Soil Management Plan for the G.O. White State Forest Nursery[1]

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Abstract – The George O. White State Forest Nursery has expanded, shifted its emphasis to producing a wider variety of species and has made changes in cultural practices. A need for soils information was recognized as a key tool on which to base important management decisions. Four major areas of management were selected for specific attention in this soils report. They are irrigation, fertility, species selection and pollution prevention.

INTRODUCTION

The George O. White Nursery was begun in 1935 with the purchase of forty acres by the U.S. Forest Service. This initial purchase became nursery blocks 1 through 6. Production of Shortleaf Pine seedlings for reforestation began soon after this purchase. With the outbreak of World War Two the nursery was closed and leased for crop production. In 1947 the Missouri Department of Conservation took over management, with the agreement that they would produce up to 2.5 million Shortleaf Pine seedlings for the National Forests in Missouri. In 1956, an additional 414 acres were added to the original purchase, most of which was not suitable for nursery applications. Approximately 30 acres of this acquisition were placed into production. This land was designated blocks 7 through 16. Ninety-nine acres were added in 1972 with production of seedlings beginning in 1977. This became blocks 17 through 22. In 1976 the Missouri Department of Conservation took title of the original 40 acres through a land exchange with the U.S. Forest Service. A final procurement of 201 acres was made in 1977. This acreage was utilized for seed production and wildlife planting. There is now a total seedbed surface area of 50 acres. The total acreage held is currently 748.

The production areas employ an irrigation system that has evolved over the years. A White Showers overhead system with one well was used during the initial years. A second well was added in 1963 and a third in 1983. The last of the White Showers system was dismantled in 1987 and a portable method of irrigation was adopted utilizing polyvinylchloride (PVC) pipes in all blocks but 17 through 22. These blocks have an underground PVC system with standpipes and sprinkler heads.

Since 1985, a wide variety of species have been planted in an attempt to meet the need for nursery stock. This is a continuation of the trend away from the production of purely forest species. Today the George O. White Nursery produces over 5 million seedlings yearly comprised of approximately 50 species.

MATERIALS AND METHODS

The George O. White Nursery is located near Licking Missouri, in the Northeast corner of Texas County. The county is located in South Central Missouri within the physiographic region known as the Salem Plateau. This area consists of Ordivician aged sedimentary rock between 438 and 505 million years old. The nursery lies on an area dominated by the Roubidoux Formation. This formation consists of sandstone with thinly interbedded chert.

The soils of the ridges and backslopes developed in residuum from sandstone and the majority are moderately deep. The soils of the footslopes and toeslopes are very deep and formed in colluvium and old alluvium. The terrace and floodplain soils are derived from old and young alluvium.

The climate of the area falls into the continental moist regime.

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The summers range from warm to cool and the winters are cold. Precipitation averages approximately 39 inches per year and is evenly distributed among the four seasons. The evapotranspiration rate exceeds the natural rainfall during the main growing period making it necessary to utilize irrigation.

The study area consists of 22 fields encompassing approximately 100 acres. This tract is made up of roads, irrigation lines, field boundaries and seedling beds. Each field was treated as its own entity according to the management strategy used at the White Nursery. Soils information was collected on the seedbeds utilizing a 100' X 100' grid. Additional data was collected at 50 foot intervals when it was needed to separate soil types.

The grids were laid out from the southeast corner of each field using the sprinklers as reference points. Using these fixed points will allow the data to be recaptured in the future to compare the effects of use and management. At each of the sites the soil properties important to our study: surface and subsoil texture, horizon thickness, gravel content and drainage were recorded to a depth of 40 inches.

A representative profile was selected from each of the different soil types, excavated to a depth of 60 inches, described and sampled. These samples were sent to the Soil Characterization Laboratory at the University of Missouri for physical and chemical analysis.

A soils map was produced from the field work (see figure 1). This map will become a portion of a multidisciplinary data base for future management decisions.

Discussion

The ensuing section will elaborate on the soils and the areas of management selected as being the most important for the George O. White Nursery.

SOILS

The soils of the George O. White Nursery were mapped utilizing the important physical properties, as listed above, and the landform. Landforms separated included footslopes, low stream terraces and floodplains. Data on chemical properties, such as Cation Exchange Capacity, Organic Carbon, pH, etc, were collected through laboratory analysis, (see Appendix). Chemical properties were used for interpretive purposes and not to group soils.

Soils with similar physical properties on the same landform were placed in delineations called map units. Five map units were set up, named and labeled by number, (see figure 1). Differences in these map units occur mainly as a result of drainage, particle size and landform. Drainage ranged from well drained to somewhat poorly drained. The texture of the soils as determined from the particle size included sand, loamy sand, sandy loam, silt loam, loam, silty clay loam and clay loam. One map unit occurred on footslopes, three on low stream terraces and one on floodplains.

The following management discussions are based on the physical and chemical properties of the soils and are not separated by map units.

Species Selection

The determination of which species to plant, where and when, needs to be based on the physical and chemical properties of the soil in conjunction with the requirements of the plant. Soil properties affect germination, seedling survival and vigor, and timing of planting and harvesting.

Physical characteristics of the soil that influence these processes are drainage and available water capacity (AWC). Aluminum saturation, cation exchange capacity (CEC), pH and organic matter have an impact from a chemical standpoint.

Management Implications

The soils drainage will have the greatest affect on the germination of seeds and the survival and vigor of young plants.

Excessive moisture in some what poorly drained soils and a deficiency of moisture in somewhat excessively drained soils will affect seeds and plants. Subsurface artificial drainage and the use of raised beds will limit the affects of excess moisture. Diversions will control runoff from adjacent uplands. The irrigation system can be utilized to increase the moisture content under droughty conditions.

A soils ability to store and release nutrients to the seedlings is affected by its CEC. The CEC of a soil is discussed in the section on soil analysis and fertility. It is sufficient to say at this point that the lower the CEC the more difficult it is to maintain the nutrient level necessary for non-stressed growth. Increasing the CEC by increasing the organic matter content in the surface to 3 percent will improve the nutrient suppling capacity of the soil.

Organic matter will help to alleviate the additional problem of surface crusting in the soils that have silt loam surfaces. This crusting phenomenon can lead to a decline in the number of seedlings that survive because the seedlings are unable to break through the crust.

High aluminum saturation (Al^{+++}) influences the rooting ability of young seedlings. Several of the soils expressed Al^{+++} saturation values which would prevent the roots from entering these horizons. The results would be less nutrient and moisture uptake. Application of lime (Ca^{++}) will lessen the affect of the Al^{+++} saturation. Of interest, two of the soils with the highest expression of toxicity were those soils that have been in production and under irrigation the longest.

A pH between 5.5 and 6.5 supplies the greatest benefits for the plants in regard to their needs and would assist in improving some of the other soil properties discussed above.

Scheduling of planting and harvesting can also related to the soil. The key here is drainage. Soils that are somewhat poorly drained or moderately well drained will have more scheduling limitations than those that are well or excessively well drained. Cultural practices completed when the soil is not at optimum moisture can contribute to the affects of other soil limiting factors.

SOIL COMPACTION

Some areas of the George O. White nursery have been under continuous cultivation for 20 to 45 years. Observations made during the data collection revealed zones of subsurface compaction from equipment traffic and soil manipulation. Soil compaction is unavoidable in this type of operation. The detrimental affects of compaction on crop production must be understood and considered in the management of soil tilth. Often it is "out of sight" and therefore "out of mind", making it more important to be aware of.

Soil compaction is the physical rearrangement of soil particles such that they are packed more closely together. This usually occurs in the surface layer of soils from machinery traffic during cultivation, planting, and harvesting. The size of the soil particles normally does not change, rather the pore space between them is reduced. This leads to reduced water infiltration, loss of aeration, impeded permeability, diminished root penetration and loss of nutrient exchange in the compacted zone.

Some of the more important symptoms of soil compaction problems are: perched water at or near the surface, increased runoff, poor plant emergence and thin stands, abnormal rooting patterns or uneven growth, and plant stress. These effects, on young plants, can be mistakenly identified as herbicide or fertilizer injury.

The soil investigations revealed a compacted zone around 7 to 9 inches beneath the seed beds. This condition exists in all soils but the Kaintuck (2B unit). The Kaintuck has a uniform, coarser particle size, which does not compact as much as soils containing a higher percentage of silt and clay. Compaction was also observed at a depth of 12 to 14 inches under the current and previous nursery bed paths.

The degree of compaction present in the 7 to 9 inch zone was not determined. This zone was consistent over the majority of the nursery. It is strong enough that it restricts water infiltration, as evidenced by gray color patterns indicating reduction of iron. Methods to accurately determine the degree of compaction are available. More commonly, observations of crop performance, root penetration patterns, water infiltration, and relative density when probing the soil are enough to determine the extent and level of compaction problems.

Management Implications

Once a compaction problem has been identified, steps can be taken to minimize the affect. Adding or maintaining organic matter levels in the soil is an important step to reduce compaction. Organic matter binds soil particles together into structural aggregates that resist being broken down by tillage or traffic. Other steps to minimize compaction are related to varying and timing equipment operations with moisture conditions. Moisture content has the greatest influence on the amount of compaction produced because it acts as a lubricant to the soil particles allowing them to be more easily rearranged.

IRRIGATION

The soil parameters that are important to irrigation are infiltration, permeability, texture and available water capacity. These characteristics of the soil determine the management of water applied by irrigation.

Infiltration is the parameter used to estimate the ease by which water can enter the soil. It is determined by surface characteristics of the soil. Some of the characteristics that affect infiltration are organic matter, structure, texture, moisture content, mulch, and surface sealing.

Permeability is the flux of downward water movement through the soil. It is related to the macropore characteristics as influenced by aggregation and structure. The permeability classes listed in the glossary describe the rates of movement of water through the soil.

Available water capacity is the ability of the soil to retain and supply water to plants. It is related to the micropore characteristics of the soil and is strongly dependent on texture. Medium textured soil, such as in the loam and silt loam classes, have the highest available water capacity. Factors that can affect the AWC are organic matter and compaction.

All of the above parameters are interrelated. An ideal parameter in one area may cause another to be less than ideal. Limitations can be minimized through careful management.

Management Implications

There are many possible calculations that can be used to help with management of irrigation. Many of the calculations are more agronomic than soil related. There are calculations for interval scheduling, rate of application, time of application, effective application, rate of infiltration, amount of water needed, and many more calculations of the kind. With specific relation to soils, the calculations are: recharge to maximum AWC; limit of permeability; and limit of infiltration.

The calculation for available water capacity is: AWC=(inches of water per inch of soil depth). The inches of water per inch of depth is based on texture. Coarse textured soils have low AWC, medium textured soils have high AWC, and fine textured soils have moderate AWC. By using one of several methods of calculating evapotranspiration, the amount of water removed from the soil is known. Subtraction from the total AWC gives the balance to be supplied by irrigation. It is important to remember to use only the depth of soil from which plant roots can obtain water.

Permeability is given in inches per hour. Once the amount of irrigation water applied per hour is known, it can be compared to the permeability to see if the irrigation is exceeding the ability of the soil to allow the water to move through. Rates that exceed the permeability can result in runoff and waste of water. Inversely, low application rates may not irrigate in a timely manner.

Infiltration calculations require experimentation to determine a constant for the soil type. Standardized experiments describe infiltration investigation procedures. Once the constant for a soil is determined, a formula is used to calculate how fast water can enter a soil. These calculations can show how fast water can be applied at a given set of beginning conditions and how long water can be applied at a given rate before runoff occurs.

On a practical basis, a manager can determine irrigation rates and effectiveness using AWC, remaining AWC after evapotranspiration, permeability, and rate of irrigation. As a manager gains experience, other calculations can be added and the entire system can be refined.

Modifications that have an affect on irrigation deal primarily with changes within the surface and soil horizon directly below. Permeability can be changed somewhat near the surface, but not at depth due to expense. Usually, the changes made to improve surface conditions will affect permeability.

Soil surface conditions can be changed dramatically. One of the more helpful practices is to increase the organic matter. Organic matter has a beneficial effect on AWC and permeability. Another practice that can help is mulching. A mulch protects the soil surface so the structure is not broken down by droplet impact. Sealing of the surface is also reduced. In addition, recent experimental information indicates that a moist surface may enhance infiltration. A mulch helps to maintain a moist soil surface. Tillage practices that minimize the breakdown of the structure of the surface improves infiltration.

Surface texture affects infiltration. Coarse textured soils, such as sandy loam, have higher infiltration rates than fine textured soils. The texture is going to be relatively constant within the surface layer so irrigation needs to be managed for the surface texture.

That brings up the last area of modification: irrigation control. The intensity and frequency of water application should be managed as indicated by the soil. Experience is a valuable teacher and can be assisted by recording observations. The manager is the one that has to decide which factors are more important and how to reach the desired goals.

To sum up, the major factors affecting irrigation are infiltration, permeability, and available water capacity. These factors are interrelated and should be dealt with in a total system of management.

FERTILITY

The fertility of the soil is related to many factors. Focus will be placed on organic matter, low pH, cation exchange capacity, aluminum toxicity, and macronutrients.

The inherent fertility of the soil, or lack thereof, is from the parent materials. Parent materials that are high in desirable minerals impart fertile characteristics to the soil. The weathering process also affects minerals present in the soil. High rainfall, particularly coupled with high temperatures, can cause much of the original fertility to be leached from the soil. Such conditions can also allow the accumulation of undesirable minerals.

Organic matter is a factor of soil fertility. Higher amounts are typically good. Organic matter contains many nutrients that are released over time for plant use. Unfortunately, organic matter is easily lost. Management practices that maintain or increase organic matter are beneficial over the long term and should be of the highest priority.

The pH of the soil determines the availability of many minerals within the soil. Low pH increases toxicity of some minerals to plants. High pH causes problems with segregation of minerals necessary to plants. A pH ranging from 5.5 to 6.5 is desirable. The addition of agricultural lime will raise the pH if it is low. If the pH is too high, the addition of sulfur compounds can increase the acidity of the soil. Applications of fertilizers will increase the acidity of the soil over time. In addition, fertilizers are much more effective when pH is in the above range.

Cation exchange capacity is a measure of a soil's ability to provide nutrients to a plant. The CEC reflects the amount and type of clay in the soil. The organic matter also adds to the CEC. Normally, it is desirable to have the CEC dominated by basic cations such as Ca^{++}, Mg^{++}, and K^{+}. Within some soils, the CEC is pH dependant so that the CEC increases as the pH increases. Typically, the CEC is constant for a soil.

Among problems in soil fertility, the most serious are toxicity problems. Laboratory analysis indicates that some areas of the nursery have aluminum concentrations high enough to be toxic to plants. Often low pH allows the aluminum to become soluble and enter the soil solution. Aluminum toxicity can be ameliorated by liming to increase the pH and thus reduce the solubility of the aluminum.

Plants require macronutrients such as: nitrogen, phosphorus, and potassium. These minerals are easily added to the soil by commercial fertilizers. Sampling of the top 6 to 8 inches of the soil, and subsequent laboratory analyses of the soil samples, provides the best method of determining fertilizer needs. There are commercial laboratories that specialize in nursery soil analysis.

In summation, soil fertility comes initially from the parent material of the soil as weathered by the environment. The cation exchange capacity and organic matter are relatively constant for each soil and are not easily changed. Soil pH and macronutrient fertility can be manipulated, at least in the surface layer. The goal is to maintain high soil fertility.

POLLUTION PREVENTION

Following is a general definition of pollution prevention, as used by the USEPA:

Pollution prevention is the use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source.

Purchasing, storage, application and clean-up are all areas in which pollution prevention can be applied. The Missouri Department of Conservation, through their management practices, already address several of these areas.

In the area of application, management of several soil properties can be utilized in developing additional practices to lessen the possibility of pollution from fertilizers and pesticides.

Surface runoff transports pesticides in solution or adsorbed to sediments. Filter strips, sediment basins, water breaks in drainage ditches and/or regulation of irrigation can reduce runoff losses.

Leaching is the process whereby pesticides are transported by percolating water below the root zone. Soil properties that need to be considered are texture, surface layer thickness, organic matter, structure and depth to water table.

Potential for leaching losses are inherent for the soils at the nursery. Increasing organic matter and its incorporation below the surface layer would increase the ability of the soil to retain pesticides in the rooting zone. Field 14, which had compost and additional fill added to the surface, showed the greatest degree of protection from leaching due to the ability of this material to lessen the downward movement of contaminants.

The texture, clay mineralogy, structure and depth to water table influence the soils natural permeability. Soils with a rapid or greater permeability or soils that have a water table near the surface have severe limitations for groundwater contamination. The Kaintuck and Moniteau soils have the greatest potential for pollution problems.

The greatest potential for pollution prevention is to have a knowledge of the soil, so as to apply chemicals appropriately and avoid over utilization of pollutants.

CONCLUSION

The soils of the nursery vary in their properties and in their response to management. Sound land use decisions are based on understanding soil properties and utilizing them in conjunction with management practices. This report provides a soil map, with detailed descriptions of the physical and chemical properties of each soil type. Discussion of species selection, compaction, irrigation, fertility management and pollution prevention are provided to supply information which will assist in determining modification of management practices or the soil resource to meet production goals.

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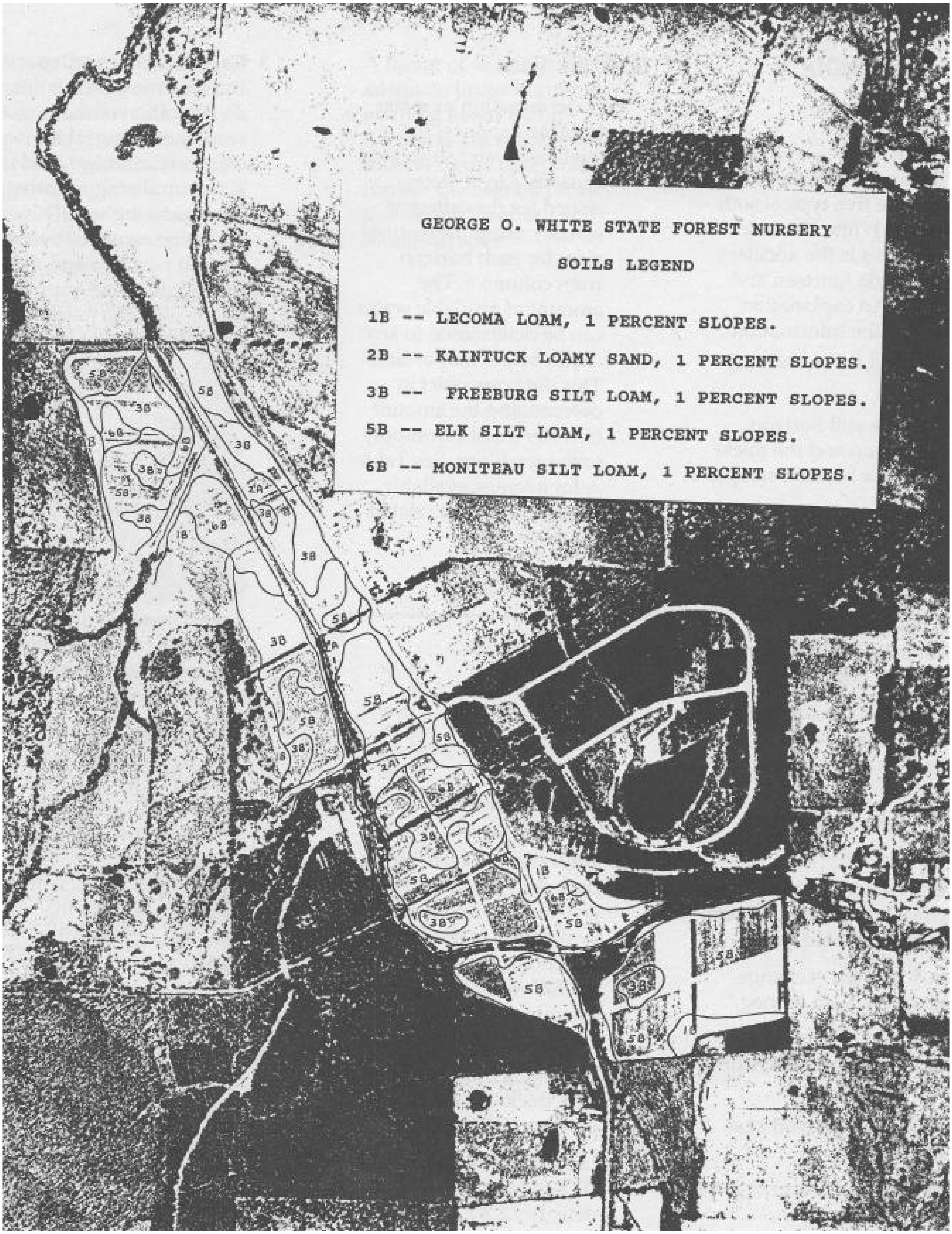

Figure 1 - Soils map of the G.O. White State Forest Nursery

APPENDIX A

Soil Analysis

The data presented in Table B represents the five typical soils found on the White Nursery. Along with this is the ancillary data from fields fourteen and twenty-two. An explanation accompanies the information.

Column 1: Soil name and map symbol.

Column 2: The soil horizon designation and the thick ness of the horizon sampled.

Column 3 : The percent total clay. Particles <0.002mm. Used to determine textural class.

Column 4 : The percent total silt. Particles 0.002mm to 0.05mm. Used to determine textural class.

Column 5 : The percent total sand. Particles 0.05 to 2mm. Used to determine textural class.

Column 6 : The textural class of the soil horizon.

Column 7 : Ammonium Acetate extractable Ca, Mg, Na and K. Given in Meq/lOOq.

Column 8 : Cation exchange capacity. Given in meq/ lOOg.

Column 11 : The percent Aluminum saturation.

Column 12 : The percent base saturation.

Column 13 : The percent organic matter.

Column 14 : The pH.

Specific Uses

1 **Determination of water holding capacity:** the available water supplying capacity can be determined for the different soils by using the textural class for each horizon from column 6. The amount of available water can be determined to any depth below the surface. This data can assist in determining the amount of water a soil can supply to the seedlings. See Table A for average available water capacity as related to soil texture.

Table A

Inches per inch of soil	
Sand	.05-.09
Loamy Sand	.08-.12
Sandy Loam	.11-.15
Loam	.19-.22
Silt Loam	.20-.24
Silty Clay Loam	.18-.20
Clay Loam	.14-.17

2 **Indication of fertility:** The figures in column 7 will give an idea of the present availability of the cations listed. Through the use of the following formulas the pounds per acre for each cation can be determined.

(#/acre = Ca meq/lOOg X 20 X thickness cm X bulk density /2.2/2.471)

(#/acre = Mg meq/lOOg X 39 X thickness cm X bulk density /2.2 /2.471)

(#/acre = K meq/lOOg X 12 X thickness cm X bulk density /2.2/2.471)

3 **Cation Exchange Capacity:** This measurement is an indication of the readily exchangeable cations (Ca^{++}, Mg^{++}, and K^{+}) neutralizing negative charges in the soil. This exchange comes between the soil particles and the soil solution and supplies plants with the nutrients they need. Therefore this figure is usually closely related to soil fertility. The CEC figure is meaningful as far as plant growth, fertilizer additions and liming are concerned. The higher the CEC the greater its ability to hold and supply fertilizers and lime to the plants. The CEC of a soil is based on the percentage of clay, the type of clay and the amount of organic matter.

4 **Aluminum saturation:** This figure presents the percent of Al^{+++} in the soil solution. Anything other than very low concentrations of Al^{+++} are toxic to most plants. Sufficient lime will remedy the problem of aluminum toxicity. A pH of 6.0 or higher is an indication that calcium is sufficient.

5 **Base saturation:** This number is related to pH and fertility. For a soil of any given organic and mineral composition, the pH and fertility level increase with an increase in the degree of base saturation. Also the availability of the basic cations (Ca++, Mg++, and

K^+) to the plant increases with the degree of base saturation. A soil with 80 percent base saturation would provide cations to a growing plant far more easily than the same soil with a base saturation of 40 percent.

6 **Organic matter:** This is the percent organic matter present. The higher the organic matter the more natural fertility a soil has. It is also an indication of the amounts of cations or chemicals that can be adsorbed before runoff or leaching occurs. The higher the organic matter the greater the adsorption.

7 **pH:** The pH of an horizon is closely tied to the other lab analyses. pH is and indication of the H^+ ion activity in the soil solution or the acidity level of a soil. The pH has an effect on the production of plants due to its influence on the availability of certain nutrients. A pH between 5.5 and 6.5 will give the most desirable results depending on species.

8 **Soil attenuation capacity:** The soil attenuation capacity is the ability of the soil to lessen or dilute the downward movement of contaminants in the soil. It is represented by the Soil Leaching Loss Rating (SLLR). The SLLR is defined as: SLLR = (Surface Layer Depth) X (Organic Matter Content). A figure of 45 will provide adequate protection from leaching losses in the Kaintuck, Elk and Lecoma soils. A figure of 65 will furnish the needed protection on the Freeburg and Moniteau soils.

Table B

1	2	3	4	5	6	7				8	9	9	11	12	13	14
Soil Name and Map Symbol	Horizon and Depth	% Clay <002	% Slit .002-05	% Sand .05-2.0	Text Class	NK40Ac Extractable Bases				Sum Bases	Acidity meq/ 100g	CEC	Al Sol.	Base sum	Org Mat	pH H2O
						CA	MG	NA	K							
1B Lecoma	Ap 0-9'	15.8	50.0	34.2	L	5.6	2.3	TR	.5	8.3	4.2	8.5	1	67	1.5	6.7
	2Bt1 9-12"	33.1	42.3	24.7	CL	3.8	2.7	0.0	.5	7.0	9.7	9.3	26	42	0.33	4.9
	2Bt2 12-22"	30.3	40.7	29.0	CL	1.6	1.9	TR	0.3	3.8	12.4	9.6	60	23	0.16	4.6
2B Kaintuck	Ap 0-12'	3.5	19.5	77.0	LS	2.2	0.0	0.0	.2	2.4	3.2	2.5	4	43	1.16	5.9
	C1 12-16'	3.1	9.9	87.0	S	1.0	0.0	0.0	.1	1.1	2.4	1.3	15	31	0.17	5.6
	C2 16-23"	1.0	3.0	95.9	S	.5	0.0	0.0	.1	0.6	1.1	.7	14	35	1R	5.6
	C3 23-27"	9.2	33.8	57.0	FSL	2.2	0.0	0.0	.2	2.4	4.5	2.7	11	35	0.66	5.3
	C4 27-41'	15.3	32.1	52.6	FSL	2.6	0.0	0.0	.2	2.8	3.7	2.9	3	43	0.5	5.6
3B Freeburg	Ap 0-9"	12.7	66.8	20.5	SIL	3.3	.8	0.0	.4	4.5	7.1	4.9	8	39	1.66	5.4
	Bt1 9-17"	21.0	7 1.4	7.6	SIL	2.8	1.2	0.0	.4	4.4	7.3	5.3	17	38	0.16	5.1
	Bt2 17-25"	25.5	68.1	6.4	SIL	3.3	1.2	0.0	.4	4.9	8.8	7.0	30	36	0.16	4.9
	Bt3 25-37"	20.4	70.4	9.2	SIL	2.5	1.1	TR	.3	3.9	8.7	6.3	38	31	0.33	4.9
	Bt4 37-54"	16.9	59.4	23.6	SIL	1.7	1.2	TR	.2	3.1	7.4	5.3	42	30	0.33	4.9
	Bt5 54-62"	5.9	25.3	68.8	COSL	.7	.4	0.0	.1	1.2	3.1	1.9	37	28	0.16	4.9
5B Elk	Ap 0-9"	14.4	74.1	11.5	SIL	5.4	1.5	TR	.4	7.3	5.2	7.4	1	58	2.0	5.9
	Bt1 9-16"	21.1	74.1	4.8	SIL	4.5	2.0	TR	.2	6.7	5.2	6.8	1	56	.83	5.9
	Bt2 16-38"	25.5	71.3	3.3	SIL	4.2	1.2	.1	.3	5.8	7.3	6.3	8	44	.50	5.2
	Bt3 38-61"	22.3	73.2	4.6	SIL	3.8	1.6	TR	.2	5.6	7.7	6.4	13	42	0.33	5.2
6B Moniteau	Ap 0-12"	16.4	66.7	16.9	SIL	6.5	1.2	0.0	.4	8.1	6.9	8.1	0	54	2.3	6.2
	E 12-21"	16.6	79.6	3.8	SIL	1.9	.4	.1	.2	2.6	7.1	5.3	51	27	0.16	4.7
	Bt1 21-35"	20.0	76.6	3.4	SIL	1.4	.8	.2	.1	2.5	10.3	7.0	64	20	0.16	4.8
	Bt2 35-45"	24.2	58.4	17.4	SIL	2.6	1.9	.6	.2	5.3	11.0	9.0	41	33	0.33	4.9
	Bt3 45-55"	25,4	71.4	3.2	SIL	3.6	2.8	.9	.2	7.5	11.1	10.6	29	40	0.33	4.9
	Bt4 55-61"	27.5	68.1	4.4	SICL	3.5	2.7	.9	.3	7.4	9.3	9.3	21	44	0.33	4.9
Field #14	Ap1 0-8"	11.9	66.1	22.0	SIL	6.8	.8	.1	.6	8.3	6.4	8.4	-	56	3.5	6.0
	Ap2 7-16"	12.1	65.9	22.0	SIL	5.3	.4	TR	.6	6.3	6.2	6.5	-	50	3.0	6.0
	Ap3 16-24"	13.5	72.1	14.4	SIL	1.9	.8	TR	.4	3.1	4.6	3.3	-	40	1.16	6.0
Field #22	Ap1 0-8"	12.4	54.7	32.9	SIL	5.9	1.6	TR	.2	7.7	4.6	7.7	0	63	1.66	6.7
	Ap2 8-17"	13.6	60.0	26.3	SIL	3.8	1.2	TR	.2	5.2	4.7	5.2	0	53	1.0	6.2
	Ap3 17-24"	9.1	38.1	52.8	FSL	2.7	.4	TR	.1	3.2	5.6	3.4	6	36	1.0	5.4