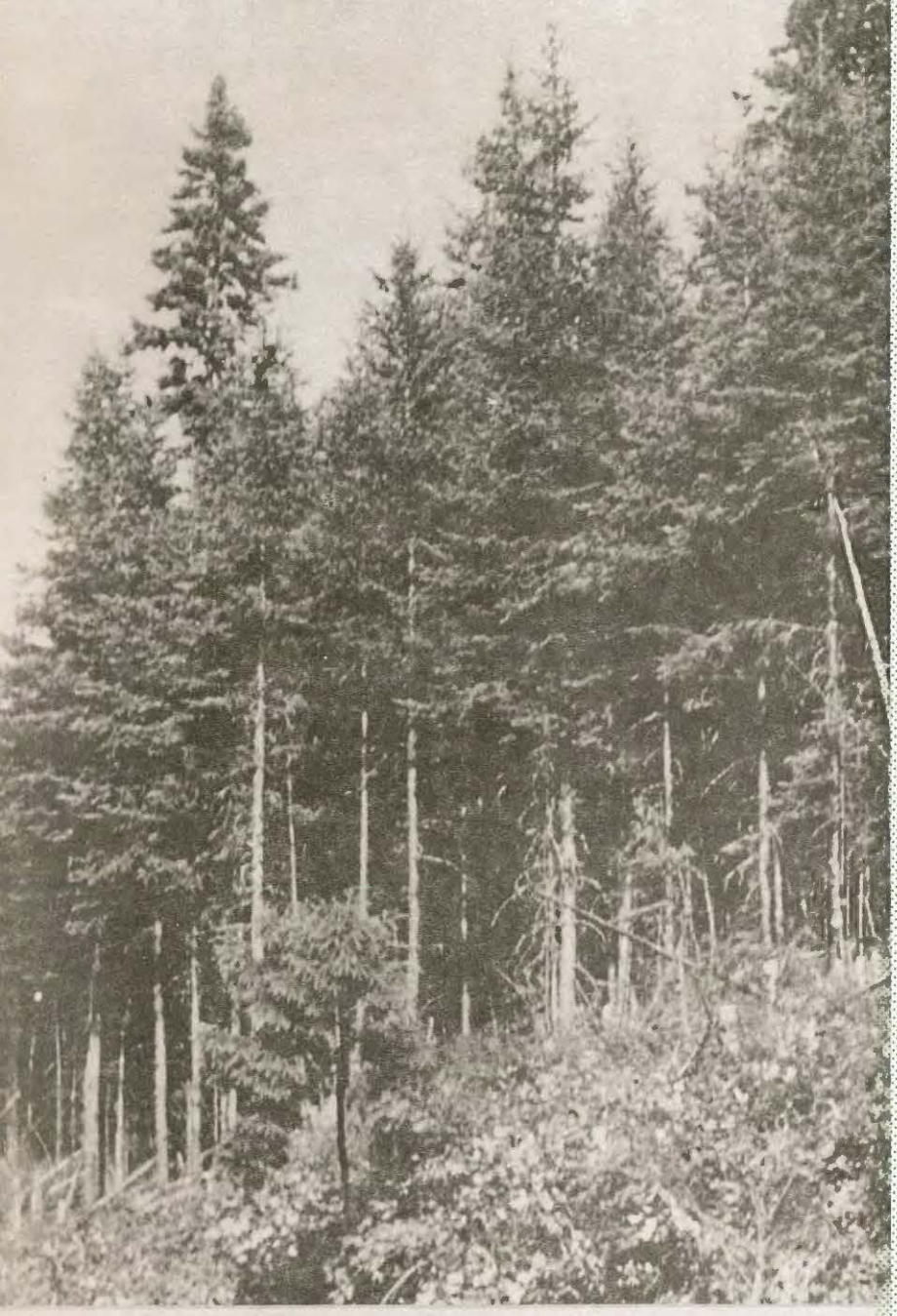

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by
P. O. SALONIUS
and
A. W. MACKAY

MARITIMES

CANADIAN FORESTRY SERVICE

MARITIMES FOREST RESEARCH CENTRE

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P.O. Salonius and A.W. MacKay

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ABSTRACT

In 1969 a young balsam fir, *Abies balsamea* (L.) Mill., stand was treated with 448 kg/ha of an NPK fertilizer, and a semi-mature white spruce stand, *Picea glauca* (Moench) Voss., was treated with 112 and 224 kg N/ha as urea. Final measurements were taken 10 growing seasons after the fertilization treatment. No increase in growth due to fertilization was recognizable. These overstocked stands demonstrated heavy mortality during the measurement period, the onset of which may have been somewhat delayed by fertilization.

RESUME

En 1969, un jeune peuplement de Sapin baumier (*Abies balsamea* (L.) Mill.) a été traité avec un fertilisant à base de NPK à raison de 448 kg/ha et un peuplement semimature d'Epinette blanche (*Picea glauca* (Moench) Voss), avec de l'azote à raison de 112 et 224 kg N/ha sous forme d'urée. Des mesurages finals ont été effectués au bout de 10 saisons de croissance après la fertilisation. Ces peuplements trop denses ont accusé une forte mortalité durant la période de mesurage, mortalité dont le début a peut-être été retardé par la fertilisation.

INTRODUCTION

In 1968 a field trial was initiated by the Pulp and Paper Research Institute of Canada (PPRIC) and Nova Scotia Forest Industries Ltd. (NSFI) to determine the growth response of balsam fir, *Abies balsamea* (L.) Mill., and white spruce, *Picea glauca* (Moench) Voss, to fertilizer applications. The company was responsible for the establishment and maintenance of the trial while the Silvicultural Section of PPRIC was responsible for the experimental design and the analysis and assessment of the response data. When the Silvicultural Section of PPRIC was phased out in 1972 the Canadian Forestry Service took over responsibility of maintenance, measurement, and the analysis and assessment of the response data. The first remeasurement of the plots was carried out by the staff of the Maritimes Forest Research Centre in 1973, five years after fertilization. Timmer (1976) described the results. This report documents the final remeasurement carried out in the fall of 1978, 10 years after treatment.

MATERIALS AND METHODS

During the winter and spring of 1968-69, four experimental plots were established by NSFI in a 48-year-old old-field white spruce stand, and four in a dense 28-year-old balsam fir stand, located 2.4 km northeast of Ferguson Lake, Richmond County, Cape Breton Island, Nova Scotia. The stands are located on opposite sides of a forest road on a stony, well-drained, sandy loam soil of the Thom series, derived largely from metamorphosed sedimentary rock.

The fertilizer trial was established according to PPRIC specifications. Four, circular 0.04-ha plots were used in the white spruce stand and 4 circular 0.02-ha plots in the balsam fir stand. All dead trees were removed from the plots before starting the trial. Fertilizer was applied to the whole plot, but only trees only in the inner 0.02-ha circle of the white spruce plots and the inner 0.005 ha circle of the balsam fir plots were numbered and measured at breast height to the nearest 0.025 cm. The heights of 10 dominant and/or codominant trees were measured in each plot to the nearest 0.5 m.

Two plots (1 and 3) in each stand were fertilized on May 20, 1969; the remaining plots (2 and 4) in each stand were maintained as controls. Both plots in the balsam fir stand were treated with 448 kg/ha of a premixed 19-19-19 granular fertilizer which is equivalent to 85 kg N, 37 kg P and 71 kg K per hectare. One plot in the white spruce stand was treated with 112 kg N/ha and the other with 224 kg N/ha as urea. Breast height diameters were remeasured on all living trees in 1973 (Timmer 1976) and 1978. The heights of the 10 dominant and/or codominant trees in each plot were remeasured in 1978.

Measured tree heights and diameters were used to adjust Honer's (1967) standard volume tables to local conditions. Merchantable volumes were calculated for living trees at the beginning and end of the trial using these adjusted volume tables.

RESULTS

Unfortunately, there was considerable blowdown mortality in plot 1 of both the white spruce (Table 1) and balsam fir (Table 2) stands. This left the experiment without replication except in the control treatments. Timmer (1976) felt that the net effect of fertilization in these stands had been to postpone mortality that naturally would have taken place during the first 5 years after treatment. Percentage mortalities of white spruce in plots 3 and 4, which had similar original densities, and

of balsam fir in plots 2 and 3, which also had similar densities, are shown in Tables 1 and 2. These seem to support the contention that mortality in these stands was postponed by fertilization. However, relative numbers of dead trees in the plots generally are related to the density of the stand at the start of the trial.

Average diameter breast height increase, periodic percent merchantable volume increase and basal area increase show growth on fertilized plots to be similar to that on controls. These response parameters on living potential crop trees are not confounded by the mortality and blowdown on the number 1 plots. For white spruce (Table 1), diameter increases on the fertilized plots are intermediate between the extremes on control plots, percent basal area increases are lower on fertilized plots than on control plots, and a similar situation exists with percent merchantable volume increase. For balsam fir (Table 2), diameter and percent basal area increases on fertilized plots are quite similar to those on control plots, while percent merchantable volume increases are generally lower on fertilized plots. Thus fertilization has had little obvious effect on any growth parameter which is detectable with this experimental design.

Of interest may be an observed phenomenon that we found quite impressive. During a visit in the summer of 1977, we noticed the forest floor of the balsam fir stand, which was almost devoid of mosses, was covered with balsam fir regenerants. We calculated that there were about 45 million regenerants per hectare. The summer of 1975 had been very dry; there had been heavy flowering and cone set in 1976; and the unusually wet summer of 1977 appears to have led to excellent germination and survival. By the fall of 1978, when we were in the stand for the final remeasurement, very few of these seedlings were still alive. A similar situation was found on the forest floor of the white spruce stand which was covered by feather mosses. Here, the spruce seedlings numbered about 6 million per hectare and were found amongst the moss fronds. Very few of these spruce seedlings survived until the fall of 1978. The fertilizer treatment did not appear to have enhanced the relative survival of seedlings on treated plots as compared with control plots.

DISCUSSION

Timmer (1976) suggested that the "opening up" of the plots at the outset of the trial by removing all dead trees may have stimulated nutrient release processes and thus, fertilizer addition may have had little stimulus in the plots which had also been "thinned". It is unlikely however, that the removal of dead trees could have significantly increased the amount of sunlight reaching the ground and thus the stimulation of nutrient release produced by the "thinning" would have been negligible. If the object of forest fertilization is to stimulate tree growth it seems to make very little economic sense to fertilize stands like those found in block 2 (Table 2), where over 5500 trees per hectare with live crowns died before 1978; each of these trees removed fertilizer from the soil at the time of treatment but did not form part of the final merchantable crop. These trees returned the nitrogen contained in their biomass to the forest floor when they died so that it was not lost from the site but the site already contained large amounts of organic nitrogen which was being mineralized so slowly as to inhibit forest growth. Further work with fertilizers in forestry might be more successful if concen-

trated on younger stands where stocking has been managed such that only potential crop trees are fertilized.

Timmer (1976) suggested that "dominance promotion in these over-crowded stands" was one of the aims of the fertilizer trial, but dominance promotion does not appear to have resulted from fertilization of these stands. Gessel and Walker (1956) reported success in dominance promotion by the application of fertilizer. However they worked with younger and denser conifer stands than those in this study and the response parameter which they found most useful in measuring dominance promotion was height growth on an individual tree basis. Unfortunately the approach used by Gessel and Walker (1956) could not be tested in this study as the original height of each tree was not measured at the outset in 1969.

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Table 1. Plot establishment and remeasurement data - white spruce stand, Barren Hill, Ferguson Lake

Treatment Block - Plot No.	Control 1-2	Control 1-4	100 N* 1-3	200 N* 1-1
1969 Measurement				
A. Live trees in 1969				
No. trees/ha	5486	2668	2570	2965
Basal area m^2/ha	36.2	35.5	36.9	35.8
Merchantable volume m^3/ha	75.9	142.0	151.6	134.5
Average dbh cm	8.81	12.32	12.85	11.84
B. Surviving trees in 1978**				
No. trees/ha	3064	1532	1779	988
Basal area m^2/ha	24.6	22.5	30.7	14.6
Merchantable volume m^3/ha	62.6	92.9	133.8	60.2
Average dbh cm	9.80	13.13	14.42	13.20
1978 Remeasurement				
C. Live trees in 1978				
No. trees/ha	3064	1532	1779	988
Basal area m^2/ha	30.3	27.8	37.2	17.7
Merchantable volume m^3/ha	97.8	125.0	174.4	80.2
Average dbh cm	10.84	14.58	15.92	14.55
D. Dead trees				
No. trees/ha	2422	1136	791	1977
Basal area m^2/ha	11.6	13.0	6.2	21.2
Merchantable volume m^3/ha	13.3	49.1	17.8	74.3
Average dbh cm	7.59	11.20	9.27	11.13
Net change in plot (C-A)				
Basal area m^2/ha	-5.9	-7.7	0.3	-18.1
Merchantable volume m^3/ha	21.9	-17.0	22.8	-54.3
Average dbh cm	2.03	2.26	3.07	2.71
Mortality (%)	44.1	42.3	30.8	66.7
Response on surviving trees (C-B)				
Basal area m^2/ha	5.7	5.3	6.5	3.1
Merchantable volume m^3/ha	35.2	32.1	40.6	20.0
Average dbh cm	1.04	1.45	1.50	1.35
Periodic BAI (%)	23.5	23.4	21.2	21.4
Periodic MVI (%)	56.3	34.6	30.3	33.1

* 112 and 224 kg N/ha applied as urea.
** 1969 measurements based only on those trees alive in 1978.

Table 2. Plot establishment and remeasurement data - balsam fir stand, Barren Hill, Ferguson Lake

Treatment Block - Plot No.	Control 2-2	Control 2-4	NPK* 2-3	NPK* 2-1
1969 Measurement				
A. Live trees in 1969				
No. trees/ha	13245	18582	12849	12256
Basal area m^2/ha	47.5	69.2	60.7	48.5
Merchantable volume m^3/ha	69.7	109.2	128.0	78.0
Average dbh cm	6.17	6.38	7.11	6.52
B. Surviving trees in 1978**				
No. trees/ha	5733	9884	7314	3954
Basal area m^2/ha	32.7	50.9	48.1	23.1
Merchantable volume m^3/ha	62.3	103.1	128.0	50.1
Average dbh cm	8.13	7.62	8.56	8.18
1978 Remeasurement				
C. Live trees in 1978				
No. trees/ha	5733	9884	7314	3954
Basal area m^2/ha	47.1	70.5	65.6	33.4
Merchantable volume m^3/ha	146.7	201.8	224.9	112.4
Average dbh cm	9.65	8.84	9.83	9.75
D. Dead trees				
No. trees/ha	7512	8698	5535	8302
Basal area m^2/ha	14.8	18.3	12.6	25.4
Merchantable volume m^3/ha	7.4	6.1	0	27.9
Average dbh cm	4.67	4.93	5.20	5.74
Net change in plot (C-A)				
Basal area m^2/ha	-0.4	1.3	4.9	-15.1
Merchantable volume m^3/ha	77.0	92.6	96.9	34.4
Average dbh cm	3.48	2.46	2.72	3.23
Mortality (%)	56.7	46.8	43.1	67.7
Response on surviving trees (C-B)				
Basal area m^2/ha	14.4	19.6	17.5	10.3
Merchantable volume m^3/ha	84.4	98.7	96.9	62.3
Average dbh cm	1.52	1.22	1.27	1.57
Periodic BAI (%)	44.0	38.5	36.4	44.6
Periodic MVI (%)	135.2	95.7	75.6	124.3

* 448 kg/ha 19-19-19 mixed fertrilizer.
** 1969 measurements based only on those trees alive in 1978.