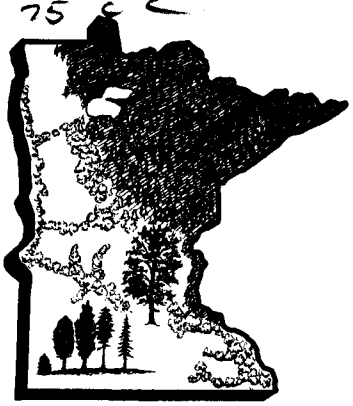

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FIELD SURVIVAL OF RED PINE SEEDLINGS AS AFFECTED BY NURSERY FERTILIZATION[1]

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With very great increases in the demand for forest nursery stock during the past decade, the necessity for producing quantities of trees has inevitably been reflected in quality standards. There have been indications of need for research in Minnesota State Nurseries to ascertain methods for raising quality of the stock. The initial investigation was directed toward an evaluation of several possible fertilization programs which might be undertaken at the C. C. Andrews State Nursery as standard practice aimed toward raising ultimate survival following field planting.

Two nursery beds of red pine (Pinus resinosa Ait.) were used in the study. One of these was in a new section of the nursery which had not previously been in seedling production. The other was in an older part of the nursery which had been producing continuous crops of seedlings since 1949. Three inches of peat had been applied to the old but not to the new bed. Weed growth was much more serious on the new bed than on the old and, in the authors' opinion, may account for the survival differences between the two beds.

Nine fertilization treatments were applied in the spring of 1957 in three replications randomly allocated to each of the two kinds of beds. One other current Minnesota Forestry Note[3] provides information relating to the treatments applied. At the time of application, the seedlings were two years of age. Seedlings (3-0) for field planting were selected from the center of each treated plot in the spring of 1958. Fifty seedlings from each treatment in the three nursery replications from both the new and old beds were placed in each of three replications in the field planting area, giving a total of 162 groups of fifty seedlings planted in the field.

This study is concerned only with the survival of the treated seedlings during the first growing season following field planting in the spring of 1958 at the Rosemount Agricultural Experiment Station. Seedlings were classified as alive or dead on August 11, 1958. The results were analyzed by means of an analysis of variance (Table 1) and Duncan's multiple range test[4] for establishing significant differences. Table 2 shows the treatments applied and the average field survival for each of the treatments in the two beds.

Differences between survival of seedlings from the old bed and the new bed in the nursery are highly significant statistically. The real increase in survival of seedlings from the old bed over the new approaches one-third. There are no significant differences

1/ A cooperative study undertaken jointly with the Minnesota Division of Forestry.
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3/ Franzmeier, Donald P. and Harold F. Arneman, 1959, "The effect of fertilizers on the available nitrogen content of a nursery soil and on the nitrogen concentration in red pine seedlings." Minnesota Forestry Notes No. 77.
4/ Snedecor, George W., 1956, "Statistical Methods," Iowa State College Press.

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among nursery treatment replications within beds nor are there significant differences among treatments in the old nursery bed. In the new bed, however, the seedlings having the heaviest application of nitrogen showed a highly significant lower survival than any other treatments. No treatments in either bed produced seedlings that survive significantly better than the check.

The findings to date point to the need of further study as to the cause of lower field survival of seedlings originating in new nursery beds. Fertility levels under present practices at the C. C. Andrews Nursery appear to be adequate for seedlings between the second and third year. Other studies are underway on the overall problem of field survival; further results covering a broader scope may be anticipated.

Table 1

Analysis of Variance

Source of variation	D.F.	Mean Square	F	5% level F	1% level F
Field replications	2	1,241.96	11.12**	3.09	4.82
Fertilization treatments	8	665.23	5.96**	2.03	2.69
Among nursery replications	5	4,290.39	38.42**	2.30	3.20
between beds	(1)	20,379.56	182.50**	3.94	6.90
among nursery replications within beds	(4)	268.10	2.40	2.46	3.51
Fertilization treatment X replications	40	251.52	2.25**	1.51	1.79
beds X treatments	(8)	557.65	4.99**	2.03	2.69
within beds X treatments	(32)	174.99	1.57*	1.57	1.89
Error	106	111.67			
Total	161				

* Significant at the 5% level
** Significant at the 1% level

Table 2

Fertilization Treatments and Field Survival

Treatment 1/	Field Survival (percent) New Nursery Bed	Old Nursery Bed
N,-P-K 2/	67	86
O-P-K + T 3/	66	79
Check	64	87
N_2(F)-P-K 4/	57	80
N_2-P-K + T 2/ 3/	55	86
N_2-P-K 2/	49	88
N_2 (P)-P-K 5/	47	82
C-P-K	45	85
N_3-P-K 2/	15	84
Mean, all treatments	52	84

1/ P indicates 100 pounds of phosphate (P_2O_5) per acre; K indicates 100 pounds of potash (K_2O) per acre; N indicates 50 pounds of nitrogen (N) per acre; N_2 indicates 100 pounds of nitrogen (N) per acre; N_3 indicates 150 pounds of nitrogen (N) per acre.
2/ Nitrogen from ammonium nitrate.
3/ Trace elements include boron, calcium, copper, iron, magnesium, manganese, and sulfur.
4/ Nitrogen from urea-formaldehyde.
5/ Nitrogen from ammonified peat.

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