MANAGEMENT PRACTICES AFFECT THE PURITY OF A LUCERNE STAND

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Summary

Many management practices influence the ability of lucerne to compete with weeds. Variety, harvesting interval, grazing management, fertilizers and irrigation are some of the factors which can influence the competitiveness of lucerne. Evidence would suggest that, where lucerne is to be grown in the complete absence of animal utilization, and where irrigation will be necessary to assure the continuity of production, more research into aspects of weed control will be necessary.

INTRODUCTION

A GREAT DEAL has been written about the lucerne crop, much of this to laud it as "alfalfa" — the perfect fodder — the King of Crops. On the other hand, much of the writings indicate the difficulties of growing the crop — its soil and climatic limitations, its diseases, its weed competitors and the difficulties of its management. There is little doubt the crop is already important in many areas in New Zealand — albeit not the most important — and that it is increasing in importance and is likely to further increase should the present attempts to establish a chain of processing units in Canterbury be attended with success. This latter approach to the utilization of lucerne will be accompanied by the need for a better realization of the interplay of factors such as management, fertilizer treatment and weed control on the eventual production and survival of the crop. There have been two main approaches to several aspects of these factors, one mainly with management techniques, and one based on the direct chemical approach. It is the intention of this paper to deal with some aspects of the former, as I believe there is a danger in the modern philosophy which leads us to think that science will produce an answer, in the form of an efficient cheap chemical, to any problem which might arise as the consequence of the neglect of good husbandry. There is a good deal of evidence, reluctant as we are to admit it, that such may not be the case.

The importance of weeds in the seedling stand has been dealt with by many authors — Meeklah (1959; 1964); Clare (1968); Palmer (1968); Allen (1967), and others. There is little doubt that a farmer should work to a plan for any area which is to be sown to lucerne, and in different areas and for different weeds the plan could vary greatly, but the aim is to thoroughly clean the area of perennial weeds and to control adequately annual seedling weeds before and at sowing. This may include such aspects as manipulation of sowing date and the use of cover crops of different types for different weeds, and so on. Anything which reduces the productive life of the lucerne stand can be considered as a weed. It is generally conceded that the main reason for failure of the lucerne stand is weed invasion and generally grass and clover are the most troublesome invaders. In a survey of 300 farms in the South Island, Blair (1965) found the average life of a stand was from 5 to 12 years and that failure was due to grass and weed invasion in from 60 to 100% of cases, depending on district.

On soils, and in climates suited to lucerne, weed control is made easier. Deep silt loam soils provide a great depth for lucerne to root and to draw moisture and nutrient and if no obstruction occurs the roots may reach the water-table. Stands under such conditions may produce upward of 14,000 lb DM/acre. These are at once very competitive against the ingress of extraneous plants. If these soils are in areas of low rainfall, surface-rooting grasses and weeds are placed at a greater disadvantage. By far the majority of the soils in the low rainfall areas do not provide this favourable environment for lucerne and it is generally on these where weed control is difficult. The problem will be greatest where rainfall is also highest.

The information given in this paper was obtained in the 30 in. rainfall area of Mid-Canterbury on a soil unfavourable for lucerne where the greatest concentration of lucerne roots on both irrigated and dry conditions was in the top 9 in. and only 5 to 8% of roots pentrated below 18 in. (Lobb, 1967). The influence of the factors of variety, fertilizer application, cutting interval, management, grazing and irrigation on weed ingress have been studied.

VARIETY

In the experiments where production cuts and lucerne percentage have been recorded, Table 1 indicates the percentage of weeds in the stand at various ages. Other observations have been made on a number of varieties not mentioned in the table.

A lucerne which is not suited to the area will not compete with weeds. For instance, the frost-tender African variety contained 46 and 38% of weeds in the first year under dry and irrigated conditions, respectively. After five years, the stand was composed mainly of weeds. Indian varieties, although not shown in this summary, performed similarly. Winter-dormant

TABLE 1: PERCENTAGE OF WEEDS IN LUCERNE VARIETIES IN STANDS AT VARIOUS AGES

	Irrigated				*Dry*			
Variety	*1st yr*	*3rd yr*	*5th yr*	*6th yr*	*1st yr*	*3rd yr*	*5th yr*	*6th yr*
Wairau	0	6		51	3	1		32
Provence	5	4		50	82	2		23
De Puits	1	5		84	5	1		38
Socheville	4	7		58	9	2		30
Eynsford	5	6		80	4	2		34
De Zaragoca	6	2		55	8	2		27
Scandia	4	8		81	5	1		48
Saladina	6	26		99	7	3		42
(First Cut Only)								
Hunter River	22	49	70		19	36	39	
Italian	17	37	74		23	32	48	
African	38	74	79		46	70	84	
Wairau	13	20	52		13	15	26	
Provence	10	16	44		14	24	23	
Du Puits	5	21	64		5	10	25	

varieties such as Scandia and Saladina (and Rambler and Rhizona) suffer severe competition and are almost completely eliminated in six years if irrigation is applied. Mediterranean varieties which have not performed well are Hunter River, Eynsford, Du Puits, Italian and Socheville, the latter especially under irrigation.

Wairau and Provence have been the best weed competitors and fortunately most areas we will be concerned with will be of these varieties. The trials which follow were all conducted on Wairau stands.

STAGE OF CUTTING

From observations on the performance of lucerne, it is certain that intervals between grazings and cuttings can have very marked effects on the invasion of weeds. This has been studied in two experiments at Winchmore, one on dryland lucerne on a young, relatively weed-free lucerne stand, and the other on an irrigated five-year-old stand where considerable weed ingress had already taken place. The intervals of cutting were determined by the following growth stages: early bud; 50% in bud; 10% in flower; and 50% in flower.

TABLE 2: PERCENTAGE OF GRASS, CLOVER AND WEEDS IN A LUCERNE STAND AS INFLUENCED BY CUTTING AT FOUR DIFFERENT STAGES OF GROWTH

Year	*Early Bud*	*Stage of Cutting* *50% Bud*	*10% Flower*	*50% Flower*
		DRY		
1964-5	3	4	1	3
1966-7	11	4	2	1
1968-9	49	38	22	12
1968-9				
Grass %	33	31	17	11
Clover %	6	3	1	—
Other weeds %	10	4	4	1
		IRRIGATED		
1964-5	25	17	17	12
1965-6	37	16	10	13
1966-7	39	30	16	13
1967-8	63	54	33	34
1967-8				
Grass %	43	39	27	33
Clover %	17	13	5	1
Other weeds %	3	2	1	—

As shown in Table 2, under dryland conditions repeated cutting at the early bud stage increased weed percentage from 3% in 1964-5 to 49% in 1968-9. Where the cutting was at 50% bud, the increase in weed was from 4% to 38%; at 10% flower from 1% to 22%; and at 50% flower from 3 to 12%. Within this relatively short period, this showed that there had been a four-fold increase in weed invasion associated with early cutting.

In each year an analysis of the type of weeds was kept for each cutting interval. This analysis for the last year is given in Table 2. At early cutting there was 33% of grass in the stand, 6% of clover, and 10% of other weeds, mainly flatweeds. It is interesting to note that cutting at 10% flower, or later, almost eliminated the ingress of white clover and this effect is even more marked under irrigation.

The irrigated trial started with a considerable percentage of weeds and the first year's production. This trial had 25% weeds in the early cut, 17% in the 50% bud and 10% flower, and 12% in the 50% flower. These weeds were largely grass with from 2 to 4% of clover.

In the 1967-8 cuts, 63% of the production under early cutting was comprised of extraneous matter. Cutting at 50% bud produced 54% of material other than lucerne and for the two latter cuts weeds account for 33 and 34% of the produce, respectively.

On the irrigated area, clover accounted for 17% of the impurities at early cutting and 13% at 50% bud. Leaving the stand to 10% flower reduced the amount of clover to 5%, and at 50% flower there was only 1% of clover in the 34% of foreign material. This no doubt reflects the inability of the clover to compete for light and to survive under long intervals of non-defoliation. The interplay of grass, clover and weeds in a study such as this provides some evidence as to the likely effects of grazing. Continuous and close grazing during summer, especially under irrigation, could change a lucerne stand to a clover-dominant one, whereas grass dominance would result from longer intervals between grazing.

Many other influences of the cutting interval are being studied in these experiments, but for the purpose of this Conference the tables given indicate clearly the inability of lucerne to compete with weeds if early cutting is practised.

MANAGEMENT

Since the removal of hay and the grazing carried out on a lucerne stand exert perhaps the greatest influence on its survival, it is important to study some of these effects. Table 3 illustrates the influence of removing hay without animal return compared with the influence of feeding hay back to the stand. The influence of the weedicide 2,2-DPA (2,2-dichloropropionic acid) can be compared with this.

Where a stand is used for hay production, and no special effort other than adequate fertilizer is made to compete with weed invasion, the stand will soon deteriorate, there being 19% of weeds in the third year, and in the sixth year a third of the production is from weeds.

Under irrigation at this stage over half of the produce is from weeds.

TABLE 3: PERCENTAGE WEEDS INDUCED BY HAY REMOVAL AND INFLUENCED BY FEEDING BACK HAY AND APPLYING WEEDICIDE

	Dry			*Irrigated*		
	1959-60	*1961-2*	*1964-5*	*1959-60*	*1961-2*	*1962-3*
Hay removed, no weedicide	1	19	32	1	12	52
Hay removed, weedicide	1	2	11	1	6	38
Hay fed back, no weedicide	0	2	8	1	1	22
Hay fed back, weedicide	1	0	3	1	0	15

The use of the weedicide reduced weeds to 11% in the dry area and to 38% in the irrigated area.

However, where feeding on the area is practised in winter, and hay is fed, good weed control can be effected. On the dry area, there were only 2% of weeds at the third year, the same as where weedicide had been applied. After six years the stand was still good, there being only 8% of weeds where hay was fed back and 11% where the weedicide had been applied. The combination of both feeding back and applying weedkiller resulted in only 3% of weed.

Similarly, for irrigation, feeding back without weedkiller controlled practically all weeds to the third year, but by the sixth year there was 22% compared with 38% where weedkiller without feeding was applied. Again a combination of both weedkiller and feeding back reduced the weed component to 15% compared with the 22% for feeding back only.

Only clean hay, and that means containing no seed, should be fed. This almost confines a farmer to feeding clean lucerne hay only. If no clean hay is available, lucerne stands can be used as a run-off for winter crops, but some control of stock movement on the run-off may then be needed.

Fertilizer

In general, it could be stated that any nutrient in short supply would react unfavourably as far as permitting the dominant plant to compete with invaders. Therefore, it would be correct to supply all the known deficient nutrients. In this respect, Harris *et al.* (1966) have shown that responses could be obtained to lime, phosphorus, sulphur, molybdenum and potassium. They showed that the treatments of high lime, sulphur, potassium and molybdenum all increased lucerne yields more than the yields of competing species. In fact, high lime and to a lesser extent molybdenum decreased the yield of other species. On the other hand, high application of phosphate increased other species.

Further work at Winchmore was undertaken to determine the importance of potassium and sulphur and the results of this experiment in respect to the invasion of weeds indicate that, for a stand containing 20% of weed in 1962-3, this increased to 62% in 1964-5 without potassium and to 32% where high levels of potassium were applied. Without potassium the lucerne yield dropped from 7,390 lb DM/acre to 2,820 lb but with potassium the lucerne yield was 5,750 lb in the final year. Although sulphur increased the total yield, it had little effect in the lucerne percentage.

As has been mentioned previously (Lobb, 1967) the significance of the correct fertilizer practice for lucerne is often related to the differential requirements of lucerne compared with the invading species, and this factor is the major one operating throughout the greatest area of potential lucerne-producing land, namely, the dry stony soils of the South Island. On these soils, there has as yet been no marked requirement for potassium for grass and clover production but in nearly all cases phosphorus is of primary importance. Thus, when using superphosphate, the fertilizer is ideally suited to the competitors but leaves the lucerne deficient in potassium so that increased topdressing with superphosphate to unthrifty stands of lucerne (this was traditional) would result in shortening the life of lucerne at the expense of grass and clover invasion.

Irrigation

There is little doubt that irrigation will increase the weed problem in the lucerne stand where there is one. It is only necessary to look at Tables

2 and 3 to see this. Table 1 shows that in five or six years even the best lucernes have 40 to 50% weed invasion under irrigation, whereas, if not irrigated, these may contain only 20 to 25%. Irrigation virtually eliminates the poorest lucernes.

Similarly, from Table 2 a marked increase is shown at all intervals of cutting in the weed content as a result of irrigation. Increases are from 49% to 63% irrigated at early bud; from 38 to 54% at 50% bud; from 22 to 33% at 10% flower; and from 12 to 34% at 50% flower.

In the management trial in Table 3, irrigation has shown a very marked increase in weed content. On the dryland, the removal of all hay without weedkiller resulted in 19% weeds, whereas the same treatment irrigated contained 52%. Management practices to contain weeds gave better results under dry conditions, the use of weedicides and hay feeding having almost eliminated weeds, but these same practices result in from 15 to 38% of weeds in the irrigated stand.

All these examples show that it is more difficult to control weeds where soil moisture conditions are kept at a level that favours surface-rooting competition, despite the fact that on these soils lucerne itself is mainly surface rooting. This fact is probably its main limitation.It may not express its true competitive nature and has not the advantage it has on deep unobstructed soils where, even under reasonable rainfall, it would be a much more competitive plant. This fact explains in no small measure the unpopularity of lucerne in many intermediate rainfall and irrigation areas in Canterbury.

DISCUSSION

The importance of management factors should not be overlooked in any discussion of weed control in lucerne. It is not intended to leave the impression, however, that chemicals have no place. In view of the interest which will be shown in growing lucerne for processing in the next few years, it is imperative that more work be done both with management techniques and chemical weed control for this system of utilizing the lucerne stand. The results of the work quoted in this paper still leave a relatively short life for the stand before weeds become troublesome and expensive to control on soils which are not ideally suited for this crop.

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