TOPDRESS FERTILIZATION

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Abstract.--Certain nutrients must often be provided to nursery crops during the growing season. Nitrogen is of primary importance though addition of other materials may also be required. Nitrogen applications should begin "early" to enhance seedling development and end "early" to enhance the hardening off process. An effective granular applicator provides for accurate placement of fertilizer and allows the flexibility to apply different rates or different materials to small as well as large areas.

Additional keywords: Pinus taeda, Liquidambar styraciflua, Platanus occidentalis, tree seedlings.

INTRODUCTION

Pine and hardwood seedling requirements for nitrogen and potassium will be briefly reviewed, and topdress application and record management techniques discussed. Also included are some unanswered questions regarding the relationship between nitrogen rates and certain nursery practices.

The discussion and recommendations are given within the context of the quotation and the brief description of the Union Camp Virginia nursery site that follows.

"The amounts of the various nutrient elements that must be added to the soil to meet the requirements of specific seedlings may vary enormously from nursery to nursery, soil to soil, and year to year. They depend not only on the apparent shortages of the necessary elements as shown by soil analyses, but also on soil texture, leaching, chemical reactions within the soil, and potential drain by seedlings and other plants" (Wakely 1954).

Union Camp seedling production by area is about 75% loblolly pine and 25% hardwood, mostly sweetgum. The site was selected for hardwood seedling production. The surface soil is a very fine sand. Depth to the clay subsoil varies from 30 to 122 cm (12 to 48 in). Most subsoil is 46 to 76 cm (18 to 30 in) below the surface. This type of soil probably retains organic matter, water and nutrients better than the coarser textured, deep-sand sites favored for ease of harvesting.

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SEEDLING REQUIREMENTS

In this discussion it is a basic assumption that the seasonal requirement for all nutrients except nitrogen (N) and potassium (K) are inherently available or have been applied preplant. No preplant N is recommended unless organic matter is less than 1% (South and Davey 1983). A preplant application and one late summer topdress application of K is usually required (May et al. 1984).

How much N and K are required? According to May et al. (1984) a pine seedling crop removes 140 kg N/ha (125 lb N/ac) and 67 kg K/ha (60 lb K/ac), but the crop only recovers 50-70% of that applied. This agrees with Armson and Sadreika (1979) who suggest that the K supply be one and one-half to two times the amount expected to be removed by the crop. At the Stauffer Nursery the annual addition of 180 kg $K_2$0/ha (160 lb $K_2$0/ac) was necessary to maintain a stable level of K under continuous cropping of pine seedlings (May and Gilmore 1985). At the Union Camp Virginia nursery annual K drawdown including plant utilization and leaching was estimated to be 146 kg/ha (130 lb/ac) during hardwood seedling production (Stone 1980).

Maintenance of a minimum of 90 ppm K is recommended by South and Davey (1983). In some instances at least, Dr. C. B. Davey through the nursery soil testing program is specifically recommending a late summer application of K. There is no visible pine or hardwood seedling response to this treatment. There are some unpublished data to indicate that available K may drop to very low levels by mid-August; therefore, the late summer addition is needed. Comparison of soil test results from year to year indicates that a portion of the K applied to seedlings in late summer may remain in the soil and be available to the subsequent crop.

The addition of about 168 kg N/ha (150 lb N/ac) is usually recommended if no preplant N is required (South and Davey 1983). Discussions with nurserymen indicate that pine seedling crops are often produced with much lower additions of N. In the early days of hardwood seedling production at the Union Camp Virginia nursery, N was applied at rates exceeding 448 kg/ha (400 lb/ac). At this site Villarubia (1980) found no significant difference between 224 kg N/ha (200 lb N/ac) and higher rates up to 448 kg N/ha (400 lb N/ac). The nominal rate in use now is 280 kg N/ha (250 lb N/ac).

Both South and Davey (1983) and May et al. (1984) discuss the relative merits of the various sources of N and K. The most commonly used sources of N are ammonium nitrate (AN) and ammonium sulphate (AS). The source of K is usually muriate of potash (KCL).

Alternate applications of AS and AN are often used at the Union Camp Virginia nursery. This practice was adopted as a result of some of the testing of hardwood seedling response to N sources. There are also some

indications that one or more applications of AS may reduce the probability or severity of summer chlorosis of pine seedlings. The change may be the result of a slight reduction of pH or possibly the increased availability of sulphur (S).

Preferably N applications should begin "early" and end "early". The first application should be about six weeks after seeding (South and Davey 1983). This is about the time true needles or in the case of hardwoods true leaves are forming. The final application should be early enough to at least allow the normal onset of winter dormancy. Late and heavy applications of N will likely result in succulent stem tissue at the time seedlings should be approaching dormancy. As a generalization, fertilization should be avoided within three months of lifting (May et al. 1984). At the Union Camp Virginia nursery, fertilization is now scheduled to end about mid-August. At one time hardwoods were fertilized into late September or even early October. As an apparent result of the change in timing top dieback of sweetgum seedlings has been substantially reduced.

APPLICATION TECHNIQUES

Another basic assumption is that soil sample collections, analyses, evaluations, and ammendment recommendations are performed consistently. If not, it is probably a waste of time to attempt to fine tune topdress or other applications.

As with any important activity whoever is responsible for topdress applications should know expected performance standards. A written schedule including times, rates, and sources should be prepared. Planned and actual rates should be compared. The schedule does not have to be rigid. Whoever prepares it can change it. In the absence of deliberate change or uncontrollable events it should be followed. The purpose of the schedule is simply to prevent a performance lapse due to procrastination or inattention. A sample schedule is included as Appendix I.

From the beginning, topdress fertilization at the Union Camp Virginia nursery has been accomplished with granular applicators of some type. The production of multiple species with at least the perception of different fertilizer requirements mandated a method that allowed rate or source changes between relatively small areas. The applicator now in use is tractor mounted consisting of three hoppers spanning three seed beds simultaneously. The agitators within the hoppers are driven by a hydraulic motor. Topdress fertilization followed by brief irrigation to prevent chemical burning is accomplished with this unit according to the schedule in effect. The advantages of this method far outweigh the disadvantages.

The following are the disadvantages.

1. Seedlings must be dry prior to application to avoid sticking and chemical burning.

2. High humidity may cause erratic flow rates of some materials through the fertilizer applicator if the material is not expended rapidly enough to avoid moisture absorption.

The advantages of this method of application are as follows:

1. It is flexible. Rates are easily adjusted to variable requirements between seedbeds. Adjusting to different rates within a seedbed is possible but more difficult.

2. Except under extreme conditions distribution of fertilizer is unaffected by wind.

3. Fertilizer is applied to the seedbed only, reducing the amount required by 35-40% and limiting the nutrient supply to wheel alley and riser line weeds.

4. The method is reasonably efficient. At a ground speed of 6.4 km/hr (4 mph) 2.4-3.2 ha/hr (6-8 ac/hr) can be fertilized depending on turnaround and loading time.

5. The rate of application can be as accurate as you wish to make it. Calibration is accomplished by correlating hopper openings with agitator rpm and with tractor ground speed.

QUESTIONS

Nitrogen may be withheld to control height growth or enhance "hardening off". This is sometimes done to the extent that seedlings demonstrate N deficiency symptoms at late season. Which is the lesser of evils; top clipped seedlings, nitrogen deficient seedlings, or over-sized seedlings? How important is N to fall root development after top growth ceases?

There appears to be a trend toward reducing bed densities to increase the proportion of larger (Grade 1) seedlings. Should there be some corresponding reduction in the quantity of nutrients?

Should N rates be adjusted to reflect varying sowing or mulching techniques? Some nurseries sow seed well below the soil surface and use little or no mulch. Others sow at or on the surface and mulch rather heavily.

It has been suggested by Armson and Sadreika (1979) that N topdress scheduling be based on degree days (cumulative heat units). Does this have any application in the South?

SUMMARY

Topdress fertilization though extremely important, must be considered in light of the uniqueness of site, crop and climatic conditions. It should be done right and done on time. It is an integral function essential to accomplishing the overall objective of producing a high proportion of seedlings that will survive and grow.

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APPENDIX I

SAMPLE
198 SEEDLING FERTILIZATION SCHEDULE

Planned				Actual				
				Total Material				
Date	N/AC	AN/AC	AS/AC	AN	AS	AN/AC	AS/AC	N/AC
Sweetgum	250 lb. N/AC; 54,000 lin. ft. = 4.96 ac.							
5-28	33	100		536		108		38
6-12	33		165		855		172	36
6-25	33	100		545		110		37
7-19	50		250		1373		277	58
7-25	50	150		671		135		46
8-13	50		250		1140		230	48
8-23	918 lb.			KCL - 185 lb/ac applied				
Pine	150 lb. N/AC; 123,293 lin. ft. = 11.32 ac.							
5-29	25	75		990		88		31
6-12	25	75		958		85		29
6-25	25	75			1381		122	26
7-19	25	75		993		88		30
7-31	25	75			1358		120	25
8-13	25	75		921		85		29
8-29	(Field Z only 1.5 ac)				176		117	25
8-23	800 lb.			KCL - 70 lb/ac				