Paper 10
WINTER MANAGEMENT OF LUCERNE

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INTRODUCTION

Because lucerne relies on root reserves for regrowth,and because plants that die are not replaced, it is extremely important that lucerne should be managed to maximise plant vigour and minimise factors that will result in plant death.

It has generally been thought that lucerne is a winter-dormant species, and that winter management has little effect on the stand (Lobb, 1967; Langer, 1973). In New Zealand this has never been strictly true and now some more winter active cultivars have been introduced, and winter grazing management is a tool for insect and disease control. It is therefore important to consider winter management.

EFFECTS ON SPRING PRODUCTION

Early spring lucerne production is important in any farming system which relies on lucerne to meet livestock feed demands. Climate and the frequency of autumn-winter defoliations have been shown to have an important influence on early-spring production (Douglas, 1971; Robinson and Abbott, 1971; Janson, 1975; Wynn-Williams, 1976).

In a very cold winter environment at Tara Hills, Douglas (1971) obtained greatest early-spring production, under a cutting regime, by spelling lucerne over the entire autumn-winter period. However, under a simulated grazing treatment (cutting with nutrient return), a defoliation after autumn growth stopped, resulted in early spring production equivalent to that of total spelling (Table 1). This utilised autumn production that would otherwise have been lost through frosting, and greatly increased total cool season (autumn-winter-spring) yield. Therefore, in a cold winter climate, it is recommended that lucerne be grazed in the autumn following the cessation of growth. While this may not increase early-spring production it will significantly increase cool season production.

In a milder climate at Winchmore, Janson (1975) obtained the greatest early-spring production, when lucerne was spelled over the entire autumn-winter period. Whether

Table 1: Effect of cool-season management on lucerne yield (kg DM/ha) at Tara Hills (Douglas, 1971).

Treatment		Yield			
Cutting	Fertilizer[1]	Autumn	Early Spring[2]	Spring Deficit	Total[3]
No autumn cut	0	—	2440	0	2440
Cut 26/3/63	0	2410	1200	−1240	3610
Cut 1/5/63	0	2560	1600	− 840	4160
Cut 1/5/63	+	2560	2160	− 280	4720

[1] McNeur's Mixture applied following cutting to simulate nutrient return following grazing.
[2] 10 October, 1963.
[3] Cool-season production Autumn + Winter + Spring.

Table 2: Effect of autumn-winter grazing management on spring lucerne yield (kg DM/ha) Winchmore (after Janson, 1975).

Grazing Treatment		Yield			
Autumn*	Winter**	Autumn Winter	Spring	Spring deficit	Total cool season deficit
Unirrigated					
Grazed	Grazed	650	3510	−1690	−1040
Grazed	Spelled	400	4840	−360	+40
Spelled	Grazed	790	4060	−1140	−350
Spelled	Spelled	–	5200	0	0
Irrigated					
Grazed	Grazed	1670	3240	−2415	−745
Grazed	Spelled	1320	4540	−1110	+210
Spelled	Grazed	970	4390	−1260	−290
Spelled	Spelled	-	5650	0	0

* Late April
** Mid June

the lucerne was irrigated or not, grazings in late-April and/or mid-June depressed spring production, and autumn production did not compensate for this loss (Table 2). Winter grazing alone reduced spring production more than autumn grazing alone, but not as much as autumn plus winter grazing. The total deficit in cool season production was reduced under irrigation because of greater autumn production.

In contrast at Lincoln, Wynn-Williams (1976 and unpubl. data) has found, autumn and/or winter cutting to have little or no effect on early spring production (Table 3). Autumn-winter defoliations depressed early-spring production by, on average, only 150 kg/ha, and production from lucerne, spelled over the autumn-winter period, failed to compensate for feed lost through frosting. As observed by Douglas (1971), Wynn-Williams found autumn cutting to be beneficial provided it occurred after autumn growth ceased and before the herbage was lost through frosting, as it resulted in significantly greater total production. Early autumn and June cutting resulted in increased total cool-season production compared to June spelling, but this increased yield advantage did not occur with late-autumn and June cutting (Table 3).

Table 3: Effect of autumn-winter cutting on cool-season lucerne yield (kg DM/ha), Lincoln mean of 1975 and 1976 (Wynn-Williams, 1976 and unpublished).

Treatment[1]	Yield			
	Autumn	Winter	Spring	Total cool season yield advantage of June cut
EA + JC	3080	1250	1020	+ 1080
EA + JS	3080		1190	
LA + JC	2430	240	1260	+ 120
LA + JS	2430		1380	

[1] EA: Early-autumn (mean of mid-March, early-April).
LA: Late-autumn (mean of mid-April, mid-May)
JC: June cut
JS: June spelling

The above results suggest that the effects of autumn-winter defoliations can be likened to those of frequent or premature defoliations, as reported by Langer (1968). The effect it has on production being determined by, previous management as it affects plant vigour, the number of premature defoliations, and subsequent stand management. This is further supported by Robinson and Abbott (1971) who obtained greatly depressed spring yields from frequent autumn grazings compared to grazings that allowed a greater bulk of herbage to develop. These factors may provide the possible explanation for the apparent differences in the results obtained by Janson (1975) and Wynn-Williams (1976). The heavier soil type of the Lincoln trials would enable more vigorous autumn growth and a greater accumulation of reserves. Also time of closing prior to autumn defoliations was early-February, a month earlier. This would allow a greater accumulation of growth and root reserves (Reynolds, 1971), and provide for greater reserves to buffer the damaging effects of autumn-winter defoliations (Chatterton *et al.* 1977; Constable *et al.* 1977).

Where early spring production is not critical, the depressive effects of autumn-winter management on spring production can be overcome also by delaying the spring defoliation. By spelling lucerne until October Janson (1975) found the effects of autumn-winter grazing on early spring production disappeared. This confirms the results of Langer (1968), that a brief period of mismanagement has little effect on subsequent yield, provided the stand is then adequately spelled.

To counter pest and disease problems, an increasing diversity of lucerne cultivars are now being used in New Zealand. As yet there is no information on the effects that cool season management will have on their production. A cultivar x management trial has been established at Lincoln, but results to date have proved inconclusive and evaluations are continuing (M.W. Dunbier, pers. comm.).

The effects of autumn-winter management may, however, be more critical in winter-active cultivars. In his review of environmental effects on lucerne growth, Christian (1977) concluded that in winter-dormant cultivars, dormancy of crown buds is established at the time of hardening-off, and next seasons growth originates from these overwintering buds and those initiated in spring. In more winter-active types however, buds continue to develop at colder temperatures, although at a reduced rate, and are therefore more vulnerable to grazing and frosting. Palmer *et al.* (1975) found this when comparing cultivars with a range of winter activities at Tara Hills and Lincoln. Of the resistant cultivars now available, AS13R and Rere are more winter-active than Wairau. The remainder of the resistant cultivars are no more winter-active than Wairau (T.P. Palmer, pers. comm.) and therefore the effects of autumn-winter management on spring production might be similar to those of Wairau.

APHID CONTROL

The potential damage that can be caused by the blue-green (*Acrythosiphon kondoi*) and pea aphid (*A. pisum*) populations in New Zealand (Trought and Kain, 1977; Kain *et al.*, 1979a; Gaynor *et al.*, 1980; Kain and Trought, Paper 7) is now a further factor which must be considered in the management of lucerne. Also because the more winter-active cultivars harbour higher overwintering aphid populations than dormant cultivars (Kain *et al.*, 1979b), farmers who hope to increase cool-season production, through the use of these cultivars, will face problems of greater cool season aphid attack than they now currently experience with the semi-dormant cv. Wairau.

Table 4: Effect of grazing on blue-green lucerne aphid numbers (per 10 shoots) and spring growth of lucerne in Manawatu (from Trought and Atkinson, 1977).

Assessment date	Aphid numbers Grazed*	Aphid numbers Ungrazed	Stem length (cm) Grazed	Stem length (cm) Ungrazed
16 Aug	1.0	21.8	2.5	7.5
4 Oct	1.4	46.1	17.9	15.9
11 Oct	4.5	40.1	18.6	15.9
18 Oct	21.5	180.1	20.8	16.2
** 25 Oct	170.5	267.2	23.9	16.7

* July 26, 1976
** Spring harvest

Until aphid-resistant cultivars are readily available, other forms of control must be adopted. Grazing management can be effective in reducing aphid populations (Kain and Atkinson, 1978; Penman *et al.*, 1979; Bishop *et al.*, 1980) but high stocking densities, preferably by sheep, are necessary for good control (Bishop *et al.*, 1980). Grazing was suggested by Trought and Kain (1977) as a possible means of controlling overwintering aphid populations, and delaying their spring build-up (Trought and Kain, 1977; Penman *et al.*, 1979) (Table 4). Such management has no deleterious effects on subsequent production when lucerne is harvested in late-spring (Smallfield *et al.*, 1980). However, where early-spring production is required, the effects on yield of cool-season grazing for aphid control would be similar to those discussed earlier.

The decision whether to graze lucerne in winter to control aphid populations, must consider the autumn plant root reserve status, as persistent heavy aphid damage reduces plant vigour, through reducing the root reserves (Kain *et al.*, 1979a). Therefore, where autumn aphid attacks have been serious, a further winter-grazing (a 'premature defoliation'), to control over-wintering aphids, may well be detrimental to plant-survival and spring production, as root reserves already reduced through the aphid attack will be further depleted (Kain *et al.*, 1979a). In such instances an insecticide control would be preferable to grazing.

DISEASE INCIDENCE

Cool season management can predispose the lucerne stand to disease attack, though information as to the effects of management on disease-incidence is very limited and mainly confined to survey results. These are often confused by a combination of factors such as management, pests and diseases, stand-age, which in combination influence disease-incidence.

Diseases principally associated with cool season management are bacterial wilt (*Corynebacterium insidiosum* McCull.), stem nematode (*Ditylenchus dipsaci* Kuhn), and crown rot "complex". Where hay is infected with bacterial wilt or stem nematode, the feeding of hay back on a stand is one of the principle means by which these pathogens are spread (Wood and Close, 1974; Close and Sanderson, 1977). Resistant cultivars are available and should be sown where these pathogens are present (Dunbier and Palmer, 1977; Janson, 1979).

Intensive grazing, feeding back hay or using the stand as a run-off, particularly under cold or wet conditions, will cause trampling and splitting of the lucerne crowns. This damage allows entry of the crown rot pathogens (Close and Sanderson, 1977). While crown rot may not in itself cause plant death (Janson, 1979) in combination with a pest attack, it could result in severe depletion of a stand (P.A. Burnett, pers. comm.). The more winter-active cultivars may also be more susceptible to disease such as crown rot, as greater cool-season use will be made of these stands.

The effects of winter management on disease is, however, still largely unknown. In the 1975/76 lucerne disease survey, it was found that in stands four years old or younger, the incidence of crown rot was significantly higher in stands grazed in winter (Dunbier *et al.*, Paper 1). However, as stand age increased the incidence of crown rot increased, but with no relationship to winter management. This may have been due to survey inaccuracies, or the effect of age swamping the effect of management. It is important therefore to establish experimentally the effect cool-season management has, not only on production, but also on disease, and to test this over the range of cultivars now available.

WEED INCIDENCE

Palmer (Paper 4) outlined the causes of weed invasion in lucerne stands and also the advantages of controlling the economically-damaging winter annuals, such as barley grass (*Hordeum murinium*), that commonly invade even well-managed stands. The management favoured by Lobb (1967) for the control of winter weeds cannot now be recommended, because of the likelihood of disease transmission (Close and Sanderson, 1977) and spring yield depression (Palmer, 1976).

Where autumn defoliations of lucerne are continuous or repeatedly at an immature stage, the proportion of weeds in the spring production will increase significantly, compared with production from stands allowed longer spelling (Robinson and Abbott 1971). It must therefore be remembered that temporary removal of the weeds is no substitute for good management.

CONCLUSION

Where good spring-summer management, that maintains plant-vigour and population is applied and cultivars resistant to pests and diseases are used, cool-season management could become critical in determining a stand's potential production and its persistence. Defoliations over the late autumn-winter can be considered 'premature', and will result in depressed spring yields if root reserves prior to defoliation are insufficient to

compensate for the effects, or if subsequent spelling is insufficient. However, adequate autumn and or spring spelling can minimise these effects.

Autumn-winter management may also predispose lucerne to a number of diseases, which alone, or in combination with other factors, can seriously affect production and persistence. The use of resistant cultivars suited to the environment, and management that minimises plant damage, should help to overcome this problem.

There are benefits to be gained from utilisation of cool-season growth, but these must be balanced against the depressive effects. It is beneficial to autumn-graze for maximum cool-season production, where frosting and loss of herbage occurs. Also, such a management strategy, if applied after the cessation of autumn aphid flights, can effectively control over-wintering aphid populations. It will also help control winter weed populations. However, intensive winter stocking of a stand as a runoff, or during the feeding back of hay, solely to control weeds, should not be practiced. Weediness is in most cases a symptom of some other problem, and intensive winter stocking may only compound that problem, resulting in extensive plant damage that will depress plant vigour and allow the ingress of disease.

Information is extremely limited on the effects of cool-season management on the range of cultivars now available. Every effort must be made, therefore, to gain this information, as such cultivars can be used to overcome the disease and pest problems which at present limit the further expansion of lucerne. The greater winter activity of some of these cultivars may make them more susceptible to winter damage, however, and changes to the recommended autumn-winter management might be required.

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DISCUSSION

Hawthorne: Were diseases assessed in the winter management trials?
Smallfield: Not that I am aware of.
Close: It is very important that diseases be looked at in these types of trials.
White: What about the control of weeds by 'hoof and tooth'.
Smallfield: It should be a secondary criterion for the decision to graze.
Dunbier: From the 1975/76 survey crown rot increased with winter grazing in stands less than 4 years of age. This is the only evidence available on winter management and its effect on disease.
Palmer: Even this evidence is suspect. There is a need for research in this area.
Gluyas: Machinery can also cause damage to crowns.