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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

of

Master of Agricultural Science

at

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by

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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 ($> 3:1$) 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.

SUMMARY continued

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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TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	1
CHAPTER I: MORPHOLOGICAL CULTURAL AND PATHOGENICITY STUDIES	
A. INTRODUCTION	8
B. MORPHOLOGICAL STUDIES	12
C. CULTURAL STUDIES	19
(1) Gross Colony Characteristics	19
(2) Growth Studies	25
(a) Influence of media type on growth	26
(b) Influence of temperature on growth	26
(c) Influence of media pH on growth	32
D. PATHOGENICITY STUDIES	35
(1) Seedlings	
(2) Mature plants	
E. CONCLUSIONS	48
CHAPTER II. <u>P. MEDICAGINIS</u> AS A SEED-BORNE PATHOGEN	
A. INTRODUCTION	52
B. A CONSIDERATION OF HEALTH SCREENING METHODS	
I. INTRODUCTION	55
II. THE MOIST BLOTTER TEST	58
(a) Temperature	58
(b) Light Regime	59
(c) Blotter Pad Moisture Level	60
(d) Percentage Humidity Within The Germinator	64

CONTENTS continued

III.	THE AGAR PLATE TEST	67
	(a) Incubation Temperature	69
	(b) Incubation Time	69
	(c) Seed Germination Within The Agar Plate	69
	(d) Activity Of The Saprophytic Microbial Seed-Borne Flora	
	(1) Type of media	74
	(2) Role of antibiotics in the agar plate test	75
	(3) Chemical pretreatment of seed	79
	(4) Positioning of the seed within the agar plate	82
IV.	SCREENING OF LUCERNE SEED FOR FUNGAL PATHOGENS OTHER THAN <u>P.MEDICAGINIS</u>	88
C.	STATE OF HEALTH OF COMMERCIALY AVAILABLE LUCERNE SEED	90
D.	THE EFFECT OF <u>P.MEDICAGINIS</u> ON SEEDLING DEVELOPMENT	
I.	INTRODUCTION	93
II.	GENERAL EXPERIMENTAL PROCEDURES	94
III.	EFFECT ON EMERGENCE	
	(a) The Significance of Seed- Borne Inoculum of <u>P.Medicaginis</u> in Inducing Damping-Off	96
	(b) The Effect of Temperature on Damping-Off Induced by Seed- Borne Inoculum of <u>P.Medicaginis</u>	105
	(c) Overall Discussion	116
IV.	MECHANISM INVOLVED IN SEEDLING ATTACK	118

CONTENTS continued

E.	METHODS OF CONTROLLING SEED-BORNE INOCULUM OF <u>P.MEDICAGINIS</u>	
I.	INTRODUCTION	131
II.	USE OF SEED SIZE AND COLOUR TO SEPARATE INFECTED FROM HEALTHY SEEDS	133
III.	AGEING THE SEED	142
IV.	USE OF THERAPEUTANTS	145
	(a) Effect Of Ten Fungicides On The Level Of <u>P.Medicaginis</u> In Seed	145
	(b) Further Experiments Relating To The Possible Commercial Application Of Benomyl And Thiram	
	(1) Laboratory assessment of the percentage active ingredient of benomyl required for total control	147
	(2) Phytotoxicity of benomyl and thiram to lucerne seed and seedlings	150
	(3) Effect of benomyl and thiram when incorporated in "coated seed" on the level of <u>P.medicaginis</u>	156
V.	DISCUSSION	159
APPENDIX I.	THE NEW ZEALAND HISTORY, AND SYMPTOMOLOGY OF SPRING BLACK STEM OF LUCERNE	163
APPENDIX II	COMPOSITION AND PREPARATION OF CULTURE MEDIA	166
APPENDIX III	COMPOSITION OF AGAR MEDIA USED TO DETERMINE THE EFFECT OF PH ON GROWTH RATE	170
APPENDIX IV	METHOD USED TO CALCULATE BLOTTER MOISTURE LEVEL	171

CONTENTS continued

APPENDIX V	SEED TRANSMISSION OF FUNGAL PATHOGENS IN COMMERCIAL LUCERNE SEED	172a
APPENDIX VI	CALCULATION OF LINEAR REGRESSION LINE FROM DATA REPRESENTING DECREASE IN INFECTION PERCENTAGE OF <u>P.MEDICAGINIS</u> AND THE RESULTING INCREASE OR DECREASE IN SEEDLING EMERGENCE	175
APPENDIX VII	THE HEAT STABILITY OF BENLATE	177
APPENDIX VIII	INVESTIGATIONS INTO PHYTOTOXICITY OF BENOMYL WHEN APPLIED AS A DUST TO THE TESTA OF LUCERNE SEED	180
BIBLIOGRAPHY		182

LIST OF TABLES

	<u>Page</u>
I. The area of lucerne grown in New Zealand utilized as hay, silage, or seed crops.	2
II. Fungal seed-borne pathogens of lucerne known to cause damping-off.	7
III. Pycnidiospore dimensions of <u>P. medicaginis</u> .	15
IV. Previously recorded pycnidiospore dimensions of <u>P. medicaginis</u> .	16
V. Influence of media type on cultural characteristics of <u>P. medicaginis</u> .	22
VI. Previous reports of the level of <u>P. medicaginis</u> associated with lucerne seed.	52
VII. The influence of blotter moisture on the expression of seed infection.	62
VIII. The effect of 0.05% sodium 2,4-D in PDA and MA on colony diameter of <u>P. medicaginis</u> .	72
IX. The effect of incorporating 0.05% 2,4-D in MA on the expression of seed infection.	74
X. The effect of penicillin and streptomycin sulphate when incorporated in MA on colony growth of <u>P. medicaginis</u> .	77
XI. The effect of incorporating streptomycin sulphate and penicillin (each at 50 p p m) in MA on the expression of seed infection.	78
XII. The effect of surface sterilizing lucerne seed on the seed infection level.	82
XIII. Effect of seed position in the agar plate on expression of <u>P. medicaginis</u> .	84
XIV. Range in level of transmission of <u>P. medicaginis</u> in seed lines examined during 1970 and 1971.	92
XV. The effect of fungicidal seed treatment on emergence of lucerne seedlings.	98

TABLES continued

XVI.	The relationship between soil temperature and the time to achieve 50% seedling emergence from thiram dusted and non-treated seed.	111
XVII.	Post-emergence damping-off attributable to <u>P.medicaginis</u> in relation to environmental temperature.	115
XVIII.	The relationship between seed colour and percentage infection with <u>P.medicaginis</u> .	138
XIX.	The relationship between seed colour and average seed weight.	138
XX.	The relationship between seed colour and percentage germination.	138a
XXI.	The effect of duration of storage on percentage infection with <u>P.medicaginis</u> and seed germination.	144
XXII.	Previous reports of fungicide application to lucerne seed for control of <u>P.medicaginis</u> .	148
XXIII.	Effect of ten fungicides on the level of <u>P.medicaginis</u> associated with lucerne seed.	149
XXIV.	The effect of benomyl on lucerne seedling characteristics.	154
XXV.	The effect of thiram on average seedling length.	155
XXVI.	The effect of incorporating benomyl and thiram into coated seed on the level of infection with <u>P.medicaginis</u> .	158

LIST OF FIGURES

	<u>Page</u>
1. The uses and respective products of lucerne.	4
2. Lucerne stem naturally infected with <u>P. medicaginis</u> .	10
3. Pycnidiospore mass exuding from pycnidium of <u>P. medicaginis</u> .	11
4. Non-septate pycnidiospores of <u>P. medicaginis</u> .	17
5. Septate pycnidiospores of <u>P. medicaginis</u> .	18
6. Colony characteristics of <u>P. medicaginis</u> .	23
7. Crystals formed by <u>P. medicaginis</u> on lab. PDA.	24
8. Effect of incubation temperature on growth of <u>P. medicaginis</u> on Oxoid PDA after 11 days in the dark.	29
9. Temperature/growth histograms of three isolates of <u>P. medicaginis</u> .	30
10. Effect of temperature on colony growth.	31
11. Growth of <u>P. medicaginis</u> on Oxoid PDA adjusted to different pH values.	34
12. Apparatus for artificial inoculation of lucerne seedlings with <u>P. medicaginis</u> .	37
13. Method used to provide conditions of high humidity to lucerne plants.	42
14. Symptoms expressed by lucerne seedlings following artificial inoculation agar/mycelium block.	43
15. Symptoms expressed on lucerne leaves following artificial inoculation with <u>P. medicaginis</u> .	44
16. Symptoms on lucerne leaves artificially inoculated with <u>P. medicaginis</u> .	45
17. Symptoms on lucerne leaves (A) and stems (B) naturally infected with <u>P. medicaginis</u> .	46,47
18. Copenhagen germinator used for routine moist blotter tests.	63

FIGURES continued

19. Pyenidia and hyphae of P. medicaginis on testa of lucerne seed. 66
20. The effect of various concentrations of sodium 2,4-D in PDA on colony growth of P. medicaginis. 71a
21. Development of fungal colonies from lucerne seed placed on the surface of MA with penicillin and streptomycin sulphate added. 87
22. Graph illustrating the effect of thiram seed treatment on seedling emergence. 101
23. Rate of seedling emergence (lines OL259, d259, OL263, OL38, OL181, OL272, OL173, OL266, OL175). 104
24. Rate of seedling emergence (6 C, 10 C, 14 C, 17 C, 20 C, 25 C). 113
25. Radicle lesioning consequent on contact between an infected testa and the radicle in the early stages of germination. 120
26. Radicle lesioning consequent on retention of the testa (site of seed infection) by the radicle. 121/122
27. Hypocotyl lesioning with inoculum provided by an unshed testa. 123/124
28. Cotyledon lesions consequent on infection by mycelium growing from an unshed testa. 126
29. Design of glass-faced plastic seed-boxes used to enable close observation of symptoms on diseased seedlings. 127
30. Infection of hypocotyl by P. medicaginis. 130a
31. Close-up view of hypocotyl lesion commonly observed in moist blotter tests. Note elongated nature of the lesions. 125
32. Infection of radicle by P. medicaginis. 130b
33. Rate of seedling emergence (pale and dark seed of seed lines OL175, OL259 and OL263). 139

FIGURES continued

34.	Pale and dark coloured lucerne seed.	140
35.	Development of <u>P.medicaginis</u> from pale and dark seed.	140
36.	Effect of concentration of benomyl on radial growth of <u>P.medicaginis</u> .	151
37.	Seed layout on moist blotter.	172
38.	The effect of incorporating benomyl into MA prior to autoclaving for 20 minutes at 121.5 C on growth of <u>P.medicaginis</u> .	178
39.	The relative heat stability of benomyl when incorporated in MA.	179
40.	Rate of seedling emergence (line OL175).	181

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).

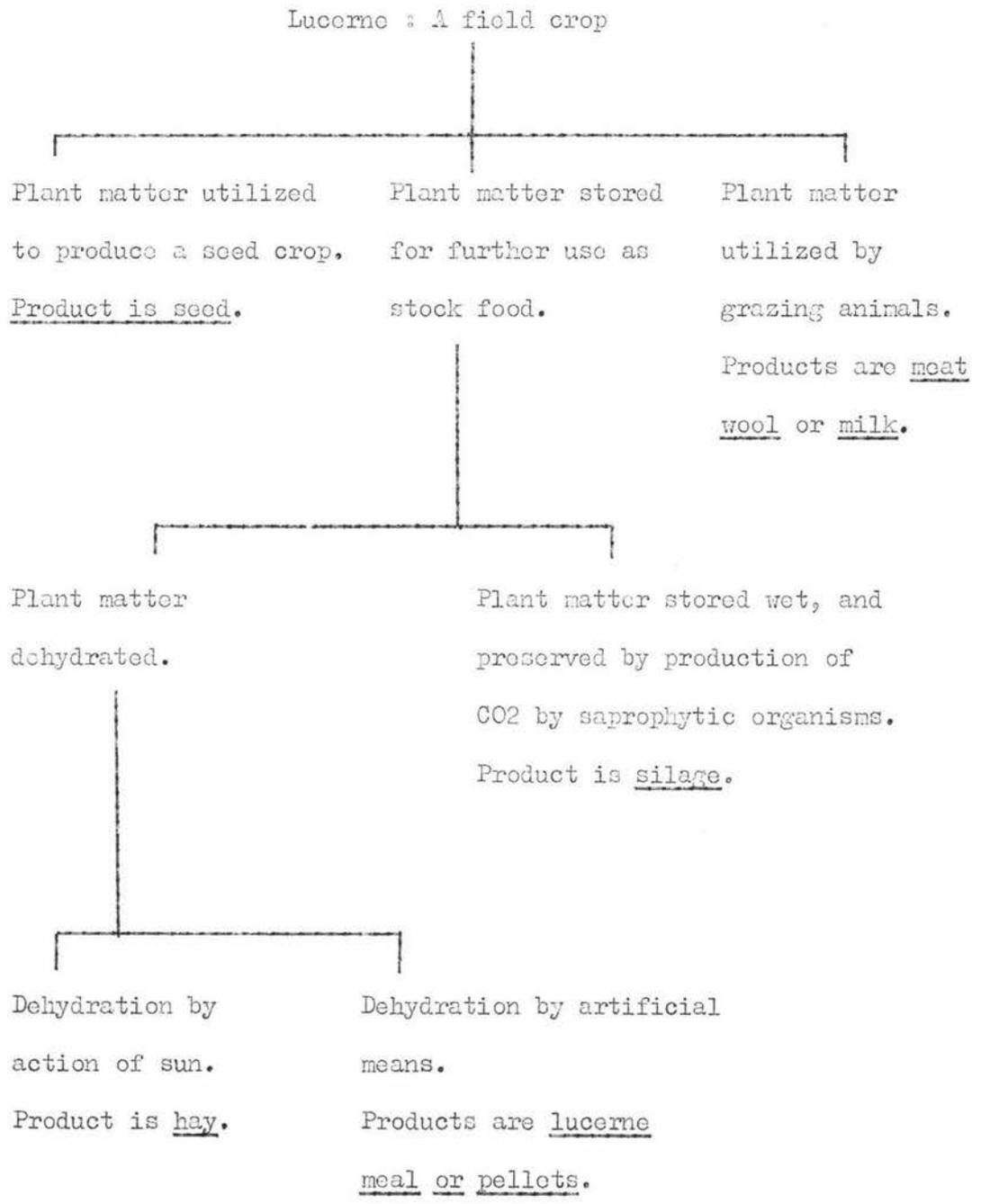
Table 1. The area of lucerne grown in New Zealand utilized as hay, silage or seed crops.

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.
<u>Botrytis cinerea</u> Pers. ex Fries.	Zukopal <u>et al.</u> , 1966.
<u>Colletotrichum trifolii</u> Bain & Essary	Weber, 1952. Roberts <u>et al.</u> , 1959.
<u>Fusarium</u> spp.	Leach, C.H., 1960. Hofer and Grosier, 1962.
<u>Phoma medicaginis</u>	Cormack, 1945. Kornkamp and Hemerick, 1953. Mead, 1953.
<u>Stemphylium botryosum</u> Wallr.	Leach, C.H., 1960. Nelson, 1955.
<u>Sclerotinia trifoliorum</u> Drayton and Groves.	Leach, C.H., 1960. Cormack, 1946.