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# WEED CONTROL FOR COMMERCIAL STRAWBERRY PLANTINGS IN VIRGINIA

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### KEYS TO THE PROPER USE OF PESTICIDES

1. Read the label on each pesticide container before each use. Follow instructions to the letter; heed all cautions and warnings; note precautions about residues.
2. Keep pesticides in the containers in which you bought them. Put them where children and animals cannot get to them, preferably locked-up and away from food, feed, seed, and other materials that may become harmful if contaminated.
3. Dispose of empty pesticide containers in the manner specified on the label.

SEE YOUR DOCTOR IF SYMPTOMS OF ILLNESS OCCUR DURING OR AFTER USE OF PESTICIDES

## WEED CONTROL FOR COMMERCIAL STRAWBERRY PLANTINGS IN VIRGINIA

H. D. Stiles and W. E. Chappell\*

INTRODUCTION: Weeds compete with strawberry plants for light, nutrients, and water. This competition reduces strawberry plant size, leaf numbers, branch crown development, fruit quality, and yield. It also shortens the profitable life of the planting, and makes harvesting more difficult, tedious, or more expensive. Luxuriant weed growth can create conditions which encourage fruit rotting and it interferes with effective application of pesticides. Weeds reduce the aesthetic value of a strawberry planting and make it less acceptable for harvesting by pick-your-own customers. Effective year-round weed control is therefore necessary for maximum production of strawberries and it is especially critical when fruit are intended for sale by the pick-your-own method.

There are numerous methods which may be considered for use in controlling weeds. These methods may be classified as biological, physical, or chemical measures, and they vary in degree of acceptability or practicality for use in commercial strawberry plantings.

No single method is likely to be totally adequate, so the grower should select several weed control measures and combine them in a coordinated weed control program.

The elements of a weed control program must be compatible with each other and take into consideration all phases of the general cultural system. Irrigation and fertilization are, for example, important in the production of vigorous high-yielding strawberry plants whose foliar canopies may aid in the suppression of weed seedling establishment. On the other hand, these practices tend to complicate weed control by increasing the germination and/or growth of weed seedlings. Excessive irrigation or rainfall may increase the weed problem by leaching herbicides from surface zones of the soil profile or by washing new weed propagules onto the field from adjacent sites. Cultivation is needed at least in certain stages of most commercial strawberry production schemes. Excessively deep cultivation can, however, displace herbicide-treated soil and bring herbicide-free soil and weed seeds to the surface where the latter can germinate and grow. Deep cultivation can also damage strawberry plant roots.

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Certain herbicides may damage plants, inhibit rooting of runners, or distort the fruit and reduce yield if used during inappropriate stages of strawberry plant and fruit development.

BIOLOGICAL CONTROL MEASURES: Biological control measures are not new to the strawberry grower. Geese have sometimes been employed to eat weeds in strawberry plantings, but their efficacy is limited in most cases and few insecticides or other pesticides may be used on sites inhabited by these birds. Details of this weed control method are available in the literature.<sup>1</sup>

Certain rotation crops may, because of their growth habit and vigor, effectively compete with and reduce the prevalence of perennial weeds (e.g., sweet potatoes appear to suppress growth of bermuda grass) and use of such crops may be considered a biological weed control measure.

Strawberry plants do not emit chemical inhibitors to reduce growth of competitors; they do, however, produce a foliar canopy which may exclude light from and interfere with germination or growth of weed seedlings. It is, therefore, extremely important to follow a cultural program which permits early establishment and rapid development of strawberry plants.

PHYSICAL CONTROL MEASURES: Hoeing and manual weed removal are, because of their drudgery and expense, least popular among strawberry growers; they are essential, however, throughout the life of the planting where long-term fruiting of a strawberry field is intended.

Mechanical hoeing and motorized cultivation are less repulsive to most growers; their use and effectiveness are greatest during early phases of establishing the strawberry bed. Tillage or cultivation can be effectively used on row crops or fallow fields, which are part of a crop rotation program, to reduce weed problems before strawberries are rotated back to those sites. Suppression and near elimination of severe nutsedge infestations have sometimes been obtained by use of periodic tillage on temporarily fallowed land.<sup>2</sup> The latter method includes planting a small grain which is harvested in June. Nutsedge is then allowed to germinate but it is plowed down when it reaches a height of 6 to 8 inches; deep discing is subsequently employed and repeated whenever the weed has regrown to similar heights.

Mulch barriers are useful for weed control in hill type planting systems. Summer mulching in the row is not as practical for the matted- or space-matted rows which are often used in the Eastern U.S. Heavy winter mulching may contribute to control of some weeds, but care must be exercised to prevent weed seeds (carried by some mulches) from germinating under, and growing through, the mulch. Salt hay does not generally contain seeds of problem weeds and where available it is an excellent mulch for strawberries.

Exclusion of new weed propagules from the planting site will help to keep weed problems simple. The grower should use only the cleanest available winter mulch material in order to minimize the number of weed seeds, rhizomes, etc.,

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<sup>1</sup> For further information, see Shoemaker, 1975. Small Fruit Culture. AVI Publishing Co., Westport, Connecticut.

<sup>2</sup> Massey, P.C., 1977 - personal communication. President, Rayner Bros. Nursery, Salisbury, Maryland.

which are brought onto the site. Supplementary control measures should be employed with most available mulches, to ensure that volunteer seedlings are eliminated before they reach seed-bearing stages and before their vegetative reproduction structures become well developed. Preemergence herbicides, if applied just prior to mulching, reduce this problem but the grower must be alert for and destroy weeds which resist or escape treatment.

CHEMICAL CONTROL MEASURES: Preplant soil fumigation may kill weed seeds and seedlings and give additional benefits by reducing nematode and soil-borne disease problems.

Methyl bromide, chloropicrin, Vorlex, Telone and Vapam are some of the available preplant fumigation products. Optimum application rates and exposure times vary among fumigants (consult current VPI pesticide bulletins, product labels, and extension personnel for more information). All fumigants are more effective when the soil has been thoroughly prepared before, and well-sealed after, application. These operations improve uniformity of fumigant dispersion in the soil and increase the length of time that seeds may be exposed to lethal concentrations of the toxicant. Plastic tarps are more effective than soil compaction for sealing the soil and maintenance of adequate fumigant concentrations in near-surface portions of the soil profile. Soil temperature, texture, moisture, organic matter, uniformity, and depth may also influence the efficacy of fumigant applications.

There are just six herbicides currently labeled for nationwide use in strawberry weed control. They are napropamide (Devrinol), diphenamid (Enide), chloroxuron (Tenoran), DCPA (Dacthal), terbacil (Sinbar), and 2,4-D (Dow Formula 40). Chemical weed control measures may be considered to include those which are allowable for use on crops (or for use in eradicating weeds) which precede strawberries in the crop rotation schedule, as well as those which are intended for use on sites actually occupied by strawberry plants.

Napropamide, diphenamid, chloroxuron, DCPA, and terbacil all have pre-emergence activity, i.e., they are effective when applied to the soil before weeds germinate and produce stems or leaves from seeds. 2,4-D is a postemergence herbicide, i.e., it must come into contact with and be absorbed by plant parts for herbicidal activity to occur; 2,4-D has little or no preemergence activity. Terbacil and chloroxuron also exhibit postemergence activity which may be useful under certain circumstances, but their greater value is usually for preemergence uses. The spectrum of control (i.e., the number of different weed species which are sensitive to a given chemical) varies among these chemicals as do the conditions under which each may be legally, effectively, and safely used. Additional information is presented below concerning each of these chemicals but since recommended chemicals, rates of usage, and label restrictions are subject to change, the grower is urged to consult local extension personnel for current issues of periodically revised pesticide recommendations.

Chloroxuron is effective in postemergence application against small seedlings (broad leaf seedlings up to 2" and grasses up to 3/4" tall) of certain species and against chickweed at all growth stages. Chloroxuron is also effective when applied before weeds emerge from the soil. Seedlings even of the same species do not germinate and grow synchronously. Some weeds will have grown past the stage of greatest herbicidal sensitivity when the majority are still small enough for spraying. Chloroxuron should, therefore, be applied before weeds emerge or at least before a troublesome number of weeds have grown out

of their more susceptible stages of development. Chloroxuron may be used for late winter or early spring postemergence control of winter weeds but such uses must not violate label restrictions, and possible conflicts with the overall preemergence control program must be considered.

Certain strawberry cultivars, e.g., Raritan and Darrow, seem particularly sensitive to chloroxuron and it should not be applied to these cultivars until transplants have become well established. New transplants of most cultivars will tolerate this chemical after they have developed 3, fully-expanded, new leaves. Chloroxuron should not be applied to any cultivar while air temperatures are 90°F (32°C) or higher. No more than 2 applications may be made during a 12-month period; applications must not occur within 60 days of harvest.

DCPA will control seedlings of numerous grasses and certain broadleaf weeds if it is applied and activated by moisture before weeds emerge from the soil. Dacthal may be applied before strawberry plants are set in the field, immediately after transplanting, or during later stages of strawberry plant growth. It is especially valuable for earliest weed control in new plantings and for the flexibility which it affords to growers whose primary herbicides cannot be applied more than once or twice a year. Dacthal may not be applied between first bloom and harvest of the fruiting year; this means that spring application should be at least 30 days prior to the first-ripe date of a given cultivar. Repeat applications are not precluded by the label but sufficient time (60 to 120 days) should elapse to ensure that the total of soil residues plus newly applied material does not exceed highest labeled rates or cause damage to the crop plant.

Diphenamid, like dacthal, is a preemergence herbicide and it must be applied to weed-free soil surfaces for best results. Unlike dacthal, it may not be applied before or immediately after transplanting. Strawberry crowns should have produced at least 3 new leaves with fully-expanded leaflets before diphenamid is applied. Diphenamid is primarily effective against grasses, but it is also registered for use on a number of broadleaf weeds, e.g., chickweed, pigweed, purslane, and smartweed. This herbicide may not be applied within 60 days before harvest. Chloroxuron is frequently used to supplement diphenamid's spectrum of activity and vice versa.

Terbacil gives good to excellent preemergence control of many broadleaf weeds and grasses. Appropriate application rates are tolerated by established strawberry plants, but damage may occur when it is applied to new transplants or during active plant growth.

Terbacil is also labeled for postemergence control of small weed seedlings (i.e., less than 2" tall or 2" wide). Growers should establish test plots to become familiar with this valuable new chemical before adopting it as part of the large scale weed control program.

Napropamide, a preemergence herbicide which is primarily effective against grasses, has been recently added to the strawberry grower's arsenal.

This chemical resembles diphenamid in some respects, but it is less leachable, it may be applied closer to harvest (i.e., just prior to first bloom), and it may be applied only once per season. Napropamide has, in some tests, been more effective than diphenamid for control of crabgrass. Like diphenamid, napropamide lacks effectiveness against certain broadleaf weeds,



and chloroxuron may be required to supplement its spectrum of activity. Napropamide is sensitive to light, so adherence to label instructions for incorporation with the soil is very important. Growers should become familiar with this herbicide, by establishing test plots, before using it on a larger scale.

2,4-D is a selective postemergence, systemic herbicide which does not accumulate in the soil, but which may be absorbed by roots as well as aerial plant parts. It is an auxin type growth regulator which, if used at certain stages of plant development, can cause malformation of strawberry fruits and/or reduced yield. Its greatest value may be in eliminating established broadleaf weeds after harvest as part of the annual bed renovation process. When used in this role, 2,4-D should be applied as soon as possible after the last harvest for the year; a waiting period of 10 to 14 days is required to permit this systemic herbicide to be translocated throughout and to kill established weeds. This treatment should, when required by the presence of weeds, be a first step in the renovation process and all others must await its completion.

2,4-D may also be applied during the dormant period to kill established broadleaved winter weeds such as chickweed. Because 2,4-D is a growth regulating chemical and because it could cause deformities of fruit under certain circumstances, dormant period usage is suggested only when made absolutely necessary by intense weed pressure.

Extremely small quantities of 2,4-D may injure certain crops (e.g., grapes); airborne movement of this chemical to nontarget sites is therefore an especially important hazard. The formulation used on strawberries has low volatility; once it is deposited on target surfaces it is unlikely to cause damage to neighboring crops. Movement of airborne droplets during application (i.e., spray drift) remains an item for particular concern.

Low pressure (20 psi or lower) application with "flat fan" or "flooding flat" type nozzles, low placement of the spray boom, and a spray thickening agent will help to reduce the hazards of drift. Spraying should not be conducted under windy conditions and it should definitely cease before wind velocities reach 5 m.p.h. 2,4-D should never be applied adjacent to 2,4-D susceptible plantings, or when wind is blowing across the target site toward such plantings. Communication with neighboring farmers, vineyardists, and nurserymen, may permit coordination of planting plans and help to avoid crop damage, lawsuits, and animosities.

Roundup or glyphosate is not cleared for use in either new or old strawberry plantings, but it may be used to eliminate tough perennial weeds on fields which will not be planted with strawberry or other proscribed crops for at least one year after the herbicide application. Oats, wheat, barley, corn, or possibly nematode resistant soybeans (cvs. Centennial or Bedford) may be planted during the year after glyphosate treatment; since they resist certain strawberry diseases and pests, these crops are appropriate for use in rotation with strawberries. It may, therefore, be desirable to treat perennial weeds with glyphosate, then to grow an allowable crop for straw, grain or green manure, and to plant strawberries after the required interim has elapsed.

Other chemicals may be used in a similar role but glyphosate seems the most effective. It is a systemic herbicide and it produces best results if applied when the weed is actively transporting photosynthates from the leaves to other plant organs, especially to the roots. This situation occurs near

the time of flowering in some but not all weed species. Multiple applications and tillage may be required for best control of certain weeds. It is, therefore, essential that the grower identify the kinds of weeds which he is trying to eradicate and that he read and follow all label instructions with regard to those species. Growers may obtain advice and assistance, in identifying recalcitrant weeds and their most susceptible stages of development, by consulting county agents and state extension specialists.

INTEGRATION OF WEED CONTROL MEASURES: Strawberry growers may reduce production costs by harvesting individual plantings for 4, 5, or more years; extended planting life depends, however, upon the grower's precision in executing all phases of the cultural program in which weed control is a vital link. It is essential, therefore, that the grower select a control program which not only eliminates weeds but which facilitates and is integrated with the other cultural and crop rotation practices which he employs.

With regard to rotational crops preceding strawberries, it is critical that growers select both crops and herbicides whose cultural requirements, label restrictions, and soil residues are consistent with the strawberry planting schedule. Certain herbicides (e.g., atrazine) may preclude planting of strawberries for a year or more after they are applied to the soil while others (e.g., dacthal) are sufficiently dissipated from the soil in much shorter periods of time. The grower must carefully evaluate the rotational crop and related herbicides to select those which may be expected to give greatest effect upon perennial weed populations without adverse or inadmissible effects upon subsequent strawberry plantings. With the advent of more effective strawberry herbicides, the grower must also be concerned about and plan to avoid damage to (or unacceptable residues in) crops following strawberries. The grower can do this by employing herbicides, in the last year or year and a half of the planting's planned life, which will necessitate fewest restrictions upon the following crop.

Timeliness of implementation is essential for best performance with any weed control program. Any delay in cultivation, herbicide application, etc., is likely to cause conflicts with other herbicide measures, or cultural events (e.g., required interval between application and harvest) and it will probably result in a more difficult to control weed problem.

Several alternative herbicide schedules involving appropriate preemergence (pre) and postemergence (post) chemicals are outlined below for established strawberry plantings. Availability of alternative schedules should permit greater flexibility in fitting a control program to the weed or soil conditions, product availability, and to the crop rotation program. One of these schedules should be selected and used in conjunction with the suggested schedule for new plantings which is also presented. The grower should try new schedules in test plots before changing from his current standard practices.



Suggested Herbicide Schedule for New Plantings

Time to Apply	Material to Use	Weeds Controlled (Pre = Preemergence)
Immediately after transplanting (late March, early April)	DCPA	Pre for grasses
After plants have produced three new trifoliolate leaves	diphenamid chloroxuron	Pre for grasses Pre for broadleaves
November - December	See individual schedules for established plantings.	

Suggested Herbicide Schedules Established Strawberry Plantings  
(Select and Use Only 1 Schedule/Field):

Schedule #1

Time to Apply	Material to Use	Weeds Controlled (Pre = Preemergence Post = Postemergence)
November - December	diphenamid chloroxuron	Pre for grasses pre for broadleaves
Late February (plants fully dormant)	2,4-D	Post for broadleaves
Late March to early April (before 1st blossom opens)	DCPA	Pre for grasses
Late June to early July (after harvest but before mowing foliage or thinning plants; wait 10-14 days after application to carry out renovation)	2,4-D	Post for broadleaves
Early July (or as soon as renovation can be completed)	diphenamid chloroxuron	Pre for grasses Pre for broadleaves

(Suggested Herbicide Schedules, Continued)

Schedule #2

Time to Apply	Material to Use	Weeds Controlled
November - December	diphenamid chloroxuron	Pre for grasses Pre for broadleaves
Mid-late February (plants fully dormant)	2,4-D	Post for broadleaves
Late March to early April	DCPA	Pre for grasses
Late June (apply soon after harvest ends for the year, then wait 10-14 days to renovate)	2,4-D	Post for broadleaves
Late June to early July (as soon as renovation can be completed)	napropamide chloroxuron	Pre for grasses Pre for broadleaves

Schedule #3

Time to Apply	Material to Use	Weeds Controlled
November - December	diphenamid chloroxuron	Pre for grasses Pre for broadleaves
Mid-February (plants fully dormant)	terbacil	Pre for grasses and broadleaves
Late June or early July (as soon as renovation can be completed)	napropamide chloroxuron	Pre for grasses Pre for broadleaves

(Suggested Herbicide Schedules, Continued)

Schedule #4

Time to Apply	Material to Use	Weeds Controlled
November - December	napropamide chloroxuron	Pre for grasses Pre for broadleaves
Mid- to late February (apply only if broadleaf weeds are present in numbers large enough to require control)	2,4-D	Post for broadleaves
March - April (before 1st blossom opens)	DCPA	Pre for grasses
Late June or early July (as soon as renovation can be completed)	terbacil	Pre for grasses and broadleaves

Schedule #5

Time to Apply	Material to Use	Weeds Controlled
December (when plants are fully dormant)	terbacil	Pre for grasses and broadleaves
Mid-late February (plants fully dormant; apply only if needed)	2,4-D	Post for broadleaves
Late March to early April before 1st blossoms open.	DCPA	Pre for grasses
Late June (if needed, apply as soon as harvest ends for the year, then wait 10-14 days to renovate)	2,4-D	Post for broadleaves
Late June to early July (as soon as renovation can be completed)	napropamide chloroxuron	Pre for grasses Pre for broadleaves

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