NITROGEN IMPROVES GROWTH OF POPULUS DELTOIDES NURSERY STOCK

JAMES W. MARTIN and MASON C. CARTER,
Department of Forestry,
Auburn University Agricultural Experiment Station,
Auburn, Ala.

The most convenient method for producing cuttings of cottonwood *(Populus deltoides* Bartr.) is by establishment of a cutting nursery (3). But, very little is known about nutritional requirements of the species.

European workers report that nitrogen supply frequently limits growth of cottonwood (4, 2) ; however, Seth and Desarber (6) warn that excess nitrogen may make poplars more susceptible to fungal parasites. Mitchell and Chandler (5) suggest that a foliar nitrogen concentration of 2 percent is a minimum for satisfactory growth of *Populus tremuloides* Michx.

The present investigation was to determine the influence of nitrogen supply upon growth of cottonwood cuttings and concentration of major nutrients in the foliage.

Materials and Methods

Cottonwood cuttings were collected from 1- and 2-year-old seedlings in the Alabama River flood plain in Clarke County, Ala. Twenty-inch cuttings were planted on April 1 at a spacing of 1.5 by 3 feet at the Auburn Forest Nursery. The nursery soil is a Norfolk loamy sand with a clay subsoil beginning at a depth of 14 to 16 inches. Soil analysis prior to planting is given in Table 1. Two weeks before planting (and before soil analysis) a broadcast application of 6 lb. N, 8 lb. P, and 15 lb. K per acre (as 4-12-12) was disked into the soil.

TABLE 1.—*Soil analysis at time of planting cottonwood cuttings*[1]

Measure	Level	Method
pH______	5.3 ± 0.2	Glass electrode (1:1 soil to H_2O) .
P_______	129 ± 18 p.p.m	Dilute acid soluble.
K_______	95 ± 14 p.p.m.	Exchangeable.
Mg______	43 ± 11 p.p.m	Do.

[1] After fertilization with 6 lb./acre N, 8 lb./acre P, 15 lb./acre K.

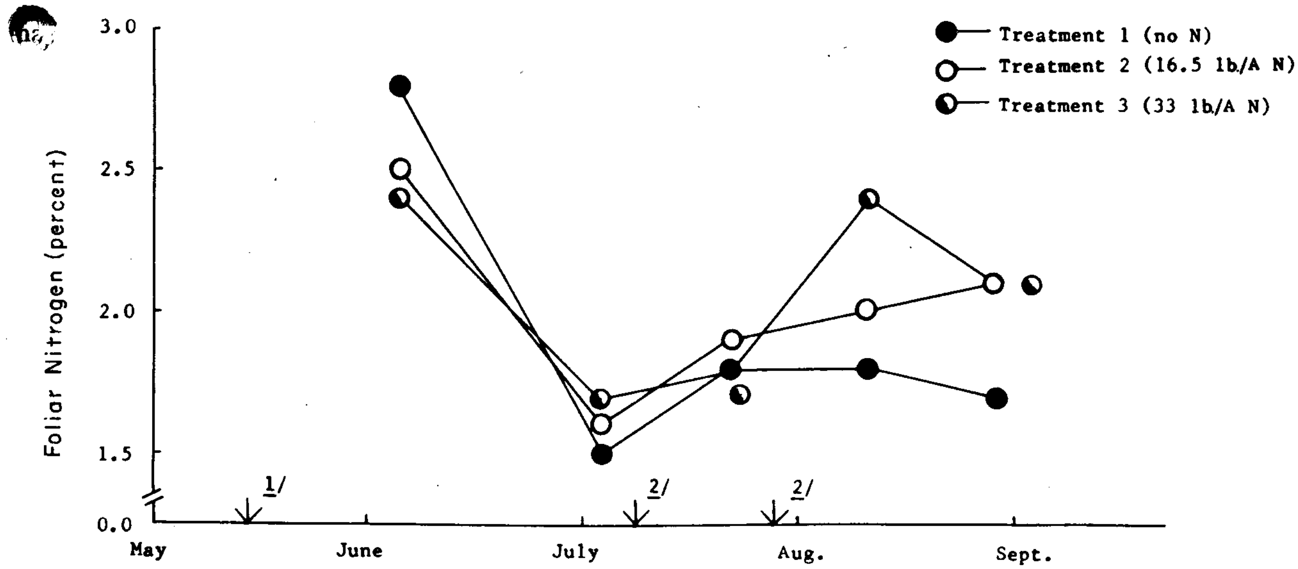
Twelve plots, 20 by 22 ft., were planted. Beginning in early June, samples of well-expanded leaves near the terminal were collected from each plot at monthly intervals until the nitrogen concentration of the leaves fell below 2 percent. When this occurred, nitrogen was applied. Treatments were as follows: (1) no additional N, (2) 16.5 lb./acre N (NH, NO_3) , (3) 33.5 lb./acre N (NH_4 NO_3) . Foliage samples were collected at 2-week intervals thereafter, and nitrogen applied as necessary to maintain a foliar nitrogen concentration above 2 percent. Artificial watering ensured a minimum of 0.5 to 1.0 inch of water each week on the cuttings.

Foliage samples were dried to a constant weight at 70°C., the petioles removed, and the leaves ground to pass through a 40-mesh screen. Nitrogen was determined by the micro-kjeldahl method modified to include nitrate. The Sept. 1 sample was wet-ashed in perchloric-nitric acid and analyzed for phosphorus by the phosphomolybdate colorimetric procedure, potassium by flame photometry, magnesium by atomic absorption, and calcium by versenate titration.

On Sept. 15, a subplot consisting of six rows of seven trees was delineated in each plot. Total height and ground line diameter were determined for each surviving tree. The average number of harvestable 20-inch cuttings per acre was calculated on the basis of the average height times number of stems per acre.

Results and Discussion

The nitrogen concentrations in the cottonwood foliage are shown in figure 1. The effects of treatments differed significantly only in samples collected in early August. In June, young foliage contained over 2 percent nitrogen, but concentration fell sharply during rapid growth of the next month. On July 2, nitrogen concentration was below 2 percent on all plots, and NH_4NO_3 was first applied. On July 20 nitrogen concentrations were



Date of fertilizer application and foliage sample.

1/ 150 lb/A of 4-12-12 applied to all plots.
2/ NH_4NO_3 treatments applied.

Figure 1.—The effect of N fertilization upon the percent foliar nitrogen of nursery grown cottonwood.

still below 2 percent and NH_4NO_3 was applied a second time. Nitrogen levels remained above 2 percent on treatments 2 and 3 throughout the balance of the study. A total of 33 lb. N per acre was applied on treatment 2 and 66 lb. N per acre on treatment 3, in addition to the 6 lb. N per acre applied to all plots in the spring.

Nitrogen affected the growth of cottonwood cuttings decidedly (table 2). Height growth of treatment 3 exceeded the control by 37 percent, diameter growth by 43 percent, and number of cuttings per acre by 37 percent. When dealing with nursery stock, volume growth is not economically important but is a valid measure of response to fertilization. Using total height and ground line diameter and assuming the boles of the cuttings to approximate a cone, the average volume per tree was calculated.

TABLE 2.—*Growth responses of cottonwood to added nitrogen, July 20*

Treat-ment	Elemental N added[1]	Total height[2]	Ground line diameter[2]	Cuttings per acre[2]
	Lb./acre	*Feet*	*Inch*	*Number*
1	6	7.14-a	0.65-a	27,722-a
2	39	8.79-b	0.82-b	34,143-b
3	72	9.80-b	0.93-c	38,064-b

[1] All plots fertilized in May with 6 lb./acre N, 8 lb./acre P, 15 lb./acre K.

[2] Means followed by different letters are significantly different at the 5 percent level (*1*).

Average volume per tree in treatment 1 was 9.46 cu. in. and in treatment 3, 26.61 cu. in.-a difference of more than 180 percent. Thus, the effect on volume growth is more impressive than either height or diameter growth.

Although there was a definite effect of nitrogen fertilization on growth, an effect on nitrogen concentrations in the foliage was not detected. Height and diameter growth were significantly greater in treatment 2 than in treatment 1, while foliar nitrogen did not differ significantly in any sampling. The nitrogen concentration varied considerably both within plots and between replications, thus producing a large experimental error. More extensive sampling would possibly produce better agreement between the foliar nitrogen concentration and growth.

Foliage was collected on Sept. 1 and analyzed (table 3). The treatment had no significant effects. But potassium data showed a trend toward a "dilution" effect where nitrogen may induce a rate of dry matter production. This exceeds the rate of ion uptake (7). A sampling problem was again apparent, and wide variations among samples may have obscured any effects of treatment.

TABLE 3.—*Foliar nutrient concentrations, Sept. 1*

Treatment	Elemental N added[1]	Foliage concentrations[2]				
		N	P	K	Mg	Ca
	Lb./acre	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
1	6	1.67	0.28	2.58	0.35	0.38
2	39	2.06	0.18	2.02	0.38	0.43
3	72	2.06	0.22	1.46	0.31	0.40

[1] All plots fertilized in May with 6 lb./acre N, 8 lb./acre P, 15 lb./acre K.

[2] No significant effects of treatment at the 5 percent level.

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Late Planting Improves Loblolly Survival

In Report SO-24 on a series of studies conducted in northern Mississippi over the past 10 years, the authors (Ursic, Williston and Burns, Southern Forest Experiment Station) conclude that a planting season between January 15 and April 1 is desirable in loblolly pine's range south of Virginia but north of the 33rd parallel. The studies reported show that with cold-storage facilities planting can be continued until April 15.

The traditional planting season in the area is from December 1 to March 1, but field tests show that survival is usually poorer among trees planted in the early part of the traditional season than among those planted in March and early April. Thus, planters can profit by delaying the start of planting and continuing into early April.

Since seedlings in the area must be lifted from nursery beds by February 15, success in late planting depends largely upon proper storage. Storage recommendations are presented in the paper.

Copies of this report may be obtained by writing the Southern Forest Experiment Station, U. S. Forest Service, New Orleans, Louisiana 70113.