for explanation of codes)

3/ TTIME = 4

4/ Not classified into field category

5/ TTIME = 3

In 1974, the population levels in corn were similar in both Isle of Wight Co. and Westmoreland Co. However, there were approximately twice as many acres of corn in Westmoreland as in Isle of Wight Co. In addition, the ratio of corn to soybean acreages varied between and among years and counties. The consequent different population levels per acre were taken into consideration in the estimator.

Several simplifying assumptions were made in calculating the estimator. First, there was no mortality in the larval population in corn after the TTIME selection. Second, it was assumed that no immigration nor emigration occurred to and from the county under study or to fields other than corn and soybean fields. Third, the entire larval population in corn, in essence, was transferred or displaced into soybeans. This displacement factor [D], part of the estimator was subject to a coefficient of expansion [X] which accounts for the decrease or increase of the population in soybeans. If the factors are to be appropriately interpreted, many environmental influences, both beneficial and detrimental to the population must be understood to be incorporated in D and X. These factors and the implications of each are discussed below.

In terms of the life cycle of the corn earworm, complete displacement [D] of the larval population in corn into soybeans may be interpreted as follows. Half of the maturing population in corn (female moths) fly to soybeans and lay their eggs. However, to maintain a straight displacement (1:1 ratio of larvae in corn to larvae in soybeans), only two of the eggs laid by each moth would survive in the larval form. If the estimate of Ditman and Cory (1931) of 500 eggs or more laid by each female is accepted, then egg and early larval mortality would be 99.6% or more, prior to the implementation of the coefficient of expansion. The displacement factor, by itself, gives a high, but not necessarily unreasonable estimate of egg and early larval mortality. Hughes and Rabb (1976) reported a 32-66% mortality of larvae in soybeans by insect parasites alone. Higher parasitization rates of corn earworm eggs (70-85%) are reported on other hosts (Lewis and Brazzel 1968). In addition, predators account for much larval and egg mortality (Turnipseed 1972). Also, heavy precipitation and high humidity promote larval drowning and entomogenous fungi.

The coefficient of expansion [X] is a proportion of the surviving larvae. The coefficient of expansion was derived from known densities of corn earworm larvae in soybeans in conjunction with the displacement factor. The sources of the larval population density in corn, represented by first through sixth instars and by third through sixth instars, respectively, provided two base populations in corn from which the coefficient of expansion was derived. In addition, the coefficient was calculated for the larval population, per acre of soybeans, for the county [L_s/A] and for the specific soybean fields in the county where the highest larval densities per acre, were observed [L_{sm}/A]. At least 4 coefficients were calculated for each year and county; these factors were compared, in turn, with those factors calculated for specific fields. These coefficients provided a basis from which future infestation levels of corn earworm larvae in soybeans could be estimated.

The soybean fields sampled were assumed to be representative of the entire county. In the county approach [L_s/A], the average larval densities determined in all fields sampled within a specific TTIME were used. The maximum infestation approach [L_{sm}/A] approach dealt with those fields which provided the more favorable oviposition sites for moths and the more favorable to optimal conditions for egg and larval survival. The identification of field susceptibility type is important in interpreting the coefficient of expansion obtained through the maximum infestation approach. A field classified as type A is considered most susceptible to high corn earworm infestation. Type B has a moderately high susceptibility; C, intermediate susceptibility; D, low susceptibility; and E, very low susceptibility. The susceptibility of fields is discussed in detail in the morphometric study of soybean fields in Section IV.C.1.b. The preliminary estimators [L_s/A and L_{sm}/A], used to calculate the coefficients of expansion (X_1 and X_2, respectively), were based on soybean samples at TTIMEs 2 and 3, the periods of highest larval densities, prior to pesticide spraying for corn earworm larvae.

Examples of the derivation of the displacement factor [D] and the coefficients of expansion [X_1 and X_2] are given in Table 8 and are discussed below.

Displacement [D] of the larval population from corn to soybeans:

$$D = [L_c/A] * [A_c/A_s]$$

where L_c/A represents the density of corn earworm larvae in the county in corn, in numbers of larvae per acre. The larval density in corn [L_c/A] incorporates both first through sixth and third through sixth instars, respectively, for each set of calculations made for the displacement factor, D (Table 8, part 4). A_c/A_s represents the ratio of acres of corn to acres of soybeans in the county under consideration. Thus, for example, if acreage in corn is two times that in soybeans [$A_c/A_s = 2$], the larval density in corn, displaced into soybeans, would be twice as dense.

Coefficient of expansion [X_1], the county approach:

$$X_1 = [L_s/A]/D$$

where L_s/A equals the density of corn earworm larvae in soybeans in the entire county, in numbers of larvae per acre. Thus, when X_1 is derived for estimates of larval densities for the soybeans in the county, the displacement factor plays an integral role.

Coefficient of expansion [X_2], the maximum infestation approach:

$$X_2 = [L_{sm}/A]/D$$

where L_{sm}/A equals the maximum density of corn earworm larvae in soybeans detected for a given field for each year and county, in numbers of larvae per acre. The coefficients of expansion for each county [X_1] and for the soybean fields with maximum numbers of larvae [X_2] are listed in Table 8, part 5.

Higher values for the coefficients of expansion were obtained, in all cases, when only third through sixth instars were considered (Table 8, part 5). In 1974, the exclusion of these first two instars yielded coefficients of expansion which differed insignificantly from the coefficients determined when these instars were included (< 0.4 units different (Table 8, part 5)). However, in 1975, the coefficients were markedly different when the two approximations were used (up to

6.5 units different (Table 8, part 5)). Because of these differences and of the errors possible in sampling first and second instars, discussed earlier, the exclusion of these instars from the approximations of the larval population in corn was considered appropriate in the final analysis.

The coefficients of expansion for the county estimates [X_1] incorporate fields with high and low investation levels. Therefore, the factors are generally low in both years. Although all 1974 fields had low infestation levels, the number of fields sampled in 1975 was almost equal in the high and low infestation categories (12 type A fields, 7 type B, 2 type C, 5 type D, and 12 type E (Section IV.C)) and therefore the average of the 1975 multiplicative factors for each field are comparable to the multiplicative factors from 1974. This is significant since the maximum population levels in 1974 and 1975 were very different: 15,000 larvae per acre and 113,000 larvae per acre, respectively. (One larva per 3 * 3 row feet equals 4840 larvae per acre.) The narrowness of the range of 0.5 - 6.5, calculated for the county approach for these two very different years of data, alludes to the potential of this method of estimating potential county infestation levels in soybeans.

The variability of the coefficient of expansion for individual fields [X_2] can be explained in terms of infestation levels and field susceptibility types. The lower coefficients (5.0 and 6.8) are associated with lower maximum numbers of corn earworms, relative to both years, respectively (Table 8, part 5). Conversely, the highest coefficient (18.3) in 1974 was obtained for the most infested field in

Isle of Wight Co. (CFLD 18), which had not quite 4 larvae per 3 row feet (approximately 19,000 larvae per acre). This value of coefficient of expansion is similar to the value obtained in Isle of Wight Co. in 1975 (19.5), where the number of larvae per 3 row feet exceeded 23 (approximately 111,000 larvae per acre). The close congruence of the maximum coefficient of expansion obtained in these extremely different fields (type E and A) and years (1974 and 1975), supports the suggestion made earlier in this section that a coefficient of expansion can be obtained whereby the maximum number of larvae in a soybean field can be predicted from samples made of the previous population in corn in the current season. Therefore, for years with infestation levels similar to those in 1974 and 1975, or between these two levels, the maximum coefficient of expansion for corn earworm larvae in the most susceptible soybean fields is approximately 20. Therefore, the estimator of the maximum infestation level of the corn earworm population in soybeans (third generation), subsequent to that generation in corn (second generation), can be summarized below:

$$\begin{aligned} \text{Estimator} &= L_{sm}/A \\ L_{sm}/A &= D * \text{maximum } X_2 \\ L_{sm}/A &= [L_c/A] * [A_c/A_s] * X_2 \\ L_{sm}/A &= [L_c/A] * [A_c/A_s] * 20 \end{aligned}$$

where L_{sm}/A represents the maximum number of larvae per acre in a single soybean field, in number of larvae per acre; D is the displacement factor, the larval density in corn times the ratio of the county acreage in corn over the acreage in soybeans; and X_2 is the maximum coefficient of expansion obtained, 20 (Table 8, part 5). The maximum coefficient of expansion is not an absolute value (20), but represents only a preliminary step in the estimate of population levels of corn earworms in soybeans, based on the population level in corn.

Immigration from other regions presents potential problems to this method of estimation. The immigration of moths from fields farther south may occur prior to the calculated emergence dates from corn. This aspect of time of infestation occurrence in soybeans is not covered in this section but in Section IV.A.3 and IV.C.1. Infestations by populations in addition to that derived from corn in the immediate county would result in infestation levels greater than those predicted. Therefore, it is important that the timing of infestation incorporate techniques that would monitor the county's emerging population (i.e., pupal cages in corn, blacklight traps, larval rearing), but also techniques that monitor possible immigration or movement of moths (i.e., blacklight trap) prior to those techniques monitoring the county's moth activity. The question of time of moth emergence from the reservoir larval population in corn is dealt with in the next section (Section IV.A.3).

IV. A. 3. Emergence Timing

Parameters relating to the dynamics of moth emergence from the second generation of _H. zea_ larvae in corn (reservoir population) were monitored in three ways: (a) by providing for emergence in field cages, (b) by taking field-collected larvae to the laboratory to complete development, and (c) by monitoring daily blacklight trap captures. For the first method, only pre-pupal sixth instars were collected over a 1 to 2 day period in each county. For the laboratory emergence studies, the first 30 corn earworm larvae encountered in selected corn fields were collected. Fields selected for the above two studies were those with highest infestations. The blacklight trap samples, taken throughout the summer, allowed all population fluctuations to be observed.

IV. A. 3. a. Emergence from Pupae in the Fields

Specimens for the field pupal studies were collected when most larvae were sixth instars in daily samples taken in selected corn fields (Table 6). The dates spanned approximately ten days in late July and early August. Because the timing of larval capture coincided with the peak of sixth instar development in each county, it was hypothesized that moth emergence in the pupal cages would be synchronized with peak emergences in the rest of the counties' populations. In 1974, the moth emergence peaked in Isle of Wight Co. approximately 5 days before it did in Westmoreland Co. (Table 9, Fig. 17). In 1975, emergence occurred approximately 9 days earlier in Isle of Wight Co. than in 1974 (Table 9, Fig. 18). The more favorable weather (less precipitation and slightly higher temperatures) in the second year probably accounted for the earlier emergence. No moths emerged from the control cages, as expected.

b. Emergence of Moths Reared from Larvae in the Field

Larvae were collected from corn fields for rearing in late July, approximately one week prior to beginning the field pupae studies. Since the corn earworm larvae were collected at random from corn ears throughout selected fields, without conscious discrimination

Table 9. Field emergence of moths placed as pre-pupal larvae into soil cages in eastern Virginia (20 larvae per field, 1 larva per cage).

			Emergence				
Date pre-pupae collected and placed in cages	County	Coded Field	No. Emerged	% Emerged	Calendar Dates, in August (Mean + s.d.)	Range (Calendar Dates, in August)	County Mean Dates and s.d.
2 Aug. 1974	Isle of	7	6	30	24 (24.5 ± 2.0)	23-27	23.8 ± 1.5
1 Aug. 1974	Wight	15	6	30	23 (no s.d.)	23	(n = 12)
6 Aug. 1974	Westmore-	39	11	55	28 (27.9 ± 1.0)	27-29	28.0 ± 1.3
5 Aug. 1974	land	41	5	25	29 (28.20 ± 1.7)	25-29	(n = 16)
28 July 1975	Isle of	61	10	50	15 (15.4 ± 0.7)	15-17	14.8 ± 2.8
27 July 1975	Wight	65	11	55	19 (19.4 ± 1.3)	18-21	(n = 60)
27 July 1975		67	9	45	14 (13.7 ± 1.0)	13-15	
27 July 1975		69	15	75	12 (12.1 ± 1.1)	10-14	
28 July 1975		73	15	75	14 (14.3 ± 1.4)	13-18	

Figure 17. Moth emergence in Isle of Wight and Westmoreland Counties, Virginia, 1974. The graph gives the number of moths captured in nightly blacklight samples in Suffolk, Virginia. The brackets indicate weekends for which nightly captures were estimated based on the cumulative catch on the Monday following the weekend. The scale beneath the graph represents FLTTIME, days calculated according to the beginning of the first major moth flight pulse of the season. In Westmoreland County, FLTTIME occurred 5 days later than in Isle of Wight County. Julian days represent the consecutive number of days of the year for the period indicated. The sequential sampling time (TTIME) bars give the unit periods of sampling in soybeans. The WFLT bar is the designated period of the peak moth flight pulse. Adult emergence from pupae monitored in the fields and from larvae taken into the laboratory, respectively, are represented by the next two sets of lines, one each for both counties; the dashed lines given the full ranges of dates during which emergence occurred under the given conditions, while the heavier lines (through which the range lines pass) indicate the range of dates during which 68% of the moths emerged.

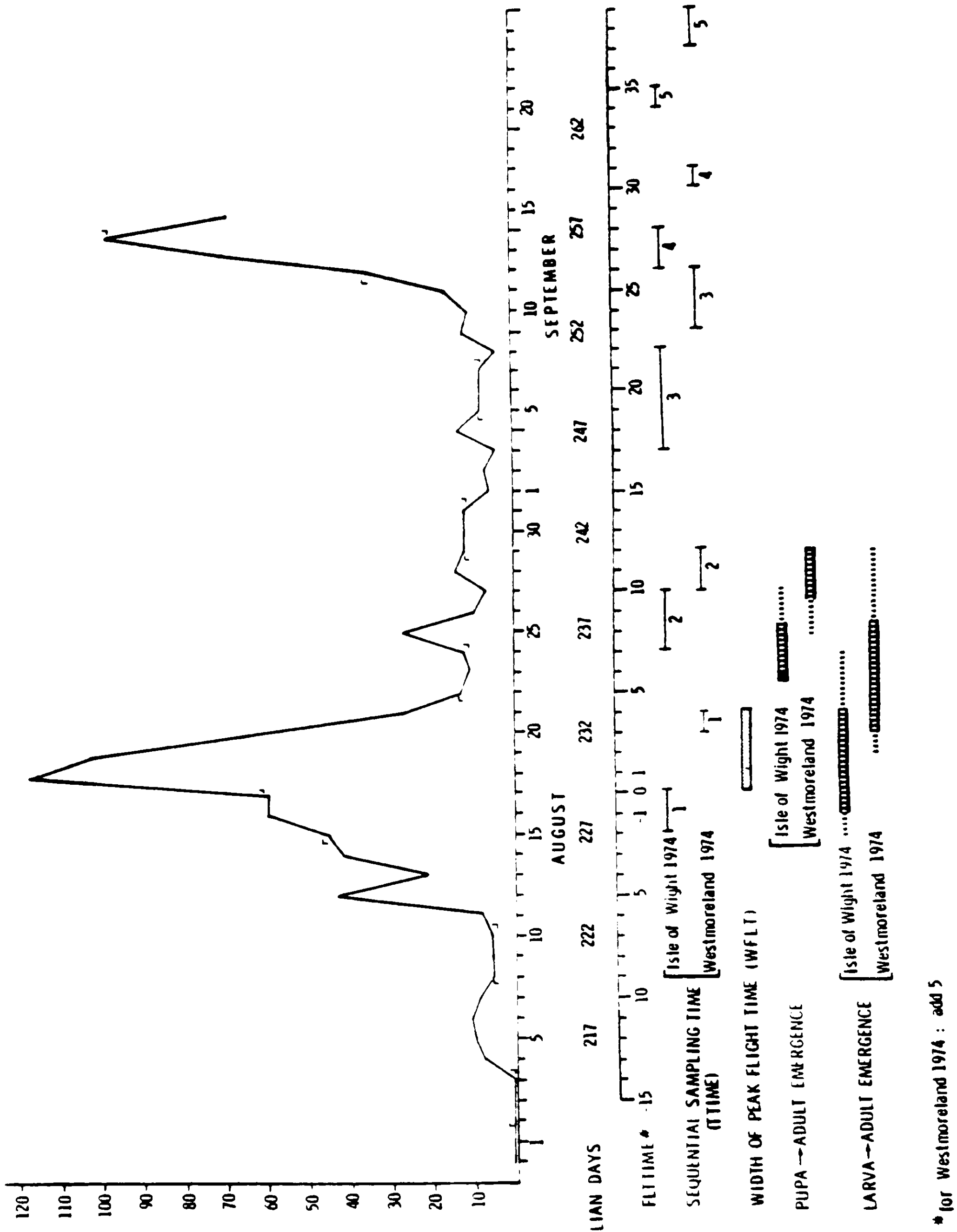
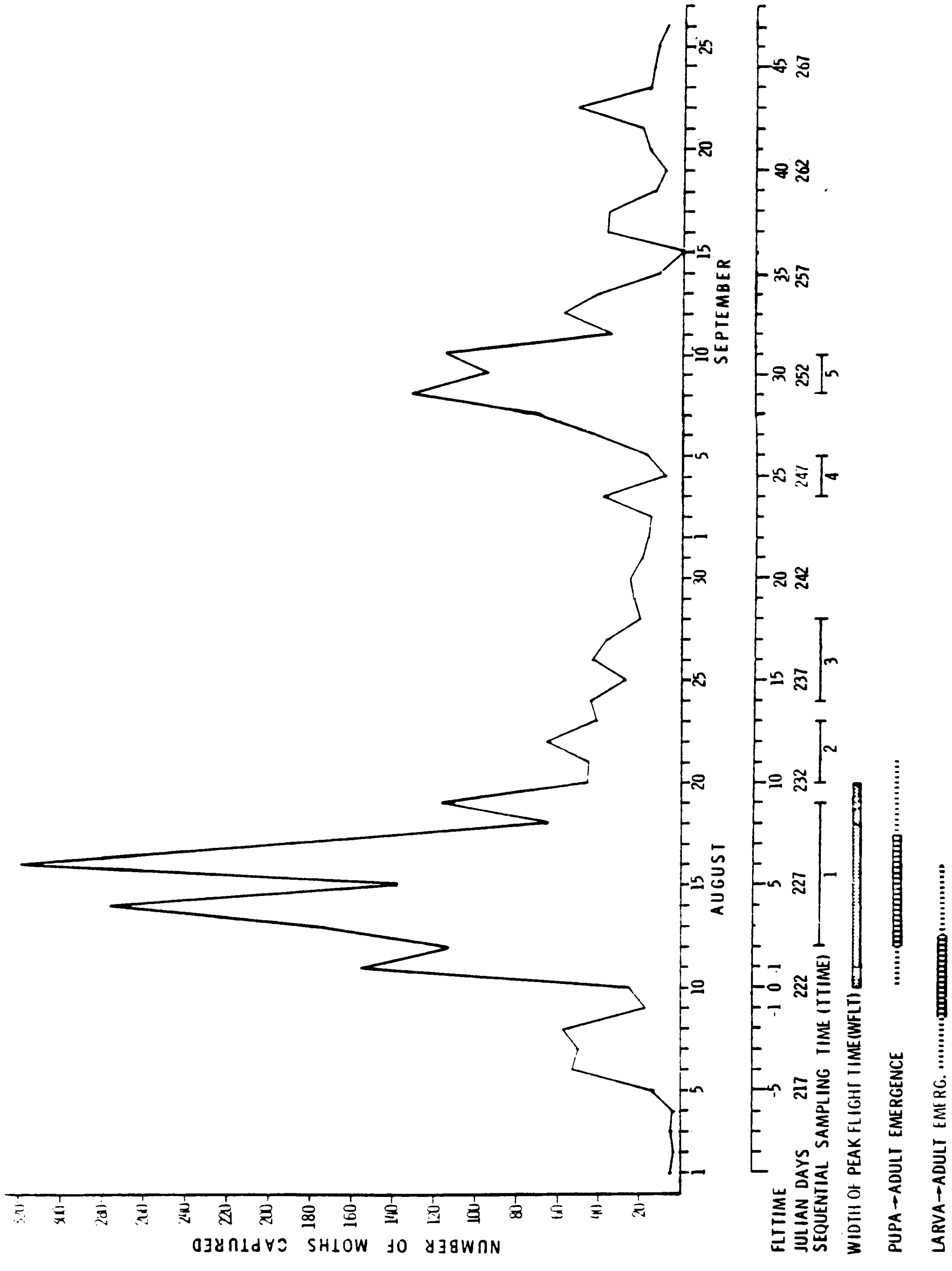

NUMBER OF MOTHS CAPTURED
120
110
100
90
80
70
60
50
40
30
20
10
JULIAN DAYS
217
222
227
232
237
242
247
252
257
262
5
10
15
AUGUST
20
25
30
1
5
10
SEPTEMBER
15
20
FLTTIME*
-15
10
5
-1 0 1
5
10
15
20
25
30
35
SEQUENTIAL SAMPLING TIME (TTIME)
Isle of Wight 1974
Westmoreland 1974
1
2
3
4
5
WIDTH OF PEAK FLIGHT TIME (WFLT)
PUPA→ADULT EMERGENCE
Isle of Wight 1974
Westmoreland 1974
LARVA→ADULT EMERGENCE
Isle of Wight 1974
Westmoreland 1974
*for Westmoreland 1974 : add 5

Figure 18. Moth emergence in Isle of Wight County, Virginia, 1975. The graph gives the number of moths captured in nightly blacklight samples in Suffolk, Virginia. The scale beneath the graph represents FLTTIME, days calculated according to the beginning of the first major moth flight pulse of the season. Julian days represent the consecutive number of days of the year for the period indicated. The sequential sampling time (TTIME) bars given the unit periods of sampling in soybeans. The WFLT bar is the designated period of the peak moth flight pulse. Adult emergence from pupae monitored in the fields and from larvae taken into the laboratory, respectively, are represented by the next two lines: the dashed lines give the range of dates during which emergence occurred under the given conditions, while the heavier lines (through which the range lines pass) indicate the range of dates during which 68% of the moths emerged.


NUMBER OF MOTHS CAPTURED
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
1
5
10
15
20
25
30
1
5
10
15
20
25
AUGUST
SEPTEMBER
FLTTIME
-5
-1 0 1
5
10
15
20
25
30
35
40
45
JULIAN DAYS
217
222
227
232
237
242
247
252
257
262
267
SEQUENTIAL SAMPLING TIME (TTIME)
1
2
3
4
5
WIDTH OF PEAK FLIGHT TIME(WFLT)
PUPA→ADULT EMERGENCE
LARVA→ADULT EMERG.

of instars, this method of sampling was considered to represent accurately the larval population and therefore was likely to give laboratory moth emergence ranges corresponding to those in the field.

The 1974 laboratory emergence results are presented in Table 10 and Fig. 17. Specimens from Isle of Wight emerged beginning August 15, through August 24; the mean emergence date was August 18. Mean emergence in Westmoreland Co. took place 5 days after that in Isle of Wight Co.; the range of emergence in Westmoreland Co. was August 19 through 29, with a mean date of August 23. In 1975, the Isle of Wight Co. mean emergence date was August 10, with the range of emergence dates being August 7 through 16 (Table 10, Fig. 18).

IV. A. 3. c. Blacklight Trap Samples

Moth flight was recorded only at Holland Station for Isle of Wight Co. (referred to as samples from Isle of Wight Co.). Flight peaked from August 18 through 22 in 1974 and from August 11 through 19 in 1975 (Appendix Table 2.2, Figs. 17, 18). The first peak (FLTTIME 1, DAY-1) in 1974 began during a weekend, when daily samples were not obtained. Based on the cumulative total of moths (165) in the following Monday's sample (Aug. 19), and the fact that the daily sample sizes of the preceding week were relatively low, whereas they were comparatively high the week of that Monday (Table 11), it seems reasonable to assume that the individual counts of 3 days might have approximated 45:60:60. Similar approximations could be made for the other weekend gaps in the 1974 data. The 1975 data were recorded daily.

Table 10. Laboratory emergence of moths reared from larvae collected in corn fields in eastern Virginia.

Date Collected	County	Coded Field	Emergence				
			No. Emerged	% Emerged	Calendar Dates, in August (Mean and s.d.)	Range (Calendar Dates, in August)	County Mean Dates and s.d.
26 July 1974	Isle of Wight	7[1]	17	56.7	18 (18.4 ± 3.0)	15-24	18.4 ± 2.5 (n = 36)
26 July 1974		15	19	63.3	18 (18.3 ± 2.0)	16-22	
30 July 1974	Westmoreland	39	23	76.7	22 (21.9 ± 2.2)	19-27	22.8 ± 2.7 (n = 40)
30 July 1974		41	17	56.7	24 (23.9 ± 2.9)	19-29	
25 July 1975	Isle of Wight	61	22	73.3	11 (10.6 ± 2.1)	7-16	10.4 ± 2.0 (n = 125)
24 July		65	28	93.3	11 (11.5 ± 1.9)	9-16	
24 July		67	26	86.7	10 (9.6 ± 2.1)	6-12	
24 July		69	22	73.3	10 (10.1 ± 1.4)	7-13	
25 July		73	27	90.0	10 (10.3 ± 2.0)	6-16	

[1] 30 larvae per field

The "capture threshold" is the number of moths which had to be exceeded for a flight pulse to be distinguished from background captures (low weekly running averages). The capture threshold varied relative to the size of the samples obtained within each year. The date at which the capture threshold was exceeded was termed FLTTIME 1: the reference date on which all subsequent timing judgments, with respect to moth activity and larval development, were based. In 1974, DAY 1 (or FLTTIME 1) fell on August 18. In 1975, the threshold level was 100 moths, placing DAY 1 on August 11. The reasons for the strong fluctuations in capture level within the 1975 pulse are unknown, but may reflect adverse weather or wind conditions. Despite fluctuations, the pulses were readily recognizable: the August pulse could be anticipated by the "shoulder" or a rise in the run of daily capture numbers (Appendix Table 2.2, Figs. 17, 18).

Based on the weekly summations (Table 11), the 5-week running average capture (background) preceding the shoulder and pulse was 1.03 moths in 1974 and 1.59 in 1975. There are, respectively: 8.1% (1/12.4) of the shoulder, 1.5% (1/66.2) of the pulse (1974); and 5.6% (1/17.9) of the shoulder, 0.92% (1/108.7) of the pulse (1975). This suggests a possible index which would allow pulses to be objectively determined: a shoulder should be at least 10 times higher than the 5-week background value, and the pulse should be at least 50 times greater than the background. Such an index would require confirmation from several years' data, however, before it could be suggested as a standard.

Table 11. Weekly cumulative capture frequencies by blacklight trap for Isle of Wight Co., Va.

	1974		1975	
	$\bar{x}$	Range	$\bar{x}$	Range
July 1 - 5	0	0	0	0
July 6 - 12	1.9	0-3	1.4	0-2
July 13 - 19	1.1	0-3	2.3	0-5
July 20 - 26	0.4	0-3	1.5	1-2
July 27 - Aug. 2	1.7	0-6	2.7	1-5
Aug. 3 - 9	7.7	1-11	28.6	4-57
Aug. 10 - 16	17.7	8-43	171.9	66-317
Aug. 17 - 23	68.3	27-118	82.4	41-193
Aug. 24 - 30	15.4	7-27	32.1	20-45
Aug. 31 - Sept. 6	9.4	4-13	23.3	9-39
Sept. 7 - 13	9.6	4-16	78.4	12-131
Sept. 14 - 18	68.0	67-69	-	-
Sept. 14 - 20	-	-	17.7	0-37
Sept. 21 - 27	-	-	19.6	8-51
Sept. 28 - Oct. 3	-	-	17.3	2-42
Oct. 4 - 10	-	-	5.5	2-19
Oct. 11 - 17	-	-	7.7	0-19
Oct. 18 - 24	-	-	7.7	0-16
Oct. 25 - 31	-	-	6.3	3-12

The pulse in August is most important in determining the timing and relative magnitude of the population emerging from corn and flying to soybeans. Both in 1974 and 1975, pulses occurred in September, but they are not relevant to the problem at hand. They represent the emergence of the populations which resulted from matings of moths in the August pulses.

IV. A. 3. d. Discussion

A comparison of the emergence dates determined by all methods, for both years and counties, is presented in Table 12. The blacklight trap samples best represented the timing of moth flight, and therefore egg-laying activity. Although weather conditions, such as rain and wind, and the location of the trap may have differentially affected the numbers of moths captured, the timing of the pulses was considered to reflect accurately the status of moth activity in the region.

The lab-reared moth emergences were consistently slightly earlier than the blacklight monitored emergences. Yet, the mean date of the 1974 Isle of Wight laboratory moth emergences occurred at the onset of the pulse determined from the 1974 blacklight (August 18). One standard deviation of emergences in the lab was concurrent with the center of the pulse period, and the range bracketed the pulse completely. Thus, the laboratory emergence of moths from Isle of Wight Co. larvae accurately reflected the timing of the natural population, as detected through blacklight trap samples. Because lab-reared Westmoreland Co. larvae had a mean emergence 4.4 days after the Isle of Wight Co. larvae, standard deviations overlapped only about 7%. It can be maintained that larval development in Westmoreland Co. in

Table 12. Summary comparison of the relative emergence dates obtained with the three methods. All numbers refer to dates in August. Ranges indicate dates between which 68% (= ± 1 s.d.) of moths were observed.

	Aug. 1974				Aug. 1975	
	Isle of Wight		Westmoreland		Isle of Wight	
Method	Mean Date	Range of One s.d.	Mean Date	Range of One s.d.	Mean Date	Range of One s.d.
Blacklight	19.5	18.1-21.0	-	-	14.4	11.8-16.7
Lab reared	18.4	15.9-20.8	22.8	20.1-25.5	10.4	8.4-12.4
Field pupae	23.7	22.2-25.3	28.0	26.7-29.3	15.0	11.8-18.2

1974 was, on the average, about 5 days behind that of Isle of Wight Co. Therefore, August 23, the mean date of laboratory emergence, was considered to represent the mean pulse date of moth emergence in Westmoreland Co., 1974.

In 1975, the mean emergence date of laboratory-reared moths coincided closely with the first day of the blacklight trap pulse (August 10 and 11, respectively). The absolute range of the laboratory moth emergence dates brackets the shoulder and middle portion of the pulse, but the onset of laboratory-reared moth emergence clearly preceded the natural emergence pulse by about 4 days (Table 12, Fig. 18). The slightly more rapid growth and emergence in the laboratory may have been the result of the more uniform laboratory conditions.

The mean dates of the emergences from the field pupae studies in 1974 in Isle of Wight Co. was less than one day earlier than the peak of the moth pulse (Table 12, Fig. 17). One standard deviation of the mean pupal emergence date, based on 61 successful emergences out of 100 trials, encompasses much of the pulse. On the other hand, the 1974 field pupae in Isle of Wight Co. emerged fully 4 days after the mean blacklight pulse date, and in Westmoreland Co., over 8 days after the pulse. Also, the survival rate was much lower in 1974 in Isle of Wight and Westmoreland Cos.: 30% and 42%, respectively.

There are several possible reasons why the field pupae in Isle of Wight Co. in 1974 may have emerged so long after the blacklight trap pulse occurred. First, sixth instars had been placed into pupal cages on soil similar, but not identical to the undisturbed corn field soil: this alone caused no apparent problem as evidenced by the emergence results in 1975. However, a rainy period following the introduction of larvae to the cages in 1974 apparently resulted in mortality due to drowning and exposure, as was noted when cages were checked after the rains. Second, several larvae and/or emerged moths escaped, and other larvae and pupae died of unknown causes. These first two reasons point to the reduction of the number of moths which emerged. Reduced sample size, due to mortality, of larvae and pupae, possibly resulted in recorded emergences not representative of the original population sampled. Third, sampling in Westmoreland Co. occurred during the blacklight pulse period (as later determined) and therefore earlier emergences than those indicated by the standard deviation, were not obtained (Table 12). Fourth, and equally important, it is possible that at the time the larvae were taken from the corn ears, the larvae represented the latter end, not the peak, of the pre-pupal population in corn.

In contrast with 1974, the 1975 period of emergence by the field pupae overlapped precisely with the blacklight trap pulse period (Fig. 18): the mean of the emergence in the field cages was about a half-day later than the blacklight trap mean (Table 12).

These emergences indicate that random samples of larvae taken to be reared in the laboratory will simulate, with reasonably certainty, the developmental status of the respective parent populations, even if separated by more than a hundred miles (> 161 km) (Isle of Wight and Westmoreland Cos.). In addition, successful larval development on the order of 80-90% emergence or better is possible (Table 10). The agreement of the laboratory-reared moth emergences and those of the blacklight trap indicate no detectable immigration of moths from other regions in 1974 and 1975. This supports observations made in North Carolina that immigration is not a significant factor in corn earworms dynamics (Stinner et al. 1977). In 1974, several unknown factors entered into the emergence dates in pupal cages which were not completely congruent with those obtained through the blacklight trap samples and the laboratory-reared moths. However, in 1975, a year when weather conditions were not inclement and the traps were monitored daily, emergence dates from pupae cage studies agreed with the dates from the other techniques. In addition, the energy and time needed to conduct the pupae cage studies is of questionable value unless timing of moth emergence is only one of the objectives of the study. The additional merits of pupal cage studies are analyzed in the next section on pupal mortality (Section IV.A.4).

IV. A. 4. Pupal Mortality

Tests conducted in corn fields in late July gave an indication of the extent of corn earworm population mortality. Distinct differences occur between mortality in 1974 and in 1975, but not between Isle of Wight and Westmoreland Counties in 1974 (Table 13). However, because the results could not be normalized, even with a variety of transformations, the analysis of variance tests were not valid and so were not used.

In 1974, pupal mortality in the field tests was over twice as high as in 1975. The differences in mortality were analyzed 3 ways. First, the depth of pupation of field larvae was examined. Second, the

Table 13 . Pupal mortality, in the field and laboratory, of corn earworms collected in eastern Virginia, in late July of 1974 and 1975.

			Field Pupal Mortality			Laboratory Pupal Mortality	
Year (YR)	County (CO)	Coded Field No. (CFLD)	% (n = 20)	Depth of Pupal Cell (in. ± s.d.)	# Found	%	# Pupated
1974	Isle of Wight	7	65	1.9 ± 1.0	9	41	29
1974	Isle of Wight	15	60	1.0 ± 0.4	7	27	26
			$\bar{x}$ = 62.5	$\bar{x}$ = 1.5 ± 0.9	Σ = 16	$\bar{x}$ = 34	Σ = 55
1974	Westmoreland	39	40	1.4 ± 0.8	4	23	30
1974	Westmoreland	41	75	0.9 ± 0.2	6	35	26
			$\bar{x}$ = 57.5	$\bar{x}$ = 1.1 ± 0.6	Σ = 10	$\bar{x}$ = 29	Σ = 56
1975	Isle of Wight	61	45	0.9 ± 0.4	10	27	30
1975	Isle of Wight	65	35	1.5 ± 0.5	13	7	30
1975	Isle of Wight	67	35	1.0 ± 0.5	14	7	28
1975	Isle of Wight	69	25	2.0 ± 1.0	12	15	26
1975	Isle of Wight	73	10	1.9 ± 0.6	18	10	30
			$\bar{x}$ = 30	$\bar{x}$ = 1.5 ± 0.8	Σ = 67	$\bar{x}$ = 13	Σ = 144

mortality of pupae collected as larvae in corn for the parasite studies (Section IV.A.5) was compared with the results obtained in the field, because field technique differences might have accounted for the two mortality levels. Third, weather conditions were examined as possible contributors to variation in pupal mortality in the field.

No correlation can be made between depth of pupation and percent mortality. After moths emerged, the 10-inch (25.4 cm) deep soil in the cages was carefully hand-sifted to determine depth of pupal cells. In 1974 and 1975, mean pupal cell depth was 1.5 inches (3.81 cm), but mortality was 62.5% and 30.0%, respectively. Therefore, no apparent association between depth of pupation and pupal mortality exists. In contrast to a maximum recorded pupal cell depth of 9 inches (22.86 cm), as recorded by Phillips and Barber (1931), 5 inches (12.70 cm) was the maximum depth attained in the present work. This maximum depth corresponds with that recorded in North Carolina by Neunzig (1969), although the mean depths recorded in this study were slightly shallower than those reported by Neunzig. Thus, it seems that larvae pupating in July and August in southeastern Virginia soils do not burrow as deep as did the larvae recorded by Phillips and Barber in central Virginia (overwintering), but burrow to depths similar to those reported in North Carolina.

A slight variation of technique in the field pupation tests was introduced in 1975, in that a small piece of prepared diet was provided for the larvae. It was placed on the soil surface, and was intended to enhance the likelihood of successful pupation by the late sixth instars selected. If this factor alone had caused the diminished

1975 mortality, then the laboratory mortality in 1974 and 1975 might be expected to have been comparable, inasmuch as there were no conscious changes in the lab-rearing technique between the two summers. Yet, for the laboratory-reared larvae which pupated, pupal mortality in 1974 was over twice (2.46 times) that obtained in 1975 (Table 13). An equivalent 2:1 mortality ratio was found in the field studies. Although the actual percentages obtained in the field are twice as high for each year and county as those obtained in the lab, the 2:1 mortality ratio between the 2 years, obtained both in the field and the lab, permit rejection of the hypothesis of differences in field technique in 1974 and 1975. The greater mortality in the field, proportionally constant both years, is most likely due to environmental resistance factors not present in the lab.

The greater mortality of pupae in 1974 was probably due to disease or deficiencies which were not manifested until the larvae pupated or the moth attempted to emerge. The origin of cause of these diseases or deficiencies were not ascertained. Neunzig (1969) attributed a small percentage of larval mortality, prior to pupation, but after entrance into the soil, to *Nosema heliothidis*, a fungus which infects pupae and prepupating larvae.

Weather conditions were studied with respect to the higher mortality obtained in the field over the lab, and with respect to the much greater field mortality in 1974. Temperatures were similar both years, but precipitation is markedly different (Table 14). In 1974, the 26-27 day period between placement of sixth instars in the field cages and the last moth emergence, precipitation was over 8.5

Table 14. Weather data for the period of corn earworm pupation in corn fields in eastern Virginia, 1974 and 1975.

Year	County	Maximum Period of Pupation	Number of Days (n)	Precipitation (inches)		Temperature (°F)
				Σ	Mean ± s.d.	Mean ± s.d.
1974	Isle of Wight	1 Aug. - 27 Aug.	27	8.72	0.32 ± 0.67	75.5 ± 4.0
1974	Westmoreland	5 Aug. - 29 Aug.	26	9.81	0.34 ± 0.83	74.8 ± 3.6
1975	Isle of Wight	27 July - 21 Aug.	26	1.12	0.04 ± 0.12	78.3 ± 4.2

inches (21.59 cm). During the equivalent time period (26 days) in 1975, the total precipitation was just over 1 inch (2.54 cm) Drainage in some cages in 1974 appeared to be a problem. The heavier rainfall in 1974 could have caused both pupal drowning and/or decomposition. In addition, wetter weather promotes fungal growth which could have reasonably contributed to the greater field mortality in 1974. Within 1974, the mean temperature was slightly lower and the mean precipitation was slightly higher in Westmoreland Co. than that in Isle of Wight Co. for the duration of the pupal mortality field experiments. These differences may have contributed to the slightly higher parasitization rate recorded in Westmoreland Co. It is possible also, that these differences are due to random flucutations in the data.

In summary, the level of pupal mortality can probably be explained in terms of adverse weather conditions (namely higher precipitation), the "vigor" of the prepupae, and other unknown causes such as prior parasitization (Section IV.A.5) or infection, and soil compaction. Not only did mortality vary between years and counties, but between fields within counties and between the techniques (lab versus field) of determining pupal mortality. Too many uncontrollable factors were present to get a good estimator of pupal mortality.

IV. A. 5. Parasites and Pathogens: Mortality in Laboratory and Field-Collected Larvae

Corn earworm larvae from corn and soybean fields were reared to provide an insight on larval mortality in the field. Once the larvae were collected, they were no longer exposed to additional parasites, pathogens, or to adverse weather conditions, but were individually reared and monitored in the laboratory. This study was useful in interpreting larval population levels found in the fields in 1974 and 1975.

IV. A. 5. a. Corn

No parasites were reared from larvae collected in the corn ears. The absence of parasitized larvae is attributable to the protection the husks provides once the larvae are in the ear. Oatman (1966), Quaintance and Brues (1905), and Smith et al. (1976) observed similar absence of parasitization in similar studies. Therefore, the number of larvae in the ears (usually one per ear) would not decrease noticeably due to parasitization. Hence, once larvae reach the kernels, their chances of survival are enhanced, and, as previously assumed, a survey of this population should provide a reasonably reliable estimate of the number of larvae which would reach the prepupal stage (Section IV.A.2).

b. Soybeans

Parasites did emerge from larvae collected in soybeans (Table 15). Nearly four times as many parasites were collected from larvae in 1974 as in 1975. Although the dates of larval collection were later in 1974 (Sept. 5-11) than in 1975 (Aug. 24), moth flight to soybeans and therefore the resultant larval hatch was proportionally later in 1974 than in 1975 (Section IV.A.3, Figs. 17, 18). Therefore, the differences in parasitization level are not likely to be

Table 15. Insect parasites reared from corn earworm larvae collected in soybean fields in eastern Virginia.

Taxa	Isle of Wight Co., 1974 n = 60 1/					Westmoreland Co., 1974 n = 60					Isle of Wight Co., 1975 n = 150				
	Date Host	Host Moribund		Parasite Emerged		Date Host	Host Moribund		Parasite Emerged		Date Host	Host Moribund		Parasite Emerged	
	Collected	Stage	Date	Number 2/	Date	Collected	Stage	Date	Number	Date	Collected	Stage	Date	Number	Date
Diptera															
Tachinidae															
Eucelatoria rubentis (Coquillett)	Sept. 5	Pupa	Sept. 27	1	Sept. 27	-	-	-	0	-	-	-	-	0	
Lespesia aletiae (Riley)	Sept. 5	Larva	Sept. 11	1	Sept. 15	-	-	-	0	-	Aug. 24	Larva	Sept. 1	3	Sept. 10 Sept. 9
Hymenoptera															
Ichneumonidae															
Campoletis flavicincta (Ashmead)	-	-	-	0		Sept. 11	Larva	Sept. 12	1	?	-	-	-	0	-
Braconidae															
Apanteles marginiventris (Cresson)	Sept. 5	Larva	Sept. 6	2	?	Sept. 11	Larva	Sept. 12	2	?	-	-	-	0	-
Meteorus autographae Muesebeck	-	-		0	-	Sept. 11	Larva	Sept. 12	3	?	Aug. 24	Larva	Aug. 31	1	Sept. 6
Meteorus laphygmae Viereck	Sept. 5	Larva	Sept. 6	1	?		-	-	0	-	-	-	-	0	-
Percent Parasitization:				8.33%					10.00%					2.67%	

1/ Number of hosts collected

2/ One host per parasite in all cases

due to what might appear to be a longer period of larval exposure in 1974.

The corn earworm population levels in soybeans were much lower in 1974 than in 1975 (Appendix Table 2.1), and at the lower population levels, the percent of parasitization was greatest. Burleigh et al. (1973) also found highest parasitization when the corn earworm population in cotton was lowest. They also found parasitization of Pseudoplusia includens (Walker) (Leipdopteria: Noctuidae), the soybean looper, to be related inversely to the looper population density.

In addition to the intrinsic differences in corn earworm population levels, the soybean fields, from which larvae were collected for this study, represented fields with the maximum number of larvae in the county that year. In 1974, during the sampling period, these fields were more mature, had more foliage and larger pods than those fields used in 1975. Therefore, in 1974, fields having high parasite numbers also had more foliage or refuge for hosts. Although this foliage presents greater obstacles for the parasites seeking suitable hosts, the possibility of build-up of parasites in alternate hosts in soybeans prior to the entry of corn earworm moths from corn is increased in the more mature fields. Therefore, parasite levels were probably higher in more mature fields versus the less mature fields. Similar field types, an aspect covered in Section IV.C., could be selected for future studies on corn earworm parasitization with respect to host plant maturity.

An increase in pathogen level, but not necessarily parasites, has been associated with wet weather (Newsom 1976). In 1974, wetter weather prevailed than in 1975 (Appendix Tables 2.3 - 2.5). Closed canopy, typical of 1974 fields sampled, is associated with the late-season samples and the entomogenous fungus Nomuraea rileyi (Farlow) Sampson (Deitz et al. 1976; Allen et al. 1971). This fungus was positively identified in one larva collected in 1974 in Isle of Wight Co. Large numbers of corn earworm cadavers, encrusted with spores (probably of this fungus) were observed in 1974, after heavy rains, particularly in Westmoreland Co. in mid-September.

Records on the number of larvae infected with this and other fungi and with viruses were not obtained in this research. Those larvae found to be infected with fungi or viruses were shipped to an insect pathologist for positive identification. However, because of secondary bacteria and specimens lost in shipment, only the above mentioned fungus was identified.

The higher parasitization rate and pathogen infection level in 1974 over 1975 may be associated with at least the following: (i) lower larval population levels, (ii) closed canopy and mature crops, and (iii) higher precipitation. This higher parasitization rate also reflects a suppression of the population, a factor contributing to the lower population levels in 1974 than in 1975.

IV. A. 6. Predators

Predator presence was monitored in both corn and soybeans to determine associations between corn earworm numbers and predator densities. A list of predator taxa encountered in corn and soybeans is presented in Table 16. The wheel bug, Arilus cristatus (Linnaeus)

Table 16. Arthropod predators of *Heliothis zea* (Boddie) larvae monitored in corn and soybeans. x = quantitatively recorded; xP = quantitatively recorded, probable predator of *H. zea*; xD = quantitatively recorded, doubtful if active predator of *H. zea*; nd = not distinguished separately from the above recorded species' adults; nr = not recorded.

Arthropod	1974	1975
INSECTA		
Hemiptera		
Anthocoridae		
Orius insidiosus (Say)	x	x
Orius nymph	nr	x
Nabidae		
Nabis roseipennis Reuter	x	x
Nabis nymph	nd	x
Reduviidae		
Arilus cristatus (Linnaeus)1/ nymph	nr	x
Lygaeidae		
Geocoris punctipes (Say)	x	x
Geocoris uliginosus (Say)	nd	x
Geocoris nymph	nr	x
Coleoptera		
Coccinellidae		
Coleomegilla fuscilabris Mulsant	x	x
Hippodamia convergens Guerin	x	x
Coccinellid larva	x	x
Neuroptera		
Chrysopidae		
Chrysopa spp. larva	x	x
ARACHNIDA		
Araneida		
Uloboridae 2/	nr	xD
Theridiidae	nr	xD
Linyphiidae	nr	xD
Micryphantidae (Erigonidae)	nr	xD
Araneidae	nr	x
Tetragnathidae	nr	xD
Pisauridae	nr	xP
Lycosidae	nr	xP
Oxyopidae	nr	x
Gnaphosidae 1/	nr	xP

Table 16. (continued).

Arthropod	1974	1975
Clubionidae	nr	xP
Anyphaenidae	nr	xP
Thomisidae (including Philodromidae)	nr	x
Salticidae	nr	x

---

[1] Observed in soybeans only

[2] Observed in corn only

is a general predator, especially of lepidopteran larvae (Mead 1974). In the literature, the wheel bug has also been an observed predator of a salticid and adult pentatomid (Swadener and Yonke 1973), but not specifically of corn earworm larvae. An _A. cristatus_ nymph was observed feeding on a third instar _Heliothis zea_ larva in one soybean field, in Isle of Wight Co., in 1975. This observation was supported by similar observations made by J. C. Smith (pers. comm.). Numerous _A. cristatus_ nymphs and adults were observed, although not feeding, in selected soybean fields in Westmoreland Co. in 1974. Reduviidae species, specifically _Sycanys indagator_ (Stal) has been suggested as a potentially useful predator of soybean pests, specifically the soybean looper (Greene and Shepard 1974).

The spider species collected in corn fields and soybean fields are presented in Appendix Tables 2.6 and 2.7, respectively. A total of 72 spider species was observed, 47 species in corn and 45 species in soybeans.

IV. A. 6. a. Corn

Predators in corn could not be associated with corn earworm densities since the larvae are essentially protected from predators by the husk. Only the eggs and neonate larvae, found outside the husk, are vulnerable. However, as pointed out previously, detecting eggs and early instar larvae is very difficult. Therefore, since the number of eggs and early instar larvae observed in any studies reported herein is not believed to truly represent the actual numbers present in the field, correlation between predators and these detected stages was not done.

IV. A. 6. b. Soybeans

Analysis of the importance of predators with respect to corn earworm larvae in soybeans was done in the regression analysis. These analyses are covered in detail in Section IV.B. Predator numbers did not enter into the final regression equations.

In addition to incorporating predator numbers as independent variables in predicting corn earworm numbers in the regression analyses, predators were studied separately. The means and standard deviations of the predators monitored are presented in Appendix Tables 2.8 - 2.10. The variation between and within fields within one TTIME and between TTIMEs is very great. Conventional transformations could not correct this variability. In addition, the number of each predator peaked at different times in different fields. These differences are probably attributable to the microenvironment in which the predators live, as shown with spiders by Dondale (1977), and high predator numbers do not necessarily result in suppression of corn earworm larvae. All of the predators observed are non-specific, although most actively feed on available corn earworm larvae and/or eggs. The presence of alternate hosts may explain some of the predator build-up, as may plant phenology and microclimate.

IV. B. Intermediate Analyses: Multiple Regression Analyses

Analyses were made of relationships of a set of field variables to corn earworm numbers; that is, which of the variables best explain corn earworm numbers? The variables were treated as if all were independent of each other, although this assumption did not hold in several cases, as will be discussed. Despite the technical assumption of independence, regression analysis provides an acceptable mathematical model if interpretation is based on solid insight into the biological attributes of the soybean-corn earworm problem (M. Lentner).

IV. B. 1. Variables Used

The 93 variables regressed on corn earworm numbers are listed in Table 17 and have all been shown to affect corn earworm numbers to some degree (see Literature Review). All variables were either (a) direct measurements taken in the field (e.g., pod length), (b) values calculated from field data (e.g., plant volume), or (c) the closest approximation possible for each field (e.g., average precipitation). Qualitative variables such as crop variety, were assigned numerical values. The reasons for including these variables and their specific pertinence in the multiple regression analyses will be discussed individually.

a. Basic Information of the County

The most essential physical characteristics of the counties under study were the corn acreage in which the reservoir population may build up, the soybean acreage available to that population, the availability of an alternate host (especially peanuts), and the size of the respective counties. Changes in the acreages would hypothetically reflect changes in the corn earworm population levels in soybeans in different counties and years.

When the various acreages in regions being compared are similar, the geographic location of the counties may explain differences in

Table 17. Variable groups used in regression analyses (see Appendix Table 1.1 for mnemonic variable codes).

1. Basic Information on the County (9)

CORNACRE	SOYACRE	NUTACRE	COSQMI
ELEV	LATDEG	LATMIN	LONGDEG
LONGMIN			

2. Basic Information on Fields (15)

PLD	ADJC1	ADJC2	ADJC3
ADJC4	ACREAGE	SPRAY	TILLAGE
MATGP	MATGP2	AVROWSP	PREVC
VARIETY	VAR2	PLANTD	

3. Blacklight Trap Data (6)

AVCCEWNO	AVFEMALE	AVMALE	AVHHVIR
FLTTIME	WFLT		

4. Climatological Data (5)

AVMNTEMP	AVMXTEMP	AVPPT	CUMPPT
DWOR			

5. Insect Predators (12)

BEB	BEBN	BLKBEB	BLKBN
CONVG	LB	LBL	NAB
NABN	NEURL	OR	ORN

6. Larval Parasitism (3)

MPCMP	PCMORTL	PCPARA

7. Plant Characteristics (8)

PL	PW	PLWV	SPACE
ROWHT	VOL	PHT[1/]	PULLHT[1/]

8. Reservoir Population Levels (4)

CORNT3A	CORNT3P	CORNT4A	CORNT4P

9. Reservoir Population Pupal Mortality (1)

MPCMP

Table 17. (continued)

10. Soil Composition (18)

a) Soil Chemistry

ACA AK AMG AP
CAO K2O MGO PH
P2O5

b) Soil Texture

C CLAY F M
SAND SILT TEXCL VC
VF

11. Spider Predators (13)

ARAN ARTH CLBAN LIMC
LYCO LYCPIS OXY SALT
SP TETRA THER THOM
ULO

12. Time Increments (2)

TIME TTIME

13. Transformations of Plant Characteristics[2] (4)

a) LOG10 (x[3] + 1) = LGx
b) SQRT (x + 0.5) = RTx
c) x * x = SQx
d) ARCSIN (x/max x) = ARCx

---

[1] Variables not included in step 6 of analyses nor in transformations.

[2] Functions on left of equal sign are precalculated in SAS76

[3] x = all plant characteristics except those noted in footnote 1. Mnemonic variable codes substitute x in actual calculations.

population levels (Hardwick 1965). Therefore the two counties' latitude, longitude, and elevation were included as possible discriminators.

IV. B. 1. b. Basic Information on Fields

Moth and/or larval preference for, and the suitability of, soybean fields is dependent upon many interrelated variables. Adjacent crops were considered to be possible attractants of moths to or from the fields studied. Observations by Johnson et al. (1975) and others support such an assumption. Crop maturity group and crop variety, planting date and plant phenological stage were considered to be indicators of crop development and host suitability. Agronomic practices (e.g., type of tillage) were considered to have an influence on the movement and oviposition of moths within the fields and to potentially affect faunal differences between fields. This basic information on fields was distinctive for each field studied and therefore used to differentiate between fields.

c. Blacklight Trap Data

The pulse of the moth flight from its reservoir host (corn) to soybeans, the width of the flight pulse, and the number of moths captured, were used as indicators of the timing and intensity of the infestation of corn earworms in soybeans. Field data determined the timing of the flight pulse, as discussed in Section IV.A.2. Blacklight trap data were used to separate infestation levels between years, not differences within fields within a given year since such data applied to all fields within the county for the season. Sampling periods within each season were labeled according to time, in days, since the moth flight pulse (FLTTIME) (first day of peak).

IV. B. 1. d. Climatological Data

Both precipitation and temperature clearly influence larval development and mortality. Precipitation, in particular days with out rain (DWOR), was hypothesized to be particularly influential. Therefore, measurements of precipitation, even more than those of temperature, were considered necessary to define infestation levels between years and counties and between field sampling times (TTIME) within a given year and county.

e. Insect Predators

Insect predators are known to suppress corn earworm egg and larval populations. Higher, rather than lower, insect predator numbers may suppress larvae. However, since some predators (e.g., *Orius* sp.) are more common on blooming plants, predator numbers may be a truer reflection of crop phenology than of mortality of corn earworm eggs or larvae. Predators were used in the regression equations to distinguish between fields both within and between years since predator numbers were recorded with each field sample.

f. Larval Parasitism

Average rates of parasitism for each county and year were considered partially explanatory of overall corn earworm levels. Parasitism, determined through laboratory-reared, field-collected larvae, was directly related to larval mortality.

g. Plant Morphometrics

Measurements of plant structure provided more precise and specific information than those presented under Basic Information on

Fields. It is possible for one or more varieties, planted on different dates, to be similar phenologically by mid-August (the time of peak moth flight). The plants were measured from mid-August through mid-September. These measurements were used specifically to differentiate between all fields at all times sampled (TTIME) in both years and counties.

IV. B. 1. h. Reservoir Population Levels

The larval density in corn was determined for each year and county. This population is the major source of the population in soybeans. These population densities provide possible distinction between population levels between years and between the counties within 1974.

i. Reservoir Population Pupal Mortality

A separate variable was studied as an index of pupal mortality in corn. This variable also was expected to contribute to separating corn earworm population levels in different years and counties.

j. Soil Composition

Soil chemistry and texture were considered because they reflect the nutrients and moisture available to the plants, and therefore possibly the susceptibility of plants to corn earworm infestations. Plants wilted more rapidly on very sandy soil, particularly in higher areas in a field. These wilted or water-stressed plants usually harbored more larvae than other plants. Since soil composition was tested once a season per field, the discriminating power of these data lay in separating fields, regardless of time of season.

IV. B. 1. k. Spider predators

Spider predators were included as possible causes of larval mortality. The analyses incorporated all represented spider families, total numbers of spiders, and spider groupings devised specifically for these analyses. These groupings were compiled to overcome problems with small numbers in the analyses and to aid in an overview of the type of spider present. The groups were: large web builders (ARTH = Araneidae and Theriidae), small web builders (LIMC) = Linyphiidae and Microphantidae), and taxonomically similar active predators (LYCPIS = Lycosidae and Pisauridae). However, since spiders were counted only in 1975, they were used to distinguish between fields and sampling times (TTIMEs) in 1975 only.

1. Time Increments

Consecutive Julian calendar day (TIME), date of sampling (DAY, MO), and sequential sampling date for specific fields (TTIME) were used as independent variables and as data categories.

m. Transformations of Plant Morphometrics

Transformations of plant morphometrics were aimed at changing the curvilinear relationships of the plant measurements to linear ones. Only plant characteristics were transformed because they appeared to be the underlying common denominators in all regression equations. With transformations, the distribution of points around the regression line should become normal and homoscedastic, thus improving the coefficient of determination.

The logarithmic transformation [$\log_{10}(x + 1)$] is frequently used to normalize data that is skewed to the right, or where the mean is positively correlated with the variance. Both of these data characteristics are typical of growth data, so the logarithmic transformation was used.

Another transformation used was the square root transformation ($\sqrt{x + 0.5}$), usually used with count data where the variance equals the mean (the Poisson distribution). Insect counts often can be normalized with this transformation.

The square of a variable (x^2) was used to magnify the differences between points for, possibly, a better fit to the regression line.

The arcsine [$\sin^{-1}$ (x/maximum x)] extends the tails and compresses the center of a normal distribution. The arcsine transformation was used since plants were measured not for their whole growth cycle, but only part of it, and this part might be better normalized through this transformation. Since this transformation is based on percentages, variables were first converted to percentages, with 100% being the highest value obtained for each variable.

IV. B. 2. Steps in the Regression Analyses

The purpose was to develop a regression equation having variables of fields, times sampled (TTIMEs), years, and counties which would predict the corn earworm numbers in any soybean field in southeastern Virginia, at any time from August through mid-September.

Coefficients of determination, R^2, were considered acceptable if they equaled or exceeded 0.5 (M. Lentner, pers. comm.). An acceptable R^2 value was not obtainable for an equation which incorporated all fields, times and years sampled. Table 18 presents a flow diagram of the steps used to produce an acceptable explanation of corn earworm numbers in terms of regression equations.

IV. B. 2. a. Step 1

Both years and counties were combined, along with all fields and times sampled (TTIMEs). Therefore, a body of information incorporating the independent variables of two years and counties was analyzed with respect to corn earworm numbers. Spider predators and the transformations of plant morphometrics were not used at this point since variables used had to be common to all observations and the significance plant morphometrics was not yet apparent. The resultant coefficient of determination was less than 0.1. This was insufficient to explain the variability in corn earworm numbers.

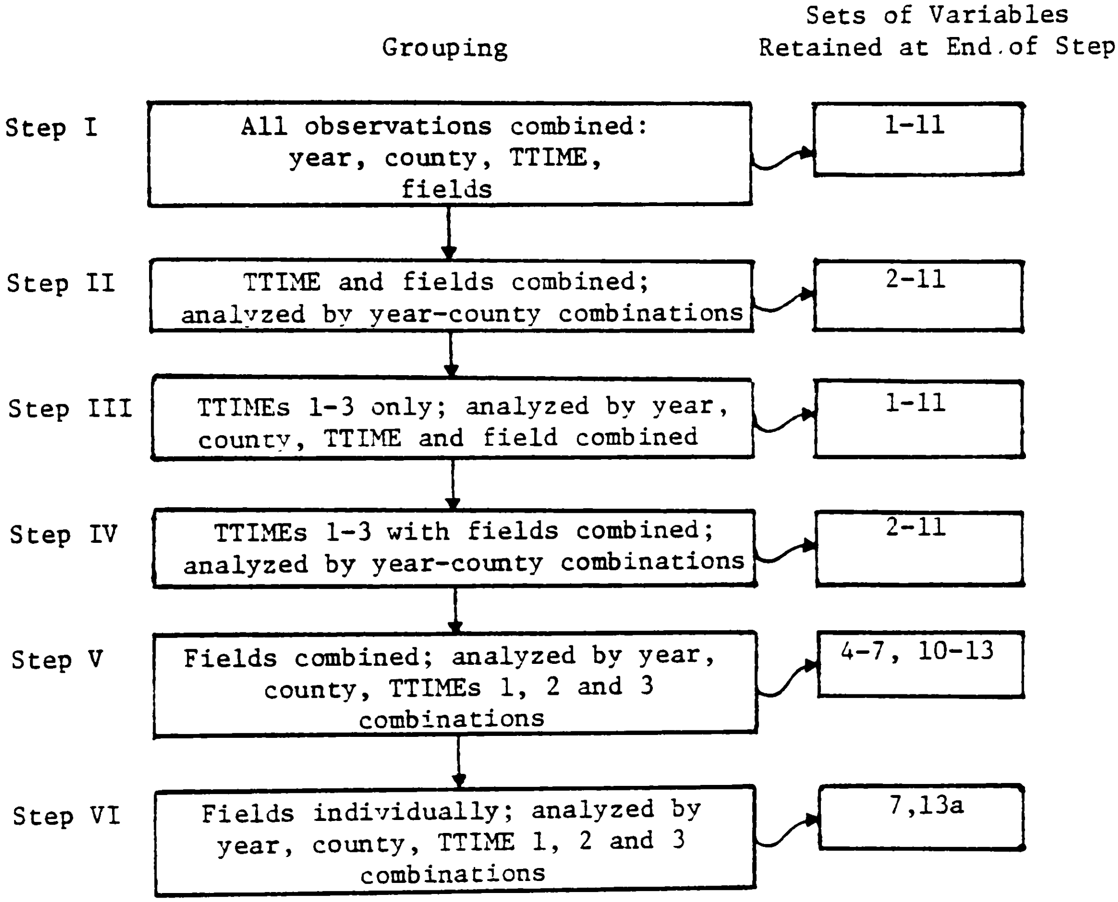
b. Step 2

Each year and county was analyzed separately, with all fields and TTIMEs within each year and county not distinguished. Separate analyses of years and counties reduced some of the variability encountered in step 1. In this step, basic information which separated counties was excluded since it offered no discriminating power once counties were no longer compared. Again, the R^2 values were very low and unacceptable ($R^2 < 0.3$).

c. Step 3

All independent variables were again used, as in step 1; however, a major modification was made in the number of samples used. Since the observed population of corn earworms in soybeans follows a bell curve through time (Fig. 19), each half of the curve represented

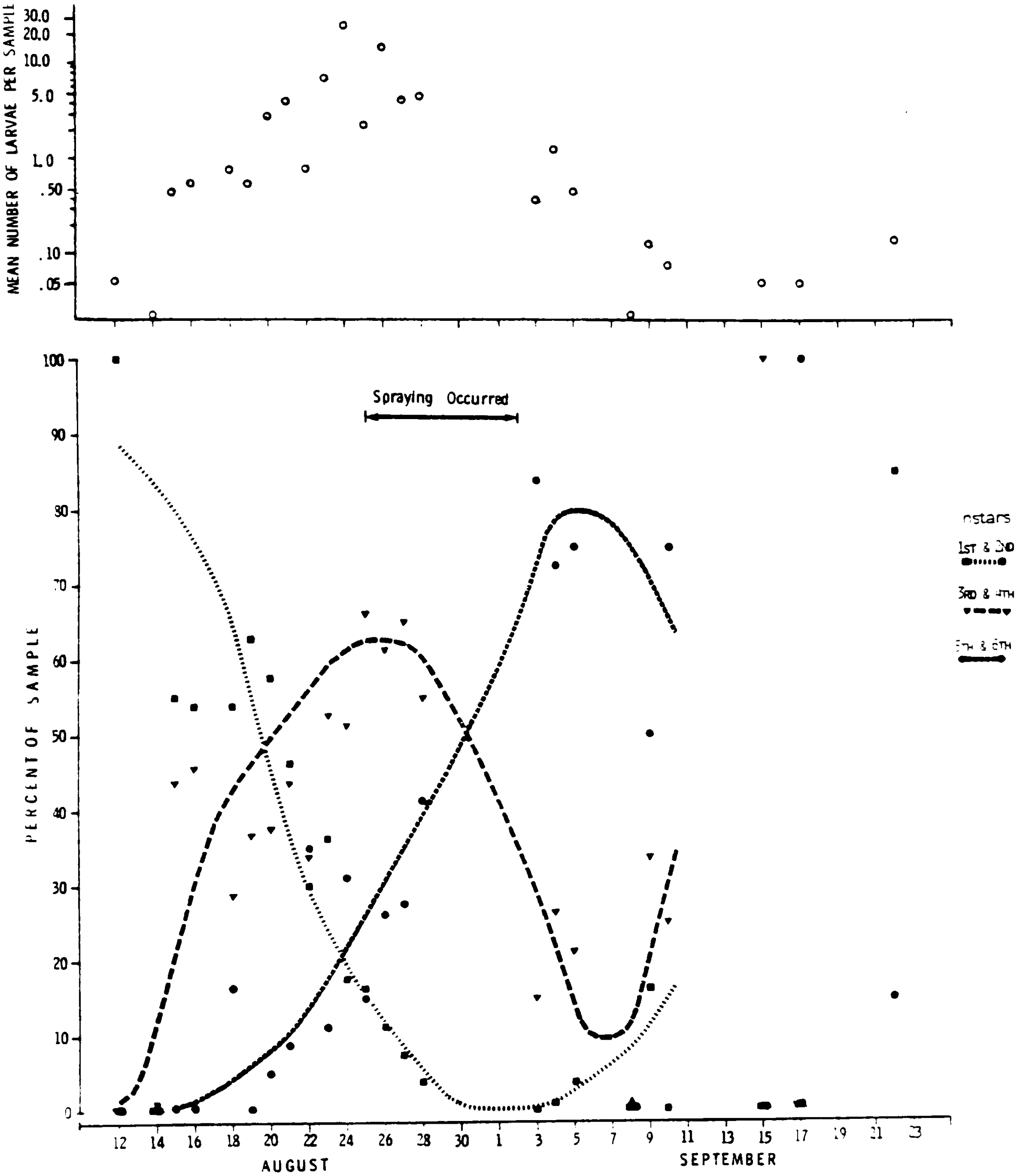
Table 18. Flowchart of regression analyses steps carried out to obtain acceptable ($r^2 \geq 0.5$) explanation of corn earworm variability in soybean fields. (TTIME = consecutive sampling period).



Code for Sets of Variables

1. Basic Information of the County
2. Basic Information on Fields
3. Blacklight Trap Data
4. Climatological Data
5. Insect Predators
6. Larval Parasitism
7. Plant Morphometrics
8. Reservoir Population Estimates
9. Reservoir Population Pupal Mortality
10. Soil Composition
11. Spider Predators
12. Time Increments
13. Transformations of Plant Morphometrics
    a. Log 10
    b. Square root
    c. Square
    d. Arcsine

Figure 19. Corn earworm larval population in soybeans, 1975. The lower graph gives the curves of the combined first and second, third and fourth, and fifth and sixth instars, respectively. The upper graph indicates the mean number of larvae encountered per sample. A sample consisted of 3 row feet (.91 m). An average of forty samples were taken on each sampling date.


MEAN NUMBER OF LARVAE PER SAMPLE
30.0
20.0
10.0
5.0
1.0
.50
.10
.05
PERCENT OF SAMPLE
100
90
80
70
60
50
40
30
20
10
0
Spraying Occurred
nstars
1st & 2nd
3rd & 4th
5th & 6th
12
14
16
18
20
22
24
26
28
30
1
3
5
7
9
11
13
15
17
19
21
23
AUGUST
SEPTEMBER

different relationships between factors influencing detectable corn earworm numbers: through time, the detectable corn earworm population first increased, then decreased. The left half of the curve, that of increasing levels of detectable corn earworm numbers, would provide all information necessary to predict peak corn earworm numbers. TTIMEs 1-3 included the detection of larvae from zero to peak levels (Fig. 19). Decline in population levels after TTIME 3 were due to natural larval mortality and pupation, or mortality after pesticide application. Therefore, the three sampling times analyzed in this step were more regressable since they dealt with only one of the two sides of the curve: data on half of the curve should yield higher R^2 values due to less variability in comparison to data from the entire curve. As in step 1, variables were included which enabled distinction between counties (Table 18). Again, however, the variability was too great and the R^2 value was unacceptable ($R^2 < 0.3$).

IV. B. 2. d. Step 4

Regression equations were next calculated for fields within TTIMEs 1-3, for each year and county. As in step 3, variables that were comparable only on the county level were omitted. However, even with the fewer sampling times and single county predictions, variability within each county was too high and the R^2 values were again less than 0.3.

e. Step 5

Further separation of the heterogeneous data was necessary in this step. For each county and year combination, one equation was expected to explain corn earworm numbers for a 4-7 day period, or for one sampling period (TTIME). Therefore, fields within each of TTIMEs 1, 2, and 3 were grouped and analyzed by year and county combinations. Since analyses were more specific here, generalized variables were omitted and new specific variables were included. Blacklight trap data, reservoir population data, and basic information on fields, all of which had been entered into past regression equations, were excluded during step 5 since they were valuable in defining differences between sampling times and counties but not in defining differences between samples taken at the same TTIME. Included were spider predators, data unique to 1975. At this point, plant morphometrics appeared more frequently in all equations, thus warranting the use of transformations. Transformations were entered, one type at a time, and the resultant equations were compared. After all of these tests, the R^2 values were still low; some ranged between 0.3 and 0.4.

IV. B. 2. f. Step 6

All fields were analyzed separately, for each TTIME (1, 2, and 3), year and county combination. Those variables dropped in step 5 remained dropped since they would not apply where each TTIME and field was analyzed separately (and step 5 equations improved without them). At this point, climatological data, insect and spider predators, specific plant characteristics, and the transformations were still included as potential variables that explained corn earworm variability. The results of all equations were compared, both for variables included and R^2 values obtained. In this step, a common complex of variables which predicted corn earworm numbers and which could be used for all fields was sought. Predator variables were included in only a few equations and therefore were not considered to be major contributing factors. Although climatological variables appeared in many equations, closer scrutiny of when and where they were included resulted in rejection of climatological variables because they did not distinguish between fields and sampling times. An example of seemingly random entry of weather data into the calculations is given by a case in which average precipitation was important in explaining corn earworm variability in one field, but not in another field that had identical values of precipitation and occurred in the same county, TTIME, and year. The difference in infestation levels was apparently due to factors other than precipitation. The inclusion of climatological data appeared to be purely mathematical and could not be reasonably explained in biological terms. The difficulty probably lies in the overgeneralizing nature of the weather station data, since as, for example, summer thunderstorm activity can be strictly local and patchy. Therefore, regression equations were again calculated, for each field and TTIME, based only on plant morphometrics and each of the transformations. The log transformations yielded the best regression equations, with R^2 values mostly above 0.7. The final regression equations are listed in Appendix 3. The R^2 values reported are the highest R^2 values obtainable for each field and TTIME, with four or more error degrees of freedom ($n = 10$).

IV. B. 3. Discussion

No single unifying regression equation could be obtained that established a clear, generally valid, relationship between the variability of corn earworms in soybeans and the 93 sets of variables examined. This was true for the data of 1974 and 1975 combined, the years separately, or even of a 4-7 day period within a given county. This can be attributed to the inherently great variation in the data gathered.

Excellent results were obtained, however, by examining each field separately, at each time sampled, with respect to soybean plant morphometrics and their log transformations. This result leads to the following conclusions, vital to the next analytical step, discriminant analyses:

a) Plant morphometrics and their respective log transformations can be used to explain corn earworm numbers encountered at a given time in a given field, prior to artificial or natural decline in the observable population levels. These plant characteristics are: pod length, pod width, pod volume, plant volume, plant row height, and minimum space between row foliage. These characteristics are associated with the observed fluctuations in corn earworm numbers in fields studied, under varying climatological conditions. These fields included different soybean varities, soybeans at varying phenological states, different predator complexes, soil types, row spacings, and cultivation techniques.

b) Plant morphometrics explain corn earworm variability better than do other variables used in the regression equations for two basic reasons: (i) The measurements are specific enough to enable the separation of similar fields and to provide a good mathematical basis for the regression equations. The variability of plant characteristics was, in general, less than that of other variables measured in the field (Appendix Tables 2.8 - 2.11). (ii) Subtle changes in plant characteristics coincide with changes in corn earworm numbers. The association between plants and corn earworm numbers may not be due to the direct influence of the plant variables on the larvae, but to the influence of undetermined factors on both variables. One critical factor appeared to be the time element (step 4).

c) The unsuitability of other variables is due, in part, to data which was constant through time (e.g., tillage, soil composition); to the general, non-specific, nature of the data, (e.g., precipitation was not measured in individual fields); and the type of data itself, even though it was specific, (e.g., predator numbers included many zeroes and low values; spiders were identified only to family). In addition, the rates of larval parasitism generally were not available, until after soybean fields had been treated for high corn earworm numbers. Larval parasitism ratios were observed after TTIME 3, since the parasites emerged in the laboratory after that date. This assessment of larval parasitism was of questionable value as far as its immediate contribution to the distinction between larval populations is concerned.

Variables other than plant morphometrics, such as climatological data, would be more specifically valuable in analyzing the variability of corn earworm numbers, in retrospect. Parasitism, specifically, would probably be better suited to life table studies. The realization of the intrinsic values of the other variables would be enhanced in stochastic models, where functions of each variable would be incorporated in a multidimensional view of corn earworm population dynamics.

d) Nor surprisingly, the relative combination of the six transformed and untransformed plant characteristics varied between regression equations (Appendix 3). Since the plants' growth and corn earworm population within a field are dynamic (Appendix Tables 2.11, 2.12), there is high variability even within fields, particularly through time.

An inductive dichotomous key was sought which utilized all 74 final equations (step 5 of each equation, Appendix 3), based on the slope, coefficients and plant variables of the equations (calculated for each sampling period and field). However, even a multi-branched key based on variables alone was not possible. In terms of variables alone, a given equation was usually comparable to approximately three other equations: one equation may have had three or four variables (of the six variables and their transformations) in common with three other equations, but all four equations had one or two variables not common with the other equations. In other words, (1) for each TTIME and field, an essentially unique combination of plant morphometrics and their transformations existed and (2) the fields were all related in space in a way not readily defined by the regression approach.

The suitability of log transformations over other transformations also alluded to the possible importance of plant growth, a biological function interpretable best in more than one dimension.

These results point to the potential biological information that may be obtained from looking at the dynamic relationship between plant growth and corn earworm development.

Therefore, discriminant analyses were undertaken to determine to what extent the corn earworm numbers could be defined in terms of plant morphometrics and what associations could be made between corn earworms and plant growth. Group definition, necessary in discriminant analyses, was possible once plant morphometrics had been isolated from all other variables, through the regression analyses. Although regression analyses are not necessarily preliminary to discriminant analyses, the final results of the regression analyses in this work provided a filtering mechanism whereby fields could be defined as field types or groups, based on plant morphometrics and corn earworms alone. Thus, the next section deals with the set of analyses presenting a multidirectional, multivariate approach to the relationships between the soybean plant communities and the corn earworm populations in different fields.

IV. C. Third Stage: Multidimensional Analyses of Soybean Field Susceptibility to Corn Earworm Infestations

This section deals with the classification of soybean fields into categories, based on apparent susceptibility of a field to corn earworm larvae. The close association between plant morphometrics and corn earworm numbers was confirmed in the regression analyses (Section IV.B). However, few conclusions could be reached about the association between specific soybean plant phenological stages and potential corn earworm population levels in fields. Therefore, in this section, there are three major objectives. The first, is to find if it is possible to classify soybean fields, based on plant morphometrics, into categories (or groups) which reflect potential corn earworm infestation levels. Second, if field classifications are possible, how statistically valid are they? Third, if the categories are statistically valid, do they yield new insights into the corn earworm - soybean plant association, and do they confirm or support previously hypothesized relationships (see Literature Review, Section II.B.1.).

IV. C. 1. Soybean Field Classification

Two basic requirements had to be met prior to classifying fields into susceptibility groups. First, a "critical detection period" had to be established, based on an identifiable time span in which the numbers of detectable larvae increase substantially, but prior to the development of the most damaging stages, i.e., the fifth and sixth instars (Miller 1972; Boldt et al. 1975). Second, the different categories of soybean fields had to be identified

a. Critical Detection Period (CDP)

i. Parameters Defined from Field Data

The critical detection period was based on the dynamics of larval development. First and second instars were treated as a uniform group, since their size (Fig. 16), developmental time, and damage to hosts were similar. Third and fourth instars were considered a group since they represented the transition between the early and later instars, and were the earliest readily-detectable instars. Fifth and sixth instars were considered as another group: their size and, in particular, damage to hosts, placed them apart from other instars. The populations sampled were not homogeneous, and more than two instars occurred in most samples. The group having the highest frequency was considered to reflect the developmental state of the population. Other instars present were considered to reflect either end of an idealized bell-shaped curve of instar development. Figure 19 illustrates the actual instar levels detected (by the three groups defined above) in soybeans in 1975, and the curves thereby produced. First and second, and particularly third and fourth instar larvae were, by definition, the most abundant groups during the critical detection period.

The percentage of each instar in each sample, and the number of larvae detected are given in Tables 19 - 24. Immediately recognizable are the 6- to 9-day gaps which occurred between DAY 10-17 (10-17 days post-pulse) and DAY 7-17 in 1974 in Isle of Wight and Westmoreland Counties, respectively. This gap could be accounted for in the alternation of sampling efforts between the two widely separated counties, as verified by the accompanying Julian calendar dates (see also Fig. 18). In addition to the alternate sampling, the flight pulse occurred 5 days later in Westmoreland than in Isle of Wight Co. (Fig. 18) (Section IV.A.3), and therefore accounts for the absence of data in comparable post-pulse periods in the two counties. Inclement weather prevented samples from being taken on the majority of the other days for which data are not given.

Table 19. Percentages of corn earworm (CEW) instars detected in soybeans, Isle of Wight Co., Virginia, August 12 through September 22, 1975.

Date	FLT 1/	TT 2/	# sam-ples 3/	Sam-ples with CEW	% sam-ples with CEW	Total # CEW	Distribution among instars %					
							1	2	3	4	5	6
Aug.12	2	1	20	1	5	1	100	0	0	0	0	0
Aug.14	4	1	30	0	0	0	0	0	0	0	0	0
Aug.15	5	1	20	7	35	8	33	22	33	11	0	0
Aug.16	6	1	20	8	40	13	0	54	31	15	0	0
Aug.18	8	1	30	11	37	24	12	42	25	4	17	0
Aug.19	9	1	40	14	35	24	46	17	25	12	0	0
Aug.20	10	2	40	23	57	108	30	28	29	9	3	2
Aug.21	11	2	40	31	77	161	17	29	32	11	7	2
Aug.22	12	2	30	12	40	26	15	15	19	15	23	12
Aug.23	13	2	50	41	82	308	8	28	32	21	9	2
Aug.24	14	3	10	10	100	234	5	13	22	29	26	5
Aug.25	15	3	40	23	58	87	1	16	32	34	12	3
Aug.26	16	3	20	20	100	266	1	10	33	28	23	4
Aug.27	17	3	50	36	72	204	0	8	40	25	16	12
Aug.28	18	3	30	24	80	140	0	4	16	39	30	11
Sep. 3	24	4	50	9	18	19	0	0	0	16	37	47
Sep. 4	25	4	60	33	55	68	0	1	15	12	21	51
Sep. 5	26	4	50	15	30	24	0	4	13	8	17	58
Sep. 8	29	5	50	0	0	0	0	0	0	0	0	0
Sep. 9	30	5	50	6	12	6	0	17	17	17	17	33
Sep.10	31	5	60	4	7	4	0	0	0	25	25	50
Sep.15	36	6	60	2	3	3	0	0	100	0	0	0
Sep.17	38	6	40	2	5	2	0	0	0	0	0	100
Sep.22	43	6	50	6	12	7	14	71	0	0	0	14

1/ FLTIME: days post-pulse.

2/ TTIME: consecutive sampling period; 12 fields were sampled during each TTIME, with 10 sample units of 3 row feet each per field.

3/ Total number of samples per TTIME fluctuated because some fields could not be sampled on a given day due to recent prior pesticide treatment or inclement weather.

Table 20. Mean numbers of corn earworm (CEW) instars detected in soybeans, Isle of Wight Co., Virginia, August 12 through September 22, 1975.

Date	FLT 1/	TT 2/	# samples 3/	Means and standard deviations of CEW in all samples						
					Individual instars					
				All instars	1	2	3	4	5	6
Aug.12	2	1	20	0.05±0.22	0.05±0.22	0	0	0	0	0
Aug.14	4	1	30	0	0	0	0	0	0	0
Aug.15	5	1	20	0.45±0.69	0.15±0.49	0.10±0.31	0.15±0.37	0.05±0.22	0	0
Aug.16	6	1	20	0.65±0.93	0	0.35±0.67	0.20±0.41	0.10±0.45	0	0
Aug.18	8	1	30	0.80±1.30	0.10±0.31	0.33±0.66	0.20±0.48	0.03±0.18	0.13±0.43	0
Aug.19	9	1	40	0.60±1.01	0.27±0.55	0.10±0.30	0.15±0.36	0.07±0.27	0	0
Aug.20	10	2	40	2.70±3.98	0.80±1.51	0.75±1.55	0.77±1.21	0.25±0.81	0.07±0.35	0.05±0.22
Aug.21	11	2	40	4.03±4.64	0.77±1.17	1.15±1.44	1.27±1.74	0.45±0.85	0.30±0.69	0.08±0.27
Aug.22	12	2	30	0.87±1.36	0.13±0.35	0.13±0.35	0.17±0.53	0.13±0.43	0.20±0.48	0.10±0.31
Aug.23	13	2	50	6.16±7.99	0.48±1.09	1.74±2.47	1.98±2.76	1.32±2.54	0.54±1.05	0.10±0.36
Aug.24	14	3	10	23.40±11.51	1.10±0.99	3.00±2.71	5.10±2.47	6.70±4.37	6.20±3.82	1.30±1.64
Aug.25	15	3	40	2.17±2.70	0.03±0.16	0.35±0.92	0.73±1.13	0.75±1.08	0.25±0.54	0.07±0.27
Aug.26	16	3	20	13.30±7.77	0.20±0.52	1.35±1.18	4.45±2.48	3.75±3.71	3.05±3.56	0.50±1.00
Aug.27	17	3	50	4.08±4.74	0	0.32±0.71	1.62±2.17	1.02±1.50	0.64±1.12	0.48±1.28
Aug.28	18	3	30	4.67±4.16	0	0.17±0.46	0.77±0.86	1.80±2.01	1.40±1.48	0.53±0.90

1/ FLTIME: days post-pulse

2/ TTIME: consecutive sampling period; 16 fields were sampled during each TTIME, with 10 sample units of 3 row feet each per field.

3/ Total number of samples per TTIME fluctuated because some fields could not be sampled on a given day due to recent prior pesticide treatment or inclement weather.

Table 20. (continued)

Date	FLT	TT	# sam- ples	Means and standard deviations of CEW in all samples						
					Individual instars					
				All instars	1	2	3	4	5	6
Sep. 3	24	4	50	0.38±1.27	0	0	0	0.06±0.24	0.14±0.61	0.18±0.56
Sep. 4	25	4	60	1.13±1.50	0	0.02±0.13	0.17±0.37	0.13±0.43	0.23±0.56	0.58±1.00
Sep. 5	26	4	50	0.48±0.89	0	0.02±0.14	0.06±0.24	0.04±0.20	0.08±0.27	0.28±0.73
Sep. 8	29	5	50	0	0	0	0	0	0	0
Sep. 9	30	5	50	0.12±0.33	0	0.02±0.14	0.02±0.14	0.02±0.14	0.02±0.14	0.04±0.20
Sep.10	31	5	60	0.07±0.25	0	0	0	0.02±0.13	0.02±0.13	0.03±0.18
Sep.15	36	6	60	0.05±0.29	0	0	0.05±0.29	0	0	0
Sep.17	38	6	40	0.05±0.22	0	0	0	0	0	0.05±0.22
Sep.22	43	6	50	0.14±0.40	0.02±0.14	0.10±0.36	0	0	0	0.02±0.14

Table 21. Percentages of corn earworm (CEW) instars detected in soybeans, Isle of Wight Co., Virginia. August 15 through September 21, 1974.

Date	FLT 1/	TT 2/	# samples 3/	Samples with CEW	% samples with CEW	Total # CEW	Distribution among instars %					
							1	2	3	4	5	6
Aug.15	- 2	1	20	0	0	0	0	0	0	0	0	0
Aug.16	- 1	1	50	0	0	0	0	0	0	0	0	0
Aug.17	0	1	50	1	2	1	0	0	100	0	0	0
Aug.24	7	2	10	1	10	1	0	0	0	100	0	0
Aug.25	8	2	40	6	15	6	33	0	50	17	0	0
Aug.26	9	2	40	10	25	12	0	25	50	25	0	0
Aug.27	10	2	30	11	37	15	0	20	53	7	13	7
Sep. 3	17	3	50	26	52	44	0	5	32	30	18	16
Sep. 5	19	3	60	34	57	87	0	9	33	26	16	15
Sep. 8	22	3	10	0	0	0	0	0	0	0	0	0
Sep.12	26	4	40	4	10	5	0	20	0	40	0	40
Sep.13	27	4	50	12	24	29	0	3	59	3	14	21
Sep.14	28	4	20	2	10	2	0	0	50	0	0	50
Sep.20	34	5	70	4	6	5	0	80	0	0	20	0
Sep.21	35	5	50	0	0	0	0	0	0	0	0	0

1/ FLTIME: days post-pulse.

2/ TTIME: consecutive sampling period; 12 fields were sampled during each TTIME, with 10 sample units of 3 row feet each per field.

3/ Total number of samples per TTIME fluctuated because some fields could not be sampled on a given day due to recent prior pesticide treatment or inclement weather.

Table 22. Mean numbers of corn earworm (CEW) instars detected in soybeans, Isle of Wight Co., Virginia, August 15 through September 21, 1974.

Date	FLT 1/	TT 2/	# samples 3/	Means and standard deviations of CEW in all samples						
					Individual instars					
				All instars	1	2	3	4	5	6
Aug.15	- 2	1	20	0	0	0	0	0	0	0
Aug.16	- 1	1	50	0	0	0	0	0	0	0
Aug.17	0	1	50	0.02±0.14	0	0	0.02±0.14	0	0	0
Aug.24	7	2	10	0.10±0.32	0	0	0	0.10±0.32	0	0
Aug.25	8	2	40	0.15±0.36	0.05±0.22	0	0.07±0.27	0.03±0.16	0	0
Aug.26	9	2	40	0.30±0.56	0	0.07±0.27	0.15±0.43	0.07±0.27	0	0
Aug.27	10	2	30	0.50±0.78	0	0.10±0.40	0.27±0.64	0.03±0.18	0.07±0.25	0.03±0.18
Sep. 3	17	3	50	0.88±1.06	0	0.04±0.20	0.28±0.61	0.26±0.53	0.16±0.37	0.14±0.45
Sep. 5	19	3	60	1.45±1.86	0	0.13±0.34	0.48±0.93	0.38±0.76	0.23±0.46	0.22±0.52
Sep. 8	22	3	10	0	0	0	0	0	0	0
Sep.12	26	4	40	0.13±0.40	0	0.03±0.16	0	0.05±0.22	0	0.05±0.22
Sep.13	27	4	50	0.58±1.36	0	0.02±0.14	0.34±0.98	0.02±0.14	0.08±0.27	0.12±0.39
Sep.14	28	4	20	0.10±0.31	0	0	0.05±0.22	0	0	0.05±0.22
Sep.20	34	5	70	0.07±0.31	0	0.06±0.29	0	0	0.01±0.12	0
Sep.21	35	5	50	0	0	0	0	0	0	0

1/ FLTIME: days post-pulse.

2/ TTIME: consecutive sampling period; 16 fields were sampled during each TTIME, with 10 sample units of 3 row feet each per field.

3/ Total number of samples per TTIME fluctuated because some fields could not be sampled on a given day due to recent prior pesticide treatment or inclement weather.

Table 23. Percentages of corn earworm (CEW) instars detected in soybeans, Westmoreland Co., Virginia, August 20 through September 24, 1974.

Date	FLT 1/	TT 2/	# samples 3/	Samples with CEW	% samples with CEW	Total # CEW	Distribution among instars %					
							1	2	3	4	5	6
Aug.20	- 2	1	60	0	0	0	0	0	0	0	0	0
Aug.21	- 1	1	60	0	0	0	0	0	0	0	0	0
Aug.27	5	2	10	0	0	0	0	0	0	0	0	0
Aug.28	6	2	60	3	5	6	0	0	83	17	0	0
Aug.29	7	2	50	0	0	0	0	0	0	0	0	0
Sep. 8	17	3	10	0	0	0	0	0	0	0	0	0
Sep. 9	18	3	20	7	35	12	0	8	50	25	17	0
Sep.10	19	3	60	12	20	13	0	0	54	31	15	0
Sep.11	20	3	20	4	20	4	0	0	25	50	25	0
Sep.15	24	4	70	14	20	18	0	5	28	22	28	17
Sep.16	25	4	50	7	14	10	0	10	30	10	50	0
Sep.23	32	5	60	5	8	6	0	0	17	50	17	17
Sep.24	33	5	60	1	2	1	0	0	0	0	0	100

1/ FLTIME: days post-pulse.

2/ TTIME: consecutive sampling period; 12 fields were sampled during each TTIME, with 10 sample units of 3 row feet each per field.

3/ Total number of samples per TTIME fluctuated because some fields could not be sampled on a given day due to recent prior pesticide treatment or inclement weather.

Table 24. Mean numbers of corn earworm (CEW) instars detected in soybeans, Westmoreland Co., Virginia, August 20 through September 24, 1974.

Date	FLT 1/	TT 2/	# sam- ples 3/	Means and standard deviations of CEW in all samples						
					Individual instars					
				All instars	1	2	3	4	5	6
Aug.20	- 2	1	60	0	0	0	0	0	0	0
Aug.21	- 1	1	60	0	0	0	0	0	0	0
Aug.27	5	2	10	0	0	0	0	0	0	0
Aug.28	6	2	60	0.10±0.44	0	0	0.08±0.38	0.02±0.13	0	0
Aug.29	7	2	50	0	0	0	0	0	0	0
Sep. 8	17	3	10	0	0	0	0	0	0	0
Sep. 9	18	3	20	0.60±0.94	0	0.05±0.22	0.30±0.66	0.15±0.37	0.10±0.31	0
Sep.10	19	3	60	0.22±0.45	0	0	0.12±0.32	0.07±0.25	0.03±0.18	0
Sep.11	20	3	20	0.20±0.41	0	0	0.05±0.22	0.10±0.31	0.05±0.22	0
Sep.15	24	4	70	0.26±0.56	0	0.01±0.12	0.07±0.26	0.06±0.23	0.07±0.31	0.04±0.20
Sep.16	25	4	50	0.20±0.53	0	0.02±0.14	0.06±0.24	0.02±0.14	0.10±0.36	0
Sep.23	32	5	60	0.10±0.35	0	0	0.02±0.13	0.05±0.22	0.02±0.13	0.02±0.13
Sep.24	33	5	60	0.02±0.13	0	0	0	0	0	0.02±0.13

[1/] FLTIME: days post-pulse.

[2/] TTIME: consecutive sampling period; 16 fields were sampled during each TTIME, with 10 sample units of 3 row feet each per field.

[3/] Total number of samples per TTIME fluctuated because some fields could not be sampled on a given day due to recent prior pesticide treatment or inclement weather.

Since sampling focused on a single county in 1975, post-pulse monitoring of fields occurred more regularly and frequently (almost daily) (Figs. 17, 18). In addition, the total number of larvae in 1975 was much greater than in 1974. Because more detailed information of the critical detection period was available in 1975, those data were used for determining the critical detection period, with 1974 data used to refine and confirm the conclusions.

In 1975, the first increase in larval numbers detected occurred on DAY 5, with the percentage of first and second instars, combined, increasing above the percentages of the other two groups on DAY-8 (Table 19). The larvae older than second instar which occurred prior to DAY 8 were considered to have hatched prior to the first day of the moth pulse (reasons for this assumption are covered later in this section). The first significant increase in the percentage of samples with corn earworms, as well as the increase in total corn earworm numbers, occurred on post-pulse DAY 10, and remained high, except for an isolated decrease on DAY 12, through DAY 18 (Table 19). DAYs 11-18 exhibited the highest numbers of third and fourth instars, combined (Table 20) as well as the highest percentage of samples having corn earworms (all instars combined (Table 19)). By DAY 18, fewer than 20% of the larvae were third instar and younger. On DAYs 13-18, the percentage of third and fourth instars, combined, was highest. By DAY 18, over half of the fields sampled, that were to be sprayed for corn earworms, had been sprayed (Table 25; Fig. 19). Therefore, based on 1975 data, DAYs 8-18 appeared to be the best choice as the critical detection period.

Table 25. Insecticide application schedule on soybean fields sampled in 1974 and 1975 in eastern Virginia.[1]

Year (YR)	County (CO)	Coded field (CFLD)	Date of application	Chemical	Target of application
74	IW[2]	14	Aug. 10	Lannate	Mexican bean beetle
74	IW	4	Sep. 13	Lannate	Mexican bean beetle
74	IW	6	Sep. 13	Lannate	Mexican bean beetle
74	IW	10	Sep. 15	Lannate	Mexican bean beetle
74	IW	14	Sep. 25	Lannate	Mexican bean beetle
74	W[3]	32	Sep. 10	Sevin	Mexican bean beetle
75	IW	56	Aug. 25	Toxaphene	Corn earworm
75	IW	62	Aug. 25	Sevin	Corn earworm
75	IW	80	Aug. 26	Sevin	Corn earworm
75	IW	60	Aug. 28	Toxaphene	Corn earworm
75	IW	66	Aug. 28	Sevin	Corn earworm
75	IW	80	Aug. 28	Sevin	Corn earworm
75	IW	76	Aug. 30	Lannate	Corn earworm
75	IW	52	Sep. 1	Sevin	Corn earworm
75	IW	54	Sep. 2	Lannate	Corn earworm
75	IW	64	Sep. 17	Lannate	Mexican bean beetle

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[1] Fields not listed were not treated.

[2] Isle of Wight Co.

[3] Westmoreland Co.

Since no samples were taken between DAYs 19-23 in 1975, the 1974 data which were examined before DAY 18 were selected as the final day of the critical detection period. Also, the first date, DAY 8, was examined with respect to 1974 data. First, it had to be determined if the data were comparable in the two years.

In Isle of Wight Co., 1974, the first and second instars were not detected prior to 8 days post-pulse. The highest percentage of third and fourth instars, combined, occurred between DAYs 8-19 (Table 21). An increase in numbers of third and fourth instar larvae, combined, was recorded as early as DAY 8, even though the levels were low (Table 23). The break in the elevated mean numbers of third and fourth instars was distinct by DAY 19 (Table 22).

In Westmoreland Co., 1974, no first and second instars were detected in the first 7 post-pulse days, and thereafter comprised a very small percentage of total instars detected (Table 23). The highest mean numbers of third and fourth instars, combined, were recorded on DAYs 18-19 (Table 24), but the percentages of third and fourth instars, with respect to other groups, were highest through DAY 24 (Table 23). Since the majority of larvae were encountered in Westmoreland Co. on DAY 18, the continuation of the high percentage of third and fourth instars was considered to be a relative phenomenon due to sampling bias caused by the low population levels present (< 0.3 larvae/3 row feet) and to mortality of fifth and sixth instars caused by fungi and unknown factors. In Westmoreland Co. in particular, fifth and sixth instars, permeated with fungal growth, were frequently encountered in the field. The percentage of parasitized larvae was greater in 1974 than in 1975 (Section IV.A.5), which probably contributed to the lower larval levels. In the lab, parasitized larvae did not behave as if parasitized until they reached later instars or pupated. These observations suggest the possibility of removal of parasitized larvae from the population only after they reached the later instars, thereby leaving proportionately more third and fourth instars to be sampled, as in Westmoreland Co. after DAY 19. High precipitation in 1974 was possibly the major detrimental factor by contributing to larval drowning, disease incidence, etc. Also contributing to the reduced numbers of later instars in 1974 (compared to 1975) was the lower average temperature during the relevant period (Table 26). In Westmoreland Co., where the temperature averaged 5°F lower than the mean temperature in 1975, larval development was undoubtedly slowed, lengthening larval exposure time.

Despite the differing weather conditions between the 2 years, it was possible to detect potentially damaging corn earworm populations within the same time-span: DAYs 8-19. These days constituted the critical detection period during which it should be possible to detect third and fourth instar corn earworms when they were the major component of the population (although the peak of their occurrence may vary within this period, due to temperature differences, as seen between 1974 and 1975). In Isle of Wight Co. in 1974 and 1975, very few first and second instars were detected prior to DAY 8 (Tables 20, 22, 24). Nor were other instars detected in significant numbers during this time, relative to later samples. Therefore, the critical detection period was considered to begin on post-pulse DAY 8

Table 26 Precipitation and temperature during the first nineteen days from the beginning of the moth flight pulse (post-pulse days 1-19) in eastern Virginia. Mnemonic code in Appendix Table 1.1.

Isle of Wight 1974				
Date	PPT	MAXTEMP	MINTEMP	AVTEMP
18 Aug.	0.00	87	66	76.5
19	0.15	81	68	74.5
20	0.00	83	69	76.0
21	0.00	82	71	76.5
22	0.27	86	72	79.0
23	1.97	80	69	74.5
24	0.07	87	68	77.5
25	0.00	89	67	78.0
26	0.08	88	68	78.0
27	0.41	87	69	78.0
28	0.00	92	73	82.5
29	0.05	92	74	83.0
30	0.02	91	71	81.0
31 Aug.	0.00	89	72	80.5
1 Sep.	0.00	90	69	79.5
2	0.03	88	71	79.5
3	0.40	90	63	76.5
4	0.04	67	61	64.0
5 Sep.	0.01	73	63	68.0
n = 19				
Σ	3.50			
Mean	0.18	85.4	68.6	77.0
s.d.	0.45	6.5	3.5	4.6

Westmoreland 1974				
Date	PPT	MAXTEMP	MINTEMP	AVTEMP
23 Aug.	0.00	84	68	76.0
24	0.03	86	68	77.0
25	0.05	87	67	77.0
26	0.02	85	69	77.0
27	0.00	87	67	77.0
28	0.00	91	72	81.5
29	0.00	92	72	82.0
30	0.00	90	74	82.0
31 Aug.	0.02	90	71	80.5
1 Sep.	0.00	89	66	77.5
2	0.00	89	67	78.0
3	0.20	88	71	79.5
4	1.18	85	59	72.0
5	0.00	70	53	61.5
6	1.50	68	62	65.0
7	1.23	66	61	63.5
8	0.00	76	62	69.0
9	0.00	81	57	69.0
10 Sep.	0.00	83	60	71.5
n = 19				
Σ	4.23			
Mean	0.22	83.5	65.6	74.6
s.d.	0.49	7.9	5.8	6.4

Date	PPT	MAXTEMP	MINTEMP	AVTEMP
11 Aug.	0.04	88	66	77.0
12	0.00	89	66	77.5
13	0.00	92	71	81.5
14	0.00	92	72	82.0
15	0.00	92	72	82.0
16	0.00	93	72	82.5
17	0.00	94	70	82.0
18	0.00	90	69	79.5
19	0.00	87	61	74.0
20	0.00	90	66	78.0
21	0.00	90	71	80.5
22	0.00	95	72	83.5
23	0.00	88	69	78.5
24	0.04	91	70	80.5
25	0.00	96	71	83.5
26	0.00	97	74	85.5
27	0.00	95	60	77.5
28	0.00	85	59	72.0
29 Aug.	0.00	86	59	72.5
n = 19				
Σ	0.08			
Mean	0.004	91.1	67.9	79.5
s.d.	0.01	3.4	4.8	3.8

(FLTTIME 8). The period with highest mean numbers of third and fourth instar larvae terminated at comparable times in both years and counties, and the increase in numbers of third and fourth instars, combined, occurred between DAYs 11 and 19, when both years were considered together. Table 27 allows comparison of the criteria used in terminating the critical detection period. Monitoring of larvae beyond DAY 19 was considered prudent, to guard against unforeseen increases in corn earworm numbers, and to verify that delayed mass migration of moths into the fields had not occurred.

Thus, the 11-day critical detection period applied to the timely detection of pre-damage causing stages of corn earworms in soybeans beginning in early to mid-August in eastern Virginia. The data used in the discriminant analyses were drawn from this period.

IV. C. 1. a. ii. Published Information on Larval Developmental Factors

Designation of days 8-19 after the moth flight pulse as the critical detection period was supported by published information on the developmental period required by third and fourth instars (Table 28, Fig. 20).

Female moths mated on the third or fourth day after emergence, with the mean time from emergence to oviposition being 4 to 5 days (Hardwick 1965). Isely (1935) reported a 1- to 8-day preoviposition period for the moths after mating. Ten days after emergence, at 25°C, 50% of the eggs were laid, or in 8 days after emergence, 56% of the eggs were laid at 33°C (91.4°F) (Fye and McAda 1972). At 25°C (77°F), Hardwick (1965) reported eggs hatched in 80 hours. At 85°F (29.4°C), the incubation period was shortened to 58.7 ± 2.0 hours

Table 27. Comparison of criteria used to decide when the critical detection period (CDP) ended, based on observations of corn earworm larvae in soybeans in eastern Virginia.

Criteria	Days Post-pulse in Each County		
	Isle of Wight 1974	Westmoreland 1974	Isle of Wight 1975
Percentage of third and fourth instars combined was highest:	8-19 (TTIMEs 2,3)[1]	18-24 (TTIMEs 3,4)[2]	13-18 (TTIMEs 1-3)[3]
Mean of third and fourth instars combined was highest:	17-19 (TTIME 3)	18-19 (TTIME 3)	11-18 (TTIMEs 2,3)
Number of larvae in all samples was highest:	9-19 (TTIMEs 2,3)	18 (TTIME 3)	11-18 (TTIMEs 2,3)
Percentage of all samples which contained larvae was highest:	9-19 (TTIMEs 2,3)	18 (TTIME 3)	11-18 (TTIMEs 2,3)

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[1] A six-day time gap was present between these TTIMEs.

[2] A two-day time gap was present between the included TTIMEs 3 and 4. A nine-day time gap was present between TTIMEs 2 and 3.

[3] No gaps present between TTIMEs.

Table 28 . Egg and larval development rates of <u>Heliothis zea</u> under laboratory conditions, as reported in literature and adapted for the present study.

Oviposition and Egg Maturation	Time	Reference
Preoviposition period	1-8 days	Isely 1935
Mean time period from adult emergence to oviposition	4-5 days	Hardwick 1965
Percent eggs laid after adult emergence		
50% at 25°C (77°F)	10 days	Fye and McAda 1972
56% at 30°C (86°F)	11 days	Fye and McAda 1972
56% at 33°C (91.4°F)	8 days	Fye and McAda 1972
Egg incubation		
No temperature given	80 hr.	Hardwick 1965
at 28°C (82.4°F)	2-3 days	Isely 1935
at 29.4°C (85°F)	58.7 hr.	Luckman 1963

Larval and Pupal Development at 33°C — Fye and McAda 1972

Instar	Days ± s.d.		Approximate Cumulative Completion Time[1] (Days ± s.d.)
	♀	♂	
1	2.0±0.0	2.0±0.0	2.0±0.0
2	1.1±0.3	1.1±0.3	3.1±0.3
3	1.7±0.5	1.5±0.5	4.7±0.8
4	1.4±0.5	1.5±0.5	6.2±1.3
5	4.8±1.3	4.6±1.6	10.9±2.9
6	5.0±0.7	4.5±1.0	15.6±3.9
Pupa	8.4±2.0	9.0±0.8	24.3±5.0

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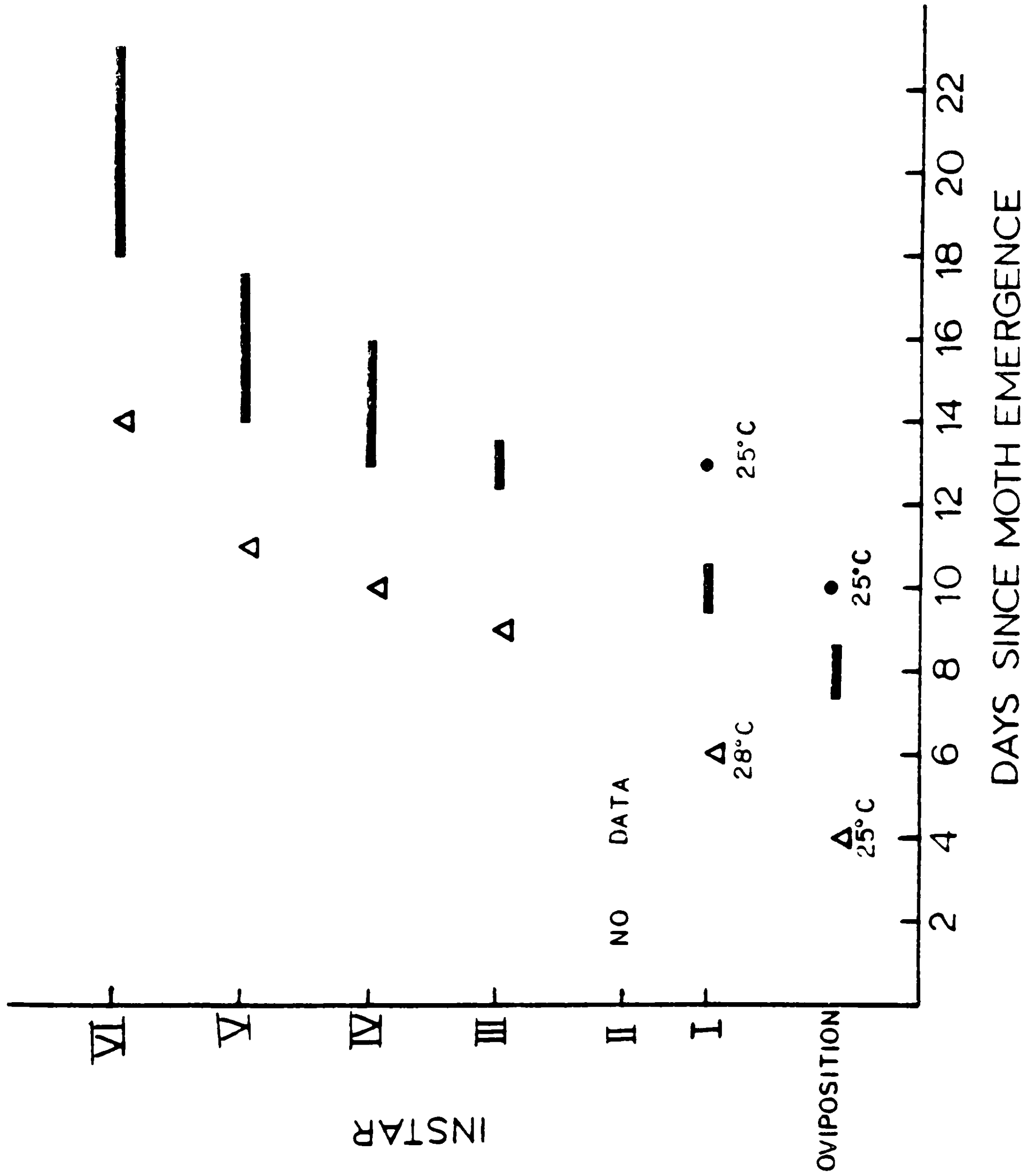
[1] As adapted for projections used in present study.

Figure 20. Estimated development times of a given Heliothis zea generation, from time of moth emergence to appearance of the sixth instars. Except where otherwise indicated, all dates assume 33°C for development. The bars show the period during which 50-60% of a population would have reached the developmental stage indicated on the ordinate. The open triangle indicates the average time of first occurrence of the various stages, while the solid circle represents the time by which, at 25°C, 50% of the population would reach the stage indicated. (Adapted from literature; see Table 28.)


INSTAR
VI
V
IV
III
II
I
OVIPOSITION
NO DATA
25°C
28°C
25°C
25°C
2
4
6
8
10
12
14
16
18
20
22
DAYS SINCE MOTH EMERGENCE

(Luckmann 1963). Fye and McAda (1972) recorded time of completion of the various instars at 33°C: second instar males molted into third instars after 3.0 days, third instar males molted after a total of 4.6 ± 0.8 days, and fourth instars completed that stage after a total of 6.1 ± 1.3 days. This larval growth was comparable to that reported by Quaintance and Brues (1905) for the respective instars on cowpeas, under field conditions, beginning in late August (August 20). Data on similarly detailed instar development at 25°C were not available.

The following estimates of larval occurrence, based on the above information, were made with the (admittedly unrealistic) assumption of no mortality of eggs and larvae (Fig. 20). In approximately thirteen days after moth emergence, at 25°C, 50% of the eggs would have hatched. At 33°C, in ten days, 56% of the eggs hatched. At 33°C, in nine days following moth emergence, the larvae would first develop into third instars, and in 10 to 12 days, the larvae first developed into fourth instars. By 13 days after moth emergence, at 33°C, 56% of the larvae would be third instars, and in fourteen to sixteen days, 56% of the larvae would be fourth instars. At 25°C, the development of the instars would be about three days later than at 33°C. Thus, in 17 to 19 days, 56% of the larvae would be fourth instars.

These derived estimates agree with the percentages of instars detected in soybean fields in southeastern Virginia during the previously determined critical detection period. In spite of varying temperatures in 1974 and 1975, larval development was not highly variable. In 1975, the mean temperature was 79.5°F (26.9°C); in 1974, Isle of Wight Co., 77.0°F (25.5°C); in Westmoreland Co., 74.6°F (24.2°C). Peaks of third and fourth instars were detected by DAY 19 in all three counties, with the peak appearing earliest in 1975 and latest in Westmoreland Co. in 1974. Therefore, 8-19 days post-pulse were considered to incorporate the time period critical to detecting pre-damage causing stages of corn earworms in soybeans in southeastern Virginia beginning in early to mid-August.

IV. C. 1. b. Establishment of Field Categories

Continuing with the strategy of analysis adopted in this section, the data had to be categorized in a way which would lend itself to stepwise discriminant analysis. For this purpose, the fields were grouped _a priori_ into 5 categories of susceptibility to corn earworm infestation. These categories were arrived at by inspecting specific sets of data, field-by-field, as outlined below. The 1975 fields served as the basis for categorizing fields because in that year, (a) all fields were sampled more frequently than in 1974, (b) corn earworm larvae were observed in higher numbers than in 1974, and (c) field types were more diverse than in 1974.

A synoptic table was constructed to assist in the process of establishing categories (Table 29). Ranked in descending order were the means of the maximum numbers of corn earworm larvae detected in each field from DAYs 8-19. Beside each field was listed the mean number of corn earworms from sampling periods within the critical detection period. The corresponding means of six plant characteristics were listed as well. These variables, drawn from the results of the multiple regression analyses, were: pod length (PL), pod width (PW), pod volume (PLWV), plant volume (VOL), plant row height (ROWHT), and

Table 29. Synopsis of variables which served as differential criteria for establishing categories of soybean field susceptibility (based on representative 1975 data from Isle of Wight Co., Virginia).

Categories					Means of Variables (n = 10)						
Initial[1]	Final[2]	Coded Field (CFLD)	Sequential Sampling Time (TTIME)	Post-Pulse Days (FLTTIME)	H. zea (CEWNO)	Pod Length (PL) cm	Pod Width (PW) cm	Pod Volume (PLWV) cm ^{3}	Plant Height (ROWHT) in.	Minimum Space Between Foliage (SPACE) in.	Plant Volume (VOL) in. ^{3}
A	A	80	1	9	0.2	0.050	0.006	0.003	16.8	16.6	7719.9
A	A	80	2	13	17.8	0.896	0.081	0.078	19.9	16.4	9349.0
A	A	56	2	10	8.2	1.447	0.116	0.167	27.0	15.2	18191.0
A	A	56	3	14	23.4	3.455	0.144	0.499	26.4	14.5	18102.3
B	A	60	2	11	3.1	0.093	0.010	0.005	25.0	16.8	16400.4
B	A	60	3	16	9.9	0.734	0.077	0.063	28.9	14.8	20371.5
B	A	76	1	9	1.6	1.620	0.106	0.180	25.0	13.1	12285.4
B	A	76	2	12	2.3	2.739	0.124	0.342	26.2	13.0	13166.8
B	B	76	3	18	8.3	4.027	0.321	1.297	26.9	12.3	13758.9
B	B	62	2	11	2.1	0.052	0.006	0.003	24.4	18.2	11185.3
B	B	62	3	17	8.1	0.395	0.043	0.031	26.8	18.8	11316.6
C	C	52	2	10	1.1	0.000	0.000	0.000	19.9	18.9	11562.3
C	C	52	3	15	3.9	0.386	0.040	0.020	25.0	18.1	14480.1
C	D	70	1	8	2.0	1.856	0.122	0.196	35.0	10.0	30268.5
C	D	70	2	13	4.1	3.915	0.183	0.717	35.3	8.8	28468.6
C	D	70	3	17	4.7	3.857	0.300	1.162	35.3	9.0	30718.8
C	D	54	2	10	1.4	2.152	0.105	0.236	34.9	9.6	26685.4
C	D	54	3	15	4.4	3.060	0.140	0.432	34.5	10.6	26469.1
C	E	74	1	9	0.5	4.073	0.253	1.030	46.0	0.0	53834.2
C	E	74	2	12	0.2	3.890	0.356	1.387	45.4	1.1	46989.4
C	E	74	3	18	0.9	3.971	0.504	2.008	42.1	0.6	48576.3
C	E	50	2	10	0.1	4.061	0.329	1.344	41.5	0.5	45923.5
C	E	50	3	15	0.4	4.119	0.420	1.741	40.8	0.7	42855.3

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[1] Based on maximum larval numbers for each field sampled during post pulse days 8-19.

[2] Based on the given plant characteristics measured each TTIME for each field during post pulse days 8-19.

minimum space between row foliage (SPACE).

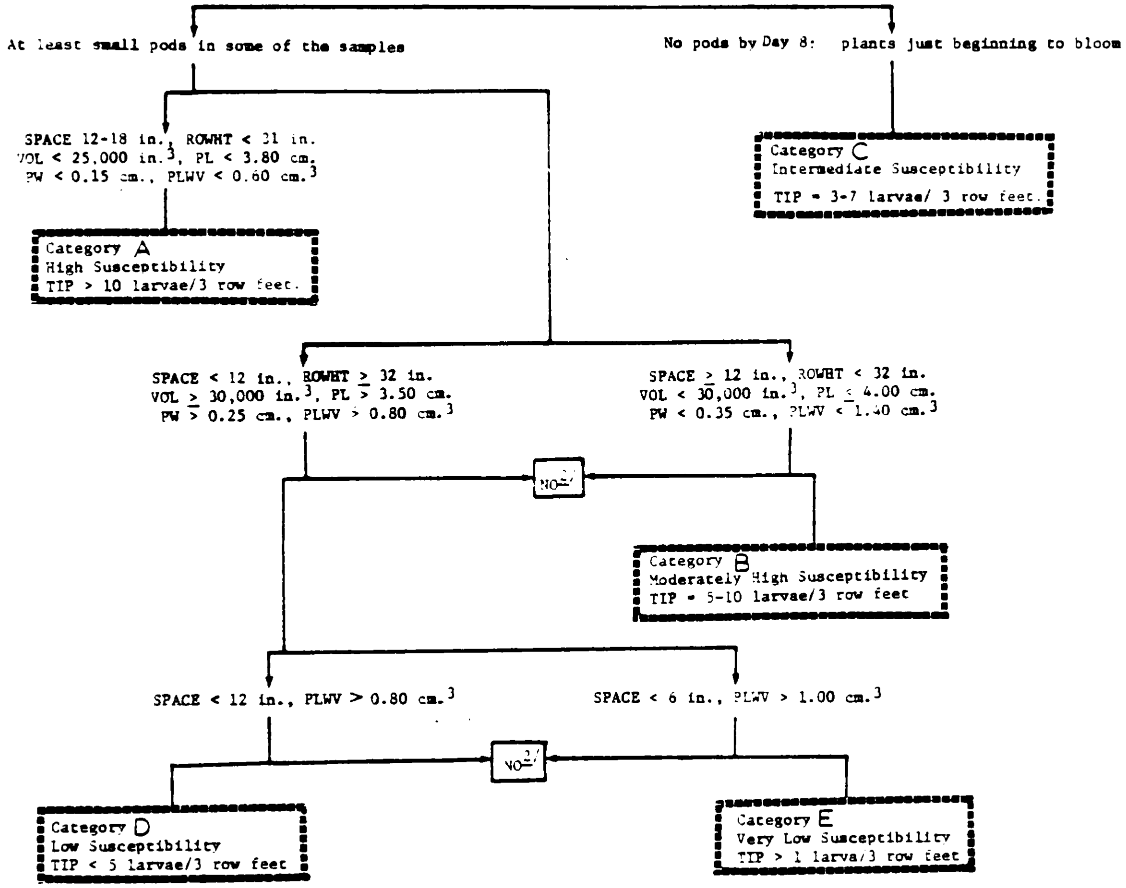
Fields were first separated on the basis of the means of the maximum number of larvae observed from DAYs 8-19. No distinction was made between TTIMEs within a field (Table 29). Three arbitrary levels were used: $<$ 5 larvae per 3 row feet (Category C), 5-10 larvae per 3 row feet (Category B), and $>$ 10 larvae per 3 row feet (Category A). Discrimination between these three categories next included the plant morphometrics. This allowed the effects of time on both larval numbers and on plant characteristics to be incorporated, providing more versatile susceptibility groupings.

The inclusion of plant morphometrics provided another set of criteria on which the fields could be distinguished. Here, corn earworm numbers served only as a guide, not as a variable in distinguishing field categories. The flow chart to separate these categories is found in Table 30. This regrouping on the basis of plant characteristics had several purposes. First, in years of low corn earworm population densities, a highly susceptible field could still be distinguishable from the low susceptibility fields, even though the fields all may harbor similar numbers of corn earworms. Second, misclassification due to undetected larvae was no longer a factor: misclassification of fields would have been highest when the groupings were done at a TTIME when the majority of the larvae were first and second instars and were extremely difficult to detect. Entry of larval numbers as a variable on DAYs 8-12 would cause an underestimation of the field's susceptibility. Third, it allowed classification of fields on the basis of one sampling period (TTIME), 6 to 11 days

Table 30. Key to categories of soybean field susceptibility to corn earworm larvae in eastern Virginia. - Capitalized acronyms are mnemonic codes of variables, as defined in footnote 1 [1]. (See Appendix Table 1.1 for complete listing of codes used in this work.)

Preliminary criteria:

1) Observations must be made 8 to 19 days after moth flight pulse.
2) Fields are classified using the mean of at least ten samples per field.
3) No large corn earworm population, or insecticide application, occurred in the fields prior to development of this larval generation (from early to mid-August through September).



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[1] PL = pod length (cm.)
PLWV = pod volume: PL * PW * 1 cm. (cm.^{3})
PW = pod width (cm.)
ROWHT = plant row height (in.)
SPACE = minimum space between row foliage (in.)
TIP = typical infestation potential
VOL = plant volume (in.^{3})

[2] If field fits into more than one of the following categories (B, D, or E), more weight should be given to the variables: SPACE, ROWHT, VOL (e.g., 1 point vs. 0.5 point). If field identity is still in question, SPACE should be given slightly more weight. Examples of this technique are discussed in the text.

prior to the occurrence of the maximum percentages of third and fourth instars (which occurred from DAYs 14-19). This single sampling period permitted early diagnosis of the field's susceptibility level. Thus, the potential susceptibility of a field would be known prior to when the maximum larval density (which could be controlled easily by pesticides and prior to the time when high percentages of fifth and sixth instars would appear in the field. Fourth, maximum corn earworm levels in high investation level years remained as guidelines for the classification of fields. An additional advantage to this final method of categorizing was that it allowed a field to change in its susceptibility status: a field in category A would become more like a field in category B as time from the moth pulse increased. Examples of the final groupings are given in Table 29 and below. The specific phenological characters used to assign fields into susceptibility categories are given in Table 31.

Ranked by corn earworm number from maximum to minimum, the categories are: A,B,C,D,E. With respect to overall maturity of the fields, categories rank from least to most mature: C,A,B,D,E.

The initial categories A and B were defined more specifically in the final susceptibility groupings. Since the infestation levels in category A were substantially higher than those in other groups (final groupings), all criteria under category A in Table 29 must be met to classify the field as A. The fields in the final category A with the highest levels of corn earworms had a minimum space between row foliage between 14 and 17 inches (Tables 30, 31). Three extra inches (7.62 cm) (12-18 in.) were allowed in the key to include

Table 31. Soybean plant and pod phenological characters used to assign fields into susceptibility categories.

Plant			Pod			
Plant volume in.^{3}	Minimum Row Space in.	Row Height in.	Length (PL) cm	Width (PW) cm	Volume (PLWV) cm^3	Susceptibility Category[1/]
$< 25,000$	12-18	< 31	< 3.80	< 0.15	< 0.60	A High
$< 30,000$	≥ 12	< 32	≤ 4.00	< 0.35	< 1.40	B Moderately high
VARIABLE			NO PODS PRESENT			C Intermediate
$\geq 30,000$	< 12	≥ 32	≥ 3.50	< 0.25	> 0.80	D Low
$\geq 30,000$	< 6	≥ 32	> 3.50	> 0.25	> 1.00	E Very low

[1/] For explanation, see Table 30 , and Discussion.

category A fields with slightly lower levels of infestation, but with maximum larval numbers still greater than ten. Final categories B and C were considered similar in susceptibility, but category C was judged to be less likely to harbor the higher larval numbers typical of B fields, if both B and C fields were available. This difference was basically because category C fields were substantially less mature than those of B, and C fields were not in bloom when the moth pulse occurred. Categories D and E distinguished between low levels of field susceptibility and between two levels of crop maturity.

IV. C. 2. Criteria for Analysis

a. Preliminary Analysis

The six plant variables used were first tested for normality by year, county and category (Appendix Tables 2.13, 2.14, 2.15). The procedure KSLTEST under the 76.4 release of SAS76 was used to test each variable and its transformations. Normality was not obtainable in all categories for all the plant morphometric variables or their transformations. Therefore, the results of the tests on individual variates in the following MANOVA were not weighed as heavily in the interpretation as they would have been if the data had been normalized: significant results of the univariate F-tests on the variates may not actually be significant. With respect to the tests of overall group effects, univariate normality is not as important. Univariate normality does not ensure multivariate normality, a criterion of the MANOVA. Also, non-normality does not usually detract from the utility of the overall group effect tests (Cooley and Lohnes 1971). Thus, the multivariate analysis of variance was performed.

IV. C. 2. b. MANOVA Hypothesis

The null hypothesis for the MANOVA was that soybean fields from post-pulse days 8-19 were not distinguishable into field categories as previously defined on the basis of the vector plant variables: pod length, pod width, pod volume, plant volume, plant row height, and minimum space between row foliage. By implication, therefore, field susceptibility to corn earworm infestation should not be distinguishable with the vector variables that define the field categories.

c. Discriminant Analysis

Once the null hypothesis that field categories were not distinguishable was rejected (based on the MANOVA tests of no overall group effect), discriminant analysis was performed to answer more specific category-related questions. These were: (a) what variables best distinguish all and/or specific groups; (b) how well do the cases classify into the categories to which they were assigned; and, (c) what are the coefficients of the canonical variables by which hypotheses concerning the discrimination among categories may be reached.

d. General Strategy

Separate analyses by year and county were necessary to understand fully and test the data, since in each year-county combination, the frequency of sampling each field, the weather conditions, and corn earworm infestations were different. Because 1975 sampling periods (TTIMEs) for each field were more frequent than in 1974, and because there was a greater number of groups in 1974, the 1975 discriminant analysis was investigated more thoroughly with respect to the test of the hypothesis of no difference in group susceptibility.

The computer outputs for the discriminant analyses (which are necessary for a thorough understanding and correct interpretation of the data) are presented for reference in Appendix 4.1, 4.2, and 4.3.

IV. C. 3. Analysis of Soybean Field Susceptibility to Corn Earworm Infestations: Isle of Wight Co., 1975

a. MANOVA

The variable group means and standard deviations are tabulated in Table 32. In general, pod length, pod width, pod volume, plant row height, and plant volume increased and minimum space between row foliage decreased in fields from categories C,A,B,D to E. Categories A and B are most similar. Although the mean of pod length in category B was less than in category A, and the pod width was similar in both groups, pod volume was greater in category B than in category A, indicating a more matured bean in category B than in category A.

The pooled covariance matrix, the best estimate of the common population correlation matrix, is shown in Table 33. Pod measurements were significantly correlated ($\alpha = 0.05$). The largest partial correlation coefficient was that of the pod width-pod volume covariance (PW - PLWV = 0.941). Plant row height (ROWHT) and plant volume (VOL) significantly covaried and were significantly negatively correlated with minimum space between row foliage (SPACE). As plant height increased, plant volume increased. As these two variables increased, minimum space between row foliage decreased. All of these

Table 32. Soybean field susceptibility classification: means and standard deviations of variables in each field category; Isle of Wight Co., Virginia, 1975. (See Table 30 for explanation of mnemonic variable codes.)

Variable	Units	Category					All Categories
		A	B	C	D	E	
				Means			
PL	cm	1.353	0.931	0.193	2.968	4.071	2.296
PW	cm	0.083	0.086	0.020	0.170	0.381	0.186
PLWV	cm^3	0.165	0.236	0.010	0.549	1.557	0.658
SPACE	in.	14.2	12.9	18.5	9.6	0.3	9.2
ROWHT	in.	24.1	25.8	22.4	35.0	41.7	31.2
VOL	$in.^3$	14099.9	9516.2	13021.2	28522.1	44214.3	24726.9
n		130	60	20	50	120	380
				Standard Deviations			
PL	cm	1.236	1.433	0.248	1.030	0.316	1.011
PW	cm	0.053	0.113	0.026	0.082	0.104	0.086
PLWV	cm^3	0.185	0.488	0.013	0.405	0.464	0.373
SPACE	in.	3.3	5.2	2.2	6.7	1.6	3.8
ROWHT	in.	5.5	4.5	3.2	5.5	3.0	4.5
VOL	$in.^3$	6855.6	4287.2	2768.2	9675.8	8172.5	7271.5

Table 33. Pooled covariance matrix from MANOVA of soybean fields classified by plant characteristics; Isle of Wight Co., Virginia, 1975. (See Table 30 for explanation of mnemonic codes.) Degrees of freedom = 374.

Variables	PL	PW	PLWV	SPACE	ROWHT
PW	0.610[1] (0.0001)[2]				
PLWV	0.650 (0.0001)	0.941 (0.0001)			
SPACE	-0.164 (0.0014)	-0.063 (0.2216)	-0.038 (0.4610)		
ROWHT	0.297 (0.0001)	0.081 (0.1178)	0.049 (0.3426)	-0.367 (0.0001)	
VOL	0.229 (0.0001)	0.009 (0.8631)	-0.027 (0.6024)	-0.472 (0.0001)	0.687 (0.0001)

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[1] Partial correlation coefficient from error sum-of-squares and cross-products matrix.

[2] Probability > $|R|$.

correlations were expected and indicate normal increases in the soybean plant morphometrics as the plant develops. Plants were not measured once they began to scenesce, so a decline in pod volume, for example, was not expected nor observed (Appendix Table 2.11).

The tests for the hypothesis of no overall group effect, Wilk's criterion, Hotelling-Lawley Trace, and Pillai's Trace and their F-approximations (Table 34) were significant. Thus, the null hypothesis of no difference between group population centroids was rejected. Therefore, at least two of the categories were distinguishable from each other.

Since the null hypothesis was rejected, the MANOVA tests of the separate variates were interpreted. All plant morphometrics contributed significantly to the difference between categories (Table 35). Therefore, all of the variables considered, not just a select few, contributed to susceptibility category differentiation.

IV. C. 3. b. Discriminant Analysis

The first step of the stepwise discriminant analysis revealed that plant volume contributed most significantly to the discrimination between groups (Table 36). The corresponding U-statistic and F-approximation indicated a significant difference between groups based on plant volume alone. The F-matrix on the equality of means between pairs of groups, tested with respect to the discrimination provided by plant volume, revealed that the F-values of categories C and A, and of categories C and B were nonsignificant ($\alpha = 0.05$) and these pairs of groups were not separable at this stage (Table 36). The classification matrix in step 1 more specifically demonstrated the

Table 34. MANOVA tests for hypothesis of no overall group effect for soybean fields classified by plant characteristics; Isle of Wight Co., Virginia, 1975.

Test	Results
Hotelling-Lawley Trace = 8.433	d.f. = 24,1474
F-approximation F(24,1474) = 129.49	Probability > F = 0.0001
Pillai's Trace V = 1.450	d.f. = 24,1492
F-approximation F(24,1492) = 35.36	Probability > F = 0.0001
Wilk's Criterion L = 0.060	d.f. = 24,1292
F-approximation F(24,1291) = 66.57	Probability > F = 0.0001

Table 35. MANOVA tests of separate soybean plant variates; Isle of Wight Co., Virginia, 1975. (See Table 30 for explanation of mnemonic codes.)

Dependent Variable	F(4,375)	Probability > F	Significance (α = 0.05)
PL	176.37	0.0001	*
PW	243.33	0.0001	*
PLWV	265.34	0.0001	*
SPACE	260.04	0.0001	*
ROWHT	275.95	0.0001	*
VOL	375.80	0.0001	*

Table 36. Step number one of discriminant analysis of soybean field susceptibility categories based on plant characteristics; Isle of Wight Co., Virginia, 1975. (See Table 30 for explanation of mnemonic codes.)

Variable	F to Remove	Force Level	Tolerance	Variable	F to Enter	Force Level	Tolerance
	d.f. = 4	375			d.f. = 4	374	
VOL	366.869	1	1.000000	PL	22.230	1	0.944641
				PW	57.624	1	0.999976
				PLWV	68.464	1	0.999405
				SPACE	35.107	1	0.797794
				ROWHT	26.595	1	0.504921

U-Statistic or Wilks' Lambda 0.2035304* Degrees of Freedom 1 4 375

Approximate F-statistic 366.868* Degrees of Freedom 4.00 375.00

F-matrix Degrees of Freedom = 1 375 (α = 0.05)

Category	A	B	C	D
B	16.31*			
C	0.38 ns	3.49 ns		
D	142.05*	186.31*	64.92*	
E	1070.21*	910.77*	315.46*	164.36*

Classification Matrix

Category	Percent Correct	Number of Cases Classified into Category A	B	C	D	E
A	91.5	119	2	0	9	0
B	5.0	57	3	0	0	0
C	0.0	20	0	0	0	0
D	28.0	21	0	0	14	15
E	87.5	1	0	0	14	105
Total	63.4	218	5	0	37	120

discriminating power of plant volume alone.

A summary of the stepwise discriminant analysis steps is presented in Table 37. Pod volume, the second variable entered, improved case classification from the previous 63.4% to 70.8% (Appendix 4.1). The corresponding F-matrix shows that categories A and C were still not distinguishable from each other, but categories C and B were. With pod length, the third variable entered (Table 37), all fields were distinguishable from each other, on the basis of the F-matrix (Appendix 4.1). Plant row height, minimum space between row foliage, and pod width were entered, in that order, each contributing significantly to the final discrimination between groups (Table 37, and Appendix 4.1). However, only beginning with the addition of minimum space between row foliage were cases in category C correctly classified (Appendix 4.1). All categories were distinguishable when all six plant morphometrics were entered (Table 38).

The discriminant functions presented in Table 39 with the multigroup discriminant function constants were uninterpretable.

The final classification matrix (Table 40) revealed the final percentage of correctly classified cases to be 79.7%. Individual case classifications are given in Appendix 4.1 and are referred to below.

In category A, 16.2% or 21 of the 130 cases were misclassified. Only six of these cases were not in the intermediate to moderately-high susceptibility groups, categories C and B. Twelve misclassified cases fit into group C. Of these twelve cases, eight were common to one TTIME and one field. When this field's variable means (Field 60, TTIME 2) (Appendix 2.11) were examined with respect to the category

Table 37. Summary of stepwise discriminant analysis of soybean field susceptibility categories based on plant characteristics; Isle of Wight Co., Virginia, 1975. (See Table 30 for explanation of mnemonic codes.)

Step Number	Variable		F Value to Enter or Remove	Number of Variables Included	U-Statistic	Approximate F-Statistic	Degrees of Freedom		Significance $\alpha = 0.05$
	Entered	Removed							
1	VOL	-	366.8687	1	0.2035	366.868	4.00	375.00	*
2	PLWV	-	68.4641	2	0.1175	179.272	8.00	748.00	*
3	PL	-	24.6309	3	0.0929	119.656	12.00	987.16	*
4	ROWHT	-	22.9088	4	0.0746	95.162	16.00	1137.12	*
5	SPACE	-	18.8573	5	0.0620	80.838	20.00	1231.42	*
6	PW	-	6.6413	6	0.0578	68.035	24.00	1291.99	*

Table 38. Final F-matrix of discriminant analysis of soybean field susceptibility categories based on plant characteristics; Isle of Wight Co., Virginia, 1975.

	Degrees of Freedom = 6,370 (α = 0.05)			
Category	A	B	C	D
B	20.63*			
C	10.97*	15.08*		
D	40.90*	41.82*	32.96*	
E	389.76*	247.70*	130.39*	103.52*

Table 39. Discriminant functions and multigroup discriminant function constants of soybean field susceptibility categories based on plant characteristics; Isle of Wight Co., Virginia, 1975. (See Table 30 for explanation of mnemonic codes.)

	Category				
Variable	A	B	C	D	E
	Discriminant Functions				
PL	-0.2660	-1.4618	-1.9476	0.1855	-2.2985
PW	45.1700	25.6510	9.8167	41.6873	20.3053
PLWV	-8.4589	-2.0421	1.1824	-5.9296	10.2749
SPACE	1.6148	1.4237	1.9266	1.5585	1.1098
ROWHT	1.7638	2.1728	1.7896	2.1363	2.1420
VOL	-0.0001	-0.0004	-0.0000	-0.0001	0.0002
	Multigroup Discriminant Function Constants				
	-33.8029	-37.3384	-40.6140	-48.2870	-58.3788

Table 40. Final classification matrix of soybean field susceptibility groupings based on plant characteristics; Isle of Wight Co., Virginia, 1975.

Category	Percent Correct	Number of Cases Classified into Category A	B	C	D	E
A	83.8	109	3	12	6	0
B	55.0	16	33	7	4	0
C	60.0	8	0	12	0	0
D	58.0	17	0	0	29	4
E	100.0	0	0	0	0	120
Total	79.7	150	36	31	39	124

key (Table 30), it was apparent that the means did not all fall into one group. The final grouping of this field was based upon the recommended weighting of the variable means (Table 30), a method used only when the category identity of a field was unclear. Discriminant analysis of individual cases could not incorporate this weighting of specific field variable means. The discrepancy between the discriminant analysis classification results and the a priori classification scheme (Table 30), was perhaps attributable to the inclusion in the latter of unquantifiable subtleties of judgement as the basis for distinction of field groups. Subjective judgements included such factors as the relative weight or importance that should be attached to certain variables. This problem is representative of one of the limitations of the discriminant analysis, whereby groups are not statistically distinguishable on the basis of the parameters measured, but any one or more of an infinite number of unmeasured variables contribute to defining intergroup differences (Green 1971).

Cases in category B, the moderately-high susceptibility group, were only 55% correctly classified. Sixteen of the 27 misclassified cases, or 59.3% of the misclassifications, were placed into category A: case susceptibility was determined by the analysis to be higher than the a priori classification would have indicated with the 10-case mean of the fields. Seven of the misclassified category B cases were placed into category C, and only 4 of the 27 misclassified cases were placed in low susceptibility categories D and E. Category B misclassified cases were mostly from 2 fields: 62 and 76. Field 62, in 2 TTIMEs within the critical detection period, DAYs 8-19, contained

7 cases classified into group A, 7 cases into group B, and 6 cases classified into C (Appendix 4.1). Since the means of the variables for each of the two sampling periods were used in the _a priori_ classification key, these high, moderately high and intermediate susceptibility cases were averaged to yield a moderately high susceptibility grouping. The extreme cases, which may be important in management decisions, were thus absorbed into a mean of overall field conditions. Interpretation of conditions, in this specific field (62), was also compounded by severe damage by Mexican bean beetles, _Epilachna varivestis_.

None of the ten cases in field 76 at TTIME 3, DAY 18, were classified by the discriminant analysis into field group B, to which the _a priori_ classification suggested that the cases belonged. In this no-till field, six of the 10 cases were placed into category A and 4 into category D. At TTIMEs 1 and 2, by contrast, field 76 was correctly classified into category A (Appendix 4.1). At this point, the classification sequence used for this field must be considered. First, since previous sampling periods determined this field to be highly susceptible, and 60% of the DAY 18 samples fit into category A, the field was probably still highly susceptible at TTIME 3. The four cases that fit into category D indicated that there was an area in the field that was both less susceptible and growing more rapidly than other areas sampled. These group D cases also indicate that as time progressed, field susceptibility levels changed. If the field was examined with respect to detected corn earworm levels, the field was placed into category B in all three sampling periods (Appendix 2.11). Three explanations for the discrepancies between categorization of the corn earworm numbers and plant characteristics were possible. (a) The volume and plant row height available to the moth in actuality may have been less than recorded because untilled stubble may have interfered with moth activity in the field by causing less of the plant to be available to the moth, thereby reducing the number of eggs deposited on the plants. (b) The field may have been highly susceptible, as indicated by plant characteristics, regardless of stubble, but predators and other environmental factors found in no-till fields, yet not in conventionally tilled fields could have accounted for the lower corn earworm numbers. (c) Because of the stubble, sampling was less accurate than in conventionally tilled fields and therefore the maximum 5-10 corn earworms per three row feet, as recorded in group B fields, would have been an underestimate of the number of larvae actually there. Based on sampling experience made in this and other no-till fields during this study, accuracy of sampling for corn earworm larvae decreased in direct proportion to spacing between rows, which is usually narrower in no-till fields. Accuracy also decreased as the ratio of plant height to stubble height decreased. In field 76, the spacing between rows did not present this problem since rows were on 36-inch (91.4-cm.) centers. However, the plants were not tall enough (26.8 inches (68.1 cm.)) to rule out the possibility of sampling error due to low plant-to-stubble ratio which was observed when the field was sampled. However, the high degree of damage to pods, typical of highly susceptible fields in 1975, was absent in field 76. Observations of the plants and corn earworm larvae in the field, prior to sampling, revealed numbers comparable to those in the shake cloth samples. The effects of the three above explanations probably all contributed in some way to explaining the results obtained in field 76. Clearly, among a large number of unmeasured variables, there may have been some that would have contributed to the further distinction of field groups.

Category C, the intermediate susceptibility group, was 60% correctly classified. The 8 incorrectly classified cases (of 20 category C cases), were placed into category A. Group C contained, by definition, fields that had no pods by DAY 8. As DAY 18 approached, pod development occurred in group C fields and the pod measurements at that time were similar to measurements taken about DAY 8 in group A fields.

Category D was 58% correctly classified, with 17 of the 21 misclassified cases placed into category A and 4 of the 21 cases placed into category E. The fields in category D were not similar to those categorized *a priori* into other groups, in that group D fields were not located on flat terrain. The group D cases placed into group A in the discriminant analysis were cases or samples taken in the higher, dryer areas of the fields, where the plants were smaller, frequently appeared water stressed, and usually hosted greater numbers of corn earworm larvae. The soil in these and the other eastern shore soybean fields is sandy (Appendix Tables 2.16, 2.17 and 2.18), and lack of sufficient moisture could be observed in the wilted plants in the elevated areas of the fields.

The category D cases placed into category E were from the lower, more moist regions of the fields. When sampling these heterogeneous fields, the irregularity in terrain immediately set them apart from all other fields. However, these heterogeneous fields were not rejected because of the insight into field susceptibility that might be gained. The discriminant analysis confirmed statistically the observed different groups within these fields.

The very low susceptibility category E was 100% correctly classified (120 cases). Both plant characteristics and lack of corn earworm larvae in this more matured soybean category were distinctive.

Overall, the discrepancies between the *a priori* classification and that of the discriminant analysis could be resolved when cases were examined individually. The next step in the discriminant analysis deals with differences among these categories A through E. Here, unlike in the past analyses, the conclusions drawn are heuristic.

The first canonical axis in discriminant space, as calculated from the eigenvalue, contributed approximately 90.7% to the discrimination among groups (Table 41). Clearly, then, the first axis, and the coefficients for the first canonical variable, contributed to the greatest distinction among groups. An interpretation of the coefficients for the canonical variable at the first axis indicated that plant growth was the greatest discriminating factor among field groups (Table 41).

The canonical variables pod length, pod width, and minimum space between row foliage, as described by the coefficients for the first axis, changed in a manner differing from the manner of change of plant volume, plant row height and pod volume. Two types of growth were represented on this axis. Pod width and pod volume changed (grew) at the greatest rate, although in different manners.

Table 41. Eigenvalues and canonical correlations for soybean field susceptibility category, based on plant characteristics; Isle of Wight Co., Virginia, 1975. (See Table 30 for explanation of mnemonic codes.)

	Canonical Axes			
	1	2	3	4
Eigenvalues	7.6993	0.4097	0.2654	0.1145
Approximate Eigenvalue Contribution	90.7%	4.8%	3.1%	1.3%
Canonical Correlations				
	0.94077	0.53909	0.45796	0.32049
Variable	Coefficients for Canonical Variables			
PL	0.2474	0.9935	-0.5871	0.3328
PW	2.5375	11.9947	-6.3630	16.1436
PLWV	-2.5873	-4.5922	2.7437	-3.4445
SPACE	0.0796	0.1138	0.0953	-0.1760
ROWHT	-0.0431	-0.1082	-0.2145	-0.1886
VOL	-0.0001	0.0001	0.0002	-0.00001
Constant	3.01034	-1.70893	2.69336	6.27670
Category	Canonical Variables Evaluated at Category Means			
A	2.2276	0.3307	0.2079	0.3070
B	2.0930	-1.1781	-0.5790	-0.0700
C	2.6752	-0.2993	1.4582	-0.9924
D	0.0147	1.0184	-0.7611	-0.4538
E	-3.9117	-0.1437	0.1384	0.0569

It appeared that pod length, pod width, and minimum space between row foliage changed linearly while pod volume, plant row height and plant volume changed geometrically. One unit of linear growth in pod width corresponded to one unit of geometric growth in pod volume. A unit of change in minimum space between row foliage decreased linearly at a rate slightly greater than a unit of geometrical increase in plant row height. For the most part, the measurements applied to plants after pod set and prior to the 30th day after blooming. Relatively speaking, changes in the pod were much greater than changes in the plant foliage. Also, foliage grew upward at a geometrical rate slightly slower than the linear rate of horizontal plant growth (ROWHT and SPACE). Since plant volume remained almost constant, the center of plant volume was found increasingly farther from the ground, even though this change was small in comparison with the rate of change in the pods. Carlson (1973) stated that plant volume was constant after pod formation for determinant growth soybeans, which was confirmed in the current investigation by the field measurements and by the interpretation of the coefficients for the first canonical axis. The present author's field observations of scenescing lower leaves, which occurred as the canopy closed, supported the measurements of minimal contribution of lower leaves to total plant photosynthate which were made by Ogren and Rinner (1973). The loss of lower leaves supported the conclusions of the present analyses, drawn from the coefficients for the first axis concerning a change in plant shape. Therefore, the slight increase in plant width (above scenescing leaves) and plant height, and the constant plant volume, as observed in the field, were detectable in the first canonical axis. During this growth, pod volume increased in size at a greater rate, due to an equivalent rate of increase in pod width. Change in pod size was more marked than the change in plant shape.

The second canonical axis contributed approximately 5% to the difference among groups (Table 41). The rates of change for all pod measurements were much greater than the rates of change of the same variables in the first axis, as shown by the coefficients for the first and second canonical variables. The rate of change in pod width on the second axis was far greater than the change in any other variable. This suggested that the second axis primarily represented a marked change among groups with respect to the marked change in pod measurements, particularly pod width (Table 42). The rapid rate of linear change in pod width was followed in magnitude by a much slower linear change in pod length. Pod volume increased geometrically at a rate greater than the rate of change in pod length. Pod width contributed much more to the change in pod volume at this point (on this axis) than pod length. Minimum space between row foliage linearly changed at a rate about one-ninth that of the rate of change in pod length. Plant row height changed geometrically at a rate similar to the rate of change in minimum space between row foliage. This suggests that minimum space between row foliage and plant row height played a minor but significant role in distinguishing among groups when very rapid rates of growth or change occur in the pod, specifically when the pod increases very rapidly in width.

Table 42. Means of soybean plant characteristics, sorted by approximate days since blooming, for each field and sampling time, for samples within the post-pulse days 8-19; Isle of Wight Co., Virginia, 1975. Each TTIME per field represents 10 samples. (See Table 30 for explanation of mnemonic codes.)

Days Since Blooming	Coded Field (CFLD)	TTIME	Field Category	Plant Characteristics PL cm	PW cm	PLWV cm^3	ROWHT in.	SPACE in.	VOL $in.^3$
-2	52	2	C	0.000	0.000	0.000	19.9	18.9	11562.3
0	80	1	A	0.050	0.006	0.003	16.8	16.6	7719.9
0	72	1	B	0.096	0.011	0.005	25.6	10.9	5600.5
0	78	1	A	0.114	0.014	0.009	17.3	12.0	6957.3
3	52	3	C	0.386	0.040	0.020	25.0	18.1	14480.1
4	62	2	B	0.052	0.006	0.003	24.4	18.2	11185.3
4	60	2	A	0.093	0.010	0.005	25.0	16.8	16400.4
4	78	2	A	0.599	0.054	0.049	20.7	15.3	6175.0
4	80	2	A	0.896	0.081	0.078	19.9	16.4	9349.0
5	72	2	B	0.367	0.052	0.022	24.4	9.2	6859.3
8	56	2	A	1.447	0.116	0.167	27.0	15.2	18191.8
9	76	1	A	1.620	0.106	0.180	25.0	13.1	12285.4
9	72	3	B	0.650	0.084	0.060	26.8	7.9	8376.3
9	60	3	A	0.734	0.077	0.063	28.9	14.8	20371.5
9	78	3	B	0.972	0.099	0.104	19.3	11.5	8060.7
10	62	3	B	0.395	0.043	0.031	26.8	18.8	11316.6
10	70	1	D	1.856	0.122	0.196	35.0	10.0	30268.5
11	66	2	A	1.202	0.099	0.123	30.9	12.3	24171.1
12	54	2	D	2.152	0.105	0.236	34.9	9.6	26685.4
12	76	2	A	2.739	0.124	0.342	26.2	13.0	13166.8
12	56	3	A	3.455	0.144	0.499	26.4	14.5	18102.3
15	70	2	D	3.915	0.183	0.717	35.1	8.8	28468.6
16	66	3	A	3.674	0.144	0.530	29.9	12.8	22347.7
17	54	3	D	3.060	0.140	0.432	34.5	10.6	26469.1
18	76	3	B	4.027	0.321	1.297	26.9	12.3	13758.9

Table 42 (cont.)

Days Since Blooming	Coded Field (CFLD)	TTIME	Field Category	Plant Characteristics PL cm	PW cm	PLWV cm ^{3}	ROWHT in.	SPACE in.	VOL in.^{3}
18	68	1	E	3.908	0.236	0.921	42.4	0.0	50950.8
18	74	1	E	4.073	0.253	1.030	46.0	0.0	53834.2
19	70	3	D	3.857	0.300	1.162	35.3	9.0	30718.8
20	50	2	E	4.061	0.329	1.344	41.5	0.5	45923.5
21	64	2	E	4.281	0.345	1.471	39.7	0.0	32903.5
21	74	2	E	3.890	0.356	1.387	45.4	1.1	46989.4
23	68	2	E	4.105	0.356	1.459	41.3	0.0	49351.8
25	50	3	E	4.119	0.420	1.741	40.8	0.7	42855.3
27	68	3	E	3.994	0.434	1.731	40.3	0.0	45797.4
27	64	3	E	4.363	0.451	1.977	39.5	0.0	33684.4
27	74	3	E	3.971	0.504	2.008	42.1	0.6	48576.3
28	58	2	E	3.955	0.394	1.567	40.9	0.9	38304.3
31	58	3	E	4.135	0.493	2.044	40.1	0.0	41400.6

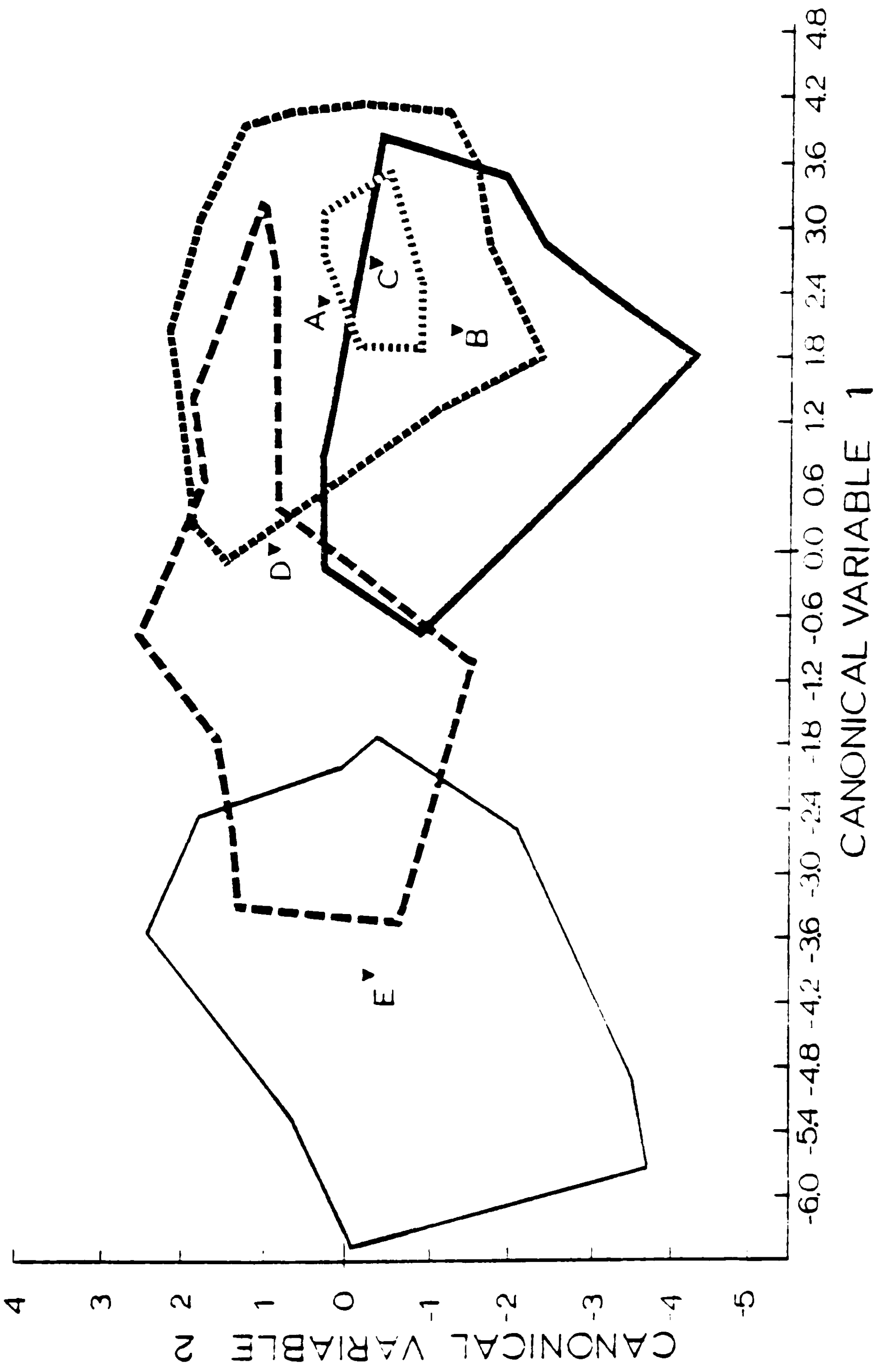
When groups were evaluated at their second axis group means (Table 41, Fig. 21), the original variable group means (Table 32) were no longer an aid in explaining the distribution of the groups. However, when fields were arranged on the basis of approximate days since blooming (number of days after majority of field was in peak of blooming) and on the basis of pod characteristics, the most important variables in the second axis were arranged in ascending order (Table 42). Thus explanations of the distribution of group means on the second axis were more easily obtained.

Examination of Table 42 reveals two important facts. First, rapid changes in pod sizes were apparent. Second, when fields were arranged by pod maturity, field types were no longer arranged in discrete arrays.

The first observation was most directly related to coefficients for the canonical variables of the second axis. A marked increase in pod volume occurred between 18 and 31 days since blooming: from a mean volume of 0.66 cm^3 from days 12-18 post blooming to 1.87 cm^3 by days 27-31 since blooming. An increase in pod volume was noted by Bils and Howell (1963), who found that the 18-36 day period after blooming was the time of most rapid cotelydon volume increase.

As noted above (Table 42), pod width, not pod length, contributed most to this geometric change in pod volume. Pod length in the 1975 fields averaged 3.44 centimeters from days 12 through 18 and increased to an average of 4.08 centimeters by days 27-31 since blooming. Pod width measured approximately 0.18 centimeters from days 12-18 since blooming and increased to 0.45 centimeters by days

Figure 21. Plot in discriminant space of the first two canonical variables for the data on soybean plant morphometrics from Isle of Wight County, Virginia, 1975. Canonical variable 1 is closely related to overall plant growth. Variable 2 is related mostly to pod growth. The letters represent groups associated with different levels of soybean field susceptibility to corn earworm infestation. Each group corresponds to a differential combination of plant measurements. Triangles represent group centroids.


A
B
C
D
E
CANONICAL VARIABLE 1
-6.0
-5.4
-4.8
-4.2
-3.6
-3.0
-2.4
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
2.4
3.0
3.6
4.2
4.8
CANONICAL VARIABLE 2
4
3
2
1
0
-1
-2
-3
-4
-5

27-31. This increase in pod width, which in proportion to the increase in pod length, is greater, is also shown by the coefficients for the canonical variables of the second axis.

With respect to corn earworm larval nutrition, a rapidly increasing nutrient supply becomes available to larvae on plants that are 18 to 36 days past blooming, because the pod volume increases so rapidly, although the increase in size of protein globules doesn't occur until days 36-52 (Bills and Howell 1963). Groups A and B, the categories with the most susceptible fields, harbored third and fourth instar larvae when the fields were 9 to 18 days past the peak of blooming (Table 42). Therefore, by the time the majority of the larvae grew to fifth and sixth instars, 2 to 10 days hence (at 33°C) (Table 29, Fig. 19), the fields would be from 11 to 28 days past blooming. Fifty to 60 per cent of the sixth instars would complete development at 33°C when the fields are 14 to 28 days past blooming, if calculations are based upon moth emergence dates and Table 29. If calculations were based on larval development after moth pulse, but at 25°C, 50 to 60 per cent of the sixth instars would be present when fields were 17-31 or more days past field blooming. Therefore, by the time fifth and sixth instars had developed, the marked pod volume increase had occurred in group A and B fields. The increase in resources appears to be synchronized with increased food requirements of the fifth and sixth instars.

The second point emerging from Table 42 was that the field susceptibility groups overlapped when the field arrangement was according to pod size (maturity). Pod characteristics alone, on the second axis, were not as effective a basis for separation of high and low susceptibility fields as is the combination of foliage and pod characteristics on the first canonical axis. For example, category D, a low susceptibility group, contained pods similar in maturity to those of certain fields in more susceptible categories, A and B (Table 42). In the same table, fields in categories A and D were equally represented from 10 to 17 days since bloom date. The canonical variable evaluated at group means (Table 41) showed that categories A and D were on one side of the midpoint and all other group means were on the other side. This split was probably due to the above mentioned similarity between groups A and D from 10-17 days after blooming versus the dissimilarity of other groups (Table 42). Categories B and D means were almost equally separated from the axis midpoint, in opposite directions. This suggested that categories B and D should have been the most distinguishable groups on the basis of pod measurements alone (since this axis deals mostly with pod morphometrics). Analysis of Table 42 and Figure 21 confirmed this: only one group B field lay in the range of pod measurements represented by fields in group D. Minimum space between row foliage also appeared to be a good variable for separating categories B and D. Categories B, C, and E were not separable solely on the basis of pod morphometrics when the canonical variables were examined at group means. There appeared, in Table 42, to be a large difference between pod measurements, especially between categories B and E, but this difference was not apparent when the group means were evaluated on the second axis (Table 41). Categories A and D were separable from category E on the basis of the canonical variable evaluated at group means (Table 41). If the pod morphometrics and measurements of minimum space between row foliage were compared between groups E, and groups A and D combined, the distinction was clear. The combination of both pod and plant measurements is vital to distinguishing susceptibility categories.

The distinction of groups, based on the first two canonical axes in discriminant space is illustrated in Figure 21. Here, the relationship of groups with respect to both axes was better visualized. The group distribution on the first axis, which represented overall plant growth, was quite different from the group distribution on the second axis, basically that of pod growth. This figure illustrated two aspects of the multidimensional changes which occurred in soybean fields.

The <u>third canonical axis</u> contributed only 3% of the distinction among groups (Table 41). As with the previous axes, when the coefficients for the canonical variables were evaluated, pod width played the most significant role in separating differences among groups (Table 41), followed by pod volume and pod length. The rate of change in pod length and pod width was probably linear and the rate of change in pod volume was still geometrical. The ordering of fields by days since blooming, in itself, was not used to distinguish the differences among groups. The third axis could not be explained in terms of pod development before and after eighteen days since blooming, or in terms of overall plant growth because: (a) the canonical axes are orthogonal and therefore cannot explain the same changes, (b) the polarity of pod length and pod width changed, and (c) the rates of change of pod length and width and pod volume were not as great as in the second axis, but were greater than in the first axis. In the third axis, both pod measurements and plant row height were important. Plant row height changed at a linear rate only slightly slower than pod length changes. The magnitude of the rate of change in row height gave a clue to interpretation of the third axis.

Note first that the most obvious divergence in third canonical variable evaluated at group means (Table 41) was group C. Inspection of Table 42 revealed that the earlier sampling of the category C field was most easily distinguishable from other groups on the basis of pod size. The importance of pod measurements to separate group C in general was confirmed by the rates of change in the coefficients for the third canonical variable. Now, if the third canonical variable, evaluated at the group means, was analyzed with respect to categories A and B and categories D and E (Table 41), the two sets of groups were distinguishable on the basis of row height and pod characteristics (Table 41). These sets of groups lay on either side of 18 days after blooming: A and B before 18 days, and D and E after. Through the third axis, distinction among groups, particularly within sets of groups, was based mostly upon the variables pod width, pod volume, pod length, and plant row height. The usefulness of plant height in distinguishing between similar categories (A and B, and D and E) is seen here.

In summary, not only were fields classified into statistically testable categories, but insights into the corn earworm-soybean plant association were made. With respect to field classification, plant volume provided 63% of the distinction between groups. The second most important variable was pod volume. After these two variables, pod length, plant row height, minimum space between row foliage, and pod width, respectively, added to group discrimination.

Aspects of multidimensional changes in the soybean plants over time were distinguished into three orthogonal axes in hyperspace. Conclusions concerning this dimension of the discriminant analysis were heuristic. The first axis, contributing the most to the distinction among groups, represented overall plant and pod growth. The second axis represented pod growth, particularly at the time when pod width was changing most rapidly. The third axis represented a more complex relationship between pod growth and plant row height. Through the canonical axes, it was possible to see how the most susceptible categories, A and B, were growing in a manner which was well synchronized with the growth of corn earworm larvae. Pod fill began in categories A and B when the larvae first markedly increased nutrient intake, which confirms the report by Boldt et al. (1975) that 90% of food intake occurred in fifth and sixth instars.

In Figure 21, overlaps were visible between the case distribution of groups. The major overlaps were attributable mostly to the time range over which samples were taken. For example, in group B, field 76, TTIME 3, pod and plant measurements fit into groups A and B (Table 41, Appendix 4.1), and therefore the cases lay in the region of overlap, whereas samples taken in field 76 at TTIMEs 1 and 2 lay in group A. As the sampling date approached DAY 19, field group identity changed, due to plant growth in the DAYs 8-19 period of sampling.

Similarly, by DAY 19 those fields in category C appeared to be category A fields. Therefore, greater separation between groups should be possible if a smaller range in sampling time was considered. Also, any number of unmeasured variables, as discussed previously, would possibly provide a greater separation between groups.

IV. C. 4. Analysis of Soybean Field Susceptibility to Corn Earworm Infestations: Isle of Wight Co., 1974

a. MANOVA

All fields sampled in Isle of Wight County in 1974 fit into two groups: A and E, the high and very low susceptibility categories, respectively. The variable means and standard deviations are tabulated by category in Table 43. The means were slightly different from those of the respective groups in 1975 (Table 32). However, the major group-discriminating characteristics were similar. Pod and plant morphometrics of category A were smaller than those in category E. Minimum space between row foliage in category A was between 12 and 18 inches, whereas the same variable was less than six inches in category E fields.

The pooled covariance matrix (Table 44) showed expected high correlations between plant growth characteristics. The largest correlation coefficient was that of the pod width-pod volume covariance. There were significant ($\alpha = 0.05$) positive correlations between pod length, pod width, and pod volume. Plant volume was significantly positively correlated with pod length and row height, but significantly negatively correlated with minimum space between row foliage.

Table 43. Soybean field susceptibility classification: means and standard deviations of variables in each field category: Isle of Wight Co., Virginia, 1974. (See Table 30 for explanation of mnemonic variable codes.)

		Category		
Variable	Units	A	E	All Categories
		Means		
PL	cm	1.457	3.163	3.008
PW	cm	0.090	0.232	0.220
PLWV	cm ^{3}	0.167	0.868	0.805
SPACE	in.	12.6	1.1	2.1
ROWHT	in.	29.9	37.5	36.8
VOL	in.^{3}	21997.8	38599.2	37089.9
n		20	200	220
		Standard Deviations		
PL	cm	1.204	1.445	1.426
PW	cm	0.032	0.148	0.142
PLWV	cm ^{3}	0.070	0.731	0.700
SPACE	in.	4.7	2.5	2.7
ROWHT	in.	2.9	7.2	6.9
VOL	in.^{3}	4675.2	10605.2	10226.1

Table 44. Pooled covariance matrix from MANOVA of soybean fields classified by plant characteristics; Isle of Wight Co., Virginia, 1974. (See Table 30 for explanation of mnemonic codes.) Degrees of freedom = 217.

Variables	PL	PW	PLWV	SPACE	ROWHT
PW	0.626[1/] (0.0001)[2/]				
PLWV	0.727 (0.0001)	0.981 (0.0001)			
SPACE	-0.125 (0.0640)	-0.003 (0.9646)	-0.041 (0.5492)		
ROWHT	0.103 (0.1280)	0.131 (0.0534)	0.130 (0.0539)	-0.071 (0.2942)	
VOL	0.206 (0.0021)	0.105 (0.1201)	0.137 (0.0427)	-0.381 (0.0001)	0.758 (0.0001)

[1/] Partial correlation coefficient from error sum-of-squares and cross-products matrix.

[2/] Probability > $|R|$.

Other combinations of these variables were not significant.

The MANOVA tests for the hypothesis of no overall group effect are given in Table 45. The statistics were significant at the $\alpha = 0.05$ level and the null hypothesis was therefore rejected. The two groups, A and E, therefore, had different population centroids.

The MANOVA tests of the separate variates, analyzed because of the significant results of the previous tests, revealed that all variables significantly contributed to the discrimination of group centroids (Table 46). The significant contribution of each variable to group discrimination, together with the rejection of the hypothesis of no overall group effect, supported the hypothesis that soybean fields may be separated into groups or categories, based on plant morphometrics. Questions remaining for the 1974 fields were: to what extent were the fields and groups distinguishable; and which variables contributed most to the distinction among the fields in groups A and E? In addition, did this data yield information on the corn earworm-soybean plant association, which was not obtained in 1975? Discriminant analysis assisted in answering these questions.

IV. C. 4. b. Discriminant Analysis

The stepwise discriminant analysis revealed that categories A and E were best separated by the variable minimum space between row foliage (SPACE) (Table 30). The U-statistic and F-approximation showed a statistically significant difference ($\alpha = 0.05$) between categories A and E on the basis of this variable (Table 47). The corresponding F-matrix of equality of means between pairs of groups (Table 47), tested with respect to the discrimination provided by

Table 45. MANOVA tests for hypothesis of no overall group effect for soybean fields classified by plant characteristics; Isle of Wight Co., Virginia, 1974.

Test	Results	
Hotelling-Lawley Trace	= 1.766	d.f. = 6,215
F-approximation F(6,213)	= 62.69	Probability > F = 0.0001
Pillai's Trace V	= 0.638	d.f. = 6,213
F-approximation F(6,213)	= 62.69	Probability > F = 0.0001
Wilk's Criterion L	= 0.361	d.f. = 6,213
Exact F F(6,213)	= 62.69	Probability > F = 0.0001

Table 46. MANOVA tests of separate soybean plant variates; Isle of Wight Co., Virginia, 1974. (See Table 30 for explanation of mnemonic codes.)

Dependent Variable	F(1,218)	Probability > F	Significance (α = 0.05)
PL	26.04	0.0001	*
PW	18.13	0.0001	*
PLWV	18.28	0.0001	*
SPACE	318.60	0.0001	*
ROWHT	22.14	0.0001	*
VOL	47.92	0.0001	*

Table 47. Step number one of discriminant analysis of soybean field susceptibility categories based on plant characteristics; Isle of Wight Co., Virginia, 1974. (See Table 30 for explanation of mnemonic codes.)

Variable	F to Remove	Force Level	Tolerance	Variable	F to Enter	Force Level	Tolerance
	d.f. = 1 218				d.f. = 1 217		
SPACE	318.596	1	1.000000	PL	3.372	1	0.984283
				PW	7.149	1	0.999991
				PLWV	5.101	1	0.998344
				ROWHT	4.794	1	0.994930
				VOL	0.006	1	0.854526

U-statistic or Wilks' Lambda	0.4062641	Degrees of Freedom	1	1	218
Approximate F-statistic	318.597	Degrees of Freedom		1.00	218.00

F-matrix Degrees of Freedom = 1 218 (α = 0.05)

	A	
E	318.60	*

Classification Matrix

Category	Percent Correct	Number of Cases Classified into Category A	E
A	85.0	17	3
E	98.0	4	196
Total	96.8	21	199

SPACE, showed that the two groups were separable ($\alpha = 0.05$). This variable alone provided 96.8% correct classification of cases (Table 47).

In order of greatest to smallest contribution to distinction between groups and cases, the variables were: minimum space between row foliage, pod length, plant volume, plant row height, pod volume, and pod width (Table 48). The F-values were reduced sharply after step one (Table 49, Appendix 4.2) and the variables past this step reveal little new information in the distinguishing of groups. The classification matrices following each step (Appendix 4.2) confirmed this. The results of the final F-matrix (Table 49), showed that all variables contributed significantly ($\alpha = 0.05$) to the discrimination between groups A and E.

The discriminant functions are presented in Table 50 with the multigroup discriminant function constants. These functions were not interpretable.

In the final classification matrix (Table 51), the percentage of correctly classified cases (97.3%) was improved little after the percentage correctly classified with the entrance of the first variable. Therefore, when only categories A and E were considered, they were separable on the basis of minimum space between row foliage.

Analysis of individual cases in the discriminant analysis aided in clarification of reasons for misclassified cases. The 220 cases were 96.8% correctly classified, with 85.0% of the category A cases and 98.5% of the category E cases correctly classified. Since the _a priori_ criteria for field classification were based upon the mean of

Table 48. Summary of stepwise discriminant analysis of soybean field susceptibility categories based on plant characteristics; Isle of Wight Co., Virginia, 1974. (See Table 30 for explanation of mnemonic variable codes.)

Step Number	Variable		F Value to Enter or Remove	Number of Variables Included	U-Statistic	Approximate F-Statistic	Degrees of Freedom		Significance α = 0.05
	Entered	Removed							
1	SPACE	-	318.5962	1	0.4063	318.597	1.00	218.00	*
2	PW	-	7.1486	2	0.3933	167.366	2.00	217.00	*
3	PLWV	-	3.5592	3	0.3869	114.079	3.00	216.00	*
4	PL	-	5.3919	4	0.3775	88.647	4.00	215.00	*
5	ROWHT	-	2.9274	5	0.3724	72.139	5.00	214.00	*
6	VOL	-	6.3771	6	0.3615	62.689	6.00	213.00	*

Table 49. Final F-matrix of discriminant analysis of soybean field susceptibility categories, based on plant characteristics; Isle of Wight Co., Virginia, 1974.

Category	Degrees of Freedom = 6,213 (α = 0.05) A
E	62.69*

Table 50. Discriminant functions and multigroup discriminant function constants of soybean field susceptibility categories, based on plant characteristics; Isle of Wight Co., Virginia, 1974. (See Table 30 for explanation of mnemonic codes.)

Variable	Category A	 B
	Discriminant Functions	
PL	4.4762	5.7603
PW	148.8179	203.9078
PLWV	-36.5617	-48.3007
SPACE	1.8675	0.1332
ROWHT	0.5122	0.7973
VOL	0.0001	-0.00004
	Multigroup Discriminant Function Constants	
	-30.28183	-26.18764

Table 51. Final classification matrix of soybean field susceptibility categories based on plant characteristics; Isle of Wight Co., Virginia, 1974.

Category	Percent Correct	Number of Cases Classified into Category	
		A	E
A	85.0	17	3
E	98.5	3	197
Total	97.3	20	200

10 cases, the 3 incorrectly classified cases would probably not cause the whole field to be misclassified. The 3 misclassified cases (field samples) represented random deviations from field means (Appendix 4.2).

One hundred per cent of the discrimination among groups was contributed by the coefficients of the first canonical axis (Table 52), since only 2 groups were distinguished. The variables pod width, pod length and plant row height, as described by the coefficients of the first canonical axis, changed in a manner opposite that change in pod volume, plant volume, and minimum space between row foliage (Table 52). Plant volume played a very minor role in the interpretation of the among-group differences and was therefore treated as a nonchanging value. Pod width changed most rapidly with respect to all other variables. Pod length changed in a similar manner to the change in pod width but at a slower rate and in a different manner than pod volume and minimum space between row foliage. The rates of change of the coefficients of the canonical variables in this axis for Isle of Wight Co. fields, 1974, were similar to the rates of change in the coefficients of the canonical variables on the second canonical axis in Isle of Wight Co. fields, 1975 (Table 41). It was therefore hypothesized that in 1974, the rapid change in pod width corresponded to linear growth. This growth was followed by a less rapid geometric growth in pod volume and a less rapid linear growth in pod length. In 1974, however, unlike 1975, minimum space between row foliage played a more important role (which reflected a geometric and not a linear change in growth rate).

Table 52. Eigenvalues and canonical correlations for soybean field susceptibility categories, based on plant characteristics; Isle of Wight Co., Virginia, 1974. (See Table 30 for explanation of mnemonic codes.)

	Canonical Axis 1
Eigenvalues	1.7659
Approximate Eigenvalue Contribution	100%
Canonical Correlations	
	0.7990
Variable	Coefficients for First Canonical Variable
PL	-0.2791
PW	-11.9724
PLWV	2.5512
SPACE	0.3769
ROWHT	-0.0620
VOL	0.00004
Constant	1.4931
Category	First Canonical Variable Evaluated at Category Means
A	4.1831
E	-0.4183

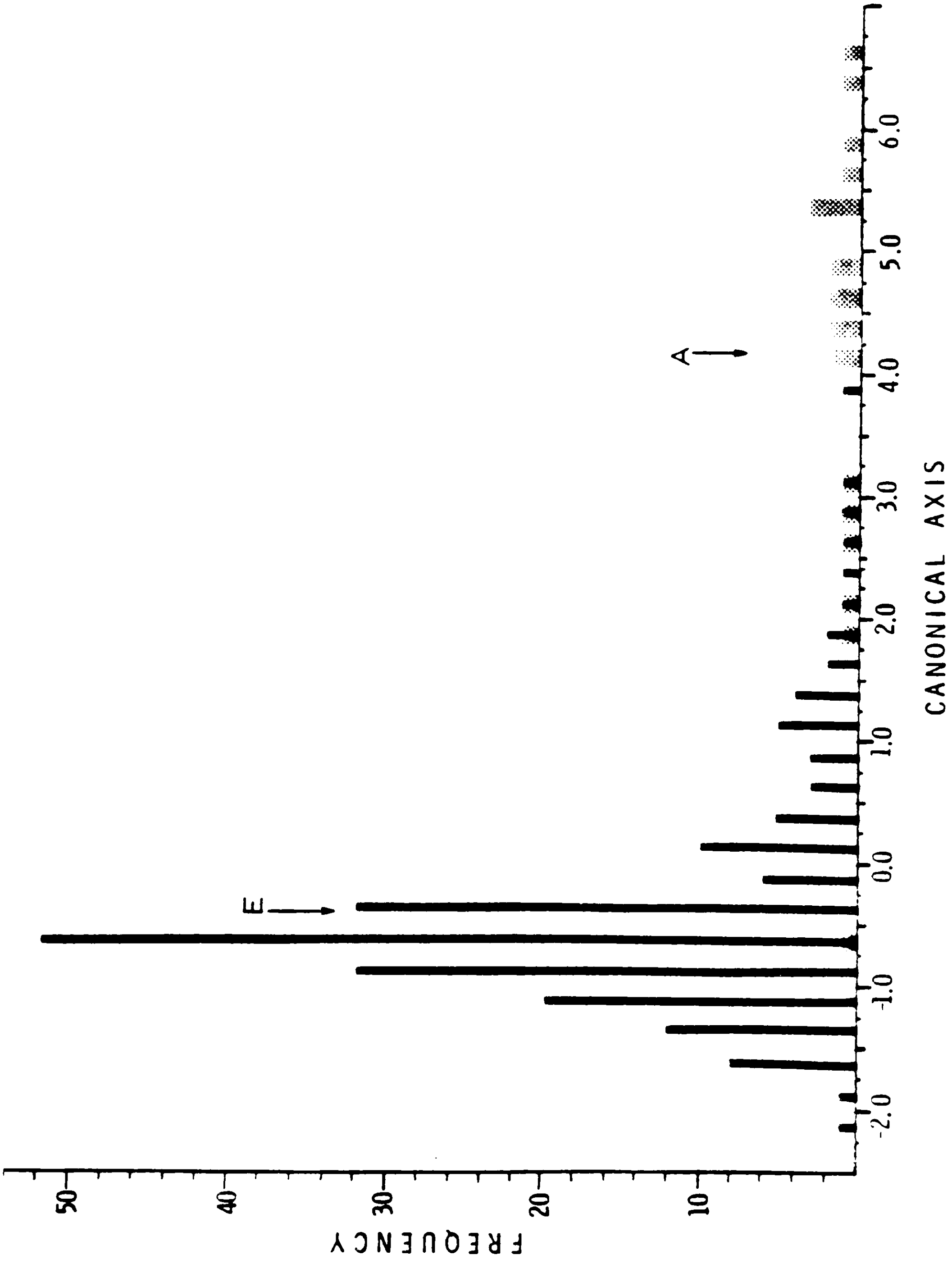
First, in Table 53, the listing of fields by days since blooming showed that almost half of the observations were of fields in the period of 18 through 36 days since blooming, the period of most rapid cotyledon volume increase (Bils and Howell, 1963). Examination of the pod morphometrics before and during this period revealed a very marked increase in pod length, pod width and pod volume, beginning 18 days after blooming. The absence of observations from 12 through 16 days after blooming made this difference in growth rate even more distinct.

When the canonical variables evaluated at group means (Table 52) were studied in light of the individual variable means of individual fields (Table 53), and in light of the coefficients for the first canonical variable, observations before and after the 18 days after blooming were distinguishable on the basis of pod morphometrics alone. However, the coefficients for the first canonical variable also indicated that minimum space between row foliage was also relatively important in separating within group differences. Thus, within the 1-17 day period after blooming, two fields, both in category A, were distinguishable from all other fields. Therefore, the canonical axis revealed 3 groups within all cases: category A fields, based on minimum space between rows; all fields from 1-17 days after blooming; and all fields from 18 plus days after blooming. The wide separation between the canonical variables evaluated at group means (Table 52), indicated the importance of minimum space between row foliage, in particular, as a basis of group A and E separation. Case distribution on the first axis, and their frequency thereon is illustrated in Figure 22.

Table 53. Means of soybean plant characteristics sorted by approximate number of days since blooming for each field and sampling time, for samples within post-pulse days 8-19; Isle of Wight Co., Virginia, 1974. Each sampling time per field represents 10 samples. (See Table 30 for explanation of mnemonic codes.)

Days Since Blooming	Coded Field (CFLD)	TTIME	Field Category	Plant Characteristics PL cm	 PW cm	 PLWV cm^3	 ROWHT in.	 SPACE in.	 VOL $in.^3$
5	20	2	A	0.368	0.061	0.022	30.9	14.3	21453.4
7	18	2	E	0.378	0.061	0.023	39.7	0.3	47376.6
10	8	2	E	1.242	0.108	0.142	32.9	1.4	32481.0
11	6	2	E	1.688	0.122	0.212	47.4	1.4	52633.6
11	12	2	E	1.169	0.109	0.130	28.1	0.0	28787.4
11	22	2	E	1.539	0.122	0.207	35.1	2.5	17818.9
11	24	2	E	0.709	0.091	0.069	35.0	3.0	28892.2
16	20	3	A	2.546	0.119	0.311	28.9	11.0	22542.1
18	12	3	E	3.897	0.171	0.678	29.7	1.2	30448.2
18	4	2	E	3.426	0.175	0.620	39.4	0.0	48079.9
18	18	3	E	3.990	0.158	0.630	39.2	0.4	44921.7
19	6	3	E	4.098	0.278	1.138	47.5	1.5	51379.8
19	8	3	E	4.490	0.249	1.121	35.0	0.0	36087.6
20	24	3	E	3.823	0.221	0.851	40.1	1.0	33763.5
21	2	2	E	3.820	0.288	1.098	37.3	4.0	37126.5
23	10	2	E	3.893	0.158	0.622	42.0	1.0	45880.5
28	4	3	E	3.961	0.324	1.279	37.6	0.0	42724.9
30	10	3	E	4.359	0.308	1.343	43.2	0.8	46858.2
31	2	3	E	4.100	0.537	2.214	38.0	2.5	39071.1
35	14	2	E	3.826	0.211	0.814	29.6	0.0	32394.1
43	14	3	E	4.544	0.358	1.625	31.3	0.0	33202.5
43	16	3	E	4.314	0.589	2.549	42.0	0.0	42054.9

Figure 22. Histogram of the first canonical variable for the data on soybean plant morphometrics from Isle of Wight County, Virginia, 1974. The first canonical axis is most closely related to pod growth. Arrows indicate group centroids.


FREQUENCY
10
20
30
40
50
CANONICAL AXIS
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
E
A

In summary, less than one half of the fields sampled in Isle of Wight Co. in 1974 were susceptible to corn earworm infestation, on the basis of pod development alone: over half of the fields had pods which were 18-36 days developed and therefore were not as susceptible to first through third instar penetration as were younger pods. In addition, of the fields with pods in the 1-18 days after blooming period, only one field, at 2 sampling times, was highly susceptible to corn earworm infestations. Only one field, at 2 TTIMEs, possessed plant characteristics, specifically minimum space between row foliage, which would categorize it as a highly susceptible field. Therefore, on the basis of susceptibility categories alone, only one of the fields surveyed had the potential for harboring high levels of corn earworm larvae. Independent of susceptibility levels, corn earworm population levels were low throughout Isle of Wight Co. in 1974 in both corn and soybeans (Table 6, Appendix Table 2.1). These low infestation levels were probably attributable to environmental factors unfavorable to Heliothis zea larvae, as discussed in Section IV.A.5. Therefore, soybean fields and the corn earworm population, combined, were not conducive to high infestation levels in any soybean fields in Isle of Wight Co., 1974.

Therefore, in 1974, as well as in 1975, the categories established a priori were statistically valid. With respect to field classification, however, minimum space between row foliage played a more important role in 1974, Isle of Wight Co. Since only two categories, A and E, were present, they were more readily distinguished, in fact, 98% of the samples were correctly identified into group A or E on the basis of SPACE alone. All of the intermediate groups present in 1975 were not present in 1974. Therefore, for categories A and E in 1974, group identity was more distinct.

With respect to the canonical axes, pod width again played a major role in distinguishing differences among cases. It was possible to visualize, through the coefficients for the canonical axis and through the raw data, why fields were, for the most part, not susceptible to corn earworm infestation. In light of the analysis of the 1975 data, the 1974 fields were seen as too mature (pod development) and possessed closed canopy. These two factors were considered unfavorable to the establishment of high corn earworm larval levels in soybeans.

IV. C. 5. Analysis of Soybean Field Susceptibility to Corn Earworm Infestations: Westmoreland Co., 1974

a. MANOVA

The variable means and standard deviations were tabulated by susceptibility category in Table 54. Fields sampled in Westmoreland Co. fit into only two categories, D and E. These low susceptibility groups were distinguishable by the minimum spacing between row foliage (Tables 30, 31). Category D generally represented fields with pods less mature than those in category E (Tables 30, 31, 32); however, this was not readily obvious from the group means and standard deviations (Table 54).

The pooled covariance matrix was presented in Table 55. Pod morphometrics were significantly correlated ($\alpha = 0.05$) with each

Table 54. Soybean field susceptibility classification: means and standard deviations of variables in each field category; Westmoreland Co., Virginia, 1974.

Variable	Units	Category D	Category E	All Categories
		Means		
PL	cm	3.801	3.914	3.890
PW	cm	0.354	0.333	0.338
PLWV	cm^3	1.362	1.320	1.330
SPACE	in.	5.5	1.1	2.1
ROWHT	in.	34.6	34.7	34.7
VOL	$in.^3$	27871.5	31808.7	30933.8
n		20	70	90
		Standard Deviations		
PL	cm	0.336	0.413	0.398
PW	cm	0.139	0.130	0.132
PLWV	cm^3	0.575	0.567	0.569
SPACE	in.	4.9	3.1	3.5
ROWHT	in.	4.7	3.3	3.6
VOL	$in.^3$	7569.3	8005.7	7913.5

Table 55. Pooled covariance matrix from MANOVA of soybean fields classified by plant characteristics; Westmoreland Co., Virginia, 1974. (See Table 30 for explanation of mnemonic codes.) Degrees of freedom = 87.

Variables	PL	PW	PLWV	SPACE	ROWHT
PW	0.302[1] (0.0040)[2]				
PLWV	0.498 (0.0001)	0.972 (0.0001)			
SPACE	0.042 (0.6928)	0.015 (0.8878)	0.013 (0.9062)		
ROWHT	0.054 (0.6170)	0.314 (0.0028)	0.287 (0.0064)	-0.173 (0.1052)	
VOL	0.067 (0.5297)	0.428 (0.0001)	0.406 (0.0001)	-0.247 (0.0194)	0.595 (0.0001)

---

[1] Partial correlation coefficient from error sum-of-squares and cross-products matrix.

[2] Probability > |R|.

other. The largest, most significant correlation coefficient was the pod width-pod volume (PW - PLWV) covariance (0.972). Plant row height was significantly correlated with plant volume, pod width and pod volume. Pod volume was also significantly correlated with pod width and pod volume, but was negatively correlated with minimum space between row foliage. These correlations indicated normal plant growth.

The MANOVA tests for the hypothesis of no overall group effect--Hotelling-Lawley Trace, Pillai's Trace, and Wilk's Criterion, and their F-approximations (Table 56)--were all significant. The null hypothesis was therefore rejected: group population centroids were not equal. Therefore, categories D and E probably represented 2 populations of plants. The MANOVA tests of the separate variates (Table 57) suggested that only minimum space between row foliage contributed significantly to group discrimination. Further clarification of group differences, based on the discriminating power of the variables, was possible through discriminant analysis.

IV. C. 5. b. Discriminant Analysis

Step one of the discriminant analysis revealed that the variable which best distinguished between categories D and E was minimum space between row foliage (Table 58), as suggested in the MANOVA tests of the separate variables. The values of the first step U-statistic and approximate F-statistic revealed a significant difference ($\alpha = 0.05$) between categories based on minimum space between row foliage alone. The F-matrix also showed this significant difference between the pair of group means. The classification matrix for the groups, based on the discriminating power of minimum space between row

Table 56. MANOVA tests for hypothesis of no overall group effect for soybean fields classified by plant characteristics; Westmoreland Co., Virginia, 1974.

Test		Results	
Hotelling-Lawley Trace	=	0.347	d.f. = 6,83
F-approximation	F(6,83) =	4.79	Probability > F = 0.0003
Pillai's Trace	V =	0.257	d.f. = 6,83
F-approximation	F(6,83) =	4.79	Probability > F = 0.0003
Wilk's Criterion	L =	0.743	d.f. = 6,83
Exact F	F(6,83) =	4.79	Probability > F = 0.0003

Table 57. MANOVA tests of separate plant variates; Westmoreland Co., Virginia, 1974. (See Table 30 for explanation of mnemonic codes.)

Dependent Variable	F(1,88)	Probability > F	Significance (α = 0.05)
PL	1.27	0.2625	ns
PW	0.38	0.5399	ns
PLWV	0.09	0.7705	ns
SPACE	24.09	0.0001	*
ROWHT	0.03	0.8663	ns
VOL	3.85	0.0529	ns

Table 58. Step one of discriminant analysis of soybean field susceptibility categories based on plant characteristics; Westmoreland Co., Virginia, 1974. (See Table 30 for explanation of mnemonic codes.)

Variable	F to Remove	Force Level	Tolerance	Variable	F to Enter	Force Level	Tolerance
	d.f. = 1	88			d.f. = 1	87	
SPACE	24.091	1	1.000000	PL	1.388	1	0.998197
				PW	0.227	1	0.999770
				PLWV	0.041	1	0.999840
				ROWHT	0.370	1	0.970108
				VOL	0.462	1	0.938780

U-statistic or Wilks' Lambda 0.7850742 Degrees of Freedom 1 1 88

Approximate F-statistic 24.091 Degrees of Freedom 1.00 88.00

F-matrix Degrees of Freedom = 1 88 ($\alpha = 0.05$)

	D	
E	24.09	*

Classification Matrix

Category	Percent Correct	Number of Cases Classified into Category D	E
D	50.0	10	10
E	94.3	4	66
Total	84.4	14	76

foliage alone (Table 58), revealed an 84.4% correct classification of the 90 cases.

Pod length, plant row height, pod volume, pod width, and plant volume, respectively, were entered into the stepwise discriminant analysis (Table 59). These variables, although significant, added relatively little to the total of group discrimination, as shown in the summary table (Table 59). As in Isle of Wight Co., 1974, the F-values decreased markedly after step one (Tables 59, 60). Groups were still significantly different when all variables had been entered (Table 60).

The discriminant functions of category D and E are given in Table 61, and are not interpreted.

Group classification improved little after step one (Table 62), however this final classification matrix was analyzed. The final classification matrix showed 85.6% of the 90 cases were correctly classified (Table 62). In category D, 7 of the 9 misclassified cases belonged to field 26 at TTIME 3 (Appendix 4.3). The variable means of field 26 (TTIME 3) (Table 2.12) did not allow a straightforward classification of the field: the recommended weighting of plant variables (Table 30) had to be used to categorize the field. When the weighting system of classification was used, with 0.5 point for each pod characteristic and 1 point for other plant characteristics, the following talley resulted: pod width lay in category B (1.5 points); pod volume in both category B and D (0.5 point each); minimum space between row foliage in category E (1.0 point); and plant row height and pod length fell equally into categories D and E (1.5 points each).

Table 59. Summary of stepwise discriminant analysis of soybean field susceptibility categories based on plant characteristics; Westmoreland Co., Virginia, 1974. (See Table 30 for explanation of mnemonic codes.)

Step Number	Variable Entered	Variable Removed	F Value to Enter or Remove	Number of Variables Included	U-Statistic	Approximate F-Statistic	Degrees of Freedom		Significance α = 0.05
1	SPACE	-	24.0913	1	0.7851	24.091	1.00	88.00	*
2	PL	-	1.3882	2	0.7727	12.793	2.00	87.00	*
3	PLWV	-	0.8061	3	0.7656	8.778	3.00	86.00	*
4	VOL	-	1.1577	4	0.7553	6.885	4.00	85.00	*
5	ROWHT	-	1.2620	5	0.7441	5.778	5.00	84.00	*
6	PW	-	0.1612	6	0.7427	4.793	6.00	83.00	*

Table 60. Final F-matrix of discriminant analysis of soybean field susceptibility categories based on plant characteristics; Westmoreland Co., Virginia, 1974.

Category	Degrees of Freedom = 6,83 (α = 0.05)
	D
E	4.79*

Table 61. Discriminant functions and multigroup discriminant function constants of soybean field susceptibility categories based on plant characteristics; Westmoreland Co., Virginia, 1974. (See Table 30 for explanation of mnemonic codes.)

Variable	Category	
	D	E
Discriminant Functions		
PL	152.56764	154.63957
PW	1529.30396	1538.15723
PLWV	-397.45996	-400.48901
SPACE	0.06044	-0.27774
ROWHT	2.06514	1.94461
VOL	0.00006	0.00013
Multigroup Discriminant Function Constants		
	-328.05200	-330.75439

Table 62. Final classification matrix of soybean field susceptibility categories based on plant characteristics; Westmoreland Co., Virginia, 1974.

Category	Percent Correct	Number of Cases Classified into Category D	E
D	55.0	11	9
E	94.3	4	66
Total	85.6	15	75

With this split: B:D:E (2:2:2.5), the process of category identification of field 26 became more apparent. In the a priori classification (Tables 30, 31), minimum space between row foliage was the most important characteristic in separating categories D and E only, but not these two groups from category B. In the discriminant analysis of these two groups (D and E, Westmoreland Co., 1974), this variable SPACE was also important. When more than categories D and E came into play, as in 1975 and as in the key, minimum space between row foliage played a less important role.

Therefore, if cases in field 26 had occurred in 1975, probably not all of its cases would have fallen into categories D and E, since, as seen above, several plant characteristics of field 26 were typical of those in field category B, a category not present in the 1974 Westmoreland Co. analysis. If category B fields had been present in the discriminant analysis, the average of cases in field 26 would probably have been category D, as projected in the a priori classification.

Identity with groups other than D and E was suggested when, in the case classification matrices, variables other than SPACE were included (Appendix 4.3). Ten percent of the misclassified category D cases were correctly re-classified when plant volume was included as a group discriminating variable. The field 26 value of plant volume (Appendix Table 2.11), more than its values of other plant morphometrics, diverged from those values of category E (Table 30). This divergence was shown only in step 4 of the discriminant analysis (Appendix 4.3). However, since the number of cases was limited, as were the number of groups in this analysis, the discriminating ability of plant volume was minimized. The limited data base was definitely a hindrance in the above discriminant analysis classification.

Unlike category D, the misclassified cases of category E (4 cases) were randomly distributed among the fields (Appendix 4.3).

From the stepwise discriminant analysis and corresponding classification tables, it was confirmed that the most important distinguishing characteristic between categories D and E was minimum space between row foliage. Second, plant characteristics, not pod characteristics, helped most in separating the two groups, as suggested in Table 30. Third, susceptibility of field 26 was overestimated in the a priori classification, not underestimated, even though susceptibility remained very low (< 5 larvae per 3 row feet).

The eigenvalues and canonical correlations are presented in Table 63. One canonical axis explained 100% of the difference among groups since there were only two groups. Analysis of the coefficients for the canonical variable (Table 63) showed that pod width changed at a rate greater than all other variables. The linear rate of change (growth) in pod length was less than the geometric rate of growth in pod volume, which was much less than the linear rate of growth in pod width (Table 63). Minimum space between row foliage decreased at a geometric rate about one tenth that of pod volume increase. Plant row height increased at an even slower geometric rate, while plant volume was essentially constant during the period represented by the cases. Most changes in the 1974 Westmoreland Co. fields occurred in the pods, while smaller geometric changes occurred in row foliage

Table 63. Eigenvalues and canonical correlations for soybean field susceptibility categories, based on plant characteristics; Westmoreland Co., Virginia, 1974. (See Table 30 for explanation of mnemonic variable codes.)

	Canonical Axis 1
Eigenvalues	0.34652
Approximate Eigenvalue Contribution	100%
Canonical Correlations	0.50729
Variable	Coefficients for First Canonical Variable
PL	-1.47984
PW	-6.32324
PLWV	2.16342
SPACE	0.24154
ROWHT	0.08609
VOL	-0.00005
Constant	3.21403
Categories	First Canonical Variable Evaluated at Category Means
D	1.08897
E	-0.31113

spacing. This growth of pod characteristics and not foliar characteristics supported the observations made in the category D and E fields.

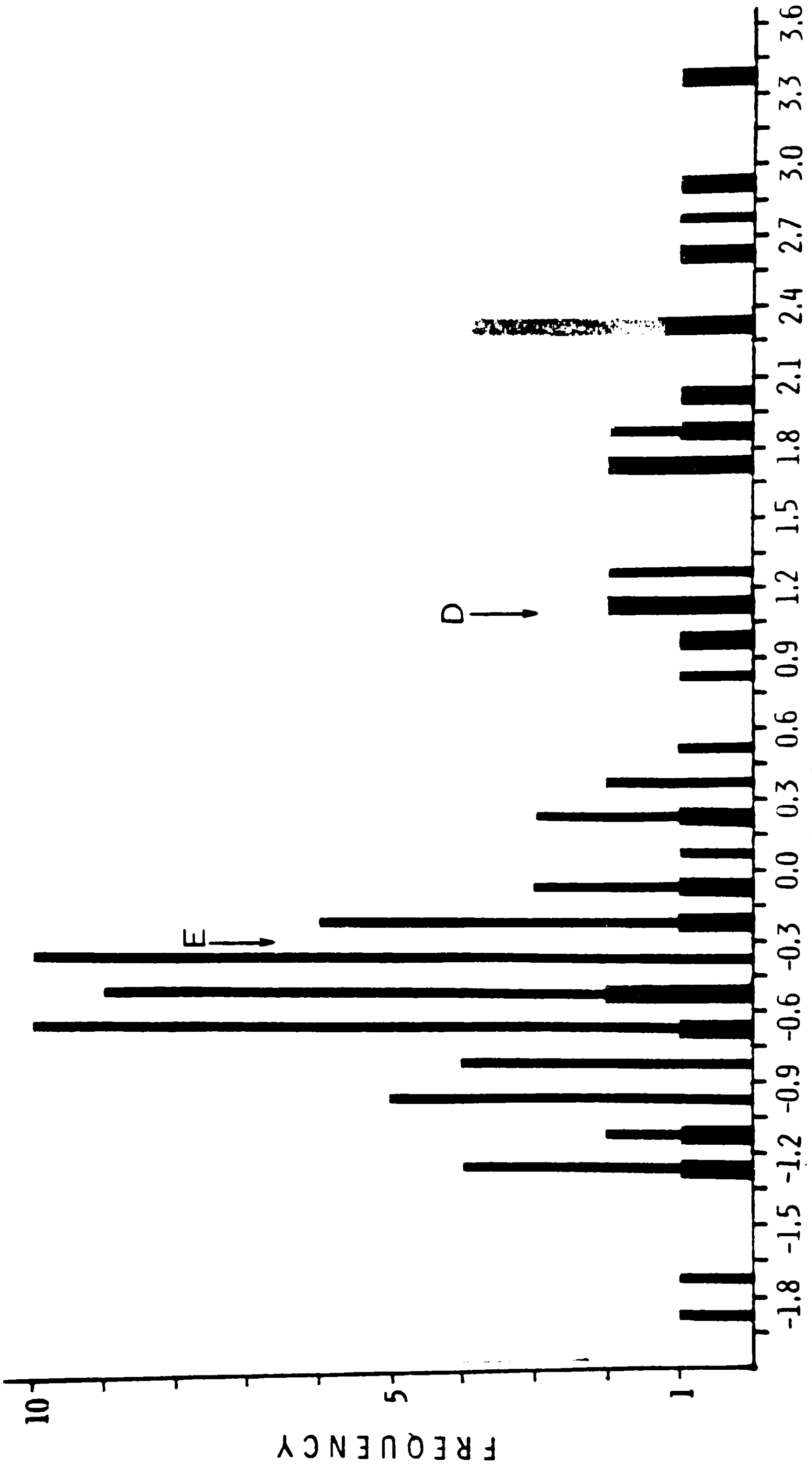
When sampling times of fields were listed by days past blooming, (Table 64), pod width increased more rapidly and consistently, in a linear manner, than any other variable. In the 16- to 37-day post-blooming period, pod width contributed most to the change in pod volume. This contribution was more evident in this data than in the 1975 data. Further examination of fields sorted by days since blooming showed that plant height increased slightly as time progressed, but that no consistent change was found in either minimum space between row foliage nor in plant volume. The coefficients for the canonical variable statistically separated the differences within groups on the basis on the plant growth as described.

Interpretation of the relationship of the 2 groups and all cases is simplified by visual means in the histogram of their distribution on the first canonical axis, presented in Fig. 63. Unlike in the classification matrix, where minimum space between row foliage played the most important role in distinguishing between groups, here (where the groups were considered together), row foliage played a minor role. The canonical axis was interpreted in terms of the biological processes which occurred during the time samples were taken. In other words, cases were distinguished in canonical space; not on the basis of group identity, but on their relative position or development, with respect to other cases or samples. When the data were interpreted in this sense, the pod morphometrics, pod width, in

Table 64. Means of soybean plant characteristics, sorted by approximate days since blooming for each field and sampling time, for samples within the post pulse days 8-18; Westmoreland Co., Virginia, 1974. Each sampling time per field represents 10 samples. (See Table 30 for explanation of mnemonic codes.)

Days Since Blooming	Coded Field (CFLD)	TTIME	Field Category	Plant Characteristics					
				PL cm	PW cm	PLWV cm^3	ROWHT in.	SPACE in.	VOL $in.^3$
16	26	3	D	3.717	0.230	0.867	31.8	2.8	22749.4
18	36	3	E	3.654	0.213	0.790	34.7	0.0	32852.8
20	38	3	E	4.111	0.231	0.965	33.9	1.3	19563.1
23	40	3	E	3.849	0.370	1.422	32.1	0.8	31468.3
23	46	3	E	3.550	0.310	1.110	35.5	0.5	30019.9
23	30	3	E	4.068	0.240	0.978	35.6	5.3	37109.7
28	48	3	E	4.030	0.443	1.795	35.5	0.0	29621.8
29	34	3	D	3.885	0.478	1.859	37.4	8.3	32993.8
37	28	3	E	4.142	0.527	2.183	36.0	0.0	42025.2

Figure 23. Histogram of the first canonical variable for the data on soybean plant morphometrics from Westmoreland County, Virginia, 1974. The first canonical axis is most closely related to pod growth. Arrows indicate group centroids.


FREQUENCY
10
5
1
CANONICAL AXIS
-1.8
-1.5
-1.2
-0.9
-0.6
-0.3
0.0
0.3
0.6
0.9
1.2
1.5
1.8
2.1
2.4
2.7
3.0
3.3
3.6
E
D

particular, represented the most dynamic plant part (17-37 days after blooming). The group means were also distinguishable on the basis of pod morphometrics (Fig. 23, Table 64), even though groups were not totally exclusive of one another, as shown in Fig. 23 and in the table of raw variable means (Table 54).

In summary, the two groups established through the use of the key (Table 30), were statistically separable. As with the 2 groups (A and E) analyzed in Isle of Wight Co., 1974, minimum space between row foliage best distinguished the Westmoreland Co. groups D and E. However, as would be expected, since categories D and E were more similar than categories A and E, classification of samples in Westmoreland Co. was not as correct (more cases were misclassified in Westmoreland Co.). The importance of SPACE in distinguishing categories D and E was anticipated since that variable was very important in the _a priori_ classification (Table 30).

As in 1974, Isle of Wight Co., the fields in Westmoreland Co. were in the stage of pod fill (18-36 days after blooming, Table 64). Thus, as with Isle of Wight Co., changes in pods, particularly in pod width, distinguished between cases, reflecting the pod maturity at the time of sampling. Pod width and pod volume provided good criteria by which categories D and E were separable (see canonical variable evaluated at group means, Table 63, Fig. 23). This value of pod development in separating categories D and E in the vector of plant morphometrics supported the inclusion of pod width in the _a priori_ classification key (Table 30).

V. CONCLUSIONS

The development of *Heliothis zea* larvae in corn and soybeans was monitored during the summers of 1974 in Isle of Wight Co. and Westmoreland Co. and 1975 in Isle of Wight Co. Several aspects of insect density and development were studied and relationships between host crops and *H. zea* were more clearly defined.

Previous uncertainty regarding the number of instars in eastern Virginia was resolved. Based on larval head capsule measurements taken on 830 field-collected larvae and on 360 laboratory-reared larvae, six instars were determined to be present in eastern Virginia from July through September (Table 4). The six instars could be distinguished on the basis of head capsule width, height, and volume, but not thickness (Table 5). Head capsule volume provided more distinct separations between third through sixth instars than head capsule width alone (Figs. 14 and 15). The difficulty in detecting first and second instars suggests that in soybeans, depletion (removal) sampling techniques based on adaptation of the shake-cloth technique could be useful in future studies. Such a change in technique would enable more precise estimates of the early instar larval densities.

The density of a county's larval population in soybeans is closely related to the density of the preceeding (second generation) population in corn. When *H. zea* density in corn was low, the population density in soybeans also was low, regardless of the type of soybean fields available. This relationship supports previous observations that the corn earworm generation in corn is the reservoir population for the generation in soybeans.

An estimator based on the reservoir population was developed whereby the relative magnitude of the maximum larval density in soybean fields could be calculated. This estimator aids in explaining yearly larval density differences in soybeans, based on the density of the reservoir larval population in corn. In the 3 year-county combinations in this study, this estimator remained relatively constant whereas the maximum larval density in soybeans varied from negligible to very high (> 20 larvae per three row feet) (Table 8).

An index for calculating peak moth flight, based on blacklight trap data, was presented. The pulse of the flight was calculated, based on 1974 and 1975 data, to be preceded by a "shoulder" or increase in moth activity. This shoulder was suggested to be 10 times higher than the background activity, or previous lull in activity. The pulse was found to be at least 50 times greater than the background.

The timing of the peak emergence of moths in early August was best monitored through blacklight trap samples and through emergence in the lab of moths reared from larvae collected at random in corn fields. Field emergence dates of moths placed as prepupal larvae into cages in the soil did not completely agree with the emergence dates recorded by the two former types of records. The emergence experiments using cages in the soil produced biases induced (a) by the difficulty of timing sampling accurately with respect to the peak occurrence of pre-pupating larvae used for placement in cages, and (b) by the disproportionate negative influence of high precipitation. In addition, daily monitoring of the traps would have been necessary for accurate estimates of peak moth emergence timing; this was not achieved in 1974. During 1975, field cages were monitored daily, precipitation was minimal, and the population in corn was more frequently monitored. Thus, the timing of emergence from the pupal cages agreed with emergence in the laboratory and moth activity sampled in the blacklight trap.

The agreement of laboratory-reared moth emergence dates and peak blacklight trap catches further supports the conclusion that the bulk of the moth flight in early August was derived from the larval population in corn. The movement of moths into soybeans was confirmed by samples taken in soybeans. Samples taken prior to, or during, the moth peak, revealed few or no larvae until after the peak (Tables 19-24, 29, Fig. 20).

Laboratory rearing of field-collected larvae would enable monitoring of emergence dates for populations over a hundred miles away (161 km). This technique could be easily utilized to monitor the developmental status of the reservoir population in regions removed from the research base.

Laboratory and field pupal mortality was approximately twice as great in 1974 as in 1975. Higher levels of pupal mortality in the lab and field were largely attributed to higher precipitation, lower overall vigor of pre-pupae, prior larval parasitization, and larval and pupal infection from fungal and other pathogens. Pupal mortality was not related to the depth of pupal cells, which averaged between 1.1 and 1.5 inches below the surface. This depth is slightly less than that previously reported in the literature (2-3 in.).

Parasites did not develop from larvae collected in protected corn ears, confirming past studies by other authors. In soybeans, parasite mortality was 8 to 10% in 1974 but less than 3% in 1975. Mortality attributed to pathogens also was greater in 1974 than in 1975, although this aspect was not quanitified. Higher levels of parasites and pathogens were associated with low corn earworm densities, closed canopy and more mature crops, and with higher precipitation.

Predators were monitored in both corn and soybeans. High variability between samples within a given field, as well as between fields (Appendix Tables 2.8 - 2.10) made it very difficult to analyze predator densities. The non-normality of data suggested that there was a need for more samples per field, sampling for target species (particularly spiders), and microenvironmental monitoring in each sample. Because data were highly variable, no generalizations could be made about the predator complex in specific fields nor in the whole country; lists of species encountered were presented. An *Arilus cristatus* nymph (Hemiptera: Reduviidae) was observed feeding on a third instar *Heliothis zea* larva, a previously unpublished account.

A number of factors which affect corn earworm-soybean plant dynamics were measured. Morphological soybean plant characteristics were measured with each field sample, and therefore provided a basis for within-field analyses. Predator and larval densities also were recorded with each sample. Other measurements, such as days without rain and cumulative precipitation, were calculated from daily records for each time a field was sampled. No significant relationships were found. Soil type and cultivation techniques were measurements which did not vary through time, but varied between fields. Parasitization rates were generalized for the whole country, for each year. Therefore, the usefulness in statistical analyses of the different variables measured differed greatly: some variables, such as parasitization rates, were useful only for analyzing between-year and -county differences, while other variables, such as plant characteristics, were useful in analyzing variability within specific fields at each sampling period.

In determining which variables could be statistically reliable for predicting corn earworm densities, the above-mentioned factors (in addition to others, Table 18) were analyzed through the use of polynomial regression analyses which utilized the maximum R^2 improvement at each step. The independent variables (all other than corn earworm densities), were first analyzed on the year-county level. Corn earworm densities at this level were so highly variable that no conclusions could be drawn. The levels (time of sampling - field combinations) at which the analyses were performed were narrowed (Table 19) until the variability was reduced and acceptable R^2 values were obtained ($R^2 > 0.5$). Excellent results were obtained by regressing corn earworm densities with respect to soybean plant morphometrics and their log transformations, examining each field separately by the time sampled. However, no single unifying regression equation could be obtained that established a clear, generally valid relationship between the variability of corn earworm densities in soybeans and the variables examined. Efforts to arrive at some inductive key, which would be valid for both years and counties, based on meaningful groupings of the plant variables and their log transformations from the regression equations, were unsuccessful.

Because of the retention of the plant morphometrics over all variables, an hypothesis that there must be a measurable relationship between the ecological niche and the trophic position of the larvae seemed appropriate. The approach to the analyses was therefore reconsidered. The basic assumption of independence in the regression of plant morphometrics was rejected. Also rejected were the transformations which tended to make the morphometrics seem more independent than they were. The corn earworm-soybean plant relationship was therefore approached in a truly multivariate sense, through stepwise discriminant analyses.

For these multivariate analyses, five empirical _a priori_ soybean field categories were established which characterized five levels of anticipated maximum larval densities. These categories were described in terms of the untransformed plant morphometrics involved in the final regression equations. These morphometrics (pod length, pod width, pod volume, plant height, minimum space between row foliage, and plant volume) were analyzed for their ability to discriminate field susceptibility levels. Larval densities and plant morphometrics were viewed in light of moth emergence. This provided a basis for predicting not only which fields would most likely harbor high levels of corn earworms, but also when treatable corn earworm infestations would be likely to occur. The _a priori_ categories enabled prediction of specific maximum density of corn earworm infestations in soybeans up to 12 days prior to the occurrence of high levels of the most damaging fifth and sixth instars (Section IV.C).

In the years and counties studied--1975 Isle of Wight, 1974 Isle of Wight, and 1974 Westmoreland--80, 98, and 86 percent, respectively, of the samples were classified correctly into the a priori categories.

In 1975, when all categories of fields were present, plant volume alone contributed 63% to the discrimination between categories. Pod volume, with plant volume, enabled 71% of the samples to be correctly classified into the a priori groups. The addition of the other plant morphometrics raised the percentage of correctly classified samples to 80%.

In 1974, Isle of Wight Co., only two categories, A and E, the high and very low susceptibility categories, were present. All samples were 97% correctly classified on the basis of minimum space between row foliage alone.

In 1974, Westmoreland Co., as in Isle of Wight Co. the same year, only two categories of fields were present: D and E, the low and very low susceptibility categories. These fields were 84% correctly classified on the basis of minimum space between row foliage alone.

Therefore. depending upon the combination of soybean field categories present, different plant morphometrics play the most significant roles in distinguishing between categories. Samples misclassified were usually those which initially had been categorized into a group higher than that which resulted from the analyses. Misclassification was due to either (a) absence of several of the established field categories in the discriminant analyses (1974 data), (b) changes in field conditions over time (fields usually became less susceptible with age), and/or (c) absence of one or more variables, out of an essentially unlimited number of potential variables which could better discriminate between categories, when field classification was questionable.

The *a priori* criteria provided a statistically reliable means of predicting maximum infestation levels and the time of infestation. The discriminant analyses of the *a priori* criteria provided a basis for interpretation of the plant growth - insect population interrelationships.

In 1975, the three canonical axes in discriminant space provided the basis for these interpretations. On the first canonical axis, all fields were separable on the basis of overall plant and pod growth. This overall change in plant and pod shape was also the basis for the separation between the five *a priori* categories (Tables 30, 31). The second canonical axis, most closely related to pod width and pod volume changes, provided the following new insights into the corn earworm-soybean plant relationship. The development of the highest densities of corn earworm larvae was best synchronized with those fields which had pods elongating (more than filling) while third and fourth instar larvae were present (up to 18 days after blooming and 10 to 19 days after the peak of the moth flight began, respectively). The development of fifth and sixth instar larvae was synchronized, in the high susceptibility fields (A and B), with the period of rapid increase in pod volume, which occurred after the 17th day after field blooming.

Although pod development enabled the greatest separation between fields on the second axis, plant growth characteristics also contributed significantly to discrimination of fields. Fields of low susceptibility, category D. overlapped in their pod development with fields of category A during 10 to 17 days after blooming. However, minimum space between row foliage and plant height separated the two field types.

Those fields which are most susceptible are blooming at the time of the peak moth flight and are shorter with less foliage (canopy is not closed) than those less susceptible fields with closed or nearly closed canopy, and which possess more foliage. Although the less susceptible fields are usually past blooming (or have not yet bloomed, as in the case of category C fields, intermediately susceptible), when the pulse of the moth flight occurs, presence of blossoms, as in the above discussed category D fields, does not guarantee high investation levels. However, as can be observed in the least susceptible fields, pods are usually forming or formed when the pulse of the moth flight occurs. At this time, these least susceptible fields possess narrow spacing between row foliage. Therefore, the most susceptible fields possess: blossoms which serve as a place of oviposition and a source of food and attraction to moths; an open canopy; and less foliage, which would not hinder moth activity. These characteristics are present in the most susceptible fields at the time of the moth pulse.

The third canonical axis also separated fields before and after 18 days since blooming, which supported the separation established on the second axis. However, with the third axis, plant height alone, not plant height and minimum space between row foliage combined, contributed to distinction between fields. The plant height variable (ROWHT) was useful in distinguishing between closely related categories A and B, and between D and E. Its importance was thus confirmed in distinguishing between field susceptibility levels.

The first canonical axis was the only one present in the 1974 data. It was similar in both Isle of Wight Co. and Westmoreland Co. As with the second axis in 1975, fields were separable before and after the 18 days post-blooming on the basis of pod characteristics, particularly pod width and pod volume. Since the majority of fields in 1974 were in the lower susceptibility groups D and E, low investation levels were both expected (retrospectively) and observed. In addition, the few category A fields present were infested by low numbers of corn earworm larvae. This observation can also be confirmed using the estimator established earlier. This estimator yielded a short-term prediction of the magnitude of the larval density in the most susceptible soybean fields, based on the reservoir population densities. In 1974, through the utilization of this estimator, the maximum larval densities in soybeans were confirmed to have been very low, as was in fact observed in the category A fields.

These observations, made in the field and confirmed by the current analyses, lead to certain conclusions regarding agronomic practices. Namely, if high corn earworm infestations are to be averted, fields should be planted earlier, with earlier maturing beans, and with closer row spacing to promote less space between row foliage. In general, it seems clear that pest management decisions will be greatly aided by knowledgeable monitoring and interpretation of soybean plant growth status with respect to its relationship to development of the pest insect.

VI. SUMMARY

Heliothis zea (Boddie) (Lepidoptera: Noctuidae) density, development, and relationships with host crops were studied in eastern Virginia. Six instars occur. The larval population in corn is the reservoir for the generation in soybeans. An estimator, based on the reservoir population, permitted calculation of the larval density in soybeans. An index, based on blacklight trap and emergence data, permitted precise timing ot peak moth flight to soybeans.

Regression analyses of biotic and abiotic factors revealed that soybean plant morphometrics best explained corn earworm densities.

Discriminant analyses on empirical *a priori* soybean field susceptibility categories (described by plant morphometrics) classified five levels of anticipated maximum larval densities 80 - 98 percent correctly. Development of highest larval densities was synchronized with overall plant growth and specific pod development: third and fourth instars were present during rapid pod elongation, while fifth and sixth were present during rapid pod volume increase.

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Appendix 1. Mnemonic Codes and Basic Program Statements

Table 1.1. Mnemonic codes used for variables used in this paper and/or in data set.

Variable Code	Description of Variable
ACA	availability of calcium in soil: 1 = very low (L-); 2 = low (L); 3 = medium low (L+); 4 = low medium (M-); etc.; to 9 = very high (H+)
ACREAGE	acreage of field sampled
ADJC1	crop adjacent to field on one of its four sides
ADJC2	crop adjacent to field on one of its four sides
ADJC3	crop adjacent to field on one of its four sides
ADJC4	crop adjacent to field on one of its four sides
AK	availability of potash in soil, scale same as for ACA
AMG	availability of magnesium in soil, scale same as for ACA
ANGN	sum of Anyphaenidae and Gnathosidae (ANY + GNA)
ANY	Anyphaenidae number observed in field samples, 1975 only
AP	availability of phosphate in soil, scale same as for ACA
ARAN	Araneidae number observed in field samples, 1975 only
ARTH	sum of Araneidae and Theridiidae (ARAN + THER)
AVCCEWNO	average number of corn earworm moths trapped in blacklight trap between consecutive sampling dates for a specific field, including present sampling date
AVFEMALE	average number of female corn earworm moths trapped in blacklight trap between consecutive sampling dates for a specific field, including present sampling date
AVHHVIR	average number of *Heliothis virescens* moths trapped in blacklight trap between consecutive sampling dates for a specific field, including present sampling date
AVMALE	average number of male corn earworm moths trapped in blacklight trap between consecutive sampling dates for a specific field, including present sampling date

Table 1.1. (continued)

Variable Code	Description of Variable
AVMNTEMP	average minimum temperature between consecutive sampling dates for a specific field, including present sampling date
AVMXTEMP	average maximum temperature between consecutive sampling dates for a specific field, including present sampling date
AVPPT	average precipitation between consecutive sampling dates for a specific field, including present sampling date
AVROWSP	average row spacing in field (ROWSP + ROWS2/2)
BEB	big-eyed bugs, Geocoris punctipes (Say), number observed in field sample
BEBN	big-eyed bug nymphs, G. punctipes, number observed in field sample, 1975 samples only
BLKBEB	black big-eyed bugs, Geocoris uliginosus, number observed in field sample, 1975 only
BLKBN	black big-eyed bug nymphs, G. uliginosus, number observed in field sample, 1975 only
C	coarse sand, (0.5 - 1.0 mm particles) percent of soil sample
CANT	Cantheridae larvae, number observed in field sample in corn
CAO	calcium available in soil, pounds per acre
CARABL	Carabidae larvae, number observed in field sample in corn
CCEWNO	corn earworm moths trapped in blacklight trap, used in Appendix Table 1.2, in development of AVCCEWNO from daily observations
CCFLD	coded, coded field (CFLD), used in development of CFLD in Appendix Table 1.2.
CEWNO	corn earworm larval numbers in field sample
CFLD	coded field, used to refer to specific fields; even numbers = soybean fields, odd numbers = corn fields, CFLD 1 is adjacent to CFLD 2
CHEM1	chemical used in first application of insecticide in field

Table 1.1. (continued)

Variable Code	Description of Variable
CHEM2	chemical used in second application of insecticide in field
CLAY	percent of soil sample which is clay (particle size < 0.0039 mm)
CLUB	Clubionidae observed in field sample, 1975 only
CO	county; Isle of Wight = 1, Westmoreland = 2
CONVG	Hippodamia convergens, number observed in field sample
CORNACRE	approximate corn acreage in county
CORNT3A	mean number of corn earworms in corn at TTIME 3
COSQMI	square miles, or size of county
CROP	crop; corn = 1, soybeans = 2
CUMPPT	cumulative precipitation for a field, begun 1 week prior to all sampling of that field
D	number of double-eared stalks in the 25 row foot corn sample
DAY	day of the month
DFLD	a coded variable for CFLD, used in development of CFLD, Appendix Table 1.2
DINFD	number of second ears on stalks in sample, infested with H. zea
DINFPC	infested second ears, n proportion of total ears infested with H. zea (DINFD/TOTINF)
DOUB	the number of corn earworm larvae in second ears on the stalks in 25 row foot sample
DPC	proportion of ears that are second ears, in second position ((D + T + Q)/TOTALE)
DPSTALK	proportion of stalks that are double eared (D/TOTALS)
DWOR	days without rain for specific field, from but not including last sampling date, but including present sampling date
EGG	number of corn earworm eggs detected in field sample

Table 1.1. (continued)

Variable Code	Description of Variable
ELEV	county's elevation, in feet, where climatological data was recorded
F	fine sand, percent of soil sample (0.125 - 0.250 mm particles)
FEMALE	number of female corn earworm moths trapped in blacklight trap, used in Appendix Table 1.2, with blacklight trap data only for development of AVFEMALE
FIN	soybean foliage width at 4 feet, a temporary variable used to calculate plant volume, Appendix Table 1.2
FIVE	number of fifth instar corn earworms in field sample
FLD	original field number, same for adjacent corn and soybean fields, used in Appendix Table 1.2, and in raw data
FLTTIME	post pulse days, number of days after pulse in moth flight, including first day of pulse
FOUR	number of fourth instar corn earworms in field sample
FSP	space between soybean row foliage at four feet, in inches
GNA	Gnaphosidae, number observed in field sample, 1975 only
HARV	Harvestmen, Phalangida, number observed in field sample, 1975 only
HHVIR	Heliothis virescens moths in blacklight trap, on given day
HVIR	H. virescens larvae detected in field sample (Appendix Table 1.2)
IDENT	an identification number, used to make each observation unique
IW	Isle of Wight County, Virginia
K20	availability of potash in soil, pounds per acre
LAG11	first instar numbers are lagged one TTIME for each CFLD
LAG12	first instar numbers are lagged two TTIMEs for each CFLD
LAG13	first instar numbers are lagged three TTIMEs for each CFLD
LAG21	second instar numbers are lagged one TTIME for each CFLD

Table 1.1. (continued)

Variable Code	Description of Variable
LAG22	second instar numbers are lagged two TTIMEs for each CFLD
LAG23	second instar numbers are lagged three TTIMEs for each CFLD
LAG31	third instar numbers are lagged one TTIME for each CFLD
LAG32	third instar numbers are lagged two TTIMEs for each CFLD
LAG33	third instar numbers are lagged three TTIMEs for each CFLD
LAG41	fourth instar numbers are lagged one TTIME for each CFLD
LAG42	fourth instar numbers are lagged two TTIMEs for each CFLD
LAG43	fourth instar numbers are lagged three TTIMEs for each CFLD
LAG51	fifth instar numbers are lagged one TTIME for each CFLD
LAG52	fifth instar numbers are lagged two TTIMEs for each CFLD
LAG53	fifth instar numbers are lagged three TTIMEs for each CFLD
LAG61	sixth instar numbers are lagged one TTIME for each CFLD
LAG62	sixth instar numbers are lagged two TTIMEs for each CFLD
LAG63	sixth instar numbers are lagged three TTIMEs for each CFLD
LATDEG	county's latitude, in degrees, where climatological data was recorded
LATMIN	county's latitude, in minutes, where climatological data was recorded
LB	lady bird beetle, Coleomegilla fuscilabris Mulsant, number observed in field sample
LBL	C. fuscilabris larvae, number observed in field sample
LG$\underline{x}$	LOG10 (x + 1.0), the log to base 10 function in SAS76.4
LIMC	sum of Linyphiidae and Micryphantidae (LINY + MICRY)
LINY	Linyphiidae, numbers observed in field sample, 1975 only
LONGDE	county's longitude, in degrees, where climatological data was recorded
LONGMI	county's longitude, in minutes, where climatological data was recorded
LYCO	Lycosidae, numbers observed in field sample, 1975 only
LYPI	sum of Lycosidae and Pisauridae (LYCO + PISA)

Table 1.1. (continued)

Variable Code	Description of Variable
M	medium sand, percent in soil sample (0.25 - 0.50 particle size)
MALE	daily number of male corn earworm moths captured in black-light trap, 1975 only, used to calculate AVMALE, Appendix Table 1.2
MATGP	crop maturity group
MATGP2	crop maturity group of second variety in field if 2 varieties are present
MAXTEMP	daily maximum temperature, Appendix Table 1.2, used to calculate AVMXTEMP
MBB	Mexican bean beetle adults, *Epilachna varivestis*, numbers observed in soybean field samples, 1974 only
MBBL	*E. varivestis* larvae, number observed in soybean field samples, 1974 only
MGO	magnesium in soil, pounds per acre
MICRY	Micryphantidae, numbers observed in field sample
MINTEMP	daily minimum temperature in Appendix Table 1.2, used to calculate AVMNTEMP
MO	month; 1 = January, 12 = December
MPCMP	mean proportion of pupae dead in field pupal cages
NAB	*Nabis roseipennis* Reuter, number observed in field sample
NABN	*N. roseipennis* nymphs, number observed in field sample, 1975 only
NEURL	Neuropteran larvae observed in field sample
NOESTK	the number of stalks of corn without ears in 25 row foot sample
NUTACRE	acreage in county planted in peanuts
OIN	soybean row foliage width at one foot, temporary variable used to calculate plant volume, Appendix Table 1.2
ONE	number of first instar corn earworms in field sample

Table 1.1. (continued)

Variable Code	Description of Variable
OR	*Orius insidiosus* (Say) adults, number observed in field sample
ORN	*O. insidiosus* nymphs, number observed in field sample, 1975 only
OSP	space between soybean row foliage at one foot, in inches
OT	the number of sucker ears in the 25 row foot corn sample
OTT	the number of larvae in sucker ears in corn sample
OTINFD	the number of sucker ears in corn sample infested with *H. zea*
OTINFPC	proportion of sucker ears infested, of total ears infested (OTINFD/TOTINF)
OTPC	proportion of total ears that are sucker ears (OT/TOTALE)
OXY	Oxyopidae, numbers observed in field sample, 1975 only
P205	phosphate in soil, pounds per acre
PCDIPS	proportion of second ears infested with *H. zea*, of total number of stalks (DINFD/TOTALS)
PCMORTL	proportion of reared larvae that died
PCPARA	proportion of reared larvae parasitized
PCQIPS	proportion of fourth ears infested, of total number of stalks (QINFD/TOTALS)
PCSIPS	proportion of single and/or top ears infested, of total number of stalks (SINDF/TOTALS)
PCTIPS	proportion of third ears infested, of total corn stalks (TINFD/TOTALS)
PH	soil pH
PHT	soybean pod height in centimeters, measured only in 1975
PISA	Pisauridae, number observed in field sample, 1975 only
PL	soybean pod length in centimeters
PLANTD	consecutive calendar day when field was planted
PLD	coded planting date

Table 1.1. (continued)

Variable Code	Description of Variable
PLSTG	coded plant stage: in corn 1 = no tassel, 2 = tassel or silking, 3 = later silking, 4 = milk or soft dough stage, 5 = black layer; in soybeans 1 = no blooms, 2 = blooms and no pods, 4 = blooms and pods
PLWHT	soybean pod volume in cm ^{3}, for 1975 only (PL * PW * PHT)
PLWV	soybean pod volume in cm ^{3}, for both years (PL * PW * 1 cm)
PPT	daily precipitation, the climatological data used to calculate AVPPT, Appendix Table 1.2
PRBM	problem number of data on disc.: 1 = field observations and incorporated blacklight trap, climatological and other data; 2 = blacklight trap data only, by date recorded; 3 = climatological data only, by date recorded
PREVC	previous crop in field
PULLHT	soybean stem length, ground to apical pod or flower structure, pulled straight, in inches
PW	soybean pod width, in centimeters
Q	number of quadruple eared corn stalks, or fourth ears on stalk in 25 row foot sample
QINFD	the number of fourth ears in sample, infested with _H. zea_ larvae
QINFPC	proportion of fourth ears infested, of total infested ears (QINFD/TOTINF)
QPC	proportion of fourth ears of total number of ears (Q/TOTALE)
QPSTALK	proportion of stalks with four ears (Q/TOTALS)
ROWHT	standing soybean row height, in inches
ROWS2	field row spacing of second row, usually equal to ROWSP, in inches
ROWSP	field row spacing, in inches

Table 1.1. (continued)

Variable Code	Description of Variable
S	the number of single eared stalks in 25 row foot corn sample
SALT	Salticidae, number observed in field sample, 1975 only
SAM	sample number, 1 through 10
SAND	percent of soil which is sand (0.125 - 2.000 mm particles)
SD	standard deviation
SILT	percent of soil which is silt (0.0039 - 0.0625 mm particles)
SINFD	number of top and/or single ears infested with *H. zea* in corn sample
SINFPC	proportion of infested ears that are first or top ears (SINFD/TOTINF)
SING	the number of larvae in top and/or single ears on the stalk
SIX	number of sixth instar corn earworm larvae in field sample
SOYACRE	soybean acreage in county
SP	total number of spiders observed in sample, 1975 only
SPACE	minimum space between soybean row foliage, in inches
SPC	proportion of ears that are top and/or single ears of all ears (TOTALS/TOTALE)
SPRAY	if field is not treated with insecticide, SPRAY = 1; once field has been treated, SPRAY = 2
SPRAY1D	day of first insecticide treatment for specific field
SPRAY1M	month of first insecticide treatment for specific field
SPRAY2D	day of second insecticide treatment for specific field
SPRAY2M	month of second insecticide treatment for specific field
SPRAYT	consecutive Julian calendar day of field's first insecticide treatment, equivalent to SPRAY1D and SPRAY1M
SPRAYT2	consecutive Julian calendar day of field's second insecticide treatment, equivalent to SPRAY2D and SPRAY2M
SPSTALK	proportion of corn stalks with one ear only (S/TOTALS)

Table 1.1. (continued)

Variable Code	Description of Variable
SQ<u>x</u>	SQRT (x + 0.5), the square root function in SAS76.4
SUMPPT	sum of precipitation since field was last sampled, including present sampling date
T	number of triple eared stalks in the 25 row foot corn sample
TETRA	Tetragnathidae, number observed in field sample, 1975 only
TEXCL	soil texture class: 1 = sand loam, 2 = silt loam, 3 = loam sand, 4 = loam, 5 = loam sand-sand loam
THER	Theriidae, number observed in field sample, 1975 only
THOM	Thomisidae, number observed in field sample, 1975 only
THREE	number of third instar corn earworms observed in field sample
TILLAGE	conventional = 1, no-till = 2
TIME	consecutive calendar day of observation
TIN	soybean foliage width at two feet, temporary variable used to calculate plant volume, Appendix Table 1.2
TINFD	the number of third ears infested with *H. zea* in corn sample
TINFPC	proportion of infested third ears to total number of ears infested (TINFD/TOTINF)
TOTALE	total number of ears in sample in corn (S + (2 * D) + (3 * T) + (4 * Q) + OT)
TOTALS	total number of stalks in corn sample (S + D + T + Q)
TOTINF	total number of infested ears in corn sample (SINFD + DINFD + TINFD + QINFD + OTINFD)
TPC	proportion of third ears of total ears ((T + Q)/TOTALE)
TPSTALK	proportion of stalks that are triple eared (T/TOTALS)
TRIN	soybean foliage width at three feet, a temporary variable used to calculate plant volume, Appendix Table 1.2

Table 1.1. (continued)

Variable Code	Description of Variable
TRIP	the number of larvae in the third ears on the stalks in the corn sample
TRSP	space between soybean row foliage at three feet, in inches
TSP	space between soybean row foliage at two feet, in inches
TTIME	consecutive sampling period or date for each field
TWO	number of second instar corn earworms observed in field sample
ULO	Uloboridae, number observed in field sample, 1975 only
UNKNO	spiders not identified to family, numbers in field sample, 1975 only
V1	number of first instar *H. virescens* in field sample
V2	number of second instar *H. virescens* in field sample
V3	number of third instar *H. virescens* in field sample
V4	number of fourth instar *H. virescens* in field sample
V5	number of fifth instar *H. virescens* in field sample
V6	number of sixth instar *H. virescens* in field sample
VAR2	second variety in field, if two varieties of crop are used
VARIETY	crop variety used in field
VC	very coarse sand, percent of sand (1.00 - 2.00 mm particle)
VF	very fine sand, percent of sand (0.0625 - 0.125 mm particle)
VOL	calculated soybean plant volume in a 3 row foot sample, in cubic inches
W	Westmoreland County, Virginia
WFLT	width of corn earworm moth flight, based on blacklight trap data
XEAR	the number of stalks with ears growing within tassel, in 25 row foot corn sample
YR	year: 1974 = 74, 1975 = 75

Table 1.1. (continued)

Variable Code	Description of Variable
YRCO	year and county combined into one variable: Isle of Wight Co., 1974 = 1 or '74 IW'; Westmoreland Co., 1974 = 2 or '74 W'; Isle of Wight Co., 1975 = 3 or '75 IW'
ZFLD	temporary monitor of CFLD, used to incorporate climatological data, Appendix Table 1.2

Table 1.2. Data adjustments: summary of essential SAS program steps. Appendix Table 1.1 has explanation of mnemonic codes.

A. Calculations of soybean plant variables:

1. Calculation of pod volume

```
PLWV = PL * PW * 1 ;
```

2. Calculation of minimum space between row foliage (SPACE)

```
IF OSP = . THEN OSP = 108;
IF TSP = . THEN TSP = 108;
IF TRSP = . THEN TRSP = 108;
IF FSP = . THEN FSP = 108;
SPACE = MIN(OSP,TSP,TRSP,FSP);
IF SPACE = 108 THEN SPACE = 0;
IF ROWHT < 12 THEN SPACE = AVROWSP - (.8 * ROWHT);
IF OSP = 108 THEN OSP = .;
IF TSP = 108 THEN TSP = .;
IF TRSP = 108 THEN TRSP = .;
IF FSP = 108 THEN FSP = .;
```

3. Calculation of plant volume

```
OIN = ROWSP - OSP; TINSP = ROWSP - TSP;
TRIN = ROWSP - TRSP; FIN = ROWSP - FSP;
IF ROWHT < 12 THEN VOL = (.8 * ROWHT) * ROWHT * 36;
IF ROWHT = 12 THEN VOL = OIN * 12 * 36;
IF ROWHT > 12 AND ROWHT < 24 THEN VOL = ((OIN * 12)
  + (((((OIN * ROWHT - 12))/12) + OIN)/2) * (ROWHT - 12)))
  * 36;
IF ROWHT = 24 THEN VOL = ((OIN * 12) + (((OIN + TIN)/2)
  * 12)) * 36;
IF ROWHT > 24 AND ROWHT < 36 THEN VOL = (((OIN * 12)
  + (((OIN + TIN)/2) * 12)) + (((((TIN * (ROWHT - 24))/12)
  + TIN)/2) * ROWHT - 24))) * 36;
IF ROWHT = 36 THEN VOL = ((OIN * 12) + ((((OIN + TIN)/2)
  + ((TIN + TRIN)/2)) * 12)) * 36;
IF ROWHT > 36 and ROWHT < 48 THEN VOL = ((OIN * 12)
  + ((((OIN + TIN)/2) + ((TIN + TRIN)/2)) * 12)
  + (((((TRIN + (ROWHT - 36))/12) + TRIN)/2) * (ROWHT - 36)))
  * 36;
IF ROWHT = 48 THEN VOL = ((OIN * 12) + ((((OIN + TIN)/2)
  + ((TIN + TRIN)/2) + ((TRIN + FIN)/2)) * 12)) * 36;
```

Table 1.2. (continued)

```
IF ROWHT > 48 THEN VOL = ((OIN * 12) + ((((OIN + TIN)/2)
  + ((TIN + TRIN)/2) + (TRIN + FIN)/2)) * 12)
  + (((((FIN * (ROWHT - 48))/12) + FIN/2) * (ROWHT - 48)))
  * 36;
DROP OIN TIN TRIN FIN;
```

B. Incorporation of climatological and blacklight trap data

1. Daily climatological and blacklight trap data were merged with each CFLD and TTIME, such that the former two data sets occurred for each CFLD-TTIME combination and on the days when no fields were sampled.

2. Modifications of climatological data were incorporated.

   a. Data was labeled so that variables such as CUMPPT and SUMPPT could be calculated.

      (1) Each day, for 6 days prior to TTIME 1, for each CFLD, was labeled with TTIME 1 and the CFLD number.

      (2) Each day after TTIME 1, for each CFLD, was labeled with TTIME + 1 and the CFLD number such that, for example, every day prior to and including sampling date TTIME 2, for CFLD 54, was labeled TTIME 2, CFLD 54.

   b. Specific variables were calculated.

      (1) Means for variables and sums were calculated for each CFLD and TTIME. (DATA A is data set resulting from previously described changes in B.2.a.(2) and above).

      Example:
```
PROC MEANS DATA=A NOPRINT;
BY CFLD TTIME;
VAR PPT MAXTEMP CCEWNO;
OUTPUT OUT=B MEAN=AVPPT AVMXTEMP
  AVCCEWNO    SUM=SUMPPT;
```

      (2) Specific variables calculated which incorporated data that spanned TTIMEs for a CFLD. (DFLD and DTIME are dummy variables.)

Table 1.2. (continued)

Example 1:

```
DATA; SET A;
IF CFLD ¬= DFLD THEN CUMPPT = PPT;
IF CFLD = DFLD THEN CUMPPT = PPT + CUMPPT;
DFLD = CFLD;
RETAIN DFLD CUMPPT;
DROP DFLD;
```

Example 2:

```
DATA; SET A;
IF DTIME = TIME AND DFLD = CFLD
  THEN DELETE;
DTIME = TIME;
DFLD = CFLD;
IF PPT > 0 THEN DWOR = 0;
IF PPT = 0 OR PPT = . THEN DWOR =
  DWOR + 1;
RETAIN DTIME DFLD DWOR;
DROP DTIME DFLD;
```

Note: First IF - THEN statement deals with observations on more than one CFLD in a given day (TIME).

3. Variables calculated in step B.2.b. were merged with the data set which resulted from step A. Therefore, the final data set consisted of CFLDs with: (a) data incremented through time, and (b) calculated plant morphometrics. The daily climatological and blacklight trap data were not present.

Appendix 2. Selected Data

Table 2.1. Descriptive statistics of corn earworm instars in soybean samples in Virginia, sorted by year, county, and TTIME. IW = Isle of Wight Co., W = Westmoreland Co. Means and standard deviations are based on the n indicated. See Appendix Table 1.1 for explanation of mnemonic codes. One sample = 3 row feet.

					Corn Earworm Instar Mean and Standard Deviation													
					One		Two		Three		Four		Five		Six		Mean Larval	
YR	CO	TTIME	Dates of Sampling	n	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
74	IW	1	Aug. 15-17	120	0.00	0.0	0.00	0.0	0.01	0.1	0.00	0.0	0.00	0.0	0.00	0.0	0.01	0.1
74	IW	2	Aug. 24-27	120	0.02	0.1	0.00	0.2	0.14	0.4	0.05	0.2	0.02	0.1	0.01	0.1	0.28	0.6
74	IW	3	Sep. 3- 8	120	0.00	0.0	0.08	0.3	0.36	0.8	0.10	0.6	0.18	0.4	0.17	0.5	1.09	1.5
74	IW	4	Sep. 12-14	120	0.00	0.0	0.02	0.1	0.15	0.7	0.02	0.2	0.03	0.2	0.08	0.3	0.30	0.9
74	IW	5	Sep. 20-21	120	0.00	0.0	0.04	0.2	0.00	0.0	0.00	0.0	0.01	0.1	0.00	0.0	0.04	0.2
74	W	1	Aug. 20-21	120	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
74	W	2	Aug. 27-29	120	0.00	0.0	0.00	0.0	0.04	0.3	0.01	0.1	0.00	0.0	0.00	0.0	0.05	0.3
74	W	3	Sep. 8-11	120	0.00	0.0	0.01	0.1	0.12	0.4	0.08	0.3	0.04	0.2	0.00	0.0	0.24	0.5
74	W	4	Sep. 15-16	120	0.00	0.0	0.02	0.1	0.07	0.2	0.04	0.2	0.08	0.3	0.02	0.2	0.23	0.5
74	W	5	Sep. 23-24	120	0.00	0.0	0.00	0.0	0.01	0.1	0.03	0.2	0.01	0.1	0.02	0.1	0.06	0.3
75	IW	1	Aug. 12-19	160	0.11	0.4	0.14	0.4	0.12	0.3	0.04	0.2	0.02	0.2	0.00	0.0	0.44	0.9
75	IW	2	Aug. 20-23	160	0.57	1.2	1.04	1.8	1.16	2.0	0.61	1.6	0.30	0.8	0.08	0.3	3.77	5.7
75	IW	3	Aug. 24-28	160	0.10	0.4	0.58	1.2	1.71	2.3	1.73	2.7	1.29	2.4	0.41	1.0	5.82	7.7
75	IW	4	Sep. 3- 5	160	0.00	0.0	0.01	0.1	0.08	0.3	0.08	0.3	0.16	0.5	0.37	0.8	0.70	1.3
75	IW	5	Sep. 8-10	160	0.01	0.1	0.02	0.2	0.01	0.1	0.01	0.1	0.01	0.1	0.02	0.3	0.08	0.3
75	IW	6	Sep. 15-22	150	0.00	0.0	0.01	0.1	0.02	0.2	0.00	0.0	0.00	0.0	0.02	0.1	0.06	0.3

Table 2.2. Daily counts of blacklight trap captures of corn earworm moths at Holland Station, eastern Virginia, in 1974 and 1975.

Day	May		June		July		August		September		October		November	
	1974	----	1974	1975	1974	1975	1974	1975	1974	1975	----	1975	----	1975
1	-		0		0	0	1	5	[12]	17		27		0
2	-		0		0	0	0	3	[12]/ 36	16		22		1
3	-		0		0	0	-	5	6	39		2		-
4	-		0		0	0	-	4	7	9		-		-
5	-		0		0	0	2	14	4	18		3		-
6	-		0	0	-	0	-	52	13	44		19		-
7	0		0	0	-	2	18	50	-	72		9		13
8	0		0	-	2	1	11	57	-	131		3		-
9	0		0	-	2	1	9	18	24	96		3		-
10	0		0	-	3	2	-	25	4	115		3		-
11	0		0	-	3	2	-	155	12	35		5		-
12	0		0	-	3	2	19	114	11	58		0		44
13	0		0	0	-	0	8	177	16	42		0		-
14	0		0	0	-	0	43	276	[35]	12		0		-
15	0		0	0	1	4	22	139	[70]	0		12		-
16	0		0	0	1	3	42	317	[98]/ 203	37		18		-
17	0		0	0	3	2	[45]1/	193	69	36		19		-
18	0		0	0	3	5	[60]	66	-	14		12		-
19	0		0	0	0	2	[60]/ 165	117	-	9		5		-
20	0		0	0	-	2	118	48	-	16		0		-
21	0		0	0	-	2	103	46	-	20		0		-
22	0		0	0	1	1	65	66	-	51		16		-
23	0		0	0	0	1	27	41	-	16		5		-
24	1		0	0	1	-	18	45	-	14		16		-
25	0		0	0	3	2	[16]	28	-	12		12		-

Table 2.2. (continued)

Day	May		June		July		August		September		October		November	
	1974	----	1974	1975	1974	1975	1974	1975	1974	1975	----	1975	----	1975
26	0		0	0	0	1	[17]1/ 50	44	-	8		8		-
27	0		0	0	-	1	27	37	-	16		4		-
28	0		0	0	-	1	10	21	-	9		5		-
29	0		0	0	6	1	7	24	-	3		7		-
30	1		0	1	3	3	14	26	-	42		5		-
31	0				2	5	[12]	20				3		

1/ Numbers in brackets are estimated nightly captures which add up to cumulative capture obtained during weekends.

Table 2.3. Precipitation and temperature during the 1974 sampling period in Isle of Wight Co., Virginia. See Appendix 1 for explanation of mnemonic codes.

Date	PPT	MAXTEMP	MINTEMP	Date	PPT	MAXTEMP	MINTEMP
1 July	0.00	88	69	12 Aug.	0.00	80	61
2	0.00	92	71	13	0.03	84	67
3	0.00	93	72	14	0.00	87	70
4	0.00	91	71	15	0.00	88	66
5	0.00	88	69	16	0.02	88	69
6	0.05	85	71	17	0.00	85	67
7	0.07	81	67	18	0.00	87	66
8	0.05	90	68	19	0.15	81	68
9	0.00	93	70	20	0.00	83	69
10	0.00	93	69	21	0.00	82	71
11	0.00	84	58	22	0.27	86	72
12	0.00	82	54	23	1.97	80	69
13	0.00	85	60	24	0.07	87	68
14	0.00	93	68	25	0.00	89	67
15	0.00	95	71	26	0.08	88	68
16	0.00	88	62	27	0.41	87	69
17	0.00	88	61	28	0.00	92	73
18	0.00	90	69	29	0.05	92	74
19	0.00	91	69	30	0.02	91	71
20	0.00	84	57	31 Aug.	0.00	89	72
21	0.00	80	56	1 Sep.	0.00	90	69
22	0.00	84	53	2	0.03	88	71
23	0.00	82	65	3	0.40	90	63
24	0.15	85	68	4	0.04	67	61
25	0.27	88	71	5	0.01	73	63
26	3.50	87	70	6	1.41	72	62
27	0.24	83	67	7	0.22	69	62
28	0.00	85	63	8	0.00	75	60
29	0.00	88	66	9	0.00	80	59
30	0.03	88	66	10	0.00	85	61
31 July	0.00	88	68	11	0.00	88	68
1 Aug.	0.00	88	71	12	0.00	90	68
2	1.10	88	69	13	0.00	90	70
3	0.00	90	74	14	0.00	80	61
4	1.20	88	70	15	0.00	76	60
5	0.13	81	69	16	0.00	81	61
6	2.73	72	67	17	0.00	75	59
7	0.00	75	62	18	0.00	82	55
8	0.50	80	66	19	0.00	85	55
9	0.05	80	69	20	0.00	86	66
10	0.01	79	57	21 Sep.	1.67	87	55
11 Aug.	0.00	77	54				

Table 2.4. Precipitation and temperature during the 1974 sampling period in Westmoreland Co., Virginia. See Appendix 1 for explanation of mnemonic codes.

Date	PPT	MAXTEMP	MINTEMP	Date	PPT	MAXTEMP	MINTEMP
4 July	0.00	95	71	15 Aug.	0.00	88	64
5	0.00	92	71	16	0.00	87	69
6	0.14	86	69	17	0.79	86	66
7	0.00	88	69	18	0.23	85	63
8	0.00	94	68	19	0.02	86	69
9	0.00	95	67	20	0.00	85	65
10	0.00	95	69	21	0.00	82	66
11	0.10	93	68	22	0.10	88	70
12	0.00	81	57	23	0.00	84	68
13	0.00	85	56	24	0.03	86	68
14	0.00	93	59	25	0.05	87	67
15	0.00	96	67	26	0.02	85	69
16	0.55	89	67	27	0.00	87	67
17	0.00	87	60	28	0.00	91	72
18	0.00	89	65	29	0.00	92	72
19	0.00	90	73	30	0.00	90	74
20	0.00	87	63	31 Aug.	0.02	90	71
21	0.00	83	56	1 Sep.	0.00	89	66
22	0.00	84	57	2	0.00	89	67
23	0.00	80	55	3	0.20	88	71
24	0.00	78	67	4	1.18	85	59
25	0.00	82	61	5	0.00	70	53
26	0.09	81	65	6	1.50	68	62
27	2.25	84	66	7	1.23	66	61
28	0.00	88	65	8	0.00	76	62
29	0.00	88	68	9	0.00	81	57
30	0.71	87	65	10	0.00	83	60
31 July	0.00	88	64	11	0.25	85	65
1 Aug.	0.00	89	61	12	0.00	88	69
2	0.15	87	70	13	0.00	89	70
3	0.18	88	69	14	0.00	87	66
4	0.01	85	71	15	0.00	75	52
5	0.02	85	70	16	0.00	79	51
6	0.00	82	65	17	0.00	79	62
7	3.17	75	63	18	0.00	82	57
8	0.00	77	60	19	0.00	83	60
9	0.17	82	68	20	0.00	84	60
10	2.11	77	65	21	0.00	86	64
11	0.00	77	56	22	0.03	80	55
12	0.00	80	53	23	0.00	80	52
13	0.00	86	67	24 Sep.	0.00	68	37
14	0.00	90	68				

Table 2.5. Precipitation and temperature during the 1975 sampling period in Isle of Wight Co., Virginia. See Appendix 1 for explanation of mnemonic codes.

Date	PPT	MAXTEMP	MINTEMP	Date	PPT	MAXTEMP	MINTEMP
1 July	0.00	81	51	12 Aug.	0.00	89	66
2	0.00	87	61	13	0.00	92	71
3	0.00	92	64	14	0.00	92	72
4	1.02	89	66	15	0.00	92	72
5	0.00	82	62	16	0.00	93	72
6	0.00	88	68	17	0.00	94	70
7	0.68	81	67	18	0.00	90	69
8	0.37	88	70	19	0.00	87	61
9	0.88	89	70	20	0.00	90	66
10	0.53	89	68	21	0.00	90	71
11	1.64	78	68	22	0.00	95	72
12	0.85	81	70	23	0.00	88	69
13	0.08	80	71	24	0.04	91	70
14	0.28	81	71	25	0.00	96	71
15	0.84	88	69	26	0.00	97	74
16	0.31	85	70	27	0.00	95	60
17	0.02	88	66	28	0.00	85	59
18	0.10	88	64	29	0.00	86	59
19	0.00	87	70	30	0.00	93	64
20	0.00	89	72	31 Aug.	1.40	92	62
21	0.00	90	73	1 Sep.	0.26	77	66
22	0.00	92	70	2	0.00	80	66
23	0.00	90	74	3	0.00	85	62
24	0.10	90	74	4	0.00	88	62
25	0.88	88	71	5	0.00	89	63
26	0.00	82	56	6	0.41	89	66
27	0.00	83	65	7	0.06	77	67
28	0.00	90	70	8	0.00	85	65
29	0.43	90	69	9	0.00	84	58
30	0.00	86	61	10	0.00	80	59
31 July	0.00	87	64	11	0.04	84	65
1 Aug.	0.00	90	65	12	0.79	88	54
2	0.00	92	68	13	0.00	71	49
3	0.00	94	74	14	0.00	67	43
4	0.00	95	73	15	0.05	67	55
5	0.25	93	72	16	1.35	67	62
6	0.39	89	65	17	0.00	77	60
7	0.01	77	60	18	0.05	79	65
8	0.00	81	57	19	0.00	80	68
9	0.00	86	63	20	0.00	87	71
10	0.00	88	70	21	0.22	85	63
11 Aug.	0.04	88	66	22 Sep.	0.02	76	65

Table 2.6. Spiders commonly found in corn fields in eastern Virginia, July through mid-August, 1975, Isle of Wight Co.

Uloboridae
- Uloborus glomosus (Walckenaer)

Theridiidae
- Achaearanea conjuncta (Gertsch and Mulaik)
- Achaearanea tepidariorum (C. L. Koch)
- Euryopis limbata (Walckenaer)
- Latrodectus mactans (Fabricius)
- Theridion albidum Banks
- Theridion differens Emerton
- Theridion spp.

Linyphiidae
- Frontinella pyramitela (Walckenaer)

Erigonidae (Micryphantidae)
- Erigone spp.
- Erigonidae imm.

Araneidae
- Acanthepeira spp. imm.
- Araneus guttulatus (Walckenaer)
- Argiope aurantia Lucas
- Argiope trifasciata (Forskal)
- Argiope spp. imm.
- Cyclosa turbinata (Walckenaer)
- Gea heptagon (Hentz)
- Mecynogea lemniscata (Walckenaer)
- Micrathena sagitiata (Walckenaer)[1]

Tetragnathidae
- Leucauge venusta (Walckenaer)
- Tetragnatha laboriosa Hentz

Pisauridae
- Pisaurina mira (Walckenaer)

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[1] Collected in corn field, 1974, Westmoreland County.

Table 2.6. (continued)

- Lycosidae
  - *Allocosa funerea* (Hentz)
  - *Pardosa floridana* Banks
  - *Pardosa* spp. imm.

- Oxyopidae
  - *Oxyopes salticus* Hentz

- Clubionidae
  - *Chiracanthium inclusum* (Hentz)
  - *Micaria* spp. imm.

- Anyphaenidae
  - *Anyphaena* spp. imm.
  - *Aysha* spp.

- Philodromidae
  - *Philodromus imbecillus* Keyserling

- Thomisidae
  - *Misumenoides formosipes* (Walckenaer)
  - *Misumenops* spp.
  - *Synema parvulum* (Hentz)
  - *Tmarus angulatus* (Walckenaer)
  - *Xysticus* spp.

- Salticidae
  - *Eris aurantia* (Lucas)
  - *Hentzia mitrata* (Hentz)
  - *Hentzia palmarum* (Hentz)
  - *Metaphippus galathea* (Walckenaer)
  - *Pellenes* spp. imm.
  - *Phidippus audax* (Hentz)
  - *Phidippus clarus* Keyserling
  - *Phidippus mystaceus* (Hentz)
  - *Phidippus* sp. prob. *princeps* (Peckham)
  - *Thiodina* sp. prob. *perupera*

Table 2.7. Spiders commonly found in soybean fields in eastern Virginia, mid-August through mid-September, 1975.

- Theridiidae
  - *Achaearanea globosum* (Hentz)
  - *Argyrodes fictilium* (Hentz)
  - *Latrodectus mactans* (Fabricius)
  - *Theridion australe* Banks
  - *Theridion cheimatos* Gertsch and Archer
  - *Theridion frondeum* Hentz
  - *Theridion rabuni* Chamberlin and Ivie
  - *Theridion* spp.
  - Theridiidae indet. (immature)

- Linyphiidae
  - *Agyneta micaria* (Emerton)

- Erigonidae (Micryphantidae)
  - *Ceraticelus similis* (Banks)
  - *Ceraticelus* sp. nr. *limnologicus* Crosby and Bishop
  - *Ceratinopsis nigriceps* Emerton
  - *Eridantes erigonoides* (Emerton)
  - *Erigone autumnalis* Emerton
  - *Erigone dentigera* O. Pickard - Cambridge
  - Erigonidae spp. imm.
  - *Grammonota* spp.
  - *Walckenaeria spiralis* (Emerton)

- Araneidae
  - *Araneus guttulatus* (Walckenaer)
  - *Araniella displicata* (Hentz)
  - *Gea heptagon* (Hentz)

- Tetragnathidae
  - *Tetragnatha laboriosa* Hentz

- Pisauridae
  - *Dolomedes* sp. imm.
  - *Pisaurina dubia* (Hentz)
  - *Pisaurina mira* (Walckenaer)

- Lycosidae
  - *Pardosa* spp. imm.

Table 2.7. (continued)

Oxyopidae
    Oxyopes salticus Hentz
    Peucetia viridans (Hentz)

Gnaphosidae
    Cesonia bilineata (Hentz)

Clubionidae
    Chiracanthium inclusum (Hentz)
    Clubiona abbotii L. Koch
    Clubiona spp.
    Micaria spp.
    Trachelas similis F. O. Pickard - Cambridge
    Trachelas spp. imm.
    Wulfila spp. imm.

Anyphaenidae
    Anyphaena spp. imm.
    Aysha sp. imm.

Thomisidae
    Misumenops spp. imm.
    Xysticus funestus Keyserling

Salticidae
    Hentzia mitrata (Hentz)
    Metaphippus galathea (Walckenaer)
    Phidippus audax (Hentz)
    Zygoballus spp. imm.

TABLE 2.8.

DESCRIPTIVE STATISTICS OF INSECT PREDATORS IN CORN AND SOYBEANS IN SOUTHEASTERN
VIRGINIA, 1974. (SEE APPENDIX TABLE 1.1 FOR EXPLANATION OF MNEMONIC CODES.)
SAMPLE SIZE = 10 PER TTIME - CFLD

YRCO	CROP	TTIME	CFLD	BEB	SD	OR	SD	LB	SD	LBL	SD	NAB	SD	CONVG	SD	NEURL	SD
74	1W	1	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	23	0.4	1.3	0.4	0.7	2.0	2.0	0.3	0.5	0.0	0.0	0.1	0.3	0.0	0.0
74	1W	1	2	1	0.0	0.0	0.4	1.0	0.2	0.4	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	2	3	0.1	0.3	2.2	2.3	1.4	1.6	1.9	1.7	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	2	5	0.3	0.7	1.5	0.5	1.2	2.3	0.3	0.5	0.0	0.0	0.3	0.7	0.0	0.0
74	1W	1	2	7	0.5	0.7	2.5	1.6	0.8	0.9	0.6	1.3	0.0	0.0	0.3	0.5	0.0	0.0
74	1W	1	2	9	0.0	0.0	1.1	0.9	1.1	1.7	0.2	0.6	0.0	0.0	0.1	0.3	0.1	0.3
74	1W	1	2	11	0.3	0.5	7.6	4.5	0.7	1.1	2.3	1.8	0.0	0.0	0.2	0.6	0.0	0.0
74	1W	1	2	13	0.4	0.5	1.8	1.1	0.5	0.8	0.6	0.5	0.0	0.0	0.0	0.0	0.1	0.3
74	1W	1	2	15	0.9	1.1	1.9	2.0	1.2	1.0	0.6	1.1	0.0	0.0	0.2	0.4	0.0	0.0
74	1W	1	2	17	0.1	0.3	2.1	0.9	1.2	1.1	0.9	1.3	0.0	0.0	0.6	0.7	0.0	0.0
74	1W	1	2	19	0.0	0.0	1.2	1.2	1.9	1.7	0.7	0.8	0.0	0.0	0.1	0.3	0.0	0.0
74	1W	1	2	21	0.3	0.5	3.7	4.4	0.6	0.7	1.6	2.0	0.0	0.0	0.1	0.3	0.2	0.6
74	1W	1	2	23	0.6	0.8	3.3	2.7	1.8	1.6	5.1	2.1	0.0	0.0	0.1	0.3	0.1	0.3
74	1W	1	3	1	0.2	0.4	1.8	1.9	0.4	0.7	5.8	2.9	0.0	0.0	0.0	0.0	0.1	0.3
74	1W	1	3	3	0.0	0.0	2.5	2.4	1.2	1.5	3.6	2.4	0.0	0.0	0.2	0.4	0.0	0.0
74	1W	1	3	5	0.5	0.8	2.7	2.9	2.4	1.8	1.9	1.4	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	3	7	0.0	0.0	7.0	2.9	0.1	0.3	0.8	1.3	0.0	0.0	0.2	0.4	0.0	0.0
74	1W	1	3	9	0.1	0.3	2.2	1.5	0.5	0.8	3.4	3.9	0.0	0.0	0.1	0.3	0.2	0.4
74	1W	1	3	11	0.1	0.3	2.6	2.1	1.6	1.3	7.3	4.2	0.0	0.0	0.1	0.3	0.3	0.5
74	1W	1	3	13	0.0	0.0	1.5	1.1	0.9	1.6	3.3	2.0	0.0	0.0	0.0	0.0	0.3	0.7
74	1W	1	3	15	0.1	0.3	1.6	1.3	2.6	2.0	1.5	1.6	0.0	0.0	0.4	0.7	0.2	0.4
74	1W	1	3	17	0.1	0.3	4.1	2.2	2.0	2.3	2.5	1.9	0.0	0.0	0.1	0.3	0.2	0.4
74	1W	1	3	19	0.3	0.5	6.0	2.7	1.5	0.8	6.9	3.0	0.0	0.0	0.2	0.4	0.0	0.0
74	1W	1	3	21	0.5	0.7	2.1	2.1	0.9	0.9	3.9	5.8	0.0	0.0	0.4	0.7	0.1	0.3
74	1W	1	3	23	0.0	0.0	2.2	2.9	1.6	1.4	3.6	2.1	0.0	0.0	0.1	0.3	0.1	0.3
74	1W	1	4	1	0.4	0.7	5.5	7.5	0.4	0.5	0.8	0.6	0.0	0.0	0.1	0.3	0.0	0.0
74	1W	1	4	3	0.4	0.7	3.3	2.5	1.1	0.7	2.4	2.8	0.0	0.0	0.0	0.0	0.2	0.4
74	1W	1	4	5	0.4	1.0	0.7	0.8	1.0	0.8	2.1	2.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	4	7	1.5	1.6	4.2	2.6	1.1	1.7	0.9	0.7	0.2	0.6	0.0	0.0	0.1	0.3
74	1W	1	4	9	0.3	0.7	2.4	1.2	0.4	0.7	2.6	2.5	0.0	0.0	0.0	0.0	0.5	0.5
74	1W	1	4	11	0.0	0.0	4.8	2.1	1.2	1.6	2.7	2.3	0.6	1.3	1.1	0.7	0.1	0.3
74	1W	1	4	13	0.4	0.5	1.9	1.4	0.5	0.7	2.5	2.2	0.0	0.0	0.0	0.0	0.2	0.4
74	1W	1	4	15	0.0	0.0	3.0	1.9	1.4	1.4	5.0	5.1	0.0	0.0	0.2	0.4	0.1	0.3
74	1W	1	4	17	0.5	0.8	1.9	1.7	1.8	1.3	3.4	3.6	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	4	19	0.5	0.5	5.5	3.6	2.6	1.9	8.2	4.5	0.0	0.0	0.0	0.0	0.1	0.3
74	1W	1	4	21	0.2	0.4	0.5	0.7	2.1	1.7	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	4	23	0.0	0.0	3.9	3.0	3.6	1.4	0.6	0.7	0.0	0.0	0.1	0.3	0.0	0.0
74	1W	1	5	1	0.0	0.0	0.1	0.3	0.9	1.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	5	3	0.0	0.0	0.0	0.0	1.4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	5	5	0.0	0.0	0.0	0.0	1.1	1.2	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0
74	1W	1	5	7	0.2	0.4	0.4	0.7	1.3	1.2	1.4	1.3	0.0	0.0	0.1	0.3	0.0	0.0

TABLE 2.8. (CONTINUED)

YRCU	CROP	TTIME	CFLD	BLB	SD	OR	SD	LB	SD	LBL	SD	NAB	SD	CONVG	SD	NEURL	SD
74	1W	1	5	9	0.0	0.0	0.2	0.6	0.8	0.9	0.5	0.8	0.0	0.0	0.1	0.3	0.0	0.0
74	1W	1	5	11	0.3	0.7	0.4	0.7	3.4	1.2	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	5	13	0.0	0.0	0.1	0.3	0.8	0.8	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	5	15	0.2	0.4	0.1	0.3	2.5	1.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	5	17	0.0	0.0	0.3	0.5	1.7	1.1	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	5	19	0.0	0.0	0.9	1.7	3.4	1.6	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	5	21	0.0	0.0	0.2	0.4	1.8	1.7	0.3	0.5	0.0	0.0	0.6	0.7	0.0	0.0
74	1W	1	5	23	0.0	0.0	0.3	0.9	1.3	0.8	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0
74	1W	1	6	1	0.3	0.5	0.0	0.0	1.2	1.8	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	6	3	0.0	0.0	0.1	0.3	1.1	1.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	6	5	0.1	0.3	0.1	0.3	1.8	1.2	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	6	7	0.6	0.7	0.5	0.7	2.6	2.6	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	6	9	0.1	0.3	0.4	0.5	1.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	6	11	0.0	0.0	0.2	0.4	1.4	1.7	0.3	0.7	0.0	0.0	0.1	0.3	0.0	0.0
74	1W	1	6	13	0.1	0.3	1.0	1.2	1.6	1.4	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	6	15	0.0	0.0	0.4	0.7	1.1	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	6	17	0.0	0.0	0.3	0.7	0.7	1.1	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	6	19	0.0	0.0	0.1	0.3	0.6	1.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	6	21	0.4	0.5	0.2	0.4	0.4	0.7	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	1	6	23	0.1	0.3	0.0	0.0	0.8	0.6	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0
74	1W	2	1	2	0.2	0.6	2.6	1.4	0.1	0.3	0.4	0.7	0.1	0.3	.	.	0.0	0.0
74	1W	2	1	4	0.1	0.3	1.7	0.8	0.1	0.3	0.0	0.0	0.8	0.9	.	.	0.0	0.0
74	1W	2	1	6	0.1	0.3	1.3	0.7	0.0	0.0	0.1	0.3	0.6	0.8	.	.	0.0	0.0
74	1W	2	1	8	0.0	0.0	1.3	1.1	0.3	0.5	0.8	0.8	0.1	0.3	.	.	0.0	0.0
74	1W	2	1	10	0.1	0.3	0.9	1.3	0.0	0.0	0.1	0.3	0.6	0.7	.	.	0.0	0.0
74	1W	2	1	12	0.0	0.0	4.3	2.5	0.3	0.5	0.8	1.1	0.0	0.0	.	.	0.0	0.0
74	1W	2	1	14	0.6	0.8	0.5	0.5	0.2	0.4	0.0	0.0	0.0	0.0	.	.	0.0	0.0
74	1W	2	1	16	0.3	0.5	0.8	1.0	0.1	0.3	0.0	0.0	0.8	0.8	.	.	0.0	0.0
74	1W	2	1	18	0.0	0.0	2.5	1.6	0.0	0.0	0.2	0.4	0.1	0.3	.	.	0.0	0.0
74	1W	2	1	20	0.0	0.0	2.1	1.4	0.1	0.3	0.1	0.3	0.2	0.4	.	.	0.0	0.0
74	1W	2	1	22	0.3	0.7	1.6	1.2	0.1	0.3	0.2	0.6	0.0	0.0	.	.	0.0	0.0
74	1W	2	1	24	0.0	0.0	2.5	2.3	0.2	0.4	0.5	1.0	0.3	0.7	.	.	0.0	0.0
74	1W	2	2	2	0.2	0.4	1.5	1.0	0.0	0.0	0.7	1.3	0.1	0.3	.	.	0.0	0.0
74	1W	2	2	4	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74	1W	2	2	6	0.6	0.8	0.1	0.3	0.0	0.0	0.4	0.7	0.4	0.5	.	.	0.0	0.0
74	1W	2	2	8	0.2	0.6	1.5	1.3	0.0	0.0	0.6	0.8	0.2	0.4	.	.	0.0	0.0
74	1W	2	2	10	0.4	0.5	0.3	0.5	0.1	0.3	0.3	0.7	0.2	0.4	.	.	0.0	0.0
74	1W	2	2	12	0.2	0.4	2.8	1.6	0.1	0.3	0.6	0.7	0.0	0.0	.	.	0.0	0.0
74	1W	2	2	14	0.2	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.5	1.1	.	.	0.0	0.0
74	1W	2	2	16	0.4	0.5	0.1	0.3	0.0	0.0	0.0	0.0	0.4	0.5	.	.	0.0	0.0
74	1W	2	2	18	0.1	0.3	2.1	1.4	0.2	0.4	0.7	1.3	0.0	0.0	.	.	0.0	0.0
74	1W	2	2	20	0.0	0.0	1.9	2.1	0.0	0.0	0.8	1.3	0.1	0.3	.	.	0.0	0.0
74	1W	2	2	22	0.3	0.7	1.1	1.2	0.0	0.0	0.2	0.4	0.0	0.0	.	.	0.0	0.0
74	1W	2	2	24	0.0	0.0	0.7	0.8	0.1	0.3	0.4	0.8	0.1	0.3	.	.	0.0	0.0
74	1W	2	3	2	0.5	0.7	1.2	0.9	0.0	0.0	0.0	0.0	0.5	0.7	.	.	0.0	0.0
74	1W	2	3	4	0.3	0.7	0.2	0.4	0.0	0.0	0.1	0.3	0.4	0.5	.	.	0.0	0.0
74	1W	2	3	6	0.1	0.3	0.4	0.7	0.0	0.0	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74	1W	2	3	8	0.5	0.8	0.3	0.5	0.0	0.0	0.5	0.7	0.2	0.6	.	.	0.0	0.0
74	1W	2	3	10	0.0	0.0	0.3	0.7	0.1	0.3	0.3	0.5	0.3	0.5	.	.	0.0	0.0
74	1W	2	3	12	0.0	0.0	0.5	0.5	0.2	0.4	0.3	0.5	0.0	0.0	.	.	0.0	0.0
74	1W	2	3	14	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.4	.	.	0.0	0.0
74	1W	2	3	16	0.1	0.3	0.1	0.3	0.1	0.3	0.0	0.0	0.4	0.7	.	.	0.0	0.0

TABLE 2.8. (CONTINUED)

YRCO	CRUP	TTIME	CFLD	BEB	SD	OR	SD	LB	SD	LBL	SD	NAB	SD	CONVG	SD	NEURL	SD
74 IW	2	3	18	0.2	0.4	2.3	2.2	0.0	0.0	0.3	0.5	0.4	0.7	.	.	0.0	0.0
74 IW	2	3	20	0.3	0.5	0.9	1.1	0.2	0.4	0.1	0.3	0.3	0.5	.	.	0.0	0.0
74 IW	2	3	22	0.1	0.3	0.5	0.7	0.1	0.3	0.1	0.3	0.3	0.7	.	.	0.0	0.0
74 IW	2	3	24	0.0	0.0	0.9	0.7	0.1	0.3	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74 IW	2	4	2	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74 IW	2	4	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.	.	0.0	0.0
74 IW	2	4	6	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	.	.	0.0	0.0
74 IW	2	4	8	0.2	0.4	0.4	0.5	0.0	0.0	0.1	0.3	0.1	0.3	.	.	0.0	0.0
74 IW	2	4	10	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	.	.	0.0	0.0
74 IW	2	4	12	0.4	0.5	0.2	0.4	0.0	0.0	0.3	0.7	0.4	0.7	.	.	0.0	0.0
74 IW	2	4	14	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4	0.5	0.7	.	.	0.0	0.0
74 IW	2	4	16	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74 IW	2	4	18	0.0	0.0	0.1	0.3	0.1	0.3	0.1	0.3	0.2	0.4	.	.	0.0	0.0
74 IW	2	4	20	0.3	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.2	0.4	.	.	0.0	0.0
74 IW	2	4	22	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4	.	.	0.0	0.0
74 IW	2	4	24	0.5	0.7	0.6	1.3	0.0	0.0	0.0	0.0	0.2	0.4	.	.	0.0	0.0
74 IW	2	5	2	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74 IW	2	5	4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	.	.	0.0	0.0
74 IW	2	5	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	.	.	0.0	0.0
74 IW	2	5	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74 IW	2	5	10	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.	.	0.0	0.0
74 IW	2	5	12	0.4	0.7	0.0	0.6	0.2	0.4	0.2	0.4	0.3	0.7	.	.	0.0	0.0
74 IW	2	5	14	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	.	.	0.0	0.0
74 IW	2	5	16	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8	.	.	0.0	0.0
74 IW	2	5	18	0.1	0.3	0.5	1.0	0.1	0.3	0.0	0.0	0.2	0.4	.	.	0.0	0.0
74 IW	2	5	20	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74 IW	2	5	24	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	.	.	0.0	0.0
74 W	1	1	25	0.0	0.0	0.0	0.0	2.9	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	1	27	0.6	1.3	10.6	4.4	1.0	1.2	0.8	1.0	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	1	29	0.6	1.3	3.6	2.7	3.6	2.4	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	1	31	0.5	0.7	4.6	2.5	4.4	2.3	0.1	0.3	0.0	0.0	0.4	0.7	0.0	0.0
74 W	1	1	33	0.8	0.9	5.8	4.2	3.7	2.4	3.4	2.6	0.2	0.6	0.6	1.1	0.0	0.0
74 W	1	1	35	0.5	0.8	1.6	1.7	2.9	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	1	37	0.0	0.0	0.1	0.3	3.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	1	39	0.0	0.0	0.0	0.0	2.3	1.7	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	1	41	0.1	0.3	0.0	0.0	1.4	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	1	43	0.3	0.9	3.4	6.8	3.4	3.3	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	1	45	0.5	0.7	11.0	3.2	4.6	2.6	3.1	1.8	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	1	47	0.8	0.9	7.3	4.0	2.9	1.8	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	2	25	0.1	0.3	0.8	0.9	4.8	2.8	1.7	0.9	0.0	0.0	0.4	0.5	0.0	0.0
74 W	1	2	27	0.1	0.3	5.2	1.9	1.6	1.3	9.8	7.0	0.0	0.0	0.3	0.5	0.1	0.3
74 W	1	2	29	1.4	1.4	2.5	1.3	2.8	2.3	0.8	0.8	0.0	0.0	0.7	1.6	0.0	0.0
74 W	1	2	31	0.5	0.8	6.6	3.5	5.6	3.5	3.6	2.0	0.0	0.0	0.0	0.0	0.1	0.3
74 W	1	2	33	0.2	0.4	3.3	2.9	1.3	1.4	8.1	4.9	0.0	0.0	0.2	0.4	0.0	0.0
74 W	1	2	35	1.0	1.1	1.8	1.9	1.8	1.5	0.3	0.5	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	2	37	0.3	0.5	7.1	3.0	8.5	4.0	1.1	1.6	0.0	0.0	0.2	0.4	0.0	0.0
74 W	1	2	39	0.1	0.3	2.3	1.7	1.7	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	2	41	0.6	0.8	5.9	4.2	6.0	2.9	0.5	1.0	0.0	0.0	0.3	0.5	0.0	0.0
74 W	1	2	43	0.8	1.0	8.0	5.6	2.5	1.4	2.1	2.1	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	2	45	0.0	0.0	1.9	2.2	2.0	1.9	3.3	2.4	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	2	47	1.7	1.2	4.4	3.7	1.9	1.2	4.9	2.8	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	3	25	0.5	1.0	3.7	4.0	4.0	2.1	3.6	3.0	0.0	0.0	0.1	0.3	0.0	0.0

TABLE 2.8. (CONTINUED)

YRCU	CROP	TTIME	CFLD	BEB	SD	UR	SD	LB	SD	LBL	SD	NAB	SD	CONVG	SD	NEURL	SD
74 W	1	3	27	0.2	0.4	3.5	2.1	2.5	1.8	4.1	2.4	0.0	0.0	0.0	0.0	0.2	0.6
74 W	1	3	29	1.3	1.9	7.5	6.6	2.2	2.0	1.2	1.6	0.0	0.0	0.2	0.4	0.2	0.4
74 W	1	3	31	0.3	0.5	0.5	0.5	3.2	3.0	1.6	1.1	0.0	0.0	0.1	0.3	0.1	0.3
74 W	1	3	33	0.6	1.1	2.9	2.7	2.2	1.1	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	3	35	0.2	0.4	1.4	1.5	0.9	1.4	0.3	0.5	0.0	0.0	0.0	0.0	0.1	0.3
74 W	1	3	37	0.2	0.4	14.6	6.7	5.6	2.0	1.7	3.0	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	3	39	0.3	0.5	7.3	3.4	2.9	2.6	1.7	2.0	0.0	0.0	0.6	0.7	0.1	0.3
74 W	1	3	41	0.4	0.7	4.4	1.1	3.6	2.0	1.7	1.5	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	3	43	0.2	0.4	3.0	2.7	2.4	1.2	4.9	3.3	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	3	45	0.1	0.3	6.1	4.1	4.2	1.5	3.7	2.9	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	3	47	1.3	1.3	1.7	1.2	1.6	1.5	2.4	1.8	0.0	0.0	0.0	0.0	0.1	0.3
74 W	1	4	25	0.1	0.3	3.3	1.9	1.6	1.1	2.9	1.7	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	4	27	0.2	0.6	2.8	1.5	3.4	1.4	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	4	29	0.2	0.6	2.7	1.8	1.9	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
74 W	1	4	31	0.2	0.4	2.1	2.2	2.4	1.2	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3
74 W	1	4	33	0.0	0.0	1.7	2.5	2.7	1.5	0.5	1.3	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	4	35	0.0	0.0	1.0	0.9	1.8	1.2	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	4	37	0.0	0.0	2.4	1.2	6.0	5.1	1.8	1.1	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	4	39	0.1	0.3	2.6	1.4	4.8	4.3	2.7	2.3	0.0	0.0	0.0	0.0	0.1	0.3
74 W	1	4	41	0.0	0.0	1.5	1.1	0.8	0.9	3.4	2.1	0.0	0.0	0.1	0.3	0.1	0.3
74 W	1	4	43	0.2	0.4	1.3	1.3	2.6	2.2	0.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	4	45	0.0	0.0	3.7	3.1	2.2	1.8	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	4	47	0.1	0.3	1.1	1.6	1.0	0.7	0.7	0.9	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	5	25	0.0	0.0	0.7	0.7	3.0	1.8	0.7	0.8	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	5	27	0.0	0.0	0.1	0.3	2.0	1.5	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	5	29	0.1	0.3	0.2	0.4	2.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	5	31	0.2	0.4	0.3	0.5	1.1	1.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	5	33	0.1	0.3	0.0	0.0	1.5	1.4	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	5	35	0.0	0.0	0.2	0.4	2.4	2.5	0.2	0.6	0.0	0.0	0.0	0.0	0.1	0.3
74 W	1	5	37	0.0	0.0	0.2	0.4	2.0	1.3	0.6	0.7	0.0	0.0	0.4	1.3	0.0	0.0
74 W	1	5	39	0.0	0.0	4.9	2.8	1.6	1.6	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	5	41	0.1	0.3	0.6	0.8	0.8	0.9	0.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	5	43	0.0	0.0	0.6	1.1	0.6	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	5	45	0.1	0.3	0.2	0.4	2.2	1.8	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	5	47	0.0	0.0	0.1	0.3	1.0	1.2	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	6	25	0.0	0.0	0.5	0.7	0.9	1.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	6	27	0.1	0.3	0.0	0.0	0.7	0.8	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	6	29	0.3	0.7	0.1	0.3	1.1	1.6	0.2	0.4	0.0	0.0	0.2	0.4	0.1	0.3
74 W	1	6	31	0.1	0.3	0.1	0.3	0.6	0.8	0.3	0.7	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	6	33	0.0	0.0	0.7	1.2	1.0	0.8	2.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	6	35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
74 W	1	6	37	0.1	0.3	0.8	1.0	0.4	0.5	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0
74 W	1	6	39	0.1	0.3	1.8	1.5	0.8	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	6	41	0.0	0.0	0.3	0.7	0.8	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	6	43	0.0	0.0	0.0	0.0	0.4	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	6	45	0.2	0.4	0.1	0.3	0.5	0.7	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
74 W	1	6	47	0.3	0.5	0.1	0.3	0.5	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
74 W	2	1	26	0.0	0.0	2.1	1.2	0.1	0.3	0.1	0.3	0.2	0.4	.	.	0.0	0.0
74 W	2	1	28	0.2	0.4	1.2	1.0	0.4	0.7	0.4	0.5	0.1	0.3	.	.	0.0	0.0
74 W	2	1	30	0.3	0.7	1.3	1.2	0.0	0.0	0.3	0.7	0.3	0.5	.	.	0.1	0.3
74 W	2	1	32	0.4	0.7	0.3	0.5	0.4	0.7	0.7	1.6	0.4	0.8	.	.	0.0	0.0
74 W	2	1	34	0.3	0.5	1.2	1.1	0.3	0.5	0.2	0.4	0.9	0.7	.	.	0.0	0.0

TABLE 2.8. (CONTINUED)

YRCU	CRUP	TTIME	CFLD	DEB	SD	DR	SD	LB	SD	LBL	SD	NAB	SD	CONVG	SD	NEURL	SD
74 W	2	1	36	0.1	0.3	1.3	0.9	0.0	0.0	0.4	0.7	0.2	0.4	.	.	0.0	0.0
74 W	2	1	38	0.0	0.0	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	.	.	0.0	0.0
74 W	2	1	40	0.3	0.7	2.4	1.6	0.2	0.4	0.3	0.5	0.5	0.7	.	.	0.0	0.0
74 W	2	1	42	0.2	0.6	1.1	0.9	0.4	0.5	0.3	0.5	0.0	0.0	.	.	0.0	0.0
74 W	2	1	44	0.2	0.4	2.0	0.9	0.7	0.9	0.6	1.1	0.1	0.3	.	.	0.0	0.0
74 W	2	1	46	0.2	0.4	0.8	1.0	0.1	0.3	0.1	0.3	0.2	0.4	.	.	0.1	0.3
74 W	2	1	48	0.0	0.0	0.4	0.5	0.2	0.4	0.5	0.8	0.3	0.5	.	.	0.0	0.0
74 W	2	2	26	0.0	0.0	1.3	1.1	0.3	0.5	0.6	1.0	0.0	0.0	.	.	0.0	0.0
74 W	2	2	28	0.3	0.5	1.1	1.1	0.1	0.3	2.6	2.0	0.3	0.7	.	.	0.0	0.0
74 W	2	2	30	0.0	0.0	1.1	1.6	0.0	0.0	0.2	0.4	0.1	0.3	.	.	0.1	0.3
74 W	2	2	32	0.1	0.3	0.6	0.8	0.1	0.3	0.9	1.3	0.1	0.3	.	.	0.0	0.0
74 W	2	2	34	0.4	0.7	0.4	0.7	0.2	0.6	0.1	0.3	0.6	0.7	.	.	0.1	0.3
74 W	2	2	36	0.1	0.3	0.3	0.5	0.0	0.0	0.4	0.5	0.2	0.4	.	.	0.0	0.0
74 W	2	2	38	0.0	0.0	0.6	0.5	0.0	0.0	0.3	0.5	0.2	0.4	.	.	0.0	0.0
74 W	2	2	40	0.1	0.3	0.9	1.0	0.2	0.4	0.4	0.7	0.0	0.0	.	.	0.0	0.0
74 W	2	2	42	0.0	0.0	0.1	0.3	0.0	0.0	0.2	0.4	0.2	0.4	.	.	0.0	0.0
74 W	2	2	44	0.0	0.0	0.5	0.7	0.1	0.3	1.0	0.7	0.1	0.3	.	.	0.0	0.0
74 W	2	2	46	0.0	0.0	1.0	0.8	0.0	0.0	0.7	0.9	0.0	0.0	.	.	0.0	0.0
74 W	2	2	48	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	.	.	0.0	0.0
74 W	2	3	26	0.0	0.0	2.3	1.7	0.0	0.0	0.5	0.5	0.2	0.4	.	.	0.0	0.0
74 W	2	3	28	0.0	0.0	1.0	0.9	0.0	0.0	1.2	0.8	0.9	0.7	.	.	0.0	0.0
74 W	2	3	30	0.0	0.0	0.6	0.8	0.1	0.3	0.1	0.3	0.6	0.7	.	.	0.1	0.3
74 W	2	3	32	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74 W	2	3	34	0.4	0.5	0.5	0.7	0.0	0.0	0.5	0.5	0.4	0.5	.	.	0.0	0.0
74 W	2	3	36	0.2	0.4	0.6	0.8	0.1	0.3	0.1	0.3	0.3	0.5	.	.	0.0	0.0
74 W	2	3	38	0.0	0.0	0.8	0.8	0.2	0.4	0.4	0.7	0.2	0.4	.	.	0.0	0.0
74 W	2	3	40	0.0	0.0	2.1	1.0	0.1	0.3	1.1	1.2	0.5	0.7	.	.	0.0	0.0
74 W	2	3	42	0.1	0.3	0.5	0.8	0.3	0.7	0.0	0.0	0.8	0.9	.	.	0.0	0.0
74 W	2	3	44	0.4	1.0	1.4	1.4	0.2	0.6	0.2	0.4	1.1	1.1	.	.	0.2	0.4
74 W	2	3	46	0.2	0.6	1.5	1.4	0.0	0.0	0.7	0.8	0.1	0.3	.	.	0.0	0.0
74 W	2	3	48	0.0	0.0	0.2	0.4	0.1	0.3	0.1	0.3	0.2	0.4	.	.	0.0	0.0
74 W	2	4	26	0.1	0.3	1.4	1.3	0.4	0.5	0.1	0.3	0.0	0.0	.	.	0.0	0.0
74 W	2	4	28	0.4	0.8	0.6	1.0	0.1	0.3	1.2	1.3	0.3	0.5	.	.	0.0	0.0
74 W	2	4	30	0.3	0.7	0.5	0.5	0.0	0.0	0.2	0.4	0.2	0.4	.	.	0.0	0.0
74 W	2	4	32	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.	.	0.0	0.0
74 W	2	4	34	0.8	1.2	1.3	1.3	0.0	0.0	0.3	0.5	0.9	1.2	.	.	0.0	0.0
74 W	2	4	36	0.0	0.0	0.4	0.7	0.0	0.0	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74 W	2	4	38	0.0	0.0	0.5	0.8	0.2	0.4	0.0	0.0	0.4	0.7	.	.	0.0	0.0
74 W	2	4	40	0.0	0.0	3.8	2.3	0.0	0.0	0.6	0.8	0.1	0.3	.	.	0.0	0.0
74 W	2	4	42	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.3	0.5	.	.	0.0	0.0
74 W	2	4	44	0.6	1.0	0.3	0.5	0.0	0.0	0.1	0.3	0.4	0.7	.	.	0.0	0.0
74 W	2	4	46	0.0	0.0	2.5	2.7	0.0	0.0	0.5	0.5	0.1	0.3	.	.	0.0	0.0
74 W	2	4	48	0.3	0.5	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.6	.	.	0.0	0.0
74 W	2	5	26	0.1	0.3	1.8	1.3	0.1	0.3	0.1	0.3	0.2	0.4	.	.	0.0	0.0
74 W	2	5	28	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.0	0.3	0.5	.	.	0.0	0.0
74 W	2	5	30	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	.	.	0.0	0.0
74 W	2	5	34	0.7	0.9	0.0	0.0	0.1	0.3	0.1	0.3	0.2	0.4	.	.	0.0	0.0
74 W	2	5	36	0.1	0.3	0.5	1.0	0.0	0.0	0.1	0.3	0.4	1.0	.	.	0.0	0.0
74 W	2	5	38	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	.	.	0.0	0.0
74 W	2	5	40	0.1	0.3	2.2	2.9	0.2	0.4	0.1	0.3	0.0	0.0	.	.	0.0	0.0
74 W	2	5	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	.	.	0.0	0.0
74 W	2	5	44	0.2	0.6	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	.	.	0.0	0.0
74 W	2	5	46	0.0	0.0	1.3	1.1	0.1	0.3	0.0	0.0	0.0	0.0	.	.	0.0	0.0
74 W	2	5	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.	.	0.0	0.0

TABLE 2.9.

DESCRIPTIVE STATISTICS OF INSECT PREDATORS IN CORN AND SOYBEANS IN ISLE OF WIGHT COUNTY, VIRGINIA, 1975. (SEE APPENDIX TABLE 1.1 FOR EXPLANATION OF MNEMONIC CODES.) SAMPLE SIZE = 10 PER TTIME - CFLD

CROP	TTIME	CFLD	BLB	SD	BEBN	SD	BLKBEB	SD	BLKBN	SD	OR	SD	ORN	SD	LB	SD	LBL	SD	NAB	SD	NABN	SD	CONVG	SD	NEURL	SD
1	1	49	0.0	0.0	0.0	0.0	.	.	.	.	2.0	1.9	0.0	0.0	3.9	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	1	51	0.3	0.7	0.0	0.0	.	.	.	.	3.2	2.7	0.0	0.0	3.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	1	53	0.1	0.3	0.0	0.0	.	.	.	.	2.2	1.5	0.1	0.3	1.8	1.7	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	1	55	0.1	0.3	0.0	0.0	.	.	.	.	1.3	1.8	0.0	0.0	3.2	2.5	0.0	0.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0
1	1	57	0.1	0.3	0.0	0.0	.	.	.	.	0.0	0.0	0.0	0.0	4.6	3.2	0.1	0.3	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0
1	1	59	0.3	0.7	0.0	0.0	.	.	.	.	1.0	1.1	0.0	0.0	4.5	2.5	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
1	1	61	0.1	0.3	0.0	0.0	.	.	.	.	2.8	1.5	0.7	1.5	2.5	2.3	0.1	0.3	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0
1	1	63	0.1	0.3	0.0	0.0	.	.	.	.	1.2	1.3	0.3	0.5	2.1	2.4	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	1	65	0.1	0.3	0.0	0.0	.	.	.	.	1.0	1.1	0.1	0.3	3.3	1.8	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
1	1	67	0.1	0.3	0.0	0.0	.	.	.	.	0.8	0.9	0.1	0.3	5.0	2.4	0.4	0.5	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0
1	1	69	0.2	0.4	0.0	0.0	.	.	.	.	9.6	4.6	3.8	3.8	4.6	2.4	1.1	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
1	1	71	0.0	0.0	0.0	0.0	.	.	.	.	6.2	5.0	0.6	1.3	6.2	4.6	0.4	0.5	0.4	0.5	0.1	0.3	0.0	0.0	0.0	0.0
1	1	73	0.0	0.0	0.0	0.0	.	.	.	.	0.6	1.1	0.0	0.0	1.5	1.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	1	75	0.3	0.5	0.0	0.0	.	.	.	.	3.1	3.0	1.3	2.8	4.1	3.0	0.3	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	1	77	0.5	0.7	0.0	0.0	.	.	.	.	1.5	1.5	0.3	0.7	2.6	2.5	0.0	0.0	0.3	0.5	0.0	0.0	0.2	0.4	0.1	0.3
1	1	79	0.3	0.9	0.0	0.0	.	.	.	.	0.3	0.5	0.0	0.0	2.6	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
1	2	49	0.0	0.0	0.0	0.0	.	.	.	.	1.4	1.3	1.0	0.8	3.1	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	51	0.1	0.3	0.0	0.0	.	.	.	.	3.9	2.9	2.6	2.3	7.3	4.8	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	2	53	0.0	0.0	0.0	0.0	.	.	.	.	1.8	2.4	0.9	1.7	2.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	55	0.0	0.0	0.0	0.0	.	.	.	.	2.4	0.8	4.2	2.0	3.7	2.9	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
1	2	57	0.1	0.3	0.0	0.0	.	.	.	.	4.9	2.8	5.3	1.7	1.9	2.5	0.5	0.5	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	2	59	0.1	0.3	0.0	0.0	.	.	.	.	6.0	3.2	5.5	3.4	4.2	1.6	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	61	0.0	0.0	0.0	0.0	.	.	.	.	10.3	3.2	1.7	1.5	3.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	63	0.3	0.5	0.0	0.0	.	.	.	.	7.0	3.2	6.6	4.8	3.5	2.5	1.1	0.9	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3
1	2	65	0.0	0.0	0.0	0.0	.	.	.	.	0.9	0.7	0.3	0.5	2.2	2.9	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	2	67	0.6	1.0	0.0	0.0	.	.	.	.	7.6	3.0	5.5	2.9	2.7	2.1	0.2	0.4	0.4	0.7	0.0	0.0	0.0	0.0	0.1	0.3
1	2	69	0.1	0.3	0.0	0.0	.	.	.	.	11.3	4.4	5.3	1.9	3.8	2.4	2.2	1.5	0.1	0.3	0.0	0.0	0.2	0.6	0.2	0.4
1	2	71	0.1	0.3	0.0	0.0	.	.	.	.	18.4	6.3	5.2	1.2	2.7	1.6	2.1	1.9	0.2	0.4	0.0	0.0	0.0	0.0	0.3	0.5
1	2	73	0.1	0.3	0.0	0.0	.	.	.	.	15.4	8.2	19.4	8.9	2.0	1.6	1.0	1.2	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	2	75	0.2	0.4	0.0	0.0	.	.	.	.	12.5	6.9	8.5	3.0	4.3	3.1	2.9	2.6	0.7	1.2	0.0	0.0	0.0	0.0	0.1	0.3
1	2	77	0.2	0.4	0.0	0.0	.	.	.	.	14.7	4.6	11.3	5.0	5.4	2.9	3.5	2.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0
1	2	79	0.0	0.0	0.0	0.0	.	.	.	.	9.0	4.0	5.0	4.1	2.7	1.8	0.4	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	3	49	0.0	0.0	0.0	0.0	.	.	.	.	8.3	3.4	9.6	3.5	2.5	1.8	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	3	51	0.3	0.5	0.2	0.4	.	.	.	.	12.3	4.8	12.3	5.4	2.6	2.1	5.6	2.7	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0
1	3	53	0.2	0.4	0.0	0.0	.	.	.	.	9.7	3.2	10.9	3.6	3.4	2.1	2.6	2.5	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
1	3	55	0.0	0.0	0.0	0.0	.	.	.	.	9.2	3.9	9.6	3.9	0.7	0.9	2.1	1.9	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
1	3	57	0.3	0.5	0.0	0.0	.	.	.	.	6.7	3.6	8.3	6.4	1.2	1.3	2.5	1.4	0.2	0.4	0.1	0.3	0.0	0.0	0.3	0.5
1	3	59	0.1	0.3	0.3	0.7	.	.	.	.	7.8	4.1	9.5	3.6	1.9	1.5	1.5	1.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	3	61	0.0	0.0	0.1	0.3	.	.	.	.	12.4	5.4	15.5	4.3	1.4	1.0	2.9	1.9	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
1	3	63	0.0	0.0	0.0	0.0	.	.	.	.	8.0	4.0	9.1	4.7	0.7	0.8	2.4	1.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	3	65	0.0	0.0	0.3	0.7	.	.	.	.	11.4	4.3	14.2	5.6	3.2	1.8	6.0	4.4	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0
1	3	67	0.1	0.3	0.0	0.0	.	.	.	.	9.3	4.5	9.7	5.6	1.1	1.2	3.4	2.5	0.0	0.0	0.1	0.3	0.1	0.3	0.1	0.3
1	3	69	0.2	0.4	0.1	0.3	.	.	.	.	15.2	7.2	32.4	19.5	1.8	1.5	5.0	2.9	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0
1	3	71	0.2	0.4	0.2	0.4	.	.	.	.	15.4	7.0	8.6	4.6	2.2	0.8	2.4	2.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	3	73	0.1	0.3	0.0	0.0	.	.	.	.	17.4	6.0	34.7	15.1	3.6	1.9	6.9	4.1	0.8	0.8	0.1	0.3	0.0	0.0	0.1	0.3
1	3	75	0.6	0.8	0.5	0.7	.	.	.	.	11.5	5.2	11.5	5.6	1.8	1.4	3.4	2.5	0.1	0.3	0.1	0.3	0.1	0.3	0.0	0.0
1	3	77	0.7	0.9	0.7	1.1	.	.	.	.	13.1	4.2	20.6	7.1	1.9	1.9	8.5	4.7	0.3	0.7	0.0	0.0	0.0	0.0	0.1	0.3
1	3	79	0.1	0.3	0.4	0.7	.	.	.	.	10.9	4.6	25.4	17.2	2.0	1.7	5.1	3.1	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0
1	4	49	0.1	0.3	0.1	0.3	.	.	.	.	13.2	4.0	11.6	6.5	0.7	0.8	4.7	3.9	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
1	4	51	0.2	0.6	1.3	0.8	.	.	.	.	13.0	4.6	7.5	3.1	1.9	1.4	4.3	2.2	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
1	4	53	0.5	0.7	1.2	1.9	.	.	.	.	10.7	5.1	8.8	4.4	1.2	1.1	2.4	1.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	4	55	0.0	0.0	0.0	0.0	.	.	.	.	8.2	2.5	8.5	2.7	0.7	0.7	3.9	1.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 2.9. (CONTINUED)

GROUP	TTIME	CFLD	BLB	SD	BLBN	SD	BLKBLB	SD	BLKBN	SD	UR	SD	ORN	SD	LB	SD	LBL	SD	NAB	SD	NABN	SD	CONVG	SD	NEURL	SD
1	4	57	0.0	0.0	0.1	0.3	.	.	.	.	11.4	5.5	10.4	4.4	1.4	1.3	2.3	1.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	4	59	0.1	0.3	0.3	0.5	.	.	.	.	13.2	9.0	3.3	2.1	1.8	1.1	1.7	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	4	61	0.1	0.3	0.7	0.8	.	.	.	.	12.6	3.3	7.4	4.0	1.6	1.4	1.9	1.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	4	63	0.0	0.0	0.2	0.4	.	.	.	.	7.5	4.8	2.6	2.3	0.8	1.3	1.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	4	65	0.2	0.4	0.3	0.7	.	.	.	.	8.1	4.5	8.2	4.8	2.6	1.5	2.7	1.8	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	4	67	0.2	0.4	0.8	1.2	.	.	.	.	3.7	1.9	3.4	2.7	1.8	1.8	0.7	0.5	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	4	69	0.0	0.0	0.4	0.5	.	.	.	.	3.9	1.5	1.1	0.7	2.1	1.6	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	4	71	0.2	0.4	0.6	0.7	.	.	.	.	6.7	2.3	3.9	2.2	1.7	1.6	0.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	4	73	0.4	0.7	0.1	0.3	.	.	.	.	13.2	7.3	9.2	5.7	2.8	2.0	1.8	1.6	0.3	0.5	0.0	0.0	0.0	0.0	0.1	0.3
1	4	75	0.1	0.3	1.2	1.1	.	.	.	.	6.7	5.4	5.2	3.3	2.1	2.3	0.6	0.8	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
1	4	77	0.6	1.0	0.3	0.5	.	.	.	.	14.0	4.6	1.7	1.3	3.9	2.2	1.3	0.9	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0
1	4	79	0.1	0.3	0.7	1.1	.	.	.	.	13.4	5.6	6.6	3.4	1.1	1.4	0.7	1.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	5	49	0.1	0.3	0.3	0.5	.	.	.	.	8.7	4.2	0.8	0.8	0.9	0.9	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6
1	5	51	0.2	0.4	2.3	2.2	.	.	.	.	7.2	3.5	2.4	1.8	1.8	2.3	0.9	1.1	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0
1	5	53	0.2	0.4	0.5	0.7	.	.	.	.	2.8	2.2	4.3	3.3	0.6	0.5	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5	55	0.0	0.0	0.6	1.0	.	.	.	.	10.9	3.9	4.4	2.1	1.2	0.9	0.9	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5	57	0.3	0.5	0.2	0.4	.	.	.	.	10.9	4.8	3.1	2.7	1.1	1.0	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	5	59	0.2	0.4	1.1	0.7	.	.	.	.	13.8	4.2	6.1	5.5	1.5	1.1	0.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5	61	0.2	0.4	1.6	1.3	.	.	.	.	9.5	3.9	1.3	0.7	2.0	1.3	0.4	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
1	5	63	0.0	0.0	0.7	0.9	.	.	.	.	4.6	2.7	1.1	1.1	2.2	2.0	0.5	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	5	65	0.0	0.0	0.5	1.0	.	.	.	.	7.1	3.2	1.1	1.3	2.8	2.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5	67	0.1	0.3	2.0	1.9	.	.	.	.	5.7	2.8	0.8	1.2	1.2	1.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
1	5	69	0.6	0.7	1.3	1.3	.	.	.	.	3.0	2.0	1.0	1.1	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3
1	5	71	0.0	0.0	1.5	2.1	.	.	.	.	6.6	3.7	3.1	2.0	1.4	1.2	0.3	0.5	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	5	73	0.1	0.3	0.6	0.7	.	.	.	.	8.5	4.8	1.4	1.1	1.8	1.6	0.3	0.5	0.2	0.6	0.0	0.0	0.0	0.0	0.1	0.3
1	5	75	0.4	0.5	1.6	1.3	.	.	.	.	6.4	3.9	2.2	2.4	2.1	1.7	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5	77	0.8	0.9	2.6	3.0	.	.	.	.	2.8	2.3	0.4	0.8	6.5	3.9	0.3	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	5	79	0.5	0.7	1.1	1.1	.	.	.	.	5.9	4.4	1.6	2.1	4.7	1.9	0.2	0.6	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0
2	1	50	0.6	0.7	0.5	0.5	0.0	0.0	0.0	0.0	0.7	1.1	2.3	1.7	0.2	0.4	1.1	1.1	0.8	0.9	0.6	0.7	0.0	0.0	0.0	0.0
2	1	52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.9	0.9	1.0	0.1	0.3	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
2	1	54	0.0	0.0	0.4	0.5	0.0	0.0	0.0	0.0	1.1	0.7	2.0	1.8	0.0	0.0	1.5	1.6	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0
2	1	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.3	0.5	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
2	1	58	0.7	0.8	0.2	0.4	0.0	0.0	0.0	0.0	1.4	1.3	0.9	1.0	0.1	0.3	0.6	0.7	0.6	0.7	0.6	1.0	0.0	0.0	0.0	0.0
2	1	60	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.3	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
2	1	62	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.5	0.8	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	64	0.1	0.3	0.5	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.2	0.4	0.4	0.5	0.7	0.9	0.0	0.0	0.0	0.0
2	1	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.1	0.3
2	1	68	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	1.2	1.0	3.1	2.4	0.1	0.3	2.0	1.5	0.5	1.0	1.0	0.9	0.0	0.0	0.0	0.0
2	1	70	0.1	0.3	0.6	0.7	0.0	0.0	0.0	0.0	1.1	1.0	2.7	1.6	0.0	0.0	0.7	1.3	0.2	0.4	0.7	0.7	0.0	0.0	0.0	0.0
2	1	72	0.0	0.0	0.2	0.6	0.0	0.0	0.0	0.0	0.9	1.0	0.4	0.7	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0
2	1	74	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.1	1.8	2.2	0.0	0.0	0.3	0.5	0.6	0.7	1.0	0.7	0.0	0.0	0.1	0.3
2	1	76	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.3	0.8	0.9	1.2	1.0	0.0	0.0	0.2	0.6	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0
2	1	78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.2	0.4	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.0	0.0	0.1	0.3
2	1	80	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	1.7	1.6	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	50	0.2	0.4	0.7	0.8	0.0	0.0	0.0	0.0	0.2	0.4	2.1	1.0	0.1	0.3	0.9	0.9	0.1	0.3	0.7	0.7	0.0	0.0	0.0	0.0
2	2	52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	2.1	0.5	0.8	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0
2	2	54	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.2	0.4	1.0	0.9	0.1	0.3	0.2	0.4	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0
2	2	56	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.6	0.8	2.5	2.6	0.0	0.0	0.0	0.0	0.4	0.5	0.0	0.0	0.0	0.0	0.1	0.3
2	2	58	0.5	1.0	0.9	1.3	0.0	0.0	0.0	0.0	0.6	1.0	1.0	1.1	0.1	0.3	1.1	1.0	0.2	0.4	0.7	0.8	0.0	0.0	0.0	0.0
2	2	60	0.1	0.3	0.7	0.8	0.0	0.0	0.0	0.0	0.7	0.7	1.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
2	2	62	0.2	0.4	0.6	0.7	0.0	0.0	0.0	0.0	0.5	0.7	0.7	0.8	0.0	0.0	1.1	1.1	0.0	0.0	0.1	0.3	0.0	0.0	0.4	1.0
2	2	64	0.3	0.7	1.1	1.2	0.0	0.0	0.0	0.0	0.2	0.4	0.2	0.4	0.1	0.3	0.3	0.5	0.3	0.5	0.4	0.7	0.0	0.0	0.0	0.0

TABLE 2.9. (CONTINUED)

CRUP	ITIME	CFLD	BEB	SD	BEBN	SD	BLKBEB	SD	BLKBN	SD	UR	SD	ORN	SD	LB	SD	LBL	SD	NAB	SD	NABN	SD	CONVG	SD	NEURL	SD
2	2	66	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3	1.0	1.2	2.1	1.3	0.1	0.3	0.4	0.8	0.4	0.5	0.4	0.7	0.0	0.0	0.1	0.3
2	2	68	0.0	0.0	0.5	1.0	0.0	0.0	0.0	0.0	0.8	0.9	0.3	0.7	0.0	0.0	0.7	1.1	0.5	0.7	0.6	0.5	0.0	0.0	0.0	0.0
2	2	70	0.2	0.4	0.5	0.7	0.0	0.0	0.0	0.0	1.1	1.0	2.4	1.7	0.0	0.0	0.0	0.0	0.2	0.4	0.8	1.0	0.0	0.0	0.1	0.3
2	2	72	0.0	0.0	0.4	0.7	0.2	0.4	0.0	0.0	1.8	1.8	1.0	0.8	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	74	0.2	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3	1.8	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.7	0.0	0.0	0.0	0.0
2	2	76	0.3	0.7	0.4	0.7	0.1	0.3	0.5	0.8	0.1	0.3	1.7	0.8	0.0	0.0	0.0	0.0	0.2	0.4	0.3	0.5	0.0	0.0	0.1	0.3
2	2	78	0.0	0.0	0.4	1.0	0.1	0.3	0.0	0.0	0.3	0.9	1.9	1.7	0.0	0.0	0.6	1.3	1.4	1.9	0.0	0.0	0.0	0.0	0.0	0.0
2	2	80	0.0	0.0	0.5	1.0	0.1	0.3	0.0	0.0	1.6	1.1	0.5	0.5	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
2	3	50	0.6	1.0	0.3	0.5	0.0	0.0	0.1	0.3	1.1	0.9	0.8	0.8	0.1	0.3	0.5	1.0	0.4	0.5	0.5	0.5	0.0	0.0	0.0	0.0
2	3	52	0.0	0.0	0.4	0.5	0.1	0.3	0.0	0.0	0.7	0.8	1.1	0.9	0.1	0.3	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0
2	3	54	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.1	0.3	0.1	0.3	0.3	0.5	0.6	0.8	0.0	0.0	0.0	0.0
2	3	56	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	1.5	1.1	4.7	2.4	0.0	0.0	0.5	0.5	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0
2	3	58	0.1	0.3	1.3	1.2	0.0	0.0	0.0	0.0	0.5	0.5	0.4	0.7	0.1	0.3	0.4	0.7	0.2	0.4	0.4	0.5	0.0	0.0	0.0	0.0
2	3	60	0.0	0.0	0.6	0.8	0.1	0.3	0.0	0.0	0.8	1.0	3.3	1.9	0.0	0.0	0.7	1.3	0.0	0.0	0.8	1.0	0.0	0.0	0.1	0.3
2	3	62	0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.0	0.3	0.5	1.8	0.9	0.0	0.0	0.5	0.7	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0
2	3	64	0.5	0.5	0.7	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.2	0.4	0.1	0.3	0.4	0.7	0.0	0.0	0.0	0.0
2	3	66	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	1.3	1.2	3.5	1.7	0.0	0.0	0.4	0.5	0.3	0.5	0.5	0.5	0.0	0.0	0.0	0.0
2	3	68	0.2	0.4	0.6	0.7	0.0	0.0	0.0	0.0	0.4	0.7	0.7	1.3	0.0	0.0	0.7	0.7	0.2	0.6	1.0	0.8	0.0	0.0	0.0	0.0
2	3	70	0.2	0.4	0.4	0.8	0.0	0.0	0.0	0.0	1.0	1.3	1.8	1.8	0.0	0.0	0.1	0.3	0.5	0.7	0.7	0.9	0.0	0.0	0.0	0.0
2	3	72	0.0	0.0	0.9	1.4	0.0	0.0	0.1	0.3	0.5	0.7	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.0	0.0	0.0
2	3	74	0.1	0.3	0.5	0.5	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.6	0.0	0.0	0.2	0.4	0.4	0.5	2.3	1.3	0.0	0.0	0.0	0.0
2	3	76	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.6	1.3	1.9	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0
2	3	78	0.0	0.0	0.6	0.7	0.0	0.0	0.0	0.0	1.5	1.5	2.0	2.2	0.0	0.0	0.4	0.7	0.3	0.7	0.2	0.4	0.0	0.0	0.0	0.0
2	3	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	50	0.3	0.5	0.2	0.4	0.0	0.0	0.0	0.0	1.0	0.5	0.4	0.7	0.0	0.0	0.0	0.0	0.4	0.7	1.6	1.1	0.0	0.0	0.0	0.0
2	4	52	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	3.9	1.8	0.3	0.5	0.0	0.0	0.0	0.0	0.5	0.5	0.9	1.0	0.0	0.0	0.0	0.0
2	4	54	0.5	0.7	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
2	4	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.2	0.4	0.0	0.0	0.0	0.0
2	4	58	0.2	0.4	1.6	1.1	0.0	0.0	0.0	0.0	0.5	0.7	0.5	0.7	0.2	0.4	0.1	0.3	0.2	0.4	1.6	1.3	0.0	0.0	0.0	0.0
2	4	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
2	4	62	0.5	0.8	0.3	0.5	0.0	0.0	0.0	0.0	0.5	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3	0.6	0.7	0.0	0.0	0.0	0.0
2	4	64	0.2	0.4	1.4	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.2	0.4	0.8	1.2	0.0	0.0	0.0	0.0
2	4	66	0.0	0.0	0.2	0.4	0.1	0.3	0.0	0.0	0.9	1.0	0.3	0.5	0.0	0.0	0.0	0.0	0.1	0.3	1.0	1.1	0.0	0.0	0.0	0.0
2	4	68	0.4	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.1	0.3	0.4	0.5	0.2	0.4	0.4	1.0	0.3	0.5	0.9	0.6	0.0	0.0	0.0	0.0
2	4	70	0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.0	0.8	0.8	0.6	1.0	0.0	0.0	0.0	0.0	0.5	1.3	2.0	2.1	0.0	0.0	0.0	0.0
2	4	72	0.0	0.0	0.7	1.3	0.0	0.0	0.0	0.0	0.3	0.7	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
2	4	74	0.5	0.8	0.3	0.5	0.0	0.0	0.0	0.0	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.2	1.1	0.0	0.0	0.0	0.0
2	4	76	0.0	0.0	0.1	0.3	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	78	0.0	0.0	0.5	1.0	0.0	0.0	0.1	0.3	0.1	0.3	0.6	0.5	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
2	4	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
2	5	50	0.4	0.5	0.6	0.8	0.0	0.0	0.0	0.0	0.8	0.9	0.2	0.4	0.0	0.0	0.1	0.3	0.2	0.4	1.8	1.1	0.0	0.0	0.0	0.0
2	5	52	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	2.7	1.2	0.6	0.7	0.0	0.0	0.0	0.0	0.2	0.4	1.1	1.1	0.0	0.0	0.0	0.0
2	5	54	0.3	0.5	1.8	2.5	0.0	0.0	0.0	0.0	0.4	0.5	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0
2	5	56	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0
2	5	58	0.3	0.7	0.5	0.7	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	1.1	1.0	0.0	0.0	0.0	0.0
2	5	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0
2	5	62	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.7	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.0	0.0	0.0	0.0
2	5	64	0.2	0.4	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.1	0.3	1.2	1.8	0.0	0.0	0.0	0.0
2	5	66	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	1.5	1.7	0.3	0.5	0.0	0.0	0.0	0.0	0.1	0.3	1.2	1.1	0.0	0.0	0.0	0.0
2	5	68	0.8	0.9	1.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.1	0.3	0.1	0.3	0.6	0.8	2.6	1.7	0.0	0.0	0.0	0.0
2	5	70	0.6	0.5	0.5	0.5	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	1.2	1.4	0.0	0.0	0.0	0.0
2	5	72	0.0	0.0	1.3	1.2	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 2.9. (CONTINUED)

CROP	TIME	CFLO	BEB	SD	BEBN	SD	BLKBEB	SD	BLKBN	SD	OR	SD	ORN	SD	LB	SD	LBL	SD	NAB	SD	NABN	SD	CONVG	SD	NFURL	SD
2	5	74	0.4	0.5	0.3	0.7	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	1.5	1.0	0.0	0.0	0.0	0.0
2	5	76	0.4	0.5	0.9	1.0	0.2	0.4	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3
2	5	78	0.2	0.4	1.0	0.9	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.7	0.9	0.0	0.0	0.2	0.4
2	6	50	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.8	0.6	0.0	0.0	0.0	0.0
2	6	52	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	1.3	1.2	0.2	0.4	0.0	0.0	0.0	0.0	0.2	0.6	2.7	2.2	0.1	0.3	0.1	0.3
2	6	54	0.0	0.0	0.7	1.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0
2	6	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.1	0.7	0.1	0.3	0.0	0.0
2	6	58	0.3	0.7	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	1.3	1.2	0.0	0.0	0.0	0.0
2	6	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.7	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.3	0.5	0.0	0.0	0.0	0.0
2	6	62	0.1	0.3	0.9	1.3	0.0	0.0	0.0	0.0	0.9	0.9	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.4	0.0	0.0	0.1	0.3
2	6	66	0.1	0.3	0.4	0.7	0.0	0.0	0.0	0.0	1.3	0.9	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.5	1.2	1.0	0.0	0.0	0.0	0.0
2	6	68	0.2	0.4	1.7	1.4	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.6	0.1	0.3	0.0	0.0	0.4	0.7	1.7	1.2	0.0	0.0	0.0	0.0
2	6	70	0.5	0.7	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.2	0.0	0.0	0.0	0.0
2	6	72	0.3	0.7	0.9	1.3	0.0	0.0	0.5	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
2	6	74	0.3	0.5	0.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	1.4	1.3	0.0	0.0	0.0	0.0
2	6	76	0.2	0.4	2.6	1.2	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	1.1	1.1	0.0	0.0	0.0	0.0
2	6	78	0.4	0.7	3.0	2.7	0.1	0.3	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.4	0.0	0.0	0.0	0.0

TABLE 2.10.

DESCRIPTIVE STATISTICS OF SPIDERS IN CORN AND SOYBEANS IN ISLE OF WIGHT COUNTY, VIRGINIA, 1975. (SEE APPENDIX TABLE 1.1 FOR EXPLANATION OF MNEMONIC CODES.) SAMPLE SIZE = 10 PER TTIME - CFLD

CROP	TTIME	CFLD	SALT	SD	THOM	SD	ARTH	SD	TETRA	SD	OXY	SD	CLUB	SD	LIMC	SD	LYPI	SD	ANGN	SD	ULO	SD	UNKNO	SD
1	1	49	0.1	0.3	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	1	51	0.5	0.7	0.0	0.0	0.3	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.9
1	1	53	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
1	1	55	0.1	0.3	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
1	1	57	0.1	0.3	0.0	0.0	1.1	1.4	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	1	59	0.2	0.4	0.0	0.0	0.9	0.3	0.4	0.5	0.0	0.0	0.0	0.0	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	1	61	0.0	0.0	0.0	0.0	0.8	0.8	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.6
1	1	63	0.2	0.6	0.2	0.4	1.2	1.3	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	1	65	0.1	0.3	0.0	0.0	0.9	1.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	1	67	0.0	0.0	0.0	0.0	0.8	0.9	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	1	69	0.2	0.4	0.0	0.0	0.9	1.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7
1	1	71	0.4	0.5	0.0	0.0	0.7	0.8	0.1	0.3	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	1	73	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	1	75	0.0	0.0	0.0	0.0	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	1	77	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	1	79	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	49	0.0	0.0	0.1	0.3	0.3	0.7	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	2	51	0.1	0.3	0.0	0.0	0.6	1.0	0.2	0.4	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.8
1	2	53	0.2	0.4	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4
1	2	55	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.7
1	2	57	0.4	0.7	0.2	0.4	0.6	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
1	2	59	0.1	0.3	0.0	0.0	1.1	1.1	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	61	0.1	0.3	0.0	0.0	0.5	0.5	0.0	0.0	0.1	0.3	0.1	0.3	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	63	0.5	0.7	0.0	0.0	0.5	0.5	0.0	0.0	0.1	0.3	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	65	0.0	0.0	0.0	0.0	0.4	0.7	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	2	67	0.0	0.0	0.1	0.3	0.2	0.4	0.4	0.5	0.0	0.0	0.2	0.4	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
1	2	69	0.2	0.4	0.1	0.3	0.0	0.0	0.2	0.4	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.8
1	2	71	1.4	1.0	0.1	0.3	0.4	0.7	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.3
1	2	73	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	75	0.6	0.5	0.1	0.3	0.4	0.5	0.2	0.4	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	2	77	0.5	0.5	0.2	0.4	0.1	0.3	0.2	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0
1	2	79	0.2	0.4	0.0	0.0	0.0	0.0	0.6	0.8	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6
1	3	49	1.2	1.5	0.2	0.6	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
1	3	51	0.7	1.3	0.4	0.5	1.3	1.6	0.2	0.4	0.0	0.0	0.3	0.5	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.3
1	3	53	1.2	1.2	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7
1	3	55	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5
1	3	57	1.0	0.8	0.2	0.4	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	3	59	1.1	1.0	0.4	0.5	0.8	0.9	0.4	0.7	0.0	0.0	0.5	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5
1	3	61	0.6	0.7	0.1	0.3	0.9	0.9	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0
1	3	63	0.8	1.0	0.2	0.4	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7
1	3	65	1.2	0.9	0.2	0.4	0.6	0.7	0.0	0.0	0.0	0.0	0.4	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
1	3	67	0.2	0.4	0.3	0.5	0.8	0.6	0.1	0.3	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
1	3	69	1.0	1.1	0.3	0.7	0.3	0.5	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
1	3	71	1.7	1.7	0.0	0.0	0.6	1.3	0.1	0.3	0.0	0.0	0.5	0.7	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	3	73	0.9	1.1	0.3	0.5	0.5	0.8	0.4	0.7	0.1	0.3	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
1	3	75	1.3	1.3	0.3	0.5	0.5	0.7	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	3	77	0.4	0.5	0.1	0.3	0.4	0.7	0.1	0.3	0.0	0.0	0.3	0.5	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7
1	3	79	0.6	1.0	0.2	0.4	0.1	0.3	0.2	0.4	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	4	49	0.9	1.0	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	4	51	1.5	1.5	0.4	0.5	1.6	1.3	0.5	1.0	0.2	0.4	0.2	0.6	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.8
1	4	53	0.5	0.5	0.4	0.5	0.2	0.4	0.0	0.0	0.2	0.6	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
1	4	55	0.2	0.4	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7

TABLE 2.10. (CONTINUED)

CROP	TTIME	CFLD	SALT	SD	THOM	SD	ARTH	SD	TETRA	SD	OXY	SD	CLUB	SD	LIMC	SD	LYPI	SD	ANGN	SD	ULO	SD	UNKNO	SD
1	4	57	0.8	0.9	0.5	0.5	0.8	0.6	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	4	59	0.5	0.5	0.0	0.0	1.0	0.8	0.1	0.3	0.0	0.0	0.2	0.4	0.5	0.8	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3
1	4	61	0.2	0.4	0.1	0.3	0.3	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.3	0.7	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3
1	4	63	0.2	0.4	0.1	0.3	0.3	0.5	0.0	0.0	0.0	0.0	0.2	0.6	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6
1	4	65	0.6	0.7	0.3	0.5	1.2	1.2	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6
1	4	67	0.3	0.5	0.1	0.3	1.2	1.1	0.3	0.5	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
1	4	69	0.2	0.4	0.1	0.3	0.4	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.4	0.7
1	4	71	1.6	1.4	0.0	0.0	1.2	1.0	0.7	0.5	0.0	0.0	0.4	0.5	0.9	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
1	4	73	0.3	0.7	0.0	0.0	0.2	0.4	0.1	0.3	0.1	0.3	0.1	0.3	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	4	75	0.9	1.0	0.2	0.4	0.2	0.6	0.2	0.4	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5
1	4	77	0.3	0.5	0.3	0.7	0.4	0.7	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	4	79	0.0	0.0	0.2	0.4	0.1	0.3	0.3	0.7	0.0	0.0	0.1	0.3	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7
1	5	49	0.8	1.0	0.1	0.3	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5	51	1.2	1.1	0.2	0.6	0.6	0.5	0.3	0.5	0.0	0.0	0.1	0.3	0.9	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3
1	5	53	0.7	0.7	0.2	0.4	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7
1	5	55	0.5	0.8	0.2	0.4	0.2	0.4	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
1	5	57	0.5	0.7	0.2	0.4	0.7	0.7	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
1	5	59	1.4	1.1	0.2	0.4	1.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8
1	5	61	0.7	1.3	0.4	0.5	1.0	0.9	0.3	0.7	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.2	0.6
1	5	63	0.5	0.8	0.2	0.4	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
1	5	65	0.4	0.7	0.2	0.4	1.1	1.4	0.1	0.3	0.0	0.0	0.2	0.4	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4
1	5	67	0.0	0.0	0.1	0.3	1.1	1.3	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5	69	0.2	0.4	0.1	0.3	0.7	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
1	5	71	0.7	0.7	0.1	0.3	1.1	1.1	0.8	1.2	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5	73	0.2	0.4	0.2	0.4	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5	75	0.7	0.8	0.5	1.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.4
1	5	77	0.3	0.5	0.3	0.7	0.5	0.7	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3
1	5	79	0.4	0.7	0.2	0.4	0.7	1.6	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	50	0.4	0.7	0.5	0.8	0.3	0.7	0.0	0.0	0.1	0.3	0.4	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	1	54	0.3	0.5	0.7	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
2	1	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	58	0.2	0.4	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	60	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	62	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	64	0.0	0.0	0.5	0.7	0.3	0.5	0.1	0.3	0.2	0.4	0.3	0.5	0.1	0.3	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0
2	1	66	0.0	0.0	0.2	0.4	0.2	0.4	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	68	0.2	0.4	1.6	1.7	0.2	0.4	0.1	0.3	0.3	0.7	0.2	0.6	0.6	0.8	0.3	0.5	0.1	0.3	0.0	0.0	0.0	0.0
2	1	70	0.2	0.4	0.2	0.4	0.2	0.4	0.1	0.3	0.0	0.0	0.3	0.7	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.5	0.7
2	1	72	0.2	0.4	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
2	1	74	0.3	0.5	0.8	0.9	0.0	0.0	0.4	0.5	0.2	0.6	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.3
2	1	76	0.3	0.5	0.8	1.0	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	78	0.1	0.3	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.2	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	1	80	0.0	0.0	0.3	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2	50	0.2	0.4	1.3	1.3	0.0	0.0	0.3	0.7	0.1	0.3	0.2	0.4	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	2	52	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	2	54	0.5	1.3	1.7	1.8	0.1	0.3	0.1	0.3	0.4	0.5	0.1	0.3	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.7	1.6
2	2	56	0.4	0.8	0.6	0.5	0.0	0.0	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	2	58	1.0	1.1	0.2	0.6	0.3	0.7	0.5	0.8	0.6	1.6	0.2	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7
2	2	60	0.1	0.3	0.5	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	2	62	0.4	0.7	0.9	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	2	64	0.2	0.4	0.3	0.7	1.3	3.1	0.2	0.4	0.5	0.8	1.1	1.5	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.5	0.7

TABLE 2.10. (CONTINUED)

CROP	TTIME	CFLD	SALT	SD	THOM	SD	ARTH	SD	TETRA	SD	OXY	SD	CLUB	SD	LIMC	SD	LYPI	SD	ANGN	SD	ULO	SD	UNKNO	SD
2	2	66	0.2	0.4	0.7	0.7	0.0	0.0	0.2	0.4	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
2	2	68	0.6	0.7	1.7	1.5	0.5	0.7	0.1	0.3	0.4	0.7	0.5	0.7	0.2	0.4	0.5	0.7	0.1	0.3	0.0	0.0	0.8	1.6
2	2	70	0.7	0.7	0.6	0.7	0.1	0.3	0.1	0.3	0.0	0.0	0.1	0.3	0.4	0.7	0.1	0.3	0.1	0.3	0.0	0.0	0.3	0.7
2	2	72	0.5	0.8	0.7	0.8	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	2	74	0.0	0.0	0.7	0.9	0.1	0.3	0.0	0.0	0.2	0.4	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7
2	2	76	0.3	0.5	1.5	1.6	0.0	0.0	0.1	0.3	0.1	0.3	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6
2	2	78	0.1	0.3	0.7	0.7	0.0	0.0	0.2	0.4	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7
2	2	80	0.2	0.4	0.3	0.5	0.1	0.3	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	3	50	0.0	0.0	0.8	0.9	0.3	0.5	0.3	0.7	0.3	0.7	0.4	0.7	0.3	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.3	0.5
2	3	52	0.2	0.4	0.2	0.4	0.3	0.7	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
2	3	54	0.1	0.3	1.4	1.8	0.1	0.3	0.2	0.6	0.1	0.3	0.2	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5
2	3	56	0.3	0.5	0.7	0.9	0.1	0.3	0.1	0.3	0.0	0.0	0.2	0.4	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	3	58	0.2	0.6	0.5	0.7	0.1	0.3	0.2	0.6	0.2	0.4	0.3	0.5	0.5	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
2	3	60	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.2	0.4	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0
2	3	62	0.0	0.0	0.4	0.7	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	3	64	0.2	0.6	0.3	0.7	0.5	0.7	0.4	0.5	0.1	0.3	0.2	0.4	0.4	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.4	0.7
2	3	66	0.3	0.5	0.6	0.8	0.1	0.3	0.0	0.0	0.1	0.3	0.2	0.4	0.3	0.5	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
2	3	68	0.1	0.3	1.0	1.2	0.2	0.4	0.0	0.0	0.1	0.3	0.1	0.3	0.3	0.7	0.3	0.7	0.0	0.0	0.0	0.0	1.9	2.6
2	3	70	0.3	0.5	0.7	0.9	0.0	0.0	0.1	0.3	0.0	0.0	0.3	0.7	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
2	3	72	0.2	0.6	1.9	1.7	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
2	3	74	0.0	0.0	1.2	1.7	0.2	0.4	0.1	0.3	0.3	0.7	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	3	76	0.1	0.3	1.4	1.4	0.0	0.0	0.0	0.0	0.2	0.6	0.2	0.4	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
2	3	78	0.3	0.5	0.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
2	3	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	50	0.0	0.0	0.6	0.7	0.2	0.4	0.1	0.3	0.1	0.3	0.2	0.4	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
2	4	52	0.2	0.4	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	4	54	0.5	0.8	0.7	1.2	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	4	56	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	58	0.7	0.7	1.2	1.1	0.2	0.4	0.3	0.5	0.4	0.5	0.1	0.3	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.4	0.5
2	4	60	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	62	0.0	0.0	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	64	0.5	0.7	0.3	0.5	1.0	1.2	0.1	0.3	0.8	1.5	0.6	0.7	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3
2	4	66	0.4	0.5	0.9	0.9	0.1	0.3	0.0	0.0	0.5	0.7	0.5	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	68	0.2	0.4	1.3	1.9	0.2	0.4	0.3	0.7	1.1	1.5	0.3	0.5	0.3	0.7	0.2	0.4	0.0	0.0	0.0	0.0	0.4	0.8
2	4	70	0.5	0.5	0.9	1.4	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	72	0.2	0.4	0.9	0.7	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4	74	0.3	0.5	0.7	1.1	0.0	0.0	0.0	0.0	0.5	0.8	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.6
2	4	76	0.1	0.3	0.8	1.0	0.1	0.3	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	4	78	0.1	0.3	0.8	0.9	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	4	80	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5	50	0.2	0.4	1.5	1.1	0.2	0.4	0.4	0.7	0.2	0.4	0.8	1.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	5	52	0.2	0.4	0.4	0.8	0.1	0.3	0.3	0.7	0.2	0.4	0.1	0.3	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3
2	5	54	0.0	0.0	0.6	0.7	0.0	0.0	0.1	0.3	0.2	0.4	0.2	0.6	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.3
2	5	56	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5	58	0.3	0.7	0.7	0.9	0.1	0.3	0.3	0.9	0.3	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5	60	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5	62	0.1	0.3	0.4	0.7	0.1	0.3	0.2	0.4	0.1	0.3	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	5	64	0.5	0.7	0.0	0.0	1.0	1.5	0.2	0.4	0.0	0.0	0.4	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.0
2	5	66	0.1	0.3	0.4	0.5	0.0	0.0	0.0	0.0	0.2	0.4	0.2	0.4	0.1	0.3	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0
2	5	68	0.4	0.5	1.2	1.9	1.4	1.6	0.3	0.7	0.2	0.4	0.6	0.8	0.7	0.8	1.0	1.2	0.1	0.3	0.0	0.0	0.3	0.7
2	5	70	0.3	0.5	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0
2	5	72	0.0	0.0	0.6	0.9	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 2.10 (CONTINUED)

CROP	TTIME	CFLD	SALT	SD	THUM	SD	ARTH	SD	TETRA	SD	OXY	SD	CLUB	SD	LIMC	SD	LYPI	SD	ANGN	SD	ULO	SD	UNKNU	SD
2	5	74	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.3	0.7	0.2	0.4	0.2	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4
2	5	76	0.3	0.5	0.6	0.7	0.0	0.0	0.1	0.3	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5	78	0.1	0.3	0.7	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
2	5	60	0.0	0.0	0.2	0.6	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	6	50	0.1	0.3	0.8	0.9	0.2	0.4	0.2	0.4	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	6	52	0.1	0.3	0.6	0.9	0.4	1.0	0.3	0.7	0.3	0.7	0.6	1.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	6	54	0.1	0.3	0.4	0.7	0.0	0.0	0.0	0.0	0.4	0.7	0.5	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
2	6	56	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	6	58	0.2	0.4	0.3	0.5	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	6	60	0.0	0.0	0.2	0.6	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	6	62	0.1	0.3	0.6	0.8	0.0	0.0	0.1	0.3	0.0	0.0	0.2	0.6	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	6	66	0.2	0.4	0.3	0.7	0.1	0.3	0.0	0.0	0.2	0.4	0.3	0.5	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.5	1.0
2	6	68	0.2	0.4	1.5	1.8	1.5	1.1	0.4	0.7	0.4	0.7	0.3	0.5	0.9	1.3	0.8	0.9	0.0	0.0	0.0	0.0	0.2	0.4
2	6	70	0.2	0.4	0.4	0.7	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
2	6	72	0.0	0.0	0.4	0.7	0.2	0.4	0.0	0.0	0.1	0.3	0.0	0.0	0.4	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	6	74	0.4	0.5	0.3	0.7	0.1	0.3	0.1	0.3	0.0	0.0	0.2	0.4	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
2	6	76	0.4	0.7	0.2	0.4	0.1	0.3	0.1	0.3	0.0	0.0	0.3	0.7	0.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
2	6	78	0.1	0.3	0.5	0.8	0.2	0.6	0.3	0.5	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.8

TABLE 2.11.

DESCRIPTIVE STATISTICS OF CORN EARWORM NUMBERS AND SOYBEAN PLANT CHARACTERISTICS, IN VIRGINIA; SORTED BY YEAR, COUNTY, TTIME AND CODE FIELD(CFLD). IW=ISLE OF WIGHT CO., W=WESTMORELAND CO., MEANS AND STANDARD DEVIATIONS ARE BASED ON N=10. SEE APPENDIX TABLE 1.1 FOR EXPLANATION OF MNEMONIC CODES.

YR	CO	TTIME	CFLD	CEWNO	SD	PL	SD	PW	SD	PLWV	SD	ROWHT	SD	SPACE	SD	VOL	SD
74	IW	1	2	0.0	0.0	1.710	0.409	0.154	0.010	0.265	0.071	37.4	2.5	4.4	3.6	36407.2	5257.0
74	IW	1	4	0.1	0.3	0.994	0.313	0.116	0.024	0.121	0.058	33.3	7.1	0.0	0.0	41410.8	9202.0
74	IW	1	6	0.0	0.0	0.121	0.206	0.022	0.037	0.009	0.017	37.8	5.3	5.1	5.5	37510.6	6553.1
74	IW	1	8	0.0	0.0	0.072	0.153	0.008	0.016	0.003	0.007	29.4	4.9	3.9	5.6	28759.5	6654.6
74	IW	1	10	0.0	0.0	1.648	0.391	0.146	0.020	0.242	0.077	41.5	2.0	2.7	4.4	42794.1	6120.1
74	IW	1	12	0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	31.7	3.9	8.6	6.1	23697.7	6340.0
74	IW	1	14	0.0	0.0	2.787	0.753	0.199	0.030	0.572	0.237	34.6	4.3	0.8	2.5	36972.9	4725.0
74	IW	1	16	0.0	0.0	2.423	0.459	0.220	0.035	0.529	0.113	43.1	1.7	0.0	0.0	47679.7	4661.9
74	IW	1	18	0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	39.5	1.2	8.0	7.3	32423.0	9027.4
74	IW	1	20	0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	26.2	2.1	21.9	2.8	11937.4	3017.5
74	IW	1	22	0.0	0.0	0.175	0.354	0.029	0.049	0.019	0.042	31.6	3.4	2.9	3.4	15271.6	4544.4
74	IW	1	24	0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	33.6	3.1	8.5	2.3	22234.1	4145.2
74	IW	2	2	0.3	0.7	3.820	0.331	0.288	0.001	1.090	0.312	37.3	5.3	4.0	3.9	37126.5	8091.2
74	IW	2	4	0.4	0.7	3.426	0.609	0.175	0.046	0.620	0.243	39.4	7.5	0.0	0.0	46079.9	8677.4
74	IW	2	6	0.4	0.5	1.668	0.639	0.122	0.015	0.212	0.109	47.4	1.6	1.4	3.0	52633.6	6535.7
74	IW	2	8	0.1	0.3	1.242	0.511	0.106	0.021	0.142	0.076	32.9	8.0	1.4	3.0	32481.0	6711.6
74	IW	2	10	0.4	0.7	3.893	0.440	0.156	0.029	0.622	0.161	42.0	3.8	1.0	2.2	45860.5	4564.8
74	IW	2	12	0.7	0.9	1.169	0.424	0.109	0.011	0.130	0.054	28.1	4.9	0.0	0.0	28787.4	3746.2
74	IW	2	14	0.1	0.3	3.826	0.374	0.211	0.070	0.814	0.315	29.6	3.8	0.0	0.0	32594.1	4651.9
74	IW	2	16	0.1	0.3	3.938	0.411	0.306	0.029	1.204	0.163	42.8	1.9	0.0	0.0	49442.3	3677.3
74	IW	2	18	0.3	0.5	0.376	0.055	0.061	0.015	0.023	0.007	39.7	3.5	0.3	0.9	47370.6	3319.9
74	IW	2	20	0.2	0.4	0.368	0.057	0.061	0.011	0.022	0.005	30.6	2.5	14.3	3.9	21453.4	4032.5
74	IW	2	22	0.0	0.0	1.539	0.900	0.122	0.028	0.207	0.145	35.1	3.8	2.5	2.9	17618.9	5036.0
74	IW	2	24	0.4	0.7	0.709	0.363	0.091	0.022	0.069	0.047	35.0	6.8	3.0	3.9	28892.2	7114.0
74	IW	3	2	0.2	0.4	4.100	0.401	0.537	0.076	2.214	0.443	38.0	3.7	2.5	3.3	39071.1	6989.4
74	IW	3	4	0.7	1.1	3.961	0.400	0.324	0.072	1.279	0.284	37.6	7.5	0.0	0.0	42724.9	6031.4
74	IW	3	6	1.5	1.2	4.098	0.261	0.278	0.077	1.138	0.321	47.5	4.9	1.5	3.4	51379.8	10977.3
74	IW	3	8	0.8	1.0	4.490	0.293	0.249	0.074	1.121	0.344	35.0	5.6	0.0	0.0	36067.6	4121.6
74	IW	3	10	0.3	0.5	4.359	0.361	0.308	0.098	1.343	0.455	43.2	3.2	0.8	1.9	40858.2	5168.2
74	IW	3	12	1.3	1.3	3.097	0.307	0.171	0.063	0.678	0.299	29.7	3.4	1.2	3.2	30448.2	5618.8
74	IW	3	14	0.5	0.7	4.544	0.254	0.358	0.077	1.625	0.334	31.3	4.6	0.0	0.0	33202.5	3440.2
74	IW	3	16	0.1	0.3	4.314	0.359	0.589	0.059	2.549	0.392	42.0	1.5	0.0	0.0	42054.9	2490.3
74	IW	3	18	3.1	2.4	3.990	0.427	0.158	0.029	0.630	0.125	39.2	3.9	0.4	1.3	44921.7	5191.0
74	IW	3	20	1.9	1.9	2.546	0.649	0.119	0.015	0.311	0.121	28.9	3.0	11.0	5.1	22342.1	5406.0
74	IW	3	22	0.0	0.0	3.891	0.379	0.275	0.115	1.095	0.530	36.7	3.7	0.4	0.8	15800.4	2675.0
74	IW	3	24	2.7	1.6	3.823	0.250	0.221	0.060	0.851	0.253	40.1	5.8	1.0	3.2	33703.5	6060.3
74	W	1	26	0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	27.7	3.0	4.4	3.4	18000.3	4179.0
74	W	1	28	0.0	0.0	1.866	0.463	0.133	0.021	0.252	0.094	33.1	2.4	0.6	1.9	40485.9	4949.5
74	W	1	30	0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	26.6	3.1	11.8	4.9	23901.8	6800.3
74	W	1	32	0.0	0.0	3.007	0.581	0.159	0.022	0.486	0.147	34.4	2.8	3.5	6.3	37550.1	6530.5
74	W	1	34	0.0	0.0	0.642	0.193	0.077	0.019	0.051	0.024	34.6	2.7	7.6	5.7	31605.1	6315.2
74	W	1	36	0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	29.5	4.6	0.8	2.5	27268.3	4418.0
74	W	1	38	0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	24.8	3.0	7.7	3.2	10283.4	3391.1
74	W	1	40	0.0	0.0	0.501	0.169	0.077	0.021	0.041	0.024	28.7	2.3	0.0	0.0	29668.5	2248.8
74	W	1	42	0.0	0.0	0.870	0.469	0.098	0.028	0.091	0.058	31.1	2.2	0.0	0.0	30067.6	2471.7
74	W	1	44	0.0	0.0	1.193	0.352	0.129	0.025	0.161	0.069	30.0	2.1	0.0	0.0	37503.7	3160.6
74	W	1	46	0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	35.7	1.5	0.0	0.0	32673.7	1645.8
74	W	1	48	0.0	0.0	1.107	0.493	0.104	0.030	0.125	0.077	31.1	2.0	0.0	0.0	26823.7	1972.3
74	W	2	26	0.0	0.0	1.493	1.818	0.134	0.200	0.461	1.218	32.4	2.2	3.3	4.1	22910.7	4872.8
74	W	2	28	0.0	0.0	3.918	0.424	0.293	0.051	1.152	0.271	38.3	2.6	0.0	0.0	46251.0	2705.9
74	W	2	30	0.4	0.8	0.730	0.162	0.102	0.020	0.077	0.027	34.8	1.6	5.0	5.1	36517.0	6758.2
74	W	2	32	0.0	0.0	4.035	0.316	0.266	0.097	1.093	0.482	36.9	1.4	0.3	0.9	43535.7	3538.0

TABLE 2.11. (CONTINUED)

YR	CO	TTIME	CFLD	CEWNO	SD	PL	SD	PW	SD	PLWV	SD	ROWHT	SD	SPACE	SD	VOL	SD
74	W	2	34	0.0	0.0	3.507	0.420	0.168	0.046	0.603	0.233	38.6	1.6	7.3	3.5	35529.0	3650.4
74	W	2	36	0.0	0.0	0.958	0.258	0.097	0.012	0.094	0.029	32.1	5.5	0.0	0.0	31260.6	5743.4
74	W	2	38	0.0	0.0	0.456	0.102	0.073	0.018	0.035	0.016	30.8	3.8	2.0	1.8	16414.0	3947.0
74	W	2	40	0.2	0.6	2.214	0.620	0.122	0.015	0.277	0.109	35.4	1.7	0.0	0.0	37611.0	2071.0
74	W	2	42	0.0	0.0	3.132	0.401	0.144	0.031	0.467	0.163	32.3	4.8	0.4	1.3	29553.0	4747.2
74	W	2	44	0.0	0.0	3.467	0.261	0.189	0.069	0.651	0.233	35.5	2.5	0.0	0.0	44058.0	3395.0
74	W	2	46	0.0	0.0	2.926	1.682	0.112	0.008	0.325	0.173	39.3	2.2	0.0	0.0	34855.9	1845.0
74	W	2	48	0.0	0.0	3.445	0.435	0.175	0.056	0.609	0.230	37.6	2.4	0.0	0.0	33045.0	1912.0
74	W	3	26	0.2	0.4	3.717	0.452	0.230	0.075	0.867	0.359	31.8	4.4	2.8	3.7	22749.4	5260.6
74	W	3	28	0.0	0.0	4.142	0.434	0.527	0.048	2.183	0.318	36.0	2.5	0.0	0.0	42025.2	3335.0
74	W	3	30	0.5	0.7	4.068	0.366	0.240	0.060	0.978	0.251	35.6	5.2	5.3	5.9	37109.7	9132.1
74	W	3	32	0.0	0.0	4.415	0.338	0.602	0.058	2.660	0.351	34.5	2.7	0.5	1.6	37942.2	4194.0
74	W	3	34	0.3	0.5	3.885	0.139	0.478	0.029	1.859	0.150	37.4	3.2	8.3	4.5	32993.8	5914.1
74	W	3	36	0.0	0.0	3.654	0.313	0.213	0.053	0.790	0.280	34.7	3.6	0.0	0.0	32852.8	3223.7
74	W	3	38	0.3	0.5	4.111	0.417	0.231	0.055	0.965	0.307	33.9	3.0	1.3	2.2	19583.1	4364.0
74	W	3	40	1.1	1.1	3.849	0.395	0.370	0.056	1.422	0.240	32.1	2.0	0.8	2.5	31468.3	5166.4
74	W	3	42	0.1	0.3	4.164	0.280	0.440	0.119	1.846	0.555	34.7	2.5	0.0	0.0	32670.9	2121.7
74	W	3	44	0.3	0.5	4.037	0.335	0.538	0.042	2.171	0.230	35.9	2.1	0.0	0.0	44644.0	2652.7
74	W	3	46	0.1	0.3	3.550	0.311	0.310	0.095	1.110	0.362	35.5	2.7	0.5	1.6	30019.9	3550.1
74	W	3	48	0.0	0.0	4.030	0.307	0.443	0.099	1.795	0.471	35.5	2.6	0.0	0.0	29621.8	2676.7
75	IW	1	50	0.0	0.0	3.708	0.480	0.154	0.025	0.582	0.162	39.5	1.7	2.3	4.5	41117.7	6574.0
75	IW	1	52	0.1	0.3	0.000	0.000	0.000	0.000	0.000	0.000	12.9	1.4	23.6	8.6	4332.7	1211.0
75	IW	1	54	0.0	0.0	0.626	0.173	0.082	0.022	0.055	0.028	33.9	7.2	11.4	5.4	27007.1	9496.8
75	IW	1	56	0.0	0.0	0.485	0.086	0.061	0.012	0.030	0.009	22.1	3.7	18.9	2.9	12724.0	3607.1
75	IW	1	58	0.0	0.0	4.042	0.368	0.188	0.056	0.761	0.241	40.8	3.7	0.6	1.9	43693.5	7789.5
75	IW	1	60	0.6	0.8	0.000	0.000	0.000	0.000	0.000	0.000	16.4	3.0	23.7	3.8	7027.0	3308.4
75	IW	1	62	0.1	0.3	0.000	0.000	0.000	0.000	0.000	0.000	17.3	4.5	20.7	8.3	5306.2	2972.4
75	IW	1	64	0.0	0.0	4.205	0.259	0.204	0.104	1.200	0.456	40.6	2.0	0.6	1.3	55547.1	8140.7
75	IW	1	66	1.3	0.9	0.469	0.184	0.052	0.019	0.027	0.012	28.3	4.7	16.8	3.1	17635.5	5186.5
75	IW	1	68	0.3	0.7	3.906	0.315	0.236	0.034	0.921	0.144	42.4	2.6	0.0	0.0	50950.0	3930.0
75	IW	1	70	2.0	1.6	1.856	0.556	0.122	0.008	0.196	0.092	35.0	5.9	10.0	7.3	30268.5	11344.1
75	IW	1	72	0.1	0.3	0.096	0.205	0.011	0.023	0.005	0.012	25.6	7.5	10.9	3.0	5600.5	3390.1
75	IW	1	74	0.5	0.8	4.073	0.269	0.253	0.065	1.030	0.271	46.0	2.4	0.0	0.0	53834.2	5343.4
75	IW	1	76	1.6	1.3	1.020	0.662	0.106	0.016	0.180	0.092	25.0	3.2	13.1	2.1	12285.4	2521.0
75	IW	1	78	0.1	0.3	0.114	0.248	0.014	0.031	0.008	0.020	17.3	3.5	12.0	3.2	6957.3	2567.4
75	IW	1	80	0.2	0.4	0.050	0.158	0.006	0.019	0.003	0.009	16.8	2.9	16.6	3.3	7719.9	2664.4
75	IW	2	50	0.1	0.3	4.081	0.209	0.325	0.068	1.344	0.310	41.5	1.3	0.5	1.1	45923.5	5762.9
75	IW	2	52	1.1	1.4	0.000	0.000	0.000	0.000	0.000	0.000	19.9	1.8	18.9	2.4	11562.5	2599.0
75	IW	2	54	1.4	1.3	2.152	0.950	0.105	0.022	0.230	0.113	34.9	5.1	9.6	7.6	26635.4	7383.0
75	IW	2	56	8.2	4.4	1.447	0.361	0.116	0.035	0.167	0.054	27.0	2.8	15.2	1.2	16191.8	3057.4
75	IW	2	58	0.1	0.3	3.955	0.251	0.394	0.074	1.567	0.351	40.9	2.7	0.9	2.8	38304.3	4217.5
75	IW	2	60	3.1	1.9	0.093	0.196	0.010	0.021	0.005	0.010	25.0	2.9	16.6	2.0	16400.4	2802.6
75	IW	2	62	2.1	2.0	0.052	0.164	0.006	0.019	0.003	0.010	24.4	5.2	18.2	4.2	11115.3	4815.5
75	IW	2	64	0.3	0.5	4.281	0.271	0.345	0.073	1.471	0.292	39.7	2.6	0.0	0.0	32903.5	6387.5
75	IW	2	66	10.6	4.1	1.202	0.239	0.099	0.022	0.123	0.047	30.9	2.8	12.3	2.7	24171.1	5902.1
75	IW	2	68	0.8	0.8	4.105	0.309	0.356	0.064	1.459	0.177	41.3	1.6	0.0	0.0	49351.0	4450.3
75	IW	2	70	4.1	2.9	3.915	0.272	0.183	0.036	0.717	0.152	35.1	6.3	8.8	6.4	28466.6	8793.0
75	IW	2	72	5.1	4.3	0.367	0.150	0.052	0.023	0.022	0.012	24.4	3.1	9.2	3.4	6659.3	3197.4
75	IW	2	74	0.2	0.4	3.690	0.363	0.350	0.066	1.387	0.294	45.4	2.8	1.1	3.5	40969.4	6993.7
75	IW	2	76	2.3	1.5	2.739	0.663	0.124	0.012	0.342	0.099	26.2	4.3	13.0	3.9	13166.6	4804.3
75	IW	2	78	3.0	2.3	0.599	0.464	0.054	0.041	0.049	0.046	20.7	2.7	15.3	4.2	6175.0	3223.7
75	IW	2	80	17.8	10.7	0.896	0.303	0.061	0.021	0.078	0.045	19.9	3.3	16.4	3.5	9349.0	3641.4

TABLE 2.11. (CONTINUED)

YR	CO	TTIME	CFLD	CEWNO	SD	PL	SD	PW	SD	PLWV	SD	ROWHT	SD	SPACE	SD	VOL	SD
75	1W	3	50	0.4	0.5	4.119	0.305	0.420	0.076	1.741	0.396	40.8	1.5	0.7	2.2	42655.3	6075.9
75	1W	3	52	3.9	3.0	0.386	0.216	0.040	0.023	0.020	0.012	25.0	2.2	18.1	2.1	14460.1	2165.9
75	1W	3	54	4.4	2.2	3.060	0.633	0.140	0.045	0.432	0.176	34.5	5.2	10.6	7.0	20409.1	9161.7
75	1W	3	56	23.4	11.5	3.455	0.167	0.144	0.024	0.499	0.092	26.4	1.9	14.5	2.6	16102.3	3297.1
75	1W	3	58	0.0	0.0	4.135	0.320	0.493	0.071	2.044	0.364	40.1	3.4	0.0	0.0	41400.6	5036.9
75	1W	3	60	9.9	4.0	0.734	0.324	0.077	0.027	0.063	0.050	28.9	2.8	14.8	2.1	20371.5	3040.1
75	1W	3	62	8.1	4.6	0.395	0.440	0.043	0.037	0.031	0.054	26.8	4.5	18.8	3.0	11316.6	2515.4
75	1W	3	64	0.5	0.7	4.363	0.335	0.451	0.082	1.977	0.449	39.5	1.2	0.0	0.0	33634.4	5040.7
75	1W	3	66	16.7	9.3	3.674	0.318	0.144	0.030	0.530	0.124	29.9	4.5	12.8	3.3	22347.7	5446.2
75	1W	3	68	0.6	1.0	3.994	0.245	0.434	0.072	1.731	0.290	40.3	2.3	0.0	0.0	45797.4	6206.2
75	1W	3	70	4.7	4.7	3.857	0.304	0.300	0.074	1.162	0.330	35.3	6.3	9.0	6.4	30718.8	11651.1
75	1W	3	72	6.3	5.2	0.650	0.235	0.084	0.028	0.060	0.041	26.8	2.6	7.9	2.8	8376.3	2706.2
75	1W	3	74	0.9	1.2	3.971	0.365	0.504	0.046	2.008	0.311	42.1	2.6	0.6	1.9	48576.3	5607.6
75	1W	3	76	8.3	3.9	4.027	0.292	0.321	0.043	1.297	0.232	26.9	1.7	12.3	2.2	13758.9	2965.5
75	1W	3	78	4.8	2.9	0.972	0.422	0.099	0.026	0.104	0.068	19.3	2.9	11.5	1.9	8660.7	2013.6
75	1W	3	60	0.0	0.0	3.335	1.216	0.231	0.098	0.852	0.583	21.6	4.2	16.3	2.5	10048.9	3157.3

TABLE 2.12.

DESCRIPTIVE STATISTICS OF CORN EARWORM INSTARS IN SHAKE-CLOTH SAMPLES IN SOYBEANS, IN VIRGINIA, SORTED BY YEAR, COUNTY, TTIME, AND CODED FIELD(CFLD). IW=ISLE OF WIGHT CO., W=WESTMORELAND CO. MEANS AND STANDARD DEVIATIONS ARE BASED ON N=10. SEE APPENDIX TABLE 1.1 FOR EXPLANATION OF MNEMONIC CODES.

YR	CO	TTIME	CFLD	ONE	SD	TWO	SD	THREE	SD	FOUR	SD	FIVE	SD	SIX	SD	CEWNO	SD
74	IW	1	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	1	4	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
74	IW	1	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	1	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	1	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	1	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	1	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	1	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	1	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	1	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	1	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	2	2	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7
74	IW	2	4	0.0	0.0	0.1	0.3	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.4	0.7
74	IW	2	6	0.0	0.0	0.2	0.4	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5
74	IW	2	8	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
74	IW	2	10	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.2	0.4	0.0	0.0	0.4	0.7
74	IW	2	12	0.0	0.0	0.0	0.0	0.6	1.0	0.0	0.0	0.0	0.0	0.1	0.3	0.7	0.9
74	IW	2	14	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
74	IW	2	16	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
74	IW	2	18	0.1	0.3	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
74	IW	2	20	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
74	IW	2	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	2	24	0.0	0.0	0.3	0.7	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.4	0.7
74	IW	3	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.2	0.4
74	IW	3	4	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.0	0.0	0.5	0.8	0.7	1.1
74	IW	3	6	0.0	0.0	0.2	0.4	0.8	1.0	0.4	0.5	0.1	0.3	0.0	0.0	1.5	1.2
74	IW	3	8	0.0	0.0	0.0	0.0	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.6	0.8	1.0
74	IW	3	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.3	0.3	0.5
74	IW	3	12	0.0	0.0	0.0	0.0	0.4	0.5	0.5	0.7	0.0	0.0	0.4	0.7	1.3	1.3
74	IW	3	14	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.3	0.5	0.0	0.0	0.5	0.7
74	IW	3	16	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
74	IW	3	18	0.0	0.0	0.1	0.3	0.8	1.0	1.2	1.2	0.6	0.7	0.4	0.7	3.1	2.4
74	IW	3	20	0.0	0.0	0.4	0.5	1.0	1.3	0.2	0.4	0.2	0.4	0.1	0.3	1.9	1.9
74	IW	3	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	IW	3	24	0.0	0.0	0.3	0.5	0.9	1.2	0.8	0.8	0.4	0.5	0.3	0.5	2.7	1.6
74	W	1	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	1	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	2	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	2	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	2	30	0.0	0.0	0.0	0.0	0.3	0.7	0.1	0.3	0.0	0.0	0.0	0.0	0.4	0.8
74	W	2	32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 2.12. (CONTINUED)

YR	CO	TTIME	CFLD	ONE	SD	TWO	SD	THREE	SD	FOUR	SD	FIVE	SD	SIX	SD	CLWNO	SD
74	W	2	34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	2	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	2	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	2	40	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6
74	W	2	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	2	44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	2	46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	2	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	3	26	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.2	0.4
74	W	3	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	3	30	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.3	0.2	0.4	0.0	0.0	0.5	0.7
74	W	3	32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	3	34	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.3	0.0	0.0	0.0	0.0	0.3	0.5
74	W	3	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	W	3	38	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
74	W	3	40	0.0	0.0	0.1	0.3	0.6	0.8	0.2	0.4	0.2	0.4	0.0	0.0	1.1	1.1
74	W	3	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3
74	W	3	44	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.3	0.5
74	W	3	46	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
74	W	3	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	IW	1	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	IW	1	52	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
75	IW	1	54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	IW	1	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	IW	1	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	IW	1	60	0.3	0.7	0.1	0.3	0.3	0.5	0.1	0.3	0.0	0.0	0.0	0.0	0.8	0.8
75	IW	1	62	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
75	IW	1	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	IW	1	66	0.0	0.0	0.7	0.8	0.4	0.5	0.2	0.6	0.0	0.0	0.0	0.0	1.3	0.9
75	IW	1	68	0.0	0.0	0.2	0.6	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.3	0.7
75	IW	1	70	0.2	0.4	0.8	0.8	0.6	0.7	0.1	0.3	0.3	0.7	0.0	0.0	2.0	1.6
75	IW	1	72	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
75	IW	1	74	0.4	0.7	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.5	0.8
75	IW	1	76	0.5	0.7	0.4	0.5	0.5	0.5	0.2	0.4	0.0	0.0	0.0	0.0	1.6	1.3
75	IW	1	78	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
75	IW	1	80	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
75	IW	2	50	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
75	IW	2	52	0.6	1.0	0.3	0.5	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.4
75	IW	2	54	0.1	0.3	0.5	0.8	0.7	0.8	0.0	0.0	0.1	0.3	0.0	0.0	1.4	1.3
75	IW	2	56	2.5	2.1	2.2	2.5	2.1	1.6	1.0	1.4	0.2	0.6	0.2	0.4	8.2	4.4
75	IW	2	58	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
75	IW	2	60	0.5	0.5	0.9	1.1	1.3	1.2	0.1	0.3	0.2	0.4	0.1	0.3	3.1	1.9
75	IW	2	62	0.4	0.7	0.5	0.7	0.8	0.8	0.2	0.4	0.1	0.3	0.1	0.3	2.1	2.0
75	IW	2	64	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
75	IW	2	66	2.1	1.5	3.0	1.3	3.0	2.4	1.5	1.1	0.9	1.1	0.1	0.3	10.6	4.1
75	IW	2	68	0.1	0.3	0.1	0.3	0.2	0.4	0.4	0.7	0.0	0.0	0.0	0.0	0.8	0.8
75	IW	2	70	0.2	0.4	0.4	0.8	0.5	0.5	1.0	1.2	1.6	1.0	0.4	0.7	4.1	2.9
75	IW	2	72	0.1	0.3	1.6	1.6	3.0	2.6	0.4	0.7	0.0	0.0	0.0	0.0	5.1	4.3
75	IW	2	74	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.4
75	IW	2	76	0.2	0.4	0.4	0.5	0.5	0.8	0.3	0.7	0.6	0.7	0.3	0.5	2.3	1.5
75	IW	2	78	0.1	0.3	1.1	1.0	1.3	1.4	0.5	0.8	0.0	0.0	0.0	0.0	3.0	2.3
75	IW	2	80	1.9	1.8	5.5	2.8	4.9	3.9	4.3	4.4	1.1	1.6	0.1	0.3	17.8	10.7

TABLE 2.12. (CONTINUED)

YR	CO	TTIME	CFLD	ONE	SD	TWO	SD	THREE	SD	FOUR	SD	FIVE	SD	SIX	SD	CEWNO	SD
75	1W	3	50	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.1	0.3	0.4	0.5
75	1W	3	52	0.0	0.0	0.8	1.6	1.9	1.3	0.9	0.7	0.3	0.7	0.0	0.0	3.9	3.0
75	1W	3	54	0.1	0.3	0.6	0.7	1.0	1.1	1.0	1.5	0.7	0.7	0.2	0.4	4.4	2.2
75	1W	3	56	1.1	1.0	3.0	2.7	5.1	2.5	6.7	4.4	6.2	3.8	1.3	1.6	23.4	11.5
75	1W	3	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	1W	3	60	0.1	0.3	1.5	0.8	4.5	3.1	2.6	2.4	1.1	0.9	0.1	0.3	9.9	4.0
75	1W	3	62	0.0	0.0	0.5	0.5	3.8	2.1	2.1	1.2	0.9	1.0	0.8	0.8	8.1	4.6
75	1W	3	64	0.0	0.0	0.2	0.4	0.2	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.5	0.7
75	1W	3	66	0.3	0.7	1.2	1.5	4.4	1.8	4.9	4.5	5.0	4.2	0.9	1.3	16.7	9.3
75	1W	3	68	0.0	0.0	0.0	0.0	0.3	0.7	0.1	0.3	0.3	0.5	0.1	0.3	0.8	1.0
75	1W	3	70	0.0	0.0	0.0	0.0	0.7	0.8	1.2	1.5	1.3	1.8	1.5	2.5	4.7	4.7
75	1W	3	72	0.0	0.0	0.9	1.3	3.1	2.6	1.6	2.2	0.7	1.1	0.0	0.0	6.3	5.2
75	1W	3	74	0.0	0.0	0.0	0.0	0.4	0.5	0.2	0.4	0.3	0.7	0.0	0.0	0.9	1.2
75	1W	3	76	0.0	0.0	0.4	0.7	1.0	0.7	3.1	2.5	2.2	1.7	1.6	0.8	8.3	3.9
75	1W	3	78	0.0	0.0	0.1	0.3	0.9	1.2	2.1	1.4	1.7	1.3	0.0	0.0	4.8	2.9
75	1W	3	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2.13. Tests for normality on untransformed and transformed variables of soybean field susceptibility categories: Isle of Wight Co., Virginia, 1975. (See Appendix 1, Table 1.1 for explanation of mnemonic codes.)

Variable	D-max	Probability	Skewness G_1	P-level G_1	Kurtosis G_2	P-level G_2
			Group A, n = 120			
PL	0.1391	0.01	0.715	0.001	-0.792	0.071
LGPL	0.1459	0.01	0.095	0.666	-1.164	0.008
SQPL	0.1313	0.01	0.317	0.151	-1.079	0.014
PW	0.1656	0.01	-0.189	0.392	-0.738	0.092
LGPW	0.1687	0.01	-0.276	0.211	-0.814	0.063
SQPW	0.1685	0.01	-0.270	0.221	-0.807	0.066
PLWV	0.1861	0.01	1.168	0.000	0.352	0.422
LGPLWV	0.1695	0.01	0.966	0.000	-0.215	0.624
SQPLWV	0.1718	0.01	0.998	0.000	-0.123	0.778
VOL	0.0704	0.15	0.177	0.422	-0.703	0.109
LGVOL	0.1150	0.01	-1.122	0.000	1.562	0.000
SQVOL	0.0849	0.05	-0.353	0.110	-0.489	0.264
SPACE	0.0983	0.01	0.216	0.327	-0.051	0.907
LGSPACE	0.0972	0.01	-0.411	0.063	0.186	0.671
SQSPACE	0.0804	0.10	-0.102	0.644	-0.052	0.905
ROWHT	0.1043	0.01	-0.276	0.211	-0.625	0.154
LGROWHT	0.1265	0.01	-0.744	0.001	-0.008	0.985
SQROWHT	0.1094	0.01	-0.508	0.021	-0.394	0.369
			Group B, n = 70			
PL	0.2910	0.01	1.776	0.000	1.740	0.002
LGPL	0.2074	0.01	1.192	0.000	0.404	0.476
SQPL	0.2380	0.01	1.422	0.000	0.888	0.117
PW	0.2396	0.01	1.592	0.000	1.583	0.005
LGPW	0.2263	0.01	1.455	0.000	1.223	0.031
SQPW	0.2276	0.01	1.470	0.000	1.264	0.026
PLWV	0.3782	0.01	2.194	0.000	3.307	0.000
LGPLWV	0.3554	0.01	2.059	0.000	2.613	0.000
SQPLWV	0.3597	0.01	2.091	0.000	2.775	0.000
VOL	0.0824	>0.20	0.348	0.224	-0.365	0.519
LGVOL	0.1105	0.05	-1.007	0.000	1.715	0.002
SQVOL	0.1036	0.10	-0.208	0.468	-0.262	0.644
SPACE	0.1084	0.05	0.447	0.119	0.235	0.679
LGSPACE	0.1154	0.05	-1.003	0.000	2.248	0.000
SQSPACE	0.0855	>0.20	-0.221	0.440	0.544	0.337
ROWHT	0.1094	0.05	0.332	0.246	0.056	0.921
LGROWHT	0.1460	0.01	-0.151	0.598	-0.331	0.559
SQROWHT	0.1282	0.01	0.079	0.783	-0.215	0.705

Table 2.13. (continued)

Variable	D-max	Probability	Skewness G_1	P-level G_1	Kurtosis G_2	P-level G_2
			Group C, n = 20			
PL	0.3815	0.01	0.586	0.253	-1.648	0.097
LGPL	0.3831	0.01	0.544	0.288	-1.758	0.076
SQPL	0.3829	0.01	0.551	0.282	-1.740	0.079
PW	0.3813	0.01	0.575	0.261	-1.716	0.084
LGPW	0.3815	0.01	0.571	0.265	-1.727	0.082
SQPW	0.3815	0.01	0.571	0.265	-1.726	0.082
PLWV	0.3719	0.01	0.839	0.101	-0.899	0.365
LGPLWV	0.3722	0.01	0.831	0.105	-0.927	0.350
SQPLWV	0.3722	0.01	0.831	0.105	-0.926	0.351
VOL	0.1173	>0.20	0.312	0.542	-0.640	0.519
LGVOL	0.0962	>0.20	-0.061	0.905	-0.807	0.416
SQVOL	0.1069	>0.20	0.125	0.807	-0.767	0.439
SPACE	0.1615	0.20	-0.298	0.560	-0.320	0.747
LGSPACE	0.1844	0.10	-0.561	0.273	-0.031	0.975
SQSPACE	0.1731	0.15	-0.433	0.398	-0.187	0.851
ROWHT	0.1244	>0.20	0.173	0.735	-0.979	0.324
LGROWHT	0.1164	>0.20	-0.040	0.938	-0.935	0.346
SQROWHT	0.1207	>0.20	0.066	0.898	-0.970	0.328
			Group D, n = 50			
PL	0.1740	0.01	-0.516	0.125	-0.888	0.180
LGPL	0.1855	0.01	-1.011	0.003	0.524	0.429
SQPL	0.1805	0.01	-0.784	0.020	-0.219	0.740
PW	0.2228	0.01	1.432	0.000	1.643	0.013
LGPW	0.2179	0.01	1.288	0.000	1.160	0.080
SQPW	0.2185	0.01	1.310	0.000	1.234	0.062
PLWV	0.1578	0.01	1.106	0.001	0.950	0.151
LGPLWV	0.1321	0.05	0.603	0.073	-0.334	0.613
SQPLWV	0.1389	0.05	0.735	0.029	-0.040	0.952
VOL	0.1148	0.10	0.482	0.152	-0.683	0.302
LGVOL	0.0752	>0.20	-0.142	0.673	-0.518	0.434
SQVOL	0.0978	>0.20	0.194	0.564	-0.769	0.245
SPACE	0.1841	0.01	-0.341	0.310	-1.114	0.092
LGSPACE	0.2988	0.01	-0.932	0.006	-0.980	0.139
SQSPACE	0.2465	0.01	-0.738	0.028	-1.107	0.095
ROWHT	0.1671	0.01	-0.154	0.647	-1.284	0.052
LGROWHT	0.1728	0.01	-0.336	0.318	-1.085	0.101
SQROWHT	0.1704	0.01	-0.244	0.469	-1.200	0.070

Table 2.13. (continued)

Variable	D-max	Probability	Skewness G_1	P-level G_1	Kurtosis G_2	P-level G_2
			Group E, n = 120			
PL	0.0469	>0.20	0.174	0.430	-0.393	0.369
LGPL	0.0429	>0.20	0.030	0.892	-0.434	0.322
SQPL	0.0403	>0.20	0.094	0.670	-0.423	0.335
PW	0.0630	>0.20	-0.059	0.790	-0.694	0.113
LGPW	0.0656	>0.20	-0.206	0.350	-0.644	0.142
SQPW	0.0649	>0.20	-0.175	0.427	-0.656	0.134
PLWV	0.0395	>0.20	0.200	0.365	-0.306	0.485
LGPLWV	0.0628	>0.20	-0.234	0.290	-0.368	0.401
SQPLWV	0.0513	>0.20	-0.073	0.741	-0.396	0.366
VOL	0.0827	0.05	-0.401	0.070	-0.520	0.235
LGVOL	0.1185	0.01	-0.801	0.000	0.067	0.879
SQVOL	0.0996	0.01	-0.597	0.007	-0.287	0.512
SPACE	0.5307	0.01	5.395	0.000	29.841	0.000
LGSPACE	0.5373	0.01	4.590	0.000	20.298	0.000
SQSPACE	0.5352	0.01	4.862	0.000	23.407	0.000
ROWHT	0.1391	0.01	0.442	0.045	-0.158	0.718
LGROWHT	0.1259	0.01	0.268	0.224	-0.208	0.634
SQROWHT	0.1320	0.01	0.355	0.108	-0.193	0.660

Table 2.14. Tests for normality on untransformed and transformed variables of soybean field susceptibility categories: Isle of Wight Co., Virginia, 1974. (See Appendix 1, Table 1.1 for explanation of mnemonic codes.)

Variable	D-max	Probability	Skewness G_1	P-level G_1	Kurtosis G_2	P-level G_2
			Group A, n = 20			
PL	0.2985	0.01	0.468	0.361	-1.265	0.202
LGPL	0.2953	0.01	0.186	0.716	-1.863	0.060
SQPL	0.2971	0.01	0.273	0.594	-1.694	0.088
PW	0.2724	0.01	0.247	0.630	-1.343	0.176
LGPW	0.2728	0.01	0.218	0.671	-1.395	0.160
SQPW	0.2728	0.01	0.220	0.667	-1.391	0.161
PLWV	0.2837	0.01	0.866	0.091	-0.196	0.843
LGPLWV	0.2882	0.01	0.681	0.184	-0.707	0.476
SQPLWV	0.2874	0.01	0.709	0.166	-0.631	0.525
VOL	0.0714	>0.20	0.258	0.614	-0.536	0.589
LGVOL	0.0650	>0.20	-0.154	0.764	-0.649	0.513
SQVOL	0.0657	>0.20	0.052	0.920	-0.643	0.517
SPACE	0.2124	0.05	-1.178	0.021	1.338	0.177
LGSPACE	0.2456	0.01	-3.114	0.000	11.213	0.000
SQSPACE	0.2279	0.05	-2.149	0.000	5.692	0.000
ROWHT	0.1443	>0.20	-0.110	0.830	-0.757	0.445
LGROWHT	0.1341	>0.20	-0.287	0.575	-0.504	0.612
SQROWHT	0.1443	>0.20	-0.110	0.830	-0.757	0.445
			Group E, n = 200			
PL	0.2213	0.01	-0.850	0.000	-0.818	0.017
LGPL	0.2771	0.01	-1.159	0.000	-0.175	0.609
SQPL	0.2542	0.01	-1.034	0.000	-0.468	0.172
PW	0.1601	0.01	1.168	0.000	0.635	0.063
LGPW	0.1503	0.01	0.962	0.000	0.116	0.735
SQPW	0.1511	0.01	1.000	0.000	0.209	0.540
PLWV	0.1219	0.01	0.959	0.000	0.404	0.238
LGPLWV	0.0866	0.01	0.283	0.100	-0.822	0.016
SQPLWV	0.0856	0.01	0.484	0.005	-0.534	0.119
VOL	0.0249	>0.20	-0.080	0.640	-0.087	0.799
LGVOL	0.0832	0.01	-1.172	0.000	2.323	0.000
SQVOL	0.0516	>0.20	-0.564	0.001	0.600	0.080
SPACE	0.4874	0.01	2.419	0.000	5.181	0.000
LGSPACE	0.4985	0.01	1.882	0.000	1.803	0.000
SQSPACE	0.4953	0.01	2.030	0.000	2.650	0.000
ROWHT	0.0975	0.01	-0.220	0.201	-0.505	0.140
LGROWHT	0.1330	0.01	-0.695	0.000	0.326	0.341
SQROWHT	0.0975	0.01	-0.220	0.201	-0.505	0.140

Table 2.15. Tests for normality on untransformed and transformed variables of soybean field susceptibility categories: Westmoreland Co., Virginia, 1974. (See Appendix 1, Table 1.1 for explanation of mnemonic codes.)

Variable	D-max	Probability	Skewness G_1	P-level G_1	Kurtosis G_2	P-level G_2
Group D, n = 20						
PL	0.1479	>0.20	0.469	0.359	-0.275	0.782
LGPL	0.1483	>0.20	0.330	0.519	-0.511	0.606
SQPL	0.1482	>0.20	0.391	0.445	-0.413	0.677
PW	0.2325	0.01	-0.287	0.575	-1.725	0.082
LGPW	0.2388	0.01	-0.341	0.506	-1.679	0.091
SQPW	0.2375	0.01	-0.330	0.519	-1.688	0.089
PLWV	0.2252	0.05	-0.267	0.602	-1.768	0.075
LGPLWV	0.2403	0.01	-0.393	0.443	-1.643	0.098
SQPLWV	0.2352	0.01	-0.348	0.497	-1.693	0.088
VOL	0.1287	>0.20	0.326	0.525	0.389	0.695
LGVOL	0.1402	>0.20	-0.460	0.369	0.128	0.898
SQVOL	0.1214	>0.20	-0.077	0.880	0.128	0.898
SPACE	0.2706	0.01	-0.121	0.813	-1.824	0.066
LGSPACE	0.2843	0.01	-0.380	0.458	-1.982	0.046
SQSPACE	0.2783	0.01	-0.301	0.556	-1.938	0.051
ROWHT	0.1492	>0.20	-0.439	0.392	-0.288	0.772
LGROWHT	0.1761	0.10	-0.720	0.160	-0.008	0.994
SQROWHT	0.1492	>0.20	-0.439	0.392	-0.288	0.772
Group E, n = 70						
PL	0.0924	0.15	0.097	0.735	-0.346	0.541
LGPL	0.0794	>0.20	-0.116	0.685	-0.186	0.742
SQPL	0.0853	>0.20	-0.020	0.945	-0.278	0.624
PW	0.1159	0.05	0.348	0.225	-1.023	0.071
LGPW	0.1048	0.10	0.223	0.437	-1.085	0.055
SQPW	0.1070	0.05	0.248	0.387	-1.074	0.058
PLWV	0.1013	0.10	0.570	0.047	-0.330	0.561
LGPLWV	0.0701	>0.20	0.104	0.718	-0.670	0.236
SQPLWV	0.0725	>0.20	0.272	0.343	-0.595	0.293
VOL	0.1197	0.05	-0.356	0.215	-0.174	0.758
LGVOL	0.1800	0.01	-1.100	0.000	1.120	0.048
SQVOL	0.1482	0.01	-0.716	0.013	0.314	0.579
SPACE	0.4861	0.01	3.424	0.000	13.740	0.000
LGSPACE	0.5051	0.01	2.137	0.000	3.094	0.000
SQSPACE	0.5000	0.01	2.462	0.000	5.468	0.000
ROWHT	0.1311	0.01	-1.081	0.000	2.818	0.000
LGROWHT	0.1365	0.01	-1.727	0.000	6.309	0.000
SQROWHT	0.1311	0.01	-1.081	0.000	2.818	0.000

Table 2.16. Soil texture of soybean fields in Isle of Wight Co., Virginia, 1974. (See Appendix 1, Table 1.1 for explanation of mnemonic codes.)

	Sand									
Coded Field (CFLD)	Very Coarse (VC)	Coarse (C)	Medium (M)	Fine (F)	Very Fine (VF)	Σ (SAND)	Silt (SILT)	Clay (CLAY)	Texture Classification (TEXCL)1/	pH (pH)
2	0.23	3.72	21.17	37.64	5.79	68.56	20.87	10.56	1	5.6
4	0.17	1.47	7.93	39.08	6.68	55.38	31.11	13.55	1	5.6
6	0.20	2.64	17.07	40.87	8.12	68.91	24.27	6.82	1	5.5
8	0.01	0.50	4.80	46.11	8.59	60.01	27.15	12.84	1	5.6
10	0.06	0.73	7.26	46.16	9.59	63.80	25.94	10.26	1	5.6
12	0.06	1.10	9.22	42.83	5.67	58.88	29.11	12.00	1	5.4
14	0.29	2.48	13.79	42.41	6.93	65.89	24.64	9.47	1	5.9
16	0.16	0.80	3.17	13.65	20.75	38.52	46.93	14.56	4	6.0
18	1.17	5.40	22.88	33.71	11.56	74.71	19.14	6.15	1	5.8
20	0.09	0.56	5.26	49.23	12.52	67.65	24.32	8.02	1	5.3
22	0.16	2.15	20.51	51.81	3.43	78.06	16.17	5.77	3	6.0
24	0.19	2.26	52.33	52.33	4.14	78.01	16.26	5.73	3	5.9

1/ 1 = sand loam

2 = silt loam

3 = loam sand

4 = loan

Table 2.17. Soil texture of soybean fields in Isle of Wight, Co., Virginia, 1974. (See Appendix 1, Table 1.1 for explanation of mnemonic codes.)

	Sand									
Coded Field (CFLD)	Very Coarse (VC)	Coarse (C)	Medium (M)	Fine (F)	Very Fine (VF)	Σ (SAND)	Silt (SILT)	Clay (CLAY)	Texture Classification (TEXCL)[1/]	pH (pH)
50	0.30	3.11	21.64	44.99	5.81	75.85	23.34	1.80	3	5.5
52	0.20	1.31	9.88	38.91	5.24	55.54	34.98	9.48	1	5.7
54	0.30	4.90	24.60	41.40	8.60	79.80	15.60	4.60	3	5.5
56	0.10	0.40	8.05	41.50	5.43	55.53	33.00	11.47	1	5.8
58	0.10	1.01	9.06	45.82	5.74	61.73	32.02	6.24	1	6.4
60	0.00	0.70	6.75	49.45	8.96	65.86	25.08	9.06	1	5.7
62	0.10	1.31	9.39	42.42	4.95	58.18	27.88	13.94	1	5.5
64	0.60	2.21	14.96	40.46	8.84	67.07	23.90	9.04	1	5.7
66	0.70	2.21	14.99	35.11	7.14	60.16	29.58	10.26	1	5.2
68	0.50	1.31	3.71	11.95	16.67	34.14	52.41	13.45	2	5.9
70	0.00	6.05	46.98	27.32	1.01	81.35	9.58	9.07	3	5.7
72	0.70	2.90	26.13	38.74	5.01	73.47	18.72	7.81	1	6.0
74	2.72	6.05	23.59	29.64	9.68	71.67	20.46	7.86	1	5.8
76	3.83	7.96	20.87	25.40	7.46	65.52	29.44	5.04	1	5.8
78	0.05	4.21	20.74	37.68	4.01	67.13	25.00	7.82	1	6.0
80	1.71	1.11	20.77	38.00	4.74	66.33	27.82	5.85	1	6.0

[1/] 1 = sand loam　　3 = loam sand

2 = silt loam　　4 = loam

Table 2.18. Soil texture of soybean fields in Westmoreland Co., Virginia, 1974. (See Appendix 1, Table 1.1 for explanation of mnemonic codes.)

	Sand									
Coded Field (CFLD)	Very Coarse (VC)	Coarse (C)	Medium (M)	Fine (F)	Very Fine (VF)	Σ (SAND)	Silt (SILT)	Clay (CLAY)	Texture Classification (TEXCL)[1]	pH (pH)
26	0.73	9.70	27.37	16.60	2.96	57.38	31.76	10.88	1	5.5
28	0.44	5.48	25.82	17.62	2.28	51.64	36.18	12.15	4	6.2
30	2.37	13.63	30.53	15.40	1.99	63.92	25.01	11.06	1	6.0
32	0.90	11.00	30.01	15.17	1.61	58.69	30.62	10.68	1	5.2
34	0.40	4.25	31.89	24.30	2.11	62.95	27.88	9.15	1	5.7
36	1.15	8.89	20.71	14.40	2.95	48.10	39.70	12.19	4	6.1
38	0.52	1.38	2.71	21.90	16.25	42.76	47.45	9.79	4	6.4
40	0.83	0.97	5.49	33.61	8.45	49.34	38.44	12.22	1	5.7
42	0.88	7.54	26.59	15.68	1.91	52.59	31.72	15.69	1	5.7
44	0.53	7.72	26.39	18.16	2.63	55.44	33.39	11.18	1	5.8
46	1.30	10.18	33.10	14.47	2.22	61.27	30.44	8.29	1	5.8
48	0.60	6.64	30.10	19.29	2.97	59.60	38.55	1.85	1	5.5

[1] 1 = sand loam 3 = loam sand
2 = silt loam 4 = loam

Appendix 3. Main Equations of Regression Analyses

Appendix 3

Regression analyses of corn earworm larvae on soybean measurements. Sample size equals 10. (See Appendix 1, Table 1.1 for explanation on mnemonic codes.)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME 1/	Step 2/	Coefficient of determination R^2	Regression Equation
74	IW	2	1	-	NO VALUE 3/	
			2	3	0.8420	CEWNO = 3.1938 + 0.1900 SPACE - 2.0258 PLWV - 2.5773 LGSPACE
			2	5	0.9144	CEWNO = 0.6201 + 0.3061 SPACE + 0.0001 VOL - 5.9795 PLWV + 17.0821 LGPLWV - 2.5238 LGSPACE
			3	5	0.8879	CEWNO = 43.1135 + 21.9248 LGPL - 1.9627 PLWV + 0.1567 ROWHT - 13.0049 LGVOL - 1.1053 LGSPACE

1/ Calendar dates for TTIMEs:

TTIME	Year	County	Time
1	1974	IW	Aug. 15-17
2	1974	IW	Aug. 24-27
3	1974	IW	Sept. 3-8
1	1974	W	Aug. 20-21
2	1974	W	Aug. 27-29
3	1974	W	Sept. 7-10
1	1975	IW	Aug. 12-19
2	1975	IW	Aug. 20-23
3	1975	IW	Aug. 24-29

2/ Step 5 regression equation only is given unless $R^2 \geq 0.7$ is obtained with fewer steps.

3/ "No value" implies that no corn earworms were found in that TTIME for that field.

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
74	IW	4	1	3	0.9327	CEWNO = 0.4429 + 130.4040 PLWV - 328.4067 LGPLWV
			1	5	0.9968	CEWNO = 0.1559 + 62.7831 LGPL - 16.3086 PL - 40.5591 PW + 253.0110 PLWV - 575.5778 LGPLWV
			2	5	0.8811	CEWNO = 971.3846 + 43.7747 LGPL - 5625.4230 LGPW + 2020.3258 PW - 0.0022 VOL + 232.8521 LGVOL
			3	2	0.7935	CEWNO = 87.9396 + 0.9224 ROWHT - 77.1756 LGROWHT
			3	5	0.8965	CEWNO = -169.8148 + 467.2145 LGPL - 40.5986 PL + 0.0001 VOL - 15.3833 PLWV + 65.8119 LGPLWV
74	IW	6	1	-	NO VALUE	
			2	4	0.7793	CEWNO = -3125.7511 + 1.3600 SPACE - 0.0058 VOL - 14.0055 LGROWHT + 731.7794 LGVOL
			2	5	0.9678	CEWNO = -3650.9688 + 1.4476 SPACE - 0.0067 VOL + 4.4378 PLWV - 0.2414 ROWHT + 850.9426 LGVOL
			3	3	0.8743	CEWNO = -60.8391 + 1.5273 SPACE + 13.1088 LGVOL - 8.5922 LGSPACE
			3	5	0.9534	CEWNO = 544.8887 - 24.0702 PW + 0.0011 VOL + 4.7067 PLWV - 127.2136 LGVOL - 3.4857 LGSPACE

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
74	IW	8	1	-	NO VALUE	
			2	5	0.4552	CEWNO = -29.1883 - 0.5629 PL + 26.8696 PW - 0.0001 VOL - 0.3756 ROWHT + 27.9473 LGROWHT
			3	5	0.7375	CEWNO = -581.9249 - 39.8080 LGPL - 271.7715 LGPW - 0.0015 VOL + 23.1099 PLWV + 146.5960 LGVOL
74	IW	10	1	-	NO VALUE	
			2	4	0.8061	CEWNO = -12.8988 + 88.4744 LGPL + 172.6265 PLWV - 0.1571 ROWHT - 712.6663 LGPLWV
			2	5	0.9221	CEWNO = -80.9711 + 322.8855 LGPL - 19.2758 PL + 252.7120 PLWV - 0.1818 ROWHT - 1034.1119 LGPLWV
			3	3	0.9196	CEWNO = 316.5059 + 2.5133 ROWHT - 258.4244 LGROWHT + 1.3085 LGSPACE
			3	5	0.9922	CEWNO = 277.8562 - 4.7072 PW + 2.1952 ROWHT - 226.5335 LGROWHT + 3.7088 LGPLWV + 1.7106 LGSPACE

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
74	IW	12	1	-	NO VALUE	
			2	3	0.7569	CEWNO = 5.6202 - 70.3278 LGPL + 19.5460 PL - 35.7046 PLWV
			2	5	0.8970	CEWNO = 33.5088 - 128.7153 LGPL + 56.8273 PL - 21837.0077 LGPW + 8794.9224 PW - 267.8527 PLWV
			3	4	0.8845	CEWNO = -52.6635 - 0.3685 SPACE - 0.0006 VOL + 51.7208 LGROWHT - 20.1101 LGPLWV
			3	5	0.9125	CEWNO = -626.9643 + 1.4798 PL - 0.0031 VOL + 1.1539 ROWHT + 153.8505 LGVOL - 33.1994 LGPLWV
74	IW	14	1	-	NO VALUE	
			2	5	0.4877	CEWNO = 49.0628 - 66.5476 LGPL - 115.8834 PW + 0.0002 VOL - 12.0419 LGROWHT + 132.0017 LGPLWV
			3	5	0.6978	CEWNO = 899.8806 + 1853.1509 LGPL - 94.1473 PL + 4293.0157 LGPW - 753.9852 PW - 835.7426 LGPLWV
74	IW	16	1	-	NO VALUE	
			2	5	0.5465	CEWNO = -854.9416 + 2875.2160 LGPW - 965.0037 PW - 6.5964 ROWHT + 656.1439 LGROWHT + 4.8564 LGVOL
			3	3	0.7266	CEWNO = 126.2547 - 336.3115 LGPL + 27.4859 PL - 0.00002 VOL
			3	5	0.9491	CEWNO = 107.3406 - 345.3603 LGPL + 35.6537 PL + 48.7612 PW - 12.02246 PLWV - 1.9230 LGVOL

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
74	IW	18	1	-	NO VALUE	
			2	2	0.8203	CEWNO = 253.2663 + 2.4298 ROWHT - 217.2960 LGROWHT
			2	5	0.9412	CEWNO = 138.3763 - 483.7197 LGPL + 152.0200 PL - 0.0001 VOL + 1.2474 ROWHT - 108.1301 LGROWHT
			3	4	0.7762	CEWNO = 3883.9693 - 0.3773 SPACE + 0.0093 VOL + 17.1219 PLWV - 927.2369 LGVOL
			3	5	0.8947	CEWNO = 6162.6182 + 14303.0684 LGPW - 5271.8493 PW - 0.7658 SPACE + 0.0147 VOL - 1483.6584 LGVOL
74	IW	20	1	-	NO VALUE	
			2	2	0.7722	CEWNO = -6.7008 - 20.4989 LGPL + 2.2392 LGVOL
			2	5	0.9431	CEWNO = 8.9415 - 372.6451 LGPL + 113.4298 PL + 0.1367 SPACE + 0.0001 VOL - 2.9722 LGSPACE
			3	5	0.7522	CEWNO = 36.5200 + 74.6891 LGPL - 597.0649 LGPW - 2.3268 SPACE - 0.0015 VOL + 13.4231 LGSPACE
74	IW	22	1	-	NO VALUE	
			2	-	NO VALUE	
			3	-	NO VALUE	

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
74	IW	24	1	-	NO VALUE	
			2	5	0.7525	CEWNO = 7.9976 - 164.7518 LGPL + 98.2112 PL - 20897.4173 LGPW + 8675.1893 PW - 591.9669 PLWV
			3	4	0.7246	CEWNO = -1162.7817 - 0.0035 VOL - 0.2843 ROWHT + 286.2335 LGVOL + 8.5830 LGSPACE
			3	5	0.8440	CEWNO = -1268.3999 - 0.0037 VOL - 0.4195 ROWHT + 311.8707 LGVOL + 13.7378 LGPLWV + 8.7989 LGSPACE
74	W	26	1	-	NO VALUE	
			2	-	NO VALUE	
			3	3	0.7219	CEWNO = -10.2146 + 3.9861 PL + 56.6672 PW - 65.8638 LGPLWV
			3	5	0.9896	CEWNO = -113.7598 + 186.3630 LGPL + 3340.9800 LGPW - 901.2057 PW + 63.7117 PLWV - 593.9927 LGPLWV
74	W	28	1	-	NO VALUE	
			2	-	NO VALUE	
			3	-	NO VALUE	

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
74	W	30	1	-	NO VALUE	
			2	5	0.4918	CEWNO = 1751.2695 + 0.3729 SPACE - 8.4465 PLWV + 19.4429 ROWHT - 1659.5127 LGROWHT + 32.6112 LGVOL
			3	1	0.7469	CEWNO = -1.9444 + 10.1852 PW
			3	5	0.9829	CEWNO = 1.0866 + 9.2000 LGPL + 0.0530 SPACE + 0.00004 VOL + 35.5259 PLWV - 149.3433 LGPLWV
74	W	32	1	-	NO VALUE	
			2	-	NO VALUE	
			3	-	NO VALUE	
74	W	34	1	-	NO VALUE	
			2	-	NO VALUE	
			3	5	0.6684	CEWNO = -87.7773 + 0.3746 SPACE - 0.00004 VOL - 0.8608 ROWHT + 76.9540 LGROWHT - 3.8516 LGSPACE
74	W	36	1	-	NO VALUE	
			2	-	NO VALUE	
			3	-	NO VALUE	
74	W	38	1	-	NO VALUE	
			2	-	NO VALUE	
			3	5	0.6978	CEWNO = 14.5883 - 1641.1880 LGPW + 569.2083 PW + 1.9460 SPACE + 1.9278 PLWV - 12.4292 LGSPACE

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	coefficient of determination R^2	Regression Equation
74	W	40	1	-	NO VALUE	
			2	5	0.8127	CEWNO = -745.0754 + 1039.1580 LGPL + 158.7921 PL + 15235.4058 LGPW + 3514.1368 PLWV - 17743.3074 LGPLWV
			3	5	0.7819	CEWNO = 2423.3431 + 1364.8249 LGPW - 447.0443 PW - 4.0347 SPACE + 0.0079 VOL - 598.3331 LGVOL
74	W	42	1	-	NO VALUE	
			2	-	NO VALUE	
			3	5	0.4992	CEWNO = -26.0913 + 34.1491 LGPL + 84.1009 LGPW + 0.0001 VOL - 6.4726 PLWV - 0.0761 ROWHT
74	W	44	1	-	NO VALUE	
			2	-	NO VALUE	
			3	3	0.7361	CEWNO = 193.8289 + 8.3922 PW + 2.1974 ROWHT - 176.7947 LGROWHT
			3	5	0.8606	CEWNO = 93.2817 + 206.1607 LGPL - 17.7038 PL + 6.8517 PW + 1.9636 ROWHT - 153.3901 LGROWHT
74	W	46	1	-	NO VALUE	
			2	-	NO VALUE	
			3	5	0.3853	CEWNO = -200.9505 + 646.7577 LGPL - 63.6275 PL + 15.0251 PLWV + 4.9220 LGROWHT - 70.3696 LGPLWV

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
74	W	48	1	-	NO VALUE	
			2	-	NO VALUE	
			3	-	NO VALUE	
75	IW	50	1	-	NO VALUE	
			2	4	0.9645	CEWNO = 293.0187 - 88.4635 PL - 3250.3617 LGPW + 84.7844 PLWV + 962.0552 LGPLWV
			2	5	0.9701	CEWNO = 284.8762 - 86.0640 PL - 3162.8499 LGPW - 0.0245 SPACE + 81.9769 PLWV + 938.6171 LGPLWV
			3	5	0.6993	CEWNO = -1848.0281 + 0.0005 VOL - 18.7058 ROWHT + 1755.6145 LGROWHT - 55.4799 LGVOL - 2.2950 LGSPACE
75	IW	52	1	5	0.1694	CEWNO = 23.9923 - 2.7372 SPACE - 0.0035 VOL + 0.7904 ROWHT - 6.2869 LGVOL + 53.1104 LGSPACE
			2	5	0.8104	CEWNO = -5015.0310 + 98.6215 SPACE - 0.0095 VOL - 43.8750 ROWHT + 1856.9762 LGVOL - 2618.7949 LGSPACE
			3	3	0.7245	CEWNO = -51.1153 + 26.6489 PL + 37.3454 LGROWHT - 964.1216 LGPLWV
			3	5	0.9268	CEWNO = -1453.2149 + 523.0093 LGPL - 157.5098 PL - 378.6454 LGPW - 23.8916 ROWHT + 1450.4353 LGROWHT

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
75	IW	54	1	-	NO VALUE	
			2	1	0.7628	CEWNO = 5.1170 - 7.7602 LGPL
			2	5	0.9424	CEWNO = 12.7958 - 16.9261 LGPL + 1.2946 PL - 0.3898 SPACE - 0.0002 VOL + 3.1392 LGSPACE
			3	3	0.7302	CEWNO = 1.5181 + 13.8091 PW + 0.6867 SPACE - 7.0192 LGSPACE
			3	5	0.9908	CEWNO = 518.8202 - 5539.8595 LGPW + 2078.3750 PW - 0.5190 SPACE + 0.0012 VOL - 117.8740 LGVOL
75	IW	56	1	-	NO VALUE	
			2	4	0.8216	CEWNO = -2616.9976 - 184.0069 PW - 96.1725 SPACE - 164.7485 LGROWHT + 3596.8366 LGSPACE
			2	5	0.8431	CEWNO = -2506.7165 + 6711.8781 LGPW - 2681.7600 PW - 92.5364 SPACE - 155.5420 LGROWHT + 3424.8631 LGSPACE
			3	4	0.8525	CEWNO = 1990.8469 - 54.6260 PLWV - 5.2002 ROWHT - 314.4424 LGVOL - 393.7701 LGSPACE
			3	5	0.8810	CEWNO = 2084.6286 + 1240.3273 LGPW - 11.1387 SPACE - 178.8481 PLWV - 292.1610 LGROWHT - 344.1746 LGVOL
75	IW	58	1	-	NO VALUE	
			2	5	0.5833	CEWNO = 0563.6394 - 0.8385 LGPL - 3.5654 PW - 0.0015 VOL + 0.0495 ROWHT + 136.0066 LGVOL
			3	-	NO VALUE	

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
75	IW	60	1	5	0.2826	CEWNO = 234.1948 + 1.4784 SPACE - 0.0024 VOL + 2.5938 ROWHT - 59.5395 LGROWHT - 158.8271 LGSPACE
			2	5	0.3312	CEWNO = -75.6584 - 19674.5981 LGPW - 6.4511 SPACE - 0.0058 VOL + 199.2998 LGROWHT + 42098.1435 LGPLWV
			3	4	0.8397	CEWNO = 424.7001 - 17.5079 SPACE + 285.3197 LGROWHT - 251.5998 LGVOL + 423.9966 LGSPACE
			3	5	0.9024	CEWNO = 363.2839 + 41.8612 PW - 20.0664 SPACE + 289.9851 LGROWHT - 253.3352 LGVOL + 504.9035 LGSPACE
75	IW	62	1	5	0.6001	CEWNO = 5.4596 - 0.4600 SPACE - 0.0006 VOL + 0.4128 ROWHT - 7.4658 LGROWHT + 7.8275 LGSPACE
			2	3	0.7516	CEWNO = 76.9046 + 28.4868 LGPL + 1.9163 SPACE - 86.5626 LGSPACE
			2	5	0.8205	CEWNO = 41.4335 + 43.4520 LGPL - 1.6355 ROWHT + 117.0147 LGROWHT - 27.2613 LGVOL - 42.6970 LGSPACE
			3	2	0.7552	CEWNO = 81.0017 + 75.4107 PLWV - 18.6194 LGVOL
			3	5	0.9325	CEWNO = -487.2738 - 70.3424 LGPL + 344.2134 PLWV - 9.2051 ROWHT + 533.7230 LGROWHT - 6.8788 LGVOL

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
75	IW	64	1	-	NO VALUE	
			2	4	0.7763	CEWNO = 249.7110 - 4.0602 PW + 0.0008 VOL - 0.1072 ROWHT - 60.0377 LGVOL
			2	5	0.8552	CEWNO = -43.4035 + 58.4846 LGPL + 174.28120 LGPW + 0.0001 VOL - 13.9832 PLWV - 0.0552 ROWHT
			3	5	0.6912	CEWNO = 352.6003 - 48.8326 LGPW + 0.0011 VOL + 2.5402 PLWV + 0.1557 ROWHT - 86.7797 LGVOL
75	IW	66	1	5	0.6553	CEWNO = 61.9782 + 3.8869 ROWHT - 277.5425 LGROWHT + 37.4435 LGVOL + 295.8062 LGPLWV + 58.7771 LGSPACE
			2	5	0.6825	CEWNO = -319.7835 + 108647.9188 LGPW - 43019.8160 PW - 1.7946 SPACE + 0.8262 ROWHT + 125.8091 LGSPACE
			3	4	0.8206	CEWNO = 986.8653 - 9.2152 SPACE + 18.8573 ROWHT - 1188.4160 LGROWHT + 309.6607 LGSPACE
			3	5	0.8330	CEWNO = 1002.4503 + 39.9029 LGPL - 9.3766 SPACE + 19.3894 ROWHT - 1231.5338 LGROWHT + 316.6976 LGSPACE

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
75	IW	68	1	5	0.7690	CEWNO = -263.9264 + 387.3811 LGPL + 1564.6255 LGPW - 31.0023 LGROWHT + 18.3331 LGVOL - 645.6670 LGPLWV
			2	4	0.8086	CEWNO = 2165.9518 + 31.1380 PLWV + 18.1072 ROWHT - 1776.4494 LGROWHT - 179.7705 LGPLWV
			2	5	0.9055	CEWNO = 4812.3124 + 0.0059 VOL + 16.5227 ROWHT - 1664.7255 LGROWHT - 653.9596 LGVOL - 22.2970 LGPLWV
			3	4	0.7142	CEWNO = 1231.6024 + 0.0027 VOL + 0.2886 ROWHT - 292.0043 LGVOL - 18.3176 LGPLWV
			3	5	0.8692	CEWNO = 1286.0144 - 2.8173 PL - 11.2188 PW + 0.0029 VOL + 29.0139 LGROWHT - 311.4208 LGVOL
75	IW	70	1	5	0.5342	CEWNO = 8.4678 - 34.5556 LGPL - 0.7225 SPACE - 0.0003 VOL + 3.4536 PLWV + 15.8610 LGROWHT
			2	1	0.8073	CEWNO = 18.6178 - 0.4136 ROWHT
			2	5	0.9938	CEWNO = 130.9404 - 931.7220 LGPL + 75.8763 PL - 2.6782 ROWHT + 184.2451 LGROWHT + 6.3345 LGVOL
			3	1	0.8394	CEWNO = 29.1339 - 0.6922 ROWHT
			3	5	0.9537	CEWNO = 1269.2817 - 0.9216 SPACE + 0.0041 VOL - 2.4471 ROWHT + 368.3278 LGROWHT - 419.4502 LGVOL

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
75	IW	72	1	2	0.7163	CEWNO = 7.8998 + 0.0002 VOL - 2.3715 LGVOL
			1	5	0.8911	CEWNO = 3.2155 - 0.1105 SPACE + 0.0002 VOL - 0.1620 ROWHT + 10.9069 LGROWHT - 3.8216 LGVOL
			2	4	0.8149	CEWNO = - 1301.8172 - 262.8412 PLWV - 21.6561 ROWHT + 1303.5391 LGROWHT + 14.0702 LGSPACE
			2	5	0.8701	CEWNO = -1455.3291 - 14038.0820 PLWV - 24.1747 ROWHT + 1454.3932 LGROWHT + 32336.4096 LGPLWV + 15.9816 LGSPACE
			3	5	0.6995	CEWNO = -153.7522 + 64.3916 PL + 0.0046 VOL + 29.4154 LGROWHT - 1025.3669 LGPLWV + 68.3580 LGSPACE
75	IW	74	1	3	0.7733	CEWNO = -21.0591 + 3.2545 PL - 24.3190 PLWV + 109.7055 LGPLWV
			1	5	0.9985	CEWNO = -25.5624 + 1.3664 PL + 951.6890 LGPW - 339.8474 PW - 0.0002 VOL + 0.5012 ROWHT
			2	4	0.7302	CEWNO = 29.1598 - 6.4958 PL - 235.3083 LGPW + 19.7321 PLWV - 0.4398 LGSPACE
			2	5	0.8832	CEWNO = -144.1372 - 7.0548 PL - 248.9751 LGPW - 0.0005 VOL + 20.4996 PLWV + 42.4520 LGVOL
			3	3	0.7818	CEWNO = 148.1893 - 5061.2181 LGPW + 1486.2223 PW - 0.3380 SPACE
			3	5	0.9849	CEWNO = 126.7713 - 5620.1826 LGPW + 1655.9617 PW - 0.3865 SPACE - 30.6791 PLWV + 202.5836 LGPLWV

Appendix 3 (continued)

Year (YR)	County (CO)	Coded field (CFLD)	TTIME	Step	Coefficient of determination R^2	Regression Equation
75	IW	76	1	5	0.6490	CEWNO = 196.4381 + 62.9052 LGPL + 0.0020 VOL - 83.2113 PLWV + 44.8302 LGROWHT - 71.7744 LGVOL
			2	5	0.5957	CEWNO = 148.9469 - 39.0287 PL - 13853.5401 LGPW + 4356.4940 PW - 2.9841 LGROWHT + 1004.1368 LGPLWV
			3	5	0.6598	CEWNO = 1258.7350 - 3392.7552 LGPL + 279.0128 PL - 0.0013 VOL + 1.8146 ROWHT - 24.7074 LGSPACE
75	IW	78	1	3	0.5503	CEWNO = 6.9037 + 1.4452 LGPL + 0.2528 SPACE - 8.9699 LGSPACE
				NOT WORKABLE PAST STEP 3 IN TTIME 1		
			2	4	0.7669	CEWNO = 308.0383 - 85.0429 LGPL + 22.5906 PL + 7.2828 ROWHT - 340.1582 LGROWHT
			2	5	0.7938	CEWNO = 290.2261 - 140.8739 LGPL + 45.2114 PL - 67.9328 PLWV + 7.0756 ROWHT - 323.4753 LGROWHT
			3	5	0.7269	CEWNO = 63.7747 - 573.5156 LGPL + 97.3982 PL - 1.2174 SPACE - 2217.0068 PLWV + 6041.1157 LGPLWV
75	IW	80	1	5	0.6627	CEWNO = -348.6768 + 11.5120 SPACE - 4.3300 ROWHT + 29.2837 LGROWHT + 138.2849 LGVOL + 273.9178 LGSPACE
			2	5	0.6975	CEWNO = 6.1588 - 2199.0560 LGPL + 681.0101 PL + 1210.1039 PW - 1895.5597 PLWV + 2.5761 ROWHT
			3		NO VALUE (FIELD SPRAYED)	

Appendix 4. Discriminant Analyses

APPENDIX 4.1. DISCRIMINANT ANALYSIS OF SOYBEAN FIELD SUSCEPTIBILITY TO CORN EARWORM INFESTATIONS: ISLE OF WIGHT CO., VIRGINIA 1975

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BMDP7M  -  STEPWISE DISCRIMINANT ANALYSIS.                                  PROGRAM REVISED APRIL, 1977
HEALTH SCIENCES COMPUTING FACILITY                                          MANUAL DATE  --  1975
UNIVERSITY OF CALIFORNIA, LOS ANGELES


IN THIS VERSION OF BMDP7M
   -- SUBPROBLEMS ARE NOT PERMITTED.
   -- GROUP CODES OR CUTPOINTS MUST BE STATED.
   -- BACKWARD STEPPING IS AVAILABLE. THE USER MAY STATE TWO
      VALUES FOR THE 'ENTER' AND 'REMOVE' PARAMETERS IN THE
      'DISC' PARAGRAPH. THE PROGRAM BEGINS STEPPING USING THE
      FIRST VALUES OF 'ENTER' AND 'REMOVE'. WHEN NO MORE
      STEPPING IS POSSIBLE WITH THESE LIMITS THE PROGRAM
      SWITCHES TO THE SECOND VALUES OF 'ENTER' AND 'REMOVE',
      WHICH, IF LARGE, WILL CAUSE BACKWARD STEPPING.
   -- NEW PARAMETERS IN THE 'PRINT' PARAGRAPH
      'WITH' - TO PRINT WITHIN COVARIANCE MATRIX (ASSUMED NO)
      'POST' - TO PRINT MAHALANOBIS D-SQ. AND POST.PROB.(YES)
      'POINT' - TO PRINT CANONICAL PLOT'S COORDINATES (YES)

   -- 1975 BMDP MANUAL ERROR -
      STATING CANON. IN THE PLOT PARAGRAPH REQUESTS THE PLOT
      OF THE FIRST TWO CANONICAL VARIABLES.  (SPECIFY NO
      CANON. IF A PLOT IS NOT WANTED.)  IF YOU WANT THE
      CANONICAL VARIBLES DEFINED IN TERMS OF THE CONTRASTS
      GIVEN IN THE DISCRIM PARAGRAPH STATE CONTR. IN THE PLOT
      PARAGRAPH.

  PROGRAM CONTROL INFORMATION

        PROBL       TITLE = 'DISCRIMINANT ANALYSIS ON 5 SOYBEAN FIELD GROUPS, 1975'./
        INPUT       VARIABL = 9.
                    FORMAT = '(10X,3F10.5,3F10.3,F10.0,F10.5,A10)'.
                    CASE = 380.
                    UNIT = 8.
                    GROUP = 5./
        VARIABL     NAME = PL, PW, PLWV, SPACE, ROWHT, VOL, GGROUP, CEWNO, TTCFLD.
                    USE= PL, PW, PLWV, SPACE, ROWHT, VOL, GGROUP.
                    LABEL = TTCFLD.
                    GROUPING = GGROUP./
        GROUP       CUTPOINT = 130,190, 210, 260.
                    CODE = 1, 2, 3, 4, 5.
                    NAME = A, B, C, D, E.
                    PRIOR = 0.3421, 0.1579, 0.0526, 0.1316, 0.3158./
        PRINT       CLASS = 1 TO 6./
        DISC        TOL = .001.
                    ENTER = .01.
                    REMOVE = .005./
        END/
```

APPENDIX 4.1. (CONTINUED)

```
PROBLEM TITLE . . . . . . . .DISCRIMINANT ANALYSIS ON 5 SOYBEAN FIELD GROUPS, 1975

NUMBER OF VARIABLES TO READ IN. . . . . . . . . .        9
NUMBER OF VARIABLES ADDED BY TRANSFORMATIONS. .          0
TOTAL NUMBER OF VARIABLES . . . . . . . . . . . .        9
NUMBER OF CASES TO READ IN. . . . . . . . . . . .      380
CASE LABELING VARIABLES . . . . . . . . . . . . .   TTCFLD
LIMITS AND MISSING VALUE CHECKED BEFORE TRANSFORMATIONS
BLANKS ARE. . . . . . . . . . . . . . . . . . . .    ZEROS
INPUT UNIT NUMBER . . . . . . . . . . . . . . . .        8
REWIND INPUT UNIT PRIOR TO READING. . DATA. . .        YES

INPUT FORMAT
      (10X,3F10.5,3F10.3,F10.0,F10.5,A10)


VARIABLES TO BE USED
             1  PL             2  PW             3  PLWV            4  SPACE           5  ROWHT
             6  VOL            7  GGROUP

TOLERANCE. . . . . . . . .    0.001
F-TO-ENTER . . . . . . . .    0.010     0.010
F-TO-REMOVE. . . . . . . .    0.005     0.005
METHOD . . . . . . . . . .        1
MAXIMUM FORCED LEVEL . . .        0
MAXIMUM NUMBER OF STEPS. .       14
GROUPING VARIABLE. . . . .        7
NUMBER OF GROUPS . . . . .        5
PRIOR PROBABILITIES. . . .   0.34210   0.15790   0.05260   0.13160   0.31580
                      BEFORE TRANSFORMATION                                               INTERVAL RANGE
VARIABLE          MINIMUM     MAXIMUM     MISSING     CATEGORY  CATEGORY         GREATER       LESS THAN
NO. NAME          LIMIT       LIMIT       CODE        CODE      NAME             THAN          OR EQUAL TO

 7   GGROUP
                                                      1.00000   A
                                                      2.00000   B
                                                      3.00000   C
                                                      4.00000   D
                                                      5.00000   E

NUMBER OF CASES READ. . . . . . . . . . . . . . .      380
```

APPENDIX 4.1. (CONTINUED)

```
    MEANS

        GROUP =     A              B              C              D              E              ALL GPS.
VARIABLE
  1 PL             1.35340        0.93117        0.19300        2.96800        4.07125        2.29639
  2 PW             0.08262        0.08617        0.02000        0.17000        0.38092        0.18558
  3 PLWV           0.16548        0.23029        0.00975        0.54873        1.55064        0.65820
  4 SPACE         14.17692       12.88333       18.50000        9.66000        0.31667        9.22105
  5 RUNHT         24.09999       25.01667       22.45000       34.95999       41.66666       31.20051
  6 VOL        14099.94141     9516.17183    13021.19922    28522.10938    44214.31250    24726.80719
  7 GGROUP         1.00000        2.00000        3.00000        4.00000        5.00000        2.92105

COUNTS              130.            60.            20.            50.           120.           380.

    STANDARD DEVIATIONS

        GROUP =     A              B              C              D              E              ALL GPS.
VARIABLE
  1 PL             1.23574        1.43343        0.24826        1.03004        0.31556        1.01088
  2 PW             0.05291        0.11264        0.02575        0.08199        0.10400        0.08550
  3 PLWV           0.18533        0.46600        0.01309        0.40537        0.46425        0.37564
  4 SPACE          3.28836        5.21110        2.23607        6.69754        1.55559        3.85671
  5 RUNHT          5.51930        4.40155        3.25212        5.54005        2.99952        4.58687
  6 VOL         6855.63072     4287.15234     2768.67031     9675.82031     8172.52344     7271.51172
  7 GGROUP         0.0            0.0            0.0            0.0            0.0            0.0

    MEANS/ST.DEVS.

        GROUP -     A              B              C              D              E              ALL GPS.
VARIABLE
  1 PL             1.09526        0.64961        0.77741        2.88145       12.90163        2.27168
  2 PW             1.50148        0.76503        0.77664        2.07341        3.66254        2.17047
  3 PLWV           0.89289        0.49420        0.74505        1.35363        3.35304        1.76446
  4 SPACE          4.31124        2.47229        8.27346        1.44336        0.20357        2.39091
  5 RUNHT          4.36649        5.70065        6.90318        6.31041       13.89111        6.81522
  6 VOL            2.05669        2.21970        4.70407        2.94777        5.41012        3.40051
  7 GGROUP         0.0            0.0            0.0            0.0            0.0            0.0
*********************************************************************************************************************

STEP NUMBER    0

   VARIABLE         F TO   FORCE   TOLERANCE   *      VARIABLE          F TO    FORCE     TOLERANCE
                   REMOVE  LEVEL               *                       ENTER    LEVEL
            DF=   4   376                      *                  DF=   4  375
                                               *       1 PL           175.271     1        1.000000
                                               *       2 PW           243.151     1        1.000000
                                               *       3 PLWV         266.086     1        1.000000
                                               *       4 SPACE        250.159     1        1.000000
                                               *       5 RUNHT        281.301     1        1.000000
                                               *       6 VOL          306.869     1        1.000000
```

APPENDIX 4.1. (CONTINUED)

```
STEP NUMBER    1
VARIABLE ENTERED    6 VOL

  VARIABLE            F TO  FORCE   TOLERANCE  *        VARIABLE          F TO   FORCE    TOLERANCE
                     REMOVE LEVEL              *                         ENTER   LEVEL
                 DF=  4  375                   *                   DF=  4  374
   6 VOL            366.009   1     1.000000   *         1 PL         22.230    1        0.944641
                                               *         2 PW         57.624    1        0.999976
                                               *         3 PLWV       68.404    1        0.999405
                                               *         4 SPACE      55.107    1        0.797794
                                               *         5 RUMMI      26.595    1        0.504921

U-STATISTIC OR WILKS' LAMBDA    0.2035504    DEGREES OF FREEDOM   1   4   375
APPROXIMATE F-STATISTIC          366.008     DEGREES OF FREEDOM     4.00  375.00

 F - MATRIX          DEGREES OF FREEDOM =    1  375

              A          B          C          D
B          16.31
C           0.38       3.49
D         142.05     186.31      64.92
E        1070.21     910.77     315.46     164.36

CLASSIFICATION FUNCTIONS

        GROUP =   A            B            C            D            E
VARIABLE
  6 VOL         0.00027      0.00018      0.00025      0.00054      0.00084

CONSTANT       -2.95258     -2.70211     -4.54832     -9.72055    -19.63823

CLASSIFICATION MATRIX

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                         A         B         C         D         E
  A          91.5       119        2         0         9         0
  B           5.0        57        3         0         0         0
  C           0.0        20        0         0         0         0
  D          28.0        21        0         0        14        15
  E          87.5         1        0         0        14       105

TOTAL        63.4       218        5         0        37       120

JACKKNIFED CLASSIFICATION

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                         A         B         C         D         E
  A          90.8       118        3         0         9         0
  B           3.3        58        2         0         0         0
  C           0.0        20        0         0         0         0
  D          28.0        21        0         0        14        15
  E          87.5         1        0         0        14       105

TOTAL        62.9       218        5         0        37       120
```

APPENDIX 4.1. (CONTINUED)

```
STEP NUMBER    2
VARIABLE ENTERED    3 PLWV

  VARIABLE           F TO   FORCE  TOLERANCE  *      VARIABLE          F TO   FORCE    TOLERANCE
                    REMOVE  LEVEL             *                        ENTER  LEVEL
               DF=   4  374                   *                  DF=    4  373
   3 PLWV           68.404    1    0.999405   *      1 PL             24.031    1      0.512210
   6 VOL           113.027    1    0.999405   *      2 PW              5.897    1      0.112554
                                              *      4 SPACE          21.819    1      0.795436
                                              *      5 KUMMT          22.658    1      0.501305

U-STATISTIC OR WILKS' LAMBDA    0.1174957     DEGREES OF FREEDOM   2   4    375
APPROXIMATE F-STATISTIC           179.272     DEGREES OF FREEDOM      8.00  748.00

 F - MATRIX          DEGREES OF FREEDOM =     2  374

                A          B          C          D
B             8.76
C             1.72       4.39
D            91.69     103.96      40.34
E           990.47     720.92     311.91     215.58

CLASSIFICATION FUNCTIONS

         GROUP =    A              B              C              D              E
VARIABLE
  3 PLWV         1.31074        1.70404        0.18733        4.20221       11.59065
  6 VOL          0.00027        0.00018        0.00025        0.00054        0.00085

CONSTANT        -3.07315       -2.92353       -4.55076      -10.94649      -28.98018

CLASSIFICATION MATRIX

GROUP      PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
           CORRECT
                      A          B          C          D          E
 A           93.1    121          1          0          8          0
 B            1.7     56          1          0          3          0
 C            0.0     20          0          0          0          0
 D           58.0     16          0          0         29          5
 E           98.3      0          0          0          2        118

TOTAL        70.8    213          2          0         42        123

JACKKNIFED CLASSIFICATION

GROUP      PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
           CORRECT
                      A          B          C          D          E
 A           93.1    121          1          0          8          0
 B            1.7     56          1          0          3          0
 C            0.0     20          0          0          0          0
 D           58.0     16          0          0         29          5
 E           98.3      0          0          0          2        118

TOTAL        70.8    213          2          0         42        123
```

APPENDIX 4.1. (CONTINUED)

```
STEP NUMBER    3
VARIABLE ENTERED    1 PL

  VARIABLE          F TO   FORCE   TOLERANCE  *        VARIABLE          F TO   FORCE    TOLERANCE
                   REMOVE  LEVEL              *                         ENTER   LEVEL
              DF=   4  373                    *                   DF=   4  372
   1 PL            24.631    1     0.512270   *        2 PH             6.036     1       0.112164
   3 PLNV          11.124    1     0.541900   *        4 SPACE         21.002     1       0.794870
   6 VOL          103.119    1     0.889153   *        5 ROMMT         22.969     1       0.479343

U-STATISTIC OR WILKS' LAMBDA      0.0929452     DEGREES OF FREEDOM    3     4      375
APPROXIMATE F-STATISTIC             119.050     DEGREES OF FREEDOM     12.00      987.16

 F - MATRIX         DEGREES OF FREEDOM =     3   373

             A          B          C          D
B          9.14
C          8.99       4.90
D         65.14      80.62      46.80
E        684.74     483.92     207.39     117.80

CLASSIFICATION FUNCTIONS

       GROUP -    A            B             C             D             E
VARIABLE                                                              -0.47422
  1 PL          1.68083      0.33904      -0.53363       1.89745      12.43591
  3 PLNV       -0.60981      1.10033       1.13849       0.82010       0.00087
  6 VOL         0.03023      0.00017       0.00027       0.00048
                                                                     -29.03903
CONSTANT       -3.37095     -2.95367      -4.62530     -11.89090

CLASSIFICATION MATRIX

GROUP       PERCENT    NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                        A         B          C          D         E
A             83.1     108        11          0         11         0
B             18.3      44        11          0          5         0
C              0.0      20         0          0          0         0
D             60.0      15         0          0         30         5
E             97.5       0         0          0          3       117

TOTAL         70.0     187        22          0         49       122

JACKKNIFED CLASSIFICATION

GROUP       PERCENT    NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                        A         B          C          D         E
A             82.3     107        12          0         11         0
B             15.0      47         9          0          4         0
C              0.0      20         0          0          0         0
D             60.0      15         0          0         30         5
E             97.5       0         0          0          3       117

TOTAL         69.2     189        21          0         48       122
```

APPENDIX 4.1. (CONTINUED)

```
STEP NUMBER    4
VARIABLE ENTERED   5 KURMI

  VARIABLE          F TO  FORCE  TOLERANCE  *      VARIABLE         F TO  FORCE   TOLERANCE
                    REMOVE LEVEL            *                       ENTER  LEVEL
               DF=  4  372                  *                  DF=  4  371
   1 PL            24.002    1    0.469820  *       2 PW            6.562    1      0.111036
   3 PLWV          72.570    1    0.536446  *       4 SPACE        18.857    1      0.792176
   5 KURMI         22.909    1    0.479343  *
   6 VOL           45.233    1    0.496023  *

U-STATISTIC OR WILKS' LAMBDA   0.0745749    DEGREES OF FREEDOM   4    4    375
APPROXIMATE F-STATISTIC           95.162    DEGREES OF FREEDOM   16.00  1137.12

 F - MATRIX         DEGREES OF FREEDOM =    4   372

            A          B          C          D
B         23.99
C          6.75      10.58
D         61.26      80.37      40.68
E        535.62     361.99     162.46     133.01

CLASSIFICATION FUNCTIONS

        GROUP =   A                 B                 C                 D                 E
VARIABLE
  1 PL         -0.51963          -1.03919          -2.16921          -0.05272          -2.43820
  3 PLWV        0.98239           3.14965           2.70650           2.76091          14.39046
  5 KURMI       1.70208           2.10622           1.67701           2.07572           2.09041
  6 VOL        -0.00047          -0.00073          -0.00043          -0.00038           0.00001

CONSTANT      -18.00217         -25.32443         -16.80754         -33.61844         -51.07529

CLASSIFICATION MATRIX

GROUP       PERCENT  NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                       A          B          C          D          E
  A          91.5     119         3          0          8          0
  B          48.3      27        29          0          4          0
  C           0.0      19         1          0          0          0
  D          56.0      17         0          0         28          5
  E          97.5       0         0          0          3        117

TOTAL        77.1     182        33          0         43        122
```

APPENDIX 4.1. (CONTINUED)

```
JACKKNIFED CLASSIFICATION

GROUP      PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
           CORRECT
                        A          B          C          D          E
 A          90.0       117         5          0          8          0
 B          48.3        27        29          0          4          0
 C           0.0        19         1          0          0          0
 D          56.0        17         0          0         28          5
 E          97.5         0         0          0          3        117

TOTAL       76.6       180        35          0         43        122
*********************************************************************************************************

STEP NUMBER    5
VARIABLE ENTERED    4 SPACE

  VARIABLE          F TO   FORCE  TOLERANCE  *         VARIABLE          F TO   FORCE    TOLERANCE
                   REMOVE  LEVEL             *                          ENTER  LEVEL
              DF=   4  371                   *                     DF=   4  370
   1 PL           24.207     1    0.409732   *          2 PW           6.041    1        0.110704
   3 PLWV         60.183     1    0.538005   *
   4 SPACE        18.857     1    0.792110   *
   5 ROWHI        23.071     1    0.477719   *
   6 VOL          39.882     1    0.452671   *

U-STATISTIC OR WILKS' LAMBDA    0.0619746    DEGREES OF FREEDOM    5   4      375
APPROXIMATE F-STATISTIC           80.830     DEGREES OF FREEDOM     20.00  1231.42

 F - MATRIX            DEGREES OF FREEDOM =      5   371

                 A          B          C          D
 B             22.32
 C              9.73      17.54
 D             49.14      49.20      37.33
 E            462.80     297.86     156.59     121.98

CLASSIFICATION FUNCTIONS

          GROUP =    A              B              C              D              E
VARIABLE
   1 PL           -0.41117       -1.54420       -1.97917        0.05144       -2.30374
   3 PLWV          1.51637        3.62200        5.35029        3.27657       14.75909
   4 SPACE         1.59427        1.41207        1.92212        1.53958        1.10059
   5 ROWHI         1.80338        2.19523        1.79617        2.17276        2.15979
   6 VOL          -0.00014       -0.00043       -0.03002       -0.00006        0.00024

 CONSTANT        -32.97726      -37.01219      -40.57491      -47.50376      -58.21194
```

APPENDIX 4.1. (CONTINUED)

```
CLASSIFICATION MATRIX

GROUP      PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
           CORRECT
                      A          B          C          D          E
 A          91.5     119          3          1          7          0
 B          56.7      17         34          4          5          0
 C          30.0      14          0          6          0          0
 D          58.0      17          0          0         29          4
 E          99.2       0          0          0          1        119

TOTAL       80.8     167         37         11         42        123

JACKKNIFED CLASSIFICATION

GROUP      PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
           CORRECT
                      A          B          C          D          E
 A          88.5     115          3          2         10          0
 B          55.0      17         33          5          5          0
 C          30.0      14          0          6          0          0
 D          54.0      18          0          0         27          5
 E          99.2       0          0          0          1        119

TOTAL       78.9     164         36         13         43        124.
********************************************************************************************************

STEP NUMBER    6
VARIABLE ENTERED    2 PW

  VARIABLE         F TO  FORCE  TOLERANCE  *       VARIABLE         F TO  FORCE   TOLERANCE
                  REMOVE LEVEL             *                       ENTER  LEVEL
             DF=   4  370                  *                 DF=  4  369
   1 PL          24.705    1    0.466022   *
   2 PW           6.641    1    0.110704   *
   3 PLWV        23.377    1    0.097617   *
   4 SPACE       18.910    1    0.769810   *
   5 ROWMT       20.082    1    0.473211   *
   6 VOL         39.754    1    0.452627   *

U-STATISTIC OR WILKS' LAMBDA    0.0578230    DEGREES OF FREEDOM    6    4     375
APPROXIMATE F-STATISTIC            68.035    DEGREES OF FREEDOM     24.00  1291.99

 F - MATRIX          DEGREES OF FREEDOM =    6  370

                A          B          C          D
B             20.63
C             10.97      15.06
D             40.93      41.62      32.96
E            389.76     247.70     130.39     103.52  .
```

APPENDIX 4.1. (CONTINUED)

```
CLASSIFICATION FUNCTIONS

           GROUP =    A              B              C              D              E
VARIABLE
  1 PL              -0.20596       -1.40179       -1.94761        0.18546       -2.29846
  2 PW              45.17001       25.05100        9.81674       41.68729       20.30526
  3 PL*V            -8.45088       -2.04241        1.18238       -5.92556       10.27491
  4 SPACE            1.01476        1.42515        1.92657        1.55049        1.10980
  5 ROWNT            1.76382        2.11270        1.78957        2.13626        2.14200
  6 VOL             -0.03014       -0.00040       -0.00002       -0.00005        0.00024

CONSTANT           -33.00292      -37.33044      -40.61397      -48.28699      -58.37877

CLASSIFICATION MATRIX

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                      A          B          C          D          E
 A           83.8     109          3         12          6          0
 B           55.0      16         33          7          4          0
 C           60.0       8          0         12          0          0
 D           58.0      17          0          0         29          4
 E          100.0       0          0          0          0        120

TOTAL        79.7     150         36         31         39        124

JACKKNIFED CLASSIFICATION

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                      A          B          C          D          E
 A           79.2     103          3         13         11          0
 B           53.3      15         32          8          5          0
 C           60.0       8          0         12          0          0
 D           54.0      18          0          0         27          5
 E           99.2       0          0          0          1        119

TOTAL        77.1     144         35         33         44        124
```

APPENDIX 4.1. (CONTINUED)

```
SUMMARY TABLE

 STEP            VARIABLE              F VALUE TO      NUMBER OF            U-STATISTIC    APPROXIMATE     DEGREES OF
NUMBER       ENTERED    REMOVED     ENTER OR REMOVE  VARIABLES INCLUDED                    F-STSTISTIC       FREEDOM
   1         6 VOL                     366.8667            1                 0.2035        366.866       4.00    375.00
   2         3 PLWV                     68.4641            2                 0.1175        179.272       8.00    748.00
   3         1 PL                       24.6309            3                 0.0929        119.656      12.00    987.16
   4         5 HUMMI                    22.9088            4                 0.0746         95.162      16.00   1137.12
   5         4 SPACE                    16.8573            5                 0.0620         80.838      20.00   1231.42
   6         2 PW                        6.6413            6                 0.0578         68.035      24.00   1291.99



                INCORRECT              MAHALANOBIS D-SQUARE FROM AND
              CLASSIFICATIONS          POSTERIOR PROBABILITY FOR GROUP -

GROUP   A                      A                B                C                D                E

  CASE
   1     176      B        4.1 0.458        2.3 0.510        6.4 0.022       10.0 0.009       44.4 0.000
   2     176               3.2 0.694        5.5 0.285       10.4 0.003        8.6 0.018       39.7 0.000
   3     176               2.1 0.764        3.1 0.218        7.8 0.007        8.7 0.011       42.0 0.000
   4     176               2.6 0.897        6.3 0.066       12.1 0.001        7.1 0.036       34.6 0.000
   5     176               1.7 0.790        3.2 0.172        9.3 0.003        6.0 0.035       37.1 0.000
   6     176               3.2 0.973        9.1 0.023       11.1 0.003       14.6 0.001       50.7 0.000
   7     176               4.0 0.970        9.9 0.023       12.1 0.003       12.7 0.005       51.7 0.000
   8     176               1.0 0.895        4.0 0.094        6.9 0.007        9.5 0.005       41.8 0.000
   9     176               1.7 0.875        4.4 0.105       10.0 0.002        7.6 0.018       41.1 0.000
  10     176               3.7 0.674        4.7 0.186       12.6 0.001        4.5 0.139       36.9 0.000
  11     178               8.3 0.603        8.0 0.326        8.8 0.072       22.7 0.000       50.1 0.000
  12     178               6.1 0.468        4.7 0.426        5.3 0.105       19.3 0.000       48.7 0.000
  13     178               6.2 0.364        5.1 0.288        2.5 0.348       20.7 0.000       57.1 0.000
  14     178              11.4 0.806       14.6 0.075       11.5 0.118       30.2 0.000       63.9 0.000
  15     178              12.0 0.804       14.2 0.123       13.0 0.074       29.6 0.000       57.9 0.000
  16     178      B        9.9 0.166        3.2 0.816       10.9 0.015       18.0 0.001       40.0 0.000
  17     178               9.5 0.924        8.1 0.072       11.9 0.004       18.0 0.000       51.7 0.000
  18     178               7.7 0.541        6.8 0.390        8.1 0.069       21.4 0.000       48.5 0.000
  19     178               6.4 0.787        7.5 0.207       12.7 0.005       18.4 0.001       45.0 0.000
  20     178               8.4 0.722       10.4 0.126        7.8 0.152       25.9 0.000       57.4 0.000
  21     180               5.6 0.570        6.8 0.140        3.2 0.290       19.4 0.000       49.5 0.000
  22     180               6.7 0.635        9.0 0.089        4.6 0.275       22.2 0.000       52.8 0.000
  23     180               4.9 0.459        5.2 0.185        1.7 0.356       17.3 0.000       47.9 0.000
  24     180               7.0 0.660        6.1 0.179        6.1 0.161       20.3 0.000       46.5 0.000
  25     180      C       11.8 0.266       17.9 0.006        6.0 0.728       32.0 0.000       72.7 0.000
  26     180               5.8 0.562        7.1 0.101        3.1 0.337       20.7 0.000       52.3 0.000
  27     180               6.9 0.842        3.3 0.112        3.0 0.043       11.1 0.002       43.7 0.000
  28     180               7.2 0.618       10.2 0.061        4.7 0.321       23.7 0.000       55.8 0.000
  29     180               7.2 0.618       10.2 0.061        4.7 0.321       23.7 0.000       55.8 0.000
  30     180      C        8.6 0.287       12.4 0.020        3.1 0.693       26.3 0.000       65.5 0.000
  31     256               2.6 0.794        4.9 0.116        5.7 0.026        5.7 0.063       34.2 0.000
  32     256               2.9 0.780        6.3 0.066        6.2 0.023        4.6 0.131       34.0 0.000
  33     256              18.1 0.993       28.1 0.003       27.4 0.001       26.5 0.002       64.5 0.000
  34     256               2.0 0.933        6.7 0.042        7.6 0.009        6.2 0.016       44.9 0.000
  35     256               1.3 0.853        4.7 0.075        6.0 0.013        4.8 0.060       34.8 0.000
  36     256               2.5 0.830        6.5 0.051        6.1 0.021        4.6 0.098       32.8 0.000
  37     256               1.2 0.858        5.8 0.040        6.1 0.012        3.8 0.091       33.7 0.000
  38     256               2.3 0.865        6.0 0.063        5.8 0.024        6.1 0.049       36.3 0.000
  39     256               2.0 0.961        8.7 0.015        7.3 0.011        6.5 0.015       42.2 0.000
  40     256               2.2 0.873        7.2 0.034        7.1 0.012        5.1 0.081       37.5 0.000
  41     260      C        8.9 0.190        7.3 0.188        2.8 0.617       14.1 0.005       40.7 0.000
  42     260      C        5.8 0.362        7.5 0.070        1.2 0.566       15.8 0.001       43.0 0.000
  43     260      C        6.6 0.208        6.8 0.120        1.4 0.669       14.0 0.003       40.2 0.000
  44     260               4.3 0.593        5.4 0.158        2.4 0.233        9.6 0.016       41.4 0.000
  45     260      C        6.7 0.309        8.0 0.261        4.1 0.414       12.7 0.016       33.2 0.000
  46     260      C        6.9 0.189        7.6 0.172        2.7 0.634       14.1 0.006       40.5 0.000
  47     260      C        6.1 0.331        7.5 0.074        1.2 0.593       15.1 0.001       41.7 0.000
  48     260      C        5.9 0.317        7.6 0.062        0.8 0.621       16.1 0.001       44.6 0.000
  49     260               3.8 0.682        8.7 0.026        1.8 0.290       15.7 0.001       53.7 0.000
  50     260      C        6.7 0.251        6.9 0.110        1.1 0.637       14.4 0.002       42.0 0.000
  51     260               5.0 0.705        8.5 0.055       10.0 0.009        5.3 0.231       29.7 0.000
```

APPENDIX 4.1. (CONTINUED)

52	260		3.2	0.955	9.8	0.010	7.3	0.019	10.6	0.009	46.5	0.000
53	260		4.5	0.504	5.3	0.180	5.8	0.047	5.0	0.182	31.5	0.000
54	260		2.9	0.730	5.2	0.109	4.4	0.053	4.8	0.107	31.7	0.000
55	260		5.0	0.414	8.1	0.063	11.0	0.005	3.6	0.459	26.6	0.000
56	260		3.7	0.725	7.5	0.051	9.6	0.006	4.2	0.218	26.8	0.000
57	260	D	6.4	0.390	8.8	0.054	11.3	0.005	3.8	0.551	21.7	0.000
58	260		6.9	0.424	7.6	0.136	7.7	0.043	5.1	0.398	28.4	0.000
59	260		3.3	0.702	6.7	0.064	7.5	0.014	4.5	0.159	29.3	0.000
60	260		4.4	0.531	7.9	0.042	10.0	0.005	2.9	0.423	26.0	0.000
61	270		1.7	0.815	4.3	0.106	9.8	0.002	7.7	0.017	41.1	0.000
62	270		2.1	0.702	3.5	0.171	9.7	0.003	5.1	0.065	37.9	0.000
63	270		8.8	0.419	11.7	0.032	20.6	0.000	7.0	0.468	31.5	0.000
64	270		4.7	0.756	3.0	0.068	15.8	0.000	5.7	0.176	32.2	0.000
65	270		7.3	0.965	15.7	0.007	13.2	0.008	22.2	0.000	66.4	0.000
66	270		5.8	0.852	9.4	0.060	15.4	0.001	8.6	0.081	43.2	0.000
67	270		4.4	0.918	8.2	0.065	11.9	0.003	10.9	0.014	51.1	0.000
68	270		4.9	0.600	6.8	0.120	13.9	0.001	5.4	0.199	37.8	0.000
69	270		5.5	0.393	5.0	0.231	15.0	0.001	3.7	0.376	31.6	0.000
70	270		6.0	0.859	9.0	0.089	14.3	0.002	9.7	0.050	48.0	0.000
71	278		4.3	0.699	4.5	0.289	14.1	0.001	10.8	0.011	40.2	0.000
72	278		3.2	0.852	5.4	0.133	7.7	0.014	15.3	0.001	56.4	0.000
73	278	C	8.0	0.314	8.6	0.100	3.0	0.579	24.7	0.000	65.5	0.000
74	278		4.0	0.543	3.1	0.401	4.8	0.055	15.1	0.001	55.5	0.000
75	278	B	6.3	0.354	3.8	0.572	5.7	0.074	17.7	0.000	45.2	0.000
76	278		2.9	0.932	6.8	0.062	9.4	0.006	16.3	0.000	53.1	0.000
77	278		3.5	0.915	6.9	0.075	9.0	0.009	17.8	0.000	52.6	0.000
78	278		2.3	0.813	3.7	0.180	8.7	0.005	12.5	0.002	46.5	0.000
79	278		1.7	0.642	1.4	0.344	5.8	0.013	11.3	0.002	43.8	0.000
80	278	C	1.1	0.295	5.3	0.329	2.9	0.376	21.1	0.000	59.1	0.000
81	280		2.0	0.962	7.5	0.029	8.1	0.007	12.3	0.002	49.2	0.000
82	280		7.1	0.939	14.7	0.010	9.2	0.051	23.6	0.000	66.1	0.000
83	280		6.2	0.923	13.9	0.009	7.6	0.008	23.8	0.000	65.5	0.000
84	280		1.9	0.929	5.9	0.060	7.4	0.009	12.1	0.002	42.4	0.000
85	280		3.0	0.913	8.2	0.031	4.9	0.055	17.4	0.000	57.1	0.000
86	280		1.9	0.845	5.6	0.062	2.6	0.093	15.4	0.000	52.6	0.000
87	280		2.4	0.960	7.9	0.028	9.5	0.004	13.0	0.002	46.2	0.000
88	280		1.1	0.916	5.9	0.052	4.7	0.031	13.0	0.001	51.5	0.000
89	280		1.7	0.953	4.9	0.084	8.1	0.006	9.5	0.007	42.9	0.000
90	280		0.9	0.760	2.2	0.190	4.5	0.020	7.7	0.010	30.1	0.000
91	350		4.5	0.712	10.9	0.013	12.8	0.002	4.5	0.273	30.1	0.000
92	350		5.6	0.498	9.3	0.027	13.6	0.001	3.2	0.474	36.7	0.000
93	350		7.9	0.932	14.9	0.013	13.7	0.000	11.9	0.048	51.7	0.000
94	350		6.5	0.872	15.7	0.010	14.0	0.003	8.4	0.115	39.7	0.000
95	350		4.9	0.615	11.4	0.011	15.6	0.001	4.0	0.373	28.9	0.000
96	350		6.5	0.656	14.1	0.009	13.2	0.005	9.2	0.090	42.9	0.000
97	350		6.0	0.005	12.9	0.016	14.1	0.003	7.8	0.176	41.7	0.000
98	350		6.5	0.901	14.9	0.006	15.1	0.002	9.2	0.091	38.4	0.000
99	350		4.4	0.963	12.2	0.008	12.3	0.003	7.2	0.066	37.7	0.000
100	350		8.0	0.788	12.0	0.048	14.5	0.005	9.1	0.167	46.0	0.000
101	360		2.0	0.933	7.1	0.034	5.5	0.024	9.4	0.009	36.7	0.000
102	360		2.1	0.719	3.4	0.170	3.1	0.007	6.1	0.036	32.1	0.000
103	360		2.9	0.863	7.2	0.046	7.3	0.015	6.5	0.056	38.6	0.000
104	360		1.4	0.766	4.5	0.077	1.3	0.129	6.6	0.009	39.0	0.000
105	360		5.0	0.828	7.9	0.092	7.7	0.033	6.9	0.046	43.4	0.000
106	360		7.2	0.415	7.1	0.224	5.3	0.171	8.2	0.110	33.1	0.000
107	360		4.5	0.626	5.3	0.191	3.9	0.150	7.5	0.054	36.2	0.000
108	360		7.5	0.493	9.0	0.109	9.9	0.024	6.2	0.374	25.0	0.000
109	360		3.4	0.766	5.3	0.130	3.3	0.116	6.9	0.048	34.1	0.000
110	360		6.2	0.756	8.6	0.103	8.2	0.043	6.0	0.118	35.5	0.000

APPENDIX 4.1. (CONTINUED)

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 111     360                 10.3 0.700     15.9 0.021     16.6 0.005     11.0 0.207     49.1 0.000
 112     360                  6.0 0.852     13.0 0.016     12.3 0.007      8.0 0.124     45.0 0.000
 113     360                  5.5 0.547     11.0 0.016     13.6 0.001      4.0 0.436     27.6 0.000
 114     360       D         13.4 0.160     15.4 0.006     18.3 0.000      5.2 0.834     31.0 0.000
 115     360       D         11.7 0.047     12.2 0.016     20.0 0.000      3.6 0.936     28.2 0.000
 116     360       D          6.1 0.267     11.0 0.008     12.6 0.031      1.5 0.784     26.7 0.000
 117     360       D         11.6 0.059     17.6 0.002     20.3 0.000      4.4 0.939     26.0 0.000
 118     360       D          9.3 0.050     13.1 0.003     18.2 0.000      1.5 0.946     17.5 0.001
 119     360                  6.7 0.956     15.8 0.005     14.7 0.003     11.0 0.043     43.7 0.000
 120     360                  6.1 0.906     14.3 0.007     14.8 0.002      9.0 0.085     38.4 0.000
 121     378                  4.7 0.651      4.5 0.334     13.6 0.001     10.6 0.013     39.0 0.000
 122     378                  5.8 0.961     10.7 0.038     15.4 0.001     18.5 0.001     53.4 0.000
 123     378                  3.4 0.660      6.0 0.114     10.3 0.004     15.6 0.001     47.7 0.000
 124     378                  4.1 0.917      7.4 0.079     11.5 0.004     17.0 0.001     51.9 0.000
 125     378                  8.9 0.972     14.5 0.027     20.6 0.000     21.2 0.001     53.1 0.000
 126     378                  7.1 0.960     12.0 0.038     18.7 0.000     18.0 0.002     50.3 0.000
 127     378                  6.5 0.951     11.0 0.047     15.3 0.002     20.5 0.000     53.6 0.000
 128     378                  3.7 0.686      6.4 0.101      9.6 0.006     16.4 0.001     53.4 0.000
 129     378                  4.6 0.938      8.8 0.054     10.5 0.008     20.0 0.000     54.7 0.000
 130     378                  2.1 0.609      2.2 0.299      6.6 0.011     12.4 0.002     43.6 0.000

GROUP    B                      A              B              C              D              E

 CASE
 131     172                  8.0 0.210      5.1 0.705      9.6 0.025     22.0 0.000     51.0 0.000
 132     172       A          7.5 0.510      6.4 0.406      7.3 0.004     23.9 0.000     57.0 0.000
 133     172                  7.4 0.129      2.1 0.869     13.0 0.001     15.9 0.001     46.7 0.000
 134     172                  7.0 0.216      3.8 0.640      5.6 0.004     21.5 0.000     56.8 0.000
 135     172                  8.2 0.162      5.4 0.817      8.6 0.021     20.3 0.000     50.2 0.000
 136     172                  7.8 0.160      3.0 0.807      7.2 0.033     20.3 0.000     52.9 0.000
 137     172                 22.0 0.004      9.5 0.995     23.5 0.000     25.5 0.000     49.6 0.000
 138     172                 24.5 0.004     12.2 0.993     30.8 0.000     23.8 0.002     50.9 0.000
 139     172                 38.2 0.000     20.7 1.000     39.3 0.000     38.5 0.000     64.8 0.000
 140     172                 21.2 0.000      9.4 0.993     22.4 0.000     23.3 0.001     44.3 0.000
 141     262                  6.2 0.280      4.1 0.361      1.9 0.557     14.3 0.002     42.9 0.000
 142     262       C          8.6 0.189     11.1 0.026      2.0 0.765     24.0 0.000     63.2 0.000
 143     262       C          6.9 0.238      8.6 0.063      1.0 0.699     20.2 0.000     56.5 0.000
 144     262       C          6.9 0.255      8.6 0.050      1.1 0.695     21.6 0.000     57.5 0.000
 145     262       A          5.1 0.431      5.5 0.185      1.6 0.382     15.3 0.001     43.0 0.000
 146     262       C         10.8 0.121     10.8 0.057      3.3 0.822     23.2 0.000     62.9 0.000
 147     262       C          9.7 0.156      6.4 0.372      3.8 0.472     18.2 0.001     52.5 0.000
 148     262                 11.4 0.115      6.2 0.716      7.0 0.156     14.0 0.012     38.0 0.000
 149     262                  7.9 0.277      4.8 0.560      5.6 0.135     13.1 0.008     34.4 0.000
 150     262                 11.6 0.237      7.6 0.693     10.8 0.046     12.3 0.055     43.8 0.000
 151     272                  9.2 0.115      3.0 0.883     15.7 0.001     16.6 0.001     50.9 0.000
 152     272                 10.2 0.127      4.8 0.664     11.6 0.009     20.8 0.000     46.6 0.000
 153     272                  5.0 0.217      1.7 0.779     10.5 0.003     15.7 0.001     50.5 0.000
 154     272                  8.5 0.153      3.6 0.844     16.2 0.001     15.6 0.002     44.1 0.000
 155     272                 15.7 0.015      5.9 0.984     20.5 0.000     20.9 0.000     53.0 0.000
 156     272                  7.0 0.187      2.5 0.811     13.7 0.001     15.0 0.001     44.6 0.000
 157     272       A          4.5 0.497      2.8 0.496      9.1 0.007     17.1 0.000     50.5 0.000
 158     272                  4.9 0.453      3.0 0.540      9.6 0.007     17.4 0.000     49.3 0.000
 159     272                 13.0 0.104      9.1 0.814     21.3 0.001     21.1 0.002     41.4 0.000
 160     272                 11.3 0.218      7.2 0.777     20.3 0.000     17.3 0.004     39.3 0.000
 161     362                 15.2 0.074      9.3 0.047      8.8 0.275     19.2 0.004     50.5 0.000
 162     362       A          2.9 0.544      2.5 0.313      1.9 0.138     16.3 0.005     43.2 0.000
 163     362       C         18.4 0.003     15.3 0.134      9.5 0.863     28.1 0.000     70.1 0.000
 164     362       A          1.2 0.793      3.7 0.105      1.6 0.099     11.2 0.002     42.1 0.000
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APPENDIX 4.1. (CONTINUED)

165	362	A	5.4	0.723	5.2	0.133	2.9	0.141	13.0	0.002	51.3	0.000
166	362	A	5.0	0.002	5.4	0.230	3.9	0.164	13.2	0.004	50.5	0.000
167	362	A	2.7	0.694	3.8	0.180	2.5	0.117	11.2	0.004	46.0	0.000
168	362	A	1.9	0.613	2.6	0.218	1.8	0.105	9.9	0.005	41.5	0.000
169	362	C	7.0	0.234	5.1	0.212	1.7	0.493	15.5	0.001	46.5	0.000
170	362		22.6	0.121	17.0	0.083	25.7	0.004	19.8	0.192	57.1	0.000
171	372		9.6	0.085	3.3	0.913	16.4	0.000	16.8	0.001	50.3	0.000
172	372	A	7.6	0.570	0.7	0.427	17.8	0.001	17.1	0.002	48.3	0.000
173	372		10.2	0.290	6.9	0.698	21.7	0.000	14.8	0.011	44.5	0.000
174	372		12.2	0.130	6.9	0.866	21.6	0.000	17.2	0.004	47.4	0.000
175	372		10.8	0.004	3.9	0.933	17.7	0.000	15.7	0.002	45.0	0.000
176	372		8.1	0.114	2.4	0.885	14.3	0.001	15.8	0.001	46.9	0.000
177	372		5.1	0.413	2.8	0.584	11.6	0.002	15.7	0.001	46.9	0.000
178	372		10.9	0.122	5.5	0.874	19.2	0.000	16.4	0.003	40.1	0.000
179	372		10.0	0.061	9.0	0.935	27.7	0.000	19.4	0.004	47.5	0.000
180	372		14.9	0.128	9.5	0.808	24.3	0.000	19.6	0.005	39.0	0.000
181	376	D	22.6	0.122	20.9	0.128	28.6	0.001	17.2	0.088	23.8	0.001
182	376	A	11.8	0.531	12.2	0.196	20.3	0.001	11.2	0.272	31.6	0.000
183	376	D	11.6	0.376	11.3	0.206	20.0	0.001	9.5	0.417	28.8	0.000
184	376	D	10.3	0.307	12.7	0.043	21.6	0.000	6.9	0.648	20.4	0.002
185	376	D	9.0	0.308	9.4	0.114	17.7	0.001	5.8	0.578	26.6	0.000
186	376	A	12.7	0.582	14.0	0.139	21.8	0.001	12.3	0.277	26.8	0.000
187	376	A	8.1	0.745	11.0	0.081	18.2	0.001	9.1	0.173	30.0	0.000
188	376	A	10.0	0.501	11.6	0.101	19.2	0.001	8.5	0.397	25.4	0.000
189	376	A	14.1	0.541	15.4	0.133	21.8	0.002	13.2	0.323	27.3	0.001
190	376	A	9.0	0.402	11.1	0.076	19.5	0.000	7.1	0.461	22.1	0.001

GROUP	C		A		B		C		D		E	
CASE												
191	252		5.7	0.374	8.2	0.051	1.1	0.575	17.7	0.000	47.3	0.000
192	252		6.0	0.350	8.9	0.038	1.2	0.612	19.1	0.000	50.3	0.000
193	252		6.7	0.399	10.6	0.027	2.2	0.574	21.5	0.000	53.5	0.000
194	252		5.9	0.299	8.0	0.049	0.6	0.652	17.2	0.000	47.6	0.000
195	252		7.5	0.228	11.1	0.010	1.4	0.754	22.0	0.000	51.5	0.000
196	252		6.7	0.235	9.2	0.031	0.7	0.734	19.3	0.000	52.7	0.000
197	252		7.7	0.105	9.4	0.034	0.8	0.801	18.9	0.000	52.8	0.000
198	252		6.4	0.422	7.9	0.090	2.4	0.486	15.0	0.002	38.8	0.000
199	252		8.1	0.176	11.2	0.017	1.5	0.807	22.0	0.000	58.4	0.000
200	252		6.7	0.235	9.2	0.031	0.7	0.734	19.3	0.000	52.7	0.000
201	352		6.7	0.233	7.4	0.076	0.8	0.609	15.4	0.001	44.6	0.000
202	352	A	1.9	0.788	6.5	0.037	1.2	0.173	12.1	0.002	45.9	0.000
203	352	A	1.8	0.845	6.3	0.043	2.2	0.110	11.4	0.003	40.8	0.000
204	352		7.9	0.164	8.6	0.052	1.0	0.765	17.0	0.001	48.8	0.000
205	352	A	4.1	0.046	5.1	0.179	3.2	0.158	9.5	0.016	42.3	0.000
206	352	A	2.2	0.723	4.0	0.134	2.0	0.123	7.5	0.019	35.8	0.000
207	352	A	4.7	0.563	3.9	0.144	2.3	0.285	11.2	0.008	44.5	0.000
208	352	A	5.6	0.653	8.1	0.097	4.0	0.248	14.7	0.003	54.6	0.000
209	352	A	1.6	0.759	4.5	0.084	1.1	0.152	10.1	0.004	42.4	0.000
210	352	A	5.0	0.451	4.5	0.201	2.2	0.281	11.7	0.006	46.1	0.000

APPENDIX 4.1. (CONTINUED)

GROUP D

CASE			A		B		C		D		E	
211	170		12.2	0.000	14.0	0.017	16.7	0.001	5.7	0.894	26.8	0.000
212	170		20.5	0.006	17.3	0.013	25.2	0.000	8.2	0.981	29.2	0.000
213	170		26.2	0.016	34.7	0.000	40.9	0.000	16.3	0.979	29.3	0.004
214	170		24.6	0.002	30.3	0.000	33.1	0.000	11.6	0.525	13.6	0.472
215	170		21.9	0.002	23.6	0.000	31.2	0.000	8.4	0.776	12.6	0.221
216	170	A	4.0	0.886	8.5	0.044	7.5	0.024	8.0	0.046	42.7	0.000
217	170	A	4.5	0.923	9.3	0.038	8.0	0.025	11.0	0.014	46.2	0.000
218	170	A	3.9	0.556	7.7	0.039	8.2	0.010	2.7	0.395	28.3	0.000
219	170	A	7.4	0.578	10.4	0.061	10.9	0.015	6.5	0.340	35.8	0.000
220	170	A	4.2	0.666	8.5	0.037	9.3	0.008	4.0	0.289	28.2	0.000
221	254		13.3	0.034	10.5	0.003	19.9	0.000	4.7	0.963	31.2	0.000
222	254	A	6.7	0.869	12.6	0.054	10.3	0.020	14.7	0.017	57.7	0.000
223	254		5.9	0.196	9.6	0.014	11.8	0.002	1.1	0.795	26.4	0.000
224	254	A	3.0	0.646	7.9	0.020	11.7	0.001	2.5	0.325	26.8	0.000
225	254	A	3.5	0.560	6.3	0.063	8.3	0.008	2.4	0.369	31.1	0.000
226	254	A	3.6	0.711	6.1	0.097	7.7	0.014	4.5	0.178	34.6	0.000
227	254		17.1	0.019	17.7	0.007	29.0	0.000	7.4	0.963	18.0	0.011
228	254		19.6	0.011	18.1	0.011	29.3	0.000	6.8	0.928	16.3	0.051
229	254		27.1	0.015	20.7	0.166	31.6	0.000	17.5	0.671	22.2	0.154
230	254		15.8	0.033	12.2	0.090	20.2	0.001	7.3	0.876	28.2	0.000
231	270		20.1	0.003	19.1	0.002	27.4	0.000	6.5	0.995	27.0	0.000
232	270		16.9	0.003	17.5	0.003	24.9	0.000	5.4	0.994	23.5	0.000
233	270		24.6	0.001	21.3	0.003	37.2	0.000	9.8	0.772	14.0	0.224
234	270	E	20.4	0.000	30.3	0.000	36.5	0.000	10.5	0.103	6.0	0.897
235	270		24.7	0.002	27.2	0.000	36.2	0.000	9.9	0.443	17.4	0.056
236	270	A	6.0	0.902	13.9	0.008	14.4	0.002	8.8	0.087	38.3	0.000
237	270		8.3	0.434	13.6	0.019	13.8	0.004	5.9	0.543	38.1	0.000
238	270	A	5.6	0.506	10.5	0.020	14.4	0.001	3.9	0.473	25.2	0.000
239	270		7.7	0.120	12.0	0.006	16.0	0.000	1.8	0.873	19.8	0.000
240	270		12.3	0.069	15.8	0.006	16.9	0.000	5.2	0.925	26.2	0.000
241	354		10.7	0.017	20.7	0.003	31.4	0.000	8.7	0.969	19.4	0.011
242	354	A	6.4	0.566	14.0	0.012	16.8	0.001	7.3	0.400	36.6	0.000
243	354	A	5.4	0.646	9.9	0.031	11.4	0.005	4.9	0.317	36.3	0.000
244	354	A	7.5	0.672	11.1	0.051	11.3	0.015	7.5	0.261	44.7	0.000
245	354	A	6.9	0.649	11.8	0.025	12.2	0.007	6.4	0.320	41.6	0.000
246	354	A	3.4	0.726	7.7	0.040	9.6	0.005	3.8	0.229	33.9	0.000
247	354		13.7	0.007	14.8	0.002	21.6	0.000	1.9	0.982	13.1	0.009
248	354		15.2	0.009	13.3	0.011	23.3	0.000	4.0	0.978	19.0	0.001
249	354		15.1	0.018	14.7	0.010	22.7	0.000	5.2	0.972	30.6	0.000
250	354		23.1	0.002	25.3	0.000	31.4	0.000	9.8	0.686	13.1	0.311
251	370		21.1	0.000	21.2	0.000	27.9	0.000	5.0	0.609	7.6	0.390
252	370	E	41.1	0.000	37.0	0.000	44.3	0.000	19.9	0.001	8.3	0.999
253	370	E	32.9	0.000	39.2	0.000	42.6	0.000	16.5	0.002	5.8	0.998
254	370	E	29.6	0.000	34.3	0.000	38.9	0.000	12.4	0.043	7.9	0.957
255	370		16.2	0.002	18.0	0.001	29.2	0.000	4.4	0.873	16.0	0.124
256	370		17.0	0.424	21.3	0.022	23.5	0.002	14.6	0.538	23.7	0.013
257	370	A	8.5	0.557	13.5	0.021	15.8	0.002	7.1	0.420	26.2	0.000
258	370		8.7	0.165	12.0	0.015	14.9	0.001	3.6	0.819	24.2	0.000
259	370		9.2	0.128	12.0	0.015	15.7	0.001	3.5	0.857	21.8	0.000
260	370		15.3	0.100	15.4	0.017	20.4	0.000	7.1	0.878	19.5	0.004

APPENDIX 4.1. (CONTINUED)

GROUP [illegible]

CASE		A		B		C		D		E	
261	168	35.4	0.000	41.0	0.000	43.4	0.000	16.3	0.002	5.9	0.998
262	168	34.3	0.000	35.6	0.000	43.1	0.000	13.4	0.031	8.3	0.969
263	168	30.1	0.000	39.6	0.000	44.4	0.000	16.1	0.000	2.1	1.000
264	168	32.0	0.000	35.6	0.000	40.7	0.000	12.1	0.070	8.7	0.930
265	168	34.2	0.000	36.6	0.000	42.4	0.000	13.6	0.007	5.4	0.993
266	168	38.7	0.000	44.4	0.000	46.4	0.000	17.8	0.001	6.4	0.999
267	168	44.4	0.000	49.7	0.000	50.6	0.000	21.2	0.001	7.8	0.999
268	168	25.0	0.000	31.8	0.000	35.9	0.000	11.4	0.070	8.0	0.930
269	168	26.7	0.000	32.3	0.000	36.9	0.000	11.9	0.026	6.4	0.974
270	168	38.5	0.000	44.3	0.000	45.9	0.000	17.3	0.003	7.7	0.997
271	174	27.7	0.000	30.9	0.000	37.3	0.000	9.9	0.089	7.0	0.911
272	174	31.4	0.000	34.5	0.000	40.3	0.000	12.3	0.007	4.0	0.993
273	174	46.0	0.000	37.5	0.000	48.2	0.000	17.4	0.000	1.2	1.000
274	174	45.3	0.000	48.7	0.000	51.6	0.000	20.1	0.002	9.5	0.998
275	174	49.7	0.000	53.4	0.000	55.9	0.000	24.1	0.000	6.1	1.000
276	174	49.2	0.000	51.6	0.000	54.6	0.000	23.6	0.000	5.3	1.000
277	174	48.6	0.000	49.2	0.000	55.2	0.000	22.8	0.000	3.0	1.000
278	174	46.2	0.000	53.1	0.000	52.7	0.000	22.5	0.014	15.6	0.986
279	174	43.5	0.000	40.4	0.000	50.3	0.000	16.7	0.003	8.8	0.997
280	174	46.0	0.000	45.2	0.000	47.2	0.000	17.9	0.002	7.1	0.998
281	258	30.9	0.000	34.9	0.000	40.2	0.000	13.3	0.002	2.9	0.998
282	258	33.0	0.000	35.6	0.000	41.9	0.000	15.4	0.000	1.5	1.000
283	258	36.2	0.000	30.5	0.000	38.3	0.000	11.1	0.003	1.2	0.997
284	258	30.3	0.000	34.6	0.000	39.1	0.000	11.8	0.159	10.2	0.841
285	258	43.2	0.000	44.1	0.000	51.0	0.000	22.7	0.000	0.6	1.000
286	258	29.3	0.000	26.7	0.000	37.6	0.000	10.7	0.007	2.7	0.993
287	258	46.5	0.000	40.2	0.000	47.8	0.000	20.0	0.000	1.9	1.000
288	258	44.4	0.000	46.4	0.000	51.6	0.000	23.6	0.000	1.0	1.000
289	258	37.1	0.000	39.1	0.000	45.4	0.000	16.8	0.000	0.8	1.000
290	258	46.4	0.000	41.0	0.000	48.3	0.000	18.9	0.000	0.6	1.000
291	258	39.1	0.000	39.1	0.000	46.4	0.000	23.1	0.000	2.5	1.000
292	258	30.9	0.000	30.3	0.000	44.1	0.000	20.3	0.002	9.4	0.998
293	258	28.2	0.000	32.5	0.000	38.5	0.000	12.3	0.007	4.2	0.993
294	258	50.7	0.000	45.7	0.000	57.7	0.000	27.4	0.000	2.7	1.000
295	258	28.3	0.000	29.3	0.000	38.8	0.000	10.8	0.005	2.0	0.995
296	258	26.9	0.000	23.8	0.000	36.9	0.000	11.5	0.013	4.6	0.987
297	258	37.1	0.000	35.1	0.000	48.9	0.000	26.4	0.000	4.2	1.000
298	258	39.0	0.000	30.1	0.000	50.1	0.000	18.7	0.008	10.9	0.992
299	258	51.7	0.000	47.9	0.000	59.1	0.000	30.8	0.000	3.4	1.000
300	258	54.0	0.000	29.2	0.000	44.7	0.000	14.6	0.002	3.5	0.998
301	264	34.1	0.000	33.9	0.000	43.2	0.000	15.7	0.000	0.5	1.000
302	264	23.5	0.000	21.2	0.000	35.5	0.000	6.2	0.267	7.9	0.732
303	264	37.8	0.000	35.4	0.000	46.4	0.000	15.7	0.005	7.0	0.995
304	264	36.5	0.000	28.2	0.000	46.1	0.000	19.8	0.003	10.1	0.997
305	264	26.5	0.001	23.4	0.003	39.6	0.000	13.1	0.410	14.1	0.586
306	264	37.5	0.000	28.8	0.000	50.7	0.000	21.6	0.004	12.3	0.996
307	264	38.5	0.000	30.7	0.000	48.7	0.000	20.2	0.002	9.9	0.998
308	264	40.4	0.000	42.1	0.000	54.0	0.000	26.4	0.000	2.4	1.000
309	264	36.2	0.000	27.2	0.000	42.4	0.000	17.2	0.001	5.8	0.999
310	264	[illegible]	0.000	25.2	0.001	44.0	0.000	16.6	0.038	11.9	0.962
311	268	45.0	0.000	45.6	0.000	54.3	0.000	26.7	0.000	2.2	1.000
312	268	34.0	0.000	35.9	0.000	42.4	0.000	14.1	0.002	3.6	0.998
313	268	44.1	0.000	40.0	0.000	50.8	0.000	23.9	0.000	2.9	1.000
314	268	37.1	0.000	42.3	0.000	45.4	0.000	17.9	0.000	3.6	1.000
315	268	40.6	0.000	45.3	0.000	55.0	0.000	21.2	0.000	3.6	1.000

APPENDIX 4.1. (CONTINUED)

316	268	44.8	0.000	49.0	0.000	53.4	0.000	24.9	0.000	4.4	1.000
317	268	52.5	0.000	56.0	0.000	58.5	0.000	26.7	0.000	3.6	1.000
318	268	49.1	0.000	44.7	0.000	47.5	0.000	20.6	0.000	3.1	1.000
319	268	59.9	0.000	45.0	0.000	48.4	0.000	20.5	0.000	3.5	1.000
320	268	41.3	0.000	45.2	0.000	48.2	0.000	18.9	0.000	4.7	1.000
321	274	42.3	0.000	34.1	0.001	47.1	0.000	22.4	0.211	21.5	0.789
322	274	50.8	0.000	46.5	0.000	58.0	0.000	25.9	0.000	3.0	1.000
323	274	49.7	0.000	46.5	0.000	58.0	0.000	24.4	0.000	5.5	1.000
324	274	38.7	0.000	41.6	0.000	47.8	0.000	19.4	0.000	1.9	1.000
325	274	39.4	0.000	40.9	0.000	47.0	0.000	15.8	0.002	4.8	0.998
326	274	40.5	0.000	41.8	0.000	50.1	0.000	16.5	0.000	5.0	1.000
327	274	32.0	0.000	38.7	0.000	41.5	0.000	14.9	0.006	6.5	0.994
328	274	44.0	0.000	44.2	0.000	51.6	0.000	20.3	0.000	1.5	1.000
329	274	41.7	0.000	39.4	0.000	49.0	0.000	19.9	0.000	4.4	1.000
330	274	55.0	0.000	52.0	0.000	61.9	0.000	28.7	0.000	3.5	1.000
331	350	56.2	0.000	55.9	0.000	61.6	0.000	33.8	0.000	3.6	1.000
332	350	45.9	0.000	46.1	0.000	53.2	0.000	24.3	0.000	0.7	1.000
333	350	27.7	0.000	26.1	0.000	58.2	0.000	9.6	0.029	4.3	0.971
334	350	66.7	0.000	65.4	0.000	71.0	0.000	43.3	0.000	7.3	1.000
335	350	37.0	0.000	36.9	0.000	46.8	0.000	17.4	0.000	1.0	1.000
336	350	30.4	0.000	38.0	0.000	46.9	0.000	17.9	0.000	2.7	1.000
337	350	67.2	0.000	60.0	0.000	72.2	0.000	44.0	0.000	7.9	1.000
338	350	22.5	0.000	21.1	0.000	30.1	0.000	7.1	0.181	5.9	0.819
339	350	43.3	0.000	39.8	0.000	52.7	0.000	26.4	0.000	4.0	1.000
340	350	44.4	0.000	40.0	0.000	52.0	0.000	24.0	0.000	3.0	1.000
341	358	40.5	0.000	39.4	0.000	50.3	0.000	23.2	0.000	2.2	1.000
342	358	54.5	0.000	48.2	0.000	63.0	0.000	35.8	0.000	7.9	1.000
343	358	63.9	0.000	56.2	0.000	71.1	0.000	40.8	0.000	8.9	1.000
344	358	75.7	0.000	67.1	0.000	80.0	0.000	47.3	0.000	11.6	1.000
345	358	32.3	0.000	32.4	0.000	44.3	0.000	16.9	0.001	3.7	0.999
346	358	47.8	0.000	45.5	0.000	57.3	0.000	31.3	0.000	5.6	1.000
347	358	64.2	0.000	65.4	0.000	68.0	0.000	41.5	0.000	7.8	1.000
348	358	80.9	0.000	61.4	0.000	65.3	0.000	56.2	0.000	15.2	1.000
349	358	50.5	0.000	52.3	0.000	61.1	0.000	32.2	0.000	8.1	1.000
350	358	35.9	0.000	34.3	0.000	44.8	0.000	15.9	0.000	0.5	1.000
351	364	43.9	0.000	35.8	0.000	53.1	0.000	25.3	0.000	8.6	1.000
352	364	42.1	0.000	35.1	0.000	53.8	0.000	24.9	0.000	10.3	1.000
353	364	31.2	0.000	30.3	0.000	40.6	0.000	14.0	0.001	1.6	0.999
354	364	36.2	0.000	34.5	0.000	44.9	0.000	18.8	0.000	3.4	1.000
355	364	84.9	0.000	75.0	0.000	89.0	0.000	63.6	0.000	22.0	1.000
356	364	35.2	0.000	26.9	0.000	48.0	0.000	26.6	0.005	11.9	0.994
357	364	36.1	0.000	32.4	0.000	47.3	0.000	17.9	0.000	3.3	1.000
358	364	74.2	0.000	62.5	0.000	79.1	0.000	51.9	0.000	19.9	1.000
359	364	51.7	0.000	47.0	0.000	60.5	0.000	31.8	0.000	5.0	1.000
360	364	54.8	0.000	49.9	0.000	61.4	0.000	34.0	0.000	5.2	1.000
361	368	44.5	0.000	41.0	0.000	55.7	0.000	27.6	0.000	6.0	1.000
362	368	49.2	0.000	47.3	0.000	58.5	0.000	27.6	0.000	3.6	1.000
363	368	44.3	0.000	46.1	0.000	56.9	0.000	24.0	0.000	2.9	1.000
364	368	40.3	0.000	41.0	0.000	49.8	0.000	20.2	0.000	1.6	1.000
365	368	42.4	0.000	42.4	0.000	52.2	0.000	20.3	0.000	3.8	1.000
366	368	55.9	0.000	50.4	0.000	61.6	0.000	33.7	0.000	4.1	1.000
367	368	54.1	0.000	57.1	0.000	60.4	0.000	31.6	0.000	3.8	1.000
368	368	34.5	0.000	40.0	0.000	44.0	0.000	16.2	0.001	5.2	0.999
369	368	69.0	0.000	71.4	0.000	75.4	0.000	45.8	0.000	9.5	1.000
370	368	34.3	0.000	32.4	0.000	43.3	0.000	15.2	0.000	1.7	1.000
371	374	53.5	0.000	51.3	0.000	58.6	0.000	33.9	0.000	9.3	1.000
372	374	52.0	0.000	52.5	0.000	59.7	0.000	31.5	0.000	3.4	1.000
373	374	59.9	0.000	61.8	0.000	69.8	0.000	39.9	0.000	11.1	1.000
374	374	70.9	0.000	64.8	0.000	74.9	0.000	44.7	0.000	8.9	1.000

APPENDIX 4.1. (CONTINUED)

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  375    374                  50.0 0.000     50.0 0.000     60.8 0.000     32.4 0.000      9.1 1.000
  376    374                  54.2 0.000     55.7 0.000     62.9 0.000     31.3 0.000      6.0 1.000
  377    374                  46.9 0.000     40.0 0.000     55.1 0.000     25.0 0.000      1.9 1.000
  378    374                  59.4 0.000     62.9 0.000     66.3 0.000     35.5 0.000      6.7 1.000
  379    374                  79.7 0.000     77.7 0.000     82.3 0.000     55.9 0.000     13.8 1.000
  380    374                  82.0 0.000     83.9 0.000     86.6 0.000     54.3 0.000     14.4 1.000

EIGENVALUES

                 7.69934      0.40968      0.26539      0.11447

CANONICAL CORRELATIONS

                 0.94077      0.53909      0.45796      0.32049

VARIABLE      COEFFICIENTS FOR CANONICAL VARIABLES

  1 PL           0.24738      0.99340     -0.58760      0.33284
  2 PW           2.53749     11.99466     -6.36298     16.14359
  3 PLWV        -2.58732     -4.59224      2.74374     -3.44448
  4 SPACE        0.07955      0.11378      0.09534     -0.17600
  5 ROWHT       -0.04315     -0.10816     -0.21452     -0.18865
  6 VOL         -0.00007      0.00010      0.00016     -0.00001

CONSTANT         3.01034     -1.70893      2.69336      6.27670

GROUP         CANONICAL VARIABLES EVALUATED AT GROUP MEANS
     A           2.22760      0.33072      0.20790      0.30702
     B           2.09302     -1.17814     -0.57902     -0.07000
     C           2.67515     -0.29926      1.45818     -0.59238
     D           0.01407      1.61843     -0.76108     -0.45377
     E          -3.91171     -0.14368      0.13637      0.05086




 POINTS TO BE PLOTTED

 GROUP           MEAN          SYMBOL     SYMBOL
              COORDINATES    FOR CASES   FOR MEAN

  A           2.23   0.33       A           1
  B           2.09  -1.18       B           2
  C           2.68  -0.30       C           3
  D           0.01   1.62       D           4
  E          -3.91  -0.14       E           5
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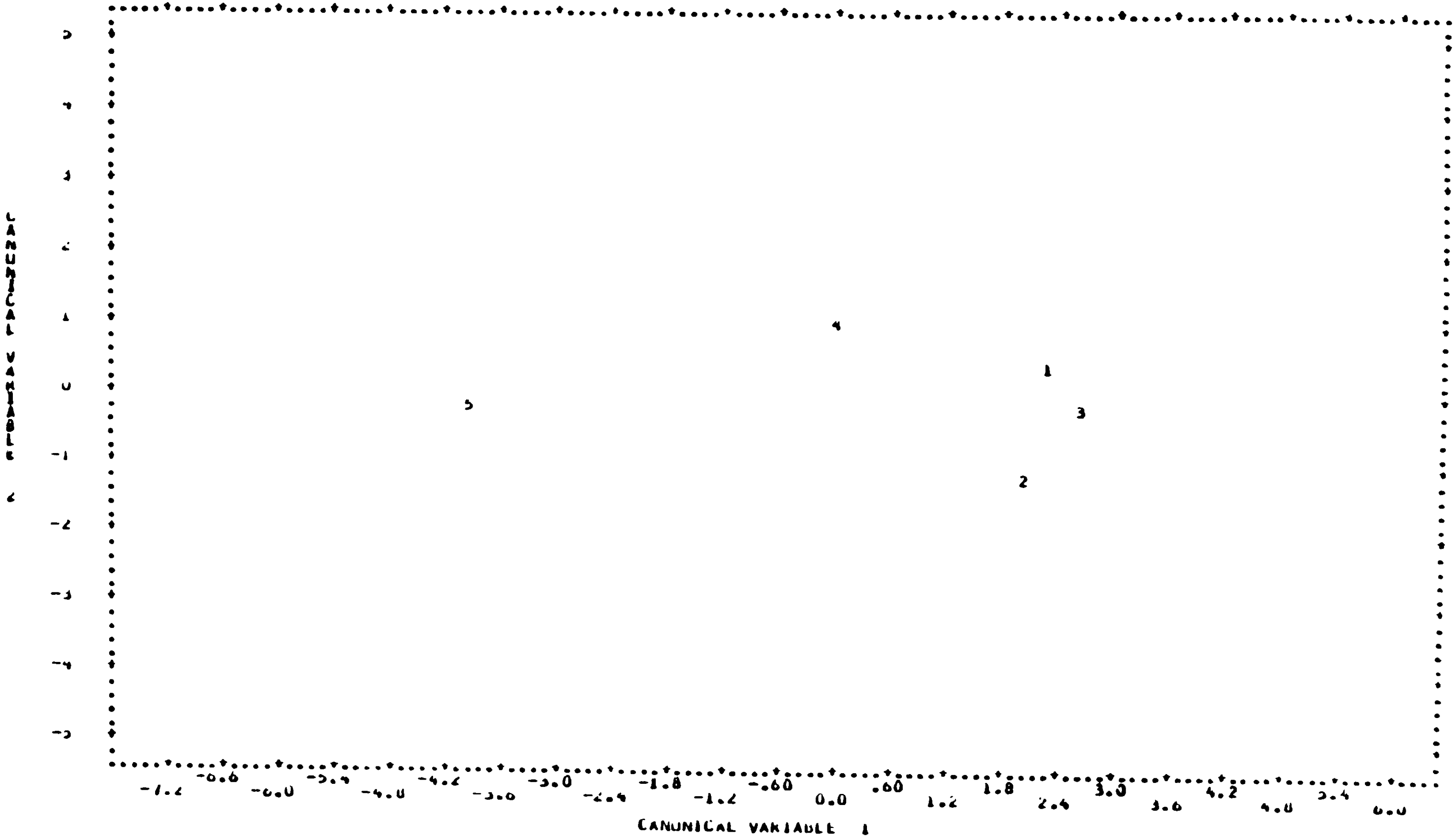
APPENDIX 4.1. (CONTINUED)

OVERLAP OF DIFFERENT GROUPS IS INDICATED BY *

PAGE 6



APPENDIX 4.1. (CONTINUED)

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POINTS TO BE PLOTTED

GROUP          MEAN         SYMBOL     SYMBOL
            COORDINATES   FOR CASES   FOR MEAN

  A          2.23   0.33      A          1
  B          2.09  -1.18      B          2
  C          2.66  -0.30      C          3
  D          0.01   1.02      D          4
  E         -3.91  -0.14      E          5

GROUP A

      CASE   X      Y           CASE   X      Y           CASE   X      Y           CASE   X      Y           CASE   X      Y

  1   116   2.53  -0.51    11   118   2.64  -1.54    21   180   2.60  -1.03    31   256   1.73   0.40    41   260   1.92  -0.90
  2   116   2.13  -0.09    12   118   2.74  -1.57    22   180   2.96  -0.91    32   256   1.67   0.68    42   260   2.27  -0.69
  3   116   2.41   0.04    13   118   3.40  -1.28    23   180   2.76  -1.08    33   256   2.71   1.91    43   260   2.02  -0.84
  4   116   1.88   0.64    14   118   3.19  -1.04    24   180   2.44  -1.19    34   256   2.57   1.12    44   260   2.25  -0.02
  5   116   2.62   0.33    15   118   2.91  -1.26    25   180   4.11  -0.08    35   256   1.85   0.73    45   260   1.29  -0.98
  6   116   2.90   0.85    16   118   1.78  -2.17    26   180   3.00  -0.92    36   256   1.59   0.87    46   260   1.90  -0.75
  7   116   2.92   1.32    17   118   2.93  -0.07    27   180   2.65  -0.12    37   256   1.74   1.11    47   260   2.15  -0.70
  8   116   2.44   0.24    18   118   2.57  -1.01    28   180   3.15  -0.79    38   256   1.89   0.75    48   260   2.40  -0.60
  9   116   2.31   0.58    19   118   2.30  -0.67    29   180   3.15  -0.79    39   256   2.31   1.36    49   260   3.21   0.46
 10   116   1.84   0.03    20   118   3.19  -1.14    30   180   3.83  -0.42    40   256   1.96   1.30    50   260   2.10  -0.02

      CASE   X      Y           CASE   X      Y           CASE   X      Y           CASE   X      Y           CASE   X      Y

 51   266   1.15   0.81    61   276   2.31   0.55    71   278   2.67  -0.25    81   280   2.90   0.89    91   356   1.11   1.04
 52   266   2.50   1.35    62   276   2.05   0.55    72   278   3.48   0.13    82   280   4.01   1.05    92   356   1.16   1.40
 53   266   1.41   0.26    63   276   0.91   1.04    73   278   3.95  -0.93    83   280   3.88   0.78    93   356   2.66   2.00
 54   266   1.32   0.40    64   276   1.31   0.91    74   278   3.44  -0.59    84   280   2.39   0.16    94   356   1.72   1.93
 55   266   0.65   0.73    65   276   3.81   1.47    75   278   2.40  -1.73    85   280   3.51   0.44    95   356   0.97   1.72
 56   266   0.98   0.70    66   276   2.12   1.21    76   278   3.18   0.18    86   280   3.28   0.03    96   356   1.97   2.03
 57   266   0.59   0.51    67   276   2.89   1.12    77   278   3.10  -0.16    87   280   2.62   0.68    97   356   1.89   1.93
 58   266   0.91   0.25    68   276   1.19   0.94    78   278   2.75  -0.19    88   280   3.18   0.50    98   356   1.57   2.00
 59   266   1.24   0.68    69   276   1.29   0.40    79   278   2.03  -0.66    89   280   2.46   0.44    99   356   1.70   1.91
 60   266   0.81   0.94    70   276   2.52   1.14    80   278   3.55  -1.32    90   280   2.04  -0.23   100   356   2.19   1.56

      CASE   X      Y           CASE   X      Y           CASE   X      Y

101   300   2.09   0.63   111   306   2.22   2.05   121   378   1.95  -0.30
102   300   1.65  -0.10   112   306   2.17   1.99   122   378   2.91   0.44
103   300   2.01   1.06   113   306   0.85   1.49   123   378   2.72  -0.20
104   300   2.23   0.20   114   306   0.74   1.88   124   378   2.98   0.03
105   300   2.27   0.76   115   306   0.50   1.09   125   378   2.60   0.54
106   300   1.37  -0.20   116   306   0.75   1.72   126   378   2.54   0.53
107   300   1.81   0.02   117   306   0.21   1.96   127   378   2.89   0.09
108   300   0.61   0.15   118   306  -0.26   1.37   128   378   3.16  -0.01
109   300   1.70   0.14   119   306   1.97   2.17   129   378   3.17  -0.10
110   300   1.55   0.50   120   306   1.61   1.94   130   378   2.57  -0.70
```

APPENDIX 4.1. (CONTINUED)

GROUP B

	CASE	X	Y		CASE	X	Y		CASE	X	Y		CASE	X	Y		CASE	X	Y
131	172	2.70	-2.06	141	262	2.31	-1.28	151	272	2.69	-1.49	161	362	2.30	-1.60	171	372	2.62	-1.65
132	172	3.29	-1.63	142	262	3.69	-0.49	152	272	2.30	-2.36	162	362	2.54	-0.53	172	372	2.48	-0.75
133	172	2.50	-1.77	143	262	3.30	-0.72	153	272	2.93	-1.42	163	362	3.59	-1.03	173	372	1.99	-0.01
134	172	3.38	-1.81	144	262	3.37	-0.66	154	272	2.17	-1.61	164	362	2.51	-0.22	174	372	2.13	-1.34
135	172	2.76	-2.17	145	262	2.35	-1.04	155	272	2.44	-2.39	165	362	3.10	0.08	175	372	2.11	-1.79
136	172	3.62	-2.09	146	262	3.54	-0.73	156	272	2.34	-1.56	166	362	2.94	-0.18	176	372	2.46	-1.71
137	172	1.75	-3.32	147	262	2.85	-1.31	157	272	2.99	-1.22	167	362	2.73	-0.17	177	372	2.05	-1.35
138	172	1.60	-2.55	148	262	1.56	-1.66	158	272	2.85	-1.30	168	362	2.45	-0.38	178	372	1.66	-1.30
139	172	1.78	-4.00	149	262	1.49	-1.56	159	272	1.53	-2.01	169	362	2.55	-1.16	179	372	1.85	-1.02
140	172	1.37	-3.17	150	262	1.96	-0.68	160	272	1.53	-1.62	170	362	2.13	-0.13	180	372	1.24	-1.92

	CASE	X	Y
181	376	-0.08	-0.74
182	376	0.76	0.04
183	376	0.57	-0.04
184	376	-0.09	0.46
185	376	0.15	0.40
186	376	0.26	-0.09
187	376	0.87	0.49
188	376	0.37	0.23
189	376	0.21	-0.11
190	376	0.10	0.29

GROUP C

	CASE	X	Y		CASE	X	Y
191	252	2.51	-0.02	201	352	2.36	-0.72
192	252	2.85	-0.54	202	352	2.72	0.39
193	252	3.00	-0.40	203	352	2.31	0.19
194	252	2.03	-0.60	204	352	2.01	-0.62
195	252	3.28	-0.35	205	352	2.33	0.02
196	252	2.99	-0.49	206	352	1.94	-0.02
197	252	2.93	-0.52	207	352	2.47	-0.07
198	252	1.88	-0.76	208	352	3.17	0.31
199	252	3.32	-0.35	209	352	2.50	0.08
200	252	2.99	-0.49	210	352	2.62	-0.40

APPENDIX 4.1. (CONTINUED)

GROUP D

	CASE	X	Y		CASE	X	Y		CASE	X	Y		CASE	X	Y		CASE	X	Y
211	170	0.34	0.96	221	254	0.57	1.66	231	270	-0.24	1.13	241	354	-0.85	0.96	251	370	-1.92	0.05
212	170	-0.02	0.44	222	254	3.12	1.28	232	270	-0.41	0.84	242	354	1.32	1.91	252	370	-3.36	-0.05
213	170	-0.03	2.01	223	254	0.78	1.48	233	270	-1.06	-0.08	243	354	1.60	1.53	253	370	-3.19	1.41
214	170	-1.85	1.57	224	254	0.99	1.28	234	270	-2.43	1.26	244	354	2.15	1.56	254	370	-2.70	1.46
215	170	-1.63	0.86	225	254	1.38	1.04	235	270	-1.51	1.40	245	354	1.91	1.85	255	370	-1.52	0.50
216	170	2.20	1.17	226	254	1.07	0.80	236	270	1.02	1.88	246	354	1.57	1.31	256	370	-0.36	0.46
217	170	2.49	1.00	227	254	-0.60	0.59	237	270	1.51	1.62	247	354	-0.90	0.90	257	370	0.56	1.00
218	170	1.10	1.08	228	254	-1.08	0.01	238	270	0.65	1.25	248	354	-0.48	0.36	258	370	0.38	1.17
219	170	1.45	1.05	229	254	-1.06	-1.49	239	270	0.00	1.38	249	354	0.45	1.12	259	370	0.15	0.99
220	170	1.05	1.02	230	254	0.29	-0.37	240	270	0.23	1.45	250	354	-1.69	0.88	260	370	-0.36	0.55

GROUP E

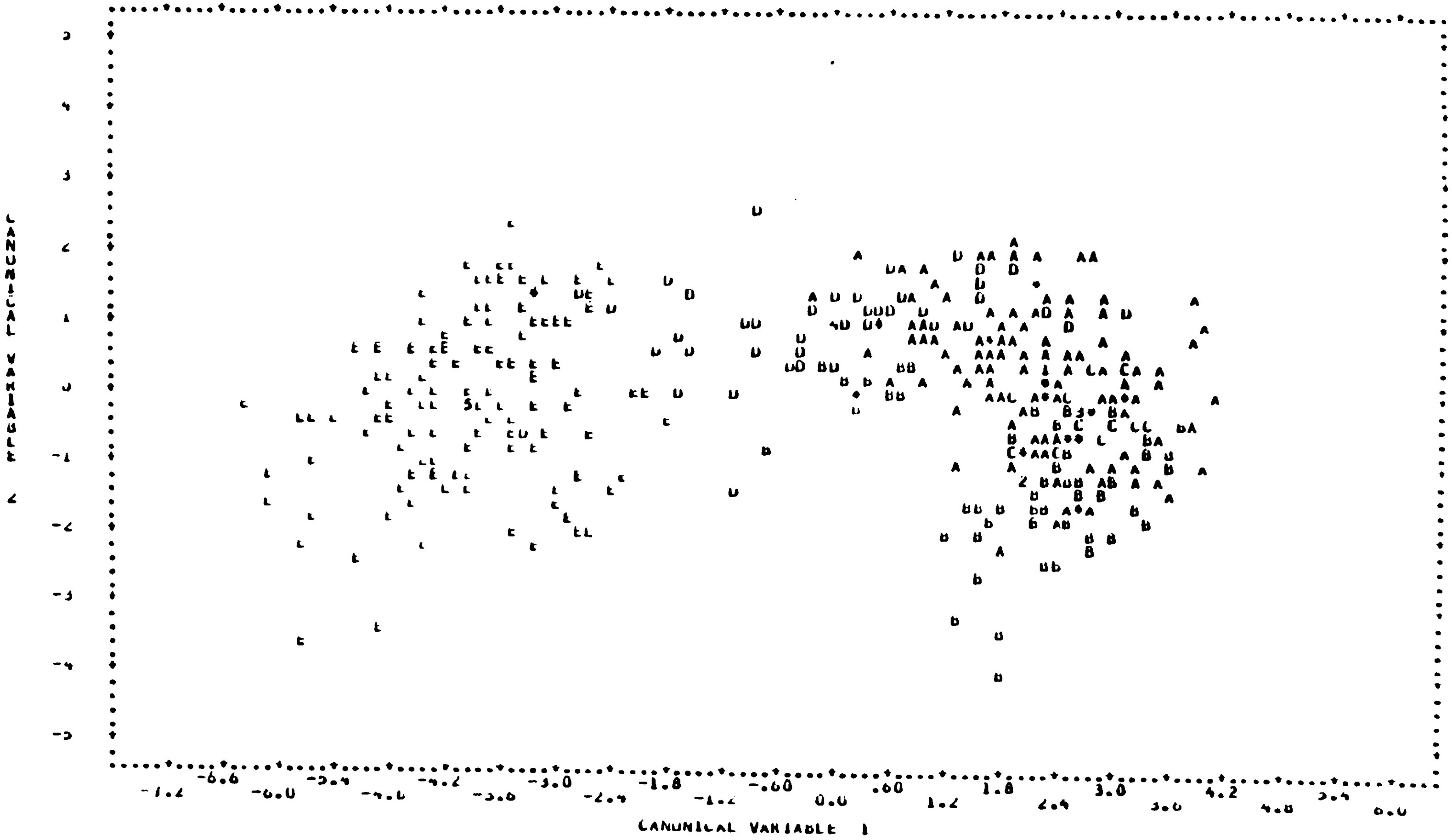
	CASE	X	Y		CASE	X	Y		CASE	X	Y		CASE	X	Y		CASE	X	Y
261	168	-3.35	1.52	271	174	-2.60	1.27	281	250	-3.20	1.00	291	258	-3.82	-0.66	301	264	-3.57	-0.15
262	168	-2.98	1.05	272	174	-3.13	1.68	282	250	-3.45	0.49	292	258	-3.14	-0.51	302	264	-2.00	-0.06
263	168	-3.07	0.94	273	174	-3.93	-0.30	283	250	-3.20	0.32	293	258	-2.89	1.05	303	264	-3.28	0.10
264	168	-2.60	1.54	274	174	-3.80	1.64	284	250	-2.57	1.70	294	258	-4.61	-1.28	304	264	-2.03	-1.03
265	168	-3.25	1.39	275	174	-4.44	1.33	285	250	-4.31	-0.08	295	258	-3.00	0.36	305	264	-1.81	-0.40
266	168	-3.58	1.09	276	174	-4.43	1.00	286	250	-2.94	-0.30	296	258	-2.62	-0.64	306	264	-2.74	-1.90
267	168	-3.90	1.72	277	174	-4.53	0.54	287	250	-3.95	-0.13	297	258	-3.49	-0.75	307	264	-3.00	-1.60
268	168	-2.43	1.53	278	174	-3.44	2.50	288	250	-4.39	0.28	298	258	-2.95	-1.48	308	264	-4.32	-1.29
269	168	-2.02	1.37	279	174	-3.70	1.52	289	250	-3.83	0.51	299	258	-4.67	-1.39	309	264	-2.78	-1.10
270	168	-3.45	1.82	280	174	-3.01	1.71	290	250	-4.09	0.36	300	258	-3.22	-0.82	310	264	-2.36	-1.55

	CASE	X	Y		CASE	X	Y		CASE	X	Y		CASE	X	Y		CASE	X	Y
311	268	-4.37	-0.58	321	274	-2.51	-1.11	331	350	-5.07	-0.65	341	358	-3.94	-0.79	351	364	-3.53	-2.02
312	268	-3.35	0.74	322	274	-4.02	-0.83	332	350	-4.56	-0.19	342	358	-4.48	-2.22	352	364	-3.25	-2.22
313	268	-4.25	0.03	323	274	-4.36	-0.28	333	350	-2.72	0.09	343	358	-5.12	-2.32	353	364	-3.21	-0.25
314	268	-3.67	1.24	324	274	-3.09	0.55	334	350	-5.59	-1.10	344	358	-5.61	-2.23	354	364	-3.46	-0.01
315	268	-4.40	-1.06	325	274	-3.07	1.02	335	350	-3.77	-0.03	345	358	-3.19	-0.22	355	364	-5.76	-3.51
316	268	-4.22	0.86	326	274	-3.76	0.69	336	350	-3.63	0.31	346	358	-4.22	-1.40	356	364	-2.50	-1.99
317	268	-4.86	0.09	327	274	-5.09	1.62	337	350	-5.65	-0.48	347	358	-5.40	-0.50	357	364	-3.44	-3.96
318	268	-3.93	0.91	328	274	-4.28	0.31	338	350	-2.15	-0.01	348	358	-6.15	-1.16	358	364	-4.96	-3.38
319	268	-3.91	1.07	329	274	-3.81	-0.29	339	350	-3.96	-1.47	349	358	-4.34	-0.14	359	364	-4.53	-1.00
320	268	-3.88	1.24	330	274	-4.95	-0.38	340	350	-4.10	-1.24	350	358	-3.66	-0.32	360	364	-4.74	-1.77

	CASE	X	Y		CASE	X	Y
361	368	-3.93	-1.25	371	374	-4.35	-1.09
362	368	-4.51	-0.65	372	374	-4.79	-0.49
363	368	-4.20	0.02	373	374	-4.86	-0.24
364	368	-4.06	0.06	374	374	-5.76	-1.90
365	368	-3.99	-0.75	375	374	-4.35	0.06
366	368	-5.01	0.02	376	374	-4.78	0.16
367	368	-4.91	0.29	377	374	-4.51	0.06
368	368	-5.55	1.24	378	374	-5.18	0.51
369	368	-5.73	-0.32	379	374	-6.09	-1.59
370	368	-3.45	-0.37	380	374	-6.33	-0.10

APPENDIX 4.1. (CONTINUED)

OVERLAP OF DIFFERENT GROUPS IS INDICATED BY *



APPENDIX 4.1.(CONTINUED)

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BMDP7M  -  STEPWISE DISCRIMINANT ANALYSIS.                                PROGRAM REVISED APRIL, 1977
HEALTH SCIENCES COMPUTING FACILITY                                        MANUAL DATE  --  1975
UNIVERSITY OF CALIFORNIA, LOS ANGELES


   PROGRAM CONTROL INFORMATION

          FINISH/

   PROGRAM TERMINATED NORMALLY.
```

APPENDIX 4.2. DISCRIMININANT ANALYSIS OF SOYBEAN FIELD SUSCEPTIBILITY TO CORN EARWORM INFESTATIONS: ISLE OF WIGHT CO., VIRGINIA, 1974

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BMDP7M  -  STEPWISE DISCRIMINANT ANALYSIS.                                      PROGRAM REVISED APRIL, 1977
HEALTH SCIENCES COMPUTING FACILITY                                              MANUAL DATE  --  1975
UNIVERSITY OF CALIFORNIA, LOS ANGELES


IN THIS VERSION OF BMDP7M
   -- SUBPROBLEMS ARE NOT PERMITTED.
   -- GROUP CODES OR CUTPOINTS MUST BE STATED.
   -- BACKWARD STEPPING IS AVAILABLE. THE USER MAY STATE TWO
      VALUES FOR THE 'ENTER' AND 'REMOVE' PARAMETERS IN THE
      'DISC' PARAGRAPH. THE PROGRAM BEGINS STEPPING USING THE
      FIRST VALUES OF 'ENTER' AND 'REMOVE'. WHEN NO MORE
      STEPPING IS POSSIBLE WITH THESE LIMITS THE PROGRAM
      SWITCHES TO THE SECOND VALUES OF 'ENTER' AND 'REMOVE',
      WHICH, IF LARGE, WILL CAUSE BACKWARD STEPPING.
   -- NEW PARAMETERS IN THE 'PRINT' PARAGRAPH
      'WITH' - TO PRINT WITHIN COVARIANCE MATRIX (ASSUMED NO)
      'POST' - TO PRINT MAHALANOBIS D-SQ. AND POST.PROB.(YES)
      'POINT' - TO PRINT CANONICAL PLOT'S COORDINATES (YES)

   -- 1975 BMDP MANUAL ERROR -
      STATING CANON. IN THE PLOT PARAGRAPH REQUESTS THE PLOT
      OF THE FIRST TWO CANONICAL VARIABLES.  (SPECIFY NO
      CANON. IF A PLOT IS NOT WANTED.)  IF YOU WANT THE
      CANONICAL VARIBLES DEFINED IN TERMS OF THE CONTRASTS
      GIVEN IN THE DISCRIM PARAGRAPH STATE CONTR. IN THE PLOT
      PARAGRAPH.

  PROGRAM CONTROL INFORMATION

        PROBL       TITLE = 'DISCRIMINANT ANALYSIS ON SOYA GROUPS, IW, 1974'./
        INPUT       VARIABL = 9.
                    FORMAT = '(10X,3F10.5,3F10.3,F10.0,F10.5,A10)'.
                    CASE = 220.
                    UNIT = 8.
                    GROUP = 2./
        VARIABL     NAME = PL,PW,PLWV,SPACE,ROWHT,VOL,GGROUP,CENNO,ITCFLD.
                    USE = PL,PW,PLWV,SPACE,ROWHT,VOL,GGROUP.
                    LABEL = ITCFLD.
                    GROUPING = GGROUP./
        GROUP       CUTPOINT = 20.
                    CODE = 1,5.
                    NAME = A,E.
                    PRIOR = 0.0909,0.9091./
        PRINT       CLASS = 1 TO 6./
        DISC        TOL = .001.
                    ENTER = .01.
                    REMOVE = .005./
        END/
```

APPENDIX 4.2. (CONTINUED)

```
PROBLEM TITLE . . . . . . . .DISCRIMINANT ANALYSIS ON SUYA GROUPS, IN, 1974

NUMBER OF VARIABLES TO READ IN. . . . . . . . .        9
NUMBER OF VARIABLES ADDED BY TRANSFORMATIONS. .        0
TOTAL NUMBER OF VARIABLES . . . . . . . . . . .        9
NUMBER OF CASES TO READ IN. . . . . . . . . . .      220
CASE LABELING VARIABLES . . . . . . . . . . . .   IICFLD
LIMITS AND MISSING VALUE CHECKED BEFORE TRANSFORMATIONS
BLANKS ARE. . . . . . . . . . . . . . . . . . .   ZEROS
INPUT UNIT NUMBER . . . . . . . . . . . . . . .        8
REWIND INPUT UNIT PRIOR TO READING. . DATA. . .      YES

INPUT FORMAT
      (10X,3F10.5,3F10.3,F10.0,F10.5,A10)


VARIABLES TO BE USED
           1  PL              2  PW              3  PLWV          4  SPACE          5  ROWHT
           6  VOL             7  GGROUP

TOLERANCE. . . . . . . . .   0.001
F-TO-ENTER . . . . . . . .   0.010     0.010
F-TO-REMOVE. . . . . . . .   0.005     0.005
METHOD . . . . . . . . . .       1
MAXIMUM FORCED LEVEL . . .       0
MAXIMUM NUMBER OF STEPS. .      14
GROUPING VARIABLE. . . . .       7
NUMBER OF GROUPS . . . . .       2
PRIOR PROBABILITIES. . . .  0.09090    0.90910

                    BEFORE TRANSFORMATION                                            INTERVAL RANGE
VARIABLE          MINIMUM      MAXIMUM      MISSING     CATEGORY   CATEGORY      GREATER      LESS THAN
NO. NAME          LIMIT        LIMIT        CODE        CODE       NAME          THAN         OR EQUAL TO

  7  GGROUP                                              1.00000   A
                                                         5.00000   E

NUMBER OF CASES READ. . . . . . . . . . . . . .      220
```

APPENDIX 4.2. (CONTINUED)

```
    MEANS

       GROUP =     A                E               ALL GPS.
VARIABLE
  1 PL              1.45700       3.16330        3.00818
  2 PW              0.09660       0.23190        0.21960
  3 PLWV            0.16658       0.86831        0.80452
  4 SPACE          12.65000       1.05000        2.10454
  5 RUWHT          29.87500      37.50499       36.81136
  6 VOL         21997.79088   38599.16791    37089.95313
  7 GGROUP          1.00000       5.00000        4.63636

COUNTS               20.          200.           220.

    STANDARD DEVIATIONS

       GROUP =     A                E               ALL GPS.
VARIABLE
  1 PL              1.20391       1.44532        1.42591
  2 PW              0.03244       0.14838        0.14209
  3 PLWV            0.16984       0.73070        0.69993
  4 SPACE           4.72701       2.50575        2.77110
  5 RUWHT           2.85563       7.18308        6.91451
  6 VOL          4675.23438   10605.20313    10226.08964
  7 GGROUP          0.0           0.0            0.0

    MEANS/ST.DEVS.

       GROUP =     A                E               ALL GPS.
VARIABLE
  1 PL              1.21022       2.18865        2.10966
  2 PW              2.97799       1.56288        1.54126
  3 PLWV            0.98081       1.18833        1.14943
  4 SPACE           2.67611       0.41904        0.75946
  5 RUWHT          10.46180       5.22130        5.32379
  6 VOL             4.70517       3.63964        3.62699
  7 GGROUP          0.0           0.0            0.0

**************************************************************************************************

STEP NUMBER    0

   VARIABLE          F TO   FORCE  TOLERANCE  *       VARIABLE        F TO   FORCE    TOLERANCE
                    REMOVE  LEVEL             *                       ENTER  LEVEL
                DF=  1  219                   *                DF=   1  218
                                              *         1 PL         26.035     1       1.000000
                                              *         2 PW         18.132     1       1.000000
                                              *         3 PLWV       18.275     1       1.000000
                                              *         4 SPACE     318.596     1       1.000000
                                              *         5 RUWHT      22.139     1       1.000000
                                              *         6 VOL        47.918     1       1.000000
```

APPENDIX 4.2. (CONTINUED)

```
STEP NUMBER    1
VARIABLE ENTERED    4 SPACE

   VARIABLE          F TO  FORCE   TOLERANCE  *      VARIABLE        F TO  FORCE    TOLERANCE
                   REMOVE LEVEL               *                     ENTER  LEVEL
                DF=  1  218                   *                DF=   1  217
    4 SPACE       318.596    1    1.000000    *       1 PL          3.372   1        0.984283
                                              *       2 PW          7.149   1        0.999991
                                              *       3 PLWV        5.161   1        0.998344
                                              *       5 ROWHI       4.794   1        0.994930
                                              *       6 VOL         0.006   1        0.854526

U-STATISTIC OR WILKS' LAMBDA    0.4062641     DEGREES OF FREEDOM    1   1     218
APPROXIMATE F-STATISTIC           318.597     DEGREES OF FREEDOM     1.00   218.00

 F - MATRIX        DEGREES OF FREEDOM =    1  218

             A
E          318.60

CLASSIFICATION FUNCTIONS

          GROUP =    A             E
VARIABLE
  4 SPACE          1.04732       0.13673

CONSTANT         -12.01730      -0.16709

CLASSIFICATION MATRIX

GROUP        PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
             CORRECT
                         A         E
 A             85.0     17          3
 E             98.0      4   -    196

TOTAL          96.8     21        199

JACKKNIFED CLASSIFICATION

GROUP        PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
             CORRECT
                         A         E
 A             85.0     17          3
 E             98.0      4        196

TOTAL          96.8     21        199
```

APPENDIX 4.2. (CONTINUED)

```
STEP NUMBER     2
VARIABLE ENTERED    2 PW

   VARIABLE            F TO   FORCE   TOLERANCE  *        VARIABLE            F TO   FORCE    TOLERANCE
                      REMOVE  LEVEL              *                           ENTER   LEVEL
                  DF=  1  217                    *                     DF=  1  216
   2 PW                7.149    1     0.999991   *        1 PL              0.036    1        0.592682
   4 SPACE           292.364    1     0.999991   *        3 PLWV            3.559    1        0.036239
                                                 *        5 ROWHT           3.318    1        0.977905
                                                 *        6 VOL             0.048    1        0.843668


U-STATISTIC OR WILKS' LAMBDA      0.3933074      DEGREES OF FREEDOM    2    1      218
APPROXIMATE F-STATISTIC             167.366      DEGREES OF FREEDOM      2.00   217.00

 F - MATRIX         DEGREES OF FREEDOM =    2  217

                 A
B             167.37

CLASSIFICATION FUNCTIONS

           GROUP =    A                  B
VARIABLE
  2 PW               4.55457          11.49388
  4 SPACE            1.64803           0.13851

CONSTANT           -13.02671          -1.50073

CLASSIFICATION MATRIX

GROUP        PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
             CORRECT
                        A          B
 A            85.0     17          3
 B            97.5      5        195

TOTAL         96.4     22        198

JACKKNIFED CLASSIFICATION

GROUP        PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
             CORRECT
                        A          B
 A            85.0     17          3
 B            97.0      6        194

TOTAL         95.9     23        197
```

APPENDIX 4.2. (CONTINUED)

```
STEP NUMBER    3
VARIABLE ENTERED    3 PLWV

  VARIABLE          F TO  FORCE   TOLERANCE  *       VARIABLE         F TO  FORCE     TOLERANCE
                   REMOVE LEVEL              *                       ENTER  LEVEL
              DF=  1  216                    *                  DF=  1  215
   2 PW              5.583    1    0.036299  *        1 PL          5.392    1        0.269552
   3 PLWV            3.559    1    0.056239  *        5 ROMMT       3.234    1        0.977900
   4 SPACE         298.619    1    0.962194  *        6 VOL         0.0      1        0.833326

U-STATISTIC OR WILKS' LAMBDA    0.3069315     DEGREES OF FREEDOM   3   1    218
APPROXIMATE F-STATISTIC           114.079     DEGREES OF FREEDOM     3.00   216.00

 F - MATRIX          DEGREES OF FREEDOM =    3  216

               A
E           114.08

CLASSIFICATION FUNCTIONS

          GROUP =    A              E
VARIABLE
  2 PW          44.75513       11.39561
  3 PLWV        -8.32023      -13.63954
  4 SPACE        1.56874        0.00853

CONSTANT       -15.64121       -3.15213

CLASSIFICATION MATRIX

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                        A        E
 A           85.0      17        3
 E           97.5       5      195

TOTAL        96.4      22      198

JACKKNIFED CLASSIFICATION

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                        A        E
 A           85.0      17        3
 E           97.5       5      195

TOTAL        96.4      22      198
```

APPENDIX 4.2. (CONTINUED)

```
STEP NUMBER    4
VARIABLE ENTERED    1 PL

  VARIABLE          F TO  FORCE  TOLERANCE  *      VARIABLE         F TO  FORCE    TOLERANCE
                   REMOVE LEVEL             *                      ENTER  LEVEL
               DF=  1  215                  *                  DF=  1  214
   1 PL             5.392    1    0.209552  *       5 RUNHI      2.927    1       0.977189
   2 PW            11.010    1    0.021173  *       6 VOL        0.033    1       0.828655
   3 PLWV           8.960    1    0.016401  *
   4 SPACE        214.972    1    0.961792  *

U-STATISTIC OR WILKS' LAMBDA     0.3174649     DEGREES OF FREEDOM   4   1     218
APPROXIMATE F-STATISTIC             86.047     DEGREES OF FREEDOM    4.00   215.00

 F - MATRIX          DEGREES OF FREEDOM =     4  215

                 A
E              88.65

CLASSIFICATION FUNCTIONS

           GROUP =     A             E
VARIABLE
  1 PL              4.73334       5.92413
  2 PW            154.15598     214.31897
  3 PLWV          -37.11470     -49.67796
  4 SPACE           1.59568       0.04150

CONSTANT          -19.70075     -12.70936

CLASSIFICATION MATRIX

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                        A        E
 A           85.0      17        3
 E           97.5       5      195

TOTAL        96.4      22      198

JACKKNIFED CLASSIFICATION

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                        A        E
 A           85.0      17        3
 E           97.5       5      195

TOTAL        96.4      22      198
```

APPENDIX 4.2 (CONTINUED)

```
STEP NUMBER    5
VARIABLE ENTERED   5 ROWHT

  VARIABLE            F TO  FORCE  TOLERANCE  *      VARIABLE          F TO  FORCE    TOLERANCE
                    REMOVE  LEVEL             *                       ENTER  LEVEL
               DF=   1  214                   *                  DF=   1  213
   1 PL            5.072    1    0.269356     *      6 VOL           6.377    1       0.304157
   2 PW           10.332    1    0.621142     *
   3 PLWV          8.580    1    0.316474     *
   4 SPACE       250.123    1    0.957604     *
   5 ROWHT         2.927    1    0.977189     *

U-STATISTIC OR WILKS' LAMBDA    0.3723707     DEGREES OF FREEDOM   5  1    218
APPROXIMATE F-STATISTIC           72.139      DEGREES OF FREEDOM     5.00   214.00

 F - MATRIX          DEGREES OF FREEDOM =     5  214

               A
E            72.14

CLASSIFICATION FUNCTIONS

          GROUP =     A              E
VARIABLE
  1 PL              4.56007       5.73543
  2 PW            145.78259     234.72405
  3 PLWV          -36.63618     -48.44206
  4 SPACE           1.71166       0.17569
  5 ROWHT           0.66084       0.75728

CONSTANT          -29.98247     -26.16597

CLASSIFICATION MATRIX

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                       A        E
 A           85.0     17        3
 E           97.5      5      195

TOTAL        90.4     22      198

JACKKNIFED CLASSIFICATION

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                       A        E
 A           85.0     17        3
 E           97.5      5      195

TOTAL        90.4     22      198
```

APPENDIX 4.2. (CONTINUED)

```
STEP NUMBER    6
VARIABLE ENTERED   6 VOL

  VARIABLE          F TO   FORCE   TOLERANCE  *      VARIABLE        F TO  FORCE   TOLERANCE
                   REMOVE  LEVEL              *                     ENTER  LEVEL
               DF=  1  213                    *                DF=   1  212
  1 PL            5.915    1     0.267205     *
  2 PW            8.000    1     0.021664     *
  3 PLWV          7.363    1     0.016413     *
  4 SPACE       224.850    1     0.757371     *
  5 RUMMT         9.344    1     0.356676     *
  6 VOL           6.377    1     0.304157     *

U-STATISTIC OR WILKS' LAMBDA     0.3615450    DEGREES OF FREEDOM   6   1    218
APPROXIMATE F-STATISTIC            62.689     DEGREES OF FREEDOM     6.00  213.00

 F - MATRIX          DEGREES OF FREEDOM =     6  213

              A
E           62.69

CLASSIFICATION FUNCTIONS

          GROUP =    A           E
VARIABLE
  1 PL             4.47019      5.70033
  2 PW           146.81789    203.90785
  3 PLWV         -30.50109    -40.30074
  4 SPACE          1.66740      0.13319
  5 RUMMT          0.51210      0.79720
  6 VOL            0.00014     -0.00004

CONSTANT         -30.20183    -26.10704

CLASSIFICATION MATRIX

GROUP      PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
           CORRECT
                       A        E
 A          85.0      17        3
 E          98.5       3      197

TOTAL       97.3      20      200

JACKKNIFED CLASSIFICATION

GROUP      PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
           CORRECT
                       A        E
 A          85.0      17        3
 E          98.0       4      196

TOTAL       96.8      21      199



SUMMARY TABLE
  STEP            VARIABLE            F VALUE TO      NUMBER OF        U-STATISTIC    APPROXIMATE     DEGREES OF
 NUMBER       ENTERED    REMOVED    ENTER OR REMOVE  VARIABLES INCLUDED               F-STSTISTIC       FREEDOM
   1        4 SPACE                   318.5962              1            0.4063        318.597      1.00   218.00
   2        2 PW                        7.1486              2            0.3933        167.366      2.00   217.00
   3        3 PLWV                      3.5592              3            0.3869        114.079      3.00   216.00
   4        1 PL                        5.3919              4            0.3775         88.647      4.00   215.00
   5        5 RUMMT                     2.9274              5            0.3724         72.139      5.00   214.00
   6        6 VOL                       6.3771              6            0.3615         62.689      6.00   213.00
```

APPENDIX 4.2. (CONTINUED)

```
                  INCORRECT                     MAHALANOBIS D-SQUARE FROM AND
               CLASSIFICATIONS                  POSTERIOR PROBABILITY FOR GROUP -

GROUP   A                                 A              E

  CASE
   1    220                           3.3 1.000      35.7 0.000
   2    220                           2.1 1.000      29.5 0.000
   3    220                           1.9 1.000      25.6 0.000
   4    220                           4.3 1.000      40.0 0.000
   5    220        E                 10.4 0.053       9.3 0.947
   6    220                           5.9 1.000      47.5 0.000
   7    220                           7.3 1.000      50.8 0.000
   8    220                           2.5 1.000      34.2 0.000
   9    220                           2.2 1.000      33.3 0.000
  10    220                           2.3 1.000      23.7 0.000
  11    320        E                 24.1 0.000       1.7 1.000
  12    320                           2.3 0.956      13.0 0.044
  13    320                           1.5 1.000      24.1 0.000
  14    320                           5.2 1.000      40.5 0.000
  15    320                           3.8 1.000      25.1 0.000
  16    320                           1.4 1.000      25.1 0.000
  17    320                           3.6 0.710      10.0 0.290
  18    320                           3.3 0.896      12.2 0.104
  19    320        E                  6.6 0.156       7.8 0.844
  20    320                           6.2 1.000      34.1 0.000

GROUP   E                                 A              E

  CASE
  21    202                          17.0 0.000       3.9 1.000
  22    202                          22.3 0.000       3.9 1.000
  23    202        A                  6.6 0.999      25.3 0.001
  24    202                          36.1 0.000       7.3 1.000
  25    202                          19.4 0.000       5.9 1.000
  26    202                          27.5 0.000       2.0 1.000
  27    202                          25.2 0.000       1.6 1.000
  28    202                          11.1 0.003       3.8 0.997
  29    202                          15.0 0.001       5.6 0.999
  30    202                          16.9 0.000       1.5 1.000
  31    302                          32.2 0.000       7.2 1.000
  32    302                          27.3 0.000      11.1 1.000
  33    302                          16.0 0.017      14.4 0.983
  34    302                          14.5 0.009       9.7 0.991
  35    302                          40.6 0.000      19.1 1.000
  36    302                          32.7 0.000       8.4 1.000
  37    302                          54.4 0.000      18.5 1.000
  38    302                          29.6 0.000       2.9 1.000
  39    302                          40.1 0.000       9.7 1.000
  40    302                          29.0 0.000      16.4 1.000
  41    204                          20.9 0.000       3.1 1.000
  42    204                          30.1 0.000       4.6 1.000
  43    204                          28.5 0.000       2.8 1.000
  44    204                          24.2 0.000       3.3 1.000
  45    204                          25.1 0.000       2.6 1.000
  46    204                          28.8 0.000       7.1 1.000
```

APPENDIX 4.2. (CONTINUED)

47	204	24.0	0.000	2.6	1.000
48	204	24.4	0.000	2.6	1.000
49	204	25.3	0.000	1.5	1.000
50	204	24.2	0.000	2.9	1.000
51	304	35.6	0.000	4.7	1.000
52	304	33.4	0.000	6.3	1.000
53	304	30.7	0.000	2.7	1.000
54	304	24.5	0.000	2.4	1.000
55	304	42.4	0.000	11.0	1.000
56	304	30.1	0.000	3.9	1.000
57	304	33.9	0.000	4.6	1.000
58	304	25.5	0.000	2.8	1.000
59	304	24.6	0.000	3.9	1.000
60	304	24.6	0.000	2.6	1.000
61	206	14.5	0.017	10.9	0.983
62	206	29.9	0.000	6.1	1.000
63	206	31.2	0.000	5.5	1.000
64	206	30.1	0.000	6.1	1.000
65	206	28.5	0.000	5.3	1.000
66	206	27.8	0.000	4.9	1.000
67	206	29.0	0.000	6.9	1.000
68	206	31.0	0.000	4.7	1.000
69	206	13.2	0.003	6.2	0.997
70	206	32.0	0.000	8.4	1.000
71	306	8.3	0.422	12.3	0.578
72	306	14.6	0.000	2.9	1.000
73	306	30.9	0.000	3.6	1.000
74	306	29.5	0.000	5.8	1.000
75	306	33.5	0.000	6.0	1.000
76	306	32.8	0.000	6.8	1.000
77	306	31.1	0.000	2.9	1.000
78	306	32.2	0.000	4.3	1.000
79	306	33.1	0.000	5.5	1.000
80	306	30.7	0.000	4.7	1.000
81	206	29.3	0.000	11.1	1.000
82	208	24.7	0.000	8.7	1.000
83	208	25.0	0.000	3.3	1.000
84	208	26.8	0.000	4.2	1.000
85	208	27.2	0.000	2.1	1.000
86	208	28.9	0.000	2.3	1.000
87	208	24.1	0.000	3.4	1.000
88	208	25.4	0.000	3.1	1.000
89	208	13.2	0.004	6.5	0.996
90	208	6.2	0.122	8.9	0.878
91	308	25.6	0.000	4.8	1.000
92	308	24.6	0.000	2.2	1.000
93	308	27.3	0.000	2.1	1.000
94	308	29.1	0.000	2.0	1.000
95	308	25.8	0.000	3.1	1.000
96	308	27.6	0.000	3.3	1.000
97	308	37.1	0.000	6.9	1.000
98	308	24.8	0.000	2.6	1.000
99	308	26.1	0.000	5.2	1.000
100	308	25.6	0.000	4.1	1.000
101	210	23.8	0.000	2.6	1.000
102	210	16.7	0.000	5.1	1.000
103	210	25.6	0.000	2.1	1.000
104	210	21.2	0.000	2.6	1.000
105	210	20.2	0.000	2.7	1.000

APPENDIX 4.2. (CONTINUED)

106	210	25.6	0.000	1.9	1.000
107	210	12.5	0.000	7.0	0.994
108	210	33.3	0.000	4.6	1.000
109	210	26.8	0.000	4.9	1.000
110	210	26.3	0.000	1.7	1.000
111	310	26.7	0.000	3.8	1.000
112	310	31.5	0.000	7.2	1.000
113	310	25.3	0.000	4.6	1.000
114	310	16.1	0.001	6.9	0.999
115	310	30.4	0.000	3.7	1.000
116	310	30.0	0.000	4.3	1.000
117	310	28.9	0.000	1.1	1.000
118	310	26.0	0.000	2.7	1.000
119	310	25.2	0.000	3.0	1.000
120	310	25.8	0.000	3.4	1.000
121	212	27.6	0.000	6.1	1.000
122	212	25.1	0.000	5.1	1.000
123	212	25.9	0.000	6.2	1.000
124	212	25.6	0.000	5.2	1.000
125	212	28.9	0.000	5.2	1.000
126	212	29.9	0.000	3.5	1.000
127	212	25.5	0.000	5.7	1.000
128	212	24.6	0.000	2.3	1.000
129	212	25.2	0.000	7.0	1.000
130	212	28.6	0.000	5.0	1.000
131	312	24.7	0.000	2.5	1.000
132	312	27.9	0.000	4.8	1.000
133	312	25.4	0.000	2.5	1.000
134	312	24.0	0.000	2.1	1.000
135	312	24.9	0.000	3.0	1.000
136	312	20.5	0.000	3.1	1.000
137	312	25.0	0.000	4.4	1.000
138	312	4.8	0.961	15.9	0.039
139	312	20.6	0.000	3.4	1.000
140	312	26.2	0.000	1.7	1.000
141	214	25.7	0.000	4.5	1.000
142	214	25.1	0.000	1.7	1.000
143	214	28.0	0.000	3.3	1.000
144	214	25.5	0.000	2.9	1.000
145	214	25.8	0.000	3.2	1.000
146	214	27.0	0.000	2.9	1.000
147	214	24.4	0.000	2.0	1.000
148	214	29.2	0.000	4.7	1.000
149	214	27.3	0.000	3.5	1.000
150	214	24.6	0.000	2.5	1.000
151	314	25.1	0.000	3.5	1.000
152	314	26.4	0.000	3.9	1.000
153	314	35.8	0.000	5.7	1.000
154	314	24.9	0.000	2.6	1.000
155	314	29.9	0.000	5.3	1.000
156	314	26.3	0.000	5.4	1.000
157	314	25.1	0.000	3.0	1.000
158	314	27.1	0.000	7.1	1.000
159	314	26.6	0.000	4.7	1.000
160	314	29.9	0.000	7.7	1.000
161	316	43.2	0.000	11.8	1.000
162	316	40.6	0.000	12.6	1.000
163	316	34.7	0.000	4.2	1.000
164	316	39.1	0.000	7.7	1.000

APPENDIX 4.2. (CONTINUED)

165	316	33.8	0.000	8.0	1.000
166	316	42.6	0.000	17.0	1.000
167	316	47.0	0.000	23.8	1.000
168	316	43.3	0.000	10.1	1.000
169	316	45.2	0.000	20.7	1.000
170	316	38.6	0.000	7.4	1.000
171	218	25.1	0.000	6.8	1.000
172	218	25.9	0.000	9.8	1.000
173	218	27.3	0.000	7.6	1.000
174	218	18.2	0.002	9.9	0.998
175	218	24.3	0.000	7.7	1.000
176	218	24.7	0.000	8.8	1.000
177	218	26.7	0.000	7.9	1.000
178	218	24.0	0.000	16.0	1.000
179	218	24.7	0.000	16.4	1.000
180	218	28.2	0.000	10.2	1.000
181	318	25.5	0.000	2.3	1.000
182	318	24.8	0.000	2.6	1.000
183	318	25.7	0.000	2.5	1.000
184	318	28.4	0.000	3.5	1.000
185	318	24.5	0.000	4.5	1.000
186	318	25.2	0.000	3.9	1.000
187	318	24.9	0.000	1.8	1.000
188	318	16.5	0.000	2.4	1.000
189	318	24.9	0.000	2.2	1.000
190	318	26.7	0.000	4.2	1.000
191	222	17.3	0.004	16.7	0.996
192	222	25.3	0.000	8.9	1.000
193	222	37.7	0.000	7.9	1.000
194	222	15.2	0.008	10.3	0.992
195	222	28.8	0.000	12.4	1.000
196	222	38.1	0.000	16.3	1.000
197	222	41.1	0.000	11.8	1.000
198	222	42.1	0.000	10.7	1.000
199	222	39.5	0.000	9.1	1.000
200	222	44.6	0.000	19.0	1.000
201	224	30.0	0.000	8.3	1.000
202	224	11.6	0.039	9.8	0.961
203	224	13.2	0.003	6.0	0.997
204	224	6.5	0.332	9.8	0.668
205	224	26.3	0.000	5.1	1.000
206	224	27.5	0.000	4.7	1.000
207	224	7.4	0.954	18.1	0.046
208	224	29.5	0.000	4.8	1.000
209	224	28.9	0.000	2.9	1.000
210	224	25.9	0.000	4.4	1.000
211	324	40.0	0.000	7.7	1.000
212	324	40.5	0.000	9.0	1.000
213	324	29.1	0.000	2.0	1.000
214	324	37.8	0.000	7.4	1.000
215	324	12.7	0.103	13.6	0.897
216	324	29.3	0.000	2.3	1.000
217	324	32.7	0.000	4.2	1.000
218	324	26.9	0.000	4.3	1.000
219	324	30.9	0.000	2.8	1.000
220	324	28.9	0.000	2.2	1.000

APPENDIX 4.2. (CONTINUED)

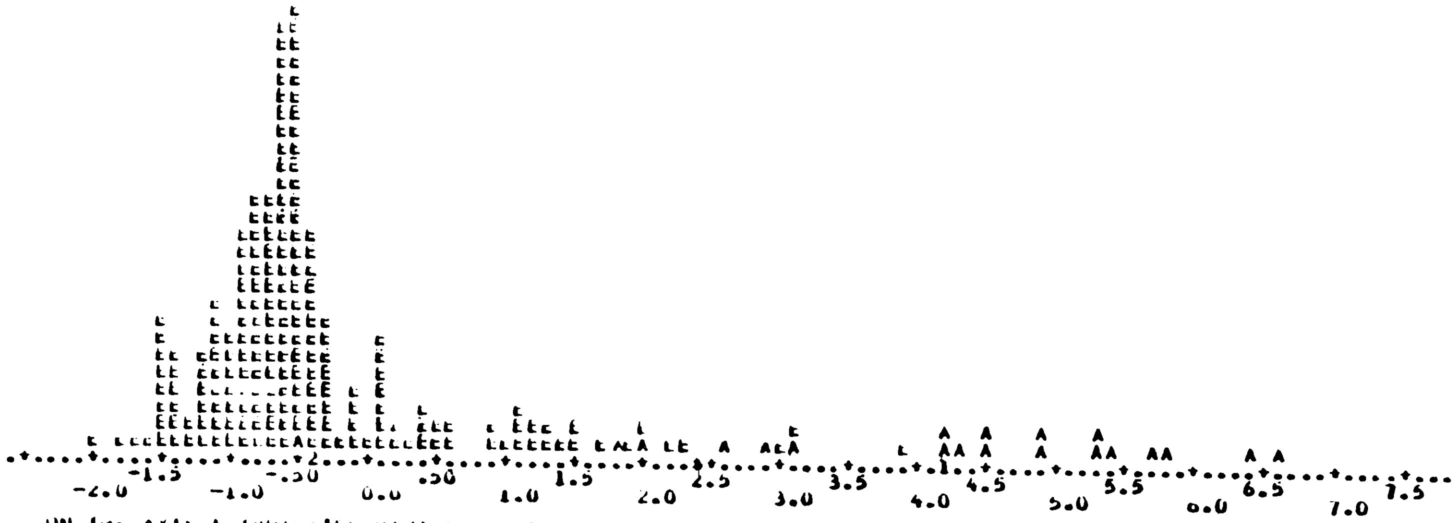
```
EIGENVALUES

                   1.76590

CANONICAL CORRELATIONS

                   0.79903

VARIABLE        COEFFICIENTS FOR CANONICAL VARIABLES

  1 PL            -0.27907
  2 PW           -11.97236
  3 PLWV           2.55117
  4 SPACE          0.31696
  5 ROWHT         -0.06195
  6 VOL            0.00504

CONSTANT           1.49301

GROUP          CANONICAL VARIABLES EVALUATED AT GROUP MEANS
     A             4.10512
     E            -0.41031
```

APPENDIX 4.2. (CONTINUED)

```
POINTS TO BE PLOTTED

GROUP             MEAN          SYMBOL      SYMBOL
              COORDINATES     FOR CASES    FOR MEAN

 A             4.18   0.0         A            1
 E            -0.42   0.0         E            2

GROUP A
     CASE      CAN.V       CASE     CAN.V

    1  220      5.40     11   320    -0.34
    2  220      4.81     12   320     3.05
    3  220      4.47     13   320     4.34
    4  220      5.76     14   320     5.71
    5  220      1.76     15   320     4.20
    6  220      6.40     16   320     4.46
    7  220      6.01     17   320     2.58
    8  220      5.33     18   320     2.85
    9  220      5.26     19   320     2.02
   10  220      4.20     20   320     4.92

GROUP E
     CASE      CAN.V       CASE     CAN.V        CASE     CAN.V        CASE     CAN.V        CASE     CAN.V        CASE     CAN.V        CASE     CAN.V

   21  202      0.46     31   302   -0.03    41   204   -0.70    51   304   -1.48    61   206    1.49    71   306    2.31    81   208   -0.10
   22  202     -0.11     32   302    0.12    42   204   -0.89    52   304   -1.07    62   206   -0.70    72   306    0.61    82   208    0.14
   23  202      3.91     33   302    1.50    43   204   -0.90    53   304   -1.16    63   206   -0.91    73   306   -1.08    83   208   -0.48
   24  202     -1.40     34   302    1.36    44   204   -0.38    54   304   -0.53    64   206   -0.72    74   306   -0.70    84   208   -0.58
   25  202      0.41     35   302   -1.11    45   204   -0.56    55   304   -1.53    65   206   -0.64    75   306   -0.89    85   208   -0.04
   26  202     -0.89     36   302   -0.76    46   204   -0.48    56   304   -0.96    66   206   -0.61    76   306   -0.94    86   208   -1.01
   27  202     -0.69     37   302   -2.02    47   204   -0.44    57   304   -1.30    67   206   -0.51    77   306   -1.18    87   208   -0.37
   28  202      1.09     38   302   -1.02    48   204   -0.48    58   304   -0.58    68   206   -0.97    78   306   -1.14    88   208   -0.54
   29  202      0.88     39   302   -1.42    49   204   -0.71    59   304   -0.31    69   206    1.12    79   306   -1.12    89   208    1.16
   30  202      0.21     40   302    0.31    50   204   -0.44    60   304   -0.50    70   206   -0.68    80   306   -0.95    90   208    1.35
     CASE      CAN.V       CASE     CAN.V        CASE     CAN.V        CASE     CAN.V        CASE     CAN.V        CASE     CAN.V        CASE     CAN.V

   91  308     -0.38    101   210   -0.42   111   310   -0.60   121   212   -0.45   131   312   -0.53   141   214   -0.42   151   314   -0.47
   92  308     -0.56    102   210    0.02   112   310   -0.75   122   212   -0.30   132   312   -0.63   142   214   -0.67   152   314   -0.50
   93  308     -0.80    103   210   -0.07   113   310   -0.36   123   212   -0.25   133   312   -0.61   143   214   -0.80   153   314   -1.40
   94  308     -1.07    104   210   -0.79   114   310    0.89   124   212   -0.34   134   312   -0.49   144   214   -0.58   154   314   -0.52
   95  308     -0.58    105   210   -0.67   115   310   -1.02   125   212   -0.69   135   312   -0.50   145   214   -0.57   155   314   -0.79
   96  308     -0.76    106   210   -0.10   116   310   -0.91   126   212   -0.98   136   312   -0.00   146   214   -0.74   156   314   -0.39
   97  308     -1.18    107   210    1.29   117   310   -1.15   127   212   -0.26   137   312   -0.36   147   214   -0.55   157   314   -0.52
   98  308     -0.60    108   210   -1.24   118   310   -0.67   128   212   -0.54   138   312    3.08   148   214   -0.78   158   314   -0.50
   99  308     -0.39    109   210   -0.50   119   310   -0.53   129   212   -0.09   139   312   -0.64   149   214   -0.70   159   314   -0.50
  100  308     -0.46    110   210   -0.19   120   310   -0.55   130   212   -0.68   140   312   -0.77   150   214   -0.52   160   314   -0.53
     CASE      CAN.V       CASE     CAN.V        CASE     CAN.V        CASE     CAN.V        CASE     CAN.V        CASE     CAN.V

  161  316     -1.53    171   218   -0.11   181   318   -0.64   191   222    1.17   201   224   -0.48   211   324   -1.62
  162  316     -1.75    172   218    0.13   182   318   -0.59   192   222    0.11   202   224    1.69   212   324   -1.54
  163  316     -1.43    173   218   -0.30   183   318   -0.64   193   222   -1.36   203   224    1.10   213   324   -1.06
  164  316     -1.53    174   218    0.98   184   318   -0.82   194   222    1.34   204   224    2.23   214   324   -1.42
  165  316     -0.92    175   218    0.08   185   318   -0.29   195   222    0.09   205   224   -0.42   215   324    1.91
  166  316     -0.84    176   218    0.16   186   318   -0.44   196   222   -0.49   206   224   -0.59   216   324   -1.06
  167  316     -0.04    177   218   -0.16   187   318   -0.62   197   222   -1.30   207   224    3.04   217   324   -1.21
  168  316     -1.73    178   218    0.37   188   318    0.35   198   222   -1.53   208   224   -0.80   218   324   -0.57
  169  316     -0.78    179   218    0.33   189   318   -0.58   199   222   -1.42   209   224   -0.94   219   324   -1.18
  170  316     -1.21    180   218    0.14   190   318   -0.56   200   222   -0.90   210   224   -0.46   220   324   -1.03
```

APPENDIX 4.2. (CONTINUED)

```
HISTOGRAM OF CANONICAL VARIABLE
```



```
ON THE AXIS $ INDICATES DIVIDING POINT AND NUMBERS THE GROUP MEANS




BMDP7M  -  STEPWISE DISCRIMINANT ANALYSIS.                          PROGRAM REVISED APRIL, 1977
HEALTH SCIENCES COMPUTING FACILITY                                  MANUAL DATE  --  1975
UNIVERSITY OF CALIFORNIA, LOS ANGELES


  PROGRAM CONTROL INFORMATION

NO MORE CONTROL LANGUAGE.  PROGRAM TERMINATED.
```

APPENDIX 4.3. DISCRIMINANT ANALYSIS OF SOYBEAN FIELD SUSCEPTIBILITY TO CORN EARWORM INFESTATIONS: WESTMORELAND CO., VIRGINIA, 1974

```
BMDP7M  -  STEPWISE DISCRIMINANT ANALYSIS.                                                PROGRAM REVISED APRIL, 1977
HEALTH SCIENCES COMPUTING FACILITY                                                        MANUAL DATE  --  1975
UNIVERSITY OF CALIFORNIA, LOS ANGELES


IN THIS VERSION OF BMDP7M
   -- SUBPROBLEMS ARE NOT PERMITTED.
   -- GROUP CODES OR CUTPOINTS MUST BE STATED.
   -- BACKWARD STEPPING IS AVAILABLE. THE USER MAY STATE TWO
      VALUES FOR THE 'ENTER' AND 'REMOVE' PARAMETERS IN THE
      'DISC' PARAGRAPH. THE PROGRAM BEGINS STEPPING USING THE
      FIRST VALUES OF 'ENTER' AND 'REMOVE'. WHEN NO MORE
      STEPPING IS POSSIBLE WITH THESE LIMITS THE PROGRAM
      SWITCHES TO THE SECOND VALUES OF 'ENTER' AND 'REMOVE',
      WHICH, IF LARGE, WILL CAUSE BACKWARD STEPPING.
   -- NEW PARAMETERS IN THE 'PRINT' PARAGRAPH
      'WITH' - TO PRINT WITHIN COVARIANCE MATRIX (ASSUMED NO)
      'POST' - TO PRINT MAHALANOBIS D-SQ. AND POST.PROB.(YES)
      'POINT' - TO PRINT CANONICAL PLOT'S COORDINATES (YES)

   -- 1975 BMDP MANUAL ERROR -
      STATING CANON. IN THE PLOT PARAGRAPH REQUESTS THE PLOT
      OF THE FIRST TWO CANONICAL VARIABLES.  (SPECIFY NO
      CANON. IF A PLOT IS NOT WANTED.)  IF YOU WANT THE
      CANONICAL VARIABLES DEFINED IN TERMS OF THE CONTRASTS
      GIVEN IN THE DISCRIM PARAGRAPH STATE CONTR. IN THE PLOT
      PARAGRAPH.

 PROGRAM CONTROL INFORMATION

        PROBL      TITLE = 'DISCRIMINANT ANALYSIS ON SOYA GROUPS,  W, 1974'./
        INPUT      VARIABLE = 9.
                   FORMAT = '(10X,3F10.5,3F10.3,F10.0,F10.5,A10)'.
                   CASE = 90.
                   UNIT = 8.
                   GROUP = 2./
        VARIABLE   NAME = PL,PW,PLWV,SPACE,ROWHT,VOL,GGROUP,CEWNO,TTCFLD.
                   USE = PL,PW,PLWV,SPACE,ROWHT,VOL,GGROUP.
                   LABEL = TTCFLD.
                   GROUPING = GGROUP./
        GROUP      CUTPOINT = 20.
                   CODE = 4, 5.
                   NAME = D,E.
                   PRIOR = 0.2222,0.7778./
        PRINT      CLASS = 1 TO 6./
        DISC       TOL = .001.
                   ENTER = .01.
                   REMOVE = .005./
        END/
```

APPENDIX 4.3. (CONTINUED)

```
PROBLEM TITLE . . . . . . . .DISCRIMINANT ANALYSIS ON SOYA GROUPS, W, 1974

NUMBER OF VARIABLES TO READ IN. . . . . . . . . . .          6
NUMBER OF VARIABLES ADDED BY TRANSFORMATIONS. . . .          3
TOTAL NUMBER OF VARIABLES . . . . . . . . . . . . .          9
NUMBER OF CASES TO READ IN. . . . . . . . . . . . .         90
CASE LABELING VARIABLES . . . . . . . . . . . . . .     TIEFLD
LIMITS AND MISSING VALUE CHECKED BEFORE TRANSFORMATIONS
BLANKS ARE. . . . . . . . . . . . . . . . . . . . .     ZEROS
INPUT UNIT NUMBER . . . . . . . . . . . . . . . . .          8
REWIND INPUT UNIT PRIOR TO READING. . DATA. . . . .        YES

INPUT FORMAT
        (10X,3F10.5,3F10.3,F10.3,F10.5,A10)

VARIABLES TO BE USED
                1  PL              2  PW              3  PLWV            4  SPACE           5  KONHT
                6  VOL             7  GGROUP

TOLERANCE. . . . . . . . . .       0.001
F-TO-ENTER . . . . . . . . .       0.010     0.010
F-TO-REMOVE. . . . . . . . .       0.005     0.005
METHOD . . . . . . . . . . .           1
MAXIMUM FORCED LEVEL . . . .           0
MAXIMUM NUMBER OF STEPS. . .          14
GROUPING VARIABLE. . . . . .           7
NUMBER OF GROUPS . . . . . .           2
PRIOR PROBABILITIES. . . . .       0.22220   0.77780

                     BEFORE TRANSFORMATION                                                   INTERVAL RANGE
 VARIABLE            MINIMUM    MAXIMUM      MISSING    CATEGORY  CATEGORY      GREATER    LESS THAN
 NO. NAME            LIMIT      LIMIT        CODE       CODE      NAME          THAN       OR EQUAL TO
  7   GGROUP
                                                         4.00000   D
                                                         5.00000   E

 NUMBER OF CASES READ. . . . . . . . . . . . . . .      90
```

APPENDIX 4.3. (CONTINUED)

```
     MEANS

        GROUP =     D               E                ALL GPS.
VARIABLE
   1 PL              3.80100         3.91400           3.88955
   2 PW              0.35400         0.33343           0.33600
   3 PLWV            1.30262         1.32040           1.32978
   4 SPACE           5.55000         1.12857           2.11111
   5 ROWHT          34.59999        34.75714          34.72221
   6 VOL         27071.64844     31068.71875       30933.81641
   7 GGROUP          4.00000         5.00000           4.77778

COUNTS                   20.             70.              90.

     STANDARD DEVIATIONS

        GROUP =     D               E                ALL GPS.
VARIABLE
   1 PL              0.33080         0.41347           0.39818
   2 PW              0.13862         0.12991           0.13184
   3 PLWV            0.57491         0.56752           0.56913
   4 SPACE           4.91479         3.07356           3.55282
   5 ROWHT           4.69490         3.33376           3.67062
   6 VOL          7569.30859      8005.75781        7913.53906
   7 GGROUP          0.0             0.0               0.0

     MEANS/ST.DEVS.

        GROUP =     D               E                ALL GPS.
VARIABLE
   1 PL             11.20374         9.46821           9.76836
   2 PW              2.55380         2.56652           2.56308
   3 PLWV            2.37014         2.32660           2.33654
   4 SPACE           1.12924         0.36710           0.59421
   5 ROWHT           7.36970        10.42519           9.45950
   6 VOL             3.66219         3.91325           3.90897
   7 GGROUP          0.0             0.0               0.0

**********************************************************************************************************

STEP NUMBER    0

   VARIABLE         F TO   FORCE   TOLERANCE  *     VARIABLE         F TO   FORCE    TOLERANCE
                   REMOVE  LEVEL              *                      ENTER  LEVEL
            DF=   1    89                     *                DF=   1    88
                                              *       1 PL           1.272    1       1.000000
                                              *       2 PW           0.379    1       1.000000
                                              *       3 PLWV         0.066    1       1.000000
                                              *       4 SPACE       24.091    1       1.000000
                                              *       5 ROWHT        0.028    1       1.000000
                                              *       6 VOL          3.850    1       1.000000
```

APPENDIX 4.3. (CONTINUED)

```
STEP NUMBER    1
VARIABLE ENTERED    4 SPACE

  VARIABLE          F TO  FORCE  TOLERANCE  *      VARIABLE          F TO   FORCE   TOLERANCE
                   REMOVE LEVEL             *                       ENTER  LEVEL
               DF=  1   88                  *                   DF=  1   87
   4 SPACE         24.091   1    1.000000   *    .     1 PL         1.388   1      0.998197
                                            *          2 PW         0.227   1      0.999770
                                            *          3 PLWV       0.041   1      0.999840
                                            *          5 KOWHI      0.370   1      0.970108
                                            *          6 VOL        0.462   1      0.938780

U-STATISTIC OR WILKS' LAMBDA    0.7850742      DEGREES OF FREEDOM    1    1      88
APPROXIMATE F-STATISTIC           24.091       DEGREES OF FREEDOM      1.00    88.00

 F - MATRIX           DEGREES OF FREEDOM =    1    88

              D
E             24.09

CLASSIFICATION FUNCTIONS

          GROUP -    D             E
VARIABLE
  4 SPACE           0.43969       0.08941

CONSTANT           -2.72431      -0.30174

CLASSIFICATION MATRIX

GROUP        PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
             CORRECT
                       D        E
 D           50.0     10       10
 E           94.3      4       66

TOTAL        84.4     14       76

JACKKNIFED CLASSIFICATION

GROUP        PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
             CORRECT
                       D        E
 D           50.0     10       10
 E           94.3      4       66

TOTAL        84.4     14       76
```

APPENDIX 4.3. (CONTINUED)

```
STEP NUMBER    2
VARIABLE ENTERED    1 PL

  VARIABLE          F TO   FORCE  TOLERANCE  *       VARIABLE        F TO   FORCE    TOLERANCE
                   REMOVE  LEVEL             *                      ENTER  LEVEL
               DF=  1   87                   *                DF=  1   86
  1 PL              1.388    1     0.998198  *       2 PW          0.742    1       0.908582
  4 SPACE          23.982    1     0.998198  *       3 PLWV        0.806    1       0.752096
                                             *       5 ROWMI       0.453    1       0.966372
                                             *       6 VOL         0.335    1       0.932684

U-STATISTIC OR WILKS' LAMBDA    0.7727441    DEGREES OF FREEDOM   2    1      88
APPROXIMATE F-STATISTIC           12.793     DEGREES OF FREEDOM    2.00     87.00

 F - MATRIX          DEGREES OF FREEDOM =    2   87

                D
E             12.79

CLASSIFICATION FUNCTIONS

          GROUP -    D            E
VARIABLE
  1 PL            23.65043     24.70276
  4 SPACE          3.32020     -0.02813

CONSTANT         -47.75700    -46.58920

CLASSIFICATION MATRIX

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                       D          E
 D           55.0      11          9
 E           92.9       5         65

TOTAL        84.4      16         74

JACKKNIFED CLASSIFICATION

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                       D          E
 D           50.0      10         10
 E           92.9       5         65

TOTAL        83.3      15         75
```

APPENDIX 4.3. (CONTINUED)

```
STEP NUMBER    3
VARIABLE ENTERED    3 PLWV

  VARIABLE          F TO   FORCE   TOLERANCE  *        VARIABLE          F TO   FORCE    TOLERANCE
                   REMOVE  LEVEL              *                          ENTER  LEVEL
             DF=    1   86                    *                    DF=    1   85
   1 PL            2.149    1      0.750601   *         2 PW           0.677     1        0.011128
   3 PLWV          0.806    1      0.752097   *         5 HUMMI        0.173     1        0.877385
   4 SPACE        23.545    1      0.998103   *         6 VOL          1.158     1        0.750674

U-STATISTIC OR WILKS' LAMBDA    0.7655675      DEGREES OF FREEDOM    3    1        88
APPROXIMATE F-STATISTIC             8.778      DEGREES OF FREEDOM      3.00     86.00

 F - MATRIX          DEGREES OF FREEDOM =     3    86

                 D
E                  8.78

CLASSIFICATION FUNCTIONS

          GROUP =    D                E
VARIABLE
  1 PL            21.75079        26.96709
  3 PLWV          -5.40595        -6.01671
  4 SPACE          0.31075        -0.03630

CONSTANT         -31.40283       -32.99870

CLASSIFICATION MATRIX

GROUP       PERCENT    NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                          D          E
 D           50.0        10         10
 E           94.3         4         66

TOTAL        84.4        14         76

JACKKNIFED CLASSIFICATION

GROUP       PERCENT    NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                          D          E
 D           50.0        10         10
 E           92.9         5         65

TOTAL        83.3        15         75
```

APPENDIX 4.3. (CONTINUED)

```
STEP NUMBER    4
VARIABLE ENTERED    6 VOL

  VARIABLE          F TO   FORCE   TOLERANCE  *      VARIABLE          F TO   FORCE    TOLERANCE
                  REMOVE  LEVEL               *                      ENTER   LEVEL
            DF=    1   85                     *                DF=    1   84
   1 PL            2.594    1     0.736500    *      2 PW             0.052    1       0.011107
   3 PLWV          1.628    1     0.605326    *      5 ROWHT          1.262    1       0.642104
   4 SPACE        17.299    1     0.923453    *
   6 VOL           1.158    1     0.750674    *

U-STATISTIC OR WILKS' LAMBDA    0.7552790     DEGREES OF FREEDOM    4   1      88
APPROXIMATE F-STATISTIC            6.885      DEGREES OF FREEDOM      4.00    85.00

 F - MATRIX          DEGREES OF FREEDOM =     4    85

                 D
E                 6.88

CLASSIFICATION FUNCTIONS

          GROUP =     D              E
VARIABLE
   1 PL            30.17102       31.55402
   3 PLWV         -10.46356      -11.31603
   4 SPACE          0.71841        0.36877
   6 VOL            0.05073        0.00077

CONSTANT          -63.84904      -67.07892

CLASSIFICATION MATRIX

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                        D          E
 D           60.0      12          8
 E           94.3       4         66

TOTAL        86.7      16         74

JACKKNIFED CLASSIFICATION

GROUP       PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                        D          E
 D           55.0      11          9
 E           92.9       5         65

TOTAL        84.4      16         74
```

APPENDIX 4.3. (CONTINUED)

```
STEP NUMBER    5
VARIABLE ENTERED    5 ROWHT

  VARIABLE          F TO   FORCE   TOLERANCE  *       VARIABLE          F TO   FORCE    TOLERANCE
                   REMOVE  LEVEL              *                        ENTER   LEVEL
              DF =   1   84                   *                  DF =   1   83
   1 PL            2.458     1     0.730208   *      2 PW           0.101      1       0.010841
   3 PLWV          1.392     1     0.662657   *
   4 SPACE        17.259     1     0.921872   *
   5 ROWHT         1.262     1     0.642165   *
   6 VOL           2.248     1     0.549373   *

U-STATISTIC OR WILKS' LAMBDA    0.7440991    DEGREES OF FREEDOM   5   1      88
APPROXIMATE F-STATISTIC             5.778    DEGREES OF FREEDOM     5.00   84.00

 F - MATRIX          DEGREES OF FREEDOM =    5   84

                 D
E                5.78

CLASSIFICATION FUNCTIONS

           GROUP =    D             E
VARIABLE
   1 PL            30.66203      32.02820
   3 PLWV         -11.67151     -12.66834
   4 SPACE          6.83199       0.49628
   5 ROWHT          3.18375       3.06970
   6 VOL           -0.00010      -0.00002

CONSTANT         -167.69041    -167.84032

CLASSIFICATION MATRIX

GROUP      PERCENT    NUMBER OF CASES CLASSIFIED INTO GROUP -
           CORRECT
                       D        E
 D          55.0      11        9
 E          94.3       4       66

TOTAL       85.0      15       75

JACKKNIFED CLASSIFICATION

GROUP      PERCENT    NUMBER OF CASES CLASSIFIED INTO GROUP -
           CORRECT
                       D        E
 D          55.0      11        9
 E          92.9       5       65

TOTAL       84.4      16       74
```

APPENDIX 4.3 (CONTINUED)

```
STEP NUMBER    6
VARIABLE ENTERED    2 PM

  VARIABLE          F TO   FORCE  TOLERANCE  *        VARIABLE        F TO   FORCE   TOLERANCE
                   REMOVE  LEVEL             *                        ENTER  LEVEL
              DF=   1  83                    *                 DF=  1   82
                                             *
   1 PL             1.119    1    0.140906   *
   2 PM             0.101    1    0.010041   *
   3 PLAV           0.293    1    0.009019   *
   4 SPACE         17.291    1    0.967606   *
   5 RUMMI          1.330    1    0.626716   *
   6 VOL            2.267    1    0.546320   *

U-STATISTIC OR WILKS' LAMBDA    0.7426569    DEGREES OF FREEDOM    6    1     88
APPROXIMATE F-STATISTIC             4.793    DEGREES OF FREEDOM       6.00   83.00

 F - MATRIX           DEGREES OF FREEDOM =    6   83

              D
E           4.79

CLASSIFICATION FUNCTIONS

        GROUP =    D               E
VARIABLE
  1 PL          152.50704     154.63957
  2 PM         1529.30390    1530.15723
  3 PLAV       -391.45990    -400.46901
  4 SPACE         0.00044      -0.27774
  5 RUMMI         2.60514       1.94461
  6 VOL           0.00006       0.00013

 CONSTANT      -320.05200    -330.75439

 CLASSIFICATION MATRIX

 GROUP      PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                        D        E
  D          55.0      11        9
  E          94.3       4       66

 TOTAL       85.6      15       75

 JACKKNIFED CLASSIFICATION

 GROUP      PERCENT   NUMBER OF CASES CLASSIFIED INTO GROUP -
            CORRECT
                        D        E
  D          55.0      11        9
  E          91.4       6       64

 TOTAL       83.3      17       73


 SUMMARY TABLE ..

   STEP              VARIABLE                 F VALUE TO        NUMBER OF          U-STATISTIC    APPROXIMATE    DEGREES OF
  NUMBER        ENTERED     REMOVED       ENTER OR REMOVE   VARIABLES INCLUDED                   F-STSTISTIC      FREEDOM
    1          4 SPACE                         24.0913               1               0.7851         24.091      1.00    88.00
    2          1 PL                             1.3882               2               0.7727         12.793      2.00    87.00
    3          3 PLAV                           0.8061               3               0.7656          8.778      3.00    86.00
    4          6 VOL                            1.1577               4               0.7553          6.685      4.00    85.00
    5          5 RUMMI                          1.2620               5               0.7441          5.778      5.00    84.00
    6          2 PM                             0.1012               6               0.7427          4.793      6.00    83.00
```

APPENDIX 4.3. (CONTINUED)

```
               INCORRECT                MAHALANOBIS D-SQUARE FROM AND
            CLASSIFICATIONS             POSTERIOR PROBABILITY FOR GROUP -

GROUP   D                               D               E

  CASE
    1     326                      2.6 0.751       7.4 0.249
    2     326      E               7.4 0.399       9.1 0.601
    3     326      E               9.7 0.064       6.9 0.936
    4     326      E               4.9 0.125       3.6 0.875
    5     326      E              11.6 0.024       6.7 0.976
    6     326      E               7.5 0.078       5.1 0.922
    7     326                      6.3 0.688      10.4 0.312
    8     326      E               4.2 0.176       3.6 0.824
    9     326      E               8.2 0.033       3.9 0.967
   10     326                      5.0 0.617       6.5 0.383
   11     334      E               6.5 0.070       3.8 0.930
   12     334                      2.6 0.629       5.6 0.371
   13     334                      7.3 0.947      15.0 0.053
   14     334                      6.9 0.852      12.9 0.148
   15     334                      5.1 0.813       8.6 0.187
   16     334                      3.2 0.812       8.6 0.188
   17     334                      4.6 0.896      11.4 0.104
   18     334      E               6.4 0.103       4.5 0.897
   19     334                      3.4 0.801       8.7 0.199
   20     334                      5.3 0.808       6.6 0.192
GROUP   E                               D               E

  CASE
   21     328                     10.0 0.062       7.0 0.938
   22     328                      7.4 0.067       4.7 0.933
   23     328                      8.7 0.062       5.8 0.938
   24     328                     11.7 0.085       9.5 0.915
   25     328                     30.1 0.032      25.6 0.968
   26     328                      8.6 0.039       4.7 0.961
   27     328                      5.4 0.055       2.3 0.945
   28     328                      7.6 0.048       4.1 0.952
   29     328                     19.2 0.051      13.9 0.949
   30     328                      6.0 0.082       3.7 0.918
   31     330                     15.3 0.013       9.1 0.987
   32     330                     10.7 0.025       5.8 0.975
   33     330                      6.7 0.039       2.8 0.961
   34     330      D              20.9 0.889      35.6 0.111
   35     330      D               5.3 0.636       6.9 0.364
   36     330                     17.0 0.011      10.6 0.989
   37     330                      7.3 0.238       7.5 0.762
   38     330                     11.1 0.070       8.4 0.930
   39     330                     10.6 0.376      12.1 0.624
   40     330      D               4.0 0.678       8.0 0.322
   41     336                      7.3 0.062       4.4 0.938
   42     336                      5.0 0.095       3.0 0.905
   43     336                      5.8 0.081       3.4 0.919
   44     336                      5.9 0.036       1.3 0.964
   45     336                      5.4 0.049       2.0 0.951
   46     336                      8.5 0.075       6.0 0.925
```

APPENDIX 4.3. (CONTINULD)

```
 47    330                        4.4  0.088      2.2  0.912
 48    330                       10.5  0.062      7.5  0.938
 49    330                        7.9  0.067      5.1  0.933
 50    330                        5.1  0.041      1.3  0.959
 51    330                        6.2  0.103      4.4  0.897
 52    330                       12.0  0.038      8.0  0.962
 53    330                        9.5  0.093      7.5  0.907
 54    330                        8.5  0.070      5.9  0.930
 55    330                        4.4  0.491      6.8  0.509
 56    330                        5.5  0.097      3.5  0.903
 57    330                        7.0  0.185      6.6  0.815
 58    330                        7.6  0,305      6.4  0.695
 59    330                       10.9  0.076      8.4  0.924
 60    330                        6.6  0.141      4.9  0.859
 61    340                        3.9  0.089      1.7  0.911
 62    340                        5.5  0.067      2.7  0.933
 63    340                        6.2  0.074      3.7  0.926
 64    340                        7.5  0.031      3.1  0.969
 65    340                        1.5  0.028      3.0  0.972
 66    340                        5.0  0.065      2.1  0.935
 67    340                        6.2  0.076      3.7  0.924
 68    340                        8.4  0.027      3.7  0.973
 69    340         0              2.3  0.677      6.3  0.323
 70    340                        9.8  0.063      6.9  0.937
 71    340                        4.6  0.066      1.6  0.934
 72    340                        3.0  0.078      0.5  0.922
 73    340                        2.6  0.464      4.8  0.536
 74    340                       18.5  0.214     18.4  0.786
 75    340                        4.2  0.086      2.0  0.914
 76    340                        3.6  0.120      2.2  0.880
 77    340                        2.8  0.107      1.1  0.893
 78    340                       10.7  0.216     10.6  0.784
 79    340                        4.0  0.074      1.4  0.926
 80    346                        3.1  0.113      1.5  0.887
 81    348                       12.1  0.161     11.3  0.839
 82    348                        5.7  0.147      4.7  0.853
 83    348                        4.6  0.096      2.6  0.904
 84    348                        4.5  0.106      2.6  0.894
 85    346                        3.2  0.077      0.8  0.923
 86    348                       10.3  0.123      8.9  0.877
 87    348                        5.0  0.043      1.3  0.957
 88    348                        4.9  0.142      3.8  0.858
 89    348                        4.6  0.100      2.7  0.900
 90    348                        6.5  0.122      5.0  0.878
EIGENVALUES

                   0.34652

CANONICAL CORRELATIONS

                   0.50729

VARIABLE         COEFFICIENTS FOR CANONICAL VARIABLES

  1 PL            -1.47984
  2 PW            -6.32324
  3 PLWY           2.16342
  4 SPACE          0.24154
  5 ROWHT          0.00009
  6 VOL           -0.00005

CONSTANT           5.21405
```

APPENDIX 4.3.(CONTINUED)

```
GROUP          CANONICAL VARIABLES EVALUATED AT GROUP MEANS
    D               1.60097
    E              -0.31113

POINTS TO BE PLOTTED

GROUP               MEAN          SYMBOL     SYMBOL
                 COORDINATES    FOR CASES   FOR MEAN

 D               1.69    0.0        D           1
 E              -0.31    0.0        E           2

GROUP D
      CASE      CAN.V       CASE     CAN.V

     1   326    2.07     11   334   -0.56
     2   326    0.99     12   334    1.66
     3   326   -0.63     13   334    3.34
     4   326   -0.10     14   334    2.53
     5   326   -1.36     15   334    2.33
     6   326   -0.46     16   334    2.55
     7   326    1.05     17   334    2.03
     8   326    0.16     18   334   -0.26
     9   326   -1.14     19   334    2.28
    10   326    1.03     20   334    2.31

GROUP E
      CASE      CAN.V       CASE      CAN.V       CASE      CAN.V       CASE      CAN.V       CASE      CAN.V       CASE      CAN.V       CASE      CAN.V

    21   328   -0.05     31   330   -1.01     41   336   -0.66     51   338   -0.26     61   340   -0.38     71   346   -0.60     81   348    0.16
    22   328   -0.59     32   330   -1.34     42   336   -0.33     52   338   -1.02     62   340   -0.60     72   346   -0.48     82   348    0.05
    23   328   -0.66     33   330   -1.01     43   336   -0.45     53   338   -0.34     63   340   -0.52     73   346    1.18     83   348   -0.32
    24   328   -0.41     34   330    2.77     44   336   -1.05     54   338   -0.57     64   340   -1.18     74   346    0.36     84   348   -0.24
    25   328   -1.14     35   330    1.68     45   336   -0.84     55   338    1.26     65   340   -1.24     75   346   -0.40     85   348   -0.49
    26   328   -1.00     36   330   -1.90     46   336   -0.51     56   338   -0.31     66   340   -0.63     76   346   -0.14     86   348   -0.12
    27   328   -0.75     37   330    0.45     47   336   -0.38     57   338    0.23     67   340   -0.50     77   346   -0.23     87   348   -0.93
    28   328   -0.80     38   330   -0.57     48   336   -0.06     58   338    0.69     68   340   -1.26     78   346    0.36     88   348   -0.60
    29   328   -0.86     39   330    0.92     49   336   -0.60     59   338   -0.50     69   340    1.81     79   346   -0.52     89   348   -0.29
    30   328   -0.44     40   330    1.61     50   336   -0.97     60   338   -0.01     70   340   -0.65     80   346   -0.19     90   348   -0.12
```

APPENDIX 4.3. (CONTINUED)

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HISTOGRAM OF CANONICAL VARIABLE
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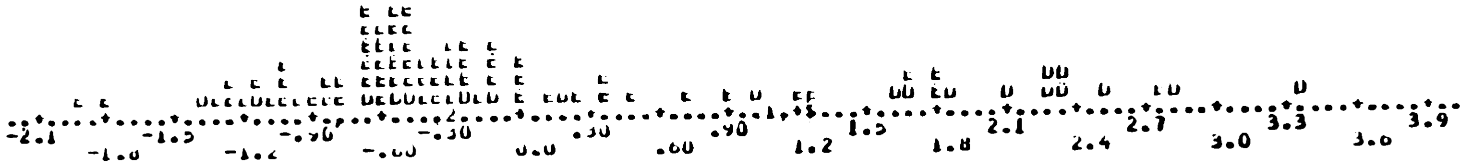

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ON THE AXIS + INDICATES DIVIDING POINT AND NUMBERS THE GROUP MEANS




BMDP7M  -  STEPWISE DISCRIMINANT ANALYSIS.                    PROGRAM REVISED APRIL, 1977
HEALTH SCIENCES COMPUTING FACILITY                            MANUAL DATE  --  1975
UNIVERSITY OF CALIFORNIA, LOS ANGELES


  PROGRAM CONTROL INFORMATION

NO MORE CONTROL LANGUAGE.  PROGRAM TERMINATED.
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VITA

Janice Gayle Burt Knausenberger was born February 3, 1951 in Redding, California to Wallace H. and Melvary E. Burt. She graduated from San Luis Obispo High School, San Luis Obispo, California, in June 1969. In 1973 she graduated with honors and received her B.S. in biology, with a concentration in entomology and plant pathology, from California Polytechnic State University at San Luis Obispo.

She began graduate work in the Department of Entomology at Virginia Polytechnic Institute and State University in the autumn of 1973. While there, she served on various departmental committees and on the Graduate Student Committee of the Eastern Branch of the Entomological Society of America.

She married Walter Ingolf Knausenberger on December 18, 1975. She and her husband are expecting the birth of their first child in December 1978.

Janice Gayle Burt Knausenberger

Janice Gayle Burt Knausenberger