EFFECT OF CRAIG MYLONE HERBICIDE ON THE GROWTH OF WHITE SPRUCE SEEDLINGS

J. G. Iyer, Project Assistant in Soils
University of Wisconsin
Madison, Wis.[1]

In the summer of 1963, W. H. Brener, Supervisor of Wisconsin State Nurseries, informed the author of a large-scale experiment involving application of Craig mylone (3,5-dimethyl-tetrahydro-1,3,5,-thiodiaz in- 2 thion). This herbicide was used in the spring of 1960 on white spruce beds at a rate of 580 pounds per acre of 50-D (50 percent dust) and 350 pounds per acre of 85-W (85 percent wettable powder). The chemicals were applied about a month ahead of seeding, on alternate beds, leaving untreated beds to serve as controls. In the fall of 1962, the 3-year-old white spruce seedlings on untreated and treated beds showed striking . differences in their height growth and height variability. The stock on untreated beds was much shorter, and its height was more uniform, with a coefficient of variability of 9.5 percent. The stock on treated beds had some seedlings of enormous heights, exceeding 20 inches, and also a very high coefficient of variability, 22.3 percent.

Four soil samples, each consisting of seven 6-inch cores, were collected using a calibrated sampling tube from the untreated and herbicide-treated beds. Samples of stock were taken with the help of a sampling board (1). The results of these soil analyses (table 1)

[1] The author is indebted to R. R. Maeglin, U.S. Forest Products Laboratory, Madison, Wis., for determining the specific gravity of seedling stems. 4

TABLE 1.--State of soil fertility factors in untreated nursery beds and beds treated with Craig mylone herbicide (Griffith State Forest Nursery, Wisconsin)

Sample No.	Reaction pH	Organic matter	Total N	Available P_2O_5	Available K_2O	Exchange Ca	Exchange Mg
Untreated nursery beds							
		Percent	*Percent*	*Lbs./a.*	*Lbs./a.*	*M.e./100 g.*	*M.e./100 g.*
1.....	5.3	2.0	0.082	205	261	0.97	0.38
2.....	5.3	1.8	.077	217	261	.97	.35
3.....	5.2	2.2	.093	212	232	.82	.29
4.....	5.2	2.4	.100	205	252	.85	.31
Average.....	5.25	2.1	.088	209.8	251.5	.90	.33
Herbicide-treated beds							
5.....	5.1	1.8	0.073	217	227	0.60	0.20
6.....	5.1	1.9	.082	217	242	.60	.22
7.....	4.9	2.3	.094	179	213	.50	.19
8.....	4.9	2.1	.091	189	208	.50	.16
Average.....	5.00	2.0	.085	200.5	222.5	.55	.19

TABLE 2.--Morphological and anatomical characteristics of 3-year-old white spruce seedlings raised on untreated soil and soil treated with Craig mylone. Results per average seedling

Nature of nursery stock	Height	Diameter	Height-diameter ratio	Ovendry weight		Top-root ratio	Titration value of roots	Drought-resistance quotient	Specific gravity	Mycorrhizal roots
				Tops	Roots					
	Cm.	*Mm.*		*Grams*	*Grams*		*Me..3NHCL*			
Untreated.....	21.3	2.8	7.6	3.01	0.79	3.8	0.233	7.7	0.473	abundant
Herbicide treated.....	36.0	3.6	10.0	3.33	.51	6.5	.175	5.3	.386	sparse

show very uniform fertility; differences were not statistically significant. A slight decrease in the pH value and available nutrients in soils of herbicide-treated beds should be attributed to a more intense feeding of the larger stock.

Morphological and anatomical analyses (table 2) have provided results which strongly suggest that the eradicant harmed the vigor or quality of seedlings. The most significant adverse features of stock produced on herbicide-treated beds are as follows:

1. Excessive height-diameter ratio predisposing seedlings to lodging and damages by snow.

2. A very abnormal top-root ratio of 6.5 and very low titration value of roots, suggesting inadequate drought resistance of seedlings.

3. A drastic decrease in the specific gravity of herbicide-treated stock, further aggravating the vulnerability of seedlings that are already affected because of their unbalanced heightdiameter ratio.

4. The scarcity of mycorrhizal roots, which may handicap the uptake of nutrients by seedlings during their initial growth under field conditions. The morphology of seedlings produced on biocide-treated and untreated beds is illustrated in figure 1.

The results of foliar analyses (table 3) indicate that herbicide treatment lowered the concentration of alcohol-benzene solubles and promoted an abnormally high uptake of nutrients or a "luxury feeding" of stock. Both of these alterations may facilitate the attack of parasitic organisms.

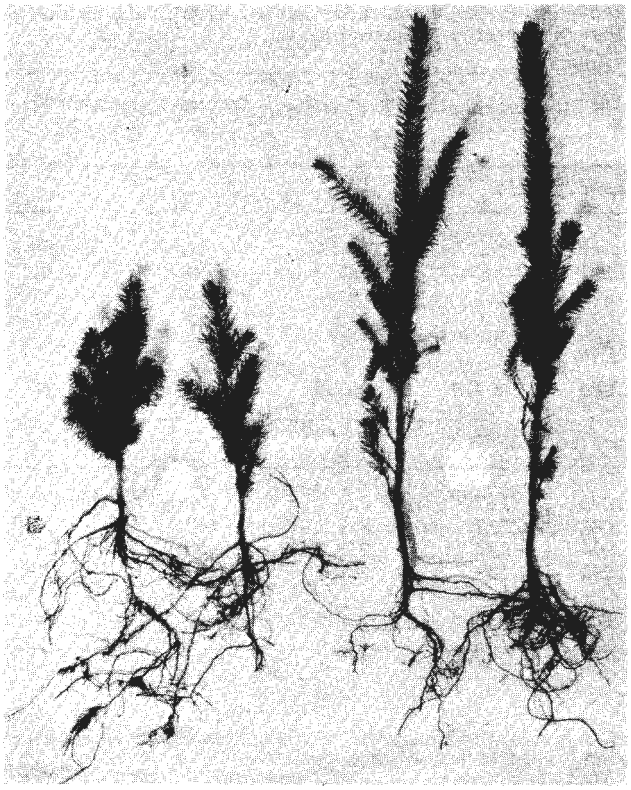

Figure 1.-Morphology of seedlings produced on herbicide-treated beds (left) and untreated beds (right).

Little information has been obtained on the relative survival and growth potential of the two kinds of nursery stock. It was noted that the seedlings lifted from herbicide-treated beds lost most of their needles within a few days upon air-drying, whereas seedlings from untreated beds retained their foliage for 3 to 4 weeks.

The pitfalls occasionally encountered in artificial propagation of plants were known as early as 600 B.C. In one of his fables, Aesop tells about a man asking a gardener a pertinent question; "Why are wild plants strong and thriving, while the cultivated ones are spindly and wilted?" In Aesop's day the reason was most likely a depletion of cultivated soils in fertility; in our time the same results are often due to excessive use of fertilizer salts, particularly nitrogen, and eradicants which upset the normal balance of plants by their unreasonable growth-promoting influence.

Literature

(1) Wilde, S.A., Voigt, G.K., and Iyer, J.G. 1963. Analysis of soils and plants for tree culture. Ed. 3. New Delhi: Oxford Books, Inc., Scindia House.

TABLE 3.--Foliar analyses of 3-year-old white spruce seedlings raised on untreated soil and soil treated with Craig mylone. Results per average seedling

Nature of nursery stock	Munsell color notation	Organo-solubles	Ash	N	P	K	Ca	Mg
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Untreated.....	7.5GY 4/4-5/4	35.5	5.65	0.99	0.107	0.356	0.483	0.067
Herbicide treated..	7.5GY 3/4-4/4; 5.PYR 4/6	30.6	4.55	1.28	.127	.391	.720	.145

randomly assigned, one kind per bed. Otherwise, the beds were prepared, seeded, irrigated, and maintained in the customary manner.

Seeding production data obtained at the end of each year were analyzed by number of plantable 1-0 seedlings per square foot, percentage of plantable seedlings, stem diameter, height, and fresh- and overdry weight. Results for both years were comparable. Data from the 1961 tests are presented in table 1.

Loblolly pine: First-year results on effectiveness of the various fertilizers showed that none were significantly better than ammonium nitrate in number or percentage of plantable seedlings, height, stem diameter, or dry weight of seedlings. The second-year tests confirmed first-year results. Of the slowly soluble forms, magnesium ammonium phosphate, ureaform, and oxamide produced more plantable seedlings per square foot than melamine.

Shortleaf pine: Results for both years showed that no treatment was better than ammonium nitrate for any of the measurement criteria. Although in the second-year tests, magnesium ammonium phosphate yielded more seedlings than all other nitrogen fertilizers, differences were not great enough to be significant.

Field Phase

To determine whether use of the various nitrogen fertilizers in the nursery produced any unusual growth or survival characteristics after outplanting, loblolly seedlings from the 1960 nursery tests were set at 11 locations and shortleaf seedlings at 8 locations in Georgia, North Carolina, Kentucky, and Tennessee. Each test planting consisted of four blocks; seedlings from each fertilizer treatment were planted at random in 25-tree rows within each block. Average first- and secondyear plantation height growth and two-year survival are given in table 2.

Loblolly seedlings grown with ammonium nitrate had a significantly greater first-year height growth than seedlings grown with all other fertilizers except diammonium phosphate. While not significant, second-year growth was also greatest for ammonium nitrate seedlings. The kind of fertilizer did not affect survival, which ranged from 92 percent for ammonium nitrate and ureaform seedlings to 85 percent for melamine seedlings.

TABLE 1.--Comparison of nine nitrogen fertilizers in production of pine seedlings, 1961

Measurement	Nitrogen sources									
	Rapidly available					Slowly available				
	Ammonium nitrate	Ammonium sulphate	Sodium nitrate	Urea	Diammonium phosphate	Melamine	Oxamide	Urea-form	Magnesium ammonium phosphate	D[1]
Loblolly pine										
Grade 1 and 2 seedlings per square foot[2].....	34	28	24	26	26	11	26	31	32	14
Average height of lifted seedlings, centimeters	16.9	16.9	14.8	17.4	17.5	12.8	16.5	17.3	16.4	1.5
Total dry weight per seedling, grams.....	1.39	1.36	1.16	1.35	1.42	.67	1.36	1.25	1.49	.38
Shortleaf pine										
Grade 1 and 2 seedlings per square foot[2].....	22	21	21	18	16	16	20	20	24	([3])
Average height of lifted seedlings, centimeters	13.7	16.7	14.6	14.1	14.3	12.5	14.5	15.5	15.8	3.7
Total dry weight per seedling, grams.....	1.89	2.17	2.65	2.20	2.28	1.11	1.91	2.04	2.19	.81

[1] Significant levels at 5 percent as computed by Snedecor's modification of Tukey's test. D represents the least significant difference between any pair of treatment means.
[2] Minimum height, 6 inches; minimum diameter, one-eighth inch.
[3] Not significant.

TABLE 2.--Average height growth and survival of outplanted seedlings grown in the nursery with nine nitrogen fertilizers

Measurement	Nitrogen sources									
	Ammonium nitrate	Ammonium sulphate	Sodium nitrate	Urea	Diammonium phosphate	Melamine	Oxamide	Urea-form	Magnesium ammonium phosphate	D[1]
Loblolly pine										
Plantation height growth, feet:										
1961	0.61	0.56	0.56	0.51	0.57	0.43	0.51	0.54	0.46	0.05
1962	1.41	1.35	1.35	1.28	1.32	1.22	1.26	1.34	1.27	([2])
Plantation survival after 2 years, percent	92	90	91	91	90	85	91	92	90	([2])
Shortleaf pine										
Plantation height growth, feet:										
1961	0.37	0.42	0.38	0.40	0.42	0.47	0.45	0.39	0.39	0.06
1962	1.03	.93	.92	.97	.94	.98	1.00	.92	.97	([2])
Two-year plantation survival, percent	64	68	63	70	69	85	76	68	74	([3])

[1] Significant levels at 5 percent as computed by Snedecor's modification of Tukey's test. D represents the least significant difference between any pair of treatment means.
[2] Not significant.
[3] For comparison, transform percents to arcsin percent and use D=5.75 to test for significance.

Shortleaf seedlings fertilized with melamine had the best first-year height growth, but by the end of the second year seedlings grown with ammonium nitrate were tallest. Two-year survival of shortleaf seedlings was best for those grown with melamine and oxamide. Both of these are nitrogen-carbon type compounds of very low water solubility, and it is doubtful that any nitrogen was available to the seedlings. The range in survival was 85 percent for melamine seedlings to 63 percent for sodium nitrate seedlings.

Summary

These nursery tests did not show any of the fertilizers to be better than standard ammonium nitrate, and its use will be continued at the Clinton Nursery. Detailed test data are available from TVA's Division of Forestry Development, Norris, Tenn.

Subsequent tests indicate that application of ammonium nitrate at planting time is less productive than top dressing 6 to 10 weeks after emergence of the seedlings. Results of these tests will be available soon.