DETERIORATION (RUNNING OUT) OF LUCERNE IN THE SOUTH ISLAND

I. D. BLAIR

Lincoln College, Canterbury

Summary

Plant population in lucerne fields is discussed in relation to weed invasion. 80% ground coverage by lucerne within drill rows seems to be a general level of plant density. Of diseases and pests, the nematode *Ditylenchus dipsaci* is widespread and occasionally severe; wilt caused by *Verticillium* and *Fusarium* fungi is prevalent but of low order in severity. No evidence has been found of bacterial wilt, *Corynebacterium insidiosum*, a disease of great concern in Australia. Comment is made on fertilizer practice in relation to deterioration and there appears to be support for the contention that much lucerne is inadequately topdressed.

DURING the past four years, the South Island lucerne crop has been under survey, within a research contract programme supported by the Department of Scientific and Industrial Research. The original enquiry was to examine the significance of disease factors, as, for example, confirmation or otherwise of the presence of bacterial wilt (*Corynebacterium insidiosum*) a disease regarded with great concern in other countries. The data assembled in the survey cover a wider range than that of disease and this paper is a progress report on some agronomic features relevant to the interests of this conference.

In the first season of field work (1965) information was obtained on farming practice on 27,000 acres of lucerne—approximately 25% of the total area reported to be in this crop in Nelson, Marlborough, Canterbury and Otago. Table 1 includes information obtained on length of life of lucerne crops, grass/weed invasion, incidence of pests and disease.

In the past three summer seasons of field work and among a high proportion of farmers contacted, the factor of weed invasion appears to dominate in discussion. The actual significance of weeds, however, is not yet clear. Weeds are conspicuous when the lucerne crop is dormant or just prior to renewed spring growth, and are much less evident when lucerne is in full growth, except in gaps or patches where lucerne has failed for some unknown reason. The only time when measurements on weeds and grass can be made with any accuracy is in the period of lucerne dormancy (July-August) and during this period in 1967 observations of the following nature were made.

POPULATION IN LUCERNE FIELDS

A survey method had first of all to be proven, and widely divergent results were obtained depending on the technique used. In a field at Lincoln College results were obtained with quadrats and line transept measurements as in Table 2.

There was no opportunity to pursue a critical and statistical study of sampling method for weed measurement. It appeared that a line transept procedure was desirable and ultimately measurements were

TABLE 1: FACTORS ASSOCIATED WITH LUCERNE DETERIORATION

	Nelson	Marlborough	North Canterbury	Springs- Ellesmere	Malvern	Mid- Canterbury	South Canterbury	North Otago	South Otago	Central Otago	Southland
Number of crops ...	16	30	31	55	38	46	41	10	6	26	16
Area of lucerne (acres) ...	261	1,996	4,885	2,579	2,351	2,734	4,281	881	74	6,854	332
Average duration yr	9	12	9	9	10	7	9	11	8	12	4
Range ...	5-15	5-40	4-20	4-20	5-20	4-15	3-15	7-20	6-12	10-20	2-12
Grass/weed invasion*	90	60	80	72	81	80	90	70	100	100	100
Diseases and pests†	1	2	2	2	1	3	2	2	—	2	—
Inoculation failure†	0	0	2	2	2	2	5	0	0	6	0

*Percentage of growers who regard this as prime factor in "running out".

†Number of crops with reported disease or inoculation problems.

TABLE 2: PLANT POPULATION IN RELATION TO METHOD OF ANALYSIS

		Percentage		
		Lucerne	Weeds-Grass	Bare Ground
Quadrats 3¼ ft × 3¼ ft in 100 squares		43	46	11
Line transects 15 ft along the rows		81	10	9
Lint transects 15 ft across the rows		60	22	18

TABLE 3: PLANT POPULATION IN LUCERNE FIELDS

Age of Crop (yr)	Previous Crop	Percentage		
		Lucerne	Weeds-Grass	Bare
1	Barley	79	2	19
1	Barley	82	7	11
3	Grass	74	22	3
3	Barley	75	10	14
3	Grass	82	3	15
3	Grass	80	18	2
3	Barley	87	4	9
3	Fallow	84	2	14
3	Fallow	91	6	1
4	—	79	11	10
5	Potatoes	91	5	4
5	—	75	21	4
5	—	80	10	10
6	Barley	76	5	19
6	—	79	12	6
6	—	70	21	8
6	Fallow	83	16	1
6	Peas	84	1	15
8	Peas	69	27	1

made in a number of fields using a line transept along the drill rows in units of 15 ft × 3 rows, 5 sampling plots in each of 4 blocks into which the fields were sectioned

Some results are given in Table 3.

The wide diversity of the figures on distribution of weeds, bare ground, only served to emphasize our ignorance of the facts on causes of weed invasion which had not been obtained in this survey. Several of the crops listed in Table 3 were examined again in mid-summer (January) when there was a dense top growth following initial cuts for hay. In each of the crops inspected at this stage, weed and grass incidence was very low. The weeds and grass of dormancy had disappeared under the influence of cutting and smothering but the proportion of bare ground had increased commensurate with the earlier occurrence of weeds.

Productivity must be linked with the actual number of lucerne plants per unit area, regardless of whether the area not occupied by lucerne

at sampling time is in weeds or is bare ground. An impression is held by some farmers that annual weeds are no problem in the first year of lucerne development in that they are eliminated by the first cuts. Their elimination, however, can be expected to be followed by an increase in the area of bare ground, which in turn becomes the site of invasion by more perennial grasses and weeds. Among all lucerne fields inspected, those most free of weeds were ones that had been heavily stocked as run-off paddocks from winter turnip feeding, the sheep on these dormant lucerne areas being also fed with lucerne hay. In the spring, such areas, with the surface then well pulverized by the action of sheep feet, were topdressed with potassic superphosphates. The success of this management technique has been commented on by Lobb (1967).

Weed invasion in some areas has rather specific features. In the Hororata district of Canterbury, subterranean clover (*Trifolium subterraneum*) has accumulated to such levels on several farms that it forms a dense mat of growth at the base of lucerne plants and in mid-summer appears to restrict growth of the latter. In this area subterranean clover at the base of lucerne is regarded as a growth-limiting weed.

Another specific weed situation is claimed by farmers to exist where lucerne is irrigated, an issue that has been analysed in several recent reports. Lammerink (1959) has described the ingress of browntop (*Agrostis tenuis*) proportional to the amount of irrigation and Lauder (1959), and Harris *et al.* (1966) showed how deterioration of irrigated lucerne was directly associated with loss of nutrients from soil, the deficiencies of which were not being replaced by the fertilizer practices in use on irrigated lucerne.

THE DISEASE FACTOR

The records of the Plant Diseases Division, D.S.I.R., show that 16 fungus, 1 bacterium and 1 virus diseases have been reported in New Zealand lucerne. Overseas reports (Bolton, 1962) list more than twice this number of diseases commonly found in this host.

While it is likely that several previously unreported diseases will be found after more intensive plant pathology survey, study to date has not revealed any disease as a major factor limiting yield or development of lucerne.

Wilt in various forms has been frequently observed and particular scrutiny has been made for the hitherto unreported bacterial wilt organism *Corynebacterium insidiosum*. This has not been observed. The bacterium *Pseudomonas medicaginis* causing a stem blight of light order of severity was found in a few places. Wilt disease as it occurs in South Island lucerne is associated with the fungus *Verticillium* (species not yet confirmed), *Stagonospora meliloti* and, more rarely, *Sclerotinia trifoliorum*. *Verticillium* wilt arising from soil-inhabiting fungi is widely distributed but within any crop it appears to be sparsely distributed and no evidence was obtained of any severe occurrence. The disease appears to occur in older crops and in a sense the onset of the symptoms may be an indication of deterioration or "running out".

Fusarium fungi are regularly being isolated from root tissue of wilted plants. Many of these are conceded the status of secondary invaders of tissue weakened or damaged by physiological or mechanical causes. A critical study of these soil organisms as lucerne pathogens has not

TABLE 4: FERTILIZER TOPDRESSING

	Nelson	Marlborough	North Canterbury	Springs- Ellesmere	Malvern	Mid- Canterbury	South Canterbury	North Otago	South Otago	Central Otago
No. of crops reported	16	30	31	55	38	46	41	10	6	26
Area in lucerne (ac)	261	1,996	4,885	2,579	2,351	2,734	4,281	881	74	6,854
% arable in lucerne	13	23	24	12	9	9	16	23	7	31
Topdressing*:										
Lime (initial application during cultiva- tion plus renewals at intervals)	98	80	90	84	88	98	80	70	50	35
Superphosphate 1-3 cwt p.a.	62	50	97	82	70	54	80	50	100	7
Sulphur superphosphate 1-3 cwt p.a.	0	40	9	9	23	26	12	30	1/6	90
Superphosphate plus potash	50	0	1/31	9	8	6	4	0	1/6	10
Boron	0	1/30	0	0	0	8	0	0	0	2/26
Molybdenum	0	0	0	3	7	6	7	0	0	0
Mixed fertilizer	1/16	0	0	0	0	17	0	1/10	0	0

*Percentage of growers, except for very low occurrences, which are expressed in fractional proportions.

yet been made but such a study is called for in view of the evidence of Jones and Smith (1953) that several *Fusarium* species are strongly pathogenic in lucerne and as such are major factors in the wilt complex. Leaf and stem diseases are widely distributed, notably black stem caused by the fungi *Ascochyta imperfecta* and *Colletotrichum trifolii*; leaf spot in various forms caused by *Pseudopeziza* sp., *Stemphylium botryosum* and *Peronospora trifoliorum*. The effect of these three fungi in yield and vigour is not yet known but it is aimed to conduct experimental work to elucidate this.

Incidentally, reports (Loper and Hansen, 1964) on the link between oestrogenic substances (coumestrol) and foliar invading fungi on lucerne, point to an aspect of lucerne leaf disease that may have significance in relation to the thrift of animals grazing on this crop.

The stem-infecting nematode, *Ditylenchus dipsaci*, appears to be the most widely distributed insect pest and its effect in producing deformed buds and abnormal stem growth has been revealed in severity in many areas. It is known that the nematodes are readily distributed in irrigation water and many reports of eelworm damage have come from Mid-Canterbury. On the other hand, in another irrigation area, Central Otago, no records have been made of severe eelworm damage. An associated effect of eelworm damage has been failure to recover growth after winter dormancy, eelworm infected patches within the crop showing as dead plants in the succeeding years. Nematodes are just as likely to be distributed when infested hay is fed out on a dormant lucerne paddock and they are also believed to be present in seed and carried by some weeds. The rootknot nematode (*Meloidogyne* sp.), producing white swellings on roots, and like the stem eelworm leading to stunted growth, is another potential hazard which has been found prevalent in Marlborough. Over all districts, stem eelworm appears to be the pest or disease of most serious consequence. Although there is no effective control within the lucerne crop once the pest has become established, there is promise in plant breeding. The aim would appear to be to seek nematode resistance by incorporating some degree of the known nematode resistance of the variety Lahontan (U.S.A.) and this work is currently in progress at the Crop Research Division, D.S.I.R.

Pottinger and Macfarlane (1967) have stated that there is no evidence that aphids are important lucerne pests in Australasia. During this last summer, heavy infestation of aphids identified as *Myzus persicae* was observed on several lucerne fields in the Greenpark district near Lake Ellesmere. Top growth of affected plants showed a wilting and this led to premature drying off. The infestation occurred in the spring (October) but did not recur in the subsequent growth following the first hay cut.

NUTRITIONAL DISORDERS

In the initial survey among South Island farmers, practice with fertilizer application on lucerne was recorded as given in Table 4.

Superphosphate is more favoured in North Canterbury (97%) for maintenance topdressing but it is used predominantly in all districts, except Central Otago (7%). In the latter, sulphur superphosphate (90%) makes up the annual topdressing. Sulphur responses have also been confirmed by the figures in Table 4—in Marlborough 40% of growers, Mid-Canterbury (26%), North Otago (30%)—the lower rainfall areas where sulphur deficiencies have been recorded. Rather little potash seems to be used except in Nelson and Central Otago and the use of boron and molybdenum among the growers questioned in this survey has been

very restricted. In the past few years, with improved *Rhizobium* cultures available, there has been much less evidence of nitrogen deficiency through failure of *Rhizobium* nodulation.

All farmers, however, are not successful in establishing good nodulation and this can continue to be listed as one of the factors contributing to deterioration on several farms.

In his appraisal of fertilizer needs for lucerne, Dale (1967) has emphasized the variability of responses on soil types but also suggested that many stands of lucerne may be under-fertilized. The pattern of treatment as shown by the figures in Table 4 is so predominantly associated with lime and phosphate that one wonders whether this state is derived from experimental proof on the farm concerned or rather from adoption of a conventionally accepted belief in the overall virtues of this restricted fertilizer regimen. An impression has certainly been obtained in the field inspections, and confirmed by the disclosure of fertilizer treatment, that a great number of lucerne crops are inadequately fertilized and this paucity of treatment seems to be linked with deterioration of the crop, in the form of low herbage yields and ingress of weeds. The most productive crops which have been recorded all feature generous fertilizer application based on phosphate but with supplemental potash, sulphur or molybdenum used according to the guidance given by the now extensive field work in this aspect by officers of the Department of Agriculture.

REFERENCES

- Bolton, J. L., 1962: *Alfalfa*. Leonard Hill, London.
Dale, W. R., 1967: in Langer (1967): 134.
Harris, P. B.; McNaught, K. J.; Lynch, P. B., 1966: *N.Z. J. Agric. Res.*, 9: 653.
Jones, F. R.; Smith, O. F., 1953: *U.S. Dept. Agric. Yearbk*: 228.
Lauder, B. A., 1959: *N.Z. J. Agric.*, 98: 57.
Lammerink, J., 1959: *N.Z. J. Agric.*, 99: 553.
Langer, R. H. M. (ed.), 1967: *The Lucerne Crop*. A. H. & A. W. Reed, Wellington.
Lobb, W. R., 1967: in Langer (1967): 150.
Loper, G. M.; Hansen, C. H., 1964: *Crop Sci.*, 4: 480.
Pottinger, R. P.; Macfarlane, R. P., 1967: in Langer (1967): 233.