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FACTORS AFFECTING ESTABLISHMENT AND SPREAD OF "GRASSLAND MAKU" LOTUSINTUSSOCKGRASSLANDS

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Abstract

Observations of blocks oversown with Maku lotus in the Otago tussock grasslands have indicated that the potential yields are not being obtained as a result of low seedling establishment and limited spread of established plants.

Satisfactory establishment is dependent on correct aerial oversowing techniques and suitable site preparation. Inoculation with rhizobia is essential for nodulation on most areas of the tussock grasslands and the present recommendation is to slurry-inoculate seed at up to 5-times the normal manufacturers rate. The incorporation of 10% (w:v) gum arabic in the slurry improves viability of rhizobia and allows seed to be stored for 1-2 weeks before sowing.

Vegetative spread of established plants depend on growth of rhizomes during the summer/autumn period. This rhizome growth is sensitive to time of defoliation of the sward. Defoliation as early as the start of January reduced the amount of rhizome present in April while early-February or early-March defoliation virtually eliminated rhizome growth. In sparse swards of Maku lotus where maximum spread of existing plants is required it is recommended that grazing be avoided over this critical period. Where adequate plant density has been obtained either through the use of correct seedling establishment techniques or earlier management for rhizome spread, it is not necessary to adhere to this recommendation and swards can be rotationally grazed over the summer/autumn period.

Seed production of Maku lotus is limited, particularly at higher altitudes and on shady aspects, and the technique of natural reseeding has limited application in these tussock grasslands.

Keywords: grazing management, inoculation, Maku lotus, rhizome, seed production.

INTRODUCTION

Lotus pedunculatus cv "Grassland Maku" has been recommended as a suitable legume for acid, low fertility tussock grassland soils (Scott & Mills, 1981). However, observations of blocks oversown with Maku lotus in Otago have indicated that the potential yields are not being obtained because of low plant density which is being exacerbated by limited spread of established plants. This paper discusses reasons for and means of overcoming, the problems of low seedling establishment and limited spread of plants.

SEEDLING ESTABLISHMENT

One of the most visually apparent establishment problems results from uneven aerial application of seed either through inaccurate flying or excessive swath widths. These problems can be overcome by the use of experienced pilots and correctly adjusted equipment (Charlton & Grant 1976).

Establishment failures have also occurred when legume seed has been oversown into thick vegetation or onto bare soil particularly where dry conditions follow sowing (Cullen, 1969). Maku lotus should be sown into the existing tussock

unless there is a thick tussock cover or litter layer. This should be burnt at least 12 months prior to oversowing to allow some regrowth to occur.

Rhizobia effective on lotus are absent from the majority of tussock grassland soils and hence inoculation is essential. Establishment can be influenced by inoculation and pelleting techniques with the largest effects occurring on the more acid soils (Lowther, 1983). The standard recommendation has been for slurry-inoculation with the incorporation of 10% (w:v) gum arabic to improve the viability of rhizobia when seed is stored for 1-2 weeks before sowing (Scott & Lowther, 1980). Recent research has shown large increases in the percentage of seedlings established from increasing the inoculation level to five times the normal rate (Table 1). This is now recommended for Maku lotus oversown in tussock grasslands and can be successfully carried out in a concrete mixer, although adequate time must be allowed for seed to dry before attempting to sow. Once inoculated, seed can be stored for at least 2 weeks before sowing.

Table 1: EFFECT OF INOCULATION LEVEL ON ESTABLISHMENT (% SEEDLINGS NODULATED) OF MAKU LOTUS OVERSOWN ON AN ACID (pH 4.6) TUSSOCK GRASSLAND SOIL (Wedderburn unpub.).

	Storage days	
Inoculum level	1	14
Normal[1]	44	41
x 5	69	74
x 10	65	62
SEM	3.8	

[1] Normal — manufacturers recommended level of 6 g peat inoculant/kg seed. Rhizocote inoculant 5 x 10^9 rhizobia per g of peat.

Only small quantities of Maku lotus seed have been commerically pelleted and few samples have been available for field and laboratory evaluation. Results have been variable with establishment being similar to or lower than that from seed slurry-inoculated at the normal rate.

RHIZOME DEVELOPMENT

Maku lotus has the ability to spread by underground rhizomes which can also emerge above ground and become stoloniferous (Armstrong, 1974). Development of rhizomes follows a seasonal pattern (Sheath, 1980; Wedderburn & Gwynne, 1981) and the quantity produced is sensitive to frequency and intensity of defoliation (Sheath, 1980). Examination of grazed swards in the Otago tussock grasslands has indicated limited rhizome spread even under the late summer/early autumn spelling advocated by Sheath (1980). This observation suggested that information on seasonal pattern of rhizome growth and the effects of defoliation was required for a range of environments.

Seasonal Pattern

Seasonal rhizome development was monitored in established Maku lotus swards in the absence of defoliation. Turfs were removed at the start of each month, from November to May, and the weight of rhizome produced over this period was recorded (Fig. 1). New rhizomes were observed in January at Tara Hills (1500 m) and growth continued throughout January and February. On the Avenel (650 m) and Waipori (650 m) sites new rhizomes were observed in February and growth continued to the end of the sampling period in May. On the higher Avenel site (945 m) new rhizomes were not observed until the start of March and growth was recorded during this month only.

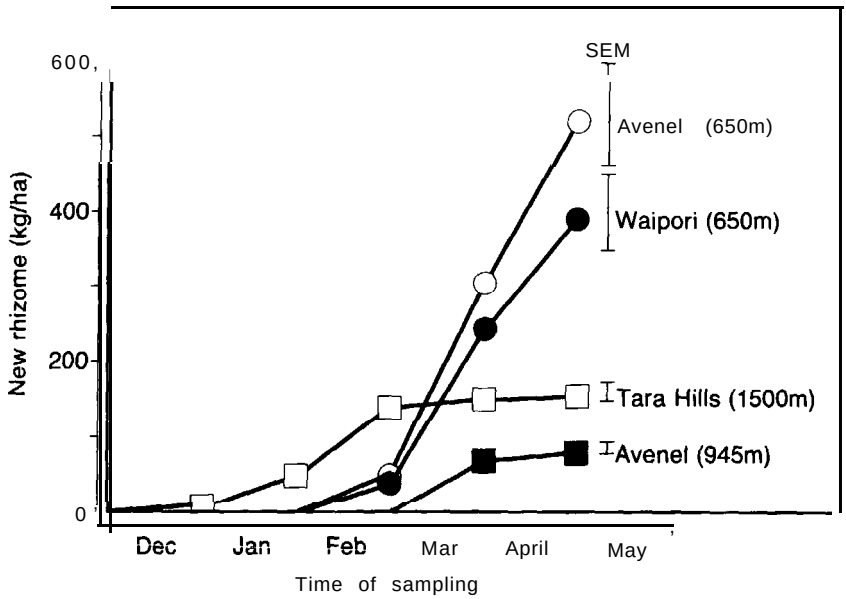

Figure 1: Seasonal development of new rhizome on undefoliated swards *ranging in altitude from 650-1500 m*

Aspect

Total amount of rhizome varied between sites but effects were confounded by differences in age, aspect and fertiliser treatments. This could not be avoided as only limited areas of established Maku lotus suitable for this experiment exist in the Otaqo tussock grassland. The effect of aspect was studied at the Avenel 945 m site on a block oversown with lotus in 1981. Rhizome production on a NW face was 453 kg/ha compared with only 77 kg/ha on an adjacent flat area and 37 kg/ha on a SE face. The effect of aspect has also been shown in the Grampian Mountains where the spread of Maku at 1460 m was found to be greater on a NW slope than an ESE slope (Dunbar & Costello, 1984). The poor results obtained on shady faces indicate that rhizome spread would be a slow means of improving plant density, therefore under these conditions resowing of low density swards may be necessary.

Time of Defoliation

The effect of time of defoliation on rhizome growth was studied at Waipori (650 m). Maku was cut once at monthly intervals from early November onwards. Swards were cut to a stubble height of approximately 1 cm to simulate the typical grazing being imposed by runholders. Turfs were removed at the beginning of April and May and the weight of rhizome produced was recorded.

The amount of rhizome present at the start of April is considered particularly important as grazing in April is recommended to prevent the possibility of loss of standing herbaqe through frosting. There was little difference in the weight of rhizome present in April between undefoliated swards and swards cut up to early December (Fig. **2). However, cutting** in early January significantly reduced rhizome weight and with early February and March cutting there was little growth of rhizome.

Sampling at the start of May showed that expansion of rhizomes continued through out April in swards defoliated up to early January (Fig. 2). In contrast little rhizome expansion occurred during April in swards defoliated in early February or

March. Therefore if grazing is deferred until May, with the associated risk of frosting, further increases in rhizome production will be obtained in early grazed swards. However, the severe effects of February/March grazings cannot be alleviated.

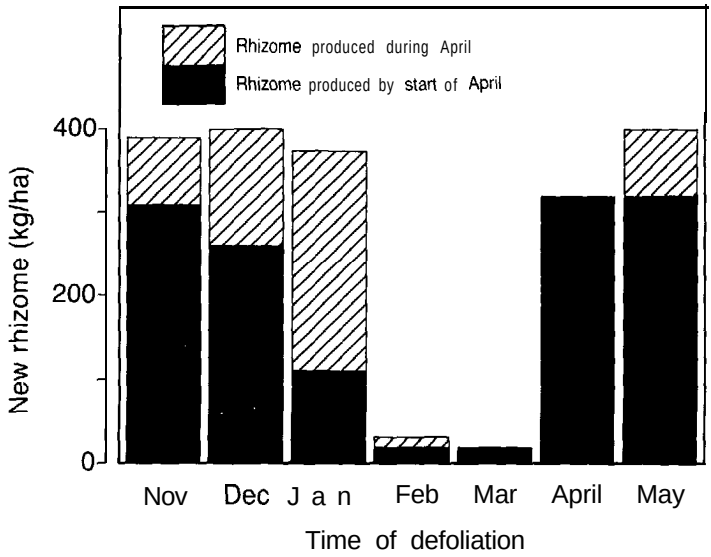

Figure 2: The effect of time of defoliation on the amount of rhizome produced by the start of April and during April. LS ratio for April data = 63% i.e. results from cutting will be significant at the 5% /eve/ if they differ ± 63% from the uncut (April) treatment. LS ratio for May data = 40%.

These present results on the effect of different times of defoliation are from one site only, but the effect of time of defoliation could be expected to be the same over sites with similar seasonal patterns of rhizome production. However, where expansion occurs earlier (i.e. Tara Hills) even December grazings may reduce rhizome growth. Furthermore, on the sites where no rhizome growth appeared to occur during April (Avenel 945 m), deferring grazing until May is unlikely to have any effect.

The effect of defoliation on rhizome production is more severe than that reported by Sheath (1980) in the Manawatu. Sheath suggested that grazing be limited during late summer and autumn to improve the spread of rhizomes. Our results have shown that rhizome production may be reduced by grazing as early as January and severely affected by a grazing in either early February or March. This study has been carried out simulating the close defoliation typically observed in grazed swards. Sheath (1980) has shown that the detrimental effect of defoliation is less with swards cut to 9.5 cm rather than 1.5 cm. It may therefore be possible to alleviate to some extent the effect of grazing during the critical period for rhizome growth by leaving higher stubble heights. This aspect requires experimental verification for two reasons. The first is the fact that the effect of defoliation on rhizome growth is more severe in the tussock grasslands than the effect observed in the Manawatu by Sheath. Secondly, because of animal grazing behaviour it may not be possible to graze to constant high stubble heights in the tussock grassland environment.

It must be made clear that the recommendation on the necessity to avoid grazing during the critical period for rhizome spread applies only where an increase

in sward density is required. On swards where satisfactory plant densities have been obtained, either through use of correct seedling establishment techniques or earlier management for rhizome spread, Maku lotus herbage can be grazed through this summer/autumn period. In the tussock grasslands Maku lotus is utilised under both lax set-stocking and rotational grazing managements. However, results of Sheath (1981) suggest that highest yields of Maku lotus will be obtained under a rotational grazing system.

NATURAL SEEDING

Reseeding of legumes through seed ingestion and defecation by stock is well established as a management tool for introducing legumes into new areas and thickening up existing swards (Suckling, 1951). Before recommending the technique for Maku lotus, information was required on Maku seed production in the tussock grasslands. Flowering and seed production were recorded at monthly intervals at a number of sites including those used for rhizome studies.

In undefoliated swards the time of flower bud initiation, flowering and seed pod formation varied over the sites. On a lower altitude site (Waiora, 400 m) flower bud initiation occurred as early as November, seed pods appeared in February and viable seed was present in April. In contrast, on the higher altitude sites (Tara Hills, 1500 m; Avenel, 945 m; Rocklands 760 m) flower bud initiation was not apparent until January/February and no seed pods formed. Visual observations at Avenel (950 m) suggests that seed production is influenced by aspect. No seed was pioducad on the flat trial area, or on the adjacent SW slope, but viable seed was produced on the sunny NW slope. Flower buds were observed to be sensitive to out-of-season frost damage over the summer on flat areas.

The present results indicate that environmental conditions can limit seed production of Maku lotus in the Otago tussock grasslands especially at higher altitudes and on shady aspects. Although further research is required to define the actual altitude x aspect limitations the present results show that natural reseeding may have limited application in these tussock grasslands.

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