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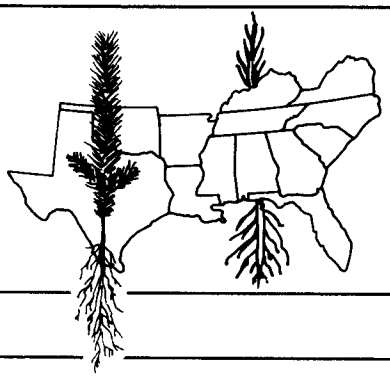

RESEARCH REPORT 97-3

Nitrogen Use Efficiencies of Two Slow Release Nitrogen Fertilizers

by
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INTRODUCTION

Nitrogen fertilization is a key component of nursery management in the South. Both loblolly and slash pine seedlings require nitrogen fertilization during the months of June, July, and August when seedlings are rapidly growing. To meet this nutrient demand, nurseries typically top dress with ammonium nitrate or ammonium sulfate at rate around 150 lbs of N per acre. Unfortunately, not all applied fertilizer nitrogen is taken up by the plant. Some estimates place nitrogen use efficiency at between 50 to 70 percent for southern pine seedling nurseries. In other words, of every 100 lbs of nitrogen applied, between 50 to 30 percent is lost to leaching, runoff, volatilization, and immobilization. Nursery managers are interested in this nitrogen loss not only because this is a production cost, but also because they do not want their nitrogen fertilizers becoming an environmental contaminant.

One of the proposed alternatives to top dressing with ammonium nitrate, ammonium sulfate, urea, or liquid fertilizers, is to use controlled release fertilizers (CRFs). These compounds release their nitrogen fertilizer over an extended period of time. The release rate is determined by formulation and varies considerably by product. CRFs have the potential to improve nitrogen use efficiency as nitrogen release is theoretically closer to actual plant demand - lower demand when the seedling is small with increasing demand as it grows. CRFs therefore may decrease environmental contamination. The objectives of this study were to determine (1) if two specific formulations of CRFs produce seedlings of suitable morphological quality, and (2) their effect on nitrogen use efficiencies.

METHODS

Two CRF formulations were tested on slash pine grown at a Coastal Plain nursery in central Georgia Application rates were based on the standard N rates for that nursery, which was 100 lbs of N per acre. Nine treatments were included:

1. Ammonium nitrate top dressed at 50, 100, and 200 lbs N/ac
2. A polymer coated urea at 50, 100, and 200 lbs N/ac (PCU)
3. A polymer coated, sulfur coated urea at 50, 100, and 200 lbs N/ac (PCSCU)

Figure 1 presents the nitrogen release curve for the two CRFs as supplied by the manufacturer.

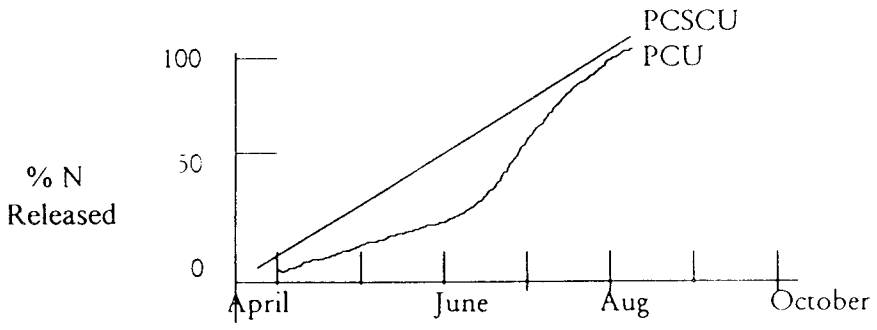

Figure 1 Nitrogen release curves for polymer coated urea and polymer coated, sulfur coated urea as provided by the manufacturer.

A randomized block design was established in the middle two rows of a 6 row nursery section with individual fertilizer plots 40 feet in length. Both CRFs were applied to the top of the bed in April and incorporated with a bed shaper prior to sowing. The ammonium nitrate was top dressed in five bi-weekly applications from early June to early August. Seedling samples (N=30) were taken from the middle 20 feet of each plot during the first week of June, July, August, September, November, and last week in January.

RESULTS

With few exceptions, the relative morphological development among treatments remained consistent through all sampling periods, therefore we are reporting only the January sampling date. Table 1 provides the average number of seedlings per square foot, total seedling dry weight, and average number of seedlings above 5 mm root collar diameter by treatment

Statistical analysis found no treatment effects for seedling density. However, both dry weight and number of seedlings above 5mm varied by treatment. Seedlings fertilized with the slow release formulations were generally smaller with fewer numbers of large seedlings Ammonium nitrate

top-dressing at 200 and 100 lbs of N per acre were the two top ranking treatments in terms of average seedling dry weight, followed by PCU at 200 lbs of N, PCSCU at 100 lbs of N, and the ammonium nitrate at 50 lbs of N. Numbers of larger diameter seedlings followed the same trend although the PCU at 200 lbs N/ac and the PCPCU at 100 lbs N/ac produced similar numbers of large seedlings when compared to the ammonium nitrate at 100 lbs N/ac.

Table 1. Results of morphological measurements by treatment

Treatment	No. seedlings per ft^2	Average Seedling Dry Weight (g)	Percent of Seedlings Over 5 mm DRC
50 lbs N/ac			
AN	23.3	3.7	16
PCU	24.3	3.4	11
PCUSCU	23.3	3.2	7
100 lbs N/ac			
AN	21.7	5.0	32
PCU	22.0	3.6	17
PCUSCU	19.4	4.2	27
200 lbs N/ac			
AN	22.2	5.3	44
PCU	24.5	5.0	33
PCUSCU	21.0	3.7	18

Table 2 presents the nitrogen use efficiencies for the various treatments. Nitrogen use efficiency is calculated by dividing the actual amount of nitrogen utilized by seedlings in that treatment (dry weight per seedling x % N x No. of seedlings per acre) by the amount of nitrogen applied as fertilizer in that treatment. N use efficiencies below 100% indicate that nitrogen was lost to the environment while treatments above 100% indicate that more nitrogen was used than was applied (trees were therefore dependent upon other sources of N rather than just applied nitrogen). The treatment with a nitrogen use efficiency closest to 100% is the poly coated urea at 100 lbs N per acre at 92%. In other words, only 8% of the nitrogen applied in this treatment was lost to the environment. The treatment with the nitrogen use efficiency farthest from 100% was the ammonium nitrate at 50 lbs N/ac with an efficiency rating of 175%. Although 175% efficiency sounds appealing, it actually means that 75% of the seedling nitrogen demand was taken from sources other than applied fertilizer (in effect, "mining" the soil).

Table 2. Nitrogen use efficiencies (percent) by treatment

	PCU	PCSCU	AN
50 lbs N	141	163	175
100 lbs N	92	74	134
200 lbs N	47	44	63

It cannot be said that the use of these two CRF formulations consistently resulted in N use efficiencies closer to 100% when compared to ammonium nitrate. It is important to note also, that while the high rate of ammonium nitrate had a 63% N use efficiency, indicating that 37% of the nitrogen applied was potentially lost to the environment, it also was the treatment with the largest trees and produced the most grade 1 seedlings (Table 1). There was, therefore, a tradeoff in seedling size with possible loss of N to the environment.

MANAGEMENT IMPLICATIONS

The growth rate of seedlings fertilized with these two controlled release fertilizers was not comparable to the standard ammonium nitrate top-dressing. We suspect nitrogen was released too quickly and was not available at the critical growth period of late July and August. Due to high cost and resulting decrease in seedling size, use of the CRFs tested in this study do not appear feasible.