A STUDY OF SEED-BORNE ASPECTS OF THE SPRING BLACK STEM DISEASE OF LUCERNE

A Thesis presented in partial fulfilment of the requirements for the Degree

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by

Neil Seeley Percival

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SUMMARY

1. Morphological, cultural, and pathogenicity studies confirmed the causal organism of the spring black stem disease of lucerne (Medicago sativa L.) present in New Zealand to be Phoma medicaginis Malbr. et Roum..

2. Of eighty six New Zealand lucerne seed lines screened during 1970 and 1971, eighty three were infected at levels ranging from one half to forty nine percent; twenty three of the seed lines had an infection level greater than twenty percent.

3. In all seed lines (both infected and uninfected) there was a gradation from dark to pale coloured seed. In infected lines the infection level of the dark seed was greater ($\geq$ 3:1) than that of the pale seed.

4. Over eighteen months the level of seed infection decreased at a rate faster than the natural decrease in germination capacity; after this period the infection level was less than ten percent of the original value.

5. Improved moist blotter and agar plate tests were developed following a critical examination of established methods for detecting fungal pathogens associated with lucerne seed.

6. Seed-borne inoculum of P.medicaginis induced both pre-emergence and post-emergence damping-off. While the pathogen was most pathogenic to seedlings at 14 C, at this temperature not all detectable seed-borne inoculum caused damping-off.

7. In most instances pre-emergence damping-off resulted from destruction of tissues concerned with seedling elongation.

8. Of ten seed dressings evaluated benomyl and thiram provided most effective control of seed-borne inoculum of P.medicaginis. However before these therapeutants can be recommended for general use there is a need of further glasshouse and field trials.

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INTRODUCTION

The area of lucerne (Medicago sativa L.) in New Zealand has increased rapidly in recent years as farmers have recognized the role it can play in farming enterprises (Table I). There are several reasons to account for this increase:

(i) A gross margin analysis of lucerne as a cash crop shows a return that is equal to or greater than for comparable crops such as barley or peas (Tocker, 1970; Lamb, 1969; Anon., 1970).

(ii) Lucerne has a greater versatility than other crops as it can be utilized in several ways to produce many final products (Fig. 1).

(iii) Lucerne provides a more assured feed supply than conventional rye grass/clover pastures in those areas subject to droughts and with light soils (Oliver, 1971).

In parts of the South Island, the area of lucerne grown is small because of the difficulty experienced in stand establishment (Oliver, 1971). The importance of even and rapid establishment of lucerne cannot be underestimated, since a resulting vigorous stand with a minimum of weed infestation will give the greatest nett annual return. Several factors have been implicated as causing poor stand establishment in lucerne:

(i) Nutrient status of the seedbed; a deficiency in the essential mineral nutrients or a soil pH below 6.2 are likely to result in poor stand establishment (McFarlane, 1970).

(ii) Seedbed preparation; lucerne seedlings require a firm, fine, weed-free seedbed with adequate moisture for successful establishment (Bonner, 1970).

(iii) Efficiency of nodulation with Rhizobium meliloti Dangeard; non-nodulated seedlings rapidly show general yellowing and poor growth (Close, Whitelaw, and Taylor, 1971).

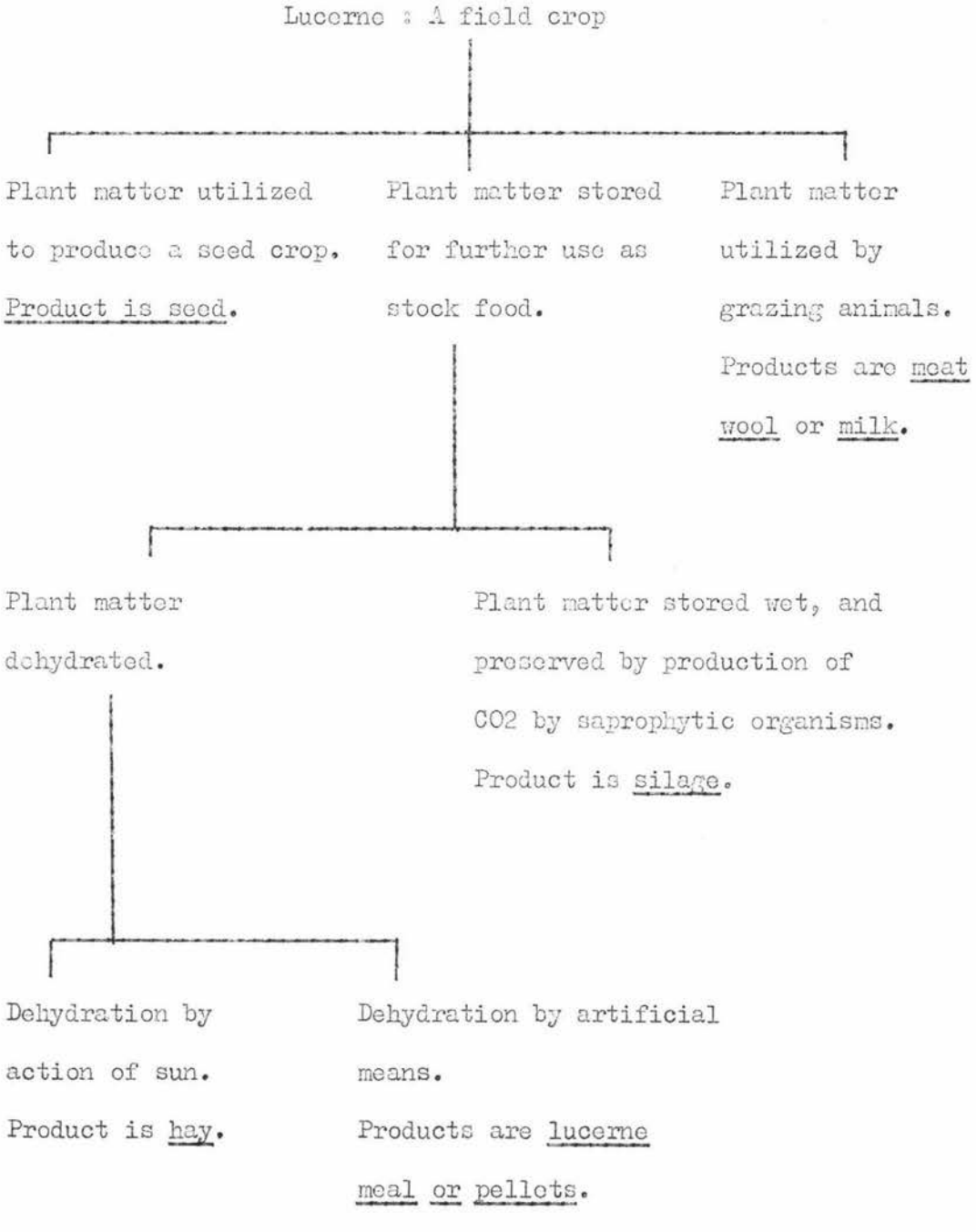
Table 1. The area of lucerne grown in New Zealand utilized as hay, silage or seed crops.

Year	Area (acres)	Authority
1958-59	144,516	N.Z. Yearbook, 1964.
1968-69	203,010	Ibid., 1970.
1970-71	300,000 x	Meeklah & Allen, 1971.

x estimate only.

(iv) Disease factor; several fungal pathogens cause pre-emergence and/or post-emergence damping-off in New Zealand, including species of Fusarium, Pellicularia, Pythium, and Phoma (Close, 1967). The pathogenic inoculum is derived from either soil or seed. As regards this latter aspect, twelve fungal pathogens of lucerne are known to be seed-borne (Cormack, 1945; Leach and Elliott, 1951; Noble and Richardson, 1966). Seven of these are present in New Zealand (Dingley, 1969), although only Phoma medicaginis Malbr. et Roum. (var. medicaginis Boerema) has been recorded as being seed-borne in this country (Matthews, 1970).

Figure 1. The uses and respective products of lucerne.



In broad outline, the present study was concerned with establishing the validity of the hypothesis that poor stand establishment as experienced in New Zealand may in part be consequent on fungal pathogens associated with seed at the time of sowing. That is, such seed-borne inoculum may induce pre-emergence and/or post-emergence damping-off.

This hypothesis is tenable in view of the following facts:

(i) Overseas work has shown that several fungal pathogens, in particular P.medicaginis, are seed-borne in lucerne and may cause damping-off (Table II).

(ii) P.medicaginis is prevalent in New Zealand lucerne crops being saved for seed x.

(iii) Preliminary studies in this laboratory earlier established that P.medicaginis was commonly associated with certified lines of New Zealand produced seed (Wenham, 1970).

More specifically the study involved

(i) establishing by morphological, cultural, and pathogenicity investigations that the tentative identification of P.medicaginis on lucerne seed was correct

x An account of the New Zealand history of blackstem of lucerne and a description of the disease is presented in Appendix I.

(ii) a critical examination of methods for the detection of *P. medicaginis* in lucerne seed

(iii) a survey of the health status of commercially available New Zealand lucerne seed

(iv) an investigation into the significance of seed-borne inoculum of *P. medicaginis* on seedling emergence

(v) a study of methods of reducing the fungal inoculum load associated with commercially available New Zealand lucerne seed.

Table 2. Fungal seed-borne pathogens of lucerne known to cause damping-off.

Causal Organism	Authority
Blackpatch (causal organism never identified)	Leach and Elliott, 1951.
Botrytis cinerea Pers. ex Fries.	Zakopal et al., 1966.
Colletotrichum trifolii Bain & Essary	Weber, 1952. Roberts et al., 1959.
Fusarium spp.	Leach, C.M., 1960. Hofer and Crosier, 1962.
Phoma medicaginis	Cormack, 1945. Kernkamp and Hemerick, 1953. Mead, 1953. Leach, C.M., 1960.
Stemphylium botryosum Wallr.	Nelson, 1955. Leach, C.M., 1960.
Sclerotinia trifoliorum Drayton and Groves.	Cormack, 1946.