PRODUCTION OF STEM CONES ON *PINUS RADIATA* AFTER FERTILIZER TREATMENT

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SYNOPSIS

Production of stem cones of 8-year-old radiata pine in Motueka State Forest, Nelson, treated with fertilizers at time of planting, is examined. A distinct increase in stem cone production was found in treated trees on a Moutere Gravels soil, but on Kaiteriteri Hill soil no significant difference in numbers was detected on treated trees compared with untreated.

INTRODUCTION

Fertilizer trials were established in radiata pine *(Pinus radiata)* stands in two blocks of Moutere State Forest, Nelson, at the time of planting in 1963. One, in Kaiteriteri Block, was on a Kaiteriteri Hill soil, which is derived from granite, is low in carbon, nitrogen and reserve phosphorus and very low in available phosphorus, and has a strong acid reaction. The other, in Waiwhero Block, was on a Moutere Gravels soil, which consists of well-rounded gravels, often mixed with large boulders and sometimes interbedded with layers of sand and clay; this soil is low in phophorus and nitrogen and often deficient in magnesium and boron. This paper analyses the effect of fertilizer application on stem cone production. Any significant increase in stem cones automatically downgrades sawn board production, as grading rules allow only a limited number of cone holes.

TABLE 1: TREATMENTS APPLIED AT TIME OF PLANTING, 1963

Treatment	*Weight of Fertilizer applied per Tree*	
	Waiwhero	*Kaiteriteri*
1	Superphosphate 85 g (9% P, 20% Ca, 11% S); commercial preparation of urea formaldehyde 28 g (34% N); borax 2.8 g (11% B); potash 28 g (40% K, 16% S).	As for Waiwhero
2	Ammonium magnesium phosphate pellets 56 g (8% N, 14% Mg, 18% P); borax 2.8 g.	As for Waiwhero
3	Superphosphate 85 g; commercial preparation of urea formaldehyde 28 g.	As for Waiwhero
4	Ammonium magnesium phosphate pellets 56 g.	Superphosphate 85 g; borax 2.8 g.
5	Control.	Control

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TABLE 2: EFFECT OF FERTILIZER ON STEM CONE PRODUCTION

Treatment	Stems/ha	Basal Area (m^2)	Mean Top Height (m)	% Stems Bearing		No. of Cones and Conelets on Bearing Trees			
						Cones		Conelets	
				Cones	Conelets	Av.	Max.	Av.	Max.
Waiwhero									
1	2270	5.74	6.07	30	52	3.3	14	3.6	12
2	2170	7.58	7.62	50	66	4.2	12	4.0	12
3	1900	6.66	6.40	22	44	4.6	10	3.7	9
4	2050	6.66	6.40	41	60	4.8	29	4.6	13
5	2200	2.75	4.57	9	29	3.0	12	3.2	9
Kaiteriteri									
1	2370	20.43	9.75	56	58	5.1	34	4.1	10
2	2470	18.14	9.45	52	52	4.3	22	3.6	5
3	2470	19.51	10.06	54	46	4.3	18	3.9	11
4	2450	22.04	9.75	47	43	4.6	16	3.9	13
5	2420	16.99	8.84	45	57	4.2	17	3.6	10

TREATMENTS

Both trial areas, which carried a vegetation of bracken *(Pteridium aquilinum* var. *esculentum),* kanuka *(Leptospermum ericoides)* and gorse *(Ulex europaeus)* were burnt before planting with 1/0 radiata pine at a rate of 2 500 stems/ha. Square plots of 0.04 ha were laid out but, to eliminate side-effects from adjoining treatments, 0.02 circular plots were established within these. Four fertilizer treatments (each replicated three times) were applied in the two trial blocks, the fertilizers being placed in a scrape alongside each tree. Controls were untreated. Details are given in Table 1.

RESULTS AND DISCUSSION

From height and basal area figures supplied for the two localities (Table 2), it can be seen that there are obvious dissimilarities in growth rates. Thus, each area had to be analysed separately.

Analyses of variance were carried out, and the results are summarized in Table 3 in descending order of treatment effects. Those treatments joined by lines cannot be separated statistically.

Number of Stem Cones

At Waiwhero a clear and consistent pattern emerged. The three treatments which gave least effect were 1, 3 and 5, always in that descending order. For number of cones, number of stems with cones, and percentage of stems with cones, the largest two are treatments 2 and 4, always in that descending order, and only for the number of conelets is the order reversed. It should be noted, however, that there were no differences for maximum number of cones or conelets detected, although the pattern of means is still consistent. Generally speaking, treatments 2 and 4 form a group of their own in terms of greatest stem cone formation, while treatments 3 and 5 are in the lowest group, with treatment 1 intermediate.

When comparing the above data with fertilizers applied, it is noted that the ammonium magnesium phosphate pellet treatments (2 and 4) have the most cones, conelets, and number of stems with cones. Analysing this further, it appears that the higher content of phosphate and magnesium could be the two elements causing the increase in stem cones. Magnesium is used only in treatments 2 and 4; phosphate and nitrogen are used also in treatments 1 and 3. With superphosphate, the percentage of P is only half that found in ammonium magnesium phosphate pellets, while the nitrogen percentage in the commercial preparation of urea formaldehyde is four times that found in these pellets. This seems conclusive proof that ammonium magnesium phosphate pellets increase the number of stem cones and conelets when applied to young radiata pine stands in the Waiwhero Block.

For the Kaiteriteri Block the picture was different. Increase in the number of stem cones and conelets where fertilizers

TABLE 3: TREATMENT EFFECT MEANS, IN DESCENDING ORDER, AND THEIR STATISTICAL DIFFERENCES AT 5% LEVEL

Characteristic	*Waiwhero*	*Kaiteriteri*
Number of cones	2 4 1 3 5	1 3 2 4 5
Number of conelets	4 2 1 3 5	1 5 2 3 4
Number of stems with cones	2 4 1 3 5	3 1 2 5 4
Percentage stems with cones	2 4 1 3 5	1 3 2 4 5
Number of stems with conelets	2 4 1 3 5	1 5 2 3 4
Maximum number of cones per tree	4 2 1 3 5	1 2 4 3 5
Maximum number of conelets per tree	4 2 1 3 5	4 3 5 1 2
Basal area per acre	2 4 3 1 5	4 1 3 2 5
Number of stems per acre	1 5 2 4 3	3 2 4 5 1
Mean top height	2 3 4 1 5	3 4 1 2 5

were applied was small, and in no instance was it as pronounced as in the Waiwhero Block. The number of stem cones was greatest where potash was used, and potash also seemed to account for the largest number of conelets. But in this Block there were no statistically significant differences between treatments.

Minimum Height of Stem Cones

A record was kept of the height above ground of the lowest stem cones in all treatments (not the mean lowest height). In both localities the range was 1.8 to 2.1 m, a difference of only 0.3 m. A study by Bannister (1962) of the height of the first stem cone in six different localities in New Zealand showed that the lowest cones recorded in his samples were at 3.5 m above ground, but on some other trees the minimum height was 1.8 m. It appears that in this study the height of the first stem cone above ground is not affected by site differences — a conclusion reached by Bannister in his study.

CONCLUSION

From the evidence in this paper it has been shown that there is a distinct relationship between sites, fertilizer applications and stem cone production. On the more fertile site (Kaiteriteri) the increases are not statistically significant. On the poorer site (Waiwhero), fertilizers, especially ammonium magnesium phosphate, produce marked increases in stem cones and conelets. Thus, there may well be undesirable repercussions if fertilizers are applied to poor sites in terms of the quality of sawn boards eventually obtained from the stand.

ACKNOWLEDGEMENTS

The author is grateful to Dr G. M. Will (Forest Research Institute) for his advice and to Dr A. G. D. Whyte (University of Canterbury) for his assistance and for the statistical analyses.

REFERENCE

Bannister, M. H., 1962. Some variations in the growth pattern of *Pinus radiata* in New Zealand. *N.Z. Jl Sci., 5:* 342-70.