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# Properties, Classification, and Upland Oak Site Quality for Residual Soils Derived from Shales, Phyllites, Siltstones, and Sandstones in Southwestern Virginia



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The Virginia Agricultural and Mechanical College came into being in 1872 upon acceptance by the Commonwealth of the provisions of the Morrill Act of 1862 "to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." Research and investigations were first authorized at Virginia's land-grant college when the Virginia Agricultural Experiment Station was established by the Virginia General Assembly in 1886.

The Virginia Agricultural Experiment Station received its first allotment upon passage of the Hatch Act by the United States Congress in 1887. Other related Acts followed, and all were consolidated in 1955 under the Amended Hatch Act which states "It shall be the object and duty of the State agricultural experiment stations . . . to conduct original and other researches, investigations and experiments bearing directly on and contributing to the establishment and maintenance of a permanent and effective agricultural industry of the United States, including the researches basic to the problems of agriculture and its broadest aspects and such investigations as have for their purpose the development and improvement of the rural home and rural life and the maximum contributions by agriculture to the welfare of the consumer . . . "

In 1962, Congress passed the McIntire-Stennis Cooperative Forestry Research Act to encourage and assist the states in carrying on a program of forestry research, including reforestation, land management, watershed management, rangeland management, wildlife habitat improvement, outdoor recreation, harvesting and marketing of forest products, and "such other studies as may be necessary to obtain the fullest and most effective use of forest resources."

In 1966, the Virginia General Assembly "established within the Virginia Polytechnic Institute a division to be known as the Research Division . . . which shall encompass the now existing Virginia Agricultural Experiment Station . . . "

# PROPERTIES, CLASSIFICATION, AND UPLAND OAK SITE QUALITY FOR RESIDUAL SOILS DERIVED FROM SHALES, PHYLLITES, SILTSTONES, AND SANDSTONES IN SOUTHWESTERN VIRGINIA

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Cover Photograph: A profile of Berks very channery silt loam developed in materials weathered from the Athens formation (MA).

# Abstract

Profiles of residual soils developed in materials weathered form shales, siltstones, phyllites, and fine-grained sandstones in Rockbridge, Botetourt, Wythe, Smyth, and Washington Counties were characterized in order (1) to select soil properties for differentiating soils developed from rocks of different time-stratagraphic units, (2) to produce a uniform correlation of these soils, (3) to evaluate the influence of soil properties on upland oak site index, (4) to evaluate the taxonomic classes of Lithic and Typic Dystrochrepts as predictors of upland oak site index, and (5) to develop a multiple regression equation for predicting upland oak site index for soils classified as members of Lithic and Typic Dystrochrepts.

Univariate and multivariate statistical analyses were used to evaluate differences among the parent materials, to select soil properties as differentiae, and/or to develop the regression equation for predicting site index for upland oak growing on these soils.

Soils developed from rocks of the Chilhowee group contain lower amount of exchangeable bases. Therefore, we recommend that soils developed from these rocks be correlated as members of the Sylco and the proposed Sylvatus series, members of Lithic and Typic Dystrochrepts, respectively.

Soils developed from rock of the Rome-Waynesboro formation contain more exchangeable $K^+$ and sand-size feldspar. We recommend that soils developed from these rocks be correlated as members of the Litz and the proposed Chiswell series, members of Ruptic Ultic and Lithic Dystrochrepts, respectively.

Soils developed from rocks of the Martinsburg and Athens and from the Brallier, Chemung, and Millboro formations that classified as members of Lithic and Typic Dystrochrepts were not separated by the properties studied. We recommend that these soils be correlated as members of the Berks and Weikert soils, a recommendation which agrees with previous correlations.

Distributions of site indices were significantly different at the 10 percent level of probability for soils developed from the parent materials, with soils developed from rocks of the Martinsburg and Athens and Rome-Waynesboro formations having higher median values than soils developed from rocks of the Chilhowee group and the Brallier, Chemung, and Millboro formations.

Site indices for upland oak were not significantly different at the 10 percent level of probability for soils classified as members of the loamy-skeletal, mixed, mesic families of Lithic and Typic Dystrochrepts. Site indices were slightly higher for soils classified as Lithic Dystrochrepts. These results can be explained by the well distributed rainfall pattern which decreases the importance of the greater available-water capacity of the Typic Dystrochrepts and by the higher exchangeable $Ca^{2+}$ and by the lower exchangeable $Al^{3+}$ saturation of the cation-exchange capacity of the Lithic Dystrochrepts.

A regression model based on a single value, base saturation by sum of cations (SBS), gave the highest $R^2$ value for predicting site index for upland oak on these soils. Although no significant differences in site index were observed for classes of soils based on a limit of 20 inches to bedrock; i.e. Lithic and Typic Dystrochrepts, depth to bedrock was an important character for predicting site index on these soils.

The development of a useable multiple regression equation for predicting site index of upland oak growing on these soils was influenced by collinearity of the soil and site properties, by the lack of even-aged, well-stocked timber stands at the sample sites, and by our inability to access nutrient levels and amount of available moisture during the growing season.

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# Introduction

## *Soil-parent material relationships*

Soils developed in parent materials weathered from shales, siltstones, phyllites, and sandstones in the Blue Ridge and Valley and Ridge provinces in Virginia have been mapped and correlated as members of the Berks and Weikert series (Photograph 1), loamy-skeletal, mixed, mesic families of Lithic and Typic Dystrochrepts, respectively (Table 1). Parent materials for these soils represent several time-rock units (Butts, 1940). Parent materials for soils on the western slopes of the Blue Ridge are represented by the Chilhowee group (BQ), rocks of Cambrian age. Parent materials for soils in portions of the Valley and Ridge (Great Valley) have weathered from the Rome-Waynesboro formation (RO), rocks of Cambrian age, and from the Martinsburg and Athens formations (MA), rocks of Ordovician age. Parent materials for soils on the ridges in portions of the Valley and Ridge have weathered from the Millboro, Brallier, and Chemung formations (BR), rocks of Devonian age. Correlation of soils developed from these rocks as members of the same soil series assumes that these rocks represent similar lithostratigraphic units; i.e., soils developed from these rock units with similar morphology are assumed to have similar mineralogical, chemical, and physical properties.

Correlation of map units of soils developed in materials weathered from rocks of Ordovician (MA) and Devonian (BR) age as members of the Berks and Weikert series has been consistent (Table 1). On the other hand, correlation of soils developed from the Cambrian rocks (BQ and RO) has not been consistent and their correlation with soils developed from Ordovician (MA) and Devonian (BR) rocks has met with considerable controversy.

For example, soil mapping in Montgomery County was completed in the early 1960's, but publication of the soil survey report was delayed until 1985 primarily because of the controversy over the correlation of soils developed from both the Rome-Waynesboro (RO) and from the Millboro and Brallier (BR) formations as members of the Berks and Weikert series. Reasons for separating the soils developed from these parent materials given by the soil surveyors that mapped Montgomery County were differences in land use and yield potentials. Reasons for not separating the soils developed from these parent materials given by the correlators were lack of differentiae for producing mutually exclusive classes of morphological, chemical, physical, and/or mineralogical properties of the soils.

Legend development and soil mapping in Montgomery County were based on the 1938 soil classification scheme. However, the correlation of the Soil Survey of Montgomery County coincided with the implementation of the *Seventh Approximation* (Soil Survey Staff, 1960) as the official soil classification scheme for the United States. Series differentiae in the *Seventh Approximation* and *Soil Taxonomy* (Soil Survey Staff, 1975) were based strictly on mutually-exclusive classes. Therefore, the concept of parent material as a series differentia, a concept used in the 1938 soil classification scheme and the soil surveyors that mapped Montgomery County, was no longer valid. The final correlation of the soils in Montgomery County (Creggar et al., 1985) by criteria given by *Soil Taxonomy* (Soil Survey Staff, 1975) also concluded that the soils developed from the two parent materials should be correlated as members of the Berks and Weikert series. However, the change in concepts of series differentiae by the national soil classification schemes in no way invalidates the observations of differences in land use and yield potentials for soils developed from the different parent materials observed by the soil surveyors that mapped Montgomery County.

This issue was rekindled in the 1980s during progressive reviews of the soil survey of Wythe County. The soil survey cooperators in Virginia, SCS, VPI&SU, and USFS, agreed that soils developed from the parent materials in this study should be separated based primarily on differences in yield potentials. The most significant differences in yield observed by the soil surveyors were related to timber, i.e. differences in site index and specie composition.

These situations provide examples of the conflict between local mapping experience and a national classification scheme as described by Webster and McBratney (1981, p. 133). They stated:

> "It is usually easy to classify the soil for mapping a small region, say a farm or forest plantation covering a few tens or hundreds of hectares. In many parts of the world clear boundaries delineate different kinds of soil. They are readily recognized by the layman, farmer or forester, and there is rarely disagreement about what constitutes each class. The same may be true for somewhat bigger areas of perhaps several thousand hectares. However, when the area of interest increases by another order of magnitude, difficulties and disagreements among different observers become the rule rather than the exception; and those people who have tried to construct reasonably precise classifications of the soil of large national territories have found it almost impossible to reconcile local mapping experience with national conformity. It seems that bodies of soil circumscribed by distinct and often quite sharp boundaries in one part of a country do not have precise equivalent elsewhere (Webster, 1968; Butler, 1980)."

Photograph 1: A profile of Weikert very channery silt loam developed in materials weathered from the Martinsburg formation (MA).

Table 1: Correlated soil series used to name map units of soils developed in materials weathered from shales, siltstones, phyllites, and fine-grained sandstones in Virginia and West Virginia

| County | Parent materials* | | | |
|---|---|---|---|---|
| | BQ | RO | MA | BR |
| | Series | | | |
| Jefferson (Hatfield and Warner, 1973): | | | | |
| | Berks<br>Weikert | Frankstown | Berks<br>Weikert | NP# |
| Clarke (Edmonds and Stiegler, 1982): | | | | |
| | Cardiff<br>Cataska | Webbtown | Berks<br>Weikert | NP |
| Warren (Holmes et. al., 1984): | | | | |
| | Cataska | Lodi<br>Endcav | Berks<br>Weikert | NP |
| Rockingham (Hockman et al., 1982): | | | | |
| | Sylco | NP | Berks<br>Weikert | Berks<br>Weikert |
| Augusta (Hockman et al., 1979): | | | | |
| | Cataska | NP | Berks<br>Weikert | Berks<br>Weikert |
| Montgomery (Creggar et al., 1985): | | | | |
| | Berks<br>Weikert | Berks | NP | Berks<br>Weikert |
| Pulaski (Cauley et al., 1985): | | | | |
| | Berks<br>Ramsey | Berks<br>Klinesville | NP | Berks<br>Weikert |

*See "Soil Parent Material" section for definitions of BQ, RO, Ma, and BR.
#Not present in the county.

# *Vegetation*

Residual soils developed from shales, siltstones, phyllites, and sandstones in southwestern Virginia are vegetated primarily by upland oaks, such as scarlet oak (*Quercus coccinea* Muenchh.), black oak (*Q. velutina* Lam.), northern red oak (*Q. rubra* L.), and chestnut oak (*Q. prinus* L.), mixed in some areas with pines, such as eastern white pine (*Pinus strobus* L.), pitch pine (*P. rigida* Mill.), and Virginia pine (*P. virginiana* Mill.).

Accessing the productive potential of forest lands is basic to intensive management. Coile (1952) stated, "If all forest land was covered with well-stocked stands of sufficient age for the entire solum and upper substratum to have affected tree growth, there would be little practical need for studying the relation between soil properties and growth because the volume of wood per acre at a given age would be a direct measure of productivity." Failing this, site index or stand height at a specific age is generally used to express site quality or productivity. Jones (1969) concluded that the site index approach was the most direct method, and for most species, good site index curves probably were the best tools for evaluating forest productivity. However, Trimble and Weitzman (1956) indicated that accurate site indices can be determined only for well-stocked, even-aged stands that were old enough to reflect the full impact of site factors. They believe that most of our forest stands fail the above requirements because of under stocked stands, cut over areas, restocked pastures and old fields, and areas of young timber.

Numerous studies have been conducted that attempted to correlate various soil chemical and physical properties and site topographic features with site index (Carmean, 1961 and 1965; Hannah, 1968A, 1968B; Yawney and Trimble, 1968; Broadfoot, 1969; Graney and Ferguson, 1972; Stage, 1976; Auchmoody and Smith, 1979; Nunn and Vimmerstedt, 1980; Barnes et al., 1982; McNab, 1984). Most of these studies have concluded that available-water as it is influenced by soil and topographic features seems to have the greatest influence on forest productivity. Soil properties and topographic features shown by these authors to reflect site index were (1) A horizon thickness; (2) aspect; (3) slope position or percent of the distance from the ridgetop; (4) slope gradient; (5) depth to a restriction, such as bedrock or a fragipan; (6) subsoil texture; (7) subsoil rock fragment content; (8) sand in the A horizon; (9) pH of the A and B horizons; (10) exchangeable bases of $Ca^{2+}$ , $Mg^{2+}$, and $K^{+}$; (11) available P and Mn; (12) percent base saturation; and (13) organic matter content (Carmean, 1961 and 1965; Hannah, 1968A, 1968B; Yawney and Trimble, 1968; Broadfoot, 1969; Graney and Ferguson, 1972; Stage, 1976; Auchmoody and Smith, 1979; Nunn and Vimmerstedt, 1980; Barnes et al., 1982; McNab, 1984).

Regression equations based on the above soil properties and topographic features do not always agree. For example, Trimble and Weitzman (1956) showed that oak site index was closely related to aspect, position on the slope, and depth of the soil to bedrock. Trimble (1968) was able to show that soil depth could be eliminated from the prediction equation without affecting the multiple regression correlation coefficient or the accuracy of the estimated site index. Doolittle (1957) showed that aspect had a definite effect on site index when considered alone, but was not significant when considered in the presence of other variables because of correlations with them. On the other hand, aspect was considered to be important in predicting site index when considered in the presence of other variables by Carmean (1961 and 1965), Yawney and Trimble (1968), Auchmoody and Smith (1979), and Nunn and Vimmerstedt (1980). Yawney and Trimble (1968) observed no relationship between A horizon thickness and stand height while Doolittle (1957), Carmean (1961), Trimble and Weitzman (1956), Auchmoody and Smith (1979), and Nunn and Vimmerstedt (1980) showed a relationship between A horizon thickness and site index.

Problems in relating soil properties and topographic features to site index for southern hardwoods are discussed by Broadfoot (1969). He pointed out that the failure of multiple regression equations to accurately predict site index resulted primarily from the inability of researchers to measure the true causes of productivity; i.e., soil moisture and nutrient availability during the growing season, soil aeration, and physical conditions including root growing space. Mader (1963) also believes that site studies generally are hindered by our poor understanding of procedures for measuring tree growth and environmental variables with a high degree of accuracy. Better understanding of the factors controlling tree growth will depend in part on better techniques for sampling forest soils reliably. Haines and Cleveland (1981) reported that surface bulk density and percent moisture, organic matter content, and exchangeable $K^+$ to 20 cm and available P to 10 cm varied significantly over time at all sites studied; and soil pH, exchangeable $Ca^{2+}$ , $Mg^{2+}$, and CEC to 20 cm and available P at 10 to 20 cm differed significantly over time at some, but not all, sites. They concluded that periodic variations must be considered when effects of forest management and research treatment of soil chemical and physical properties are considered.

Other studies have shown the inability of soil map units used by the National Cooperative Soil Survey to accurately predict site index or productivity for use in forest management. Van Lear and Hosner (1967) presented evidence to show little, if any, usable correlation between soil mapping units and the site index of yellow-poplar (*Liriodendron tulipifera* L.) in southwestern Virginia, based on a wide variety of site indices exhibited within each soil mapping unit. Carmean (1961) reported that site index was not closely related to soil taxonomic units used prior to 1960 for naming and interpreting map units of residual soils in Ohio. He showed that site index varied greatly within each soil type and that average site index was very similar for most of the soil types. A reclassification of these map units into new taxonomic units by criteria in *Seventh Approximation* (Soil Survey Staff, 1960) still did not improve their relations with site index (Carmean, 1967). Shetron (1972) indicated that precision in soil-tree growth ratings is affected by the lack of significant site differences among soil taxa used to name and interpret map units in soil surveys in Michigan. Auchmoody and Smith (1979) reported no significant differences among Muskingum, Gilpin, and Upshur soils in northwestern West Virginia. Smalley (1984) described thirty landtypes to be used in forest management in the Cumberland Mountains and grouped several soil series that ranged in classification from Lithic Dystrochrepts to Typic Hapludults in a single landtype. In addition, a single site index value was published for a given timber species within a given landtype indicating the dominance of topographic site features over soil series for predicting site productivity.

Nevertheless, site index values given by the soil interpretations records (SCS-SOI-5) dated 9-83 for soils of the Berks and Weikert series reflect estimates based on assumed influences of greater available-water capacity in the Berks soils related to greater depths and on assumed influences of aspect. The soil interpretations record for soils of the Berks series estimates an average site index of 70 for northern red oak growing on soils with slopes of 15 to 35 percent on north aspects and a site index of 60 for soils with similar slopes on south aspects. The soil interpretations record for soils of the Weikert series estimates an average site index of 64 for northern red oak growing on soils with slopes of 15 to 35 percent on north aspects and a site index of 55 for soils with similar slopes on south aspects.

# *Study objectives*

Objectives of this study were (1) to evaluate the influence of selected parent materials representing several time-rock units on the distributions of selected soil properties, (2) to produce a uniform correlation of these soils in the five counties in Southwestern Virginia with soil surveys in progress, (3) to evaluate the influence of properties of soils developed from these parent materials on upland oak site index, (4) to evaluate the influence of the grouping of soils by taxonomic criteria for Lithic and Typic Dystrochrepts on distributions of selected soil properties, (5) to evaluate the taxonomic classes of Lithic and Typic Dystrochrepts as predictors of upland oak site index, and (6) to develop a multiple regression equation for predicting upland oak site index based on soil characteristics and topographic site features for soils in the study area.

# Materials and Methods

## Study Area

### Physiography

Rockbridge, Botetourt, Wythe, Smyth, and Washington counties are located in the Blue Ridge and the Valley and Ridge provinces and extend in a southwestern direction from Lexington to Bristol (Figure 1).

#### *Blue Ridge Province*

Eastern portions of the above counties are in the Blue Ridge province, a mountain range extending from northern Georgia to southern Pennsylvania (Pirkle and Yoho, 1982).

Linear, hogback ridges in the Blue Ridge portion of the study area are capped with sandstones, quartzites, and conglomerates with shales, siltstones, phyllites, and sandstones of the Chilhowee group (BQ) (Butts, 1940) on sideslopes. Magmas have intruded the metamorphic rocks of the Blue Ridge to form intrusive igneous rock bodies.

North of Roanoke, the Blue Ridge province is relatively narrow, generally less than 12 to 14 miles wide with no peaks higher than about 4,000 feet. South of Roanoke, the Blue Ridge widens and becomes more rugged and mountainous. In this area the Blue Ridge widens to about 70 miles with peaks reaching elevations greater than 6,000 feet (Pirkle and Yoho, 1982).

#### *Valley and Ridge Province*

The western portions of the above counties are in the Valley and Ridge province, a region of valleys and ridges that trend in a northeast-southwest direction (Pirkle and Yoho, 1982). A continuous lowland known as the Great Valley occurs along the eastern portion of this province and is underlain by shale; i.e., the Rome-Waynesboro (RO) and Martinsburg and Athens formations (MA), and limestones in the study area (Butts, 1940; Edmonds and Rector, 1985). The floor of the Great Valley descends from about 2000 feet at the Shenandoah-James River divide to about 1200 feet within a distance of 25 miles (Fenneman, 1938). The valley floor remains near this elevation for many miles along the several branches of the James River. The elevation rises to about 1500 feet on the James-Roanoke River divide south of Fincastle. Where the Roanoke River leaves the province near the City of Roanoke, the valley floor is at an elevation of 1000 feet and slowly rises to 1100 feet at Salem. From Salem it rises to 1400 feet at the confluence of the North and South Forks of the Roanoke River. The North and South Forks of the Roanoke River flow out of 1000-foot gorges in an upland 2200 feet high with a ruggedly dissected escarpment known as the Pedlar Hills. The valley floor in the New River drainage basin rises from 2200 feet near Christiansburg to about 2500 feet along Cripple Creek and Reed Creek in Wythe County. Southwest of Wytheville, the valley floor descends into the Tennessee River drainage basin.

Ridges in the Valley and Ridge portion of the study area are capped with sandstones, quartzites, and conglomerates with sideslopes of shales, siltstone, mudstones, and sandstones of the Millboro, Brallier, and Chemung formations (BR) (Butts, 1940). As a result of erosion of tilted and folded strata, a trellis drainage pattern has developed in parts of the study area. In some areas erosion has produced an inversion of the topography with original synclinal valleys now standing as synclinal ridges, and original anticlinal ridges now occurring as anticlinal valleys (Pirkle and Yoho, 1982). The ridges in this province northwest of Roanoke Gap are generally above 3,000 feet and rise several hundred feet near the New-Tennessee River divide.

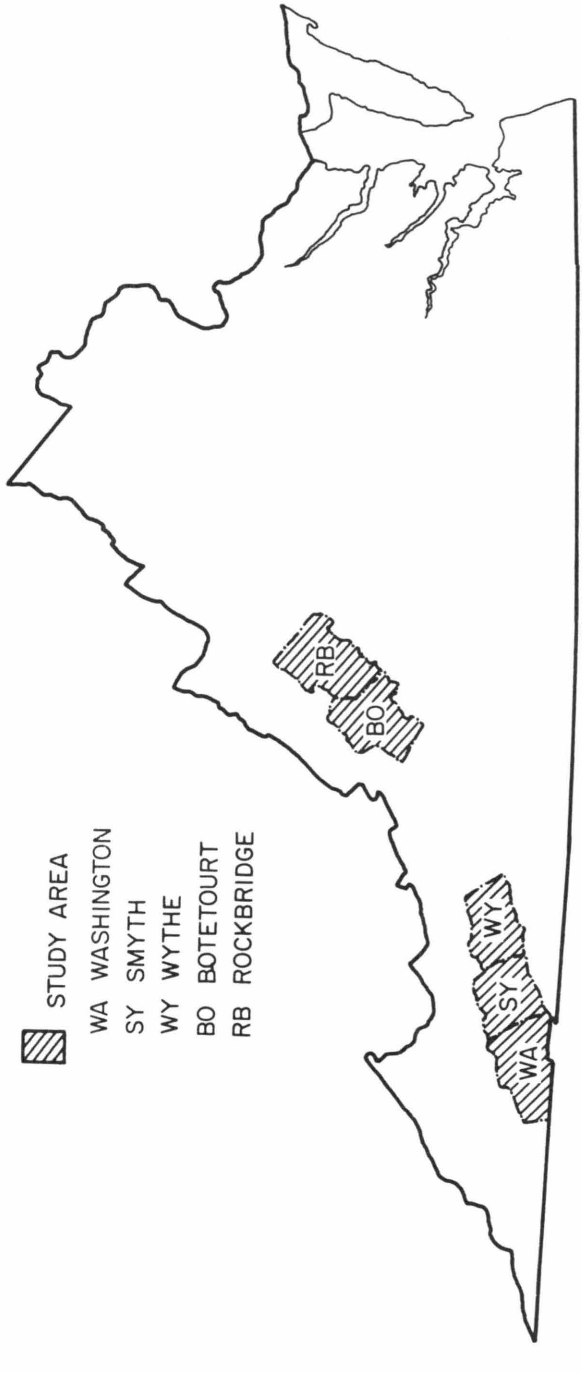



Figure 1: Location of the study area.

## Soil Parent Materials (Geologic Formations)

The following descriptions of the soil parent materials or geologic formations are taken primarily from Butts (1940).

### *BQ - Basal Cambrian Rocks (Chilhowee Group)*

The estimated outcrop of the Basal Cambrian rocks, based on the geologic map by Butts (1933), is given by county for the study area in Table 2.

#### Unicoi formation

The Unicoi formation represents the first sediments deposited in the Appalachian trough. The formation may be conveniently divided into a lower heterogeneous unit of conglomerate, sandstone, shale, and basalt and an upper, more homogeneous unit of dominantly sandstone (Photograph 2). The sandstone strata contains beds of arkose. Beds of red shale as much as 5 to 10 feet thick occur sparingly throughout the formation. The sandstone is medium thick-bedded and coarse-grained. The conglomeritic beds are commonly made up of small quartz pebbles and commonly occur in the lower part of the formation. In places the formation contains three distinct beds of igneous rock of basaltic composition, called amygadloid from the occurrence of small globular inclusions resembling almonds (Latin, amygalus). The amygadloid rock is easily distinguished by its dark greenish or purplish color, its pink and greenish globular inclusions, and its higher density.

#### Hampton-Harpers shale

The Hampton-Harpers shale is typically composed of thin-bedded, non-fissile, fine-grained, siliceous, rusty-weathering rock. It consists of alternating siltstone and fine-grained subgraywacke interbedded with quartzose sandstone (Photograph 3). The graywacke is greenish gray and thinbedded, it consists of subrounded and angular arenaceous grains in an argillaceous matrix.

#### Erwin quartzite

The Erwin quartzite is a remarkably homogeneous formation consisting of a quartzose sandstone or quartzite, depending on the degree of metamorphism. The formation is mainly a medium- to fine-grained, moderately thick- to massive-bedded, gray, whitish-weathering rock. The main mass of the material appears to have been thoroughly sorted, clean, white, beach sand. Locally the grains are completely cemented with silica to form a compact quartzite. It is more thinly bedded toward the top. The upper part of the formation has a brownish or rusty color due to iron oxide staining.

## *RO - Rome-Waynesboro formation*

The estimated outcrop of the Rome-Waynesboro formation, based on the geologic map by Butts (1933), is given by county for the study area in Table 2.

The Rome-Waynesboro formation is an extremely heterogeneous formation composed of red and green shale, sandstone, dolomite, and pure limestone, all of which vary greatly in proportion and distribution throughout the formation (Photograph 4). The red shale is the most impressive feature, but represents a minor component of the formation. The red color of the shale is inherited by the soils and is a reliable indicator of the Rome-Waynesboro formation since no significant beds of red rock underly or overly the formation for several thousand feet. The gray or greenish portion of the formation commonly has a silky luster, due to a high sericite content, and is nearly as good an indicator of the Rome-Waynesboro formation as the red shale. Beds of dolomite occur locally. Beds of pure, blue-banded limestone occur in the Rome-Waynesboro formation throughout the area, but these beds are neither numerous nor thick. Thin beds of argillaceous limestones are common but constitute only a small part of the formation. Beds of medium- to fine-grained, rusty to reddish brown sandstone commonly occur in the Rome-Waynesboro formation. Some of these beds are ripple marked.

## *MA - Athens and Martinsburg formations*

The estimated outcrop of the Athens and Martinsburg formations, based on the geologic map by Butts (1933), is given by county for the study area in Table 2.

### Athens formation

The Athens formation has three distinct facies in Virginia: gray to black shale, sandstone, and limestone. The limestone facies lies to the northeast (Rockbridge County), the sandstone facies to the southwest (Washington County), and the shale facies lies between them. The name Athens shale, though not applicable to this variable unit, is widely used for this formation because it is predominantly a shale and because through long use the name has become firmly established. Soils included in this study were developed primarily from the Athens shale.

In areas where the limestone or sandstone prevails, black shale usually comprises the lower part of the Athens formation. On weathering, outcrops of the black shale of the Athens shale fade to dark gray, pale gray, and finally to yellowish or reddish color. The unweathered shale is firm and moderately fissile; it generally cleaves into good-sized plates or slabs. The shale, composed mainly of clay, contains a small amount of lime, as shown by the weak effervescence with dilute hydrochloric acid. The limestone facies, where completely developed and prevailing through nearly the full thickness of the Athens formation, is composed of a dense black, very fine-grained, thin-bedded limestone that breaks with a conchoidal fracture.

The sandstone facies is a combination of shale and sandstone without limestone. Shale is below and interbedded with the sandstone. The sandstone is arkosic. The larger quartz grains are well rounded. The feldspar grains are irregularly shaped.

A local feature of the shale facies is a coarse conglomerate in the black shale which occurs 1 mile north of Fincastle in Botetourt County. The bed appears to be about 50 feet thick. It is composed of coarse gravel containing cobbles of quartzite 4 to 6 inches in diameter.

**Martinsburg shale**

The Martinsburg formation is predominantly shale. The unweathered shale is bluish, but weathers to a yellowish or brownish color (Photograph 5). The main body of the formation is a thin-bedded, calcareous mudrock, but layers composed of very fine quartz sand and many thin layers of fossiliferous limestone are scattered through the mass from top to bottom. The top member of the Martinsburg, known as the *Orthorhynchula* bed from the large brachiopod, is a slightly calcareous, generally fine-grained, bluish-gray, thick or massively bedded sandstone. Weathering reduces the rock to a dark brown friable mass that can be easily recognized.

## *BR - Millboro, Brallier, and Chemung formations*

The estimated outcrop of the Millboro, Brallier, and Chemung formations, based on the geologic map by Butts (1933), is given by county for the study area in Table 2.

**Millboro shale**

The Millboro formation is almost wholly a black fissile shale in its unweathered condition, but it bleaches, on weathering, to a light-gray color. The typical black shale is so fissile that it splits into very thin flakes. Beds that contain large, symmetrical, lenticular concretions of calcium carbonate or calcium sulfate are present throughout the Millboro shale (Photograph 6). Abundant calcite-filled vugs, calcite-coated fracture surfaces, and disseminated sulfides occur throughout the formation (Bartholomew and Lowry, 1979). These sulfides oxidize on weathering to produce extremely high soil acidity and possibly acid-sulfate soils.

**Brallier shale**

The Brallier formation is a rather monotonous mass of subfissile, sandy and micaceous, green shale (Photograph 7) with uneven or dimpled surfaces and interbedded layers of very-fine grained, evenly thin-bedded, and blocky-jointed greenish sandstone. In the southwestern counties the mass becomes thinner bedded with less sandstone and beds of black shale in the lower half, making separation from the Millboro formation difficult.

### Chemung formation

The Chemung formation is a thick body of sandstone and shale. The sandstone is thick bedded, medium grained, gray to greenish, and arkosic. Most of the shale is green, soft, poorly fissile, and clayey. Thin layers of conglomerate, commonly not more than 1 foot thick, contain quartz pebbles and are scattered throughout the mass.

Table 2: Estimated acreage of the outcrop of the soil parent materials or geologic formations in the study area

| County | Geologic formations* | | | |
|---|---|---|---|---|
| | BQ | RO | MA | BR |
| | Acres | | | |
| Rockbridge | 28,000 | 8,000 | 38,000 | 19,000 |
| Botetourt | 16,000 | 14,000 | 26,000 | 73,000 |
| Wythe | 42,000 | 73,000 | 6,000 | 32,000 |
| Smyth | 58,000 | 23,000 | 11,000 | 22,000 |
| Washington | 21,000 | 3,000 | 30,000 | 14,000 |
| Total | 165,000 | 121,000 | 111,000 | 160,000 |

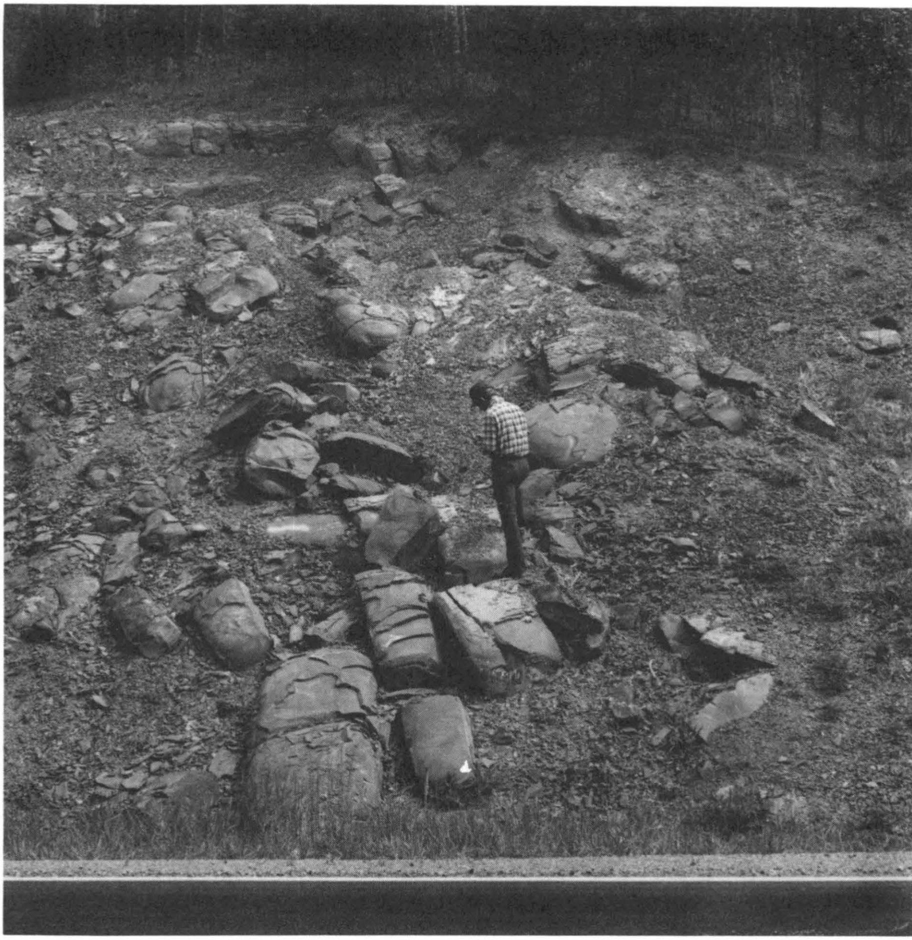
*Based on Butts (1933).

Photograph 2: Sandstone in the Unicoi formation (BQ).

Photograph 3: Siltstone and sandstone in the Hampton formation (BQ).

Photograph 4: Shale, siltstone, sandstone, dolomite, and limestone in the Rome formation (RO).

Photograph 5: Shale in the Martinsburg formation (MA).



Photograph 6: Large concretions in the Millboro formation (BR).

Photograph 7: Shale in the Brallier formation (BR).

## Climate

The air temperature, frost-free days, and annual precipitation are fairly uniform throughout the study area according to data presented by the Agricultural Yearbook Committee (1941). The average January air temperature is 35.4°$F$ and ranges from 34.2°$F$ at Lexington in Rockbridge County to 37.4°$F$ at Emory in Washington County (Table 3A). The average July air temperature is 73.4°$F$ and ranges from 71.4°$F$ at Wytheville in Wythe County to 75.9°$F$ at Buchanan in Botetourt County.

The average annual temperature of the upper 1 m of the soil, estimated by adding 2°$F$ to the mean annual air temperature (Soil Survey Staff, 1975), is 56.3°$F$ and ranges from 55.0°$F$ at Wytheville in Wythe County to 57.9°$F$ at Buchanan in Botetourt County. The average number of frost-free days is 177.6 and ranges from 168 at Marion in Smyth County to 189 at Buchanan in Botetourt County.

The average annual precipitation is 41.6 inches and ranges from 37.8 inches at Wytheville in Wythe County to 45.4 inches at Emory in Washington County (Table 3B). Precipitation is well distributed throughout the growing season with from 60 to 64 percent falling between April 1 and October 31.

Table 3A: Average air temperature for January and July and average dates for the last killing frost in spring and the first killing frost in the fall for the study area

| County | Temperature | | Killing frost | |
|---|---|---|---|---|
| | January | July | Spring | Fall |
| | Degrees F | | Date | |
| RB (Lexington) | 34.2 | 75.4 | Apr 24 | Oct 19 |
| BO (Buchanan) | 36.3 | 75.9 | Apr 16 | Oct 22 |
| WY (Wytheville) | 34.9 | 71.4 | Apr 17 | Oct 16 |
| SY (Marion) | 34.5 | 72.3 | Apr 27 | Oct 12 |
| WA (Emory) | 37.4 | 73.0 | Apr 25 | Oct 13 |

*Taken from Yearbook Committee (1941).

Table 3B: Precipitation* for the study area

| Location | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|
| | inches | | | | | |
| Lexington | 3.22 | 2.73 | 3.52 | 3.01 | 3.22 | 4.09 |
| Buchanan | 3.64 | 2.68 | 3.43 | 3.15 | 3.53 | 4.36 |
| Wytheville | 2.82 | 2.56 | 3.25 | 3.00 | 2.46 | 4.16 |
| Marion | 3.09 | 3.36 | 3.85 | 3.62 | 3.56 | 5.10 |
| Emory | 4.10 | 3.71 | 4.82 | 3.93 | 4.25 | 3.80 |

| Location | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|
| | inches | | | | | | |
| Lexington | 2.77 | 4.09 | 2.76 | 3.01 | 2.26 | 3.08 | 38.76 |
| Buchanan | 4.57 | 4.41 | 3.20 | 3.73 | 2.54 | 3.35 | 42.59 |
| Wytheville | 3.90 | 3.89 | 2.93 | 2.86 | 2.05 | 2.79 | 37.77 |
| Marion | 4.37 | 4.52 | 2.95 | 2.59 | 2.46 | 3.92 | 43.39 |
| Emory | 4.33 | 5.02 | 2.89 | 2.85 | 2.43 | 3.29 | 45.42 |

*Taken from Agricultural Yearbook Committee (1941).

# Sampling Methods

Three random sample sites of soils developed in materials weathered from the Basal Cambrian rock of the Chilhowee group (BQ) and three sites of soils developed in materials weathered from the Millboro, Brallier, and/or Chemung (BR) formations were selected in each of Rockbridge, Botetourt, Wythe, Smyth, and Washington Counties for study. Five sample random sites of soils developed in materials weathered from the Rome-Waynesboro formation (RO) were selected in Botetourt, Wythe, and Smyth Counties. Five random sites of soils developed in materials weathered from the Athens and/or Martinsburg formations (MA) were selected in Rockbridge, Botetourt, and Washington Counties. The reason for the unequal number of sample sites per parent material per county was the unequal acreages of the various geologic formations in the various counties (Table 2). Sample sizes in this study were limited by time and cost constraints.

One randomly selected soil profile within each of the above sites was selected for study. Site index or tree height at age 50 years was determined for the dominant species. In order to provide a constant species for comparison, the site index for species other than scarlet, black, northern red, and chestnut oaks were converted by the method of Doolittle (1958). Percentage composition of the species that formed the forest canopy was recorded. Dominant understory species were also recorded. The canopy and ground or understory species are given for each sample site in Appendix B. Scientific plant names are according to Gray's Manual of Botany (Fernald, 1950).

Each soil profile was described according to currently accepted methods of the National Cooperative Soil Survey in excavated pits. Each soil characteristics at each site was described by the same soil scientist in order to give as much consistency to the qualitative soil characters as possible. Descriptions of each soil profile are given in Appendix B.

Particle-size, mineralogical, and chemical control sections as defined by Soil Survey Staff (1975) were thoroughly mixed and sampled.

# Laboratory Methods

The samples were air dried and sieved to remove particles > 2 mm in diameter.

## Chemical Analysis

Exchangeable bases of $Ca^{2+}$, $Mg^{2+}$, and $K^{+}$ were determined by a modification of the procedure proposed by Jackson (1958). Ten grams of soil were equilibrated with 50 ml of $N$ $NH_4OAc$, pH 7.0, by mechanically shaking for 30 minutes. The solution was then filtered through Whatman No. 42 filter paper and the sample washed with three 10 ml portions of the $N$ $NH_4OAc$ solution. The resulting filtrate was made to exactly 100 ml by adding the $N$ $NH_4OAc$, pH 7.0, solution. Solutions for $Ca^{2+}$ and $Mg^{2+}$ determinations were prepared by mixing 9 ml of the above filtrate with 1 ml of $La_2O_3$ solution prepared by adding 500 ml of deionized water to 117.3 g of $La_2O_3$ , mixing with 417 ml of concentrated HCl, and making to exactly 1000 ml with deionized water. Solutions for $K^+$ determinations were prepared by mixing 9 ml of the above filtrate with 1 ml of a 10,000 ppm $Na^+$ solution. Amounts of exchangeable bases were determined by atomic absorption spectroscopy using an air-acetylene flame. Standards used for these analyses were prepared using proper matrix solutions. Amounts of exchangeable bases are reported for the taxonomic control section of each soil profile in each Table A following the profile descriptions in Appendix B.

Cation exchange capacity (NHCEC) was determined by the ammonium saturation, displacement, and distillation method given by Chapman (1965) and reported for the taxonomic control section of each soil profile in each Table A following the profile descriptions in Appendix B.

pH was determined for 1:1 mixtures of soil and water and reported for the taxonomic control section of each soil profile in each Table B following the profile descriptions in Appendix B.

Exchange acidity ($H^+$) was determined by a modification of the barium chloride-triethanolamine procedure proposed by Peech (1965). Ten grams of soil and 50 ml of 0.5 $N$ $BaCl_2$-0.2 $N$ triethanolamine, pH 8.2, were equilibrated by mechanically shaking for 1 hour. The solution was filtered through Whatman No. 42 filter paper and the sample washed with four 25 ml portions of 0.6 $N$ $BaCl_2$ solution. The resulting solutions were titrated with 0.20 $N$ HCl using brom cresol green-methyl red as an indicator. Amounts of exchange acidity are reported for the taxonomic control section of each soil profile in each Table B following the profile descriptions in Appendix B.

Exchangeable aluminum ($Al^{3+}$) was determined by a modification of the procedure proposed by Yuan (1959). Ten grams of soil were equilibrated with 25 ml of $N$ KCl solution by mechanically shaking for 30 minutes. The solution was filtered through Whatman No. 42 filter paper and the sample washed with three 25 ml portions of $N$ KCl solution. The resulting solutions were titrated with 0.10 $N$ NaOH using 0.10 percent phenalphthalein as an indicator. Amounts of exchangeable $Al^{3+}$ are reported for the taxonomic control section of each soil profile in each Table B following the profile descriptions in Appendix B.

## Particle-Size Analysis

Particle-size distributions were determined by the hydrometer method of Day (1965) and reported for the taxonomic control section in each Table C following the profile descriptions in Appendix B.

## Mineralogical Analysis

Subsamples for mineralogical analysis were treated with citrate-dithionite-bicarbonate to remove oxide coatings. The sand fraction was separated by wet sieving. The silt and clay fractions were separated by centrifugation and decantation using dilute $N$ $Na_2CO_3$ adjusted to pH 9.5 as a dispersant. The sand fraction was ground for 5 minutes in a reciprocating ball mill. Semi-oriented smear mounts of the silt and ground-sand fractions were made on glass slides using distilled $H_2O$. X-ray diffraction patterns of the sand and silt fractions were obtained using a Diano XRD-8300-AD x-ray diffractometer equipped with a graphite crystal monochrometer, LSI-11 computer, and printer. Samples were scanned at 2° 2θ $minute^{-1}$ using $CuK\alpha$ radiation.

Amounts of silt and sand minerals were estimated from integrated x-ray diffraction peak intensities by regression equations developed by W. G. Harris, University of Florida, Gainesville, FL 32611 (1985, personal communications) for the x-ray diffractometer at Virginia Tech.

The ratio of the relative x-ray diffraction peak intensity of mineral a, $I_a$, to mineral b, $I_b$, is related to the ratio of their masses, $M_a$ and $M_b$, by the following:

$$\frac{I_a}{I_b} = \frac{1}{C_x}\frac{M_a}{M_b} \tag{1}$$

where $C_x$ is a constant determined empirically from the relationship of the intercept and slope of a line given by:

$$\frac{M_a}{M_b} = a + b\frac{I_a}{I_b} \tag{2}$$

formed by regressing known mixtures of of $M_a$ and $M_b$ on their relative x-ray diffraction peak intensities. Other minerals in the subsample were estimated from:

$$M_{a1} + M_{a2} + \cdots + M_{an} + M_b = 100 \tag{3}$$

which can be approximated by:

$$\frac{M_{a1}}{M_b}M_b + \frac{M_{a2}}{M_b}M_b + \cdots + \frac{M_{an}}{M_b}M_b + M_b \cong 100 \tag{4}$$

This relationship assumes that the minerals detected represent the mineralogical composition of the soil. From this relationship, $M_b$ can be estimated from:

$$M_b \cong \frac{100}{\sum_{i=1}^{n}\frac{M_{ai}}{M_b} + 1.0} \tag{5}$$

Then $M_{ai}$ can be estimated from :

$$M_{ai} \cong \frac{M_{ai}}{M_b}M_b \tag{6}$$

Regression equations were developed that related ratios of integrated x-ray diffraction peak intensities to ratios of known masses of albite and quartz, microcline and quartz, muscovite and quartz, albite and muscovite, microcline and muscovite, muscovite and kaolinite, quartz and kaolinite, and microcline and kaolinite for the diffractometer at Virginia Tech.

This procedure has advantages over the petrographic technique for determining the mineralogy of the 0.02 - 2.0 mm fraction of soils. It requires less time and cost, aids in the identification of minerals in the coarse silt and very fine sand fractions, and alleviates problems associated with the number of rock fragments usually encountered in the silt and sand fractions of soils developed from argillaceous rocks, such as shales, siltstones, and phyllites, by the petrographic technique. This procedure aids in the identification of highly weathered mineral phases, such as phyllosilicates; e.g., kaolinite, chlorite, etc., and pseudomorphs after precursor minerals; e.g., kaolinite after biotite, in the sand and silt fractions which are difficult to identify by petrographic techniques. The difference in weight associated with grain morphology of mica is compensated for by this procedure. Weatherable minerals tend to increase with a decrease in particle size. Therefore, this technique has the advantage of being able to economically analyze the finer portion of the 0.02 - 2.0 mm soil fraction which can lead to a better representation of the soil mineralogy than a petrographic grain count of the dominant sand fraction, especially if the distribution of sand sizes is skewed toward the coarser end.

Disadvantages of this procedure are related to the assumption that the minerals identified by x-ray diffraction equal 100 percent. In random or semi-oriented smear mounts, many crystalline mineral phases have peaks that are close together or overlap. Small concentrations of minerals may not be detected. Amorphous soil components are not detected. Therefore, this procedure tends to inflate values for the dominant minerals.

However, the exact quantification of mineral suites of soils is not always necessary because semi-quantitative values determined by this procedure are relative and considered to be sufficient for computing ranks for comparing mineralogical properties of soils by nonparametric statistical methods. However, if one is interested in the exact quantification of the mineral suite of soils for classification or other purposes, then this procedure has the same limitations as other analysis that use x-ray diffraction, for example, quantitative analysis of the mineral suites of clayey soils.

Amounts of the minerals detected in the sand and silt fractions are reported for the taxonomic control section of each soil profile in each Table E following the profile descriptions in Appendix B.

## *Statistical Methods*

The parametric procedure, analysis of variance (anova), assumes independent samples, normality, and equal variance (Ott, 1984). When the assumptions of normality and equal variance are not valid, but the sample sizes are large and not too disparate, the results obtained using the F-test in anova are approximately correct (Ott, 1984); i.e. the F-test is rescued by the central limit theorem (Miller, 1986). However, when sample sizes are small, as is the case in this study, the $\alpha$-levels associated with the F-tests are not maintained for nonnormal data. The UNIVARIATE procedure (SAS Institute, 1985a) was used to calculate both quantiles and probabilities (p-values) associated with the Shapiro-Wilk W-statistic for testing the null hypothesis that the data values were random samples from normal distributions. The Shapiro-Wilk test is well suited to small sample sizes (Afifi and Clark, 1984) and has been shown to be the best currently available procedure for testing normality (Miller, 1986).

The distribution-free Kruskal-Wallis test is an alternative procedure, based on ranks of the data values, that requires less stringent assumptions and can be used for small sample sizes (Ott, 1984). The assumptions of the Kruskal-Wallis test are:
(1) observations, $X_{ij}$; e.g. site index, pH, $Ca^{2+}$, SQTZ, etc., are explainable by the basic model:

$$X_{ij} = \mu + \tau_j + \varepsilon_{ij} \tag{7}$$

where $\mu$ is the (unknown) overall mean, $\tau_j$ is the (unknown) treatment j effect (the influence of a given parent material on the distribution of a given soil property), and the sum of the $\tau_j$ 's from j = 1 to k groups is 0;
(2) the $\varepsilon$'s (error variables associated with sampling and laboratory procedures as well as the inherent variability in the soils) are mutually independent; and
(3) each $\varepsilon$ comes from the same continuous population (Hollander and Wolfe, 1973). When variances are unequal, typically power is reduced, but the $\alpha$-levels are still reliable.

Probabilities (p-values) and estimations associated with all the nonparametric statistical procedures used in this study were calculated using the Virginia Tech Nonparametric Statistics Package (Pirie, 1982).

The Kruskal-Wallis H'-statistic was used to test the null hypothesis that the distributions of soil properties developed from the parent materials (BQ, RO, MA, and BR) were identical (Ott, 1984; Hollander and Wolfe, 1973) against the alternative that all the distributions were not the same.

Distribution-free multiple comparisons based on Kruskal-Wallis rank sums (Hollander and Wolfe, 1973) were used to determine which soil parent materials, BQ, RO, MA, and BR, produced significantly different distributions of a given soil property within the study area.

When there are only two samples to compare, more convenient versions of the anova F-test and the Kruskal-Wallis test are the two-sample t-test and the Wilcoxon rank sum test, respectively. These two sample versions have the advantages of applying the one-sided alternative hypotheses and are somewhat easier to apply. All previous comments on properties apply here as well.

The Wilcoxon rank sum test assumes:
(1) the observations, $X_i$ ; e.g. site index, pH, $Ca^{2+}$, SQTZ, etc., for groups of soil profiles classified as members of Lithic Dystrochrepts are explainable by the basic model:

$$X_i = \varepsilon_i \tag{8}$$

where $i = 1, \dots, m$ and the observations, $Y_i$, for groups of soil profiles classified as members of Typic Dystrochrepts are explainable by:

$$Y_i = \varepsilon_{m+j} + \Delta \tag{9}$$

for $i = 1, \dots, n$ where the X's and Y's are observable, $\varepsilon_{m+1}, \dots, \varepsilon_{m+n}$ are unobservable random error variables associated with sampling and laboratory procedures as well as variability in the soils, and $\Delta$, the parameter of interest, is the unknown shift in location for distributions of particular soil properties for the above taxonomic classes;
(2) the m + n $\varepsilon$'s are mutually independent; and
(3) each $\varepsilon$ comes from the same continuous population (Hollander and Wolfe, 1973).
These assumptions imply that the X and Y populations differ only in $\Delta$ or location and that the dispersion or variances of the two populations are equal. When variances are unequal, typically power is reduced, but the $\alpha$-levels are still reliable.

The Moses ranklike test was used to test the the null hypothesis of equal dispersion or variance:

$$Ho\colon \gamma^2 = \frac{\sigma_2^2}{\sigma_1^2} = 1 \tag{10}$$

against:

$$Ha\colon \gamma^2 \neq 1 \tag{11}$$

for groups of soil profiles classified as members of Lithic and Typic Dystrochrepts. The Moses ranklike test assumes:
(1) variances of groups of soil profiles classified as members of Lithic Dystrochrepts are explainable by the model:

$$X_i = \sigma_1\varepsilon_i + \mu_1 \tag{12}$$

for $i = 1, \dots, m$ and variances of groups of soil profiles classified as members of Typic Dystrochrepts are explainable by:

$$Y_j = \sigma_2 \varepsilon_{m+j} + \mu_2 \tag{13}$$

for $j = 1, \ldots, n$ where $\varepsilon_1, \ldots, \varepsilon_{m+j}$ are unobservable random variables associated with sampling and laboratory procedures and inherent variability in the soils, $\mu_1$ and $\mu_2$ are the unknown medians of the X and Y populations, respectively, and the parameter of interest is the unknown ratio of the scale parameters $\gamma = \sigma_2 \div \sigma_1$;
(2) the m + n $\varepsilon$'s are mutually independent; and
(3) each $\varepsilon$'s come from the same continuous population with median zero.

Shorack 89% confidence intervals for $\gamma^2$ (Hollander and Wolfe, 1973) were calculated.

The distribution-free Wilcoxon rank sum W-statistic was used to test for differences between distributions of properties for groups of soil profiles classified as members of Lithic and Typic Dystrochrepts developed from all parent materials; i.e. the null hypothesis:

$$Ho\colon \Delta = 0 \tag{14}$$

against:

$$Ha\colon \Delta < 0 \; and \; \Delta > 0 \tag{15}$$

(Hollander and Wolfe, 1973; Ott, 1984).

Hodges-Lehman estimations of $\Delta$ (Hollander and Wolfe, 1973) were calculated. Negative values for $\Delta$ indicate median shifts for given soil properties toward groups of soil profiles classified as members of Lithic Dystrochrepts; i.e. $\Delta < 0$, which means that median values for given properties are larger for groups of soil profiles classified as members of Lithic than for Typic Dystrochrepts. Positive values for $\Delta$ indicate median shifts for given soil properties toward Typic Dystrochrepts; i.e., $\Delta > 0$, which means that median values are larger for groups of soil profiles classified as members of Typic than for Lithic Dystrochrepts.

Moses 90% confidence intervals for $\Delta$ (Hollander and Wolfe, 1973) were calculated.

Multivariate statistical methods are heuristic and assume normality of the data. Lebart et al. (1984) suggest the use of nonparametric methods for multivariate analysis when the data are very heterogeneous and nonnormal. Statistical methods that use ranks of the data provide extremely robust results since they are very insensitive to outliers. Standardization to remove location and scale attributes of the data is unnecessary since all variables have the same range, mean, and standard deviation, except cases with a large number of tied values. The distribution of the distance is nonparametric and depends only on the assumption that the data are distributed continuously. The RANK procedure (SAS Institute, 1985b) was used to rank data values.

Principal component (PC) analysis was used to reduce the number of dimensions needed to ordinate the soil profiles in character space, and to remove multicollinearity in soil characters (Cattell, 1965; Gould, 1967; Davis, 1973; Sneath and Sokal, 1973; Mather, 1976; Webster, 1977; Afifi and Clark, 1984). The PRINCOMP procedure (SAS Institute, 1985b) was used to calculate principal components, correlation of variables on which the principal components were based, proportions of the variance contributed by the principal components, loading values of the variables onto the principal components, and principal component scores. Specific soil characters on which the principal components were based were: pH, $Ca^{2+}$, $Mg^{2+}$, NHBS, NHALSAT, silt, clay, SQTZ, and SFLD. Ranks of the data values were used to give a common mean of 30.5 and standard deviation of 17.5 in order to remove location and scale attributes (Lebart et al., 1984). The FACTOR procedure (SAS Institute, 1985b) was used to calculate the final communality estimates for estimating how well the principal components represent the soil properties used to develop them. The graphics capabilities of Supercalc3 Release 2 (1984) were used to produce histograms of the loading values for the variables onto the principal components. The PLOT procedure (SAS Institute, 1985a) was used to produce the scatter plot of the principal component scores for principal components 1 and 2.

A dendrogram or phenogram of the phenetic similarities of the soil profiles was produced by the hierarchical CLUSTER program given by Davis (1973) using principal component scores for the first six principal components based on ranks of the data values. The soil profiles were grouped by the weighted pair-group average clustering method (Davis, 1973) using the Euclidean distance (Arkley, 1976; Mather, 1976) as the similarity coefficient. Heterogeneity within the groups of soil profiles increases as the Euclidean distance between group means increases.

Discrimination is the task of assigning individuals to categories based on prior knowledge of group characteristics. Soils developed from specific parent materials or geologic formations were considered to belong to groups. Two groups of soil profiles characterized by several soil properties can be separated in multivariate space by a line (discriminant function) along which the two groups have the maximum separation and the least inflation. That is, the variability between the groups is maximized and the variability within the groups is minimized.

The following procedure is taken from Davis (1973). Multiple regression is used to calculated a set of λ coefficients for the discriminant function. Then,

$$R = \lambda_1\psi_1 + \lambda_2\psi_2 + \cdots + \lambda_m\psi_m \tag{16}$$

is a linear function that reduces the data for several soil properties used to characterize a soil profile to a single number or discriminant score. Substitution of the midpoint between the two group means in equation 12 gives the discriminant index, $R_O$. The resulting equation is:

$$R_O = \lambda_1\frac{\overline{A}_1 + \overline{B}_1}{2} + \lambda_2\frac{\overline{A}_2 + \overline{B}_2}{2} + \cdots + \lambda_m\frac{\overline{A}_m + \overline{B}_m}{2} \tag{17}$$

$R_O$ is the point halfway between the centers or multivariate means of groups A and B. Next, we substitute the means for the properties used to characterize soils in group A into equation 12 to obtain:

$$R_A = \lambda_1\overline{A}_1 + \lambda_2\overline{A}_2 + \cdots + \lambda_m\overline{A}_m \tag{18}$$

which gives the multivariate mean of group A. Finally, we substitute the means for the properties used to characterize soils in group B into equation 10 to obtain:

$$R_B = \lambda_1\overline{B}_1 + \lambda_2\overline{B}_2 + \cdots + \lambda_m\overline{B}_m \tag{19}$$

which gives the multivariate mean of soil groups B. Now, we can plot the discriminant score for each soil profile; the discriminant index, $R_O$; the multivariate mean for group A, $R_A$; and the multivariate mean for group B, $R_B$. The multivariate distance between $R_A$ and $R_B$ is called *Mahalanobis' distance* ($D^2$) and is defined as the difference between $R_A$ and $R_B$. The statistical significance of $D^2$ can be tested using Hotelling's $T^2$ test. The amount of the separation between the multivariate means of the two groups contributed by a specific soil property, i, can be estimated by

$$D_i = \frac{\overline{A}_i - \overline{B}_i}{D^2}100 \tag{20}$$

which gives an estimation of the percentage contribution of variable i to the separation of the two groups. However, collinearity of the soil properties used to characterize the soils influences $D^2$. Discriminant functions were calculated by the DISCRM program given by Davis (1973) for different combinations of soil properties. The PLOT procedure (SAS Institute, 1985a) was used to produce scatter plots of the discriminant scores for the soil profiles.

The RSQUARE procedure (SAS Institute, 1985b) was used to develop regression models with highest $R^2$ values for combinations of variables.

The REG procedure (SAS Institute, 1985b) was used to calculate regression parameter estimates and associated statistics for the dependent variable site index. The graphics capabilities of Supercalc3 Release 2 (1984) were used to plot quantile distributions of site indexes for upland oaks.

# Results and discussion

## *Data distributions*

Symbols used throughout this bulletin to represent soil and site properties are defined and their units of measurement are given in Tables 4A and 4B.

P-values associated with the Shapiro-Wilk W-statistic (Table 5) for the majority of the soil characteristics developed from these parent materials were less than 0.05. Based on these p-values, sufficient evidence exists to support the conclusion that numerous soil properties are not normally distributed. Therefore; $\alpha$ -levels associated with the F-test in the analysis of variance procedure would not be maintained for the majority of these soil properties because of the small sample sizes. Consequently, the nonparametric Kruskal-Wallis test statistic was used to evaluate differences among soils developed from these parent materials.

P-values associated with the Shapiro-Wilk W-statistic (Table 6) for the majority of the soil characteristics for groups of soils classified as members of the loamy-skeletal, mixed, mesic families of Lithic and Typic Dystrochrepts were less than 0.05, indicating the possibility of nonnormal distributions. Thus, $\alpha$ -levels associated with the two-sample t-test would not be maintained for the majority of these data because of the small sample sizes. Therefore, the nonparametric Wilcoxon rank sum test statistic was used to evaluate differences among soils classified as members of these taxa.

Table 4A: Definitions of symbols and units of measurement used to represent soil and site properties throughout this bulletin

| Symbol | Definition and unit of measurement |
|---|---|
| SI | Site index (tree height at age 50 years) |
| Slope | Slope (% or feet rise or fall / 100 feet) |
| DTC | Depth to C horizon (inches) |
| DTR | Depth to bedrock (inches) |
| AH2O | Estimated available water capacity (inches / profile) |
| pH | pH (-log $[H^+]$) |
| $Ca^{2+}$ | $NH_4OAc$, pH 7, extractable $Ca^{2+}$ (cmol (+) $kg^{-1}$ of soil) |
| $Mg^{2+}$ | $NH_4OAc$, pH 7, extractable $Mg^{2+}$ (cmol (+) $kg^{-1}$ of soil) |
| $K^+$ | $NH_4OAc$, pH 7, extractable $K^+$ (cmol (+) $kg^{-1}$ of soil) |
| SBAS | Sum of $NH_4OAc$, pH 7, extractable $Ca^{2+}$, $Mg^{2+}$, and $K^+$ (cmol (+) $kg^{-1}$ of soil) |
| $H^+$ | $BaCl_2$-TEA, pH 8.2, exchangeable acidity (cmol (+) $kg^{-1}$ of soil) |
| $Al^{3+}$ | KCl extractable $Al^{3+}$ (cmol (+) $kg^{-1}$ of soil) |
| SCEC | Cation exchange capacity determined by the sum of SBAS and $H^+$ (cmol (+) $kg^{-1}$ of soil) |
| ECEC | Cation exchange capacity determined by the sum of SBAS and $Al^{3+}$ (cmol (+) $kg^{-1}$ of soil) |
| NHCEC | Cation exchange capacity determined by the $NH_4OAc$, pH 7.0, method (cmol $(NH_4^+)$ $kg^{-1}$ of soil) |
| SALSAT | $Al^{3+}$ saturation of the SCEC (%) |

Table 4B: Definitions of symbols and units of measurement used to represent soil and site properties throughout this bulletin

| Symbol | Definition and unit of measurement |
|---|---|
| NHALSAT | $Al^{3+}$ saturation of the NHCEC (%) |
| EALSAT | $Al^{3+}$ saturation of the ECEC (%) |
| Sand | 0.05 - 2.0 mm fraction (g $kg^{-1}$ of soil) |
| Silt | 0.002 - 0.05 mm fraction (g $kg^{-1}$ of soil) |
| Clay | < 0.002 mm fraction (g $kg^{-1}$ of soil) |
| SCECLAY | Ratio of the SCEC to clay (cmol (+) $kg^{-1}$ of clay) |
| ECECLAY | Ratio of the ECEC to clay (cmol (+) $kg^{-1}$ of clay) |
| NHCECLAY | Ratio of the NHCEC to clay (cmol (+) $kg^{-1}$ of clay) |
| NHBS | (SBAS / NHCEC)100 (%) |
| SBS | (SBAS / SCEC)100 (%) |
| EBS | (SBAS / ECEC)100 (%) |
| SQTZ | Quartz (g $kg^{-1}$ of the 0.05 to 2.0 mm fraction) |
| SIQTZ | Quartz (g $kg^{-1}$ of the 0.002 to 0.05 mm fraction) |
| SMICA | Mica (g $kg^{-1}$ of the 0.05 to 2.0 mm fraction) |
| SIMICA | Mica (g $kg^{-1}$ of the 0.002 to 0.05 mm fraction) |
| SFLD | Feldspar (g $kg^{-1}$ of the 0.05 to 2.0 mm fraction) |
| SIFLD | Feldspar (g $kg^{-1}$ of the 0.002 to 0.05 mm fraction) |

Table 5: P-values for Shapiro-Wilk tests of normality for selected properties of soils developed from the parent materials or geologic formations

| Variable@ | Geologic formations* BQ | RO | MA | BR |
|---|---|---|---|---|
| | $\alpha(W)$# | | | |
| SI | 0.436 | 0.949 | 0.679 | 0.746 |
| Slope | 0.325 | 0.706 | 0.979 | 0.389 |
| DTC | 0.183 | 0.015 | 0.175 | 0.141 |
| DTR | 0.449 | < 0.01 | 0.078 | 0.099 |
| AH2O | 0.040 | < 0.01 | 0.022 | 0.071 |
| pH | 0.445 | 0.695 | < 0.01 | 0.036 |
| $Ca^{2+}$ | 0.135 | < 0.01 | < 0.01 | < 0.01 |
| $Mg^{2+}$ | < 0.01 | < 0.01 | < 0.01 | 0.052 |
| $K^{+}$ | 0.066 | 0.650 | 0.146 | < 0.01 |
| $H^{+}$ | 0.494 | 0.640 | 0.301 | 0.970 |
| $Al^{3+}$ | 0.124 | < 0.01 | 0.230 | 0.832 |
| SBAS | 0.096 | < 0.01 | < 0.01 | < 0.01 |
| SCEC | 0.468 | 0.345 | 0.393 | 0.745 |
| NHCEC | 0.071 | 0.046 | 0.687 | 0.602 |
| ECEC | 0.089 | 0.012 | < 0.01 | 0.328 |
| SALSAT | 0.246 | 0.434 | 0.041 | 0.773 |
| NHALSAT | 0.488 | 0.418 | 0.098 | 0.035 |
| EALSAT | 0.078 | 0.148 | 0.040 | < 0.01 |
| Sand | 0.303 | 0.310 | 0.049 | 0.394 |
| Silt | 0.877 | 0.353 | 0.060 | 0.437 |
| Clay | 0.364 | < 0.01 | 0.948 | 0.096 |
| SCECLAY | < 0.01 | < 0.01 | 0.044 | 0.895 |
| ECECLAY | 0.010 | 0.079 | 0.014 | 0.999 |
| NHCECLAY | < 0.01 | < 0.01 | < 0.01 | 0.798 |
| NHBS | 0.040 | 0.012 | < 0.01 | < 0.01 |
| SBS | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| EBS | 0.078 | 0.148 | 0.040 | < 0.01 |
| SQTZ | < 0.01 | 0.457 | 0.010 | 0.023 |
| SIQTZ | 0.502 | 0.099 | 0.018 | 0.730 |
| SMICA | < 0.01 | 0.036 | < 0.01 | < 0.01 |
| SIMICA | 0.262 | 0.183 | 0.043 | 0.505 |
| SFLD | 0.018 | 0.108 | < 0.01 | < 0.01 |
| SIFLD | 0.571 | 0.493 | 0.010 | 0.592 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR.
@See Tables 4A and 4B for definitions of symbols used for variables.
#Shapiro-Wilk W-statistic.

Table 6: P-values for Shapiro-Wilk tests of normality for selected properties of soils classified as Lithic and Typic Dystrochrepts

| Variable* | Lithic Dystrochrepts | Typic Dystrochrepts |
|---|---|---|
| | α(W)# | |
| SI | 0.423 | 0.686 |
| Slope | 0.537 | 0.650 |
| DTC | 0.285 | 0.480 |
| DTR | 0.018 | < 0.01 |
| AH2O | 0.191 | 0.666 |
| pH | 0.153 | 0.308 |
| $Ca^{2+}$ | < 0.01 | < 0.01 |
| $Mg^{2+}$ | < 0.01 | < 0.01 |
| $K^{+}$ | < 0.01 | 0.409 |
| $H^{+}$ | 0.058 | 0.376 |
| $Al^{3+}$ | 0.605 | 0.489 |
| SBAS | < 0.01 | < 0.01 |
| SCEC | 0.418 | 0.317 |
| NHCEC | 0.330 | 0.029 |
| ECEC | 0.269 | 0.062 |
| NHBS | < 0.01 | < 0.01 |
| SBS | < 0.01 | < 0.01 |
| EBS | < 0.01 | < 0.01 |
| SALSAT | 0.410 | 0.952 |
| NHALSAT | 0.020 | 0.278 |
| EALSAT | < 0.01 | < 0.01 |
| Sand | 0.342 | 0.485 |
| Silt | 0.760 | 0.290 |
| Clay | 0.511 | 0.509 |
| ECECLAY | 0.070 | 0.179 |
| NHCECLAY | < 0.01 | 0.299 |
| ECECLAY | 0.070 | 0.179 |
| SQTZ | 0.037 | < 0.01 |
| SIQTZ | 0.054 | 0.094 |
| SMICA | < 0.01 | < 0.01 |
| SIMICA | 0.068 | < 0.01 |
| SFLD | < 0.01 | < 0.01 |
| SIFLD | 0.034 | 0.083 |

*See Tables 4A and 4B for definitions of symbols used for variables.
#Shapiro-Wilk w-statistic.

# *Parent materials*

P-values associated with the Kruskal-Wallis H′-statistic, results of the multiple comparisons based on Kruskal-Wallis rank sums, and quantiles for the soil and site properties associated with these parent materials are reported in Tables 7 through 40. Most of the soil and site properties exhibited considerable overlap in their quantile distributions, indicating that mutually exclusive classes were not differentiated by soils grouped according to their parent materials. However, certain generalizations about statistical differences in the soils developed from these parent materials can be inferred from the data and criteria for establishing soil series to name and interpret map units of soils developed from these parent materials can be developed.

Soil and site properties that did not differ significantly at the 10 percent level of probability among the parent materials were slope (Table 7), DTC (Table 8), DTR (Table 9), AH2O (Table 10), sand (Table 28), NHCECLAY (Table 32), SCECLAY (Table 33), SIQTZ (Table 35), and SMICA (Table 36).

$Ca^{2+}$ (Table 11), $Mg^{2+}$ (Table 12), $K^{+}$ (Table 13), and SBAS (Table 14) were significantly lower at the 10 percent level of probability for soils developed from rocks of the Chilhowee group (BQ) than for most of the other parent materials. These results indicate that soils developed from rocks of the Chilhowee group (BQ) generally have the lower plant nutrient supplying capacities than soils developed from the other parent materials.

SCEC (Table 15), NHCEC (Table 16), and ECEC (Table 17) were significantly lower at the 10 percent level of probability for soils developed from rocks of the Rome-Waynesboro formation than for soils developed from most of the other parent materials.

Differences between SCEC and ECEC provide a gross estimate of the pH-dependent charge (Coleman et al., 1959) and were significantly lower for soils developed from rocks of the Rome-Waynesboro formation. The proportion of SCEC represented by pH-dependent charge for all the soils was approximately one-half.

SBS (Table 19), NHBS (Table 20), and EBS (Table 21) were significantly lower at the 10 percent level of probability for soils developed from rock of the Chilhowee group (BQ) than for soils developed from most of the other parent materials. These results indicate that soils developed from rock of the Chilhowee group (BQ) have lower base saturations than have soils developed from rocks of the other parent materials.

pH values (Table 22) for soils developed from rocks of the Chilhowee group (BQ) were significantly lower than for soils developed from the Rome-Waynesboro (RO) and Athens and Martinsburg (MA) formations, but not significantly different from soils developed from the Millboro, Brallier, and Chemung (BR) formations.

$H^+$ (Table 23) and $Al^{3+}$ (Table 24) were significantly lower at the 10 percent lever of probability for soils developed from the Rome-Waynesboro formation than for most of the other parent materials. SALSAT (Table 25), NHALSAT (Table 26), and EALSAT (Table 27) for soils developed from the Rome-Waynesboro were not significantly different at the 10 percent level of probability from soils developed from the Athens and Martinsburg formations, but were significantly lower than soils developed from rocks of the Chilhowee group and from the Millboro, Brallier, and Chemung formations. These results indicate that soils developed from rocks of the Chilhowee group and from the Millboro, Brallier, and Chemung formations could have sufficient $Al^{3+}$ to influence plant growth more than soils developed from the Rome-Waynesboro and from the Athens and Martinsburg formations.

Silt content (Table 29) was significantly higher at the 10 percent level of probability and clay content (Table 30) was significantly lower, for soils developed from rocks of the Rome-Waynesboro formation than for soils developed from most of the other parent materials.

ECECLAY (Table 31) for soils developed from rocks of the Chilhowee group were not significantly different from soils developed from the Rome-Waynesboro formation, but were significantly lower than for soils developed from the other parent materials. This ratio was not significantly different for soils developed from rocks of the Rome-Waynesboro; Athens and Martinsburg; and the Millboro, Brallier, and Chemung formations.

SQTZ (Table 34) was significantly lower for soil developed from rocks of the Rome-Waynesboro formation than for soils developed from the other parent materials.

SIMICA (Table 37) was significantly lower in soils developed from rocks of the Rome-Waynesboro formation than for soils developed from the Millboro, Brallier, and Chemung formations, but not significantly different from soils developed from rocks of the Chilhowee group and from the Athens and Martinsburg formation. Soils developed from rocks of the Millboro, Brallier, and Chemung formations generally had higher mica contents.

SFLD (Table 38) and SIFLD (Table 39) were significantly higher for soils weathered from rocks of the Rome-Waynesboro formation than for soils developed from the other parent materials.

Table 7: Comparisons of distributions of slope

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | | | | % | | | |
| Geologic formations - $\alpha(H') = 0.7266$*: | | | | | | | |
| BQ(a) | 20 | 22 | 30 | 37 | 54 | 61 | 62 |
| RO(a) | 15 | 18 | 31 | 40 | 51 | 71 | 81 |
| MA(a) | 7 | 9 | 25 | 35 | 47 | 60 | 67 |
| BR(a) | 4 | 8 | 22 | 46 | 54 | 68 | 72 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.33698$ | | | | | | | |
| $\Delta = 2.0$ | | | | | | | |
| 90% CI for $\Delta$ is -7.0 to 12.0. | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.4634$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.3 to 5.3 | | | | | | | |
| LD | 7 | 17 | 25 | 35 | 52 | 63 | 67 |
| TD | 4 | 8 | 30 | 42 | 52 | 75 | 81 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 8: Comparisons of distributions of depths to C horizons (DTC)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | | | | inches | | | |
| Geologic formations - $\alpha(H') = 0.8252$*: | | | | | | | |
| BQ(a) | 10 | 10 | 12 | 15 | 20 | 27 | 29 |
| RO(a) | 5 | 8 | 12 | 18 | 30 | 48 | 60 |
| MA(a) | 9 | 10 | 11 | 15 | 21 | 24 | 26 |
| BR(a) | 8 | 10 | 12 | 17 | 23 | 33 | 38 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.00003$ | | | | | | | |
| $\Delta = 8.0$ | | | | | | | |
| 90% CI for $\Delta$ is 6.0 to 10.0. | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.1231$ | | | | | | | |
| 89% CI for $\gamma^2$ is 1.0 to 24.2 | | | | | | | |
| LD | 5 | 10 | 10 | 12 | 14 | 16 | 18 |
| TD | 9 | 11 | 18 | 20 | 23 | 31 | 35 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 9: Comparisons of distributions of depths to bedrock (DTR)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | inches | | | | | | |
| Geologic formations - α(H′) = 0.7436*: | | | | | | | |
| BQ(a) | 10 | 11 | 14 | 19 | 25 | 30 | 35 |
| RO(a) | 7 | 9 | 13 | 18 | 35 | 54 | 60 |
| MA(a) | 11 | 11 | 13 | 19 | 30 | 44 | 50 |
| BR(a) | 8 | 10 | 16 | 20 | 33 | 52 | 56 |
| Lithic (LD) and Typic (TD) Dystrochrepts@:<br>Rank sum test (Wilcoxon):<br>$\alpha(W)$ = < 0.00001<br>$\Delta$ = 12.0<br>90% CI for $\Delta$ is 9.0 to 15.0.<br>Ranklike test (Moses)<br>$2\alpha(W)$ = 0.2566<br>89% CI for $\gamma^2$ is 0.8 to 6.6 | | | | | | | |
| LD | 7 | 10 | 11 | 15 | 18 | 19 | 19 |
| TD | 20 | 20 | 23 | 25 | 35 | 44 | 50 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 10: Comparisons of distributions of estimated available water water capacity (AH2O)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | inches | | | | | | |
| Geologic formations - $\alpha(H') = 0.8148$*: | | | | | | | |
| BQ(a) | 0.28 | 0.35 | 0.66 | 0.82 | 2.29 | 3.20 | 3.50 |
| RO(a) | 0.52 | 0.54 | 0.88 | 1.36 | 2.34 | 6.55 | 7.90 |
| MA(a) | 0.34 | 0.42 | 0.66 | 1.22 | 2.77 | 3.20 | 3.26 |
| BR(a) | 0.36 | 0.37 | 0.69 | 1.30 | 2.57 | 4.05 | 4.39 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.00001$ | | | | | | | |
| $\Delta = 1.13$ | | | | | | | |
| 90% CI for $\Delta$ is 0.76 to 1.43 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.0136$ | | | | | | | |
| 89% CI for $\gamma^2$ is 2.3 to 15.4 | | | | | | | |
| LD | 0.28 | 0.36 | 0.53 | 0.71 | 1.12 | 1.32 | 1.76 |
| TD | 0.66 | 0.68 | 1.36 | 1.84 | 2.41 | 3.06 | 3.50 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 11: Comparisons of distributions of Ca

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H')$ = < 0.0001*: | | | | | | | |
| BQ(c) | 0.07 | 0.07 | 0.18 | 0.23 | 0.31 | 0.32 | 0.32 |
| RO(bc) | 0.10 | 0.10 | 0.13 | 0.32 | 0.61 | 1.37 | 2.05 |
| MA(a) | 0.23 | 0.27 | 0.45 | 1.14 | 4.88 | 14.54 | 19.10 |
| BR(ab) | 0.15 | 0.20 | 0.29 | 0.43 | 0.65 | 7.36 | 8.30 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W)$ = 0.04744 | | | | | | | |
| $\Delta$ = -0.10 | | | | | | | |
| 90% CI for $\Delta$ is -0.30 to 0 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W)$ = 0.3.861 | | | | | | | |
| 89% CI for $\gamma^2$ is 0 to 2.4 | | | | | | | |
| LD | 0.07 | 0.12 | 0.29 | 0.47 | 0.70 | 2.20 | 6.73 |
| TD | 0.07 | 0.09 | 0.23 | 0.29 | 0.40 | 1.44 | 1.89 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 12: Comparisons of distributions of Mg

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H')$ = 0.0003*: | | | | | | | |
| BQ(b) | 0.03 | 0.04 | 0.05 | 0.06 | 0.13 | 0.46 | 0.66 |
| RO(a) | 0.12 | 0.13 | 0.27 | 0.38 | 0.94 | 2.51 | 4.30 |
| MA(a) | 0.04 | 0.04 | 0.32 | 0.58 | 1.39 | 4.01 | 7.60 |
| BR(a) | 0.02 | 0.06 | 0.11 | 0.35 | 0.60 | 1.15 | 1.47 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W)$ = 0.21086 | | | | | | | |
| $\Delta$ = -0.06 | | | | | | | |
| 90% CI for $\Delta$ is -0.22 to 0.10 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W)$ = 0.2571 | | | | | | | |
| 89% CI for $\gamma^2$ is 0.6 to 18.1 | | | | | | | |
| LD | 0.04 | 0.05 | 0.13 | 0.28 | 0.45 | 1.33 | 1.47 |
| TD | 0.02 | 0.03 | 0.05 | 0.10 | 0.92 | 1.20 | 1.61 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 13: Comparisons of distributions of K

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H') = 0.0045$*: | | | | | | | |
| BQ(b) | 0.09 | 0.10 | 0.12 | 0.15 | 0.21 | 0.31 | 0.32 |
| RO(a) | 0.15 | 0.16 | 0.21 | 0.28 | 0.34 | 0.45 | 0.49 |
| MA(b) | 0.08 | 0.08 | 0.09 | 0.17 | 0.23 | 0.33 | 0.33 |
| BR(ab) | 0.09 | 0.11 | 0.15 | 0.21 | 0.25 | 0.51 | 0.80 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.12274$ | | | | | | | |
| $\Delta = -0.03$ | | | | | | | |
| 90% CI for $\Delta$ is -0.08 to 0.01 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.9468$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.2 to 3.7 | | | | | | | |
| LD | 0.08 | 0.12 | 0.16 | 0.21 | 0.31 | 0.36 | 0.80 |
| TD | 0.09 | 0.10 | 0.13 | 0.18 | 0.25 | 0.33 | 0.34 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 14: Comparisons of distributions of the sum of Ca, Mg, and K (SBAS)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H') = < 0.0001$*: | | | | | | | |
| BQ(b) | 0.23 | 0.24 | 0.42 | 0.49 | 0.63 | 0.93 | 0.95 |
| RO(a) | 0.54 | 0.56 | 0.79 | 0.95 | 1.66 | 4.44 | 5.40 |
| MA(a) | 0.46 | 0.47 | 1.19 | 1.97 | 5.52 | 18.55 | 20.57 |
| BR(ab) | 0.41 | 0.47 | 0.72 | 0.99 | 1.54 | 8.96 | 9.00 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.0704$ | | | | | | | |
| $\Delta = -0.24$ | | | | | | | |
| 90% CI for $\Delta$ is -0.47 to 0.01 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.9468$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.1 to 5.8 | | | | | | | |
| LD | 0.25 | 0.49 | 0.64 | 0.91 | 1.46 | 3.93 | 9.00 |
| TD | 0.23 | 0.33 | 0.47 | 0.51 | 1.54 | 2.94 | 3.76 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 15: Comparisons of distributions of the cation-exchange capacity determined by the sum of cations (SCEC)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H') = <0.0025$*: | | | | | | | |
| BQ(ab) | 5.20 | 7.07 | 9.98 | 12.43 | 15.74 | 21.87 | 21.97 |
| RO(b) | 4.45 | 4.85 | 5.96 | 9.18 | 10.98 | 16.54 | 16.85 |
| MA(a) | 8.76 | 9.13 | 11.52 | 16.10 | 23.91 | 27.22 | 28.25 |
| BR(a) | 5.77 | 7.13 | 11.29 | 14.16 | 16.69 | 18.92 | 19.47 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.01331$ | | | | | | | |
| $\Delta = -3.00$ | | | | | | | |
| 90% CI for $\Delta$ is -5.2 to -0.7 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.46336$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.4 to 1.6 | | | | | | | |
| LD | 5.96 | 7.75 | 10.27 | 13.93 | 16.74 | 19.72 | 28.25 |
| TD | 5.11 | 5.47 | 8.04 | 11.42 | 13.52 | 14.47 | 15.44 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 16: Comparisons of distributions of the cation-exchange capacity determined by the ammonium acetate, pH 7, method (NHCEC)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg-1$ of soil | | | | | | |
| Geologic formations - $\alpha(H')$ = < 0.0039*: | | | | | | | |
| BQ(ab) | 5.90 | 6.32 | 9.50 | 10.30 | 14.30 | 19.20 | 19.20 |
| RO(b) | 5.90 | 6.20 | 6.80 | 8.00 | 11.90 | 13.30 | 13.30 |
| MA(a) | 8.40 | 8.52 | 11.10 | 14.40 | 17.60 | 20.72 | 23.00 |
| BR(a) | 5.60 | 7.34 | 9.70 | 12.00 | 15.80 | 17.12 | 17.30 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.01613$ | | | | | | | |
| $\Delta = -2.1$ | | | | | | | |
| 90% CI for $\Delta$ is -4.3 to -0.6 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.12520$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.1 to 1.1 | | | | | | | |
| LD | 5.90 | 6.35 | 8.38 | 11.20 | 14.63 | 17.30 | 19.20 |
| TD | 5.60 | 6.32 | 8.50 | 8.90 | 9.90 | 13.64 | 15.80 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 17: Comparisons of distributions of the cation-exchange capacity determined by the sum of SBAS and KCl extractable aluminum (ECEC)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H')$ = < 0.0009*: | | | | | | | |
| BQ(ab) | 2.62 | 3.21 | 4.00 | 5.68 | 6.63 | 9.21 | 11.56 |
| RO(b) | 2.64 | 2.91 | 3.28 | 3.89 | 5.56 | 7.78 | 7.83 |
| MA(a) | 4.09 | 4.47 | 5.75 | 6.72 | 11.12 | 18.63 | 20.62 |
| BR(a) | 2.96 | 4.35 | 5.49 | 6.64 | 9.41 | 10.67 | 10.68 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W)$ = 0.38962 | | | | | | | |
| $\Delta$ = -0.23 | | | | | | | |
| 90% CI for $\Delta$ is -1.33 to -0.86 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W)$ = 0.84148 | | | | | | | |
| 89% CI for $\gamma^2$ is 0.2 to 2.9 | | | | | | | |
| LD | 2.62 | 3.05 | 3.65 | 5.54 | 7.09 | 8.97 | 10.21 |
| TD | 2.96 | 3.27 | 4.00 | 5.44 | 5.84 | 8.85 | 10.66 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 18: Comparisons of distributions of differences between SCEC and ECEC (a gross estimate of the pH-dependent charge)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H')$ = < 0.0459*: | | | | | | | |
| BQ(ab) | 1.13 | 1.96 | 5.88 | 7.18 | 9.87 | 13.41 | 14.39 |
| RO(b) | 0.49 | 1.05 | 2.23 | 5.00 | 6.95 | 10.74 | 11.57 |
| MA(a) | 3.61 | 3.77 | 5.92 | 7.78 | 11.59 | 15.47 | 19.31 |
| BR(a) | -0.07 | 1.27 | 5.08 | 6.01 | 8.29 | 9.30 | 9.35 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W)$ = 0.00094 | | | | | | | |
| $\Delta$ = -2.64 | | | | | | | |
| 90% CI for $\Delta$ is -4.27 to -1.36 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W)$ = 0.38612 | | | | | | | |
| 89% CI for $\gamma^2$ is 0.1 to 1.3 | | | | | | | |
| LD° | 2.86 | 4.76 | 6.33 | 8.00 | 9.61 | 12.92 | 9.31 |
| TD | -0.07 | 0.83 | 4.30 | 5.80 | 6.76 | 8.24 | 9.83 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 19: Comparisons of distributions of base saturation by (SBAS divided by SCEC)100 (SBS)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | | | | % | | | |
| Geologic formations - $\alpha(H') = 0.0001$*: | | | | | | | |
| BQ(b) | 2.30 | 2.33 | 2.67 | 3.48 | 5.86 | 9.42 | 11.43 |
| RO(a) | 5.52 | 6.26 | 7.57 | 13.26 | 23.26 | 45.91 | 58.82 |
| MA(a) | 2.42 | 3.44 | 5.24 | 19.32 | 32.64 | 78.99 | 81.21 |
| BR(a) | 3.30 | 3.99 | 5.05 | 8.72 | 13.64 | 50.51 | 53.51 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.3324$ | | | | | | | |
| $\Delta = -0.72$ | | | | | | | |
| 90% CI for $\Delta$ is -3.54 to 2.94 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.0956$ | | | | | | | |
| 89% CI for $\gamma^2$ is 1.1 to 33.6 | | | | | | | |
| LD | 2.42 | 3.04 | 4.96 | 7.62 | 12.34 | 24.02 | 48.52 |
| TD | 2.30 | 2.65 | 3.48 | 5.10 | 17.16 | 31.23 | 32.64 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 20: Comparisons of distributions of base saturation by (SBAS divided by NHCEC)100 (NHBS)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | | | | % | | | |
| Geologic formations - $\alpha(H') = < 0.0001$*: | | | | | | | |
| BQ(b) | 2.48 | 2.49 | 2.94 | 3.93 | 6.36 | 8.75 | 8.81 |
| RO(a) | 5.64 | 6.23 | 10.60 | 13.57 | 20.11 | 37.15 | 45.38 |
| MA(a) | 3.43 | 4.73 | 7.39 | 15.40 | 43.72 | 90.65 | 92.47 |
| BR(a) | 3.22 | 4.44 | 6.99 | 7.98 | 11.72 | 56.01 | 62.01 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.21851$ | | | | | | | |
| $\Delta = -1.19$ | | | | | | | |
| 90% CI for $\Delta$ is -4.18 to 2.16 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.8415$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.1 to 15.0 | | | | | | | |
| LD | 2.48 | 3.53 | 5.90 | 8.40 | 14.99 | 31.95 | 52.02 |
| TD | 2.50 | 2.94 | 3.93 | 7.32 | 18.12 | 33.78 | 43.72 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 21: Comparisons of distributions of base saturation by (SBAS divided by ECEC)100 (EBS)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | % | | | | | | |
| Geologic formations - $\alpha(H') = 0.0001$*: | | | | | | | |
| BQ(b) | 4.05 | 4.27 | 6.94 | 9.01 | 12.50 | 21.46 | 23.88 |
| RO(a) | 11.24 | 12.82 | 19.84 | 28.35 | 45.08 | 64.94 | 69.68 |
| MA(a) | 6.38 | 8.55 | 13.31 | 31.42 | 78.99 | 99.56 | 99.76 |
| BR(ab) | 4.78 | 6.27 | 13.53 | 16.35 | 22.44 | 89.30 | 97.83 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.08842$ | | | | | | | |
| $\Delta = -4.97$ | | | | | | | |
| 90% CI for $\Delta$ is -11.0 to 0.99 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.5708$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.7 to 22.0 | | | | | | | |
| LD | 6.38 | 8.77 | 12.29 | 19.45 | 28.61 | 63.15 | 97.82 |
| TD | 4.05 | 4.49 | 7.24 | 13.53 | 28.05 | 66.66 | 78.99 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 22: Comparisons of distributions of pH

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | -log $[H^+]$ | | | | | | |
| Geologic formations - $\alpha(H') = 0.0011$*: | | | | | | | |
| BQ(b) | 4.25 | 4.28 | 4.40 | 4.50 | 4.60 | 4.82 | 4.85 |
| RO(a) | 4.55 | 4.57 | 4.66 | 4.83 | 4.95 | 5.08 | 5.11 |
| MA(a) | 4.32 | 4.33 | 4.54 | 4.88 | 5.18 | 6.18 | 7.03 |
| BR(ab) | 4.34 | 4.34 | 4.44 | 4.67 | 4.78 | 5.10 | 5.42 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.40926$ | | | | | | | |
| $\Delta = -0.025$ | | | | | | | |
| 90% CI for $\Delta$ is -0.15 to 0.11 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.31732$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.6 to 6.0 | | | | | | | |
| LD | 4.25 | 4.41 | 4.47 | 4.64 | 4.81 | 5.10 | 5.42 |
| TD | 4.34 | 4.34 | 4.40 | 4.66 | 4.88 | 5.11 | 5.18 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 23: Comparisons of distributions of exchange acidity

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H') = 0.0238$*: | | | | | | | |
| BQ(a) | 4.78 | 6.33 | 9.75 | 11.94 | 15.32 | 21.29 | 21.29 |
| RO(b) | 2.79 | 3.38 | 4.38 | 7.16 | 10.15 | 13.65 | 15.32 |
| MA(ab) | 3.98 | 5.17 | 7.56 | 11.34 | 14.13 | 21.93 | 27.06 |
| BR(a) | 4.78 | 6.33 | 7.76 | 11.74 | 14.13 | 17.08 | 18.51 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.04260$ | | | | | | | |
| $\Delta = -2.37$ | | | | | | | |
| 90% CI for $\Delta$ is -4.97 to 0 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.2571$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.1 to 1.3 | | | | | | | |
| LD | 5.17 | 7.10 | 9.60 | 11.54 | 14.13 | 18.79 | 27.06 |
| TD | 3.98 | 4.22 | 6.37 | 9.75 | 13.13 | 13.97 | 14.93 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 24: Comparisons of distributions of KCl extractable aluminum

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H') = 0.0127$*: | | | | | | | |
| BQ(a) | 2.10 | 2.58 | 3.50 | 4.95 | 6.15 | 8.77 | 11.05 |
| RO(b) | 1.45 | 1.63 | 2.30 | 2.35 | 3.45 | 5.27 | 6.95 |
| MA(ab) | 0.05 | 0.05 | 1.00 | 4.10 | 5.60 | 7.15 | 7.75 |
| BR(a) | 0.20 | 1.13 | 3.95 | 5.05 | 7.85 | 9.61 | 10.15 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.37020$ | | | | | | | |
| $\Delta = 0.20$ | | | | | | | |
| 90% CI for $\Delta$ is -0.95 tp 1.5 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.5485$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.4 to 7.6 | | | | | | | |
| LD | 0.20 | 1.63 | 2.35 | 3.78 | 5.35 | 6.98 | 9.25 |
| TD | 1.00 | 1.42 | 2.55 | 4.25 | 5.45 | 8.41 | 10.15 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 25: Comparisons of distributions of the aluminum saturation of the SCEC (SALSAT)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | | | | % | | | |
| Geologic formations - $\alpha(H') = 0.0209$*: | | | | | | | |
| BQ(a) | 23.65 | 24.13 | 28.55 | 34.63 | 53.62 | 63.10 | 70.19 |
| RO(ab) | 14.38 | 16.96 | 22.31 | 30.65 | 43.51 | 55.12 | 57.73 |
| MA(b) | 0.19 | 0.36 | 8.68 | 27.43 | 37.18 | 40.05 | 42.16 |
| BR(a) | 1.07 | 6.72 | 31.93 | 42.77 | 56.85 | 73.07 | 84.06 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.01331$ | | | | | | | |
| $\Delta = 10.17$ | | | | | | | |
| 90% CI for $\Delta$ is 2.38 to 20.02 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.2053$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.9 to 12.1 | | | | | | | |
| LD | 1.07 | 13.95 | 23.11 | 31.67 | 36.78 | 43.52 | 47.51 |
| TD | 8.68 | 15.12 | 30.65 | 39.82 | 54.61 | 73.07 | 84.06 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 26: Comparisons of distributions of the aluminum saturation of the NHCEC (NHALSAT)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | | | | % | | | |
| Geologic formations - $\alpha(H') = 0.0034$*: | | | | | | | |
| BQ(a) | 25.66 | 28.82 | 35.35 | 40.00 | 55.30 | 63.70 | 70.39 |
| RO(ab) | 19.58 | 19.68 | 22.66 | 33.57 | 38.98 | 46.93 | 52.26 |
| MA(b) | 0.22 | 0.41 | 11.22 | 29.17 | 45.28 | 50.46 | 50.60 |
| BR(a) | 1.15 | 7.75 | 39.71 | 46.47 | 56.06 | 63.38 | 67.08 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.00582$ | | | | | | | |
| $\Delta = 11.34$ | | | | | | | |
| 90% CI for $\Delta$ is 5.32 to 17.02 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 04634$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.7 to 4.8 | | | | | | | |
| LD | 1.16 | 18.75 | 33.12 | 37.04 | 40.73 | 48.36 | 56.06 |
| TD | 11.63 | 16.24 | 35.35 | 50.41 | 54.49 | 66.70 | 70.39 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 27: Comparisons of distributions of the aluminum saturation of the ECEC (EALSAT)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | % | | | | | | |
| Geologic formations - $\alpha(H') = 0.0001$*: | | | | | | | |
| BQ(a) | 76.12 | 78.54 | 87.50 | 90.99 | 93.06 | 95.73 | 95.95 |
| RO(b) | 30.32 | 35.06 | 54.92 | 71.65 | 80.16 | 87.18 | 88.76 |
| MA(b) | 0.24 | 0.44 | 21.01 | 68.58 | 86.69 | 91.47 | 93.62 |
| BR(ab) | 2.17 | 10.70 | 77.56 | 83.65 | 86.47 | 93.73 | 95.22 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.08842$ | | | | | | | |
| $\Delta = 4.97$ | | | | | | | |
| 90% CI for $\Delta$ is -0.99 to 11.45 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.8415$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.1 to 7.5 | | | | | | | |
| LD | 2.17 | 36.85 | 71.39 | 80.54 | 87.71 | 91.23 | 93.62 |
| TD | 21.01 | 33.34 | 71.95 | 86.47 | 92.76 | 95.51 | 95.95 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 28: Comparisons of distributions of sand in the particle-size control section

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | g $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H')$ = 0.5088*: | | | | | | | |
| BQ(a) | 145 | 156 | 204 | 257 | 350 | 430 | 513 |
| RO(a) | 34 | 77 | 137 | 218 | 266 | 388 | 497 |
| MA(a) | 111 | 121 | 157 | 182 | 368 | 434 | 465 |
| BR(a) | 90 | 92 | 120 | 210 | 328 | 369 | 398 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W)$ = 0.22226 | | | | | | | |
| $\Delta$ = 2.5 | | | | | | | |
| 90% CI for $\Delta$ is -2.7 to 7.8 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W)$ = 0.9468 | | | | | | | |
| 89% CI for $\gamma^2$ is 0.5 to 3.7 | | | | | | | |
| LD | 105 | 136 | 178 | 232 | 312 | 378 | 497 |
| TD | 94 | 125 | 199 | 269 | 350 | 370 | 398 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 29: Comparisons of distributions of silt in the particle-size control section

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | g $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H')$ = 0.0024*: | | | | | | | |
| BQ(b) | 294 | 347 | 425 | 472 | 518 | 568 | 607 |
| RO(a) | 390 | 397 | 523 | 601 | 655 | 715 | 723 |
| MA(b) | 340 | 352 | 431 | 509 | 548 | 562 | 563 |
| BR(ab) | 425 | 435 | 469 | 550 | 580 | 682 | 732 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.23775$ | | | | | | | |
| $\Delta = -2.5$ | | | | | | | |
| 90% CI for $\Delta$ is -7.0 to 2.8 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.0532$ | | | | | | | |
| 89% CI for $\gamma^2$ is 1.1 to 5.8 | | | | | | | |
| LD | 390 | 439 | 478 | 531 | 588 | 656 | 723 |
| TD | 409 | 419 | 442 | 508 | 589 | 657 | 732 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 30: Comparisons of distributions of clay in the particle-size control section

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | g $kg^{-1}$ of soil | | | | | | |
| Geologic formations - $\alpha(H') = 0.0061$*: | | | | | | | |
| BQ(a) | 176 | 177 | 223 | 252 | 319 | 361 | 361 |
| RO(b) | 113 | 121 | 140 | 173 | 210 | 396 | 564 |
| MA(a) | 123 | 136 | 195 | 266 | 344 | 395 | 430 |
| BR(ab) | 160 | 166 | 199 | 224 | 266 | 355 | 392 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.47967$ | | | | | | | |
| $\Delta = -0.15$ | | | | | | | |
| 90% CI for $\Delta$ is -3.2 t0 3.6 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.2571$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.1 to 1.8 | | | | | | | |
| LD | 113 | 138 | 164 | 218 | 265 | 285 | 344 |
| TD | 130 | 148 | 178 | 212 | 248 | 295 | 339 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 31: Comparisons of distributions of the ratio of the ECEC to clay (ECECLAY)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of clay | | | | | | |
| Geologic formations - $\alpha(H') = 0.0063$*: | | | | | | | |
| BQ(b) | 10.87 | 12.50 | 15.88 | 19.56 | 25.47 | 42.98 | 43.07 |
| RO(ab) | 9.85 | 13.10 | 17.48 | 22.07 | 28.70 | 47.75 | 54.42 |
| MA(a) | 19.02 | 20.18 | 23.27 | 29.54 | 46.34 | 55.49 | 66.80 |
| BR(a) | 17.01 | 20.09 | 27.43 | 31.26 | 35.52 | 42.28 | 45.58 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.36064$ | | | | | | | |
| $\Delta = -1.12$ | | | | | | | |
| 90% CI for $\Delta$ is -6.0 to 3.8 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.9468$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.4 to 3.3 | | | | | | | |
| LD | 10.87 | 15.09 | 18.74 | 25.07 | 34.46 | 46.39 | 54.42 |
| TD | 16.13 | 16.39 | 19.02 | 24.66 | 29.35 | 41.21 | 42.92 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 32: Comparisons of distributions of the ratio of the NHCEC to clay (NHCECLAY)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of clay | | | | | | |
| Geologic formations - α(H′) = 0.1240*: | | | | | | | |
| BQ(a) | 24.48 | 30.29 | 34.20 | 39.61 | 53.19 | 82.95 | 109.09 |
| RO(a) | 23.58 | 29.55 | 40.95 | 46.43 | 55.94 | 82.36 | 106.20 |
| MA(a) | 38.36 | 38.71 | 44.56 | 50.70 | 71.81 | 94.70 | 101.38 |
| BR(a) | 30.61 | 31.56 | 42.92 | 50.00 | 64.12 | 76.27 | 80.19 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.02075$ | | | | | | | |
| $\Delta = -8.0$ | | | | | | | |
| 90% CI for Δ is -15.7 to -1.9 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.2571$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.1 to 1.6 | | | | | | | |
| LD | 24.48 | 34.11 | 44.01 | 50.35 | 66.48 | 101.86 | 109.09 |
| TD | 32.18 | 34.47 | 38.36 | 41.26 | 52.31 | 58.48 | 59.40 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 33: Comparisons of distributions of the ratio of the SCEC to clay (SCECLAY)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | cmol (+) $kg^{-1}$ of clay | | | | | | |
| Geologic formations - $\alpha(H') = 0.0592$*: | | | | | | | |
| BQ(b) | 26.05 | 26.59 | 37.74 | 44.75 | 60.39 | 95.50 | 124.83 |
| RO(ab) | 18.72 | 23.80 | 39.31 | 45.85 | 64.87 | 112.79 | 144.60 |
| MA(a) | 40.74 | 45.13 | 52.15 | 59.69 | 81.78 | 104.78 | 113.17 |
| BR(a) | 27.22 | 32.56 | 46.21 | 58.74 | 71.62 | 82.80 | 86.92 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.01331$ | | | | | | | |
| $\Delta = -13.68$ | | | | | | | |
| 90% CI for $\Delta$ is -26.32 to -3.79 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.1615$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.1 to 1.1 | | | | | | | |
| LD | 36.85 | 42.09 | 46.74 | 61.71 | 85.20 | 114.34 | 144.60 |
| TD | 27.19 | 27.21 | 40.74 | 49.33 | 59.69 | 72.72 | 75.96 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 34: Comparisons of distributions of quartz in the sand fraction of the mineralogical control section (SQTZ)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | g $kg^{-1}$ of sand | | | | | | |
| Geologic formations - α(H′) = 0.0002*: | | | | | | | |
| BQ(a) | 550 | 676 | 860 | 900 | 980 | 1000 | 1000 |
| RO(b) | 500 | 542 | 600 | 640 | 720 | 866 | 890 |
| MA(a) | 380 | 536 | 770 | 900 | 970 | 1000 | 1000 |
| BR(a) | 590 | 716 | 810 | 910 | 970 | 988 | 1000 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.25757$ | | | | | | | |
| $\Delta = 20.0$ | | | | | | | |
| 90% CI for Δ is -60.0 to 100.0 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.2053$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.8 to 43.1 | | | | | | | |
| LD | 380 | 590 | 645 | 835 | 908 | 971 | 1000 |
| TD | 0 | 330 | 590 | 890 | 980 | 1000 | 1000 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 35: Comparisons of distributions of quartz in the silt fraction of the mineralogical control section (SIQTZ)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | g $kg^{-1}$ of silt | | | | | | |
| Geologic formations - $\alpha(H') = 0.3896$*: | | | | | | | |
| BQ(a) | 500 | 512 | 590 | 680 | 770 | 818 | 830 |
| RO(a) | 530 | 536 | 590 | 640 | 700 | 844 | 910 |
| MA(a) | 380 | 476 | 610 | 760 | 810 | 818 | 830 |
| BR(a) | 460 | 490 | 590 | 690 | 780 | 834 | 840 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.16294$ | | | | | | | |
| $\Delta = -40.0$ | | | | | | | |
| 90% CI for $\Delta$ is -100.0 to 30.0 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.3861$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.6 to 11.2 | | | | | | | |
| LD | 460 | 539 | 605 | 690 | 795 | 812 | 830 |
| TD | 500 | 506 | 550 | 670 | 770 | 824 | 830 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 36: Comparisons of distributions of mica in the sand fraction of the mineralogical control section (SMICA)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | g $kg^{-1}$ of sand | | | | | | |
| Geologic formations - $\alpha(H')$ = 0.4092*: | | | | | | | |
| BQ(a) | 0 | 0 | 0 | 30 | 60 | 212 | 380 |
| RO(a) | 0 | 0 | 0 | 80 | 100 | 200 | 230 |
| MA(a) | 0 | 0 | 0 | 70 | 100 | 264 | 450 |
| BR(a) | 0 | 12 | 30 | 60 | 90 | 202 | 280 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W)$ = 0.38877 | | | | | | | |
| $\Delta$ = 0 | | | | | | | |
| 90% CI for $\Delta$ is -30.0 to 20.0 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W)$ = 0.4232 | | | | | | | |
| 89% CI for $\gamma^2$ is 0.2 to 9.2 | | | | | | | |
| LD | 0 | 0 | 15 | 60 | 90 | 114 | 450 |
| TD | 0 | 0 | 20 | 50 | 80 | 320 | 380 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 37: Comparisons of distributions of mica in the silt fraction of the mineralogical control section (SIMICA)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | | | | g $kg^{-1}$ of silt | | | |
| Geologic formations - $\alpha(H') = 0.0011$*: | | | | | | | |
| BQ(ab) | 0 | 0 | 30 | 70 | 100 | 190 | 190 |
| RO(b) | 0 | 0 | 10 | 30 | 60 | 90 | 90 |
| MA(ab) | 30 | 30 | 40 | 70 | 120 | 174 | 180 |
| BR(a) | 0 | 24 | 80 | 110 | 190 | 258 | 300 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.16884$ | | | | | | | |
| $\Delta = 10.0$ | | | | | | | |
| 90% CI for $\Delta$ is -20.0 to 40.0 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.5485$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0 to 3.8 | | | | | | | |
| LD | 0 | 0 | 30 | 65 | 120 | 181 | 230 |
| TD | 30 | 36 | 50 | 70 | 100 | 234 | 300 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 38: Comparisons of distributions of feldspar in the sand fraction of the mineralogical control section (SFLD)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | g $kg^{-1}$ of sand | | | | | | |
| Geologic formations - $\alpha(H')$ = < 0.0001*: | | | | | | | |
| BQ(b) | 0 | 0 | 0 | 60 | 90 | 124 | 130 |
| RO(a) | 0 | 66 | 200 | 260 | 300 | 360 | 360 |
| MA(b) | 0 | 0 | 0 | 30 | 50 | 174 | 210 |
| BR(b) | 0 | 0 | 0 | 30 | 60 | 90 | 90 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W)$ = 0.00922 | | | | | | | |
| $\Delta$ = -50.0 | | | | | | | |
| 90% CI for $\Delta$ is -80.0 to 0 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W)$ = 0.0945 | | | | | | | |
| 89% CI for $\gamma^2$ is 0 to 0.7 | | | | | | | |
| LD | 0 | 0 | 10 | 60 | 260 | 320 | 360 |
| TD | 0 | 0 | 0 | 0 | 60 | 200 | 200 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Table 39: Comparisons of distributions of feldspar in the silt fraction of the mineralogical control section (SIFLD)

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | g $kg^{-1}$ of silt | | | | | | |
| Geologic formations - α(H′) = < 0.0001*: | | | | | | | |
| BQ(b) | 0 | 24 | 100 | 110 | 140 | 180 | 210 |
| RO(a) | 0 | 10 | 220 | 280 | 370 | 430 | 460 |
| MA(b) | 0 | 0 | 100 | 110 | 140 | 340 | 370 |
| BR(b) | 0 | 0 | 40 | 90 | 130 | 208 | 250 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W)$ = 0.27424 | | | | | | | |
| Δ = -30.0 | | | | | | | |
| 90% CI for Δ is -90.0 to 30.0 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W)$ = 0.2053 | | | | | | | |
| 89% CI for $\gamma^2$ is 0.7 to 4.7 | | | | | | | |
| LD | 0 | 36 | 100 | 130 | 235 | 365 | 460 |
| TD | 0 | 0 | 50 | 130 | 210 | 370 | 370 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Upland oak site index distributions (Table 40 and Figure 2) were significantly different at the 5 percent level of probability for soils developed from these parent materials. Soils developed from rocks of the Rome-Waynesboro and Martinsburg and Athens formations have higher median values than soils developed from rocks of the Chilhowee group and the Millboro, Brallier, and Chemung formation.

A scatter plot (Figure 3) shows no discernible influence of aspect on site index of upland oak growing on soils developed from these parent materials. Slopes for the study sites ranged from 4 to 81 percent. Stage (1976) pointed out the necessity of having slopes of all plots the same in order to access the influence of aspect on site index. Lower slope gradients supply little information on the influence of aspect on tree growth. Since data in this study were collected from a wide range of slopes, they are not appropriate for the evaluation of the influence of aspect n upland oak site index.

Table 40: Comparisons of distributions of site indices for upland oaks

| | Quantiles | | | | | | |
|---|---|---|---|---|---|---|---|
| | Min | 10% | 25% | Med | 75% | 90% | Max |
| | height in feet at age 50 years | | | | | | |
| Geologic formations - $\alpha(H') = 0.0433$*: | | | | | | | |
| BQ(a) | 35 | 37 | 49 | 52 | 59 | 62 | 64 |
| RO(a) | 45 | 46 | 54 | 58 | 64 | 73 | 77 |
| MA(a) | 43 | 47 | 55 | 60 | 65 | 72 | 72 |
| BR(a) | 37 | 39 | 43 | 52 | 61 | 71 | 76 |
| Lithic (LD) and Typic (TD) Dystrochrepts@: | | | | | | | |
| Rank sum test (Wilcoxon): | | | | | | | |
| $\alpha(W) = 0.15530$ | | | | | | | |
| $\Delta = -4.0$ | | | | | | | |
| 90% CI for $\Delta$ is -8.0 to 2.0 | | | | | | | |
| Ranklike test (Moses) | | | | | | | |
| $2\alpha(W) = 0.6098$ | | | | | | | |
| 89% CI for $\gamma^2$ is 0.1 to 1.8 | | | | | | | |
| LD | 37 | 40 | 50 | 56 | 60 | 66 | 68 |
| TD | 35 | 38 | 45 | 52 | 60 | 63 | 63 |

*See "Materials and Methods" for definitions of BQ, RO, MA, and BR. Formations with the same letter in parenthesis are not significantly different at the 10 percent level of probability.
@All geologic formations.

Figure 2: Plot of upland oak site index for soils derived from parent materials BQ, RO, MA, and BR.

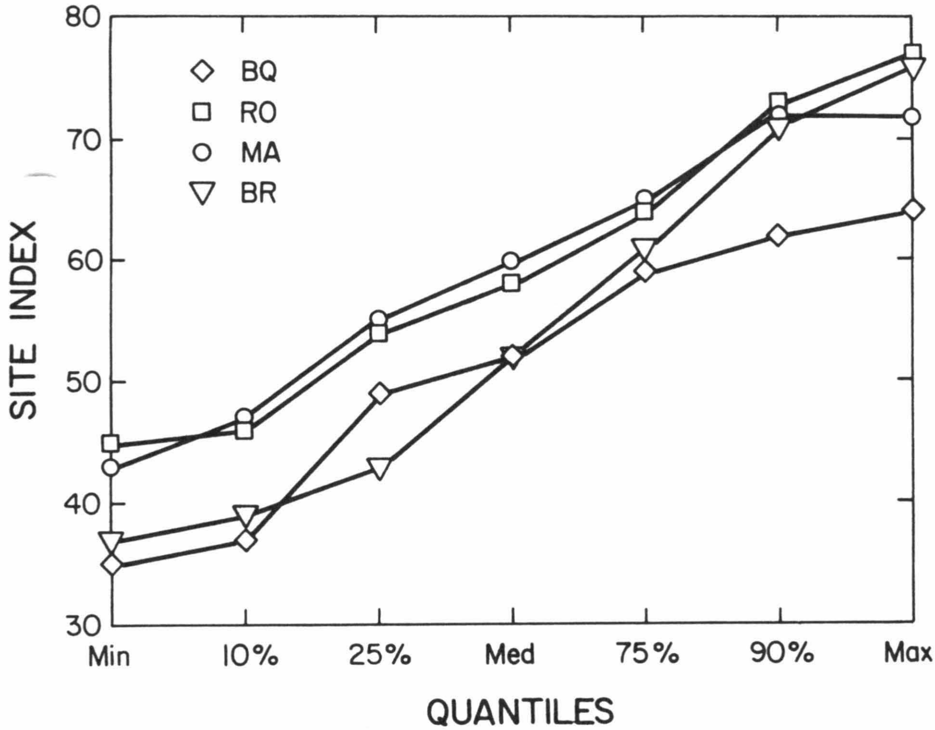
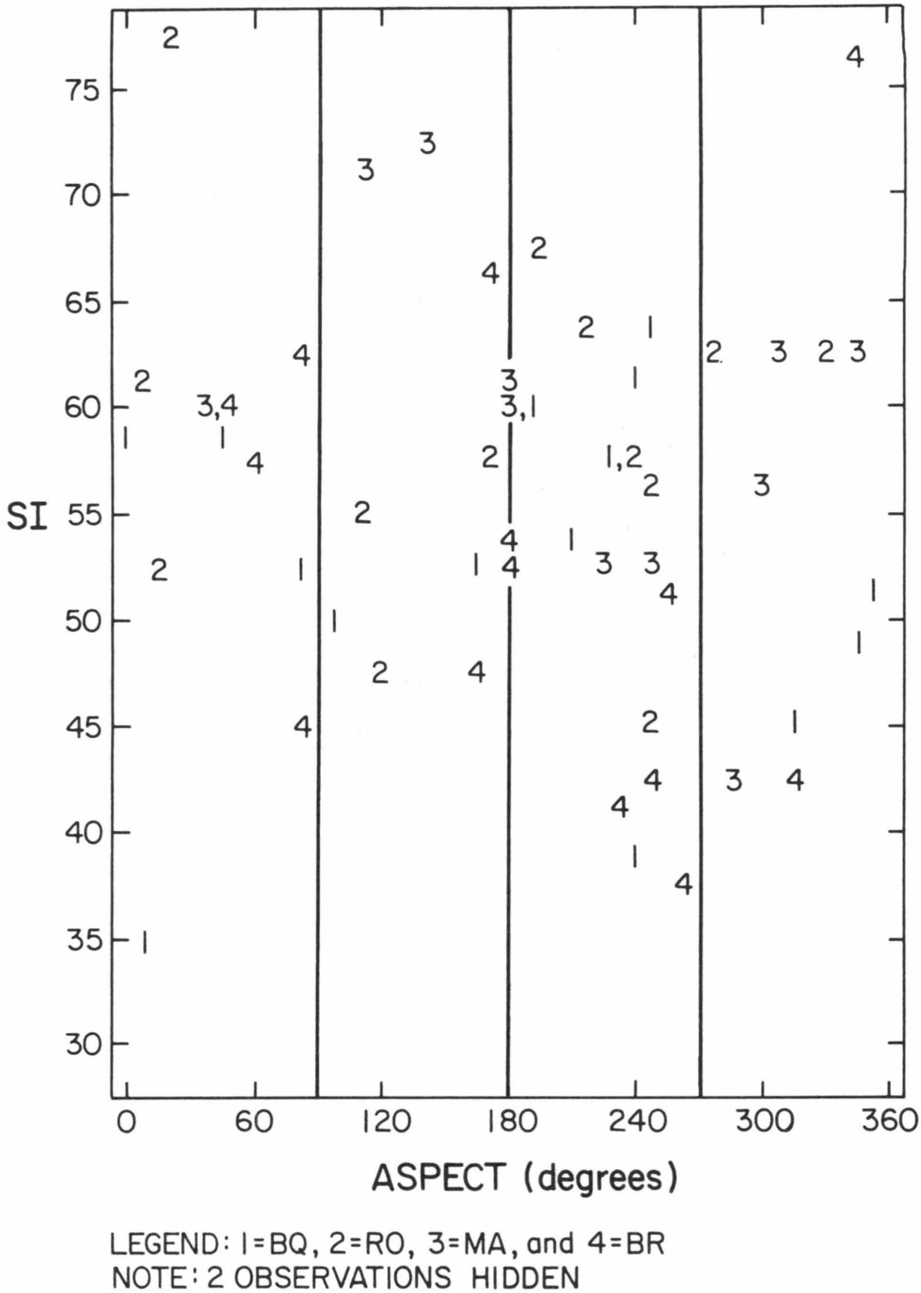


Figure 3: Plot of site index vs. aspect for soils derived from parent materials BQ, RO, MA, and BR.



# *Lithic and Typic Dystrochrepts.*

P-values associated with the Wilcoxon W-statistic, median shifts ($\Delta$), 90 percent confidence intervals for $\Delta$, p-values associated with the Moses ranklike test, 89 percent confidence intervals for $\gamma^2$, and quantiles for the soil and site properties associated with soils classified as members of the loamy-skeletal, mixed, mesic families of Lithic and Typic Dystrochrepts are given in Tables 7 through 40.

P-values associated with the Moses ranklike test indicate that all the soil and site properties studied, except for AH2O, have similar dispersions. Therefore, we assume that the distribution-free Wilcoxon rank sum test is an appropriate procedure for evaluating differences between groups of soils classified as members of loamy-skeletal, mixed, mesic families of Lithic and Typic Dystrochrepts for all soil and site properties except for AH2O.

Soil and site properties that did not differ significantly at the 10 percent level of probability among groups of soils classified as members of loamy-skeletal, mixed, mesic families of Lithic and Typic Dystrochrepts were slope (Table 7), $Mg^{2+}$ (Table 12), $K^+$ (Table 13), ECEC (Table 17), SBS (Table 19), NHBS (Table 20), pH (Table 22), $Al^{3+}$ (Table 24), sand (Table 28), silt (Table 29), clay (Table 30), ratio of ECEC to clay (Table 31), SQTZ (Table 34), SIQTZ (Table 35), SMICA (Table 36), SIMICA (Table 37), SIFLD (Table 39), and site index for upland oak (Table 40).

Soil properties with significantly larger values for soils classified as members of Typic than for Lithic Dystrochrepts were DTC (Table 8), DTR (Table 9), AH2O (Table 10), SALSAT (Table 25), NHALSAT (Table 26) and EALSAT (Table 27).

Soil properties with larger values for Lithic than for Typic Dystrochrepts were $Ca^{2+}$ (Table 11), SBAS (Table 14), SCEC (Table 15), NHCEC (Table 16), difference between SCEC and ECEC (Table 18), EBS (Table 21), $H^+$ (Table 23), NHCECLAY (Table 32), SCECLAY (Table 33), and SFLD (Table 38).

These results indicate that soils classified as members of Typic Dystrochrepts are deeper by virtue of their definition, have larger available-water capacities, and have higher degrees of exchangeable $Al^{3+}$ saturation of their cation-exchange capacities (SCEC, NHCEC, and ECEC) than do soils classified as members of Lithic Dystrochrepts. Conversely, soils classified as members of Lithic Dystrochrepts have more exchangeable $Ca^{2+}$; more exchangeable bases, higher cation-exchange capacities (SCEC and NHCEC); more pH-dependent charge; more exchange acidity; higher ratios of the cation-exchange capacities by the $NH_4OAc$, pH 7, method, and by sum of cations to clay; they also have more feldspar in their sand fractions. Therefore, we conclude that soils classified as members of Typic Dystrochrepts are considerably more mature than soils classified as Lithic Dystrochrepts.

Figure 4 is a plot of the quantile distributions of site index for upland oak growing on soils classified as Lithic and Typic Dystrochrepts. Note the almost complete overlap of the these distributions and that Lithic Dystrochrepts almost always have insignificant, but slightly higher site indices than do soils classified as Typic Dystrochrepts. A possible explanation for these results could be that the well distributed rainfall pattern for the study area (Table 3B) decreases the influence of differences in available-water capacity on tree growth. Trees growing on these soils are moisture stressed about the same time because of limited capillary rise of soil moisture due to the close proximity of bed rock to the soil surface. Therefore, the higher exchangeable $Ca^{2+}$ and lower exchangeable $Al^{3+}$ saturation of the cation-exchange capacity determined by the sum of cations for soils classified as members of Lithic Dystrochrepts could explain the slightly higher site index for upland oak growing on these soils. Also, the higher feldspar in the sand fraction of soils classified as members of Lithic Dystrochrepts could weather over the life of a forest to provide more plant nutrients. The higher exchange acidity may not adversely influence tree growth since it appears to be a residual effect of the laboratory procedure resulting primarily from a higher pH-dependent charge.

A scatter plot (Figure 5) shows no discernible influence of aspect on site index of upland oak for soils classified as members of the loamy-skeletal, mixed, mesic families of Lithic and Typic Dystrochrepts. Slopes for the study sites ranged from 7 to 81 percent. Stage (1976) pointed out the necessity of having slopes of all plots the same in order to access the influence of aspect on site index. Lower slope gradients supply little information on the influence of aspect on tree growth. Since data in this study were collected from a wide range of slopes, they are not appropriate for the evaluation of the influence of aspect on upland oak site index.

Quantile distributions of these soil properties reveal considerable overlap. Therefore, mutually-exclusive classes were not produced by arraying these soils according to the taxonomic criteria for Lithic and Typic Dystrochrepts. The only property that produced mutually-exclusive classes was depth to bedrock, imposed by the criteria of classification.

Figure 4: Plot of upland oak site index for soils classified as members of Lithic (L) and Typic (T) Dystrochrepts.

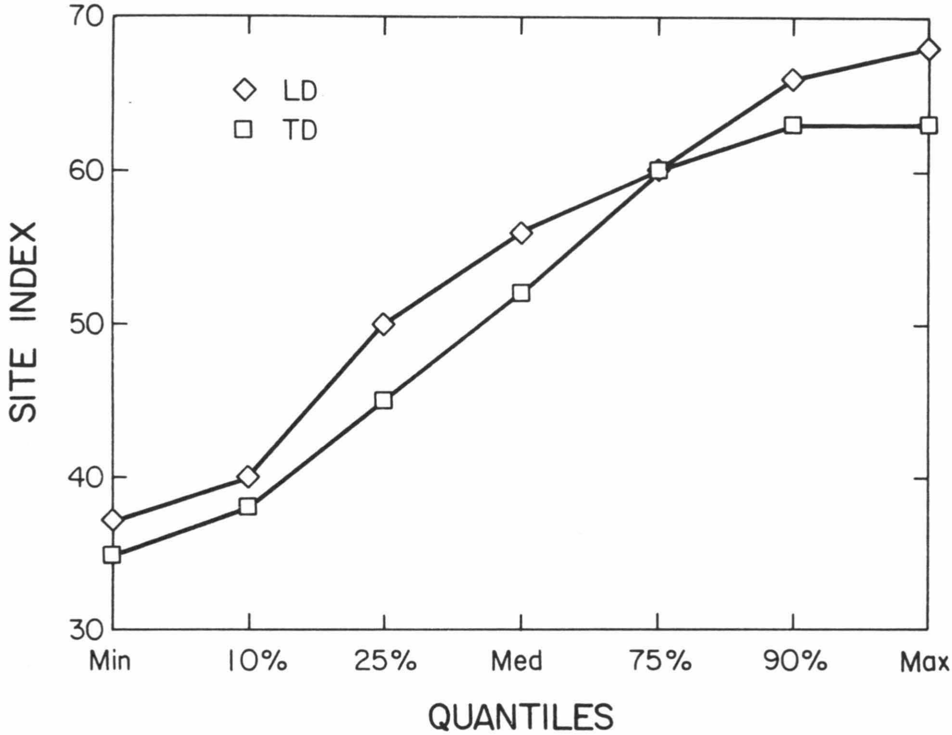
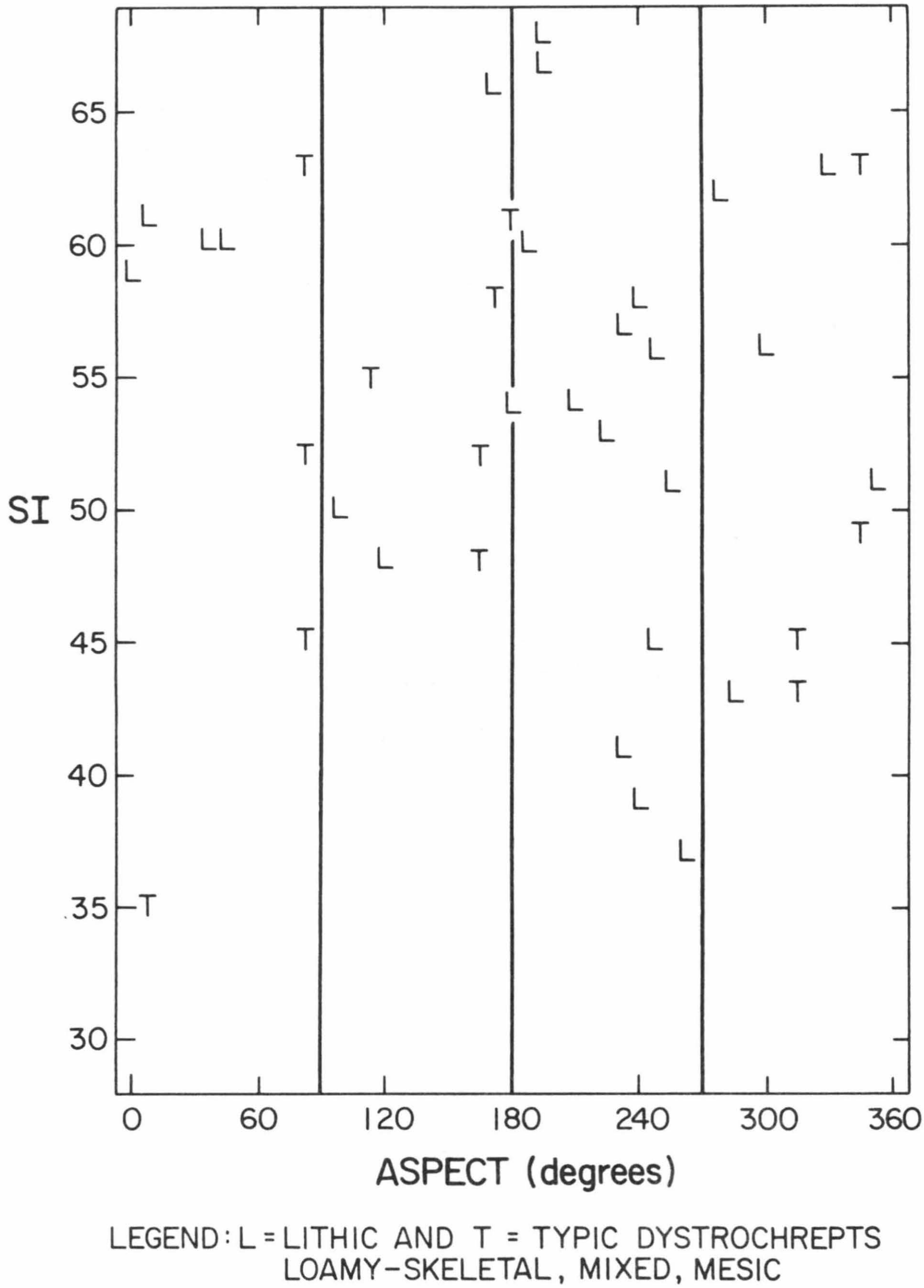


Figure 5: Plot of site index vs. aspect for soils classified as members of Lithic (L) and Typic (T) Dystrochrepts.



# *Multivariate statistical analysis*

Multivariate statistical methods are heuristic and assume normality of the data. As shown by the p-values associated with the Shapiro-Wilk W-statistic (Tables 5 and 6), there is sufficient evidence to suspect that numerous properties of the soils developed from these parent materials are nonnormal. Lebart et al. (1984) suggest the use of nonparametric methods for multivariate analysis when the data are very heterogeneous and nonnormal, such as the data for these soils. Therefore, ranks of the data were used for all multivariate analysis.

## Principal component analysis

*Soil Taxonomy* (Soil Survey Staff, 1975) was tailored to the limitation of the human mind that prevents it from considering more than a few things simultaneously (Smith, 1963). Current computer programs provide techniques that can break down this barrier. Principal component analysis can be used to study relationships between numerous soil individuals on the basis of several properties considered simultaneously.

Principal component analysis simplifies the description of a set of interrelated or correlated soil properties (Afifi and Clark, 1984). Specific soil properties used to developed the principal components in this study were ranks of the values for pH, $Ca^{2+}$, $Mg^{2+}$ , $K^{+}$, NHBS, NHALSAT, silt, clay, SQTZ, and SFLD. Interrelationships or correlations among these properties are reported in Table 41. For example, pH is highly correlated with $Ca^{2+}$, $Mg^{2+}$, NHBS, and NHALSAT. Principal component analysis is a technique for transforming these correlated soil properties into new, uncorrelated variables called principal components or eigenvectors (Table 42). Each principal component is a linear combination of the ranked data values for the 10 soil properties listed above.

One measure of the amount of information conveyed by each principal component is its variance, estimated by the proportion of its eigenvalue to the total number of eigenvectors (Table 42). The proportion of each eigenvalue decreases from principal component 1 (PRIN1) through 10 (PRIN10). This means that principal component 1 is the most informative, and principal component 10 is the least informative. Therefore, principal components can be used to reduce the dimensionality of a data set; i.e., reduce the number of variables without losing much of the information or variance in the original data. For example, a two-dimensional plot of the principal component scores for the first two principal components in this study (Figure 8A) accounts for a cumulative proportion of 0.608316 (Table 42) or about 60 percent of the total variance in the original 10 soil properties. Final communality estimates by factor analysis (Table 43) indicate that exchangeable $K^{+}$, silt, and clay are not well accounted for by these principal components. Therefore, these soil properties are not as important as the others for differentiating the soil profiles developed from these parent materials. Principal components developed after the elimination of these soil properties will be discussed later.

Coefficients or loading values associated with each soil characteristic for each principal component are given in Table 44. The magnitude and sign of these coefficients indicate the contribution of a specific soil property to the variance expressed by a given principal component. Contributions of the soil properties to principal component 1 are shown graphically by Figure 6 and to principal component 2 by Figure 7. These loading values can be used to select differentiae for defining groups of soils, possibly soil series.

Principal component scores (Tables 45A and 45B) represent the sum of specific values for the properties of a given soil profile; e.g., RB1BQ, times the specific coefficients for the properties (Table 44). The principal component score for profile RB1BQ for principal component 1 is -2.4367 and for RB2BQ is -2.6889. Using these principal component scores, the soil profiles can be ordinated in multidimensional character space.

Ordination of the soil profiles in the first two dimensions of the character space are shown graphically in Figure 8A. Using this scatter plot, we can study relationships among soil profiles developed from the parent materials to see if any of the resulting groups correspond to soils developed from specific parent materials. The most obvious feature of this scatter plot is the concentration of soil profiles labelled as 2 (developed from rocks of the Rome-Waynesboro formation) located in the upper left quadrant and the concentration of soil profiles labelled as 3 (developed from the Athens and Martinsburg formations) located in the upper right quadrant. Soil profiles primarily labelled as 1 (developed from rocks of the Chilhowee group) and as 4 (developed from the Millboro, Brallier, and Chemung formations) form an intermingled group in the lower part of the plot. Since both principal components represent linear combinations of all 10 soil properties, we must resort to the magnitude and sign of the coefficients or loading values for each variable for each principal component in order to determine which variables actually separate these groups of soil profiles.

Soil properties that contribute to the separation of the soil profiles in the first dimension (PRIN1) are primarily chemical (Table 44 and Figure 6). pH, $Ca^{2+}$, $Mg^{2+}$, $K^{+}$, and NHBS contribute to the separation of the soil profiles in the positive direction, and NHALSAT contributes in the negative direction. Therefore, soils developed from rocks of the Rome-Waynesboro, Athens, and Martinsburg formations are separated for soils developed from rocks of the Chilhowee group and the Millboro, Brallier, and Chemung formations on the basis of more exchangeable plant nutrients and less $Al^{3+}$ saturation.

Soil properties that contribute to the separation of the soil profiles in the second dimension (PRIN2) are primarily texture and mineralogy (Table 44 and Figure 7) with moderate contributions by $Ca^{2+}$ and $K^{+}$ . $Ca^{2+}$, clay, and SQTZ contribute to the separation in the positive direction of the second principal component and SIFLD, and SFLD contribute in the negative direction. Thus, soils developed from the Rome-Waynesboro formation can be separated from soils developed from the Athens and Martinsburg formation on the basis of more silt and feldspar in the sand fraction and less $Ca^{2+}$, clay, and quartz in the sand fraction.

Soils developed from rocks of the Chilhowee group and from the Millboro, Brallier, and Chemung formations are so intermingled in the lower part of the plot that no discernible differences are revealed by these two dimensions. However, soils developed from these parent materials may be separated within other dimensions of the character space.

Deletion of the soil properties with low final communality estimates - i.e., $K^+$, silt, and clay - increases the communality estimates as well as the amount of the total variance in the seven soil properties explained by the first two principal components (Table 43). These increases are primarily the result of the reduction in the number of dimensions of the character space. A plot of the first two principal components based on the seven soil properties is shown in Figure 8B. Positions of the soil profiles and the directions of the contributions by the soil properties has remained essentially the same as for the principal components based on the ten soil properties. However, the magnitude of the contributions of the soils properties has generally increased (Table 43).

If we review the results of individual Kruskal-Wallis tests, we can also show, for example, that soils developed from rocks of the Rome-Waynesboro formation have more $K^+$ (Table 13), less $Ca^{2+}$ (Table 11), more silt (Table 29), less clay (Table 30), more SFLD (Table 38), and less SQTZ (Table 34) than soils developed from the other parent materials. However, we also see that there is considerable overlap in the quantile distributions of these soil properties. Thus, none of the soil properties studied provide a differentia for separating mutually exclusive classes or groups of soils, and we are not even sure that groups actually exist when soil properties are analyzed one at a time. By resorting to principal component analysis, which evaluates all the soil properties considered simultaneously, we can show that natural classes or groups of soil profiles do exist a conclusion that was known intuitively by the soil surveyors that mapped Montgomery County in the 1960s and the soil surveyors in the counties encompassed by this study. These groups of soil profiles are differentiated by the interrelationships of all the characteristics considered.

Table 41: Correlations of the variables used to calculate principal components

| | pH | $Ca^{2+}$ | $Mg^{2+}$ | $K^{+}$ | NHBS |
|---|---|---|---|---|---|
| | | | r | | |
| pH | 1.0000 | 0.5114 | 0.7490 | 0.2435 | 0.8875 |
| $Ca^{2+}$ | 0.5114 | 1.0000 | 0.4777 | 0.0408 | 0.7206 |
| $Mg^{2+}$ | 0.7490 | 0.4777 | 1.0000 | 0.3814 | 0.8153 |
| $K^{+}$ | 0.2435 | 0.0408 | 0.3814 | 1.0000 | 0.2372 |
| NHBS | 0.8875 | 0.7206 | 0.8153 | 0.2372 | 1.0000 |
| NHALSAT | -0.6627 | -0.5331 | -0.5377 | -0.1970 | -0.6754 |
| Silt | 0.1021 | -0.1259 | 0.0010 | 0.0927 | 0.1221 |
| Clay | -0.1642 | -0.0362 | -0.0722 | -0.3005 | -0.2451 |
| SQTZ | -0.2458 | 0.0213 | -0.0641 | -0.2287 | -0.2730 |
| SFLD | 0.2770 | -0.0862 | 0.1491 | 0.2514 | 0.2499 |

| | NHALSAT | Silt | Clay | SQTZ | SFLD |
|---|---|---|---|---|---|
| | | | r | | |
| pH | -0.6627 | 0.1021 | -0.1642 | -0.2458 | 0.2770 |
| $Ca^{2+}$ | -0.5331 | -0.1259 | -0.0362 | 0.0213 | -0.0862 |
| $Mg^{2+}$ | -0.5377 | 0.0010 | -0.0722 | -0.2641 | 0.1491 |
| $K^{+}$ | -0.1970 | 0.0927 | -0.3005 | -0.2287 | 0.2514 |
| NHBS | -0.6754 | 0.1221 | -0.2451 | -0.2730 | 0.2499 |
| NHALSAT | 1.0000 | 0.0004 | 0.1049 | 0.3282 | -0.3994 |
| Silt | 0.0004 | 1.0000 | -0.2586 | -0.2012 | 0.2694 |
| Clay | 0.1049 | -0.2586 | 1.0000 | 0.2833 | -0.3916 |
| SQTZ | 0.3282 | -0.2012 | 0.2833 | 1.0000 | -0.7136 |
| SFLD | -0.3994 | 0.2694 | -0.3916 | -0.7136 | 1.0000 |

Table 42: Proportions of the variance contributed by the principal components

| Eigen-vector | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| PRIN1 | 4.082400 | 2.081642 | 0.408240 | 0.408240 |
| PRIN2 | 2.000758 | 1.032611 | 0.200076 | 0.608316 |
| PRIN3 | 0.968147 | 0.059294 | 0.096815 | 0.705130 |
| PRIN4 | 0.908853 | 0.174868 | 0.090885 | 0.796016 |
| PRIN5 | 0.733985 | 0.268205 | 0.073399 | 0.869414 |
| PRIN6 | 0.465780 | 0.063249 | 0.046578 | 0.915992 |
| PRIN7 | 0.402532 | 0.175857 | 0.040253 | 0.956245 |
| PRIN8 | 0.226675 | 0.052732 | 0.022667 | 0.978913 |
| PRIN9 | 0.173942 | 0.137012 | 0.017394 | 0.996307 |
| PRIN10 | 0.036930 | --- | 0.003693 | 1.000000 |

Table 43: Final and total communality estimates for the first two principal components developed using different sets of soil properties

| | Principal component | |
|---|---|---|
| Property | Model 1 | Model 2 |
| | Final communality | |
| pH | 0.805817 | 0.813618 |
| $Ca^{2+}$ | 0.684745 | 0.699588 |
| $Mg^{2+}$ | 0.727194 | 0.713679 |
| $K^{+}$ | 0.253431 | Not used |
| NHBS | 0.925532 | 0.937206 |
| NHALSAT | 0.641782 | 0.672326 |
| Silt | 0.277903 | Not used |
| Clay | 0.395867 | Not used |
| SQTZ | 0.627049 | 0.813122 |
| SFLD | 0.743837 | 0.862880 |
| Total communality | 6.083158 | 5.512418 |
| Percent of total variance explained | 60.84158 | 78.74883 |

Table 44: Loading values for the variables onto the principal components

| | PRIN1 | PRIN2 | PRIN3 | PRIN4 | PRIN5 |
|---|---|---|---|---|---|
| pH | 0.43383 | 0.13681 | 0.02031 | 0.10515 | 0.13344 |
| $Ca^{2+}$ | 0.30353 | 0.39275 | 0.01498 | 0.16124 | -0.34605 |
| $Mg^{2+}$ | 0.40423 | 0.17334 | 0.12520 | -0.16274 | 0.31061 |
| $K^{+}$ | 0.20452 | -0.20325 | 0.55178 | -0.60939 | 0.22614 |
| NHBS | 0.46128 | 0.16860 | 0.07087 | 0.16294 | -0.02792 |
| NHALSAT | -0.39248 | -0.08038 | 0.30066 | 0.00812 | 0.07035 |
| Silt | 0.07681 | -0.35617 | 0.31189 | 0.71308 | 0.42811 |
| Clay | -0.16491 | 0.37731 | -0.42748 | -0.09073 | 0.71948 |
| SQTZ | -0.24027 | 0.44227 | 0.41949 | 0.13727 | -0.06678 |
| SFLD | 0.23826 | -0.50591 | -0.35749 | -0.05399 | -0.06065 |

| | PRIN6 | PRIN7 | PRIN8 | PRIN9 | PRIN10 |
|---|---|---|---|---|---|
| pH | -0.23154 | -0.40785 | 0.25482 | -0.58148 | 0.37519 |
| $Ca^{2+}$ | 0.31859 | 0.58317 | 0.26073 | 0.04723 | 0.30956 |
| $Mg^{2+}$ | -0.42653 | 0.04568 | -0.23444 | 0.59716 | 0.26890 |
| $K^{+}$ | 0.37380 | 0.11131 | 0.10466 | -0.15298 | -0.05837 |
| NHBS | -0.17359 | 0.04644 | 0.15097 | -0.01650 | -0.81919 |
| NHALSAT | -0.56980 | 0.34525 | 0.54559 | -0.04084 | 0.02937 |
| Silt | 0.22168 | 0.12510 | -0.08300 | 0.04316 | 0.06812 |
| Clay | 0.21307 | 0.12916 | 0.22405 | -0.03618 | -0.09057 |
| SQTZ | 0.23773 | -0.53840 | 0.28343 | 0.34706 | -0.01406 |
| SFLD | 0.13173 | -0.18843 | 0.58589 | 0.39251 | 0.05191 |

Figure 6: Variable loadings on the first principal component (PRIN1).

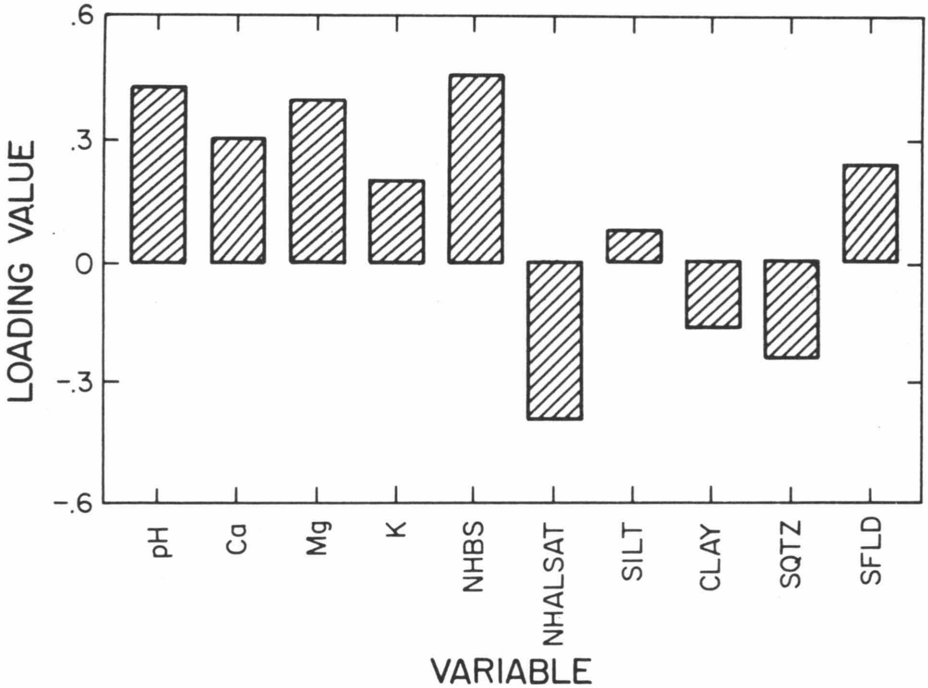


Figure 7: Variable loadings on the second principal component (PRIN2).

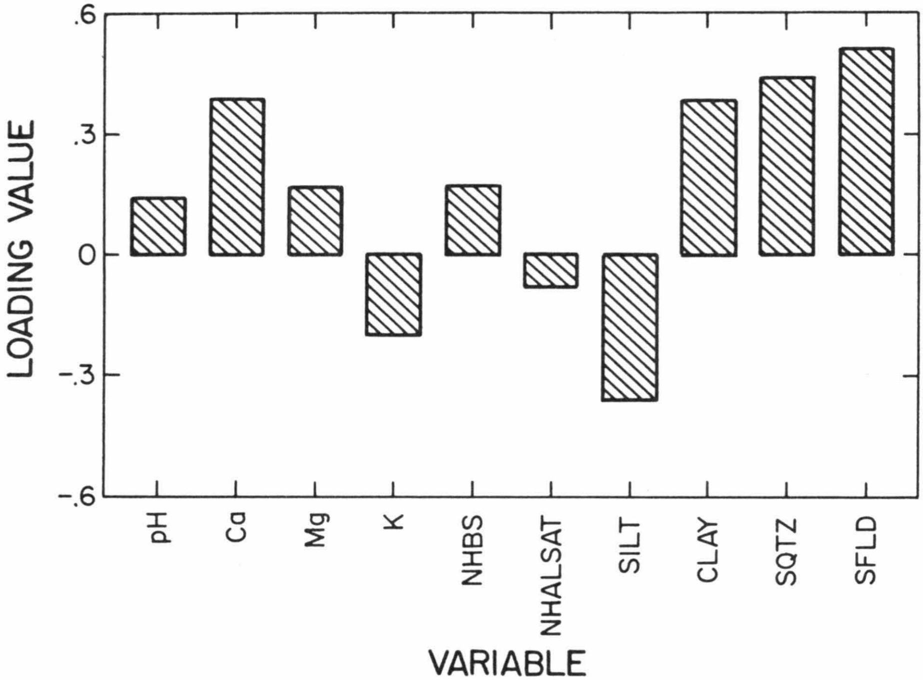


Table 45A: Principal component scores* for the soil profiles

| Pro-file | PRIN1 | PRIN2 | PRIN3 | PRIN4 | PRIN5 | PRIN6 |
|---|---|---|---|---|---|---|
| RB1BQ | -2.4367 | -0.3849 | -1.0806 | -1.0385 | 0.4962 | -0.1286 |
| RB2BQ | -2.6889 | -1.2440 | -0.3223 | 0.0675 | -1.3510 | -0.5766 |
| RB3BQ | -2.5846 | 0.7189 | 0.6235 | -1.2069 | -0.2183 | -0.0541 |
| BO1BQ | -1.8949 | -0.3933 | -1.5502 | 0.0983 | -0.2823 | 0.5543 |
| BO2BQ | -1.7375 | -0.1185 | -0.1428 | 1.2668 | 0.2084 | 0.9880 |
| BO3BQ | -1.0114 | 0.5984 | 0.0592 | 1.0151 | -0.2315 | 0.8089 |
| WY1BQ | -2.2078 | -0.7003 | -1.3001 | 0.3237 | 0.2926 | 0.5733 |
| WY2BQ | 0.9895 | -0.7346 | -0.4738 | -1.1615 | 0.3927 | 0.6058 |
| WY3BQ | -3.6569 | 0.5398 | 0.0953 | -0.1436 | -0.6800 | -0.9758 |
| SY1BQ | -1.1856 | -0.5564 | -0.2801 | -1.8434 | 0.2512 | 1.3449 |
| SY2BQ | -1.1934 | -1.0663 | -0.3693 | -1.0267 | -1.3582 | 0.7053 |
| SY3BQ | -0.4570 | 0.3274 | -0.9058 | 0.3420 | 1.2327 | -1.2276 |
| WA1BQ | -2.5188 | 1.2233 | 0.1614 | -0.0568 | -1.5674 | -1.1761 |
| WA2BQ | -3.4434 | 0.8475 | -0.1137 | -1.5403 | 0.3832 | 0.0270 |
| WA3BQ | -2.2149 | -0.7014 | -1.4280 | -0.7797 | 0.6005 | 0.9936 |
| BO1RO | 1.0154 | -1.8026 | -1.1581 | 0.1809 | -1.4120 | 0.3862 |
| BO2RO | 2.4644 | -1.1416 | -0.0964 | 1.2115 | -0.4773 | 0.5636 |
| BO3RO | 3.3680 | -0.4193 | 0.1329 | -1.8176 | -1.5280 | -0.0635 |
| BO4RO | 0.8355 | -0.6315 | 0.2872 | 1.6183 | -0.5011 | -0.1136 |
| BO5RO | 2.2664 | -1.6064 | 0.3366 | -0.0300 | -0.1298 | 0.6038 |
| WY1RO | 3.5684 | -1.3222 | 0.7963 | 0.1623 | 0.7510 | 0.4811 |
| WY2RO | -0.1446 | -3.0751 | 0.6575 | -0.2625 | 0.0370 | 0.0050 |
| WY3RO | 2.3985 | -2.4097 | 0.5027 | 0.2023 | 0.2272 | -0.3821 |
| WY4RO | 0.8896 | -2.3839 | 0.8517 | 0.2345 | 0.2876 | -0.9692 |
| WY5RO | 1.2591 | -2.9688 | 0.1920 | 0.6035 | 0.3000 | -0.3906 |
| SY1RO | -0.2705 | -2.5466 | -1.2130 | 0.7143 | 0.9460 | 0.3507 |
| SY2RO | 3.0145 | -0.9872 | -0.0484 | -0.7257 | 0.5097 | 0.1331 |
| SY3RO | 1.1545 | 0.2384 | -0.8998 | -2.3240 | 1.8303 | -0.1951 |
| SY4RO | -1.0884 | -0.1914 | 0.4361 | -1.3305 | 1.4790 | -0.8655 |
| SY5RO | 1.8763 | -2.2219 | 0.4133 | 0.4941 | 0.0179 | 0.2398 |

*Principal component scores for PRIN7 through PRIN10 are not shown since they account collectively for about 5% of the total variance.

Table 45B: Principal component scores* for the soil profiles

| Profile | PRIN1 | PRIN2 | PRIN3 | PRIN4 | PRIN5 | PRIN6 |
|---|---|---|---|---|---|---|
| RB1MA | 3.6124 | 1.3085 | -1.6494 | -0.9231 | -0.2926 | 0.4023 |
| RB2MA | 2.1703 | 2.1275 | 1.5774 | -0.0481 | -0.3562 | 0.4121 |
| RB3MA | 2.7924 | 1.0787 | -2.3889 | 1.2950 | 0.4096 | 0.1845 |
| RB4MA | -2.9205 | -0.0834 | -1.0915 | 0.5696 | 0.2358 | 0.6090 |
| RB5MA | 1.8649 | 4.1910 | -1.1381 | 0.6832 | 0.1175 | -0.1042 |
| BO1MA | 2.9576 | 0.7598 | -1.4997 | 0.4665 | -1.6559 | -1.4430 |
| BO2MA | -3.0222 | 1.1878 | -0.0712 | 0.3490 | -1.5135 | -0.0352 |
| BO3MA | -1.4475 | 1.5326 | 0.8286 | 0.7141 | 0.5128 | 0.5617 |
| BO4MA | 0.6316 | 1.6785 | 1.0933 | 0.2730 | 0.8796 | 0.0237 |
| BO5MA | 1.5677 | 2.0492 | -1.6009 | 0.2789 | 0.2704 | -0.0211 |
| WA1MA | 0.9268 | 1.6022 | 0.2200 | -0.7590 | -1.5348 | 0.6431 |
| WA2MA | 1.2357 | 0.2726 | 1.9031 | -0.4096 | -1.1918 | 0.4026 |
| WA3MA | 2.3751 | 1.3789 | 1.5728 | 0.1416 | 0.4926 | 0.7035 |
| WA4MA | -0.2240 | 0.9413 | -0.6445 | 0.5047 | 0.7443 | -0.4640 |
| WA5MA | -1.2332 | 0.0237 | 0.0817 | 0.4240 | 1.1434 | -0.5672 |
| RB1BR | 0.0262 | -0.6575 | 0.2606 | 0.9492 | -0.9987 | -0.0225 |
| RB2BR | 1.1457 | -0.2635 | 0.2145 | -0.8777 | -0.8070 | -1.8678 |
| RB3BR | -1.8930 | -0.2804 | 1.1517 | 2.3634 | -0.5860 | 0.1437 |
| BO1BR | -0.6502 | -0.2958 | -0.0795 | -0.2803 | -0.5187 | -1.0659 |
| BO2BR | -0.2430 | 1.5122 | 1.7876 | 0.5504 | 1.6343 | -0.5235 |
| BO3BR | 2.0732 | 1.2946 | -1.7221 | 1.5372 | 0.3480 | 0.3103 |
| WY1BR | -1.1687 | -0.4436 | 0.4356 | -1.0894 | -0.3766 | 0.0748 |
| WY2BR | -2.8783 | 1.1237 | -0.0869 | 0.3283 | 0.6193 | -0.0035 |
| WY3BR | -1.4643 | 0.0281 | 1.5040 | 1.1286 | -0.1450 | 0.8587 |
| SY1BR | -2.8160 | -0.5840 | 0.4174 | 0.4196 | 0.7472 | 0.1320 |
| SY2BR | 0.1505 | -1.2491 | 0.6110 | -0.2098 | 1.3621 | -1.1341 |
| SY3BR | -0.4363 | 0.6019 | 1.1946 | 1.3060 | 0.3568 | -1.1034 |
| WA1BR | -0.3101 | 0.3584 | 0.8030 | -1.1496 | -0.6311 | 0.6733 |
| WA2BR | 2.8176 | 2.1774 | 1.2109 | -0.7354 | 0.6484 | 0.7531 |
| WA3BR | -0.0054 | 1.7426 | 0.9416 | -1.0479 | -0.4208 | 0.0258 |

*Principal component scores for PRIN7 through PRIN10 are not shown since they account collectively for about 5% of the total variance.

Figure 8A: Plot of principal component scores for PRIN1 and PRIN2 for model I (BQ = 1, RO = 2, MA = 3, and BR = 4).

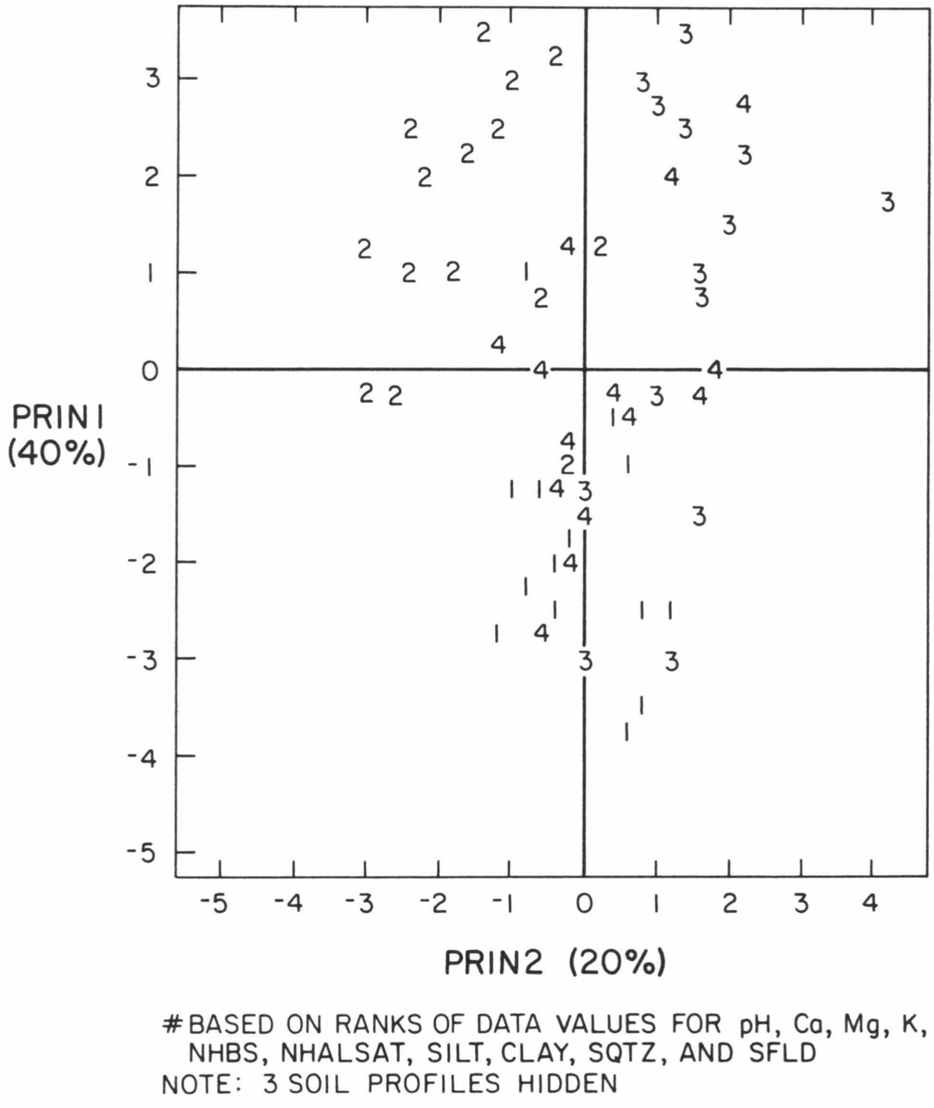
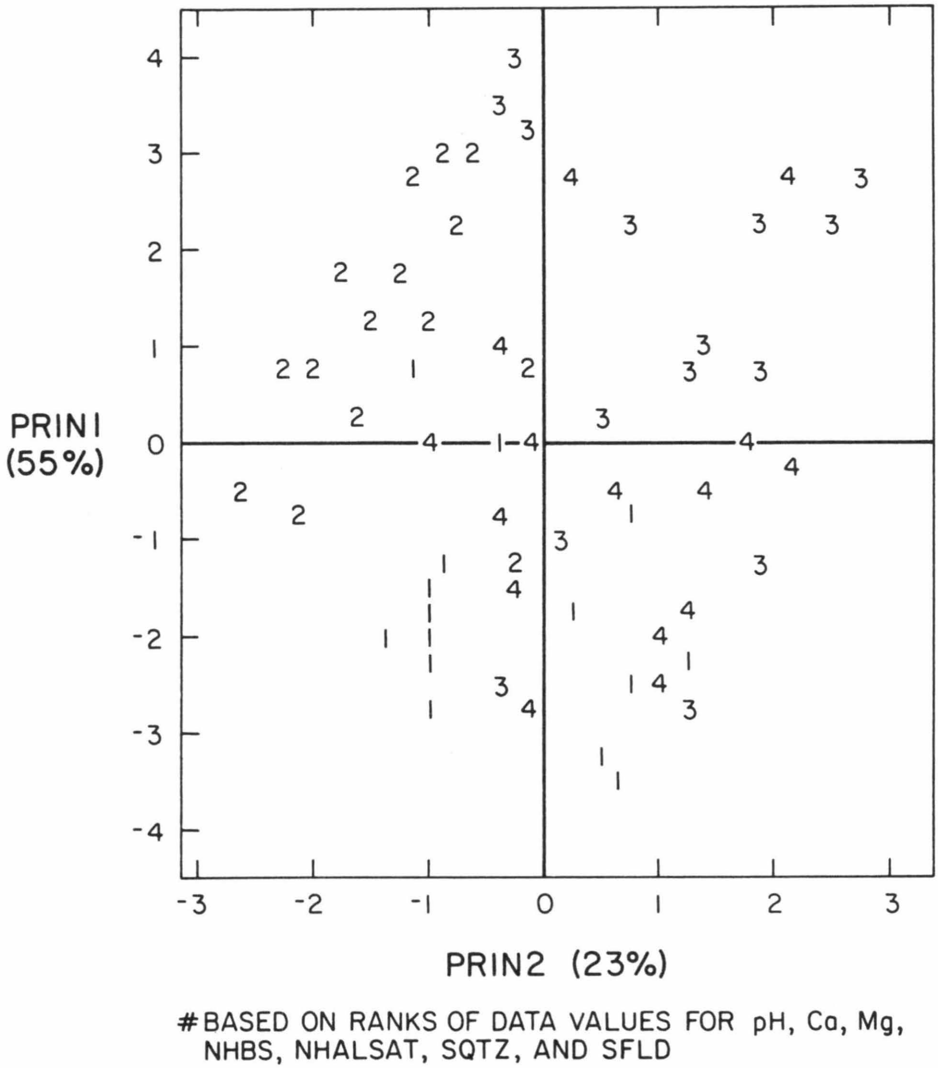


Figure 8B: Plot of principal component scores for PRIN1 and PRIN2 for model II (BQ = 1, RO = 2, MA = 3, and BR = 4).



## Cluster analysis

Cluster analysis is a method that systematically searches for order and similarity in multidimensional character space. Cluster analysis in this study was used to arrange the soil profiles developed from these parent materials into relatively uniform groups to see if any of these groups represented soils developed from a given parent material. By studying group characteristics, we can deduce the soil characteristics that separate soils developed from different parent materials and use them to differentiate soil series.

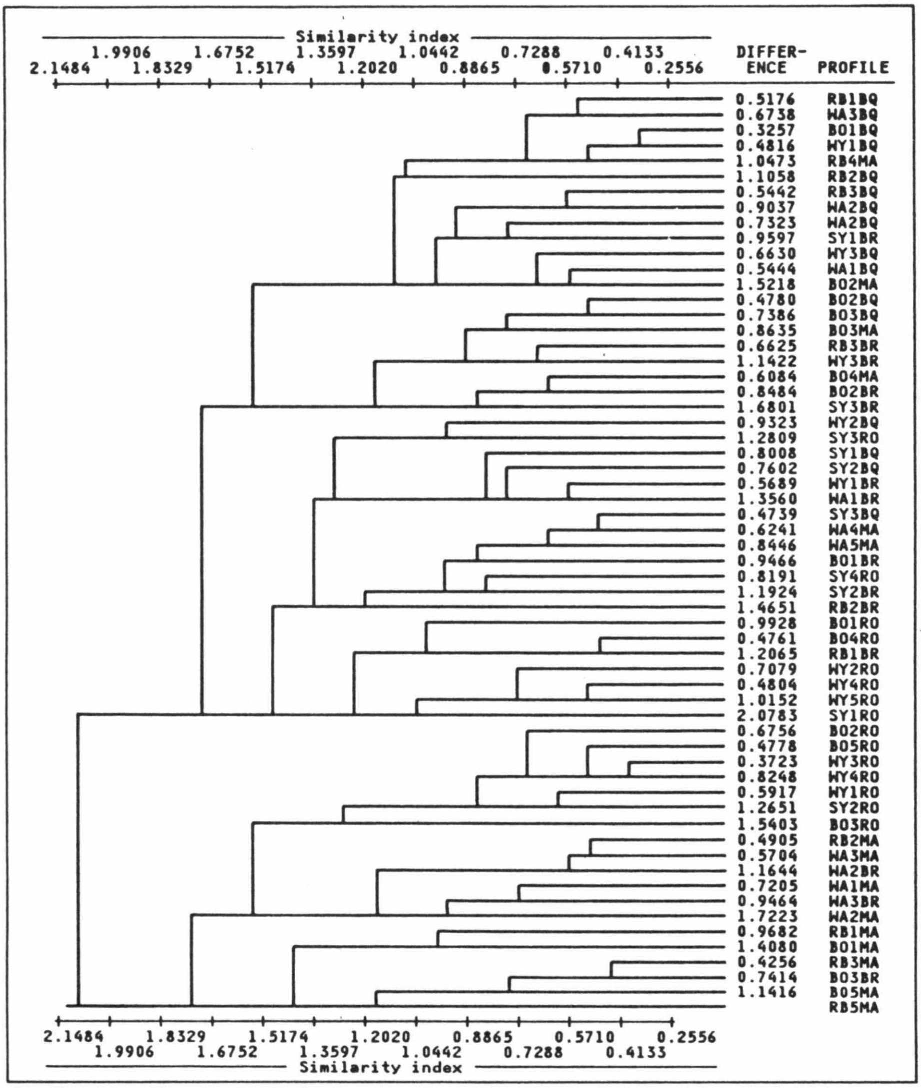
A dendrogram of the similarities of the soil profiles based on principal component scores for the first six principal components, or about 92 percent of the total variance in the original ten soil properties (Table 42), is given in Figure 9. At a similarity index of about 1.6500, four groups or clusters of soil profiles are produced. The first group, starting at the top, consists of the first 21 soil profiles, the second consists of the next 20, the third consists of the next 13, and the fourth group consists of the last 6. These groups are very similar to the groups produced by plotting principal component scores for the first two principal components (Figures 8A and 8B).

Cluster one is composed of eleven soil profiles that developed from the Chilhowee group; six from the Millboro, Brallier, and Chemung, and four from the Athens and Martinsburg; cluster two is composed of four soil profiles developed the Chilhowee group, eight from the Rome-Waynesboro; six from the Millboro, Brallier, and Chemung, and two from the Athens and Martinsburg formations; cluster three is composed of seven soil profiles developed from the Rome-Waynesboro, four from the Athens and Martinsburg formations, and two from the Millboro, Brallier, and Chemung; cluster four is composed of five soil profiles developed from the Athens and Martinsburg and one from the Millboro, Brallier, and Chemung.

These results indicate that soils developed from the Chilhowee group are represented by clusters one and two, that soils developed from the Rome-Waynesboro are represented primarily by clusters two and three, and that soils developed from the Athens and Martinsburg and from the Millboro, Brallier, and Chemung are divided roughly among clusters one, two, three, and four. The existence of three distinct facies in the Athens - i.e. shale, sandstone, and limestone (Butts, 1940) - probably accounts for the variability in cluster membership of the soils developed from these rocks. The Millboro formation contains beds of black fissile shale and beds that contain large, symmetrical, lenticular concretions of calcium carbonate or calcium sulfate that could account for the variability in cluster membership.

Minimum, median, and maximum values for soil properties used to develop the principal component scores used as data for cluster analysis (Figure 9) are reported in Tables 46A and 46B.

Figure 9: Dendrogram of the similarities* of the soil profiles.




*Based on the first six principal components (92% of the total variance) developed using ranks of the data values for pH, Ca, Mg, K, NHBS, NHALSAT, silt , clay, SQTZ, and SFDL.

Table 46A: Minimum, median, and maximum values for soil properties of the clusters produced by the dendrogram in Figure 9

| Cluster | Min | Med | Max |
|---|---|---|---|
| | | pH (-log $[H^+]$): | |
| 1 | 4.30 | 4.48 | 4.83 |
| 2 | 4.25 | 4.67 | 4.96 |
| 3 | 4.62 | 4.89 | 5.42 |
| 4 | 4.88 | 5.31 | 7.03 |
| | | $Ca^{2+}$ (cmol (+) $kg^{-1}$ soil): | |
| 1 | 0.07 | 0.30 | 0.87 |
| 2 | 0.10 | 0.26 | 0.69 |
| 3 | 0.25 | 0.87 | 6.73 |
| 4 | 3.57 | 8.85 | 19.10 |
| | | $Mg^{2+}$ (cmol (+) $kg^{-1}$ soil): | |
| 1 | 0.02 | 0.06 | 0.87 |
| 2 | 0.12 | 0.34 | 0.94 |
| 3 | 0.21 | 0.92 | 4.30 |
| 4 | 0.51 | 0.99 | 7.60 |
| | | $K^+$ (cmol (+) $kg^{-1}$ soil): | |
| 1 | 0.09 | 0.15 | 0.24 |
| 2 | 0.12 | 0.22 | 0.33 |
| 3 | 0.21 | 0.33 | 0.80 |
| 4 | 0.08 | 0.09 | 0.20 |
| | | NHBS (%): | |
| 1 | 2.48 | 5.16 | 15.04 |
| 2 | 3.54 | 8.02 | 18.12 |
| 3 | 11.12 | 20.12 | 52.02 |
| 4 | 28.75 | 65.58 | 92.47 |
| | | NHALSAT (%): | |
| 1 | 33.17 | 50.42 | 70.39 |
| 2 | 25.66 | 40.26 | 56.06 |
| 3 | 1.16 | 22.66 | 38.43 |
| 4 | 0.21 | 6.04 | 29.17 |

Table 46B: Minimum, median, and maximum values for soil properties of the clusters produced by the dendrogram in Figure 9

| Cluster | Min | Med | Max |
|---|---|---|---|
| | | Silt (g $kg^{-1}$ of soil): | |
| 1 | 294 | 526 | 732 |
| 2 | 402 | 512 | 723 |
| 3 | 340 | 538 | 709 |
| 4 | 360 | 448 | 550 |
| | | Clay (g $kg^{-1}$ of soil): | |
| 1 | 174 | 265 | 392 |
| 2 | 130 | 218 | 564 |
| 3 | 113 | 184 | 259 |
| 4 | 145 | 345 | 430 |
| | | SQTZ (g $kg^{-1}$ of sand): | |
| 1 | 550 | 950 | 1000 |
| 2 | 500 | 805 | 900 |
| 3 | 570 | 720 | 1000 |
| 4 | 380 | 730 | 1000 |
| | | SFLD (g $kg^{-1}$ of sand): | |
| 1 | 0 | 0 | 100 |
| 2 | 0 | 85 | 360 |
| 3 | 0 | 200 | 300 |
| 4 | 0 | 70 | 210 |

## Discriminant analysis

Discriminant analysis has two uses that can be important in soil classification: (1) to predict group membership on the basis of several soil properties considered simultaneously, and (2) to determine which soil properties are important for defining group differences. Therefore, discriminant analysis provides an objective technique for developing series criteria below the family level (*Soil Taxonomy*, Soil Survey Staff, 1975). This procedure can also be used to test the significance or usefulness of differentiae in relation to soil properties selected as differentiae above the family level.

Discriminant analysis is a technique that assumes multivariate normality and equal variance (Afifi and Clark, 1984). Ranks of the values for the soil properties produce a common mean and variance (Lebart et al., 1984) and were used in this study.

Discriminant analysis can be used to classify an individual soil profile into one of two or more alternative groups, such as the parent materials in this study, on the basis of several soil properties considered simultaneously, provided the groups are distinct and each individual belongs to one of them (Afifi and Clark, 1984).

The resulting discriminant function can be used to indicate the direction and degree to which each soil property contributes to the separation of the groups. The sign of the coefficient for a given soil property indicates the direction of its contribution. The relative degree of the contribution of a given soil property is indicated by the difference between its means for the two groups divided by the distance between the multivariate means for the two groups; i.e. the Mahalanobis $D^2$ (Davis, 1973). Percentage contributions are obtained by multiplying by 100. Therefore, soil properties can be arranged in descending order of their contributions and the most important ones selected as differentiae. By identifying the properties that have the greatest influence on defining differences between groups, we can better predict differences in group responses to use and management.

### *Parent materials*

If soils developed from rocks of the Chilhowee group are considered to be one group and soils developed from the Rome-Waynesboro formation are considered to be another, a discriminant function can be developed that describes their separation, based on several soil properties considered simultaneously. The resulting discriminant function based on the same soil properties used to develop the principal components is:

$$\begin{aligned} R = &- 0.6838\mathrm{pH} + 0.1089\mathrm{Ca} - 0.1144\mathrm{Mg} - 0.4544\mathrm{K} \\ &+ 0.1773\mathrm{NHBS} - 0.3158\mathrm{NHALSAT} - 0.2637\mathrm{Silt} \\ &+ 0.2080\mathrm{Clay} + 0.2578\mathrm{SQTZ} - 0.4374\mathrm{SFLD} \end{aligned} \qquad (21)$$

The percentage contribution of each property used to develop the discriminant function is given in Table 47. By eliminating properties with negative values and contributions of less than 10 percent, discriminant functions II was developed. Discriminant function II (Figure 10) shows that pH, $K^+$, silt, SQTZ, and SFLD contribute to the differentiation of these soils. pH, $K^+$, silt, and SFLD contribute in the negative direction while SQTZ contributes in the positive direction. Contributions in descending order of magnitude are pH, SFLD, $K^+$, SQTZ, and silt (Table 47 and Figure 10). The discriminant index (RO), the point halfway between the multivariate means of group 1 (R1) and group 2 (R2), clearly separates the majority of the soils developed from rocks of the Chilhowee group (1) from soils developed from the Rome-Waynesboro formation (2). Using the discriminant scores (Figure 10), we can predict that soils developed from the Rome-Waynesboro formation have higher pH values, more feldspar in the sand fraction, more exchangeable $K^+$, and more silt since they have larger negative discriminant scores. Conversely, soils developed from rocks of the Chilhowee group have more quartz in the sand fraction since they have smaller negative discriminant scores.

Discriminant functions were developed in the same manner to describe differences and differentiae between groups of soils developed from the Chilhowee group (1) as compared to soils developed from the Athens and Martinsburg formations (3) (Figure 11); the Chilhowee group (1) as compared to soils developed from the Millboro, Brallier, and Chemung formations (4) (Figure 12); the Rome-Waynesboro formation (2) as compared to soils developed from the Athens and Martinsburg formation (3) (Figure 13); the Rome-Waynesboro formation (2) as compared to soils developed from the Millboro, Brallier, and Chemung formations (4) (Figure 14); and the Athens and Martinsburg formations (3) as compared to soils developed from the Millboro, Brallier, and Chemung formations (4) (Figure 15).

Discriminant functions developed to describe differences and differentiae between soils developed from rocks of the Chilhowee group and soils developed from the other parent materials indicate that soils developed form rocks of the Chilhowee group can be separated (1) from soils developed from the Rome Waynesboro formation using pH, SFLD, SQTZ, $K^+$ , and silt (Figure 10); (2) from soils developed from the Athens and Martinsburg formations using $Ca^{2+}$ and $Mg^{2+}$ (Figure 11); and (3) from soils developed from the Millboro, Brallier, and Chemung formations using $Ca^{2+}$ , $Mg^{2+}$ and silt (Figure 12). Based on these results, we recommend that the Sylco and the proposed Sylvatus series (Appendix A) be used to name and interpret map units of soils developed from rocks of the Chilhowee group that classify as members of the loamy-skeletal, mixed, mesic families of Typic and Lithic Dystrochrepts, respectively.

Discriminant functions developed to describe differences and differentiae between soils developed from rocks of the Rome-Waynesboro formation and soils developed from the other parent materials indicate that soils developed from the Rome-Waynesboro formation can be separated (1) from soils developed from the rocks of the Chilhowee group using pH, SQTZ, $K^+$ , and SQTZ (Figure 10); (2) from soils developed from the Athens and Martinsburg formations using SFLD, $Ca^{2+}$, and $K^+$ (Figure 13); and (3) from soils developed from the Millboro, Brallier, and Chemung formations using SFLD and $K^+$ (Figure 14). Based on these results, we recommend that the Litz and the proposed Chiswell series (Appendix A) be used to name and interpret map units of soils developed from rocks of the Rome-Waynesboro formation that classify as members of the loamy-skeletal, mixed, mesic families of Ruptic Ultic and Lithic Dystrochrepts, respectively.

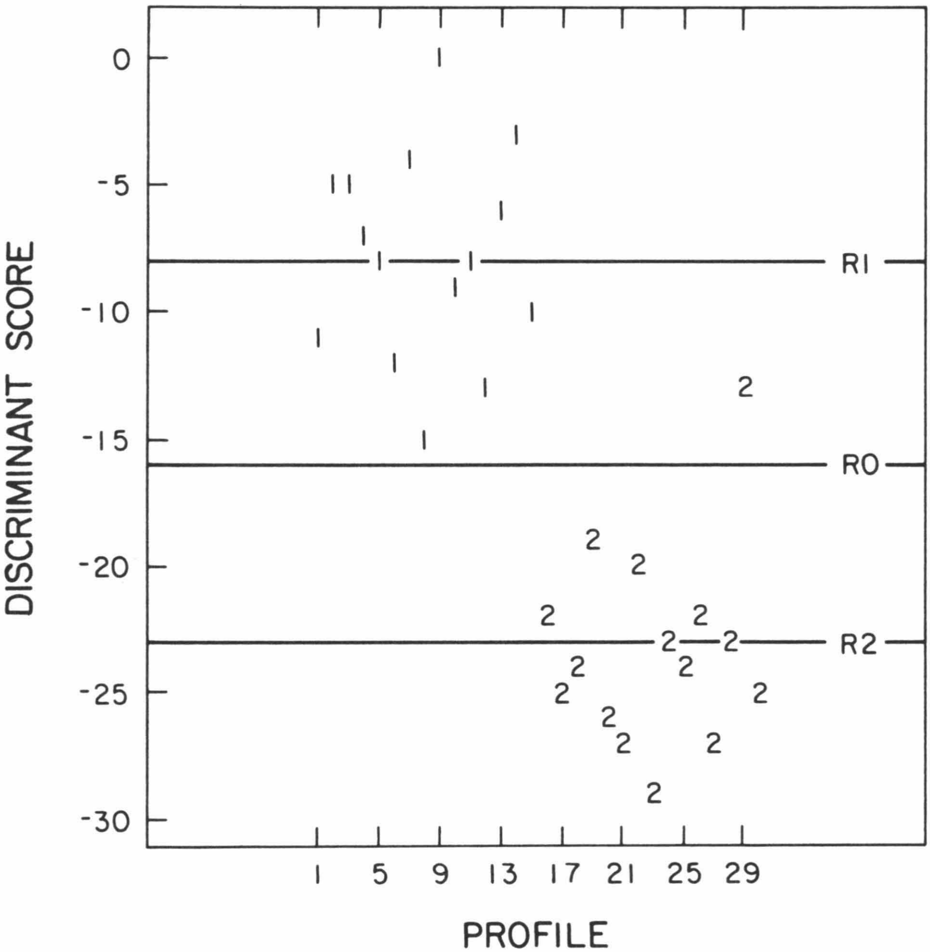
Discriminant functions developed to describe differences and differentiae between soils developed from rocks of the Athens and Martinsburg formations and soils developed from the other parent materials indicate that soils developed from the Athens and Martinsburg formations can be separated (1) from soils developed from rocks of the Chilhowee group using $Ca^{2+}$ and $Mg^{2+}$ (Figure 11) and (2) from soils developed the Rome-Waynesboro formation using SFLD, $Ca^{2+}$ and $K^+$ (Figure 13). However, soils developed from the Athens and Martinsburg formations are not separated from soils developed from the Millboro, Brallier, and Chemung formations (Figure 15). Based on these results, we recommend that soils developed from the shale and fine-grained sandstone facies of the Athens and Martinsburg formations along with soils developed from the Millboro, Brallier, and Chemung formations be correlated as members of the Berks and Weikert series.

Table 47: Contributions of the variables selected to discriminate between soils developed from rocks of the Chilhowee group (BQ) and soils developed form rocks of the Rome-Waynesboro formation (RO)

| Variable | Discriminant function I | Discriminant function II |
|---|---|---|
| | % added | |
| pH | 35.7* | 31.2 |
| $Ca^{2+}$ | 1.8 | -- |
| $Mg^{2+}$ | 6.4 | -- |
| $K^{+}$ | 20.4* | 15.8 |
| NHBS | -10.9 | -- |
| NHALSAT | -10.7 | -- |
| Silt | 11.7* | 11.5 |
| Clay | 9.3 | -- |
| SQTZ | 14.1* | 13.3 |
| SFLD | 25.7* | 28.2 |

*Variable selected to develop the next discriminant function.

Figure 10: Plot of discriminant scores based on ranks of data values for selected properties of soils developed from rocks of the Chilhowee group (1) and from rocks of the Rome-Waynesboro formation (2).




DISCRIMINANT FUNCTION:

$R = -0.4125\,(\text{pH}) - 0.2438\,(\text{K}) - 0.1792\,(\text{SILT}) + 0.1688\,(\text{SQTZ}) - 0.3318\,(\text{SFLD})$

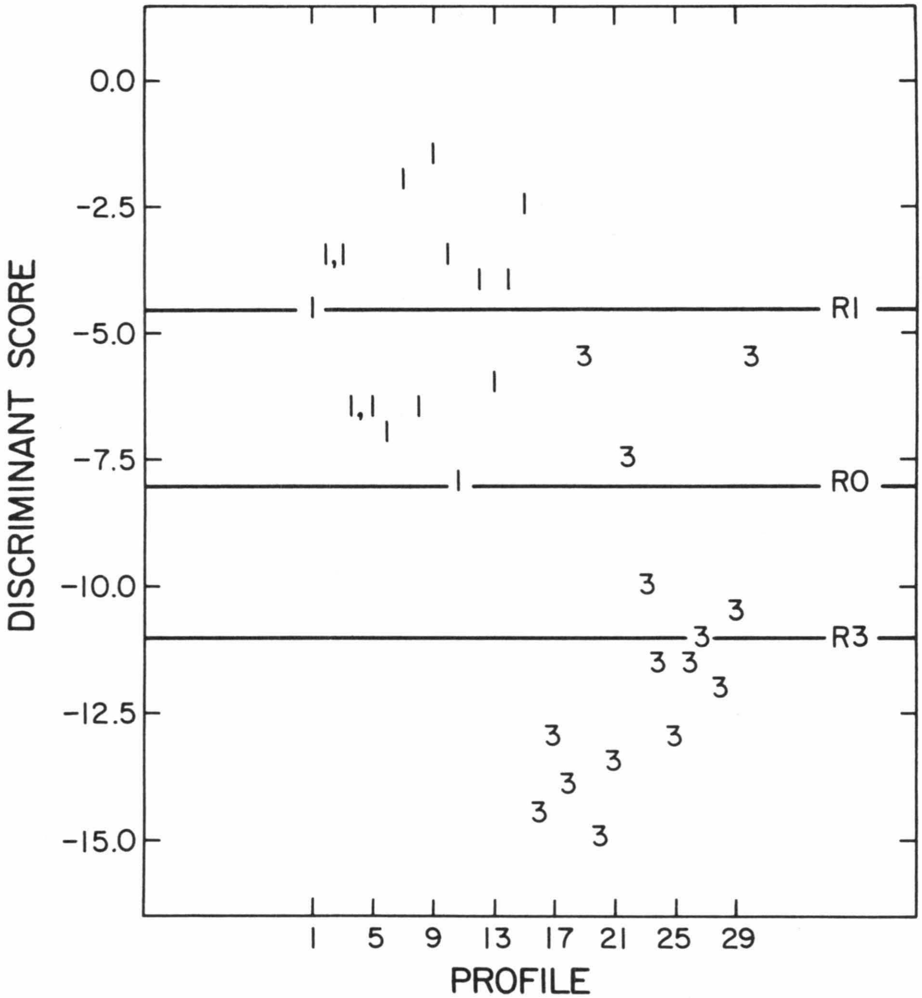
$F = 19.8621$ WITH 5 AND 24 df, $\alpha(F) < 0.0001$

MAHALANOBIS $D^2 = 15.45$

CONTRIBUTIONS TO THE DISCRIMINANT FUNCTION:

pH 31.2%, K 15.8%, SILT 11.5%, SQTZ 13.3%, SFLD 28.2%

Figure 11: Plot of discriminant scores based on ranks of data values for selected properties of soils developed from rocks of the Chilhowee group (1) and from rocks of the Athens and Martinsburg formations (3).

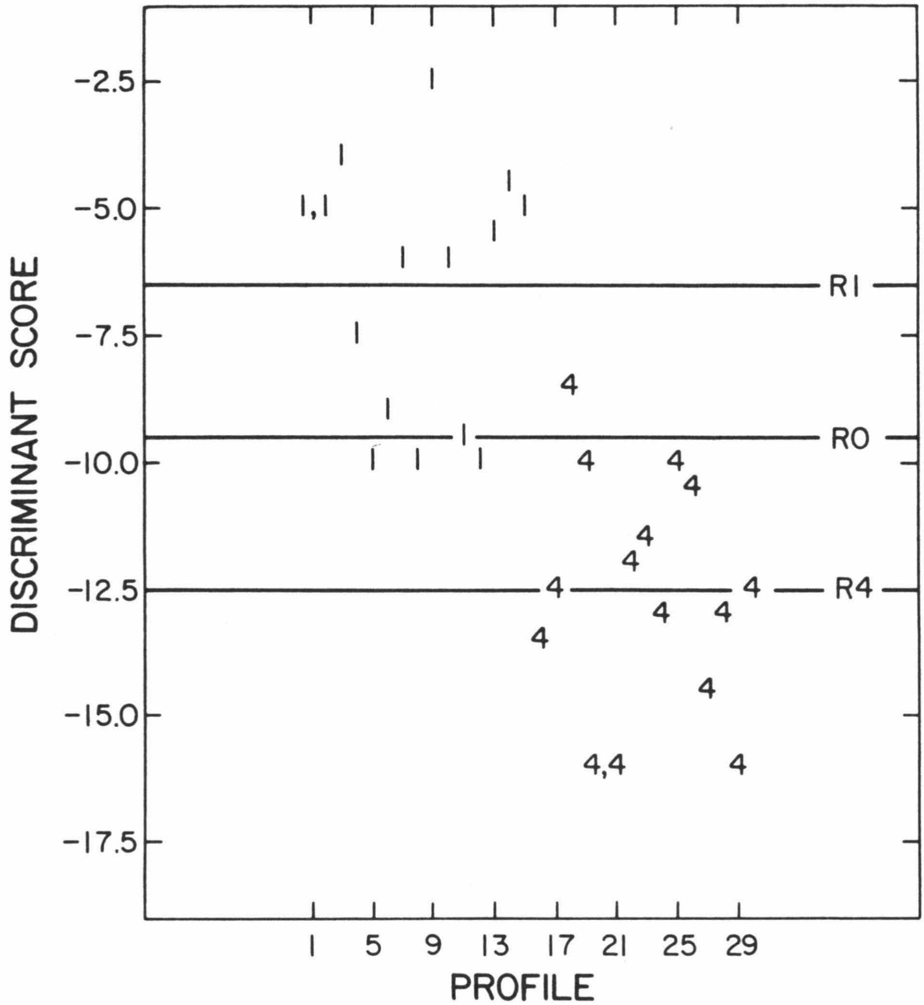



DISCRIMINANT FUNCTION:
$R = -0.3935\,(Ca) - 0.1156\,(Mg)$
$F = 23.6032$ WITH 2 AND 27 df, $\alpha(F) < 0.0001$

MAHALANOBIS $D^2 = 6.53$

CONTRIBUTIONS TO THE DISCRIMINANT FUNCTION:
Ca 81.6 %, Mg 18.4

Figure 12: Plot of discriminant scores based on ranks of data values for selected properties of soils developed from rocks of the Chilhowee group (1) and from rocks of the Millboro, Brallier, and Chemung formations (4).




DISCRIMINANT FUNCTION:

$R = -0.2292\,(Ca) - 0.2127\,(Mg) - 0.1812\,(SILT)$

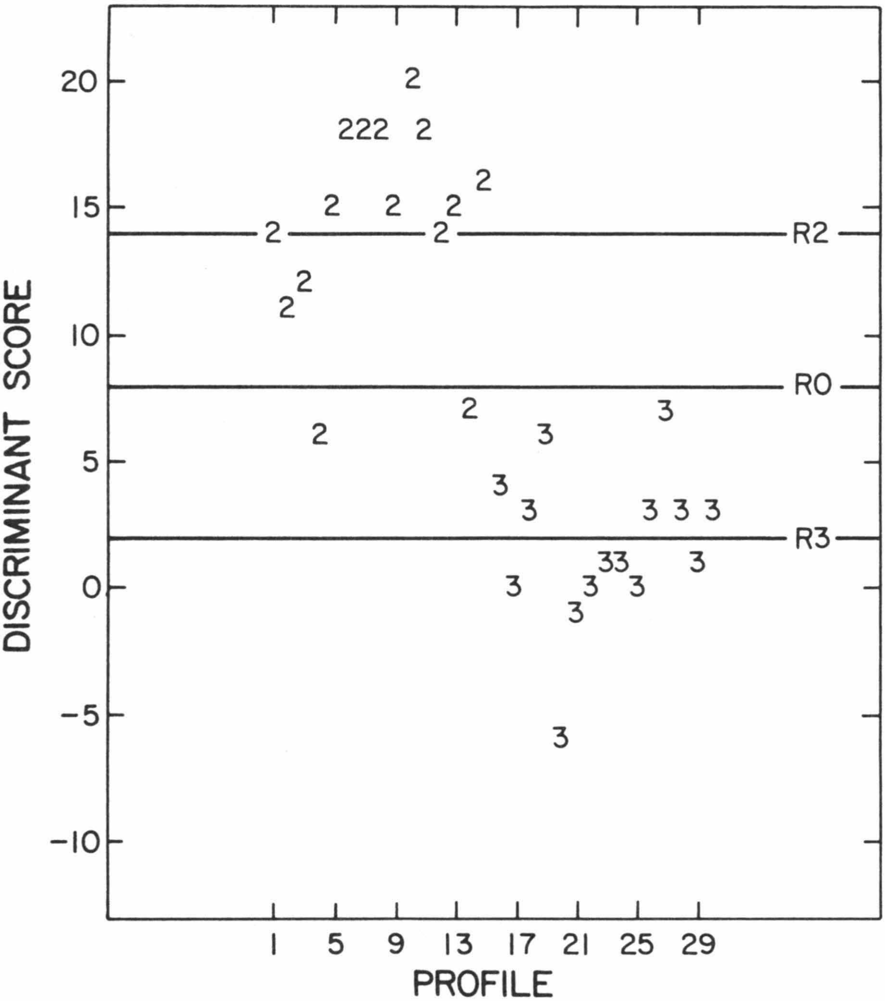
$F = 13.7025$ WITH 3 AND 26 df, $\alpha(F) < 0.0001$

MAHALANOBIS $D^2 = 5.90$

CONTRIBUTIONS TO THE DISCRIMINANT FUNCTION:

Ca 43.2%, Mg 35.1%, AND SILT 21.7%

Figure 13: Plot of discriminant scores based on ranks of data values for selected properties of soils developed from rocks of the Rome-Waynesboro formation (2) and form rocks of the Athens and Martinsburg formations (3).




DISCRIMINANT FUNCTION:

$R = -0.3191\,(Ca) + 0.2850\,(K) + 0.5469\,(SFLD)$

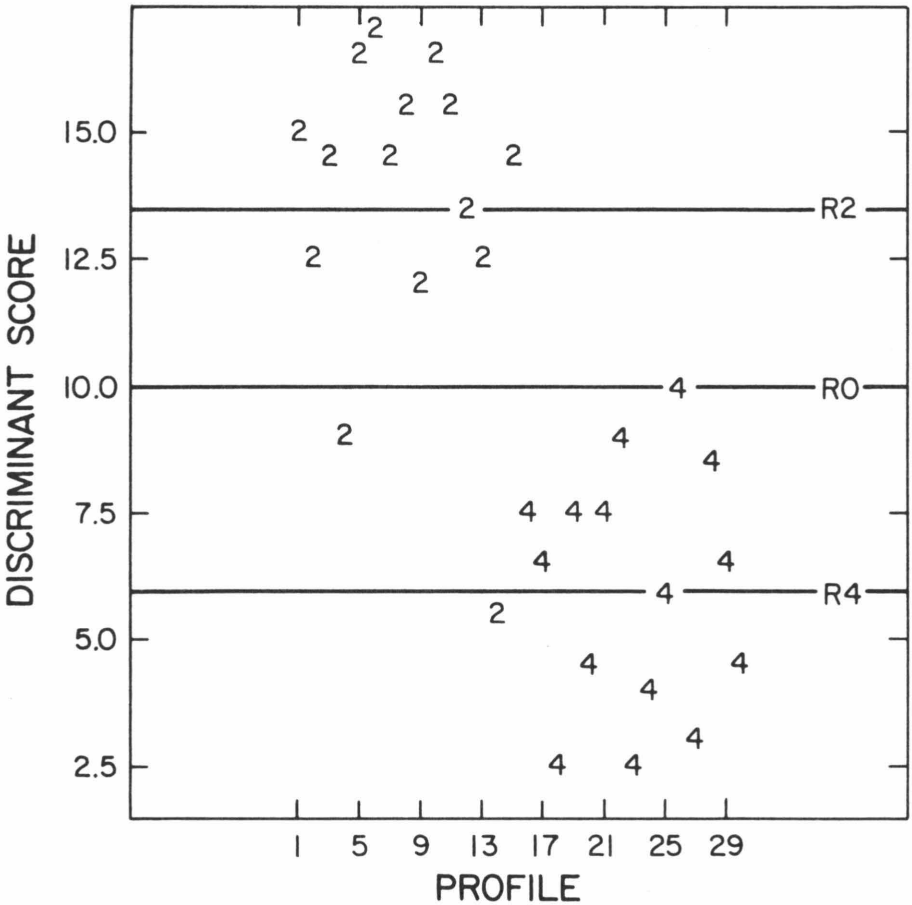
$F = 29.4051$ WITH 3 AND 26 df, $\alpha(F) < 0.0001$

MAHALANOBIS $D^2 = 12.67$

CONTRIBUTIONS TO THE DISCRIMINANT FUNCTION:

Ca 24.0%, K 20.7%, AND SFLD 55.3%

Figure 14: Plot of discriminant scores based on ranks of data values for selected properties of soils developed from rocks of the Rome-Waynesboro formation (2) and from rocks of the Millboro, Brallier, and Chemung formations (4).




DISCRIMINANT FUNCTION:

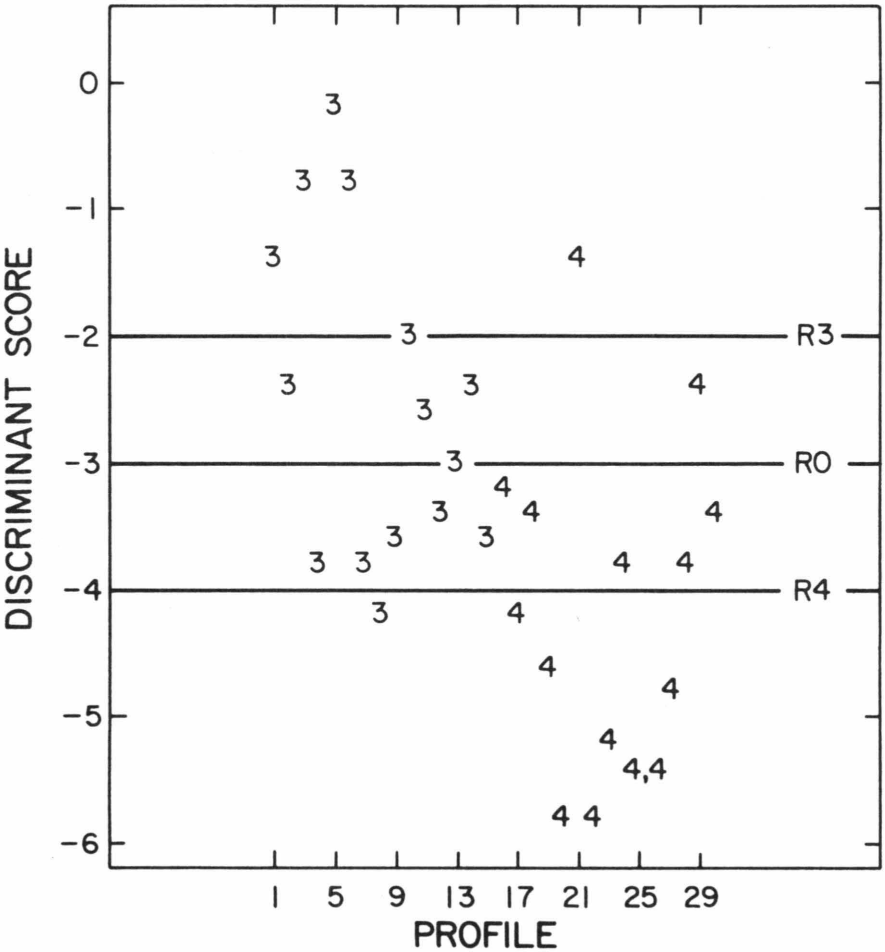
$R = 0.1501\,(K) + 0.4820\,(SFLD)$

$F = 27.2346$ WITH 2 AND 27 df, $\alpha(F) < 0.0001$

MAHALANOBIS $D^2 = 7.53$

CONTRIBUTIONS TO THE DISCRIMINANT FUNCTION:
K 13.8%, SFLD 86.2%

Figure 15: Plot of discriminant scores based on ranks of data values for selected properties of soils developed from rocks of the Athens and Martinsburg formations (3) and from rocks of the Millboro, Brallier, and Chemung formations (4).




DISCRIMINANT FUNCTION:

$R = -0.0625(K) - 0.1552(NHALSAT)$

$F = 5.8661$ WITH 2 AND 27 df, $\alpha(F) = 0.0077$

MAHALANOBIS $D^2 = 1.62$

CONTRIBUTIONS TO THE DISCRIMINANT FUNCTION:
K 15.2% AND NHALSAT 84.8%

## *Lithic and Typic Dystrochrepts*

If soil profiles classified as members of the loamy-skeletal, mixed, mesic family of Lithic Dystrochrepts are considered to form one group and soil profiles classified as members of the loamy-skeletal, mixed, mesic family of Typic Dystrochrepts are considered to form another, a discriminant function can be developed that describes their separation. Such a discriminant function based on soil properties that are significantly different at the 5 percent level of probability according to the Wilcoxon rank sum test is:

$$\begin{aligned} R = & - 0.0840DTC - 0.5758DTR - 0.1128AH2O \\ & + 0.0212Ca + 0.3247SCEC + 0.2168NHCEC \\ & - 0.0269PHD78 - 0.3588H + 0.0008SALSAT \\ & + 0.1758NHALSAT - 0.2990NHCECLAY \\ & + 0.1042SCECLAY + 0.2079SFLD \end{aligned} \tag{22}$$

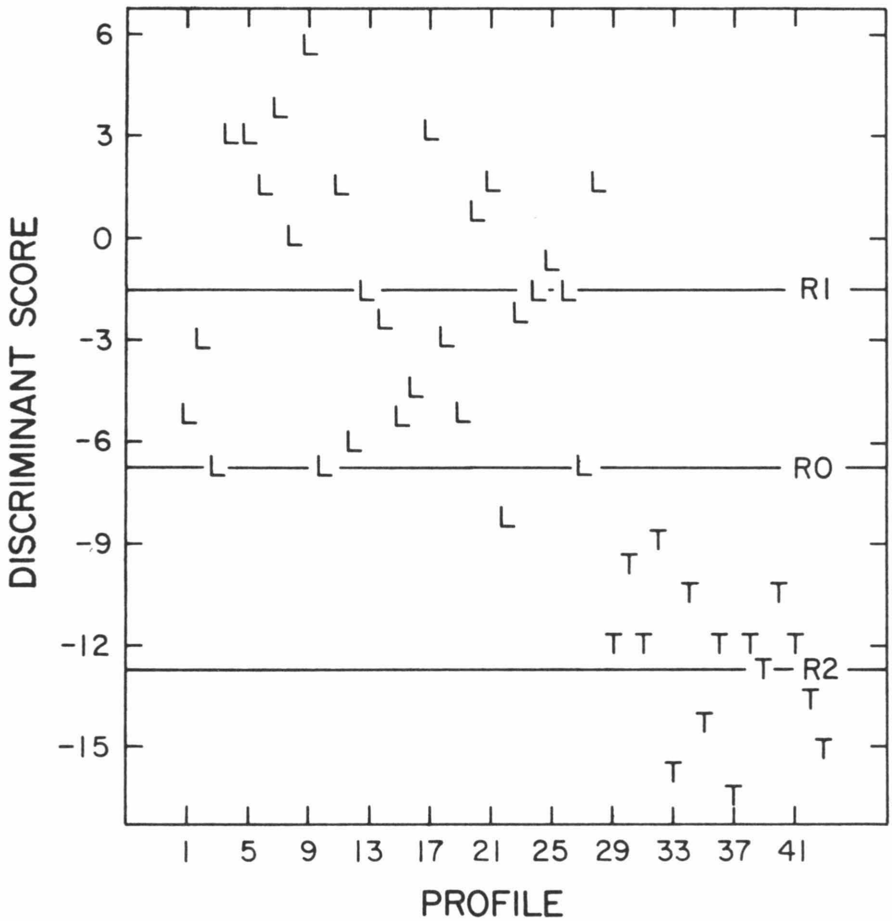
The percentage contribution by each of the soil properties is given in Table 48. By eliminating soil properties with negative contributions and contributions of less than 10 percent, discriminant functions II was developed. Discriminant function III (Table 48 and Figure 16) is the result of eliminating soil properties with less than 5 percent contributions. Soils classified as members of the loamy-skeletal, mixed, mesic families of Lithic and Typic Dystrochrepts can be separated by this discriminant function within the study area. However, DTR contributes about 78.8 percent of the separation while AH2O, SCEC, and SFLD each contribute less than 10 percent. If DTR is eliminated from the discriminant function and the same procedure for selecting differentiae are followed, the discriminant function given in Figure 17 is the result. Soils classified as members of these taxa merge about the discriminant index (RO) with no clear separation of the two groups. Since DTR was the primary criterion used by *Soil Taxonomy* (Soil Survey Staff, 1975) to define these two taxa and contributes the majority of their separation, these results make the same point as Webster (1977, p. 75), who states, "Definitional classifications dissect the scales of the properties on which the definition is based. But they rarely produce disjoint division of the scales of other properties: there is almost always overlap in the latter, and when used to predict these other properties, they present much the same problems as intuitive classifications."

Table 48: Contributions of the variables selected to discriminate between soils classified as members of Lithic and Typic Dystrochrepts

| Variable | Discriminant function I | II | III |
|---|---|---|---|
| | % added | | |
| DTC | -9.7 | -- | -- |
| DTR | 89.3* | 78.2* | 78.8 |
| AH2O | 13.7* | 5.4* | 5.5 |
| Ca | 1.0 | -- | -- |
| SCEC | 20.9* | 5.1* | 7.8 |
| NHCEC | 13.5* | 3.1 | -- |
| PHD78 | -1.0 | -- | -- |
| H | -17.9 | -- | -- |
| SALSAT | -1.0 | -- | -- |
| NHALSAT | -12.9 | -- | -- |
| NHCECLAY | -17.7 | -- | -- |
| SCECLAY | 6.7 | -- | -- |
| SFLD | 13.8* | 8.2* | 7.9 |

*Variable selected to develop the next discriminant function.

Figure 16: Plot of discriminant scores based on ranks of data values for DTR, AH2O, SCEC, and SFLD for soils classified as members of Lithic (L) and Typic (T) Dystrochrepts.




DISCRIMINANT FUNCTION:

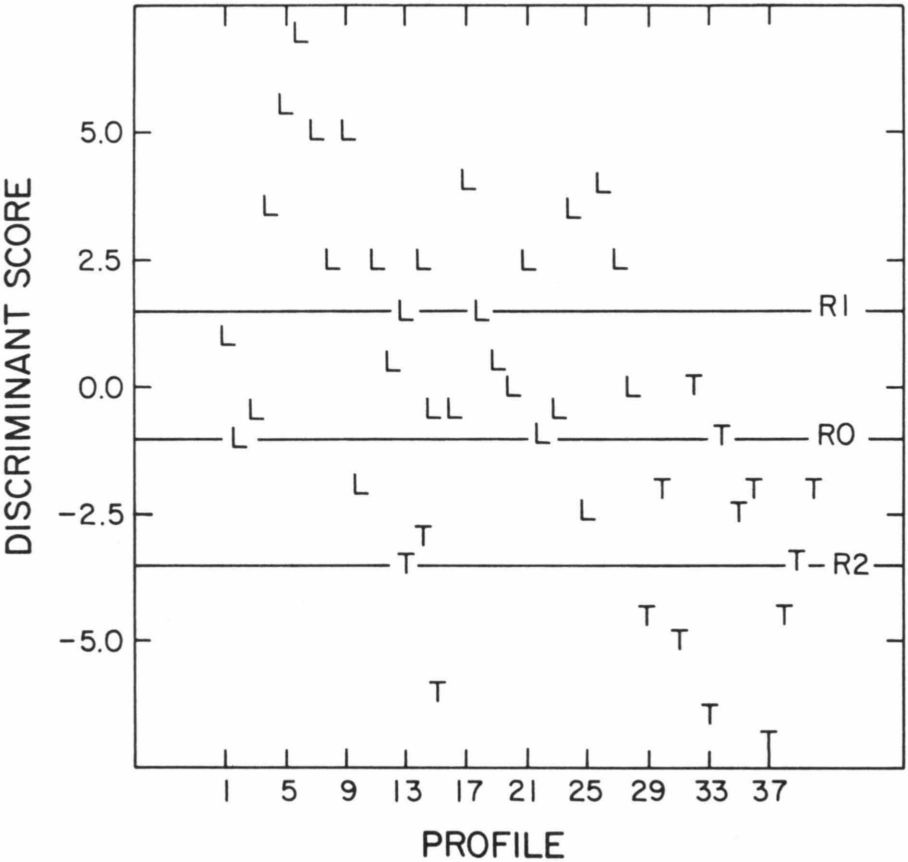
$R = -0.3990\,(DTR) - 0.0356\,(AH2O) + 0.0950\,(SCEC) + 0.0932\,(SFLD)$

$F = 24.6307$ with 4 and 38 df, &alp.(F) < 0.0001

MAHALANOBIS $D^2 = 10.88$

CONTRIBUTIONS TO THE DISCRIMINANT FUNCTION:
DTR 78.8%, AH2O 5.5%, SCEC 7.8%, and SFLD 7.9%

Figure 17: Plot of discriminant scores based on ranks of data values for AH2O, NHCEC, and SFLD for soils classified as members of Lithic (L) and Typic (T) Dystrochrepts.




DISCRIMINANT FUNCTION:

R= −0.2029 (AH2O) + 0.0531 (NHCEC) + 0.1418 (SFLD)

F= 16.0120 with 3 and 39 df, &alp.(F) < 0.0001

MAHALANOBIS $D^2 = 5.17$

CONTRIBUTIONS TO THE DISCRIMINANT FUNCTION:

AH2O 65.9%, NHCEC 8.8%, and SFLD 25.3%

# *Site index estimation for upland oak*

Regression models developed by the RSQUARE procedure (SAS Institute, 1985b) for estimating site index of upland oak for immature timber stands and unforested areas of these soils are reported in Table 49. The highest $R^2$ for a regression model based on a single soil property was for SBS (base saturation by the sum of cations or (SBAS/SCEC)100).

A regression model based on the six soil properties that gave the highest $R^2$ value was developed with the parameter estimates and associated statistics given in Table 50. All the parameter estimates for this model were significantly greater than zero at the 5 percent level of probability. Collinearity diagnosis of the variables (Table 51) indicates a collinearity problem by the high condition index for eigenvector 7 and a high contribution by $Al^{3+}$, SBS, and ECEC. Therefore, the direction of the contributions by these variables as indicated by their sign is difficult to interpret.

Observed and predicted site indices, standard errors of the predictions, 95 percent confidence intervals, and residuals for the model are reported in Table 52 for soils classified as members of the loamy-skeletal, mixed, mesic families of Lithic and Typic Dystrochrepts.

Reasons for the low $R^2$ values obtained in this study are (1) collinearity of the soil and site properties used, (2) lack of even-aged, well-stocked timber stands at the sample sites from which the site indices were obtained, and (3) the inability to access nutrient levels and available moisture during the growing season.

Table 49: Regression models estimated by the RSQUARE procedure in SAS for dependent variables site index for upland oaks growing on soils classified as Lithic and Typic Dystrochrepts

| Number of variables in model | R-Square | Variables in the model |
|---|---|---|
| 1 | 0.17984746 | SBS |
| 2 | 0.27151269 | DTR SBS |
| 3 | 0.34907821 | DTR Sand SBS |
| 4 | 0.38920544 | DTR Sand SBS K |
| 5 | 0.44528666 | DTR Al ECECLAY SBS SIMICA |
| 6* | 0.49173537 | DTR Al ECECLAY SBS SIMICA ECEC |
| 7 | 0.52025669 | DTR Al NHALSAT ECECLAY SBS SIMICA ECEC |
| 8 | 0.53524601 | DTR Al NHALSAT ECECLAY SBS SIMICA SIFLD ECEC |
| 9 | 0.55028153 | DTR Al NHALSAT SBS Clay SIMICA SIFLD ECEC SMICA |
| 10 | 0.55772375 | SLOPE DTR AH2O Al ECECLAY SBS SIMICA ECEC SQTZ SMICA |
| 11 | 0.56305594 | SLOPE DTR pH Al NHALSAT SBS Clay SIMICA SIFLD ECEC SMICA |
| 12 | 0.56893682 | SLOPE DTR AH2O pH Al NHALSAT SBS Clay SIMICA SIFLD ECEC SMICA |
| 13 | 0.57216416 | SLOPE DTR AH2O Al NHALSAT ECECLAY SBS SFLD Clay SIMICA SIFLD ECEC SMICA |
| 14 | 0.57342170 | SLOPE DTR AH2O pH Al NHALSAT ECECLAY SBS Clay SIMICA SIFLD ECEC SQTZ SMICA |
| 15 | 0.57381431 | SLOPE DTR AH2O pH Al NHALSAT ECECLAY SBS Clay SIMICA SIFLD ECEC H SQTZ SMICA |
| 16 | 0.57404634 | SLOPE DTR AH2O pH Al NHALSAT ECECLAY NHBS SBS SFLD Clay SIMICA SIFLD ECEC H SMICA |
| 17 | 0.57412735 | SLOPE DTR AH2O pH Al NHALSAT ECECLAY NHBS SBS SFLD Clay SIMICA SIFLD ECEC H SQTZ SMICA |
| 18 | 0.57415500 | SLOPE DTR AH2O pH Al NHALSAT Sand ECECLAY NHBS SBS SFLD Clay SIMICA SIFLD ECEC H SQTZ SMICA |

* Regression model developed.

Table 50: Parameter estimates for the regression model for predicting site index of upland oak on Lithic and Typic Dystrochrepts

| Variable | df | Parameter estimate | Standard error | T for H0: parameter = 0 | PROB > \|T\| |
|---|---|---|---|---|---|
| Intercept | 1 | 57.52299 | 4.340806 | 13.252 | 0.0001 |
| DTR | 1 | -0.64869 | 0.178026 | -3.644 | 0.0009 |
| $Al^{3+}$ | 1 | 5.81381 | 2.144018 | 2.712 | 0.0107 |
| ECECLAY | 1 | -0.37818 | 0.157036 | -2.408 | 0.0220 |
| SBS | 1 | 1.19565 | 0.316605 | 3.776 | 0.0007 |
| SIMICA | 1 | -0.36898 | 0.200413 | -1.841 | 0.0749 |
| ECEC | 1 | -2.97296 | 1.738491 | -1.710 | 0.0969 |

Table 51: Collinearity diagnostics for the variables in the regression model

| Eigenvector | Eigenvalue | Cond. index | Portion Intercep | Portion DTR | Portion $Al^{3+}$ |
|---|---|---|---|---|---|
| 1 | 5.8780 | 1.000 | 0.0016 | 0.0023 | 0.0003 |
| 2 | 0.6212 | 3.076 | 0.0003 | 0.0002 | 0.0030 |
| 3 | 0.2485 | 4.863 | 0.0037 | 0.0092 | 0.0032 |
| 4 | 0.1572 | 6.113 | 0.0110 | 0.3529 | 0.0004 |
| 5 | 0.0559 | 10.250 | 0.7125 | 0.0969 | 0.0103 |
| 6 | 0.0341 | 13.123 | 0.2030 | 0.3195 | 0.0228 |
| 7 | 0.0050 | 34.122 | 0.0678 | 0.2190 | 0.9600 |

| Eigenvector | Portion ECECLAY | Portion SBS | Portion SIMICA | Portion ECEC |
|---|---|---|---|---|
| 1 | 0.0015 | 0.0009 | 0.0064 | 0.0003 |
| 2 | 0.0000 | 0.0639 | 0.0411 | 0.0001 |
| 3 | 0.0101 | 0.0066 | 0.9207 | 0.0011 |
| 4 | 0.0922 | 0.0043 | 0.0001 | 0.0050 |
| 5 | 0.0313 | 0.0391 | 0.0002 | 0.0273 |
| 6 | 0.8636 | 0.0412 | 0.0310 | 0.0443 |
| 7 | 0.0012 | 0.8442 | 0.0006 | 0.9219 |

Table 52: Observed and predicted site indices for upland oak growing on soils classified as Lithic (L) and Typic (T) Dystrochrepts by the regression model with standard errors of prediction, 95% confidence limits, and residuals

| Profile | Site index Obs. | Site index Pred. | STD ERR Pred. | Confidence Limits L95% | Confidence Limits U95% | Resid. |
|---|---|---|---|---|---|---|
| 1 | 39 | 47.1 | 2.928 | 32.388 | 61.870 | -8.1 |
| 2 | 51 | 53.8 | 2.238 | 39.586 | 68.048 | -2.8 |
| 3 | 60 | 47.3 | 2.525 | 32.877 | 61.734 | 12.7 |
| 4 | 50 | 56.1 | 2.120 | 41.894 | 70.205 | -6.1 |
| 5 | 54 | 55.9 | 1.912 | 41.902 | 69.967 | -1.9 |
| 6 | 57 | 53.4 | 3.084 | 38.562 | 68.307 | 3.6 |
| 7 | 48 | 55.8 | 1.986 | 41.728 | 69.878 | -7.8 |
| 8 | 63 | 62.1 | 2.282 | 47.887 | 76.406 | 0.9 |
| 9 | 56 | 53.4 | 4.231 | 37.370 | 69.371 | 2.6 |
| 10 | 61 | 55.2 | 1.684 | 41.243 | 69.064 | 5.8 |
| 11 | 62 | 51.9 | 1.574 | 38.021 | 65.735 | 10.1 |
| 12 | 68 | 60.8 | 2.326 | 46.487 | 75.066 | 7.2 |
| 13 | 45 | 55.2 | 2.080 | 41.113 | 69.375 | -10.2 |
| 14 | 58 | 52.5 | 2.031 | 38.411 | 66.614 | 5.5 |
| 15 | 56 | 52.0 | 2.716 | 37.414 | 66.558 | 4.0 |
| 16 | 59 | 57.6 | 3.129 | 42.646 | 72.470 | 1.4 |
| 17 | 60 | 57.5 | 1.891 | 43.444 | 71.485 | 2.5 |
| 18 | 43 | 54.5 | 3.204 | 39.536 | 69.492 | -11.5 |
| 19 | 67 | 61.7 | 2.498 | 47.253 | 76.071 | 5.3 |
| 20 | 53 | 55.1 | 1.964 | 41.028 | 69.152 | -2.1 |
| 21 | 41 | 48.6 | 1.789 | 34.615 | 62.544 | -7.6 |
| 22 | 37 | 50.1 | 3.682 | 34.664 | 65.516 | -13.1 |
| 23 | 51 | 53.2 | 1.573 | 39.344 | 67.057 | -2.2 |
| 24 | 54 | 53.1 | 2.087 | 38.983 | 67.253 | 0.9 |
| 25 | 60 | 60.6 | 6.054 | 42.364 | 78.904 | -0.6 |
| 26 | 66 | 61.4 | 2.818 | 46.721 | 76.026 | 4.6 |
| 27 | 52 | 51.5 | 2.156 | 37.349 | 65.704 | 0.5 |
| 28 | 52 | 40.9 | 3.164 | 26.006 | 55.891 | 11.1 |
| 29 | 49 | 46.8 | 1.844 | 32.777 | 60.765 | 2.2 |
| 30 | 45 | 49.0 | 2.021 | 34.920 | 63.110 | -4.0 |
| 31 | 35 | 41.6 | 3.524 | 26.360 | 56.907 | -6.6 |
| 32 | 58 | 53.7 | 2.358 | 39.402 | 68.024 | 4.3 |
| 33 | 55 | 61.6 | 4.355 | 45.516 | 77.791 | -6.7 |
| 34 | 61 | 60.8 | 2.796 | 46.187 | 75.455 | 0.2 |
| 35 | 63 | 63.2 | 2.834 | 48.506 | 77.836 | -0.2 |
| 36 | 48 | 48.8 | 2.237 | 34.532 | 62.992 | -0.8 |
| 37 | 43 | 40.8 | 3.057 | 25.938 | 55.636 | 2.2 |
| 38 | 45 | 44.7 | 4.166 | 28.806 | 60.664 | 0.3 |
| 39 | 63 | 58.6 | 2.613 | 44.143 | 73.131 | 4.4 |

# Conclusions

The results of this study indicate that numerous properties used to characterize and classify soils are not normally distributed. Therefore, parametric statistical procedures are not appropriate for evaluating class differences because of the low number of samples resulting from time and cost constraints. Alternative statistical procedures based on ranks of the data values require less stringent assumptions, provide extremely robust results since they are very insensitive to outliers, and are well suited to small sample sizes. Ranks of variables used in multivariate procedures provide a common mean and variance, and scale and location attributes of the variables are automatically removed. The distribution of the distance in multivariate analysis is nonparametric and depends only on the assumption that the data are distributed continuously.

Site indices for upland oak were not significantly different for soils classified as members of the loamy-skeletal, mixed, mesic families of Lithic and Typic Dystrochrepts. Site indices were slightly higher for soils classified as Lithic Dystrochrepts. These results can be explained by the well distributed rainfall pattern which decreases the importance of the greater available-water capacity of the Typic Dystrochrepts. In addition, the Lithic Dystrochrepts have higher exchangeable $Ca^{2+}$ and lower exchangeable $Al^{3+}$ saturation of the cation-exchange capacity than do Typic Dystrochrepts.

Based on quantile distributions of the data, depth to bedrock was the only property that did not exhibit considerable overlap among classes based on parent materials or on taxonomic criteria. Differences in depth to bedrock was the criterion for distinguishing between soils classified as Lithic and Typic Dystrochrepts by the current classification scheme. Therefore, results of this study indicate that dissection of the scale of depth to bedrock did not produce disjoint division of the scale of other properties important to use and management. However, depth to bedrock is an important consideration for engineering uses of these soils.

Differentiation of classes of soils based on a single property is time consuming and not very informative since soils respond as integrated systems. By considering classes of soils based on the division of the scale of a single property, we cannot be sure that natural groups of soils that respond differently to use and management exist.

Multivariate statistical procedures, such as principal component, cluster, and discriminant analysis, can be used to access the similarities or differences among numerous soil individuals based on several properties considered simultaneously. Therefore, the requirement that the classification scheme be based on only a few properties because the human mind can consider only a few things at a time may no longer be a valid requirement in light of the capabilities of the computer. Multivariate procedures - e.g. principal component and discriminant analysis - can be used to determine (1) whether natural groups of soils exist based on several properties considered simultaneously, (2) which properties actually contribute to the separation of the groups, and (3) the extent of the contribution of each property. Therefore, these statistical procedures provide an objective, heuristic method for establishing criteria for defining soil series below the family level in the current classification scheme.

Based on the results of the Kruskal-Wallis, principal component, cluster, and discriminant analyses of the groups of soils developed from these parent materials, sufficient evidence exists to support the separation of soils developed from rocks of the Chilhowee group and from rocks of the Rome-Waynesboro formation from each other and from the other parent materials. However, separation of the soils developed from the Athens and Martinsburg formations from soils developed from the Millboro, Brallier, and Chemung formations is not supported by these data.

Based the results of this study, we recommend (1) that soils developed from rocks of the Chilhowee group be named and correlated by the Sylco and the proposed Sylvatus series (Appendix A), (2) that soils developed from rocks of the Rome-Waynesboro formation be named and correlated by the Litz and the proposed Chiswell series (Appendix A), and (3) that soils developed from the shale and fine-grained sandstone facies of the Athens and Martinsburg formations and and soils developed from the Millboro, Brallier, and Chemung formations be named and correlated by the Berks and Weikert series.

The results of this study support the recommendations made by H. C. Porter, W. H. Creggar, H. C. Hudson, and H. L. Mathews, who mapped the soils of Montgomery County, and by the soil surveyors mapping soils in the study area for separating soils developed from these parent materials and provide a means for substantiating the intuitive estimates of soil surveyors.

A regression model based on base saturation by sum of cations gave the highest $R^2$ value for predicting site index for upland oak growing on these soils. Although no significant difference in site index was observed for classes of soils based on a limit of 20 inches to bedrock, depth to bedrock was an important character for predicting site index on these soils since depth to bedrock and base saturation by sum of cations gave the second highest $R^2$ value.

The development of a useable multiple regression equation for predicting site index of upland oak growing on these soils was influenced by collinearity of the soil and site properties on which the prediction equation was based, by the lack of even-aged, well-stocked timber stands at the sample sites, and by an inability to access nutrient levels and the amount of available moisture during the growing season.

# Literature Cited


Afifi, A. A., and V. Clark. 1984. Computer-aided multivariate analysis. Lifetime Learning Publications. Belmont, Calif.

Agricultural Yearbook Committee. 1941. Climate and man, yearbook of agriculture. U. S. Dept. of Agric.. U. S. Government Printing Office, Washington, D.C.

Arkley, R. J. 1976. Statistical methods in soil classification research. Adv. Agron. 28:37-70.

Auchmoody, L. R., and H. C. Smith. 1979. Oak soil-site relationships in northwestern West Virginia. NE Forest Exp. Stn., U. S. Dept. of Agric., Forest Serv., Res. Paper NE-434.

Barnes, B. V., K. S. Pregitzer, T. A. Spies, and V. H. Spooner. 1982. Ecological forest site classification. J. For. 80:493-498.

Bartholomew, M. J., and W. D. Lowry. 1979. Geology of the Blacksburg quadrangle, Virginia: Va. Div. of Miner. Res., Publ. 14 (GM81B), text and 1:24,000 scale map, Blacksburg, Va.

Broadfoot, W. M. 1969. Problems in relating soil to site index for southern hardwoods. For. Sci. 15:344-354.

Butler, B. E. 1980. Soil classification for soil survey. Clarendon Press, Oxford.

Butts, C. 1933. Geologic map of the Appalachian Valley in Virginia. Va. Geol. Survey., Va. Div. of Miner. Res., Charlottesville, Va.

Butts, C. 1940. Geology of the Appalachian Valley in Virginia. Part 1. Geologic text and illustrations. Va. Geol. Surv. Bull. 52, Va. Div. of Miner. Res., Charlottesville, Va.

Carmean, W. H. 1961. Soil survey refinements needed for accurate classification of black oak site quality in southeastern Ohio. Soil Sci. Soc. Am. Proc. 25:394-397.

Carmean, W. H. 1965. Black oak site quality in relation to soil and topography in southeastern Ohio. Soil Sci. Soc. Am. Proc. 29:308-312.

Carmean, W. H. 1967. Soil survey refinements for predicting black oak site quality in southeastern Ohio. Soil Sci. Soc. Am. Proc. 31:805-810.

Cattell, R. B. 1965. Factor analysis: an introduction to essentials II. The roll of factor analysis in research. Biometrics 21:405-435.

Cauley, P. M., R. K. Conner, R. L. Vick, B. A. Poulan, R. C. Cronce, T. L. Arnold, C. K. Staples, and D. A Gall. 1985. Soil survey of Pulaski County, Virginia. U. S. Dept. of Agric., Soil Conserv. Serv., U. S. Government Printing Office, Washington, D.C.

Chapman, H. D. 1965. Cation-exchange capacity. *In* C. A. Black et al. eds. Methods of soil analysis. Part 2. Chemical and microbiological properties. Agronomy 9:891-901. American Society of Agronomy, Madison, Wisc.

Coile, T. S. 1952. Soil and the growth of forests. Adv. Agron. 4:329-398.

Coleman, N. T., S. B. Weed, and R. J. McCracken. 1959. Cation-exchange capacity and exchangeable cations in Piedmont soils of North Carolina. Soil Sci. Soc Am. Proc. 23:146-149.

Creggar, W. H., H. C. Hudson, and H. C. Porter. 1985. Soil Survey of Montgomery County, Virginia. U. S. Dept. of Agric., Soil Conserv. Serv., U. S. Government Printing Office, Washington, D.C.

Davis, J. C. 1973. Statistics and data analysis in geology. John Wiley and Sons, New York.

Day, P. R. 1965. Particle fractionation and particle-size analysis. *In* C. A. Black et al. eds. Methods of soil analysis. Part 1. Physical and mineralogical analysis, including statistics of measurement and sampling. Agronomy 9:545-567. American Society of Agronomy, Madison, Wisc.

Doolittle, W. T. 1957. Site index of scarlet and black oak in relation to southern Appalachian soil and topography. For. Sci. 3:114-124.

Doolittle, W. T. 1958. Site index comparisons of several forest species in the southern Appalachians. Soil Sci. Soc. of Am. Proc. 22:455-458.

Edmonds, W. J. 1983. Grouping of soil profiles in three mapping units by conventional and numerical classifications. Ph.D. Thesis. Va. Poly. Inst. and State Univ. Blacksburg. Diss. Abstr. 83-16872.

Edmonds, W. J., and D. D. Rector. 1985. Properties and classification of residual soils derived from Cambrian and Ordovician limestones and dolomites in southwestern Virginia. Va. Agric. Exp. Stn. Bull. 85-10, Blacksburg.

Edmonds, W. J., and J. Stiegler. 1982. Soil survey of Clarke County, Virginia. U. S. Dept. of Agric., Soil Conserv. Serv., U. S. Government Printing Office, Washington, D.C.

Fenneman, N. M. 1938. Physiography of eastern United States. McGraw-Hill, New York.

Fernald, M. L. 1950. Gray's manual of botany - Eighth (centennial) edition - illustrated. American Book Company, New York.

Graney, D. L., and E. R. Ferguson. 1972. Shortleaf pine site-index relationships in the Ozark Highlands. Soil Sci. Soc. Am. Proc. 36:495-500.

Gould, P. R. 1967. On the geographical interpretation of eigenvalues. Trans. Inst. Br. Geogr. 42:53-86.

Haines, S. G., and G. Cleveland. 1981. Seasonal variation in properties of five forest soils in southwest Georgia. Soil Sci. Soc. Am. J. 45:139-143.

Hannah, P. R. 1968A. Estimating site index for white and black oak in Indiana from soil and topographic factors. J. For. 66:412-417.

Hannah, P. R. 1968B. Topographic relations for white and black oak in southern Indiana. North Central Forest Exp. Stn.. U. S. Dept. of Agric., Forest Serv., Res. Paper NC-25.

Hatfield, W. F., and J. W. Warner. 1973. Soil survey of Jefferson County, West Virginia. U. S. Dept. of Agric., Soil Conserv. Serv., U. S. Government Printing Office, Washington, D.C.

Hockman, J. R., J. C. McKenny, T. R. Burruss, D, Jones, and R. F. Modesitt. 1979. Soil survey of Augusta County, Virginia. U. S. Dept. of Agric., Soil Conserv. Serv., U. S. Government Printing Office, Washington, D.C.

Hockman, J. R., C. F. Neal, D. L. Racey, and D. F. Wagner. 1982. Soil survey of Rockingham County, Virginia. U. S. Dept. of Agric., Soil Conserv. Serv., U. S. Government Printing Office, Washington, D.C.

Hollander, M., and D. A. Wolfe. 1973. Nonparametric statistical analysis. John Wiley and Sons, New York.

Holmes, R., D. Wagner, and D. Racey. 1984. Soil survey of Warren County, Virginia. U. S. Dept. of Agric., Soil Conserv. Serv., U. S. Government Printing Office, Washington, D.C.

Jackson, M. L. 1958. Soil chemical analysis. Prentice-Hall, Inc. New Jersey.

Jones, J. R. 1969. Review and comparison of site evaluation methods. Rocky Mountain Forest and Range Exp. Stn.. U. S. Dept. of Agric., Forest Serv., Res. Paper RM-51.

Lebart, L., A. Morineau, and K. W. Warwick. 1984. Multivariate descriptive statistical analysis - Correspondence analysis and related techniques for large matrices. John Wiley and Sons, New York.

Mader, D. L. 1963. Soil variability - a serious problem in soil-site studies in the northeast. Soil Sci. Soc. Am. Proc. 27:707-709.

Mather, P. M. 1976. Computational methods in multivariate analysis in physical geography. John Wiley and Sons, New York.

Miller, R. G., Jr. 1986. Beyond anova, basics of applied statistics. John Wiley and Sons, New York.

McNab, W. H. 1984. Geomorphic factors associated with quality of yellow-poplar sites in the southern Appalachians. *In* Third Biennial Southern Silvicultural Res. Conf. Atlanta, Georgia, 7-8 Nov. 1984. U. S. Dept. of Agric., Forest Serv., Southern Forest Exp. Stn. General Technical Rep. SO-54.

Nunn, L. C., and J. P. Vimmerstedt. 1980. Predicting height growth for yellow-poplar from soils and topography in southern Ohio. Soil Sci. Soc. Am. J. 44:384-387.

Ott, L. 1984. An introduction to statistical methods and data analysis, second edition. Duxbury Press, Boston.

Peech, M. 1965. Exchange acidity. *In* C. A. Black et al. eds. Methods of soil analysis. Part 2. Chemical and mineralogical properties. Agronomy 9:905-913. American Society of Agronomy, Madison, Wisc.

Pirkle, E. C., and W. H. Yoho. 1982. Natural landscapes of the United States, third edition. Kendall/Hunt Publishing Co., Dubuque, Iowa.

Pirie, W. R. 1982. User's guide for the Virginia Tech nonparametric statistics package. Statistics Dept. Va. Tech, Blacksburg.

SAS Institute, Inc. 1985a. SAS user's guide: basics, version 5 edition. Cary, NC: SAS Institute, Inc.

SAS Institute, Inc. 1985b. SAS user's guide: statistics, version 5 edition. Cary, NC: SAS Institute, Inc.

Shetron, S. G. 1972. Forest site productivity among soil taxonomic units in lower Michigan. Soil Sci. Soc. Am. Proc. 36:358-363.

Smalley, G. W. 1984. Classification and evaluation of forest sites in the Cumberland Mountains. Southern Forest Exp. Stn. U. S. Dept. Agric., Forest Serv., General Technical Rep. SO-50.

Smith, G. D. 1963. Objectives and basic assumptions of the new classification system. Soil Sci. 96:6-16.

Sneath, P. H. A., and R. R. Sokal. 1973. Numerical taxonomy. W. H. Freeman and Co., San Francisco.

Soil Survey Staff. 1960. Soil classification: a comprehensive system, seventh approximation. U. S. Dept. of Agric., Soil Conserv. Serv., U. S. Government Printing Office, Washington, D.C.

Soil Survey Staff. 1975. Soil taxonomy: a basic system for soil classification for making and interpreting soil surveys. Agric. Handb. 436. U. S. Dept. of Agric., Soil Conserv. Serv., U. S. Government Printing Office, Washington, D.C.

Stage, A. R. 1976. An expression for the effect of aspect, slope, and habitat type on tree growth. For. Sci. 22:457-460.

SuperCalc3 Release 2. 1984. User's guide and reference manual, first edition. SORCIM/IUS Micro Software, San Jose, Calif.

Trimble, G. R. 1968. Growth of Appalachian hardwoods as affected by site and residual stand density. NE Forest Exp. Stn. U. S. Dept. Agric., Forest Serv., Res. Paper NE-98.

Trimble, G. R., and S. Weitzman. 1956. Site index studies of upland oaks in the northern Appalachians. For. Sci. 2:162-173.

Van Lear, D. H., and J. F. Hosner. 1967. Correlation of site index and soil mapping units: poor for yellow-poplar in southwest Virginia. J. For. 65:22-24.

Webster, R. 1968. Fundamental objections to the 7th approximation. J. Soil Sci. 19:354-356.

Webster, R. 1977. Quantitative and numerical methods in soil classification and survey. Clarendon Press, Oxford.

Webster, R., and A. B. McBratney. 1981. Soil segment overlay in character space and its implications for soil classification. J. Soil Sci 32:133-147.

Yawney, H. W., and G. R. Trimble, Jr., 1968. Oak soil-site relationships in the Ridge and Valley region of West Virginia and Maryland. NE Forest Exp. Stn., U. S. Depart. of Agric., Forest Serv., Res. Paper NE-96.

Yuan, T. L. 1959. Determination of exchangeable hydrogen in soils by a titration method. Soil Sci. 88:164-167.

# Appendix A - Soil series proposed based on this study

## *Chiswell Series*

Proposed Series
DDR, DAG, WJE
8/86

CHISWELL SERIES

The Chiswell series consists of shallow, well drained, moderately permeable soils on uplands. They formed in materials weathered from shales, siltstones, and fine-grained sandstones. Slopes range from 2 to 80 percent. Mean annual air temperature is 55 degrees F. Mean annual precipitation is 42 inches.

Taxonomic Class: Loamy-skeletal, mixed, mesic Lithic Dystrochrepts

Typical Pedon: Chiswell very channery silt loam - on a 29 percent convex south-facing slope in a hardwood forest. (Colors are for moist soil.)

A -- 0 to 3 inches; dark reddish brown (5YR 3/3) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 45 percent rock fragments; extremely acid; clear wavy boundary. (2 to 6 inches thick).

Bw -- 3 to 13 inches; reddish brown (5YR 4/3) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; common fine and medium roots; common faint silt coatings on rock fragments; 50 percent rock fragments; extremely acid; clear smooth boundary. (3 to 15 inches thick).

R -- 13 inches; mottled yellowish red (5YR 5/6) and reddish brown (5YR 4/4) shale.

Type Location: Wythe County, Virginia; about 0.5 mile southeast 137 degrees of the junction of Highways VA-619 and VA-629 and 1.5 miles east 88 degrees of the junction of Highways VA-627 and VA-628.

Range in Characteristics: Solum thickness ranges from 5 to 19 inches. Depth to bedrock ranges from 10 to 20 inches. Rock fragments of shale, siltstone, or fine-grained sandstone range from 5 to 70 percent in the A horizon, from 20 to 80 percent in the Bw horizon, and from 45 to 90 percent in the C horizon. Reaction ranges from very strongly acid through moderately acid, unless limed.

The A horizon has hue of 5YR through 10YR, value of 3 through 5, and chroma of 2 through 5. It is silt loam or loam in the fine-earth fraction.

The Bw horizon has hue of 5YR through 10YR, value of 4 through 6, and chroma of 3 through 6. It is silt loam, loam, silty clay loam, or clay loam in the fine-earth fraction.

The C horizon, where present, has hue of 5YR through 5Y, value of 4 through 6, and chroma of 3 through 8. It is silt loam, loam, silty clay loam, or clay loam in the fine-earth fraction.

Competing Series: Arnot, Dimal, Klinesville, Nassau, Sylvatus. Unicoi, Weikert, and Zango series are in the same family. Arnot and Nassau soils are developed in a mantel of glacial till. Arnot soils are underlain with sandstone bedrock and Nassau soils are underlain with slate bedrock. Woodland site indexes are less than 55 for Arnot and Nassau soils. Dimal soils have clay loam in the surface layer and have from 140 to 180 inches of annual rainfall. Klinesville soils have 5YR through 10R hue and includes rock fragments of slate. Sylvatus soils have more acid reactions, less exchangeable potassium, less silt, more clay, and more quartz in the sand fraction. Sylvatus soils have site indices less than 65 for northern red oak. Zango soils are in MLRA 1, 2, or 3 and no information is available for differentiation. Unicoi soils are underlain with arkose and arkosic sandstone bedrock and include rock fragments of arkose and arkosic sandstone. Weikert soils have 10 to 40 percent kaolinite in the clay fraction and woodland site indexes less than 65 for northern red oak.

Geographic Setting: Chiswell soils formed in materials weathered from shales, siltstones, and fine-grained sandstones of the Rome-Waynesboro formation. They are on gently sloping ridgetops and very steep convex sideslopes in the Valley and Ridge province. Slopes range form 2 to 80 percent. The climate is temperate and humid. The mean air temperature ranges form 53 degrees to 56 degrees F. The mean annual precipitation ranges form 38 to 45 inches.

Geographically Associated Soils: These include the Austinville, Frederick, Groseclose, Litz, Marbie, Rayne, and Shelocta series. The Austinville, Frederick, Groseclose, and Rayne soils are deeper to bedrock, have continuous argillic horizons, and occur on similar landscape positions. Litz soils are deeper to bedrock, have discontinuous argillic horizons, and occur on similar landscape positions. Marbie and Shelocta soils are deeper to bedrock, have continuous argillic horizons, and occur along drainageways and in upland depressions.

Drainage and Permeability: Well drained. Permeability is moderate. Runoff is medium to very rapid.

Use and Vegetation: Native vegetation is mixed hardwoods and pines. Northern aspects of steeper slopes commonly are wooded. Southern aspects and lower slope gradients are usually cleared and used for pasture and hay crops.

Distribution and Extent: Virginia and possibly West Virginia, Maryland, and Tennessee. The series is of large extent.

Series Proposed: Wythe County, Virginia, 1986. Additional proposed names are Riner and Laswell. Chiswell, Riner, and Laswell are village names in Wythe and Montgomery Counties.

Remarks: Diagnostic horizons and features recognized in this pedon are:

> Ochric epipedon - the zone from 0 to 3 inches (A horizon)
> Cambic horizon - the zone from 3 to 13 inches (Bw horizon)
> Lithic contact - shallow depth to shale bedrock (13 inches).

Soil now within the range of the Chiswell series were correlated in Berks, Klinesville, Webbtown, and Weikert in several published soil surveys.

Additional Data: Ranges for morphology, chemistry, particle-size distribution, and sand and silt minerals are based on 21 pedons. Ranges for clay minerals are based on 12 pedons. Dominant minerals in the sand fraction are quartz, 11 to 89 percent, and feldspar, 8 to 36 percent. Dominant minerals in the silt fraction are quartz, 53 to 83 percent, and feldspar, 17 to 46 percent. Dominant minerals in the clay fraction are mica, 11 to 74 percent; quartz, 5 to 45 percent; vermiculite, 5 to 28 percent; and kaolinite, 2 to 7 percent. Some of these data are reported by Edmonds (1983).

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# *Sylvatus Series*

Proposed Series
DDR, DAG, WJE
8/86

SYLVATUS SERIES

The Sylvatus series consists of shallow, well drained, moderately permeable soils on uplands. They formed in materials weathered from metasediments of phyllites, slates, shales, siltstones, and fine-grained sandstones. Slopes range from 2 to 80 percent. Mean annual air temperature is 55 degrees F. Mean annual precipitation is 42 inches.

Taxonomic Class: Loamy-skeletal, mixed, mesic Lithic Dystrochrepts

Typical Pedon: Sylvatus channery silt loam - on a 37 percent convex, south-facing slope in a mixed pine and hardwood forest. (Colors are for moist soil.)

A -- 0 to 3 inches, brown (10YR 4/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 30 percent rock fragments; clear smooth boundary. (1 to 3 inches)

Bw1 -- 3 to 7 inches, strong brown (7.5YR 5/6) channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; common fine, medium, and coarse roots; 25 percent rock fragments; clear smooth boundary.

Bw2 -- 7 to 15 inches, strong brown (7.5YR 5/6) extremely channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; common fine, medium, and coarse roots; 70 percent rock fragments; clear smooth boundary. (Combined thickness of the Bw - 7 to 14 inches)

C -- 15 to 18 inches, mottled reddish yellow (7.5YR 6/6) and very dark gray (10YR 3/1) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; 90 percent rock fragments; clear wavy boundary. (3 to 8 inches)

R -- 18 inches, reddish yellow (7.5YR 6/6) and very dark gray (10YR 3/1) phyllite.

Type Location: Wythe County, Virginia; about 3.4 miles southeast 149 degrees of the junction of Highways US-21 and VA-619 and 3.2 miles south 190 degrees of the junction of Highways VA-619 and VA-707.

Range in Characteristics: Solum thickness ranges from 10 to 18 inches. Depth to bedrock ranges from 10 to 20 inches. Rock fragments of metasediments, primarily phyllite, slate, shale, siltstone, or fine-grained sandstone, range from 15 to 75 percent in the A horizon, from 25 to 80 percent in the Bw horizon, and from 45 to 90 percent in the C horizon. Reaction ranges from extremely acid or very strongly acid.

The A horizon has hue of 10YR, value of 2 through 5, and chroma of 1 through 4. It is silt loam or loam in the fine-earth fraction.

The Bw horizon has hue of 7.5YR through 10YR, value of 5 through 6, and chroma of 4 through 8. It is silt loam, loam, silty clay loam, or clay loam in the fine-earth fraction.

The C horizon has hue of 5YR through 10YR, value of 3 through 5, and chroma of 6 through 8. It is silt loam, loam, silty clay loam, or clay loam in the fine-earth fraction.

Competing Series: Arnot, Chiswell, Dimal, Klinesville, Nassau, Unicoi, Weikert, and Zango series are in the same family. Arnot and Nassau soils are developed in a mantel of glacial till. Arnot soils are underlain with sandstone bedrock and Nassau soils are underlain with slate bedrock. Woodland site indexes are less than 55 for Arnot and Nassau soils. Chiswell soils have less acid reactions, more exchangeable potassium, more silt, less clay, and less quartz in the sand fraction. Chiswell soils have site indexes greater than 65 for northern red oak. Dimal soils have clay loam in the surface layer and have from 140 to 180 inches of annual rainfall. Klinesville soils have 5YR through 10R hue. Zango soils are in MLRA 1, 2, or 3. They have no information available for differentiation. Unicoi soils are underlain with arkose and arkosic sandstone bedrock and include rock fragments of arkose and arkosic sandstone. Weikert soils have more exchangeable calcium and magnesium and silt. Weikert soils lack silty clay loam textures in the Bw horizon.

Geographic Setting: Sylvatus soils formed in materials weathered from metasediments of phyllites, slates, shales, siltstones, and fine-grained sandstones of the Chilhowee group. They are on gently sloping ridgetops and very steep convex sideslopes in the Blue Ridge province. Slopes range form 2 to 80 percent. The climate is temperate and humid. The mean air temperature ranges form 53 degrees to 56 degrees F. The mean annual precipitation ranges form 38 to 45 inches.

Geographically Associated Soils: These include the Cataska, Dekalb, Jefferson, Lily, Matneflat, Sylco, and Tumbling series. Cataska, Dekalb, Lily, and Sylco soils are deeper to bedrock and occur on similar landscape positions. Jefferson, Matneflat, and Tumbling soils are deeper to bedrock and occur on colluvial fans and footslopes.

Drainage and Permeability: Well drained. Permeability is moderate. Runoff is medium to very rapid.

Use and Vegetation: Native vegetation is mixed hardwoods and pines.

Distribution and Extent: Virginia, North Carolina, and Tennessee. The series is of large extent.

Series Proposed: Wythe County, Virginia, 1986. Other proposed names are Pennywinckle and Stutler. Sylvatus, Pennywinckle, and Stutler are village names in Carroll and Wythe Counties.

Remarks: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - the zone from 0 to 3 inches (A horizon)
Cambic horizon - the zone from 3 to 15 inches (Bw horizon)
Lithic contact - shallow depth to phyllite bedrock (18 inches).

Soil now within the range of the Sylvatus series were correlated in Berks, Cataska, Ramsey, and Weikert in several published soil surveys.

Additional Data: Ranges for morphology, chemistry, particle-size distribution, and sand and silt minerals are based on 8 pedons. Dominant minerals in the sand fraction are quartz, 76 to 98 percent, and feldspar, 1 to 12 percent. Dominant minerals in the silt fraction are quartz, 52 to 83 percent, and feldspar, 1 to 21 percent. These data are contained in:

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# Appendix B - Profile descriptions and data

# *Profile RB1BQ: Sylco very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 2.0 miles southeast 112 degrees of the junction of Highways VA-603 and VA-608 and 2.0 miles east 98 degrees of the junction of Highways VA-757 and VA-716 in Rockbridge County.

*Vegetation:*

*Canopy:* eastern white pine (*Pinus strobus* L.) 30%, hickory (*Carya* Nutt.) 20%, white oak (*Quercus alba* L.) 20%, chestnut oak (*Quercus prinus* L.) 20%, and pitch pine (*Pinus rigida* Mill.) 10%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), eastern white pine (*Pinus strobus* L.), white oak (*Quercus alba* L.), persimmon (*Diospyros virginiana* L.), black gum (*Nyssa sylvatica* Marsh.), hickory (*Carya* Nutt.), pitch pine (*Pinus rigida* Mill.), and mountain-laurel (*Kalmia latifolia* L.)

*Site index:* eastern white pine (*Pinus strobus* L.) 60 and upland oaks (scarlet, black, northern red, and chestnut) 52

*Parent material:* Unicoi formation - phyllite

*Relief:* 1200 feet

*Elevation:* 1610 feet

*Slope:* 34 percent

*Aspect:* south 168 degrees

*Drainage:* well

A -- 0 to 2 inches, yellowish brown (10YR 5/4) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 40 percent rock fragments; clear wavy boundary.

Bw1 -- 2 to 8 inches, yellowish brown (10YR 5/6) very channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 40 percent rock fragments; clear wavy boundary.

Bw2 -- 8 to 19 inches, yellowish brown (10YR 5/6) very channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 45 percent rock fragments; clear wavy boundary.

C -- 19 to 25 inches, yellowish brown (10YR 5/6) soil material between reddish yellow (7.5YR 6/6) phyllite; extremely flaggy silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; 90 percent rock fragments; clear wavy boundary.

R -- 25 inches, reddish yellow (7.5YR 6/6) phyllite.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| RB1BQ | 0.23 | 0.05 | 0.20 | 0.48 | 12.2 | 3.93 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100(*SBAS* ÷ *NHCEC*).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB1BQ | 4.34 | 13.33 | 6.15 | 13.81 | 6.63 | 3.47 | 7.24 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100(*SBAS* ÷ *SCEC*), and EBS = 100(*SBAS* ÷ *ECEC*).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| RB1BQ | 78 | 35 | 22 | 34 | 35 | 204 | 457 | 339 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB1BQ | 50.4 | 92.7 | 44.5 | 36.0 | 19.6 | 40.7 |

Table E: Silt and sand mineralogy - taxonomic control section - RB1BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 680 | 70 | 50 | 0 | 0 | 200 |
| Sand | 550 | 380 | TR | 70 | 0 | 0 |
| 0.02-2 mm | 625 | 200 | 30 | 30 | 0 | 115 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly inter-stratified chlorite, vermiculite, and/or kaolinite.

# *Profile RB2BQ: Sylco channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 2.6 miles east 98 degrees of the junction of Highways VA-757 and VA-631 and 2.9 miles southeast 152 degrees of the junction of Highways VA-757 and VA-716 in Rockbridge County.

*Vegetation:*

*Canopy:* northern red oak (*Quercus rubra* L.) 40%, hickory (*Carya* Nutt.) 30%, chestnut oak (*Quercus prinus* L.) 20%, and eastern white pine (*Pinus strobus* L.) 10%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), American chestnut (*Castanea dentata* Marsh.), northern red oak (*Quercus rubra* L.), sassafras (*Sassafras albidum* Nutt.), and flowering dogwood (*Cornus florida* L.)

*Site index:* northern red oak (*Quercus rubra* L.) 52

*Parent material:* Unicoi formation - phyllite with arkose

*Relief:* 800 feet

*Elevation:* 2480 feet

*Slope:* 30 percent

*Aspect:* east 82 degrees

*Drainage:* well

A -- 0 to 2 inches, yellowish brown (10YR 5/4) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 15 percent rock fragments; clear smooth boundary.

Bw1 -- 2 to 7 inches, brownish yellow (10YR 6/6) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; common very fine, fine, and medium roots; 15 percent rock fragments; gradual wavy boundary.

Bw2 -- 7 to 18 inches, yellowish brown (10YR 5/6) very channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; common medium and coarse roots; 40 percent rock fragments; clear smooth boundary.

C -- 18 to 25 inches, yellowish brown (10YR 5/6) soil material between brownish yellow (10YR 6/8) and white (10YR 8/1) phyllite; extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; 90 percent rock fragments; clear wavy boundary.

R -- 25 inches, reddish yellow (7.5YR 6/6) phyllite.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| RB2BQ | 0.23 | 0.03 | 0.13 | 0.39 | 10.3 | 3.79 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB2BQ | 4.40 | 13.13 | 7.25 | 13.52 | 7.64 | 2.88 | 5.10 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| RB2BQ | 36 | 32 | 29 | 117 | 136 | 350 | 472 | 178 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB2BQ | 70.3 | 94.8 | 53.6 | 57.9 | 42.9 | 76.0 |

Table E: Silt and sand mineralogy - taxonomic control section - RB2BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 500 | 190 | 160 | 0 | 0 | 150 |
| Sand | 890 | 20 | 90 | TR | 0 | 0 |
| 0.02-2 mm | 710 | 100 | 120 | TR | 0 | 70 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile RB3BQ: Sylco channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 0.5 miles northeast 41 degrees of the junction of Highways US-60 and Blue Ridge Parkway and 2.6 miles east 100 degrees of the junction of Highways US-60 and US-501 in Rockbridge County.

*Vegetation:*

*Canopy:* scarlet oak (*Quercus coccinea* Muenchh.) 40%, chestnut oak (*Quercus prinus* L.) 40%, and pitch pine (*Pinus rigida* Mill.)

*Ground:* mountain-laurel (*Kalmia latifolia* L.), sassafras (*Sassafras albidum* Nutt.), American chestnut (*Castanea dentata* Marsh.), huckleberry (*Vaccinium arboreum* Marsh.), rhododendron (*Rhododendron catawbiense* Michx.), and red maple (*Acer rubrum* L.)

*Site index:* scarlet oak (*Quercus coccinea* Muenchh.) 49

*Parent material:* Unicoi formation - phyllite with arkose

*Relief:* 800 feet

*Elevation:* 2160 feet

*Slope:* 30 percent

*Aspect:* northwest 342 degrees

*Drainage:* well

A -- 0 to 2 inches, yellowish brown (10YR 5/6) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common very fine, fine, and medium roots; 15 percent rock fragments; clear smooth boundary.

Bw1 -- 2 to 10 inches, brownish yellow (10YR 6/6) very channery silt loam; weak medium and fine granular structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; common fine, medium, and coarse roots; 50 percent rock fragments; clear wavy boundary.

Bw2 -- 10 to 20 inches, brownish yellow (10YR 6/6) very channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; few medium roots; 50 percent rock fragments; clear wavy boundary.

C -- 20 to 25 inches, brownish yellow (10YR 6/6) soil material between light gray (10YR 7/1) phyllite; extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; 90 percent rock fragments; clear wavy boundary.

R -- 25 inches, light gray (10YR 7/1) phyllite.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| RB3BQ | 0.21 | 0.06 | 0.22 | 0.49 | 9.5 | 5.16 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB3BQ | 4.52 | 11.94 | 4.95 | 12.43 | 5.44 | 3.94 | 9.01 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| RB3BQ | 51 | 50 | 46 | 82 | 110 | 339 | 409 | 252 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB3BQ | 52.1 | 90.9 | 39.8 | 37.7 | 21.6 | 49.3 |

Table E: Silt and sand mineralogy - taxonomic control section - RB3BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 570 | 100 | 130 | 0 | 0 | 200 |
| Sand | 980 | 20 | TR | TR | 0 | 0 |
| 0.02-2 mm | 800 | 50 | 60 | TR | 0 | 90 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile BO1BQ: Sylvatus channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.4 miles southeast 154 degrees of the junction of Highways VA-606 and VA-640 and 2.5 miles east 90 degrees of the junction of Highways VA-711 and VA-647 in Botetourt County.

*Vegetation:*

*Canopy:* loblolly pine (*Pinus taeda* L.) 50% and black oak (*Quercus velutina* Lam.) 50%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), sassafras (*Sassafras albidum* Nutt.), American chestnut (*Castanea dentata* Marsh.), fern (*Asplenium*), black oak (*Quercus velutina* Lam.), mountain-laurel (*Kalmia latifolia* L.), and black gum (*Nyssa sylvatica* Marsh.)

*Site index:* loblolly pine (*Pinus taeda* L.) 48 and black oak (*Quercus velutina* Lam.) 39

*Parent material:* Harpers formation - phyllite

*Relief:* 800 feet

*Elevation:* 1590 feet

*Slope:* 23 percent

*Aspect:* west southwest 240 degrees

*Drainage:* well

A -- 0 to 2 inches, brown (10YR 5/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many fine and medium roots; 30 percent rock fragments; clear smooth boundary.

Bw -- 2 to 10 inches, brownish yellow (10YR 6/6) extremely channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 65 percent rock fragments; gradual wavy boundary.

C -- 10 to 18 inches, yellowish red (5YR 5/6) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few fine roots; 90 percent rock fragments; abrupt wavy boundary.

R -- 18 inches, reddish yellow (7.5YR 6/6) phyllite.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO1BQ | 0.32 | 0.04 | 0.13 | 0.49 | 9.5 | 5.16 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO1BQ | 4.42 | 11.74 | 3.80 | 12.23 | 4.29 | 4.01 | 11.42 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| BO1BQ | 66 | 47 | 37 | 46 | 30 | 226 | 496 | 278 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO1BQ | 40.0 | 88.5 | 31.0 | 34.2 | 15.4 | 44.0 |

Table E: Silt and sand mineralogy - taxonomic control section - BO1BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 810 | 140 | TR | 0 | TR | 50 |
| Sand | 800 | 100 | 60 | 0 | 0 | 40 |
| 0.02-2 mm | 805 | 115 | 30 | 0 | TR | 50 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile BO2BQ: Sylco very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 1.5 miles south 172 degrees of the junction of Highways VA-606 and VA-640 and 2.6 miles east 91 degrees of the junction of Highways VA-711 and VA-644 in Botetourt County.

*Vegetation:*

*Canopy:* scarlet oak (*Quercus coccinea* Muenchh.) 50%, pitch pine (*Pinus rigida* Mill.) 20%, chestnut oak (*Quercus prinus* L.) 20%, and shortleaf pine (*Pinus echinata* Mill.) 10%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), sassafras (*Sassafras albidum* Nutt.), mountain-laurel (*Kalmia latifolia* L.), black oak (*Quercus velutina* Lam.), black gum (*Nyssa sylvatica* Marsh.), fern (*Asplenium*), American chestnut (*Castanea dentata* Marsh.), and Galax (*Galax aphylla* L.)

*Site index:* scarlet oak (*Quercus coccinea* Muenchh.) 45

*Parent material:* Harpers formation - phyllite

*Relief:* 1000 feet

*Elevation:* 1400 feet

*Slope:* 32 percent

*Aspect:* northwest 316 degrees

*Drainage:* well

A -- 0 to 2 inches, dark brown (10YR 3/3) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 40 percent rock fragments; clear smooth boundary.

Bw -- 2 to 12 inches, light yellowish brown (10YR 6/4) extremely channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 70 percent rock fragments; clear smooth boundary.

C -- 12 to 20 inches, strong brown (7.5YR 5/8) and red (2.5YR 4/6) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few faint silt coatings on rock fragments; few fine roots; 90 percent rock fragments; abrupt smooth boundary.

R -- 20 inches, reddish yellow (7.5YR 6/6) phyllite.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO2BQ | 0.31 | 0.05 | 0.14 | 0.50 | 9.9 | 5.05 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO2BQ | 4.50 | 13.33 | 3.50 | 13.83 | 4.00 | 3.62 | 12.50 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| BO2BQ | 59 | 32 | 19 | 20 | 15 | 145 | 607 | 248 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO2BQ | 35.3 | 87.5 | 25.3 | 39.9 | 16.1 | 55.8 |

Table E: Silt and sand mineralogy - taxonomic control section - BO2BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 770 | 60 | 120 | 0 | TR | 50 |
| Sand | 890 | 60 | 0 | 0 | 0 | 50 |
| 0.02-2 mm | 800 | 60 | 90 | 0 | TR | 50 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile BO3BQ: Sylvatus very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.3 miles southeast 148 degrees of the junction of Highways VA-606 and VA-640 and 2.7 miles east 88 degrees of the junction of Highways VA-711 and VA-647 in Botetourt County.

*Vegetation:*

*Canopy:* northern red oak (*Quercus rubra* L.) 75% and Virginia pine (*Pinus virginiana* Mill.) 25%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), black gum (*Nyssa sylvatica* Marsh.), mountain-laurel (*Kalmia latifolia* L.), sassafras (*Sassafras albidum* Nutt.), red maple (*Acer rubrum* L.), teaberry (*Gaultheria procumbers* L.), and Galax (*Galax aphylla* L.)

*Site index:* northern red oak (*Quercus rubra* L.) 51

*Parent material:* Harpers formation - red siltstone

*Relief:* 800 feet

*Elevation:* 1525 feet

*Slope:* 20 percent

*Aspect:* north northwest 352 degrees

*Drainage:* well

A -- 0 to 3 inches, yellowish brown (10YR 5/4) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many fine, medium, and coarse roots; 45 percent rock fragments; clear smooth boundary.

Bw -- 3 to 10 inches, brownish yellow (10YR 6/6) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; few fine, medium, and coarse roots; 55 percent rock fragments; gradual wavy boundary.

C -- 10 to 13 inches, yellowish red (5YR 5/8) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; many faint silt coatings on rock fragments; few fine roots; 90 percent rock fragments; abrupt wavy boundary.

R -- 13 inches, yellowish red (5YR 5/8) siltstone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO3BQ | 0.32 | 0.05 | 0.15 | 0.52 | 5.9 | 8.81 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO3BQ | 4.67 | 8.36 | 2.10 | 8.88 | 2.62 | 5.86 | 19.85 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| BO3BQ | 28 | 22 | 25 | 78 | 64 | 217 | 542 | 241 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO3BQ | 35.5 | 80.1 | 23.6 | 24.5 | 10.9 | 36.8 |

Table E: Silt and sand mineralogy - taxonomic control section - BO3BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 780 | 70 | 100 | 0 | TR | 50 |
| Sand | 990 | 0 | 10 | 0 | 0 | 0 |
| 0.02-2 mm | 860 | 40 | 70 | 0 | TR | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WY1BQ: Sylvatus channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 3.4 miles southeast 149 degrees of the junction of Highways US-21 and VA-619 and 3.2 miles south 190 degrees of the junction of Highways VA-619 and VA-707 in Wythe County.

*Vegetation:*

*Canopy:* eastern white pine (*Pinus strobus* L.) 50%, northern red oak (*Quercus rubra* L.) 20%, white oak (*Quercus alba* L.) 20%, and chestnut oak (*Quercus prinus* L.) 10%

*Ground:* Galax (*Galax aphylla* L.), huckleberry (*Vaccinium arboreum* Marsh.), black oak (*Quercus velutina* Lam.), maple (*Acer* L.), eastern white pine (*Pinus strobus* L.), teaberry (*Gaultheria procumbers* L.), American chestnut (*Castanea dentata* Marsh.), Virginia pine (*Pinus virginiana* Mill.), blue beech (*Carpinus caroliniana* Walt.), greenbrier (*Smilax rotundifolia* L.), and rhododendron (*Rhododendron catawbiense* Michx.)

*Site index:* eastern white pine (*Pinus strobus* L.) 70 and upland oaks (scarlet, black, northern red, and chestnut) 60

*Parent material:* Unicoi formation - gray phyllite

*Relief:* 680 feet

*Elevation:* 3020 feet

*Slope:* 37 percent

*Aspect:* south 184 degrees

*Drainage:* well

A -- 0 to 3 inches, brown (10YR 4/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 30 percent rock fragments; clear smooth boundary.

Bw1 -- 3 to 7 inches, strong brown (7.5YR 5/6) channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; common fine, medium, and coarse roots; 25 percent rock fragments; clear smooth boundary.

Bw2 -- 7 to 15 inches, strong brown (7.5YR 5/6) extremely channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; common fine, medium, and coarse roots; 70 percent rock fragments; clear smooth boundary.

C -- 15 to 18 inches, mottled reddish yellow (7.5YR 6/6) and very dark gray (10YR 3/1) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; 90 percent rock fragments; clear wavy boundary.

R -- 18 inches, reddish yellow (7.5YR 6/6) and very dark gray (10YR 3/1) phyllite.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY1BQ | 0.07 | 0.06 | 0.12 | 0.25 | 10.1 | 2.48 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY1BQ | 4.50 | 9.75 | 3.35 | 10.00 | 3.60 | 2.50 | 6.94 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| WY1BQ | 55 | 41 | 36 | 48 | 29 | 209 | 526 | 265 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY1BQ | 33.1 | 93.0 | 33.5 | 38.1 | 13.6 | 37.7 |

Table E: Silt and sand mineralogy - taxonomic control section - WY1BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 590 | 140 | 150 | 0 | 20 | 100 |
| Sand | 900 | 40 | 60 | 0 | 0 | 0 |
| 0.02-2 mm | 710 | 100 | 120 | 0 | 10 | 60 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile WY2BQ: Sylvatus channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.3 miles west 278 degrees of the junction of Highways VA-602 and VA-653 and 2.9 miles south 184 degrees of the junction of Highways VA-619 and VA-602 in Wythe County.

*Vegetation:*

*Canopy:* white oak (*Quercus alba* L.) 40%, northern red oak (*Quercus rubra* L.) 20%, pitch pine (*Pinus rigida* Mill.) 20%, and eastern white pine (*Pinus strobus* L.) 20%

*Ground:* teaberry (*Gaultheria procumbers* L.), flowering dogwood (*Cornus florida* L.), eastern white pine (*Pinus strobus* L.), red maple (*Acer rubrum* L.), huckleberry (*Vaccinium arboreum* Marsh.), black oak (*Quercus velutina* Lam.), and hickory (*Carya* Nutt.)

*Site index:* white oak (*Quercus alba* L.) 50

*Parent material:* Unicoi formation - gray phyllite

*Relief:* 800 feet

*Elevation:* 2500 feet

*Slope:* 62 percent

*Aspect:* east 100 degrees

*Drainage:* well

A -- 0 to 3 inches, brown (10YR 5/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 25 percent rock fragments; clear smooth boundary.

Bw -- 3 to 10 inches, strong brown (7.5YR 5/4) extremely channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; few fine roots; few faint silt coatings on rock fragments; 65 percent rock fragments; clear smooth boundary.

R -- 10 inches, light olive brown (2.5Y 5/4) phyllite.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY2BQ | 0.28 | 0.32 | 0.31 | 0.91 | 11.3 | 8.05 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY2BQ | 4.85 | 10.95 | 2.90 | 11.86 | 3.81 | 7.67 | 23.88 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| WY2BQ | 82 | 50 | 44 | 40 | 40 | 265 | 495 | 240 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY2BQ | 25.6 | 76.1 | 24.4 | 47.1 | 15.9 | 49.4 |

Table E: Silt and sand mineralogy - taxonomic control section - WY2BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 730 | 100 | 100 | 0 | 20 | 50 |
| Sand | 760 | 70 | 120 | 0 | 0 | 50 |
| 0.02-2 mm | 740 | 90 | 110 | 0 | 10 | 50 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WY3BQ: Sylco loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 2.5 miles northwest 295 degrees of the junction of Highways VA-645 and VA-640 and 1.1 miles south 182 degrees of the junction of Highways VA-640 and VA-720 in Wythe County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 50%, black oak (*Quercus velutina* Lam.) 30%, and red maple (*Acer rubrum* L.) 20%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), American chestnut (*Castanea dentata* Marsh.), mountain-laurel (*Kalmia latifolia* L.), black oak (*Quercus velutina* Lam.), rhododendron (*Rhododendron catawbiense* Michx.), fern (*Asplenium*), azalea (yellow honeysuckle) (*Rhododendron calendulaceum* Michx.), and red maple (*Acer rubrum* L.),

*Site index:* chestnut oak (*Quercus prinus* L.) 35

*Parent material:* Erwin formation - yellow sandstone

*Relief:* 600 feet

*Elevation:* 3120 feet

*Slope:* 52 percent

*Aspect:* north 10 degrees

*Drainage:* well

A -- 0 to 1 inches, brown (10YR 5/3) loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 10 percent rock fragments; clear smooth boundary.

Bw1 -- 1 to 13 inches, light yellowish brown (10YR 6/4) channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 15 percent rock fragments; gradual wavy boundary.

Bw2 -- 13 to 29 inches, light yellowish brown (10YR 6/4) extremely channery silty clay loam; weak medium granular structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; few fine roots; 60 percent rock fragments; clear smooth boundary.

C -- 29 to 35 inches, yellowish brown (10YR 5/6) and light yellowish brown (10YR 6/4) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; few faint silt coatings on rock fragments; 90 percent rock fragments; clear wavy boundary.

R -- 35 inches, yellowish brown (10YR 5/6) fine-grained sandstone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY3BQ | 0.07 | 0.05 | 0.11 | 0.23 | 9.2 | 2.50 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY3BQ | 4.52 | 9.75 | 5.45 | 9.98 | 5.68 | 2.30 | 4.05 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| WY3BQ | 22 | 78 | 145 | 73 | 34 | 352 | 425 | 223 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY3BQ | 59.2 | 95.9 | 54.6 | 41.3 | 25.5 | 44.8 |

Table E: Silt and sand mineralogy - taxonomic control section - WY3BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 770 | 30 | 130 | 0 | 20 | 50 |
| Sand | 1000 | 0 | 0 | 0 | 0 | 0 |
| 0.02-2 mm | 900 | 10 | 60 | 0 | 10 | 20 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile SY1BQ: Sylvatus very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.7 miles west 271 degrees of the junction of Highways VA-650 and VA-16 and 0.5 miles northwest 319 degrees of the junction of Highways VA-741 and VA-16 in Smyth County.

*Vegetation:*

*Canopy:* scarlet oak (*Quercus coccinea* Muenchh.) 75% and black oak (*Quercus velutina* Lam.) 25%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), eastern white pine (*Pinus strobus* L.), mountain-laurel (*Kalmia latifolia* L.), rhododendron (*Rhododendron catawbiense* Michx.), American chestnut (*Castanea dentata* Marsh.), striped maple (*Acer pensylvanicum* L.), teaberry (*Gaultheria procumbers* L.), witchhazel (*Hamamelis virginiana* L.), azalea (yellow honeysuckle) (*Rhododendron calendulaceum* Michx.), serviceberry (*Amelanchier* Medic.), black gum (*Nyssa sylvatica* Marsh.), and Galax (*Galax aphylla* L.),

*Site index:* scarlet oak (*Quercus coccinea* Muenchh.) 54

*Parent material:* Hampton formation - gray shale

*Relief:* 800 feet

*Elevation:* 3020 feet

*Slope:* 33 percent

*Aspect:* south southwest 208 degrees

*Drainage:* well

A -- 0 to 2 inches, very dark grayish brown (10YR 3/2) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 40 percent rock fragments; clear smooth boundary.

Bw -- 2 to 12 inches, brownish yellow (10YR 6/6) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few fine, medium, and coarse roots; common faint silt coatings on rock fragments; 75 percent rock fragments; clear wavy boundary.

R -- 12 inches, mottled strong brown (7.5YR 5/8) and very dark gray (N 3/) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY1BQ | 0.18 | 0.13 | 0.32 | 0.63 | 17.3 | 3.64 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY1BQ | 4.46 | 18.11 | 5.35 | 18.74 | 5.98 | 3.36 | 10.54 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| SY1BQ | 55 | 54 | 48 | 74 | 59 | 290 | 446 | 264 |

*Hydrometer method (Day, 1965).

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY1BQ | 30.9 | 89.4 | 28.5 | 65.5 | 22.7 | 71.0 |

Table E: Silt and sand mineralogy - taxonomic control section - SY1BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 830 | 70 | 100 | 0 | TR | TR |
| Sand | 900 | 30 | 70 | 0 | 0 | TR |
| 0.02-2 mm | 870 | 50 | 80 | 0 | TR | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile SY2BQ: Sylvatus extremely flaggy silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.7 miles northwest 306 degrees of the junction of Highways VA-16 and VA-741 and 1.9 miles northwest 292 degrees of the junction of Highways VA-650 and VA-16 in Smyth County.

*Vegetation:*

*Canopy:* northern red oak (*Quercus rubra* L.) 50%, scarlet oak (*Quercus coccinea* Muenchh.) 20%, eastern white pine (*Pinus strobus* L.) 20%, and red maple (*Acer rubrum* L.) 10%

*Ground:* red maple (*Acer rubrum* L.), eastern white pine (*Pinus strobus* L.), eastern hemlock (*Tsuga canadensis* L.), mountain-laurel (*Kalmia latifolia* L.), rhododendron (*Rhododendron catawbiense* Michx.), Galax (*Galax aphylla* L.), black snakeroot (*Zigadensus densus* Desr.), teaberry (*Gaultheria procumbers* L.), and flowering dogwood (*Cornus florida* L.)

*Site index:* northern red oak (*Quercus rubra* L.) 57

*Parent material:* Hampton formation - green siltstone with some fine-grained sandstone

*Relief:* 800 feet

*Elevation:* 2840 feet

*Slope:* 54 percent

*Aspect:* south southwest 234 degrees

*Drainage:* well

A -- 0 to 2 inches, black (10YR 2/1) extremely flaggy silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 75 percent rock fragments; abrupt smooth boundary.

Bw -- 2 to 14 inches, brownish yellow (10YR 6/8) extremely flaggy silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common fine and medium roots; few faint silt coatings on rock fragments; 80 percent rock fragments; abrupt wavy boundary.

R -- 14 inches, light olive brown (2.5Y 5/4) siltstone.

Table A: Chemical properties - taxonomic control section

| | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| Profile | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY2BQ | 0.32 | 0.15 | 0.21 | 0.68 | 19.2 | 3.54 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY2BQ | 4.25 | 21.29 | 6.90 | 21.97 | 7.58 | 3.10 | 8.97 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| | Sand | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Profile | VC | C | M | F | VF | Total | Silt | Clay |
| | g $kg^{-1}$ of soil | | | | | | | |
| SY2BQ | 28 | 33 | 49 | 146 | 118 | 374 | 450 | 176 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY2BQ | 35.9 | 91.0 | 31.4 | 109.1 | 43.1 | 124.8 |

Table E: Silt and sand mineralogy - taxonomic control section - SY2BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 690 | TR | 210 | TR | 50 | 50 |
| Sand | 950 | 50 | TR | TR | 0 | 0 |
| 0.02-2 mm | 795 | 0 | 165 | TR | 20 | 20 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile SY3BQ: Gilpin silt loam*

*Classification:* fine-loamy, mixed, mesic Typic Hapludults

*Location:* About 2.7 miles south 190 degrees of the junction of Highways VA-676 and VA-614 and 2.1 miles southwest 208 degrees of the junction of Highways VA-675 and VA-677 in Smyth County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 40%, northern red oak (*Quercus rubra* L.) 30%, and scarlet oak (*Quercus coccinea* Muenchh.) 30%

*Ground:* chokeberry (*Pyrus melanocarpa* Michx.), red maple (*Acer rubrum* L.), mountain-laurel (*Kalmia latifolia* L.), black oak (*Quercus velutina* Lam.), huckleberry (*Vaccinium arboreum* Marsh.), chestnut oak (*Quercus prinus* L.), American chestnut (*Castanea dentata* Marsh.), teaberry (*Gaultheria procumbers* L.), rhododendron (*Rhododendron catawbiense* Michx.), eastern hemlock (*Tsuga canadensis* L.), and witchhazel (*Hamamelis virginiana* L.)

*Site index:* chestnut oak (*Quercus prinus* L.) 59

*Parent material:* Hampton formation - siltstone and fine-grained sandstone

*Relief:* 600 feet

*Elevation:* 3080 feet

*Slope:* 38 percent

*Aspect:* north 0 degrees

*Drainage:* well

A -- 0 to 1 inches, brown (10YR 4/3) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 5 percent rock fragments; clear smooth boundary.

E -- 1 to 7 inches, brownish yellow (10YR 6/6) silty clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common fine and medium roots; 10 percent rock fragments; clear wavy boundary.

Bt -- 7 to 25 inches, brownish yellow (10YR 6/6) channery silty clay loam; moderate medium subangular blocky structure; friable, sticky, plastic; common distinct clay films on faces of peds and rock fragments; common fine and medium roots; 25 percent rock fragments; clear wavy boundary.

R -- 25 inches, mottled yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) siltstone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY3BQ | 0.17 | 0.66 | 0.12 | 0.95 | 10.9 | 8.72 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY3BQ | 4.80 | 7.36 | 4.85 | 8.31 | 5.80 | 11.43 | 16.38 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| SY3BQ | 16 | 24 | 33 | 53 | 37 | 163 | 518 | 319 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY3BQ | 44.4 | 83.6 | 58.3 | 34.2 | 18.2 | 26.1 |

Table E: Silt and sand mineralogy - taxonomic control section - SY3BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 680 | 30 | 140 | 50 | TR | 100 |
| Sand | 900 | 20 | 80 | 0 | 0 | TR |
| 0.02-2 mm | 750 | 30 | 120 | 30 | TR | 70 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WA1BQ: Lily loam*

*Classification:* fine-loamy, siliceous, mesic Typic Hapludults

*Location:* About 1.6 miles southwest 257 degrees of the junction of Highways US-58 and VA-603 and 2.4 miles northwest 279 degrees of the junction of Highways US-58 and VA-601 in Washington County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 70%, scarlet oak (*Quercus coccinea* Muenchh.) 10%, white oak (*Quercus alba* L.) 10%, and maple (*Acer* L.) 10%

*Ground:* witchhazel (*Hamamelis virginiana* L.), Galax (*Galax aphylla* L.), chestnut oak (*Quercus prinus* L.), sassafras (*Sassafras albidum* Nutt.), eastern hemlock (*Tsuga canadensis* L.), mountain-laurel (*Kalmia latifolia* L.), yellow poplar (*Liridendron tulipifera* L.), black gum (*Nyssa sylvatica* Marsh.), maple (*Acer* L.), greenbrier (*Smilax rotundifolia* L.), and lily (*Lilium* L.)

*Site index:* chestnut oak (*Quercus prinus* L.) 59

*Parent material:* Unicoi formation - conglomerate

*Relief:* 600 feet

*Elevation:* 3080 feet

*Slope:* 41 percent

*Aspect:* northeast 48 degrees

*Drainage:* well

A -- 0 to 3 inches, very dark grayish brown (10YR 3/2) loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 5 percent rock fragments; clear smooth boundary.

Bt1 -- 3 to 14 inches, yellowish brown (10YR 5/8) sandy loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint clay films on faces of peds and rock fragments; common fine and medium roots; 10 percent rock fragments; gradual wavy boundary.

Bt2 -- 14 to 22 inches, strong brown (7.5YR 5/8) channery sandy clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common distinct clay films on faces of peds and rock fragments; few fine roots; 20 percent rock fragments; gradual wavy boundary.

C -- 22 to 26 inches, mottled yellowish red (5YR 5/8) and reddish yellow (7.5YR 6/8) extremely channery sandy loam; massive; friable, slightly sticky, slightly plastic; common distinct clay flows in relic rock joints; few fine roots; 90 percent rock fragments; clear smooth boundary.

R -- 26 inches, reddish yellow (7.5YR 6/8) conglomerate.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA1BQ | 0.25 | 0.08 | 0.09 | 0.42 | 6.6 | 6.36 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA1BQ | 4.60 | 4.78 | 3.65 | 5.20 | 4.07 | 8.08 | 10.32 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WA1BQ | 122 | 75 | 164 | 116 | 36 | 513 | 294 | 193 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA1BQ | 55.3 | 89.6 | 70.1 | 34.2 | 21.1 | 26.9 |

Table E: Silt and sand mineralogy - taxonomic control section - WA1BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 650 | 0 | 40 | 210 | 0 | 100 |
| Sand | 1000 | 0 | 0 | 0 | 0 | 0 |
| 0.02-2 mm | 900 | 0 | 10 | 60 | 0 | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WA2BQ: Sylvatus channery silt loam*

*Classification:* clayey-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.6 miles southwest 219 degrees of the junction of Highways US-58 and VA-603 and 2.0 miles southwest 254 degrees of the junction of Highways US-58 and VA-601 in Washington County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 60%, scarlet oak (*Quercus coccinea* Muenchh.) 20%, maple (*Acer* L.) 10%, and northern red oak (*Quercus rubra* L.) 10%

*Ground:* black oak (*Quercus velutina* Lam.), witchhazel (*Hamamelis virginiana* L.), rhododendron (*Rhododendron catawbiense* Michx.), goldenrod (*Solidago* L.), fern (*Asplenium*), eastern white pine (*Pinus strobus* L.), chestnut oak (*Quercus prinus* L.), northern red oak (*Quercus rubra* L.), greenbrier (*Smilax rotundifolia* L.), black gum (*Nyssa sylvatica* Marsh.), and huckleberry (*Vaccinium arboreum* Marsh.)

*Site index:* chestnut oak (*Quercus prinus* L.) 61

*Parent material:* Unicoi formation - siltstone

*Relief:* 600 feet

*Elevation:* 3100 feet

*Slope:* 60 percent

*Aspect:* west southwest 240 degrees

*Drainage:* well

A -- 0 to 2 inches, dark brown (10YR 3/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 25 percent rock fragments; abrupt smooth boundary.

Bw1 -- 2 to 6 inches, yellowish brown (10YR 5/4) very channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 35 percent rock fragments; clear wavy boundary.

Bw2 -- 6 to 13 inches, yellowish brown (10YR 5/8) extremely channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; few fine roots; 75 percent rock fragments; clear wavy boundary.

C -- 13 to 19 inches, reddish yellow (7.5YR 6/6) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; 90 percent rock fragments; abrupt smooth boundary.

R -- 19 inches, mottled strong brown (7.5YR 5/6), very dark gray (N 3/) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA2BQ | 0.22 | 0.08 | 0.21 | 0.51 | 19.2 | 2.66 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA2BQ | 4.30 | 21.29 | 11.05 | 21.80 | 11.56 | 2.34 | 4.41 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| WA2BQ | 53 | 38 | 64 | 65 | 37 | 257 | 382 | 361 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA2BQ | 57.5 | 95.5 | 50.6 | 53.2 | 32.0 | 60.4 |

Table E: Silt and sand mineralogy - taxonomic control section - WA2BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 520 | 100 | 110 | 0 | 220 | 50 |
| Sand | 950 | 50 | TR | TR | 0 | 0 |
| 0.02-2mm | 750 | 70 | 50 | TR | 110 | 20 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile WA3BQ: Sylvatus very channery silt loam*

*Classification:* clayey-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.9 miles southwest 244 degrees of the junction of Highways US-58 and VA-603 and 2.0 miles southwest 245 degrees of the junction of Highways US-58 and VA-601 in Washington County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 50%, black oak (*Quercus velutina* Lam.) 30%, and maple (*Acer* L.) 20%

*Ground:* teaberry (*Gaultheria procumbers* L.), American chestnut (*Castanea dentata* Marsh.), greenbrier (*Smilax rotundifolia* L.), sassafras (*Sassafras albidum* Nutt.), rhododendron (*Rhododendron catawbiense* Michx.), grape (*Vitis* L.), black oak (*Quercus velutina* Lam.), huckleberry (*Vaccinium arboreum* Marsh.), violet (*Viola* L.), wild ginger (*Asarum virginicum* L.), red maple (*Acer rubrum* L.), and northern red oak (*Quercus rubra* L.)

*Site index:* chestnut oak (*Quercus prinus* L.) 64

*Parent material:* Hampton formation - red and yellow shale

*Relief:* 600 feet

*Elevation:* 3100 feet

*Slope:* 55 percent

*Aspect:* west southwest 244 degrees

*Drainage:* well

A -- 0 to 1 inches, dark brown (10YR 3/3) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 45 percent rock fragments; clear smooth boundary.

Bw -- 1 to 15 inches, yellowish brown (10YR 5/6) extremely channery silty clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; few very fine and fine roots; 70 percent rock fragments; clear wavy boundary.

C -- 15 to 19 inches, brownish yellow (10YR 6/8) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; 90 percent rock fragments; clear wavy boundary.

R -- 19 inches, mottled red (2.5YR 5/6) and reddish yellow (7.5YR 6/8) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA3BQ | 0.18 | 0.05 | 0.19 | 0.42 | 14.3 | 2.94 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA3BQ | 4.40 | 15.32 | 5.45 | 15.74 | 5.87 | 2.67 | 7.16 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WA3BQ | 42 | 26 | 22 | 36 | 39 | 165 | 474 | 361 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA3BQ | 38.1 | 92.8 | 34.6 | 39.6 | 16.3 | 43.6 |

Table E: Silt and sand mineralogy - taxonomic control section - WA3BQ

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 700 | 70 | 110 | 0 | 70 | 50 |
| Sand | 860 | 40 | 100 | 0 | 0 | TR |
| 0.02-2 mm | 760 | 60 | 110 | 0 | 40 | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile BO1RO: Chiswell channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.9 miles east 79 degrees of the junction of Highways US-11 and VA-606 and 1.1 miles north 4 degrees of the junction of Highways US-11 and VA-639 in Botetourt County.

*Vegetation:*

*Canopy:* hickory (*Carya* Nutt.) 100%

*Ground:* black cherry (*Prunus serotina* Ehrh.), eastern redbud (*Cercis canadensis* L.), flowering dogwood (*Cornus florida* L.), Virginia creeper (*Pathenocissus quinquefolia* L.), ash (*Fraxinus* L.), red maple (*Acer rubrum* L.), black oak (*Quercus velutina* Lam.), rattlesnake plantain (*Goodyera pubescens* Willd.), bedstraw (*Galium triflorum*), green ash (*Fraxinus pennsylvanica* Marsh.), American chestnut (*Castanea dentata* Marsh.), and sassafras (*Sassafras albidum* Nutt.),

*Site index:* hickory (*Carya* Nutt.) 48 and upland oaks (scarlet, black, northern red, and chestnut) 48

*Parent material:* Rome formation - purple shale

*Relief:* 200 feet

*Elevation:* 1250 feet

*Slope:* 35 percent

*Aspect:* south 120 degrees

*Drainage:* well

A -- 0 to 2 inches, dark brown (10YR 3/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many fine and medium roots; 20 percent rock fragments; clear smooth boundary.

Bw -- 2 to 10 inches, yellowish brown (10YR 5/4) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few fine and medium roots; 80 percent rock fragments; clear smooth boundary.

R -- 10 inches, dark reddish brown (2.5YR 3/4) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO1RO | 0.53 | 0.12 | 0.18 | 0.83 | 7.4 | 11.22 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO1RO | 4.58 | 10.15 | 2.45 | 10.98 | 3.28 | 7.56 | 25.30 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| BO1RO | 98 | 70 | 47 | 49 | 51 | 315 | 523 | 162 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO1RO | 33.1 | 74.6 | 22.3 | 45.7 | 20.2 | 67.8 |

Table E: Silt and sand mineralogy - taxonomic control section - BO1RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 600 | 030 | 340 | 00 | 30 | TR |
| Sand | 590 | 100 | 310 | TR | 0 | 0 |
| 0.02-2 mm | 610 | 60 | 330 | TR | 20 | 0 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile BO2RO: Chiswell channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.7 miles southeast 152 degrees of the junction of Highways US-11 and VA-606 and 0.8 miles northwest 344 degrees of the junction of Highways VA-606 and VA-641 in Botetourt County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 100%

*Ground:* Japanese honeysuckle (*Lonicera japonica* Thunb.), Virginia pine (*Pinus virginiana* Mill.), eastern red cedar (*Juniperus virginiana* L.), black oak (*Quercus velutina* Lam.), blackberry (*Rhubus* L.), rose (*Rosa* L.), hickory (*Carya* Nutt.), sumac (*Rhus* L.), flowering dogwood (*Cornus florida* L.), may apple (*Epigaea repens* L.), ragweed (*Ambrosia* L.), and cinquefoil (*Potentilla* L.),

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 65 and upland oaks (scarlet, black, northern red, and chestnut) 63

*Parent material:* Rome formation - green shale

*Relief:* 250 feet

*Elevation:* 1190 feet

*Slope:* 31 percent

*Aspect:* north northwest 332 degrees

*Drainage:* well

A -- 0 to 2 inches, dark brown (10YR 3/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common fine and medium roots; 15 percent rock fragments; clear smooth boundary.

Bw -- 2 to 12 inches, yellowish brown (10YR 5/4) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few fine and medium roots; few faint silt coatings on rock fragments; 65 percent rock fragments; clear smooth boundary.

R -- 12 inches, interbedded olive (5Y 4/3) and yellow (2.5Y 7/8) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO2RO | 0.70 | 0.28 | 0.21 | 1.19 | 6.4 | 18.59 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO2RO | 5.11 | 6.57 | 1.45 | 7.76 | 2.64 | 15.34 | 45.08 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| BO2RO | 40 | 35 | 28 | 36 | 51 | 190 | 637 | 173 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO2RO | 22.6 | 54.9 | 18.6 | 37.0 | 15.3 | 44.9 |

Table E: Silt and sand mineralogy - taxonomic control section - BO2RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 650 | 20 | 320 | 0 | 10 | TR |
| Sand | 720 | 20 | 260 | 0 | 0 | 0 |
| 0.02-2 mm | 670 | 20 | 300 | 0 | 10 | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile BO3RO: Chiswell channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.2 miles east 98 degrees of the junction of Highways VA-640 and VA-645 and 1.6 miles northeast 65 degrees of the junction of Highways VA-640 and VA-606 in Botetourt County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 50%, hickory (*Carya* Nutt.) 40%, and white oak (*Quercus alba* L.) 10%

*Ground:* black oak (*Quercus velutina* Lam.), huckleberry (*Vaccinium arboreum* Marsh.), Japanese honeysuckle (*Lonicera japonica* Thunb.), hickory (*Carya* Nutt.), flowering dogwood (*Cornus florida* L.), ragweed (*Ambrosia* L.), eastern redbud (*Cercis canadensis* L.), sumac (*Rhus* L.), and red maple (*Acer rubrum* L.)

*Site index:* chestnut oak (*Quercus prinus* L.) 56

*Parent material:* Rome formation - green shale

*Relief:* 250 feet

*Elevation:* 1150 feet

*Slope:* 51 percent

*Aspect:* west southwest 244 degrees

*Drainage:* well

A -- 0 to 2 inches, very dark gray (10YR 3/1) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many fine and medium roots; 20 percent rock fragments; abrupt smooth boundary.

Bw -- 2 to 5 inches, brown (10YR 5/3) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common medium roots; few faint silt coatings on rock fragments; 45 percent rock fragments; clear smooth boundary.

C -- 5 to 7 inches, mottled olive (5Y 5/3) and light gray (N 6/) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few very fine roots; few faint silt coatings on rock fragments; 90 percent rock fragments; clear smooth boundary.

R -- 7 inches, olive (5Y 4/3) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO3RO | 2.05 | 1.32 | 0.43 | 3.80 | 12.0 | 31.67 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO3RO | 4.85 | 12.54 | 2.35 | 16.34 | 6.15 | 23.26 | 61.79 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| BO3RO | 159 | 123 | 95 | 92 | 28 | 497 | 390 | 113 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO3RO | 19.5 | 38.2 | 14.3 | 106.2 | 54.4 | 144.6 |

Table E: Silt and sand mineralogy - taxonomic control section - BO3RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 650 | 60 | 240 | TR | TR | 50 |
| Sand | 640 | 110 | 250 | 0 | 0 | 0 |
| 0.02-2 mm | 640 | 90 | 250 | TR | TR | 20 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile BO4RO: Chiswell cobbly silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.3 miles southwest 200 degrees of the junction of Highways VA-640 and VA-606 and 2.9 miles south 168 degrees of the junction of Highways VA-606 and US-11 in Botetourt County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 30%, chestnut oak (*Quercus prinus* L.) 20%, eastern white pine (*Pinus strobus* L.) 20%, yellow poplar (*Liridendron tulipifera* L.) 20%, and sourwood (*Oxydendrum arboreum* L.) 10%

*Ground:* eastern white pine (*Pinus strobus* L.), red maple (*Acer rubrum* L.), grape (*Vitis* L.), ash (*Fraxinus* L.), chestnut oak (*Quercus prinus* L.), Virginia creeper (*Pathenocissus quinquefolia* L.), sourwood (*Oxydendrum arboreum* L.), teaberry (*Gaultheria procumbers* L.), and sassafras (*Sassafras albidum* Nutt.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 63 and upland oaks (scarlet, black, northern red, and chestnut) 61

*Parent material:* Rome formation - red shale

*Relief:* 150 feet

*Elevation:* 1150 feet

*Slope:* 20 percent

*Aspect:* north 4 degrees

*Drainage:* well

A -- 0 to 3 inches, very dark grayish brown (10YR 3/2) cobbly silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 30 percent rock fragments; clear smooth boundary.

Bw -- 3 to 14 inches, yellowish brown (10YR 5/4) cobbly silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few very fine and fine roots; few faint silt coatings on rock fragments; 30 percent rock fragments; clear wavy boundary.

2C -- 14 to 18 inches, brown (7.5YR 5/4) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few very fine roots; few faint silt coatings on rock fragments; 90 percent rock fragments; abrupt wavy boundary.

2R -- 18 inches, reddish brown (5YR 5/4) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO4RO | 0.48 | 0.28 | 0.15 | 0.91 | 5.9 | 15.42 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO4RO | 4.75 | 7.16 | 2.30 | 8.07 | 3.21 | 11.28 | 28.35 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| BO4RO | 29 | 32 | 33 | 55 | 43 | 192 | 632 | 176 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO4RO | 38.9 | 71.6 | 28.5 | 33.5 | 18.2 | 45.9 |

Table E: Silt and sand mineralogy - taxonomic control section - BO4RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 800 | 30 | 170 | 0 | TR | TR |
| Sand | 890 | 0 | 110 | 0 | 0 | 0 |
| 0.02-2 mm | 830 | 20 | 150 | 0 | TR | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile BO5RO: Chiswell channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.9 miles east 96 degrees of the junction of Highways VA-738 and VA-658 and 1.4 miles northeast 60 degrees of the junction of Highways VA-604 and Blue Ridge Parkway in Botetourt County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 100%

*Ground:* hickory (*Carya* Nutt.), black cherry (*Prunus serotina* Ehrh.), poison oak (*Rhus radicans* L.), red maple (*Acer rubrum* L.), ash (*Fraxinus* L.), black oak (*Quercus velutina* Lam.), cinquefoil (*Potentilla* L.), rattlesnake plantain (*Goodyera pubescens* Willd.), sassafras (*Sassafras albidum* Nutt.), hawthorn (*Crataegus* L.), blackhaw (*Viburnum prunifolium* L.), and flowering dogwood (*Cornus florida* L.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 64 and upland oaks (scarlet, black, northern red, and chestnut) 62

*Parent material:* Rome formation - green limestone and shale

*Relief:* 225 feet

*Elevation:* 1325 feet

*Slope:* 35 percent

*Aspect:* west 278 degrees

*Drainage:* well

A -- 0 to 2 inches, dark grayish brown (10YR 4/2) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many fine and medium roots; 30 percent rock fragments; clear smooth boundary.

Bw -- 2 to 10 inches, light yellowish brown (10YR 6/4) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 55 percent rock fragments; gradual wavy boundary.

C -- 10 to 18 inches, mottled brownish yellow (10YR 6/8) and light olive brown (2.5Y 5/4) massive; weak fine granular structure; friable, slightly sticky, slightly plastic; many faint silt coatings on rock fragments; few fine roots; 90 percent rock fragments; abrupt wavy boundary.

R -- 18 inches, mottled brownish yellow (10YR 6/8) and light olive brown (2.5Y 5/4) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO5RO | 0.92 | 0.26 | 0.35 | 1.53 | 10.0 | 15.30 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO5RO | 4.59 | 15.32 | 3.75 | 16.85 | 5.28 | 9.08 | 28.98 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| BO5RO | 74 | 58 | 44 | 40 | 23 | 239 | 577 | 184 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO5RO | 37.5 | 71.0 | 22.2 | 54.3 | 28.7 | 91.6 |

Table E: Silt and sand mineralogy - taxonomic control section - BO5RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 550 | 90 | 270 | 0 | TR | 10 |
| Sand | 600 | 100 | 300 | 0 | 0 | 0 |
| 0.02-2 mm | 565 | 90 | 285 | 0 | TR | 60 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile WY1RO: Leck Kill silt loam*

*Classification:* coarse-loamy, mixed, mesic Ultic Hapludalfs

*Location:* About 0.8 miles southwest 255 degrees of the junction of Highways US-21 and VA-651 and 0.8 miles northwest 288 degrees of the junction of Highways US-21 and VA-670 in Wythe County.

*Vegetation:*

*Canopy:* white oak (*Quercus alba* L.) 40%, hickory (*Carya* Nutt.) 30%, black gum (*Nyssa sylvatica* Marsh.) 10%, chestnut oak (*Quercus prinus* L.) 10%, and pitch pine (*Pinus rigida* Mill.) 10%

*Ground:* black gum (*Nyssa sylvatica* Marsh.), flowering dogwood (*Cornus florida* L.), black locust (*Robinia Pesudo-Acacia* L.), black cherry (*Prunus serotina* Ehrh.), and may apple (*Epigaea repens* L.)

*Site index:* white oak (*Quercus alba* L.) 67, site not used in data analysis

*Parent material:* Rome formation - purple siltstone

*Relief:* 200 feet

*Elevation:* 2640 feet

*Slope:* 40 percent

*Aspect:* southeast 124 degrees

*Drainage:* well

Ap -- 0 to 3 inches, dark brown (7.5YR 3/2) loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 10 percent rock fragments; clear smooth boundary.

Bt1 -- 3 to 14 inches, reddish brown (5YR 4/3) channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint clay films on faces of peds and rock fragments; common very fine, fine, and medium roots; 15 percent rock fragments; gradual wavy boundary.

Bt2 -- 14 to 40 inches, yellowish red (5YR 5/6) channery silt loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; few prominent clay films on faces of peds and rock fragments; few fine and medium roots; 25 percent rock fragments; gradual wavy boundary.

C -- 40 to 50 inches, reddish brown (5YR 5/4) and brownish yellow (10YR 6/6) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; many prominent clay flows in relic rock joints; few fine roots; 90 percent rock fragments; clear wavy boundary.

R -- 50 inches, red (2.5YR 5/6) and yellow (10YR 7/6) siltstone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY1RO | 0.61 | 4.30 | 0.49 | 5.40 | 11.9 | 45.38 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY1RO | 4.90 | 3.78 | 2.35 | 9.18 | 7.75 | 58.82 | 69.68 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WY1RO | 27 | 23 | 16 | 23 | 23 | 112 | 709 | 179 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY1RO | 19.7 | 30.3 | 25.5 | 66.5 | 43.3 | 51.3 |

Table E: Silt and sand mineralogy - taxonomic control section - WY1RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 600 | TR | 400 | TR | TR | TR |
| Sand | 700 | TR | 300 | TR | 0 | 0 |
| 0.02-2 mm | 620 | TR | 380 | TR | TR | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile WY2RO: Chiswell very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.8 miles southeast 167 degrees of the junction of Highways VA-690 and VA-602 and 1.7 miles west 276 degrees of the junction of Highways VA-602 and VA-646 in Wythe County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 50% and black oak (*Quercus velutina* Lam.) 50%

*Ground:* red maple (*Acer rubrum* L.) and cinquefoil (*Potentilla* L.)

*Site index:* chestnut oak (*Quercus prinus* L.) 38, site not used in data analysis

*Parent material:* Rome formation - red siltstone

*Relief:* 300 feet

*Elevation:* 2510 feet

*Slope:* 64 percent

*Aspect:* northwest 324 degrees

*Drainage:* well

A -- 0 to 3 inches, dark reddish brown (5YR 3/2) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine and fine roots; 45 percent rock fragments; abrupt smooth boundary.

Bw1 -- 3 to 6 inches, reddish brown (5YR 4/4) channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; common fine, medium, and coarse roots; 30 percent rock fragments; gradual wavy boundary.

Bw2 -- 6 to 16 inches, reddish brown (5YR 5/4) very channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; many fine and medium roots; 55 percent rock fragments; gradual wavy boundary.

R -- 16 inches, dark red (10R 3/6) siltstone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY2RO | 0.10 | 0.13 | 0.31 | 0.54 | 8.0 | 6.75 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY2RO | 4.65 | 7.16 | 3.35 | 7.70 | 3.89 | 7.01 | 13.88 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| WY2RO | 88 | 57 | 38 | 82 | 01 | 266 | 591 | 143 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY2RO | 41.8 | 86.1 | 43.5 | 55.9 | 27.2 | 53.8 |

Table E: Silt and sand mineralogy - taxonomic control section - WY2RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 640 | 40 | 220 | TR | TR | 100 |
| Sand | 660 | 80 | 260 | TR | 0 | TR |
| 0.02-2 mm | 645 | 60 | 235 | TR | TR | 60 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WY3RO: Leck Kill channery silt loam*

*Classification:* coarse-loamy, mixed, mesic Ultic Hapludalfs

*Location:* About 0.8 miles northwest 316 degrees of the junction of Highways VA-630 and VA-631 and 1.9 miles west 264 degrees of the junction of Highways VA-630 and US-52 in Wythe County.

*Vegetation:*

*Canopy:* eastern white pine (*Pinus strobus* L.) 50%, maple (*Acer* L.) 20%, black oak (*Quercus velutina* Lam.) 20%, and white oak (*Quercus alba* L.) 10%

*Ground:* hickory (*Carya* Nutt.), red maple (*Acer rubrum* L.), and Virginia creeper (*Pathenocissus quinquefolia* L.)

*Site index:* eastern white pine (*Pinus strobus* L.) 61 and upland oaks (scarlet, black, northern red, and chestnut) 52

*Parent material:* Rome formation - red siltstone

*Relief:* 200 feet

*Elevation:* 2190 feet

*Slope:* 50 percent

*Aspect:* north 14 degrees

*Drainage:* well

A -- 0 to 3 inches, dark reddish gray (5YR 4/2) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 30 percent rock fragments; clear smooth boundary.

Bt1 -- 3 to 14 inches, reddish brown (5YR 5/4) channery silty clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint clay films on faces of peds and rock fragments; common fine and medium roots; 30 percent rock fragments; gradual wavy boundary.

Bt2 -- 14 to 30 inches, reddish brown (5YR 5/4) extremely channery silt loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; few distinct clay films on faces of peds and rock fragments; common medium roots; 65 percent rock fragments; gradual wavy boundary.

C -- 30 to 50 inches, mottled strong brown (7.5YR 5/6) and reddish brown (5YR 5/4) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few clay flows in relic rock joints; few fine roots; 90 percent rock fragments; clear wavy boundary.

R -- 50 inches, reddish brown (5YR 5/4) siltstone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY3RO | 0.25 | 1.13 | 0.28 | 1.66 | 7.1 | 23.38 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY3RO | 4.70 | 2.79 | 2.30 | 4.45 | 3.96 | 37.30 | 41.92 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WY3RO | 58 | 54 | 36 | 34 | 42 | 224 | 650 | 126 |

*Hydrometer method (Day, 1965).

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY3RO | 32.3 | 58.0 | 51.6 | 56.3 | 31.4 | 35.3 |

Table E: Silt and sand mineralogy - taxonomic control section - WY3RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 670 | 50 | 230 | 0 | TR | 50 |
| Sand | 600 | 100 | 300 | TR | 0 | 0 |
| 0.02-2 mm | 650 | 70 | 250 | TR | TR | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile WY4RO: Litz channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 0.6 miles northeast 75 degrees of the junction of Highways VA-619 and VA-626 and 1.0 mile west 272 degrees of the junction of Highways VA-626 and VA-611 in Wythe County.

*Vegetation:*

*Canopy:* black oak (*Quercus velutina* Lam.) 55%, scarlet oak (*Quercus coccinea* Muenchh.) 15%, white oak (*Quercus alba* L.) 15%, and hickory (*Carya* Nutt.) 15%

*Ground:* flowering dogwood (*Cornus florida* L.), blackberry (*Rhubus* L.), black oak (*Quercus velutina* Lam.), rattlesnake plantain (*Goodyera pubescens* Willd.), huckleberry (*Vaccinium arboreum* Marsh.), red maple (*Acer rubrum* L.), ash (*Fraxinus* L.), cinquefoil (*Potentilla* L.), greenbrier (*Smilax rotundifolia* L.), and pitch pine (*Pinus rigida* Mill.)

*Site index:* black oak (*Quercus velutina* Lam.) 58

*Parent material:* Rome formation - red fine-grained sandstone

*Relief:* 200 feet

*Elevation:* 2190 feet

*Slope:* 32 percent

*Aspect:* south 174 degrees

*Drainage:* well

A -- 0 to 3 inches, dark reddish brown (5YR 3/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 30 percent rock fragments; clear smooth boundary.

Bw1 -- 3 to 11 inches, reddish brown (5YR 4/4) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 45 percent rock fragments; gradual wavy boundary.

Bw2 -- 11 to 23 inches, reddish brown (5YR 5/3) extremely channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; few fine roots; 70 percent rock fragments; gradual wavy boundary.

R -- 23 inches, yellowish red (5YR 5/6) and dark reddish brown (5YR 4/3) fine-grained sandstone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY4RO | 0.10 | 0.38 | 0.25 | 0.73 | 6.8 | 10.74 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY4RO | 4.90 | 4.38 | 2.95 | 5.11 | 3.68 | 14.29 | 19.84 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WY4RO | 62 | 47 | 35 | 52 | 73 | 269 | 601 | 130 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY4RO | 43.3 | 80.1 | 57.7 | 52.3 | 28.3 | 39.3 |

Table E: Silt and sand mineralogy - taxonomic control section - WY4RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 700 | 40 | 210 | TR | TR | 50 |
| Sand | 750 | 50 | 200 | 0 | 0 | 0 |
| 0.02-2 mm | 720 | 40 | 210 | TR | TR | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly inter-stratified chlorite, vermiculite, and/or kaolinite.

## *Profile WY5RO: Chiswell very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.5 miles northwest 317 degrees of the junction of Highways VA-619 and VA-629 and 1.5 miles east 88 degrees of the junction of Highways VA-627 and VA-628 in Wythe County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 30%, black oak (*Quercus velutina* Lam.) 20%, northern red oak (*Quercus rubra* L.) 20%, white oak (*Quercus alba* L.) 20%, eastern white pine (*Pinus strobus* L.) 10%

*Ground:* flowering dogwood (*Cornus florida* L.), chestnut oak (*Quercus prinus* L.), huckleberry (*Vaccinium arboreum* Marsh.), greenbrier (*Smilax rotundifolia* L.), eastern white pine (*Pinus strobus* L.), hickory (*Carya* Nutt.), grape (*Vitis* L.), teaberry (*Gaultheria procumbers* L.), hazelnut (*Corylus americana* Walt.), American chestnut (*Castanea dentata* Marsh.), and sassafras (*Sassafras albidum* Nutt.)

*Site index:* black oak (*Quercus velutina* Lam.) 68

*Parent material:* Rome formation - red shale

*Relief:* 180 feet

*Elevation:* 2190 feet

*Slope:* 29 percent

*Aspect:* south 194 degrees

*Drainage:* well

A -- 0 to 3 inches, dark reddish brown (5YR 3/3) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 45 percent rock fragments; clear wavy boundary.

Bw -- 3 to 13 inches, reddish brown (5YR 4/3) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; common fine and medium roots; common faint silt coatings on rock fragments; 50 percent rock fragments; clear smooth boundary.

R -- 13 inches, mottled yellowish red (5YR 5/6) and reddish brown (5YR 4/4) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $Ca^{2+}$ | $Mg^{2+}$ | $K^{+}$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | *$NH_4OAc$, pH 7.0* | | | | | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY5RO | 0.12 | 0.45 | 0.22 | 0.79 | 6.5 | 12.15 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^{+}$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY5RO | 4.69 | 4.38 | 2.95 | 5.17 | 3.74 | 15.28 | 21.12 |

*SCEC = SBAS + $H^{+}$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| WY5RO | 42 | 32 | 20 | 20 | 23 | 137 | 723 | 140 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY5RO | 35.4 | 78.9 | 57.1 | 46.4 | 26.7 | 36.9 |

Table E: Silt and sand mineralogy - taxonomic control section - WY5RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 590 | TR | 410 | TR | TR | TR |
| Sand | 640 | 90 | 270 | TR | 0 | TR |
| 0.02-2 mm | 600 | TR | 400 | TR | TR | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile SY1RO: Chiswell extremely channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.1 miles northeast 48 degrees of the junction of Highways VA-729 and VA-615 and 0.3 miles northeast 63 degrees of the junction of Highways VA-683 and VA-615 in Smyth County.

*Vegetation:*

*Canopy:* black oak (*Quercus velutina* Lam.) 40%, chestnut oak (*Quercus prinus* L.) 30%, and black locust (*Robinia Pesudo-Acacia* L.) 30%

*Ground:* witchhazel (*Hamamelis virginiana* L.), huckleberry (*Vaccinium arboreum* Marsh.), ash (*Fraxinus* L.), rhododendron (*Rhododendron catawbiense* Michx.), aster (*Aster* L.), red maple (*Acer rubrum* L.), and black locust (*Robinia Pesudo-Acacia* L.)

*Site index:* black oak (*Quercus velutina* Lam.) 45

*Parent material:* Rome formation - red siltstone

*Relief:* 150 feet

*Elevation:* 2650 feet

*Slope:* 63 percent

*Aspect:* west southwest 246 degrees

*Drainage:* well

A -- 0 to 3 inches, dark reddish brown (5YR 3/2) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 70 percent rock fragments; clear smooth boundary.

Bw -- 3 to 16 inches, yellowish red (5YR 5/6) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few medium roots; few faint silt coatings on rock fragments; 50 percent rock fragments; clear smooth boundary.

R -- 16 inches, yellowish red (5YR 5/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY1RO | 0.13 | 0.27 | 0.17 | 0.57 | 10.1 | 5.64 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY1RO | 4.55 | 9.75 | 3.45 | 10.32 | 4.02 | 5.52 | 14.18 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| SY1RO | 20 | 20 | 19 | 23 | 23 | 105 | 665 | 230 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY1RO | 34.1 | 85.8 | 33.4 | 43.9 | 17.5 | 44.9 |

Table E: Silt and sand mineralogy - taxonomic control section - SY1RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 640 | TR | 360 | TR | 0 | TR |
| Sand | 640 | TR | 360 | TR | 0 | 0 |
| 0.02-2 mm | 640 | TR | 360 | TR | 0 | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile SY2RO: Litz very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 0.2 miles northwest 288 degrees of the junction of Highways VA-683 and VA-615 and 0.4 miles west 270 degrees of the junction of Highways VA-615 and VA-727 in Smyth County.

*Vegetation:*

*Canopy:* northern red oak (*Quercus rubra* L.) 30%, black oak (*Quercus velutina* Lam.) 30%, hickory (*Carya* Nutt.) 20%, black locust (*Robinia Pesudo-Acacia* L.) 10%, and yellow poplar (*Liridendron tulipifera* L.) 10%

*Ground:* Virginia creeper (*Pathenocissus quinquefolia* L.), ash (*Fraxinus* L.), witchhazel (*Hamamelis virginiana* L.), hazelnut (*Corylus americana* Walt.), hickory (*Carya* Nutt.), fern (*Asplenium*), red maple (*Acer rubrum* L.), Solomons-seal (*Polygonatum pubescens* Willd.), and flowering dogwood (*Cornus florida* L.)

*Site index:* northern red oak (*Quercus rubra* L.) 55

*Parent material:* Rome formation - green shale

*Relief:* 200 feet

*Elevation:* 2640 feet

*Slope:* 81 percent

*Aspect:* southeast 114 degrees

*Drainage:* well

A -- 0 to 2 inches, brown (10YR 4/3) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 45 percent rock fragments; clear smooth boundary.

Bw1 -- 2 to 20 inches, yellowish brown (10YR 5/8) very channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; common fine, medium, and coarse roots; 40 percent rock fragments; clear wavy boundary.

Bw2 -- 20 to 35 inches, yellowish brown (10YR 5/8) extremely channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; few medium and coarse roots; 70 percent rock fragments; clear smooth boundary.

R -- 35 inches, yellow (10YR 7/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY2RO | 0.47 | 0.92 | 0.34 | 1.73 | 8.6 | 20.12 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY2RO | 5.06 | 3.98 | 1.75 | 5.71 | 3.48 | 30.30 | 49.71 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| SY2RO | 52 | 64 | 47 | 48 | 41 | 252 | 538 | 210 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY2RO | 20.3 | 50.2 | 30.6 | 41.0 | 16.6 | 27.2 |

Table E: Silt and sand mineralogy - taxonomic control section - SY2RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 550 | 80 | 370 | TR | 0 | TR |
| Sand | 570 | 230 | 200 | TR | 0 | 0 |
| 0.02-2 mm | 560 | 140 | 300 | TR | 0 | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile SY3RO: Groseclose silt loam*

*Classification:* clayey, mixed, mesic Typic Hapludults

*Location:* About 0.4 miles southeast 165 degrees of the junction of Highways VA-683 and US-11 and 1.5 miles west 270 degrees of the junction of Highways VA-615 and VA-616 in Smyth County.

*Vegetation:*

*Canopy:* yellow poplar (*Liridendron tulipifera* L.) 70% and black locust (*Robinia Pesudo-Acacia* L.) 30%

*Ground:* hawthorn (*Crataegus* L.), yellow poplar (*Liridendron tulipifera* L.), poison oak (*Rhus radicans* L.), jewelweed (*Impatiens pallida* Nutt.), Indian turnip (*Arisaema triphyllum* L.), red maple (*Acer rubrum* L.), Virginia creeper (*Pathenocissus quinquefolia* L.), hickory (*Carya* Nutt.), black cherry (*Prunus serotina* Ehrh.), blackberry (*Rhubus* L.), and flowering dogwood (*Cornus florida* L.)

*Site index:* yellow poplar (*Liridendron tulipifera* L.) 85 and upland oaks (scarlet, black, northern red, and chestnut) 77

*Parent material:* Rome formation - green shale and limestone

*Relief:* 350 feet

*Elevation:* 2510 feet

*Slope:* 41 percent

*Aspect:* northeast 22 degrees

*Drainage:* well

A -- 0 to 10 inches, brown (10YR 4/3) silt loam; moderate fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 2 percent rock fragments; abrupt smooth boundary.

Bt1 -- 10 to 30 inches, yellowish brown (10YR 5/6) silty clay loam; moderate medium subangular blocky structure; firm, sticky, plastic; many distinct clay films on faces of peds; few fine and medium roots; 5 percent rock fragments; gradual wavy boundary.

Bt2 -- 30 to 60 inches, mottled strong brown (7.5YR 5/6), reddish yellow (7.5YR 6/8) and yellowish red (5YR 5/6) clay; moderate medium subangular blocky structure; firm, sticky, plastic; many distinct clay films on faces of peds; few fine roots; 10 percent rock fragments.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY3RO | 0.14 | 0.94 | 0.33 | 1.41 | 13.3 | 10.60 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY3RO | 4.96 | 9.15 | 4.15 | 10.56 | 5.56 | 13.35 | 25.36 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| SY3RO | 1 | 3 | 4 | 12 | 14 | 34 | 402 | 564 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY3RO | 31.2 | 74.6 | 39.2 | 23.6 | 9.9 | 18.7 |

Table E: Silt and sand mineralogy - taxonomic control section - SY3RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 650 | 20 | 280 | 50 | 0 | TR |
| Sand | 850 | TR | 150 | 0 | 0 | 0 |
| 0.02-2 mm | 675 | 20 | 265 | 40 | 0 | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile SY4RO: Litz silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Hapludults

*Location:* About 0.4 miles northeast 78 degrees of the junction of Highways VA-615 and VA-708 and 1.6 miles east 99 degrees of the junction of Highways US-11 and VA-615 in Smyth County.

*Vegetation:*

*Canopy:* black oak (*Quercus velutina* Lam.) 60% and northern red oak (*Quercus rubra* L.) 40%

*Ground:* teaberry (*Gaultheria procumbers* L.), American chestnut (*Castanea dentata* Marsh.), sassafras (*Sassafras albidum* Nutt.), red maple (*Acer rubrum* L.), black oak (*Quercus velutina* Lam.), black gum (*Nyssa sylvatica* Marsh.), greenbrier (*Smilax rotundifolia* L.), chestnut oak (*Quercus prinus* L.), huckleberry (*Vaccinium arboreum* Marsh.), and Galax (*Galax aphylla* L.)

*Site index:* black oak (*Quercus velutina* Lam.) 64

*Parent material:* Rome formation - green shale

*Relief:* 200 feet

*Elevation:* 2640 feet

*Slope:* 15 percent

*Aspect:* southwest 216 degrees

*Drainage:* well

Ap -- 0 to 4 inches, very dark grayish brown (10YR 3/2) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many fine and medium roots; 10 percent rock fragments; clear smooth boundary.

Bt1 -- 4 to 12 inches, brown (10YR 5/3) channery silty clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common distinct clay films on faces of peds and rock fragments; common medium and coarse roots; 30 percent rock fragments; gradual wavy boundary.

Bt2 -- 12 to 22 inches, yellowish brown (10YR 5/4) extremely channery silty clay loam; strong medium subangular blocky structure; friable, slightly sticky, slightly plastic; common distinct clay films on faces of peds and rock fragments; few fine roots; 65 percent rock fragments; clear smooth boundary.

C -- 22 to 25 inches, mottled brownish yellow (10YR 6/6), reddish yellow (7.5YR 6/8), and yellow (2.5Y 7/6) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; common distinct clay flows in relic rock joints; few fine roots; 90 percent rock fragments; clear smooth boundary.

R -- 25 inches, interbedded brownish yellow (10YR 6/6), reddish yellow (7.5YR 6/8), and yellow (2.5Y 7/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $Ca^{2+}$ | $Mg^{2+}$ | $K^{+}$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | $NH_4OAc$, pH 7.0 | | | | | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY4RO | 0.15 | 0.44 | 0.29 | 0.88 | 13.3 | 6.62 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^{+}$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY4RO | 4.66 | 12.14 | 6.95 | 13.02 | 7.83 | 6.76 | 11.24 |

*SCEC = SBAS + $H^{+}$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| SY4RO | 57 | 44 | 41 | 50 | 26 | 218 | 498 | 284 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY4RO | 52.2 | 88.7 | 53.3 | 46.8 | 27.6 | 45.8 |

Table E: Silt and sand mineralogy - taxonomic control section - SY4RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 910 | 90 | TR | TR | TR | TR |
| Sand | 720 | 180 | 0 | 0 | 0 | 100 |
| 0.02-2 mm | 830 | 130 | TR | TR | TR | 40 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile SY5RO: Chiswell silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.1 miles northeast 21 degrees of the junction of Highways VA-615 and VA-708 and 1.3 miles east 99 degrees of the junction of Highways US-11 and VA-615 in Smyth County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 20%, black oak (*Quercus velutina* Lam.) 20%, northern red oak (*Quercus rubra* L.) 20%, chestnut oak (*Quercus prinus* L.) 20%, white oak (*Quercus alba* L.) 10%, American beech (*Fagus grandifolia* Ehrh.) 10%,

*Ground:* bedstraw (*Galium triflorum*), yellow poplar (*Liridendron tulipifera* L.), red maple (*Acer rubrum* L.), sassafras (*Sassafras albidum* Nutt.), greenbrier (*Smilax rotundifolia* L.), American chestnut (*Castanea dentata* Marsh.), black locust (*Robinia Pesudo-Acacia* L.), and serviceberry (*Amelanchier* Medic.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 60 and upland oaks (scarlet, black, northern red, and chestnut) 58

*Parent material:* Rome formation - red shale

*Relief:* 180 feet

*Elevation:* 2560 feet

*Slope:* 46 percent

*Aspect:* southwest 240 degrees

*Drainage:* well

A -- 0 to 3 inches, dark brown (7.5YR 3/2) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 10 percent rock fragments; clear smooth boundary.

Bw -- 3 to 12 inches, reddish brown (5YR 5/3) very channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common fine and medium roots; common faint silt coatings on faces of peds and on rock fragments; 40 percent rock fragments; clear smooth boundary.

C -- 12 to 18 inches, mottled reddish brown (5YR 4/3) and weak red (2.5YR 4/2) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; common faint silt coatings on faces of peds and on rock fragments; 90 percent rock fragments; abrupt smooth boundary.

R -- 18 inches, interbedded dark reddish brown (5YR 3/3) and weak red (2.5YR 4/2) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY5RO | 0.32 | 0.35 | 0.28 | 0.95 | 7.0 | 13.57 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY5RO | 4.83 | 9.30 | 2.35 | 10.25 | 3.30 | 9.27 | 28.79 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| SY5RO | 45 | 40 | 36 | 38 | 28 | 187 | 655 | 158 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY5RO | 33.5 | 71.2 | 22.9 | 44.3 | 20.9 | 64.9 |

Table E: Silt and sand mineralogy - taxonomic control section - SY5RO

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 530 | 10 | 460 | 0 | TR | TR |
| Sand | 640 | 90 | 270 | TR | 0 | TR |
| 0.02-2 mm | 560 | 40 | 400 | TR | TR | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile RB1MA: Faywood silt loam*

*Classification:* fine-loamy, mixed, mesic Typic Hapludalfs

*Location:* About 0.2 miles southeast 158 degrees of the junction of Highways VA-610 and VA-683 and 2.2 miles northeast 61 degrees of the junction of Highways VA-610 and VA-690 in Rockbridge County.

*Vegetation:*

*Canopy:* eastern white pine (*Pinus strobus* L.) 30%, white oak (*Quercus alba* L.) 20%, eastern hemlock (*Tsuga canadensis* L.) 30%, hickory (*Carya* Nutt.) 10%, and Virginia pine (*Pinus virginiana* Mill.) 10%

*Ground:* wild ginger (*Asarum virginicum* L.), eastern hemlock (*Tsuga canadensis* L.), huckleberry (*Vaccinium arboreum* Marsh.), white oak (*Quercus alba* L.), rattlesnake plantain (*Goodyera pubescens* Willd.), and red maple (*Acer rubrum* L.)

*Site index:* eastern whit pine (*Pinus strobus* L.) 71, white oak (*Quercus alba* L.) 44, and upland oaks (scarlet, black, northern red, and chestnut) 62

*Parent material:* Martinsburg formation - thinly bedded limestone

*Relief:* 200 feet

*Elevation:* 1180 feet

*Slope:* 55 percent

*Aspect:* northwest 304 degrees

*Drainage:* well

A -- 0 to 2 inches, brown (7.5YR 4/2) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common fine, medium, and coarse roots; clear smooth boundary.

Bt1 -- 2 to 8 inches, light yellowish brown (10YR 6/4) silty clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint clay films on faces of peds; common fine and medium roots; clear smooth boundary.

Bt2 -- 8 to 17 inches, brown (7.5YR 5/4) channery clay; weak medium subangular blocky structure; friable, sticky, plastic; many distinct clay films on faces of peds and rock fragments; few fine and medium roots; 15 percent rock fragments; gradual wavy boundary.

C -- 17 to 40 inches, brown (7.5YR 4/4) extremely channery clay; massive; friable, slightly sticky, slightly plastic; few medium roots; many distinct clay flows in relic rock joints; 90 percent rock fragments; clear wavy boundary.

R -- 40 inches, reddish yellow (7.5YR 6/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| RB1MA | 9.40 | 7.60 | 0.20 | 17.20 | 18.6 | 92.47 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB1MA | 7.03 | 3.98 | 0.10 | 21.18 | 17.30 | 81.21 | 99.42 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| RB1MA | 111 | 105 | 72 | 58 | 35 | 381 | 360 | 259 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB1MA | 0.5 | 0.6 | 0.5 | 71.8 | 66.8 | 81.7 |

Table E: Silt and sand mineralogy - taxonomic control section - RB1MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 380 | 90 | 320 | 0 | 210 | TR |
| Sand | 640 | 70 | 150 | 0 | 140 | TR |
| 0.02-2 mm | 540 | 80 | 210 | 0 | 170 | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile RB2MA: Berks gravelly silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 0.6 miles east 100 degrees of the junction of Highways VA-610 and VA-634 and 1.0 mile northeast 72 degrees of the junction of Highways VA-610 and VA-690 in Rockbridge County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 80% and eastern red cedar (*Juniperus virginiana* L.) 20%

*Ground:* Virginia creeper (*Pathenocissus quinquefolia* L.), flowering dogwood (*Cornus florida* L.), Japanese honeysuckle (*Lonicera japonica* Thunb.), yellow poplar (*Liridendron tulipifera* L.), poison oak (*Rhus radicans* L.), and red maple (*Acer rubrum* L.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 63 and upland oaks (scarlet, black, northern red, and chestnut) 61

*Parent material:* Martinsburg formation - gray shale

*Relief:* 160.feet

*Elevation:* 1300 feet

*Slope:* 10 percent

*Aspect:* south 180 degrees

*Drainage:* well

A -- 0 to 2 inches, yellowish brown (10YR 5/6) gravelly silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 25 percent rock fragments; clear smooth boundary.

Bw -- 2 to 9 inches, yellowish brown (10YR 5/6) extremely gravelly silt loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; few fine roots, 65 percent rock fragments; gradual wavy boundary.

C -- 9 to 25 inches, yellowish brown (10YR 5/6) extremely gravelly silt loam; massive; friable, slightly sticky, slightly plastic; many faint silt coatings on rock fragments; few fine roots; 90 percent rock fragments; clear wavy boundary.

R -- 25 inches, yellowish brown (10YR 5/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| RB2MA | 1.89 | 1.61 | 0.26 | 3.76 | 8.6 | 43.72 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB2MA | 4.88 | 7.76 | 1.00 | 11.52 | 4.76 | 32.64 | 78.99 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| RB2MA | 74 | 54 | 53 | 64 | 54 | 299 | 508 | 193 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB2MA | 11.6 | 21.0 | 8.6 | 44.6 | 24.7 | 59.7 |

Table E: Silt and sand mineralogy - taxonomic control section - RB2MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 540 | 50 | 370 | 0 | 40 | TR |
| Sand | 1000 | 0 | 0 | 0 | 0 | 0 |
| 0.02-2 mm | 760 | 30 | 190 | 0 | 20 | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile RB3MA: Faywood silt loam*

*Classification:* clayey, mixed, mesic Ultic Hapludalfs

*Location:* About 0.9 miles west 272 degrees of the junction of Highways VA-631 and VA-638 and 1.7 miles southwest 244 degrees of the junction of Highways US-60 and VA-638 in Rockbridge County.

*Vegetation:*

*Canopy:* eastern red cedar (*Juniperus virginiana* L.) 30%, black walnut (*Juglans nigra* L.) 30%, black locust (*Robinia Pesudo-Acacia* L.) 30%, and black oak (*Quercus velutina* Lam.) 10%

*Ground:* poison oak (*Rhus radicans* L.), Japanese honeysuckle (*Lonicera japonica* Thunb.), Virginia creeper (*Pathenocissus quinquefolia* L.), flowering dogwood (*Cornus florida* L.), eastern redbud (*Cercis canadensis* L.), blackberry (*Rhubus* L.), red maple (*Acer rubrum* L.), elm (*Ulmus* L.), black cherry (*Prunus serotina* Ehrh.), fern (*Asplenium*), hickory (*Carya* Nutt.), and black oak (*Quercus velutina* Lam.)

*Site index:* upland oaks (scarlet, black, northern red, and chestnut) 60

*Parent material:* Martinsburg formation - thinly-bedded, fine-grained limestone

*Relief:* 300 feet

*Elevation:* 1310 feet

*Slope:* 47 percent

*Aspect:* south 180 degrees

*Drainage:* well

Ap1 -- 0 to 2 inches, dark yellowish brown (10YR 4/4) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; clear smooth boundary.

Ap2 -- 2 to 8 inches, dark yellowish brown (10YR 4/6) silty clay loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few fine and medium roots; clear smooth boundary.

Bt1 -- 8 to 17 inches, strong brown (7.5YR 5/6) clay; moderate medium subangular blocky structure; friable, sticky, plastic; few faint clay films on faces of peds and rock fragments; few fine roots; 10 percent rock fragments; gradual wavy boundary.

Bt2 -- 17 to 26 inches, strong brown (7.5YR 4/6) channery clay; moderate medium subangular blocky structure; friable, sticky, plastic; common distinct clay films on faces of peds and rock fragments; few fine roots; 30 percent rock fragments; clear smooth boundary.

C -- 26 to 30 inches, yellowish brown (10YR 5/4) extremely channery clay; massive; friable, sticky, plastic; common thick clay flows in relic rock joints; 90 percent rock fragments; abrupt smooth boundary.

R -- 30 inches, yellowish brown (10YR 5/4) limestone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| RB3MA | 11.50 | 0.58 | 0.09 | 12.17 | 17.6 | 69.15 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB3MA | 5.52 | 11.74 | 0.15 | 23.91 | 12.32 | 50.90 | 98.78 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| RB3MA | 26 | 24 | 20 | 21 | 20 | 111 | 529 | 360 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB3MA | 0.8 | 1.2 | 0.6 | 48.9 | 34.2 | 66.4 |

Table E: Silt and sand mineralogy - taxonomic control section

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 700 | 80 | 120 | 0 | 50 | 50 |
| Silt | 650 | 140 | 210 | TR | 0 | 0 |
| 0.02-2 mm | 680 | 100 | 140 | TR | 40 | 40 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile RB4MA: Weikert channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.9 miles southwest 233 degrees of the junction of Highways US-60 and VA-646 and 0.9 miles south southwest 210 degrees of the junction of Highways US-60 and VA-629 in Rockbridge County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 60%, eastern white pine (*Pinus strobus* L.) 30%, and northern red oak (*Quercus rubra* L.) 10%

*Ground:* red maple (*Acer rubrum* L.), mountain-laurel (*Kalmia latifolia* L.), huckleberry (*Vaccinium arboreum* Marsh.), eastern white pine (*Pinus strobus* L.), American chestnut (*Castanea dentata* Marsh.), rattlesnake plantain (*Goodyera pubescens* Willd.), and American beech (*Fagus grandifolia* Ehrh.)

*Site index:* chestnut oak (*Quercus prinus* L.) 56

*Parent material:* Martinsburg formation - gray shale

*Relief:* 200 feet

*Elevation:* 1350 feet

*Slope:* 40 percent

*Aspect:* northwest 300 degrees

*Drainage:* well

A -- 0 to 3 inches, yellowish brown (10YR 5/4) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 20 percent rock fragments; clear smooth boundary.

Bw -- 3 to 14 inches, brownish yellow (10YR 6/6) very channery silty clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 45 percent rock fragments; clear wavy boundary.

C -- 14 to 18 inches, yellowish brown (10YR 5/6) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine and medium roots; common faint silt coatings on rock fragments; 90 percent rock fragments; clear wavy boundary.

R -- 18 inches, yellowish brown (10YR 5/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| RB4MA | 0.30 | 0.04 | 0.12 | 0.46 | 13.4 | 3.43 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB4MA | 4.32 | 18.51 | 6.75 | 18.97 | 7.21 | 2.42 | 6.38 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| RB4MA | 43 | 33 | 22 | 20 | 10 | 128 | 528 | 344 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB4MA | 50.3 | 93.6 | 35.5 | 39.0 | 21.0 | 55.1 |

Table E: Silt and sand mineralogy - taxonomic control section - RB4MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 580 | 180 | 140 | 0 | 100 | TR |
| Sand | 900 | 50 | 50 | TR | 0 | TR |
| 0.02-2 mm | 680 | 140 | 110 | TR | 70 | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile RB5MA: Dandridge silty clay loam*

*Classification:* clayey-skeletal, mixed, mesic Lithic Hapludalfs

*Location:* About 4.2 miles east 100 degrees of the junction of Highways US-60 and VA-633 and 0.6 miles northeast 20 degrees of Sycamore Valley Church in Rockbridge County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 60%, black locust (*Robinia Pesudo-Acacia* L.) 30%, and eastern red cedar (*Juniperus virginiana* L.) 10%
*Ground:* eastern red cedar (*Juniperus virginiana* L.), Virginia creeper (*Pathenocissus quinquefolia* L.), pawpaw (*Asimina triloba* L.), black haw (*Viburnum prunifolium*), Japanese honeysuckle (*Lonicera japonica* Thunb.), red maple (*Acer rubrum* L.), and hackberry (*Celtis occidentalis* L.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 48 and upland oaks (scarlet, black, northern red, and chestnut) 45

*Parent material:* Martinsburg formation - thinly-bedded, fine-grained limestone

*Relief:* 200 feet

*Elevation:* 1525 feet

*Slope:* 25 percent

*Aspect:* southwest 244 degrees

*Drainage:* well

A -- 0 to 3 inches, yellowish brown (10YR 5/4) silty clay loam; weak fine granular structure; friable, sticky, plastic; common fine and medium roots; 5 percent rock fragments; clear smooth boundary.

Bt -- 3 to 16 inches, strong brown (7.5YR 5/6) very channery clay; moderate coarse subangular blocky structure; firm, sticky, plastic; many distinct clay films on faces of peds and rock fragments; few fine roots; 40 percent rock fragments; clear smooth boundary.

C -- 16 to 18 inches, strong brown (7.5YR 5/6) extremely channery clay; massive; firm, sticky, plastic; few fine roots; many clay flows in relic rock joints; 90 percent rock fragments; abrupt smooth boundary.

R -- 18 inches, very dark grayish brown (10YR 3/2) limestone.

Table A: Chemical properties - taxonomic control section

| | *$NH_4OAc$*, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| Profile | *$Ca^{2+}$* | *$Mg^{2+}$* | *$K^{+}$* | SBAS* | NHCEC | NHBS* |
| | cmol (+) *$kg^{-1}$* of soil | | | | | % |
| RB5MA | 19.10 | 1.39 | 0.08 | 20.57 | 23.0 | 89.43 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^{+}$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB5MA | 5.62 | 5.97 | 0.05 | 26.54 | 20.62 | 77.51 | 99.76 |

*SCEC = SBAS + $H^{+}$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| RB5MA | 37 | 40 | 28 | 28 | 24 | 157 | 413 | 430 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB5MA | 0.2 | 0.2 | 0.2 | 53.5 | 48.0 | 61.7 |

Table E: Silt and sand mineralogy - taxonomic control section - RB5MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 610 | 130 | 190 | 0 | 70 | TR |
| Sand | 1000 | 0 | 0 | 0 | 0 | 0 |
| 0.02-2 mm | 760 | 80 | 120 | 0 | 40 | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile BO1MA: Weikert very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.1 miles northwest 340 degrees of the junction of Highways VA-693 and VA-43 and 2.2 miles northeast 53 degrees of the junction of Highways VA-688 and VA-43 in Botetourt County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 40%, black oak (*Quercus velutina* Lam.) 40%, and pitch pine (*Pinus rigida* Mill.) 20%

*Ground:* grape (*Vitis* L.), black gum (*Nyssa sylvatica* Marsh.), huckleberry (*Vaccinium arboreum* Marsh.), black oak (*Quercus velutina* Lam.), witchhazel (*Hamamelis virginiana* L.), red maple (*Acer rubrum* L.), goldenrod (*Solidago* L.), serviceberry (*Amelanchier* Medic.), eastern redbud (*Cercis canadensis* L.), hickory (*Carya* Nutt.), and striped maple (*Acer pensylvanicum* L.)

*Site index:* not computed because of the age of the trees

*Parent material:* Martinsburg formation - gray fossiliferous shale

*Relief:* 800 feet

*Elevation:* 1960 feet

*Slope:* 67 percent

*Aspect:* southwest 234 degrees

*Drainage:* well

A -- 0 to 2 inches, brown (10YR 4/3) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many fine and medium roots; 40 percent rock fragments; clear wavy boundary.

Bw -- 2 to 11 inches, brown (10YR 5/3) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 80 percent rock fragments; clear wavy boundary.

R -- 11 inches, gray (10YR 5/1) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO1MA | 3.57 | 1.42 | 0.08 | 5.07 | 14.7 | 34.49 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO1MA | 5.10 | 11.34 | 1.65 | 16.41 | 6.72 | 30.90 | 75.45 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| BO1MA | 172 | 111 | 60 | 39 | 32 | 414 | 441 | 145 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO1MA | 11.2 | 24.5 | 10.0 | 101.4 | 46.3 | 113.2 |

Table E: Silt and sand mineralogy - taxonomic control section - BO1MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 800 | 120 | TR | 0 | 30 | 50 |
| Sand | 380 | 450 | 50 | 0 | 20 | 100 |
| 0.02-2 mm | 550 | 320 | 30 | 0 | 20 | 80 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile BO2MA: Berks very flaggy sandy loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 2.7 miles northeast 54 degrees of the junction of Highways VA-622 and VA-43 and 1.3 miles east 81 degrees of the junction of Highways VA-612 and VA-622 in Botetourt County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 40%, Virginia pine (*Pinus virginiana* Mill.) 20%, scarlet oak (*Quercus coccinea* Muenchh.) 20%, and pitch pine (*Pinus rigida* Mill.) 20%

*Ground:* American chestnut (*Castanea dentata* Marsh.), huckleberry (*Vaccinium arboreum* Marsh.), red maple (*Acer rubrum* L.), black oak (*Quercus velutina* Lam.), black gum (*Nyssa sylvatica* Marsh.), mountain-laurel (*Kalmia latifolia* L.), sassafras (*Sassafras albidum* Nutt.), Galax (*Galax aphylla* L.), and greenbrier (*Smilax rotundifolia* L.)

*Site index:* chestnut oak (*Quercus prinus* L.) 32, site not used in data analysis

*Parent material:* Martinsburg formation - gray shale

*Relief:* 800 feet

*Elevation:* 2430 feet

*Slope:* 42 percent

*Aspect:* northwest 302 degrees

*Drainage:* well

A -- 0 to 2 inches, brown (10YR 4/3) very flaggy sandy loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 40 percent rock fragments; clear wavy boundary.

Bw1 -- 2 to 15 inches, yellowish brown (10YR 5/6) flaggy loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 15 percent rock fragments; gradual wavy boundary.

2Bw2 -- 15 to 23 inches, strong brown (7.5YR 5/8) very channery silty clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 55 percent rock fragments; gradual wavy boundary.

2C -- 23 to 50 inches, reddish yellow (7.5YR 6/8) extremely flaggy silt loam; massive; friable, slightly sticky, slightly plastic; few faint silt coatings on rock fragments; 90 percent rock fragments; abrupt smooth boundary.

2R -- 50 inches, reddish yellow (7.5YR 6/8) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO2MA | 0.34 | 0.04 | 0.09 | 0.47 | 8.4 | 5.60 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO2MA | 4.34 | 10.95 | 4.25 | 11.42 | 4.72 | 4.12 | 9.96 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| BO2MA | 21 | 27 | 72 | 160 | 70 | 350 | 431 | 219 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO2MA | 50.5 | 90.0 | 37.2 | 38.4 | 21.6 | 52.1 |

Table E: Silt and sand mineralogy - taxonomic control section - BO2MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 670 | 70 | 110 | 0 | 100 | 50 |
| Sand | 1000 | 0 | 0 | 0 | 0 | 0 |
| 0.02-2 mm | 860 | 30 | 50 | 0 | 40 | 20 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile BO3MA: Weikert channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.4 miles west 280 degrees of the junction of Highways VA-606 and VA-600 and 1.4 miles south 180 degrees of the junction of Highways VA-606 and VA-666 in Botetourt County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 40%, white oak (*Quercus alba* L.) 20%, northern red oak (*Quercus rubra* L.) 20%, and hickory (*Carya* Nutt.) 20%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), white oak (*Quercus alba* L.), teaberry (*Gaultheria procumbers* L.), ash (*Fraxinus* L.), hickory (*Carya* Nutt.), blackberry (*Rhubus* L.), bedstraw (*Galium triflorum* Michx.), eastern redbud (*Cercis canadensis* L.), eastern red cedar (*Juniperus virginiana* L.), flowering dogwood (*Cornus florida* L.), and rattlesnake plantain (*Goodyera pubescens* Willd.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 61 and upland oaks (scarlet, black, northern red, and chestnut) 59

*Parent material:* Athens formation - black shale

*Relief:* 150 feet

*Elevation:* 1225 feet

*Slope:* 7 percent

*Aspect:* north 2 degrees

*Drainage:* well

A -- 0 to 2 inches, dark brown (10YR 3/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium and coarse roots; 30 percent rock fragments; clear smooth boundary.

Bw -- 2 to 11 inches, yellowish brown (10YR 5/6) extremely channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 75 percent rock fragments; clear smooth boundary.

C -- 11 to 17 inches, yellowish brown (10YR 5/6) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; many faint silt coatings on rock fragments; 90 percent rock fragments; clear wavy boundary.

R -- 17 inches, reddish yellow (7.5YR 6/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO3MA | 0.69 | 0.32 | 0.18 | 1.19 | 16.1 | 7.39 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO3MA | 4.48 | 27.06 | 7.75 | 28.25 | 8.94 | 4.21 | 13.31 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| BO3MA | 45 | 48 | 28 | 19 | 8 | 148 | 554 | 298 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO3MA | 48.1 | 86.6 | 27.4 | 54.0 | 30.0 | 94.8 |

Table E: Silt and sand mineralogy - taxonomic control section - BO3MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 810 | 30 | 100 | 0 | 10 | 50 |
| Sand | 1000 | 0 | 0 | 0 | 0 | 0 |
| 0.02-2 mm | 860 | 20 | 70 | 0 | 10 | 40 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile BO4MA: Weikert channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.6 miles north 358 degrees of the junction of Highways VA-606 and VA-600 and 1.3 miles southwest 245 degrees of the junction of Highways VA-600 and VA-655 in Botetourt County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 55%, hickory (*Carya* Nutt.) 25%, and eastern red cedar (*Juniperus virginiana* L.) 20%

*Ground:* Japanese honeysuckle (*Lonicera japonica* Thunb.), hickory (*Carya* Nutt.), black oak (*Quercus velutina* Lam.), blackhaw (*Viburnum prunifolium* L.), Virginia creeper (*Pathenocissus quinquefolia* L.), poison oak (*Rhus radicans* L.), rose (*Rosa* L.), flowering dogwood (*Cornus florida* L.), eastern redbud (*Cercis canadensis* L.), and eastern red cedar (*Juniperus virginiana* L.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 62 and upland oaks (scarlet, black, northern red, and chestnut) 60

*Parent material:* Athens formation - dark gray shale

*Relief:* 200 feet

*Elevation:* 1120 feet

*Slope:* 18 percent

*Aspect:* northeast 34 degrees

*Drainage:* well

A -- 0 to 2 inches, dark brown (10YR 3/3) channery silt loam; weak fine granular structure; friable, slightly sticky; many very fine, fine, medium and coarse roots; 30 percent rock fragments; clear smooth boundary.

Bw -- 2 to 12 inches, brownish yellow (10YR 6/6) extremely channery silt loam; weak fine granular structure; friable, slightly sticky; few faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 80 percent rock fragments; clear smooth boundary.

C -- 12 to 18 inches, yellowish brown (10YR 5/4) extremely channery silt loam; massive; friable, slightly sticky; few very fine roots; few faint silt coatings on rock fragments; 90 percent rock fragments; clear smooth boundary.

R -- 18 inches, yellowish brown (10YR 5/4) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO4MA | 0.87 | 0.87 | 0.23 | 1.97 | 13.1 | 15.04 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO4MA | 4.75 | 14.13 | 5.30 | 16.10 | 7.27 | 12.24 | 27.10 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| BO4MA | 34 | 44 | 36 | 41 | 22 | 177 | 548 | 275 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO4MA | 40.4 | 72.9 | 32.9 | 47.6 | 26.4 | 58.5 |

Table E: Silt and sand mineralogy - taxonomic control section - BO4MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 780 | 60 | 110 | 0 | TR | 50 |
| Sand | 900 | 50 | 50 | TR | 0 | TR |
| 0.02-2 mm | 840 | 60 | 70 | TR | TR | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile BO5MA: Berks silt loam*

*Classification:* clayey-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 0.8 miles southwest 213 degrees of the junction of Highways US-220 and VA-779 and 0.8 miles northwest 285 degrees of the junction of Highways US-220 and VA-653 in Botetourt County.

*Vegetation:*

*Canopy:* yellow poplar (*Liridendron tulipifera* L.) 50%, ash (*Fraxinus* L.) 30%, hickory (*Carya* Nutt.) 10%, and black locust (*Robinia Pesudo-Acacia* L.) 10%

*Ground:* Japanese honeysuckle (*Lonicera japonica* Thunb.), black oak (*Quercus velutina* Lam.), sumac (*Rhus* L.), Virginia creeper (*Pathenocissus quinquefolia* L.), poison oak (*Rhus radicans* L.), spice bush (*Lindera benzoin* L.), stinging nettle (*Cnidoscolus stimulosus* Michx.), and blackberry (*Rhubus* L.)

*Site index:* yellow poplar (*Liridendron tulipifera* L.) 74 and upland oaks (scarlet, black, northern red, and chestnut) 71

*Parent material:* Martinsburg formation - gray fossiliferous shale

*Relief:* 200 feet

*Elevation:* 1325 feet

*Slope:* 43 percent

*Aspect:* east southeast 115 degrees

*Drainage:* well

Ap -- 0 to 7 inches, dark brown (10YR 3/3) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 12 percent rock fragments; clear smooth boundary.

Bw -- 7 to 21 inches, yellowish brown (10YR 5/4) very channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; common fine, medium, and coarse roots; 38 percent rock fragments; clear wavy boundary.

C -- 21 to 25 inches, mottled brownish yellow (10YR 6/8) and light olive brown (2.5Y 5/4) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few faint silt coatings rock fragments; few fine roots; 90 percent rock fragments; abrupt wavy boundary.

R -- 25 inches, mottled brownish yellow (10YR 6/8) and light olive brown (2.5Y 5/4) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO5MA | 4.88 | 0.51 | 0.13 | 5.52 | 19.2 | 28.75 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO5MA | 4.95 | 18.51 | 5.60 | 24.03 | 11.12 | 22.97 | 49.64 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| BO5MA | 41 | 44 | 37 | 34 | 18 | 174 | 454 | 372 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO5MA | 29.2 | 50.3 | 23.3 | 51.6 | 30.0 | 64.6 |

Table E: Silt and sand mineralogy - taxonomic control section - BO5MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 710 | 170 | TR | 0 | 70 | 50 |
| Sand | 850 | 100 | 50 | 0 | 0 | 0 |
| 0.02-2 mm | 765 | 145 | 20 | 0 | 40 | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WA1MA: Gilpin loam*

*Classification:* fine-loamy, siliceous, mesic Typic Hapludults

*Location:* About 2.7 miles east 96 degrees of the junction of Highways VA-611 and VA-647 and 2.1 miles south 177 degrees of the junction of Highways VA-647 and US-19 in Washington County.

*Vegetation:*

*Canopy:* northern red oak (*Quercus rubra* L.) 40%, white oak (*Quercus alba* L.) 40%, and red maple (*Acer rubrum* L.) 20%

*Ground:* Virginia creeper (*Pathenocissus quinquefolia* L.), flowering dogwood (*Cornus florida* L.), red maple (*Acer rubrum* L.), black gum (*Nyssa sylvatica* Marsh.), hickory (*Carya* Nutt.), and Solomons-seal (*Polygonatum pubescens* Willd.)

*Site index:* northern red oak (*Quercus rubra* L.) 72

*Parent material:* Athens formation - gray shales with interbedded sandstone

*Relief:* 250 feet

*Elevation:* 2300 feet

*Slope:* 26 percent

*Aspect:* southeast 144 degrees

*Drainage:* well

A -- 0 to 4 inches, dark brown (10YR 3/3) loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 5 percent rock fragments; clear smooth boundary.

E -- 4 to 10 inches, dark yellowish brown (10YR 4/4) loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common fine and medium roots; 10 percent rock fragments; gradual wavy boundary.

Bt -- 10 to 22 inches, yellowish brown (10YR 5/4) channery loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; many distinct clay films on faces of peds and rock fragments; few fine roots; 15 percent rock fragments; clear smooth boundary.

C -- 22 to 30 inches, mottled yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) extremely channery loam; massive; friable, slightly sticky, slightly plastic; few clay flows in relic rock joints; few fine roots; 90 percent rock fragments; clear smooth boundary.

R -- 30 inches, mottled yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA1MA | 1.38 | 0.21 | 0.22 | 1.81 | 14.9 | 12.15 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA1MA | 4.89 | 7.56 | 3.95 | 9.37 | 5.76 | 19.32 | 31.42 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WA1MA | 6 | 15 | 63 | 271 | 110 | 465 | 340 | 195 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA1MA | 26.5 | 68.5 | 42.1 | 76.4 | 29.5 | 48.1 |

Table E: Silt and sand mineralogy - taxonomic control section - WA1MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 760 | 40 | 100 | 0 | TR | 100 |
| Sand | 970 | TR | 30 | 0 | 0 | 0 |
| 0.02-2 mm | 910 | 10 | 50 | 0 | TR | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WA2MA: Weikert channery loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.8 miles southeast 110 degrees of the junction of Highways VA-611 and VA-647 and 2.3 miles northeast 63 degrees of the junction of Highways VA-647 and VA-808 in Washington County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 90% and hickory (*Carya* Nutt.) 10%

*Ground:* red maple (*Acer rubrum* L.), huckleberry (*Vaccinium arboreum* Marsh.), black oak (*Quercus velutina* Lam.), rattlesnake plantain (*Goodyera pubescens* Willd.), goldenrod (*Solidago* L.), flowering dogwood (*Cornus florida* L.), chestnut oak (*Quercus prinus* L.), aster (*Aster* L.), black locust (*Robinia Pesudo-Acacia* L.), and serviceberry (*Amelanchier* Medic.)

*Site index:* chestnut oak (*Quercus prinus* L.) 43

*Parent material:* Athens formation - shale interbedded with fine-grained sandstone

*Relief:* 250 feet

*Elevation:* 2280 feet

*Slope:* 35 percent

*Aspect:* west northwest 288 degrees

*Drainage:* well

A -- 0 to 3 inches, brown (10YR 4/3) channery loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 30 percent rock fragments; clear smooth boundary.

Bw -- 3 to 11 inches, yellowish brown (10YR 5/6) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common fine, medium, and coarse roots; common faint silt coatings on rock fragments; 45 percent rock fragments; clear smooth boundary.

R -- 11 inches, olive brown (2.5Y 4/6) shale and sandstone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA2MA | 0.87 | 0.45 | 0.33 | 1.65 | 11.1 | 14.86 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA2MA | 4.72 | 10.55 | 4.10 | 12.20 | 5.75 | 13.52 | 28.70 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| WA2MA | 34 | 30 | 78 | 152 | 74 | 368 | 509 | 123 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA2MA | 36.9 | 71.3 | 33.6 | 90.2 | 46.7 | 99.2 |

Table E: Silt and sand mineralogy - taxonomic control section - WA2MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 780 | 30 | 100 | TR | 40 | 50 |
| Sand | 960 | 0 | 40 | 0 | 0 | 0 |
| 0.02-2 mm | 880 | 10 | 70 | TR | 20 | 20 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WA3MA: Berks channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 0.9 miles southeast 127 degrees of the junction of Highways VA-75 and I-81 and 0.8 miles east 94 degrees of the junction of Highways VA-75 and VA-670 in Washington County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 60%, northern red oak (*Quercus rubra* L.) 25%, and hickory (*Carya* Nutt.) 15%

*Ground:* flowering dogwood (*Cornus florida* L.), greenbrier (*Smilax rotundifolia* L.), sassafras (*Sassafras albidum* Nutt.), chestnut oak (*Quercus prinus* L.), rattlesnake plantain (*Goodyera pubescens* Willd.), fern (*Asplenium*), eastern white pine (*Pinus strobus* L.), serviceberry (*Amelanchier* Medic.), black gum (*Nyssa sylvatica* Marsh.), and American chestnut (*Castanea dentata* Marsh.)

*Site index:* chestnut oak (*Quercus prinus* L.) 63

*Parent material:* Athens formation - gray shale

*Relief:* 250 feet

*Elevation:* 2275 feet

*Slope:* 47 percent

*Aspect:* north northwest 342 degrees

*Drainage:* well

A -- 0 to 3 inches, brown (10YR 4/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 15 percent rock fragments; clear smooth boundary.

Bw1 -- 3 to 11 inches, brown (10YR 5/3) very channery silt loam; moderate medium granular structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 40 percent rock fragments; gradual wavy boundary.

Bw2 -- 11 to 21 inches, light yellowish brown (10YR 6/4) extremely channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 65 percent rock fragments; clear smooth boundary.

C -- 21 to 23 inches, light yellowish brown (10YR 6/4) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; few faint silt coatings on rock fragments; 90 percent rock fragments; abrupt smooth boundary.

R -- 23 inches, strong brown (7.5YR 5/6), light yellowish brown (10YR 6/4), and olive brown (2.5Y 4/4) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA3MA | 1.14 | 0.92 | 0.33 | 2.39 | 8.8 | 27.16 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA3MA | 5.18 | 6.37 | 1.70 | 8.76 | 4.09 | 27.28 | 58.44 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| WA3MA | 80 | 44 | 31 | 38 | 30 | 223 | 562 | 215 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA3MA | 19.3 | 41.5 | 19.4 | 40.1 | 19.0 | 40.7 |

Table E: Silt and sand mineralogy - taxonomic control section - WA3MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 810 | 70 | 0 | 0 | 70 | 50 |
| Sand | 920 | 70 | 0 | 0 | 10 | TR |
| 0.02-2 mm | 850 | 70 | 0 | 0 | 50 | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile WA4MA: Weikert very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.3 miles southeast 128 degrees of the junction of Highways VA-677 and US-58 and 0.3 miles southeast 156 degrees of the junction of Highways US-58 and VA-706 in Washington County.

*Vegetation:*

*Canopy:* northern red oak (*Quercus rubra* L.) 30%, white oak (*Quercus alba* L.) 30%, Virginia pine (*Pinus virginiana* Mill.) 25%, and hickory (*Carya* Nutt.) 15%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), red maple (*Acer rubrum* L.), hickory (*Carya* Nutt.), black gum (*Nyssa sylvatica* Marsh.), flowering dogwood (*Cornus florida* L.), northern red oak (*Quercus rubra* L.), and American beech (*Fagus grandifolia* Ehrh.)

*Site index:* northern red oak (*Quercus rubra* L.) 67

*Parent material:* Athens formation - gray shale

*Relief:* 200 feet

*Elevation:* 2120 feet

*Slope:* 32 percent

*Aspect:* south southwest 196 degrees

*Drainage:* well

A -- 0 to 2 inches, brown (10YR 4/3) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 45 percent rock fragments; clear smooth boundary.

Bw -- 2 to 11 inches, yellowish brown (10YR 5/4) extremely channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; few fine and medium roots; few faint silt coatings on rock fragments; 75 percent rock fragments; abrupt smooth boundary.

R -- 11 inches, light yellowish brown (10YR 6/4) and light olive brown (2.5Y 5/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA4MA | 0.45 | 0.68 | 0.13 | 1.26 | 14.4 | 8.75 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA4MA | 4.54 | 13.13 | 5.35 | 14.39 | 6.61 | 8.76 | 19.06 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WA4MA | 58 | 50 | 32 | 24 | 18 | 182 | 534 | 284 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA4MA | 37.1 | 80.9 | 37.1 | 50.7 | 23.3 | 50.7 |

Table E: Silt and sand mineralogy - taxonomic control section - WA4MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 810 | 50 | 120 | 0 | 20 | TR |
| Sand | 770 | 80 | TR | 150 | TR | TR |
| 0.02-2 mm | 800 | 60 | 80 | 50 | 10 | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WA5MA: Weikert silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.3 miles east 88 degrees of the junction of Highways US-58 and VA-708 and 1.6 miles southwest 230 degrees of the junction of Highways VA-91 and VA-708 in Washington County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 30%, chestnut oak (*Quercus prinus* L.) 30%, eastern white pine (*Pinus strobus* L.) 20%, scarlet oak (*Quercus coccinea* Muenchh.) 10%, and hickory (*Carya* Nutt.) 10%

*Ground:* flowering dogwood (*Cornus florida* L.), hickory (*Carya* Nutt.), northern red oak (*Quercus rubra* L.), ash (*Fraxinus* L.), huckleberry (*Vaccinium arboreum* Marsh.), eastern white pine (*Pinus strobus* L.), red maple (*Acer rubrum* L.), blackberry (*Rhubus* L.), chestnut oak (*Quercus prinus* L.), and eastern hemlock (*Tsuga canadensis* L.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 55 and upland oaks (scarlet, black, northern red, and chestnut) 53

*Parent material:* Athens formation - gray shale

*Relief:* 220 feet

*Elevation:* 2300 feet

*Slope:* 30 percent

*Aspect:* southwest 224 degrees

*Drainage:* well

A -- 0 to 2 inches, brown (10YR 4/3) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 10 percent rock fragments; clear smooth boundary.

Bw -- 2 to 15 inches, yellowish brown (10YR 5/4) extremely channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few faint silt coatings on faces of peds and rock fragments; common very fine and medium roots; 70 percent rock fragments; gradual wavy boundary.

C -- 15 to 19 inches, yellowish brown (10YR 5/8) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; 90 percent rock fragments; abrupt wavy boundary.

R -- 19 inches, olive brown (2.5Y 4/4) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA5MA | 0.23 | 0.38 | 0.17 | 0.78 | 12.7 | 6.14 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA5MA | 4.60 | 14.10 | 5.75 | 14.88 | 6.53 | 5.24 | 11.94 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WA5MA | 50 | 45 | 37 | 26 | 13 | 171 | 563 | 266 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA5MA | 45.2 | 88.0 | 38.6 | 47.7 | 24.5 | 55.9 |

Table E: Silt and sand mineralogy - taxonomic control section - WA5MA

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 830 | 30 | 120 | 0 | 20 | TR |
| Sand | 830 | 80 | TR | 10 | TR | TR |
| 0.02-2 mm | 830 | 50 | 80 | 30 | 10 | TR |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile RB1BR: Weikert very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.5 miles northwest 296 degrees of the junction of Highways VA-780 and VA-39 and 0.8 miles northwest 304 degrees of the junction of Highways VA-39 and Bratons Run in Rockbridge County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 80% and white oak (*Quercus alba* L.) 20%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), bear oak (*Quercus ilicifolia* Wang.), hickory (*Carya* Nutt.), eastern white pine (*Pinus strobus* L.), red maple (*Acer rubrum* L.), greenbrier (*Smilax rotundifolia* L.), mountain laurel (*Kalmia latifolia* L.), sassafras (*Sassafras albidum* Nutt.), hawthorn (*Crataegus* L.), and black gum (*Nyssa sylvatica* Marsh.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 42 and upland oaks (scarlet, black, northern red, and chestnut) 41

*Parent material:* Brallier formation - green shale with interbedded green sandstone

*Relief:* 125 feet

*Elevation:* 1485 feet

*Slope:* 12 percent

*Aspect:* southwest 234 degrees

*Drainage:* well

A -- 0 to 2 inches, brown (10YR 4/3) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many fine and medium roots; 40 percent rock fragments; clear wavy boundary.

Bw1 -- 2 to 7 inches, very pale brown (10YR 7/4) very channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 40 percent rock fragments; clear wavy boundary.

Bw2 -- 7 to 14 inches, very pale brown (10YR 7/4) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; few medium roots; 50 percent rock fragments; clear wavy boundary.

C -- 14 to 16 inches, light olive brown (2.5Y 5/4) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; many faint silt coatings on rock fragments; 90 percent rock fragments; abrupt wavy boundary.

R -- 16 inches, light olive brown (2.5Y 5/4) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| RB1BR | 0.57 | 0.13 | 0.17 | 0.87 | 10.9 | 7.98 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB1BR | 4.70 | 12.74 | 4.45 | 13.61 | 5.32 | 6.39 | 16.35 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | Silt | Clay |
| | g $kg^{-1}$ of soil | | | | | | | |
| RB1BR | 123 | 76 | 39 | 24 | 10 | 272 | 558 | 170 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB1BR | 40.8 | 83.6 | 32.6 | 64.1 | 31.3 | 80.1 |

Table E: Silt and sand mineralogy - taxonomic control section - RB1BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 460 | 120 | 180 | 0 | 190 | 50 |
| Sand | 850 | 90 | 60 | 0 | 0 | TR |
| 0.02-2 mm | 625 | 110 | 125 | 0 | 110 | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile RB2BR: Berks channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 0.7 miles north 4 degrees of the junction of Highways VA-42 and VA-39 and 2.7 miles north northwest 284 degrees the junction of Highways VA-615 and VA-601 in Rockbridge County.

*Vegetation:*

*Canopy:* eastern white pine (*Pinus strobus* L.) 50%, Virginia pine (*Pinus virginiana* Mill.) 30%, and chestnut oak (*Quercus prinus* L.) 20%

*Ground:* poison oak (*Rhus radicans* L.), sassafras (*Sassafras albidum* Nutt.), black locust (*Robinia Pesudo-Acacia* L.), and eastern white pine (*Pinus strobus* L.)

*Site index:* eastern white pine (*Pinus strobus* L.) 46, site not used in data analysis

*Parent material:* Brallier formation - green shale

*Relief:* 200 feet

*Elevation:* 1440 feet

*Slope:* 50 percent

*Aspect:* west southwest 233 degrees

*Drainage:* well

Ap1 -- 0 to 2 inches, very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common very fine, fine, and medium roots; 30 percent rock fragments; abrupt smooth boundary.

Ap2 -- 2 to 6 inches, yellowish brown (10YR 5/4) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common fine and medium roots; many faint silt coatings on rock fragments; 15 percent rock fragments; clear smooth boundary.

Bw -- 6 to 20 inches, yellowish brown (10YR 5/6) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 55 percent rock fragments; clear wavy boundary.

C -- 20 to 25 inches, yellowish brown (10YR 5/6) soil material between gray (10YR 5/1) shale; extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; many faint silt coatings on rock fragments; 90 percent rock fragments; clear smooth boundary.

R -- 25 inches, gray (10YR 5/1) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| RB2BR | 0.40 | 0.93 | 0.21 | 1.54 | 8.5 | 18.12 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB2BR | 4.70 | 9.75 | 3.95 | 11.29 | 5.49 | 13.64 | 28.05 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| RB2BR | 182 | 116 | 53 | 32 | 15 | 398 | 442 | 160 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB2BR | 46.4 | 71.9 | 34.9 | 53.1 | 34.3 | 70.6 |

Table E: Silt and sand mineralogy - taxonomic control section - RB2BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 560 | 300 | 50 | 0 | 40 | 50 |
| Sand | 590 | 280 | 30 | 0 | TR | 100 |
| 0.02-2 mm | 575 | 285 | 40 | 0 | 20 | 80 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile RB3BR: Berks very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 1.6 miles southeast 131 degrees of the junction of Highways VA-600 and VA-614 and 0.7 miles northwest 296 degrees of the junction of Highways VA-42 and VA-614 in Rockbridge County.

*Vegetation:*

*Canopy:* pitch pine (*Pinus rigida* Mill.) 25%, eastern white pine (*Pinus strobus* L.) 25%, white oak (*Quercus alba* L.) 25%, and northern red oak (*Quercus rubra* L.) 25%

*Ground:* flowering dogwood (*Cornus florida* L.), mountain laurel (*Kalmia latifolia* L.), huckleberry (*Vaccinium arboreum* Marsh.), Virginia pine (*Pinus virginiana* Mill.), red maple (*Acer rubrum* L.), and chestnut oak (*Quercus prinus* L.)

*Site index:* northern red oak (*Quercus rubra* L.) 48

*Parent material:* Brallier formation - green siltstone

*Relief:* 100 feet

*Elevation:* 1777 feet

*Slope:* 4 percent

*Aspect:* south 162 degrees

*Drainage:* well

A -- 0 to 1 inches, black (10YR 2/1) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, and fine roots; 40 percent rock fragments; abrupt smooth boundary.

Bw -- 1 to 12 inches, very pale brown (10YR 7/4) extremely channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 65 percent rock fragments; clear wavy boundary.

C -- 12 to 20 inches, very pale brown (10YR 7/4) soil material between strong brown (7.5Y 5/6) siltstone fragments; extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; many faint silt coatings on rock fragments; few fine and medium roots; 90 percent rock fragments; clear wavy boundary.

R -- 20 inches, strong brown (7.5Y 5/6) siltstone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| RB3BR | 0.27 | 0.02 | 0.12 | 0.41 | 5.6 | 7.32 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| RB3BR | 4.66 | 7.63 | 2.55 | 8.04 | 2.96 | 5.10 | 13.85 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| RB3BR | 26 | 14 | 09 | 17 | 28 | 94 | 732 | 174 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| RB3BR | 45.5 | 86.1 | 31.7 | 32.2 | 17.0 | 46.2 |

Table E: Silt and sand mineralogy - taxonomic control section - RB3BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 590 | 40 | 250 | 0 | 70 | 50 |
| Sand | 980 | 20 | 0 | 0 | 0 | 0 |
| 0.02-2 mm | 655 | 40 | 205 | 0 | 60 | 40 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile BO1BR: Berks silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 0.9 miles northeast 28 degrees of the junction of Highways VA-743 and VA-615 and 1.8 miles northwest 332 degrees the junction of Highways VA-615 and VA-685 in Botetourt County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 50%, black oak (*Quercus velutina* Lam.) 20% eastern white pine (*Pinus strobus* L.) 20%, and white oak (*Quercus alba* L.) 10%

*Ground:* mountain-laurel (*Kalmia latifolia* L.), huckleberry (*Vaccinium arboreum* Marsh.), serviceberry (*Amelanchier* Medic.), red maple (*Acer rubrum* L.), sassafras (*Sassafras albidum* Nutt.), and eastern white pine (*Pinus strobus* L.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 45 and upland oaks (scarlet, black, northern red, and chestnut) 43

*Parent material:* Brallier formation - green fissile shale

*Relief:* 150 feet

*Elevation:* 1080 feet

*Slope:* 53 percent

*Aspect:* northwest 314 degrees

*Drainage:* well

A -- 0 to 2 inches, brown (10YR 5/3) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 5 percent rock fragments; clear smooth boundary.

Bw1 -- 2 to 13 inches, brownish yellow (10YR 6/6) channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 25 percent rock fragments; gradual wavy boundary.

Bw2 -- 13 to 23 inches, brownish yellow (10YR 6/8) very channery silty clay loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 50 percent rock fragments; gradual wavy boundary.

C -- 23 to 28 inches, reddish yellow (7.5YR 6/6) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few faint silt coatings on rock fragments; few medium roots; 90 percent rock fragments; clear smooth boundary.

R -- 28 inches, reddish yellow (7.5YR 6/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO1BR | 0.29 | 0.33 | 0.17 | 0.79 | 9.9 | 7.98 |

*SBAS = $Ca^{2+} + Mg^{2+} + K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO1BR | 4.67 | 11.74 | 5.05 | 12.53 | 5.84 | 6.30 | 13.53 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| BO1BR | 156 | 95 | 45 | 25 | 11 | 332 | 469 | 199 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO1BR | 51.0 | 86.4 | 40.3 | 49.7 | 29.3 | 63.0 |

Table E: Silt and sand mineralogy - taxonomic control section - BO1BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 510 | 190 | 130 | 0 | 120 | 50 |
| Sand | 860 | 80 | 60 | TR | 0 | TR |
| 0.02-2 mm | 700 | 130 | 90 | TR | 60 | 20 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile BO2BR: Gilpin silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Hapludults

*Location:* About 3.1 miles southwest 252 degrees of the junction of Highways US-220 and VA-722 and 2.8 miles southwest 228 degrees of the junction of Highways VA-702 and VA-622 in Botetourt County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 65% and black oak (*Quercus velutina* Lam.) 35%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), sassafras (*Sassafras albidum* Nutt.), mountain-laurel (*Kalmia latifolia* L.), eastern white pine (*Pinus strobus* L.), black oak (*Quercus velutina* Lam.), maple (*Acer* L.), serviceberry (*Amelanchier* Medic.), fern (*Asplenium*), and flowering dogwood (*Cornus florida* L.).

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 59 and upland oaks (scarlet, black, northern red, and chestnut) 57

*Parent material:* Brallier formation - greenish gray fissile shale with large carbonate nodules

*Relief:* 200 feet

*Elevation:* 1240 feet

*Slope:* 30 percent

*Aspect:* northeast 58 degrees

*Drainage:* well

A -- 0 to 2 inches, pale brown (10YR 6/3) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many fine and medium roots; 2 percent rock fragments; clear smooth boundary.

E -- 2 to 15 inches, light yellowish brown (10YR 6/4) silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; many faint silt coatings on faces of peds and rock fragments; common fine and medium roots; 10 percent rock fragments; gradual wavy boundary.

Bt -- 15 to 30 inches, strong brown (7.5YR 5/6) very channery silty clay loam; weak medium subangular blocky structure; firm, sticky, plastic; few faint clay skins on faces of peds and rock fragments; few fine roots; 45 percent rock fragments; gradual wavy boundary.

C -- 30 to 33 inches, yellowish red (5YR 5/8) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few faint silt coatings on rock fragments; few fine roots; 90 percent rock fragments; clear wavy boundary.

R -- 33 inches, yellowish red (5YR 5/8) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO2BR | 0.45 | 0.87 | 0.24 | 1.56 | 13.3 | 11.73 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO2BR | 4.83 | 16.12 | 7.85 | 17.68 | 9.41 | 8.82 | 16.58 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| BO2BR | 63 | 17 | 09 | 18 | 12 | 119 | 580 | 301 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO2BR | 59.0 | 83.4 | 44.4 | 44.2 | 31.3 | 58.7 |

Table E: Silt and sand mineralogy - taxonomic control section - BO2BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 840 | TR | 110 | 0 | TR | 50 |
| Sand | 1000 | 0 | 0 | 0 | 0 | 0 |
| 0.02-2 mm | 880 | TR | 80 | 0 | TR | 40 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile BO3BR: Berks channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Eutrochrepts

*Location:* About 1.4 miles southeast 138 degrees of the junction of Highways VA-616 and VA-621 and 1.6 miles northwest 334 degrees of the junction of Highways VA-621 and VA-615 in Botetourt County.

*Vegetation:*

*Canopy:* black oak (*Quercus velutina* Lam.) 50%, pitch pine (*Pinus rigida* Mill.) 30%, and chestnut oak (*Quercus prinus* L.) 20%.

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), sassafras (*Sassafras albidum* Nutt.), black locust (*Robinia Pesudo-Acacia* L.), flowering dogwood (*Cornus florida* L.), witchhazel (*Hamamelis virginiana* L.), greenbrier (*Smilax rotundifolia* L.), white oak (*Quercus alba* L.), red maple (*Acer rubrum* L.), and teaberry (*Gaultheria procumbers* L.)

*Site index:* pitch pine (*Pinus rigida* Mill.) 38 and upland oaks (scarlet, black, northern red, and chestnut) 42

*Parent material:* Millboro formation - black fissile shale

*Relief:* 500 feet

*Elevation:* 1690 feet

*Slope:* 54 percent

*Aspect:* southwest 244 degrees

*Drainage:* well

A -- 0 to 1 inches, very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common very fine, fine, and medium roots; 20 percent rock fragments; abrupt smooth boundary.

E -- 1 to 6 inches, light yellowish brown (10YR 6/4) very channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; common fine and medium roots; 50 percent rock fragments; gradual wavy boundary.

Bw -- 6 to 17 inches, brown yellow (10YR 6/6) extremely channery silty clay loam; strong coarse subangular blocky structure; firm, sticky, plastic; few distinct silt coatings on faces of peds and rock fragments; few fine and medium roots; 65 percent rock fragments; clear smooth boundary.

C -- 17 to 20 inches, yellowish brown (10YR 5/6) soil material between grayish brown (10YR 5/2) shale fragments; extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few faint silt coatings on fragments; few fine roots; 90 percent rock fragments; abrupt smooth boundary.

R -- 20 inches, grayish brown (10YR 5/2) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| BO3BR | 8.30 | 0.54 | 0.09 | 8.93 | 14.4 | 62.01 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| BO3BR | 4.88 | 7.76 | 1.75 | 16.69 | 10.68 | 53.51 | 83.61 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| BO3BR | 30 | 35 | 23 | 20 | 12 | 120 | 550 | 330 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| BO3BR | 12.1 | 16.4 | 10.4 | 43.6 | 32.4 | 50.6 |

Table E: Silt and sand mineralogy - taxonomic control section - BO3BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 750 | 190 | TR | 0 | 10 | 50 |
| Sand | 810 | 100 | 90 | 0 | 0 | TR |
| 0.02-2 mm | 765 | 165 | 20 | 0 | 10 | 40 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WY1BR: Weikert extremely channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.3 miles northeast 70 degrees of the junction of Highways US-21 and VA-717 and 0.5 miles southeast 116 degrees of the junction of Highways US-21 and VA-686 in Wythe County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 95% and white oak (*Quercus alba* L.) 5%

*Ground:* greenbrier (*Smilax rotundifolia* L.), huckleberry (*Vaccinium arboreum* Marsh.), black oak (*Quercus velutina* Lam.), eastern white pine (*Pinus strobus* L.), sassafras (*Sassafras albidum* Nutt.), teaberry (*Gaultheria procumbers* L.), black locust (*Robinia Pesudo-Acacia* L.), mountain laurel (*Kalmia latifolia* L.), black cherry (*Prunus serotina* Ehrh.), and hickory (*Carya* Nutt.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 45 and upland oaks (scarlet, black, northern red, and chestnut) 42

*Parent material:* Brallier formation - black fissile shale

*Relief:* 1800 feet

*Elevation:* 2490 feet

*Slope:* 46 percent

*Aspect:* west 262 degrees

*Drainage:* well

A -- 0 to 3 inches, dark grayish brown (10YR 4/2) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common fine and medium roots; 65 percent rock fragments; clear smooth boundary.

Bw -- 3 to 11 inches, light yellowish brown (10YR 6/4) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 65 percent rock fragments; clear smooth boundary.

C -- 11 to 17 inches, very dark gray (N 3/) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; common faint silt coatings on rock fragments; few fine roots; 90 percent rock fragments; clear smooth boundary.

R -- 17 inches, very dark gray (N 3/) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY1BR | 0.51 | 0.17 | 0.28 | 0.96 | 16.5 | 5.82 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY1BR | 4.42 | 18.51 | 9.25 | 19.47 | 10.21 | 4.93 | 9.40 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WY1BR | 116 | 78 | 55 | 41 | 14 | 304 | 472 | 224 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY1BR | 56.0 | 90.5 | 47.5 | 73.7 | 45.6 | 86.9 |

Table E: Silt and sand mineralogy - taxonomic control section - WY1BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 650 | 230 | 50 | TR | 20 | 50 |
| Sand | 800 | 150 | 50 | 0 | TR | 0 |
| 0.02-2 mm | 730 | 190 | 50 | TR | 10 | 20 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WY2BR: Gilpin silt loam*

*Classification:* clayey, mixed, mesic Typic Hapludults

*Location:* About 2.6 miles northeast 78 degrees of the junction of Highways US-21 and VA-717 and 2.7 miles east 84 degrees of the junction of Highways US-21 and VA-606 in Wythe County.

*Vegetation:*

*Canopy:* pitch pine (*Pinus rigida* Mill.) 60%, Virginia pine (*Pinus virginiana* Mill.) 25%, white oak (*Quercus alba* L.) 10%, and eastern white pine (*Pinus strobus* L.) 5%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), black oak (*Quercus velutina* Lam.), eastern white pine (*Pinus strobus* L.), sassafras (*Sassafras albidum* Nutt.), American chestnut (*Castanea dentata* Marsh.), greenbrier (*Smilax rotundifolia* L.), black gum (*Nyssa sylvatica* Marsh.), mountain laurel (*Kalmia latifolia* L.), red maple (*Acer rubrum* L.), black oak (*Quercus velutina* Lam.), teaberry (*Gaultheria procumbers* L.), and hickory (*Carya* Nutt.)

*Site index:* pitch pine (*Pinus rigida* Mill.) 45 and upland oaks (scarlet, black, northern red, and chestnut) 53

*Parent material:* Brallier formation - green fissile shale

*Relief:* 200 feet

*Elevation:* 2580 feet

*Slope:* 10 percent

*Aspect:* south 182 degrees

*Drainage:* well

A -- 0 to 3 inches, brown (10YR 5/3) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 10 percent rock fragments; clear smooth boundary.

Bt1 -- 3 to 11 inches, yellowish brown (10YR 5/6) silty clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few distinct clay films on faces of peds and rock fragments; common fine and medium roots; 10 percent rock fragments; gradual wavy boundary.

Bt2 -- 11 to 22 inches, strong brown (7.5YR 5/8) silty clay loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; common distinct clay films on faces of peds and rock fragments; few fine and medium roots; 5 percent rock fragments; clear smooth boundary.

C -- 22 to 56 inches, mottled red (2.5YR 5/6) and brownish yellow (10YR 6/6) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; common clays flows in relic rock joints; few fine roots; 90 percent rock fragments; abrupt smooth boundary.

R -- 56 inches, mottled red (2.5YR 5/6) and yellow (10YR 7/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY2BR | 0.38 | 0.11 | 0.14 | 0.63 | 12.0 | 5.25 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY2BR | 4.34 | 13.53 | 8.05 | 14.16 | 8.68 | 4.45 | 7.26 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WY2BR | 16 | 18 | 21 | 23 | 12 | 90 | 518 | 392 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY2BR | 67.1 | 92.7 | 56.8 | 30.6 | 22.1 | 36.1 |

Table E: Silt and sand mineralogy - taxonomic control section - WY2BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 690 | 100 | 80 | 0 | 30 | 100 |
| Sand | 950 | 50 | 0 | 0 | 0 | 0 |
| 0.02-2 mm | 750 | 90 | 60 | 0 | 20 | 80 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile WY3BR: Weikert channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 2.1 miles west 274 degrees of the junction of Highways VA-717 and US-21 and 1.9 miles west 263 degrees of the junction of Highways VA-686 and US-21 in Wythe County.

*Vegetation:*

*Canopy:* pitch pine (*Pinus rigida* Mill.) 60%, Table-Mountain pine (*Pinus pungens* Lamb.) 20%, and chestnut oak (*Quercus prinus* L.) 20%

*Ground:* huckleberry (*Vaccinium arboreum* Marsh.), American chestnut (*Castanea dentata* Marsh.), greenbrier (*Smilax rotundifolia* L.), mountain laurel (*Kalmia latifolia* L.), rhododendron (*Rhododendron catawbiense* Michx.), fern (*Asplenium*), and sassafras (*Sassafras albidum* Nutt.),

*Site index:* pitch pine (*Pinus rigida* Mill.) 43 and upland oaks (scarlet, black, northern red, and chestnut) 51

*Parent material:* Brallier formation - green shale

*Relief:* 800 feet

*Elevation:* 2800 feet

*Slope:* 52 percent

*Aspect:* west 256 degrees

*Drainage:* well

A -- 0 to 3 inches, brown (10YR 5/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common very fine, fine, and medium roots; 20 percent rock fragments; clear smooth boundary.

Bw -- 3 to 12 inches, brownish yellow (10YR 6/6) very channery silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; common fine and medium roots; few faint silt coatings on rock fragments; 45 percent rock fragments; clear smooth boundary.

R -- 12 inches, mottled light yellowish brown (10YR 6/4) and grayish brown (2.5Y 5/2) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WY3BR | 0.43 | 0.08 | 0.21 | 0.72 | 10.3 | 6.99 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WY3BR | 4.47 | 13.53 | 4.55 | 14.25 | 5.27 | 5.05 | 13.66 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| WY3BR | 54 | 32 | 24 | 18 | 18 | 146 | 648 | 206 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WY3BR | 44.1 | 86.3 | 31.9 | 50.0 | 25.6 | 69.2 |

Table E: Silt and sand mineralogy - taxonomic control section - WY3BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 620 | 100 | 120 | 0 | 60 | 100 |
| Sand | 970 | 30 | 0 | 0 | 0 | 0 |
| 0.02-2 mm | 720 | 80 | 90 | 0 | 40 | 70 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile SY1BR: Berks channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 0.2 miles northwest 348 degrees of the junction of Highways VA-694 and VA-622 and 1.9 miles north northeast 356 degrees of the junction of Highways VA-617 and VA-622 in Smyth County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 50%, scarlet oak (*Quercus coccinea* Muenchh.) 30%, hickory (*Carya* Nutt.) 10%, and black oak (*Quercus velutina* Lam.) 10%

*Ground:* sassafras (*Sassafras albidum* Nutt.), flowering dogwood (*Cornus florida* L.), red maple (*Acer rubrum* L.), hickory (*Carya* Nutt.), American chestnut (*Castanea dentata* Marsh.), huckleberry (*Vaccinium arboreum* Marsh.), rattlesnake plantain (*Goodyera pubescens* Willd.), black oak (*Quercus velutina* Lam.), violet (*Viola* L.), eastern hemlock (*Tsuga canadensis* L.), and serviceberry (*Amelanchier* Medic.)

*Site index:* scarlet oak (*Quercus coccinea* Muenchh.) 45

*Parent material:* Brallier formation - black fissile shale

*Relief:* 200 feet

*Elevation:* 2480 feet

*Slope:* 42 percent

*Aspect:* east 80 degrees

*Drainage:* well

A -- 0 to 2 inches, brown (10YR 4/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 15 percent rock fragments; clear smooth boundary.

Bw1 -- 2 to 9 inches, yellowish brown (10YR 5/6) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common fine and medium roots; common faint silt coatings on faces of peds and on rock fragments; 20 percent rock fragments; clear smooth boundary.

Bw2 -- 9 to 19 inches, brownish yellow (10YR 6/6) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few fine and medium roots; common faint silt coatings on faces of peds and on rock fragments; 75 percent rock fragments; gradual smooth boundary.

C -- 19 to 40 inches, mottled dark brown (10YR 3/3) and dark yellowish brown (10YR 4/4) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; common faint silt coatings on rock fragments; 90 percent rock fragments; clear smooth boundary.

R -- 40 inches, dark brown (10YR 3/3) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY1BR | 0.23 | 0.10 | 0.18 | 0.51 | 15.8 | 3.23 |

*SBAS = $Ca^{2+} + Mg^{2+} + K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY1BR | 4.34 | 14.93 | 10.15 | 15.44 | 10.66 | 3.30 | 4.78 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| SY1BR | 55 | 44 | 32 | 25 | 12 | 168 | 566 | 266 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY1BR | 64.2 | 95.2 | 65.7 | 59.4 | 40.1 | 58.0 |

Table E: Silt and sand mineralogy - taxonomic control section - SY1BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 830 | 80 | 40 | TR | 0 | 50 |
| Sand | 910 | 60 | 30 | 0 | 0 | 0 |
| 0.02-2 mm | 860 | 70 | 40 | TR | 0 | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile SY2BR: Gilpin extremely channery silt loam*

*Classification:* fine-loamy, mixed, mesic Typic Hapludults

*Location:* About 1.0 miles east 88 degrees of the junction of Highways VA-694 and VA-622 and 2.0 miles northeast 31 degrees of the junction of Highways VA-622 and VA-617 in Smyth County.

*Vegetation:*

*Canopy:* white oak (*Quercus alba* L.) 30%, scarlet oak (*Quercus coccinea* Muenchh.) 30%, northern red oak (*Quercus rubra* L.) 30%, and red maple (*Acer rubrum* L.) 10%

*Ground:* Galax (*Galax aphylla* L.), eastern white pine (*Pinus strobus* L.), hickory (*Carya* Nutt.), black oak (*Quercus velutina* Lam.), red maple (*Acer rubrum* L.), grape (*Vitis* L.), striped maple (*Acer pensylvanicum* L.), and serviceberry (*Amelanchier* Medic.)

*Site index:* scarlet oak (*Quercus coccinea* Muenchh.) 76

*Parent material:* Chemung formation - green siltstone

*Relief:* 250 feet

*Elevation:* 2480 feet

*Slope:* 65 percent

*Aspect:* north northwest 342 degrees

*Drainage:* well

A -- 0 to 1 inches, dark yellowish brown (10YR 4/4) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine and fine roots; 75 percent rock fragments; abrupt smooth boundary.

E -- 1 to 7 inches, brownish yellow (10YR 6/6) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common very fine, fine, and medium roots; 10 percent rock fragments; clear wavy boundary.

Bt1 -- 7 to 27 inches, brownish yellow (10YR 6/8) channery silty clay loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; common distinct clay films on faces of peds and rock fragments; few very fine and fine roots; 20 percent rock fragments; clear wavy boundary.

Bt2 -- 27 to 38 inches, brownish yellow (10YR 6/8) very channery silty clay loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; common distinct clay films on faces of peds and rock fragments; few fine roots; 45 percent rock fragments; gradual wavy boundary.

C -- 38 to 50 inches, mottled yellowish brown (10YR 5/8) and olive brown (2.5Y 4/4) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; common clay flows in relic rock joints; few fine roots; 90 percent rock fragments; abrupt smooth boundary.

R -- 50 inches, olive brown (2.5Y 4/4) siltstone.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY2BR | 0.15 | 0.60 | 0.25 | 1.00 | 9.7 | 10.31 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY2BR | 4.78 | 7.36 | 5.20 | 8.36 | 6.20 | 11.96 | 16.13 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| SY2BR | 91 | 54 | 29 | 20 | 16 | 210 | 564 | 226 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY2BR | 53.6 | 83.8 | 62.2 | 42.9 | 27.4 | 37.0 |

Table E: Silt and sand mineralogy - taxonomic control section - SY2BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 710 | 110 | 130 | 0 | TR | 50 |
| Sand | 800 | 60 | 90 | 0 | 0 | 50 |
| 0.02-2 mm | 740 | 90 | 120 | 0 | TR | 50 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile SY3BR: Berks very channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Typic Dystrochrepts

*Location:* About 0.4 miles south 178 degrees of the junction of Highways VA-16 and VA-348 and 3.8 miles south 179 degrees of the junction of Highways VA-16 and VA-610 in Smyth County.

*Vegetation:*

*Canopy:* chestnut oak (*Quercus prinus* L.) 45%, black oak (*Quercus velutina* Lam.) 45%, and red maple (*Acer rubrum* L.) 10%

*Ground:* Galax (*Galax aphylla* L.), hickory (*Carya* Nutt.), rhododendron (*Rhododendron catawbiense* Michx.), sourwood (*Oxydendrum arboreum* L.), sassafras (*Sassafras albidum* Nutt.), black gum (*Nyssa sylvatica* Marsh.), Solomons-seal (*Polygonatum pubescens* Willd.), huckleberry (*Vaccinium arboreum* Marsh.), grape (*Vitis* L.), red maple (*Acer rubrum* L.), flowering dogwood (*Cornus florida* L.), and goldenrod (*Solidago* L.)

*Site index:* black oak (*Quercus velutina* Lam.) 63

*Parent material:* Brallier formation - green siltstone

*Relief:* 250 feet

*Elevation:* 2480 feet

*Slope:* 72 percent

*Aspect:* east 80 degrees

*Drainage:* well

A -- 0 to 3 inches, brown (10YR 5/3) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 55 percent rock fragments; clear smooth boundary.

Bw1 -- 3 to 13 inches, yellowish brown (10YR 5/6) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; few fine and medium roots; 30 percent rock fragments; gradual wavy boundary.

Bw2 -- 13 to 24 inches, brownish yellow (10YR 6/8) very channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common faint silt coatings on faces of peds and rock fragments; few fine roots; 50 percent rock fragments; gradual wavy boundary.

C -- 24 to 26 inches, strong brown (7.5YR 5/8) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; 90 percent rock fragments; abrupt wavy boundary.

R -- 26 inches, yellowish brown (10YR 5/4) and reddish yellow (7.5YR 6/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| SY3BR | 0.37 | 0.47 | 0.15 | 0.99 | 8.9 | 11.12 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| SY3BR | 4.72 | 4.78 | 4.85 | 5.77 | 5.84 | 17.16 | 16.95 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| SY3BR | 80 | 49 | 30 | 23 | 17 | 199 | 589 | 212 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| SY3BR | 54.4 | 83.0 | 84.0 | 42.0 | 27.5 | 27.2 |

Table E: Silt and sand mineralogy - taxonomic control section - SY3BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 820 | 80 | TR | TR | TR | 100 |
| Sand | 910 | 40 | 0 | 0 | 0 | 50 |
| 0.02-2mm | 850 | 70 | TR | TR | TR | 80 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

## *Profile WA1BR: Weikert extremely channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.5 miles northwest 332 degrees of the junction of Highways VA-613 and VA-747 and 0.6 miles northwest 282 degrees of the front gate of Montgomery Cemetery in Washington County.

*Vegetation:*

*Canopy:* Virginia pine (*Pinus virginiana* Mill.) 40%, hickory (*Carya* Nutt.) 20%, white oak (*Quercus alba* L.) 20%, and chestnut oak (*Quercus prinus* L.) 20%

*Ground:* Virginia creeper (*Pathenocissus quinquefolia* L.), poison oak (*Rhus radicans* L.), black oak (*Quercus velutina* Lam.), and blackberry (*Rhubus* L.)

*Site index:* Virginia pine (*Pinus virginiana* Mill.) 56 and upland oaks (scarlet, black, northern red, and chestnut) 54

*Parent material:* Millboro formation - dark gray shale

*Relief:* 250 feet

*Elevation:* 1930 feet

*Slope:* 22 percent

*Aspect:* south 182 degrees

*Drainage:* well

A -- 0 to 2 inches, dark brown (10YR 3/3) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 65 percent rock fragments; clear smooth boundary.

Bw -- 2 to 11 inches, yellowish brown (10YR 5/4) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; common fine and medium roots; common faint silt coatings on faces of peds and on rock fragments; 75 percent rock fragments; gradual wavy boundary.

C -- 11 to 16 inches, yellowish brown (10YR 5/6) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; few faint silt coatings on rock fragments; 90 percent rock fragments; abrupt wavy boundary.

R -- 16 inches, mottled olive brown (2.5Y 4/4) and strong brown (7.5YR 4/6) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA1BR | 0.69 | 0.35 | 0.31 | 1.35 | 17.0 | 7.94 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA1BR | 4.44 | 14.13 | 6.75 | 15.48 | 8.10 | 8.72 | 16.67 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WA1BR | 118 | 87 | 61 | 46 | 16 | 328 | 460 | 212 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA1BR | 39.7 | 83.3 | 43.6 | 80.2 | 38.2 | 73.0 |

Table E: Silt and sand mineralogy - taxonomic control section - WA1BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 640 | 140 | 90 | 30 | 0 | 100 |
| Sand | 900 | 70 | 30 | TR | 0 | TR |
| 0.02-2mm | 780 | 100 | 60 | 10 | 0 | 50 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WA2BR: Weikert extremely channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 1.6 miles southwest 260 degrees of the junction of Highways VA-80 and VA-689 and 2.0 miles northwest 284 degrees of the junction of Highways VA-80 and VA-611 in Washington County.

*Vegetation:*

*Canopy:* scarlet oak (*Quercus coccinea* Muenchh.) 50%, chestnut oak (*Quercus prinus* L.) 20%, yellow poplar (*Liridendron tulipifera* L.) 20%, and hickory (*Carya* Nutt.) 10%

*Ground:* chestnut oak (*Quercus prinus* L.), Virginia creeper (*Pathenocissus quinquefolia* L.), black cherry (*Prunus serotina* Ehrh.), ash (*Fraxinus* L.), flowering dogwood (*Cornus florida* L.), eastern hemlock (*Tsuga canadensis* L.), buckeye (*Aesculus octandra* Marsh.), and red maple (*Acer rubrum* L.)

*Site index:* chestnut oak (*Quercus prinus* L.) 60

*Parent material:* Millboro formation - dark gray shale

*Relief:* 120 feet

*Elevation:* 1800 feet

*Slope:* 41 percent

*Aspect:* northeast 44 degrees

*Drainage:* well

A -- 0 to 3 inches, very dark grayish brown (10YR 3/2) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, medium, and coarse roots; 75 percent rock fragments; clear smooth boundary.

Bw -- 3 to 12 inches, brown (10YR 4/3) extremely channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; common fine and medium roots; common faint silt coatings on faces of peds and on rock fragments; 85 percent rock fragments; clear wavy boundary.

C -- 12 to 19 inches, yellowish brown (10YR 5/4) extremely channery silt loam; massive; friable, slightly sticky, slightly plastic; few fine roots; common faint silt coatings on rock fragments; 90 percent rock fragments; abrupt wavy boundary.

R -- 19 inches, very dark gray (N 3/) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | NHBS* |
|---|---|---|---|---|---|---|
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA2BR | 6.73 | 1.47 | 0.80 | 9.00 | 17.3 | 52.02 |

*SBAS = $Ca^{2+} + Mg^{2+} + K^+$ and NHBS = $100(SBAS \div NHCEC)$.

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA2BR | 5.42 | 9.55 | 0.20 | 18.55 | 9.20 | 48.52 | 97.83 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = $100(SBAS \div SCEC)$, and EBS = $100(SBAS \div ECEC)$.

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand VC | C | M | F | VF | Total | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of soil | | | | | | | |
| WA2BR | 67 | 57 | 48 | 47 | 19 | 238 | 503 | 259 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA2BR | 1.1 | 2.1 | 1.0 | 66.8 | 35.5 | 71.6 |

Table E: Silt and sand mineralogy - taxonomic control section - WA2BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 710 | 80 | 160 | 0 | 0 | 50 |
| Sand | 910 | 90 | 0 | 0 | 0 | TR |
| 0.02-2 mm | 800 | 80 | 90 | 0 | 0 | 30 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# *Profile WA3BR: Weikert channery silt loam*

*Classification:* loamy-skeletal, mixed, mesic Lithic Dystrochrepts

*Location:* About 0.2 miles northeast 58 degrees of the junction of Highways US-19 and VA-689 and 1.2 miles northwest 330 degrees of the junction of Highways VA-611 and US-19 in Washington County.

*Vegetation:*

*Canopy:* scarlet oak (*Quercus coccinea* Muenchh.) 60%, hickory (*Carya* Nutt.) 20%, black locust (*Robinia Pesudo-Acacia* L.) 10%, and Virginia pine (*Pinus virginiana* Mill.) 10%

*Ground:* blackhaw (*Viburnum prunifolium* L.), Virginia creeper (*Pathenocissus quinquefolia* L.), red maple (*Acer rubrum* L.), flowering dogwood (*Cornus florida* L.), black cherry (*Prunus serotina* Ehrh.), black gum (*Nyssa sylvatica* Marsh.), hawthorn (*Crataegus* L.), hickory (*Carya* Nutt.), and white oak (*Quercus alba* L.)

*Site index:* scarlet oak (*Quercus coccinea* Muenchh.) 66

*Parent material:* Brallier formation - green shale

*Relief:* 800 feet

*Elevation:* 1820 feet

*Slope:* 57 percent

*Aspect:* south 170 degrees

*Drainage:* well

A -- 0 to 3 inches, dark brown (10YR 3/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many very fine, fine, and medium roots; 25 percent rock fragments; clear smooth boundary.

Bw -- 3 to 8 inches, yellowish brown (10YR 5/4) very channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; few fine and medium roots; common faint silt coatings on rock fragments; 55 percent rock fragments; abrupt wavy boundary.

R -- 8 inches, dark yellowish brown (10YR 4/4) shale.

Table A: Chemical properties - taxonomic control section

| Profile | $NH_4OAc$, pH 7.0 | | | | | NHBS* |
|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | SBAS* | NHCEC | |
| | cmol (+) $kg^{-1}$ of soil | | | | | % |
| WA3BR | 0.65 | 0.59 | 0.25 | 1.49 | 13.4 | 11.12 |

*SBAS = $Ca^{2+}$ + $Mg^{2+}$ + $K^+$ and NHBS = 100($SBAS \div NHCEC$).

Table B: Chemical properties - taxonomic control section

| Profile | pH | H | $Al^{3+}$ | SCEC* | ECEC* | SBS* | EBS* |
|---|---|---|---|---|---|---|---|
| | | cmol (+) $kg^{-1}$ of soil | | | | % | |
| WA3BR | 4.62 | 10.55 | 5.15 | 12.04 | 6.64 | 12.38 | 22.44 |

*SCEC = SBAS + $H^+$, ECEC = SBAS + $Al^{3+}$, SBS = 100($SBAS \div SCEC$), and EBS = 100($SBAS \div ECEC$).

Table C: Particle-size distribution* - taxonomic control section

| Profile | Sand | | | | | | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | VC | C | M | F | VF | Total | | |
| | g $kg^{-1}$ of soil | | | | | | | |
| WA3BR | 102 | 79 | 56 | 80 | 33 | 350 | 425 | 225 |

*Hydrometer method (Day, 1965)

Table D: Selected ratios - taxonomic control section

| Profile | $Al^{3+}$ to NHCEC | $Al^{3+}$ to ECEC | $Al^{3+}$ to SCEC | NHCEC to Clay | ECEC to Clay | SCEC to Clay |
|---|---|---|---|---|---|---|
| | % | | | cmol (+) $kg^{-1}$ of clay | | |
| WA3BR | 38.4 | 77.5 | 42.7 | 59.6 | 29.5 | 53.5 |

Table E: Silt and sand mineralogy - taxonomic control section - WA3BR

| Fraction | Quartz | Mica | Feld* | Kaol* | Chlor* | II* |
|---|---|---|---|---|---|---|
| | g $kg^{-1}$ of specified fraction | | | | | |
| Silt | 780 | 130 | 40 | 0 | 0 | 50 |
| Sand | 970 | 30 | 0 | 0 | 0 | TR |
| 0.02-2 mm | 890 | 70 | 20 | 0 | 0 | 20 |

*Feld = feldspar, Kaol = kaolinite, Chlor = chlorite and/or vermiculite, II = irregularly interstratified chlorite, vermiculite, and/or kaolinite.

# Virginia's Agricultural Experiment Stations

1—Blacksburg
Virginia Tech, Main Station
Dairy, Poultry, and all other topics

2—Steeles Tavern
Shenandoah Valley Agricultural Experiment Station
Beef, Forages, Fruit, Insect and Pest Control, Sheep

3—Orange
Northern Piedmont Agricultural Experiment Station
Alfalfa, Corn, Crops, Small Grains

4—Winchester
Winchester Agricultural Experiment Station
Fruit, Insect and Pest Control

5—Middleburg
Middleburg Agricultural Experiment Station
Beef, Forages

6—Warsaw
Eastern Virginia Agricultural Experiment Station
Field Crops, Insect and Pest Control

7—Holland Station, Suffolk
Tidewater Agricultural Experiment Station
Corn, Peanuts, Pest Control, Small Grains, Soybeans, Swine

8—Blackstone
Southern Piedmont Agricultural Experiment Station
Forages, Horticulture Crops, Small Grains, Tobacco, Turfgrass

9—Critz
Reynolds Homestead Agricultural Experiment Station
Aquaculture, Forestry, Wildlife

10—Glade Spring
Southwest Virginia Agricultural
Experiment Station
Beef, Burley Tobacco, Sheep

11—Hampton
Virginia Seafood Agricultural Experiment Station
Seafood

12—Virginia Beach
Hampton Roads Agricultural Experiment Station
Ornamentals, Vegetables, Insect and Pest Control

13—Painter
Eastern Shore Agricultural Experiment Station
Fruit, Field Crops, Herbs, Insect and Pest Control, Vegetables