

**THE BIOHERBICIDAL POTENTIAL OF THE SEED-
BORNE PATHOGEN *PYRENOPHORA SEMENIPERDA*
FOR CONTROL OF ANNUAL GRASS WEEDS IN
CEREAL CROPS**

BY

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DECLARATION OF ORIGINALITY

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree.

I certify that to the best of my knowledge, any help in preparing this thesis and all sources used have been acknowledged in this thesis.



Mathew A. Campbell

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ABSTRACT

Annual grass weeds are a major limitation to cereal production throughout the world and reproduce and spread only by the production of seed. One strategy for the control of annual grass weeds may be the inundative application of indigenous seed-borne pathogens as mycoherbicides to curb seed production and therefore re-infestation. A feasibility study was undertaken to investigate the potential of the seed-borne pathogen *Pyrenophora semeniperda* for bioherbicidal control of the grass weed *Bromus diandrus*.

The requirements for optimal growth and sporulation were defined. Growth and sporulation were optimal at 23.2 °C and 19.2 °C respectively when grown on modified alphacel medium with a pH of between 4.7 and 5.7. *P. semeniperda* required mycelial wounding and an alternating light/dark sequence for best sporulation with light wavelengths shorter than 500 nm.

The variation in growth and sporulation of isolates of *P. semeniperda* was investigated after using single-spore and mass transfer isolation techniques and storage. Some variation occurred but was attributed to chance and not genetic make-up. Conidia stored in aqueous suspension retained viability and pathogenicity for three months.

P. semeniperda was shown to produce toxic metabolites under *in vitro* conditions. Using a bioassay which used coleoptile and radicle length as an assay of toxicity, it was shown that filtrates of *P. semeniperda* cultures had a severe impact on seedling growth of both wheat and *B. diandrus*. Infiltration of leaves with culture filtrates resulted in symptoms similar to those produced by conidial inoculation.

The infection process of *P. semeniperda* on seedling and adult leaves of wheat and *B. diandrus* and floral tissue of wheat was investigated. Appressoria were formed as an essential component of the infection process on leaf material but not on floral tissue. Resistance to infection was associated with the formation of papillae. Infection hyphae ramified intercellularly in spaces of the mesophyll in leaf material and within the confines of the epidermis and integuments of developing caryopses.

The environmental and physical factors influencing infection of wheat leaves and florets and *B. diandrus* leaves tested were dew period temperature, dew period duration, light requirements during the dew period and physiological age of host. The optimum temperature

for lesion development on wheat leaves was $20.6 \pm 0.3^{\circ}\text{C}$, whilst the optimum for infection of developing wheat caryopses was $23.6 \pm 0.6^{\circ}\text{C}$. A dew period of 21 h and 48 h duration was required for maximal infection of wheat leaves and seeds respectively. An initial dark phase during the dew period was a requirement for infection of wheat and *B. diandrus* leaves. Infection of wheat seeds occurred at all stages of inflorescence development tested with a maximal proportion when inflorescences were inoculated at the end of anthesis (GS 70).

The infection of field grown and inoculated grass species was investigated in three trials in Armidale, NSW and one in Orange, NSW. In one trial 73 % of *B. diandrus* seeds were infected by the fungus. Several different inoculum types were trialed. Application of conidia resulted in the greatest level of infection and application of mycelium resulted in moderate levels of infection. *P. semeniperda* was able to infect a variety of annual grass species under field conditions.

TABLE OF CONTENTS

Title	
Declaration of Originality	i
Acknowledgements	ii
Abstract	iv
CHAPTER ONE: INTRODUCTION	1
1.1 Biological Control of Weeds with Plant Pathogens	2
1.1.1 The classical approach	2
1.1.2 The inundative approach	3
1.1.3 Integration of bioherbicides with conventional control measures	7
1.2 Annual Grass Weeds in Cereal Crops	9
1.2.1 Annual grass weeds and the Australian winter cereal industry	9
1.2.2 Competitive effects of annual grass weeds	12
1.2.3 Control of annual grass weeds in cereal crops- a brief account	14
1.2.4 Seed kill as a strategy to control annual grass weeds in cereal crops	17
1.2.5 The potential of seed-borne pathogens as biocontrol agents	20
1.3 <i>Bromus diandrus</i> and the Seed Pathogen <i>Pyrenophora semeniperda</i> as a Model to Study the Potential of Seed-Borne Pathogens for Control of Annual Grasses	24
1.3.1 The use of <i>Bromus diandrus</i> as a tool for research of annual grass weeds	24
1.3.2 Nomenclature and distribution of <i>Pyrenophora semeniperda</i>	25
1.3.3 Host range and symptoms of infection	26
1.3.4 Objectives of this study	27
CHAPTER TWO: GENERAL MATERIALS AND METHODS	31
2.1 Maintaining Cultures of Pathogens	31
2.1.1 Source, storage, maintenance and identity of isolates	31
2.1.2 Preparation of media and cultures	32
2.2 Maintenance of Host Material	33
2.2.1 Source of seed	33

2.2.2	Plant production	33
2.3	Inoculum Production	33
2.4	Inoculation and Incubation Techniques	35
2.5	Disease Assessment	35
2.5.1	Lesion development	35
2.5.2	Seed infection	36
2.6	Statistical Analyses	37
CHAPTER THREE: GROWTH AND SPORULATION OF <i>PYRENOPHORA SEMENIPERDA</i> CULTURED <i>IN VITRO</i>		38
3.1	Introduction	38
3.2	Materials and Methods	39
3.2.1	Effect of culture medium on growth and sporulation	40
3.2.2	Effect of temperature on growth, sporulation conidial germination and conidial germinability	40
3.2.3	Effect of pH on growth and sporulation	41
3.2.4	Effect of photoperiod on growth and sporulation	42
3.2.5	Effect of light quality on growth and sporulation	42
3.2.6	Growth and sporulation in liquid culture	43
3.2.7	The effect of wounding on sporulation	44
3.2.8	Integrated optima for mass production of conidia	44
3.3	Results	45
3.3.1	Effect of culture medium on growth and sporulation	45
3.3.2	Effect of temperature on growth, sporulation conidial germination and conidial germinability	47
3.3.3	Effect of pH on growth and sporulation	50
3.3.4	Effect of photoperiod on growth and sporulation	52
3.3.5	Effect of light quality on growth and sporulation	52
3.3.6	Growth and sporulation in liquid culture	53
3.3.7	The effect of wounding on sporulation	55
3.2.8	Integrated optima for mass production of conidia	55
3.4	Discussion	56
3.5	Summary	65

CHAPTER FOUR: HOMOGENEITY AND PATHOGENICITY OF MONOCONIDIAL CULTURES		
OF <i>PYRENOPHORA SEMENIPERDA</i>		66
4.1	Introduction	66
4.2	Materials and Methods	68
4.2.1	Colony variation when using different transferral techniques	68
4.2.2	Growth and sporulation of monoconidial isolates	69
4.2.3	Growth and sporulation of monoconidial isolate progeny	69
4.2.4	Cultural variation and pathogenicity after storage	69
4.2.5	Effect of culture age on conidial germination and pathogenicity	70
4.3	Results	70
4.3.1	Colony variation when using different transferral techniques	70
4.3.2	Growth and sporulation of monoconidial isolates	71
4.3.3	Growth and sporulation of monoconidial isolate progeny	71
4.3.4	Cultural variation and pathogenicity after storage	71
4.3.5	Effect of culture age on conidial germination and pathogenicity	72
4.4	Discussion	73
4.5	Summary	76
CHAPTER FIVE: THE PRODUCTION OF TOXIC METABOLITES BY <i>PYRENOPHORA SEMENIPERDA</i> IN VITRO, AND POSSIBLE ROLES IN PATHOGENESIS		77
5.1	Introduction	77
5.2	Materials and Methods	81
5.2.1	Initial investigations	82
5.2.2	Toxicity of culture filtrates derived from different isolates of <i>P. semeniperda</i>	83
5.2.3	Correlation between disease severity in the glasshouse and reaction to toxic filtrates	83
5.2.4	Toxin production in relation to culture age	84
5.2.5	Relationship between filtrate toxicity and pH	84
5.2.6	Effect of filtrate concentration on toxic reaction type	84
5.2.7	Effect of filtrates at different plant growth stages	85
5.2.8	Host specificity of culture filtrates	85

5.2.9	A comparison of the toxicity of filtrates produced by <i>P. semeniperda</i> and <i>P. teres</i>	85
5.3	Results	86
5.3.1	Initial investigations	86
5.3.2	Toxicity of culture filtrates derived from different isolates of <i>P. semeniperda</i>	87
5.3.3	Correlation between disease severity in the glasshouse and reaction to toxic filtrates	89
5.3.4	Toxin production in relation to culture age	91
5.3.5	Relationship between filtrate toxicity and pH	93
5.3.6	Effect of filtrate concentration on toxic reaction type	94
5.3.7	Effect of filtrates at different plant growth stages	95
5.3.8	Host specificity of culture filtrates	95
5.3.9	A comparison of the toxicity of filtrates produced by <i>P. semeniperda</i> and <i>P. teres</i>	96
5.4	Discussion	96
5.5	Summary	100

CHAPTER SIX: INFECTION OF WHEAT AND *BROMUS DIANDRUS* BY *PYRENOPHORA*

	<i>SEMENIPERDA</i> : THE INFECTION PROCESS	102
6.1	Introduction	102
6.2	Materials and Methods	103
6.2.1	The infection process on leaves	103
6.2.2	The infection process on floral tissue	104
6.3	Results	105
6.3.1	The infection process on leaves	105
6.3.2	The infection process on floral tissue	107
6.4	Discussion	108
6.5	Summary	123

CHAPTER SEVEN: INFECTION OF WHEAT BY <i>PYRENOPHORA SEMENIPERDA</i> : SOME FACTORS INFLUENCING INFECTION	125
7.1 Introduction	125
7.2 Materials and Methods	126
7.2.1 Dew period temperature	126
7.2.2 Dew period	127
7.2.3 Light requirements during the dew period	127
7.2.4 Effect of different pre- and post-inoculation temperatures on disease development	128
7.2.5 Effect of inflorescence age on seed infection	128
7.2.6 Effect of seed inoculation on growth of host plants	128
7.2.7 Timing of inoculation of wheat plants with respect to growth stage and subsequent disease development	129
7.3 Results	129
7.3.1 Dew period temperature	129
7.3.2 Dew period	132
7.3.3 Light requirements during the dew period	134
7.3.4 Effect of different pre- and post-inoculation temperatures on disease development	136
7.3.5 Effect of inflorescence age on seed infection	136
7.3.6 Effect of seed inoculation on growth of host plants	137
7.3.7 Timing of inoculation of wheat plants with respect to growth stage and subsequent disease development	137
7.4 Discussion	138
7.5 Summary	144
CHAPTER EIGHT: A FIELD EVALUATION OF <i>P. SEMENIPERDA</i> AS A SEED-BORNE BIOHERBICIDE	146
8.1 Introduction	146
8.2 Materials and Methods	147
8.2.1 Preliminary field trial 1992/93 season	149
8.2.2 Trials of different inoculum types	150

8.2.3	Inoculation of six grass species	150
8.3	Results	151
8.3.1	Preliminary field trial 1992/93 season	151
8.3.2	Trials of different inoculum types	153
8.3.3	Inoculation of six grass species	155
8.4	Discussion	156
8.5	Summary	160
CHAPTER NINE: GENERAL DISCUSSION		161
9.1	Conclusion	167
LITERATURE CITED		168
APPENDIX 1 FUNGAL CULTURE MEDIA		191
APPENDIX 2 PREPARATION OF MATERIAL FOR MICROSCOPY		197
APPENDIX 3 INFLORESCENCE MAPS		198
APPENDIX 4 STANDARD ERRORS OF DATA IN CHAPTER EIGHT		201
PUBLICATIONS ARISING FROM THIS STUDY		204