THE POTENTIAL ROLE OF LEGUMES IN THE REHABILITATION OF LEVELLED GOLD DREDGE TAILINGS, TARAMAKAU RIVER, N.Z.

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Abstract

Recent increases in the value of gold have led to renewed interest in gold mining — particularly by the dredging of the river flats bordering West Coast rivers. In any future licensing of such dredging, the rehabilitation of the "destroyed" land will be a ***major*** consideration. Nitrogen is the main nutrient limiting the growth of radiata pine on the gold dredge tailings; this paper outlines initial results of an exploratory legume-fertilizer trial on levelled tailings in the Taramakau River valley. Twelve legume species ***were*** grown with and without superphosphate (+ MO, Mg and K). Tree lucerne (*Cytisus proliferus*), Russell lupin (*Lupinus polyphyllus*) and yellow tree lupin (*L. arboreus*) grew well without the application of fertilizer but the pasture legumes had substantially increased dry matter production where P was added — in white clover (***Trifolium repens***) dry matter production was increased from 5.4 to 8.9 t/ha; and total N was 180 and 310 kg N/ha. Tree nutrition and growth were greatly improved by association with a vigorous legume species, In addition, the presence of legumes improved the appearance of the tailings and with a pasture species grazing potential was created

INTRODUCTION

THE FOLIAGE of radiata pine trees growing on degree tailings is usually chlorotic due to nitrogen deficiency. Observations suggest that trees growing close to gorse bushes tend to be greener and have higher foliage N levels. The benefits to tree growth on coastal sands of association with yellow tree lupins are well established (Mead and Gadgil, 1978), so it seemed likely that trees planted on dredge tailings might also benefit from being grown in association with legumes.

In November 1977, a small exploratory trial was established on recently levelled dredge tailings. The aim was to assess:

(1) The potential for establishing 12 traditional legume species (see Table 1).

(2) The effect of fertilizer on DM production and nitrogen inputs. The fertilizer consisted of 1200 kg/ha serpentine-superphosphate + Mo at establishment with a maintenance dressing of 250 kg/ha in 1978 and 1979 + 100 kg/ha potassium sulphate in 1979.

(3) The effect of legumes on radiata pine nutrition.

RESULTS

LEGUMES

1. *Establishment*

Germination was good for all species. The early growth of the pasture legumes was substantially increased by the addition of fertilizers. Lupins and tree lucerne showed little response to P. The initial vigour of tree lucerne was low but after the application of lotus inoculant subsequent response and growth were dramatic.

2. Production

Periodic assessments of herbage DM and nutrient content have been carried out since 1978; results for the April 1980 assessment are given in Table 1. Where fertilizer had been applied, 'Grasslands Maku' lotus, white and red clover, and hybrid lotus (G 4712) were the most productive pasture legumes *(ca. 8.7* t/ha); without fertilizer the two lotus cultivars were the highest producers *(ca.* 6.3 t/ha).

3. Herbage Analyses

N, P and S levels were below those required for maximum white clover growth (McNaught, 1970). The fertilizer applications were apparently inadequate to satisfy the plant requirements. K, Ca and Mg levels were satisfactory.

4. Nitrogen Imputs

Although DM production of fertilized white and red clover and Maku lotus were similar, measures of total kg N/ha in herbage show white clover as the most important species over red clover and Maku lotus at 310, 230 and 190 kg N/ha, respectively. In the absence of fertilizer, the three species produced 180, 60 and 120 kg N/ha, respectively.

5. Root Growth

Weights to 20 cm depth were assessed in April 1980. Results showed white clover and Maku lotus roots weighed 2.0 and 2.7

TABLE 1: THE EFFECT OF SUPERPHOSPHATE ON THE GROWTH AND CHEMICAL COMPOSITION OF THE FOLIAGE OF ASSOCIATED LEGUMES AND RADIATA PINE TWO OR THREE YEARS AFTER PLANTING

Species	Fertilizer Level	Legumes DM (kg/ha) (Apr 80)	Legumes N%	Legumes P% (Dec 1979)	Legumes S%	Radiata Pine Height* (m) (Jun 1980)	Radiata Pine N% (Feb 1980)	Radiata Pine P% (Feb 1980)
Red clover	–	2780	2.88	0.16	0.17	0.88	1.51	0.14
(*Trifolium prafense*)	+	8550	2.60	0.22	0.19	1.18	1.90	0.23
White clover	–	5370	3.66	0.22	0.25	1.05	1.52	0.13
(*Trifolium repens*)	+	8870	3.96	0.36	0.30	1.31	1.84	0.21
Subterranean clover	–	2600	2.00	0.08	0.17	0.91	1.42	0.13
(*Trifolium subterraneum*)	+	4270	3.00	0.23	0.29	1.20	1.73	0.18
Grasslands Maku lotus	–	6690	2.43	0.12	0.19	1.02	1.61	0.14
(*Lotus pedunculatus*)	+	9050	3.46	0.31	0.29	1.20	1.76	0.18
Grasslands lotus G4712	–	5940	2.62	0.14	0.20	0.89	1.59	0.17
(*Lotus hybridum*)	+	8430	3.34	0.28	0.24	1.30	1.92	0.23
Caucasian clover	–	4720	3.16	0.16	0.18	1.08	1.51	0.18
(*Trifolium ambiguum*)	+	4070	3.47	0.25	0.22	1.24	1.81	J.19
Alsike clover, diploid	–	3090	2.65	0.19	0.24	1.13	1.89	0.10
(*Trifolium hybridum*)	+	5810	2.79	0.28	0.28	1.04	1.79	0.19
Alsike clover, tetraploid	–	3840	2.50	0.16	0.23	1.01	1.62	0.16
(*Trifolium hybridum*)	+	4110	2.93	0.26	0.30	0.95	1.88	0.19
Russell lupin	–	6020	2.26	0.17	0.16	1.23	1.73	0.19
(*Lupinus polyphyllus*)	+	4630	2.54	0.20	0.17	1.33	1.97	0.23
Yellow tree lupin	–	7750	1.36	0.10	0.11	1.11	1.72	0.15
(*Lupinus arboreus*)	+	9200	1.72	0.24	0.20	1.39	1.52	0.20
Lucerne	–	3030	2.93	0.20	0.26	1.00	1.60	0.15
(*Medicago sativa*)	+	6500	3.30	0.30	0.28	1.21	1.88	0.21
Tree lucerne	–	65670	1.18	0.08	0.10	–	–	–
(*Cytisus proliferus*)	+	34700	1.97	0.11	0.11	–	–	–
No legume	–	–	–	–	–	0.51	0.95	0.18
	+	–	–	–	–	0.49	1.04	0.23
Satisfactory levels for white clover			5.50	0.40	0.30			
Satisfactory levels for radiata pine							1.50	0.14

*Mean of between 4 and 15 trees per plot

t/ha without fertilizer and 1 .0 and 1 .4 t/ha with fertilizer, respectively.

RADIATA PINE

1. *Growth*

Three years after establishment the following differences could be seen at the trial site:

(a) As indicated in Table 1, there was a tendency for tree heights to be greater when growing in association with a vigorous (fertilized) legume; however, the results were not suitable for statistical analysis.

(b) Tree form was better in pasture legume plots — competitioa from woody species adversely affected tree straightness and shape in other plots.

(c) Tree lucerne had severely suppressed tree growth. However, because of its vigorous growth without fertilizer, this species may have a use when not planted in association with young trees.

2. Needle Analyses

In the absence of any legume, radiata pine foliage N levels were low (Will, 1978). When growing in association with a legume, N levels were satisfactory (highest % N in the + fertilizer treatments). Percent P in the pine needles showed a response to the fertilizer application. Mg levels were marginal, with K, Ca and Cu being adequate. Foliar B levels were satisfactory to high in February 1980; visual boron deficiency symptoms appeared in December 1979 and a dressing of 2 kg/ha was then broadcast.

CONCLUSION

By using traditional agricultural techniques, legumes can be readily established on recent dredge tailings. Whether improved tree growth will result from growing trees in association with legumes on such sites has not yet been sufficiently established.

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