Host Range, Distribution and Importance of the Fungus *Pyrenophora semeniperda* (Brittlebank & Adam) Shoemaker (Ascomycotina: Pyrenomycetes) in Australia

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A field survey of *Pyrenophora semeniperda* (Brittlebank & Adam) Shoemaker, undertaken throughout southern Australia from 1984 to 1986, confirmed its widespread and common occurrence and provided additional information on the host range, geographic distribution and economic importance. The fungus was isolated from 12 of the 26 previously known host genera and an additional seven new genera, all in the family Poaceae. The survey extended the known geographic range of the organism northward and eastward in Western Australia besides adding many new location records within the known range in south-eastern Australia. In New South Wales, the fungus was found only south of Lat. 32°S. Some implications of its wide host range and geographic distribution are discussed together with factors which indicate that the fungus is of negligible economic importance on winter cereals, particularly wheat, either as a leaf spotting or seedling blight organism or as a seed pathogen.

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INTRODUCTION

Pyrenophora semeniperda (Brittlebank & Adam) Shoemaker, the teleomorph of *Drechslera campanulata* (Lév.) Sutton (see Sivanesan, 1987 for synonymy) was described originally as *Angiopoma campanulatum* Lév., from seed of *Bromus sterilis* L. collected at Versailles, France (Léveillé, 1841). Brittlebank and Adam (1924) gave a detailed description of the fungus and of early Australian records, noting that it had been isolated from *Bromus sterilis* in 1899, from wheat in 1913 and that the anamorph had been found on seed of *Avena fatua* L. collected at Ardmona in 1898. Since 1924 the fungus has been recorded throughout southern regions of the continent on a wide range of grasses, including wheat, oats, rye and barley, and some dicotyledonous species (Butler, 1961; Smith, 1965; Walker, 1967; Khan *et al.*, 1968; Shivas, 1989). The fungus also occurs in North America, New Zealand, South Africa and has been recorded once from Europe, as detailed in an annotated checklist of its worldwide host range compiled by Medd (1992).

The fungus is known as a seed pathogen (O'Gara, 1915; Wallace, 1959; Shoemaker, 1966), and has been implicated in seedling blight of a range of grasses including the winter cereals. In addition it has been associated with leaf spotting (Drechsler, 1923; Carne, 1927; Smith, 1965) and leaf stripe symptoms (Carne, 1927) on several grasses.

This paper reports the findings of a survey in Australia undertaken to provide an updated account of the host range and geographic distribution of the disease, and discusses its economic significance.

MATERIALS AND METHODS

Between 1984 and 1986 areas throughout most wheat growing regions in southern Australia were surveyed during late winter and spring for the disease. The survey extended throughout Western Australia (W.A.), South Australia (S.A.), Victoria (Vic.) and New South Wales (N.S.W.), but did not include Tasmania (Tas.) or Queensland (Qld.) since the disease has not been recorded in those states (Sampson, 1989 pers. comm.; Alcorn, 1983 pers. comm.). Grass plants on roadsides and in adjacent crops displaying leaf spot lesions were collected, dried in plant presses and recorded along with physiographical data for the location. Seed or litter material was not generally collected, although some isolates emanated from submissions of such material to our laboratory. Dicotyledonous species were not surveyed.

Host specimens were identified, where necessary, by the National Herbarium of N.S.W. and are held at our laboratory. A number of immature plant specimens lacking reproductive structures remain unidentified.

Leaf spot lesions caused by *P. semeniperda* are non-specific so the fungus must be identified by isolation. Senescent or green leaves (when available) were surface sterilized by immersing for about 5 seconds in a 1% solution of sodium hypochlorite and then washed for approx. two minutes in sterile distilled water. The fungus was isolated by placing sections containing lesions onto the surface of potato dextrose agar (PDA) in petri dishes and incubated at 20°C under fluorescent light. Isolations were purified by subculturing onto fresh plates of PDA, incubated as above, identified and maintained on slopes in screw-capped bottles under refrigeration. A selection of *P. semeniperda* isolates has been lodged as dried cultures with the NSW Agriculture Plant Pathology Branch Herbarium (DAR), Rydalmere. Details of collections, which have been recorded in a computer data base, are outlined in the Appendix.

Results and Discussion

Host Range

P. semeniperda has a wide host range in Australia, having previously been recorded on 24 grass genera (Table 1). The incidence on twenty of these genera is thus far confined to Australia, and it is known to occur on *Avena*, *Bromus*, *Danthonia* and *Triticum* in other countries as well as Australia. In addition, it has been recorded on *Agropyron* and *Trisetum* in North America and on the dicotyledonous genera *Daucus*, *Goodenia*, *Hedypnois* and *Hypochoeris* in Australia (Smith, 1965) and *Tragopogon* in N. America (Cooke and Shaw, 1952).

The field survey of 635 grass samples collected throughout W.A., S.A., Vic. and N.S.W. yielded 176 isolates of *P. semeniperda*, ranging over 19 genera in all five sub-families of Poaceae plus seven isolates from unidentified hosts (Table 1). Isolations spanned 12 of the 26 grass genera known to be hosts prior to this survey, and an additional seven new genera, *Brachypodium*, *Chloris*, *Cynodon*, *Cynosurus*, *Dichelachne*, *Panicum* and *Paspalum*. One of the specimens, isolated from *Agropyron*, represented the first Australian record for that genus.

Host grasses encompassed a number of summer growing perennials and many natives. The most frequently encountered hosts, however, were exotic winter annual species within the sub-family Pooideae, which includes the winter cereals. This result is biased because the survey concentrated on crops and their associated flora. Consequently, higher incidence on particular genera cannot be construed as an indication of preferred hosts. However, there tended to be agreement between the frequency of isolations made from *Avena*, *Bromus*, *Danthonia*, *Hordeum*, *Lolium*, *Phalaris* and *Triticum* in the survey, and its previous incidence on those hosts. The fungus had continental distribution on most host genera examined, but was only isolated from plants of *Danthonia* collected from south-eastern regions (Table 1, Fig. 1).

In the field there were circumstantial indications that host specific adaptations occurred within the fungus, and in some instances these appeared to be absolute. For example, healthy susceptible hosts often coexisted within infected crops; in another instance, unaffected wheat plants grew adjacent to a heavily infected rogue barley plant. Also, crops often remained uninfected despite being adjacent to a mix of infected annual grasses. Variation in the extent of the disease even existed among cohabiting species encountered on the margin of infected crops. Whilst these observations indicated that pathogenic variation in the fungus may occur, more detailed host range studies with a selection of isolates is needed before this can be demonstrated.

Geographic Distribution

This survey, which concentrated on wheat growing areas, confirmed the widespread distribution of the fungus in all major temperate cropping regions throughout mainland Australia except northern N.S.W. and Qld. (Fig. 1). Some of the new and existing records from coastal and arid regions show, however, that the organism is not confined to the wheat belt. In W.A., the known range of the fungus was extended northward and eastward of previous records. The survey also verified the widespread occurrence of the fungus in S.A., where it was reputedly common but where few validated records existed. Within Vic. and N.S.W., additional records from the survey coincided with the known range of the fungus.

The fungus was not isolated from any of the 143 leaf spotted plant samples collected north of Dubbo/Narromine (Lat. approx. 32°S.) in the eastern wheat belt (Fig. 1), indicating a possible limit to its distribution. This proposition is supported by previous accession records; these reveal that the fungus has only once been recorded from just north of that zone — from near Quirindi, on *Festuca arundinacea* Schreb. In contrast to these findings, Murray and Brown (1987) subjectively assessed that *P. semeniperda* occurs in localized areas on wheat in most seasons in northern N.S.W. Considering that only one record from the southern part of the region exists and that no specimens resulted from the present survey, Murray and Brown's report must be questioned.

Given that the fungus is common throughout the southern wheat belt, it is highly unlikely for inoculum not to have been spread north of the purported boundary. Host availability is likewise unlikely to be limiting distribution since there is considerable overlap in the range of known host species across these regions. Furthermore, delimitation of the fungus cannot be attributed to simple climatic variables. For instance, the organism occurs over a wide range of rainfall zones, from cool temperate regions e.g. Orange, N.S.W. with around 1000 mm annual rainfall to semi-arid regions such as Wilpena, S.A. and Kalgoorlie, W.A. with an annual rainfall of 378 mm and 250 mm respectively. Any suggestion of the north-eastern boundary being defined by day length can probably also be discounted since the organism occurs at more northerly latitudes (Lat. 27°42′S) in the west of the continent. However, the distribution depicted in Fig. 1 does coincide closely with that of the predominately winter-spring rainfall or Mediterranean-type climatic zone (Dell *et al.*, 1986). The north-eastern boundary falls roughly west of the $<$ 350 mm winter, and east of the $>$ 300 mm summer rainfall isohyets calculated by Nix (1975). Temperature, like absolute rainfall or seasonal rainfall patterns, is by itself unlikely to determine distribution; but all three factors probably combine to subtly influence seasonal dew periods, or the synchronization of fungal and plant life cycles critical for complete disease development.

The dichotomy in distribution between northern and southern N.S.W. is not unique to *P. semeniperda*, or indeed to fungi. *Mycosphaerella graminicola* (Fuckel) Schroeter, and *Leptosphaeria nodorum* Muller, for example, are important wheat diseases of southern Australia that are uncommon in the north-eastern wheat belt, whereas it is the reverse for the nematode *Pratylenchus thornei* Sher & Allen (Murray and Brown, 1987).

TABLE 1

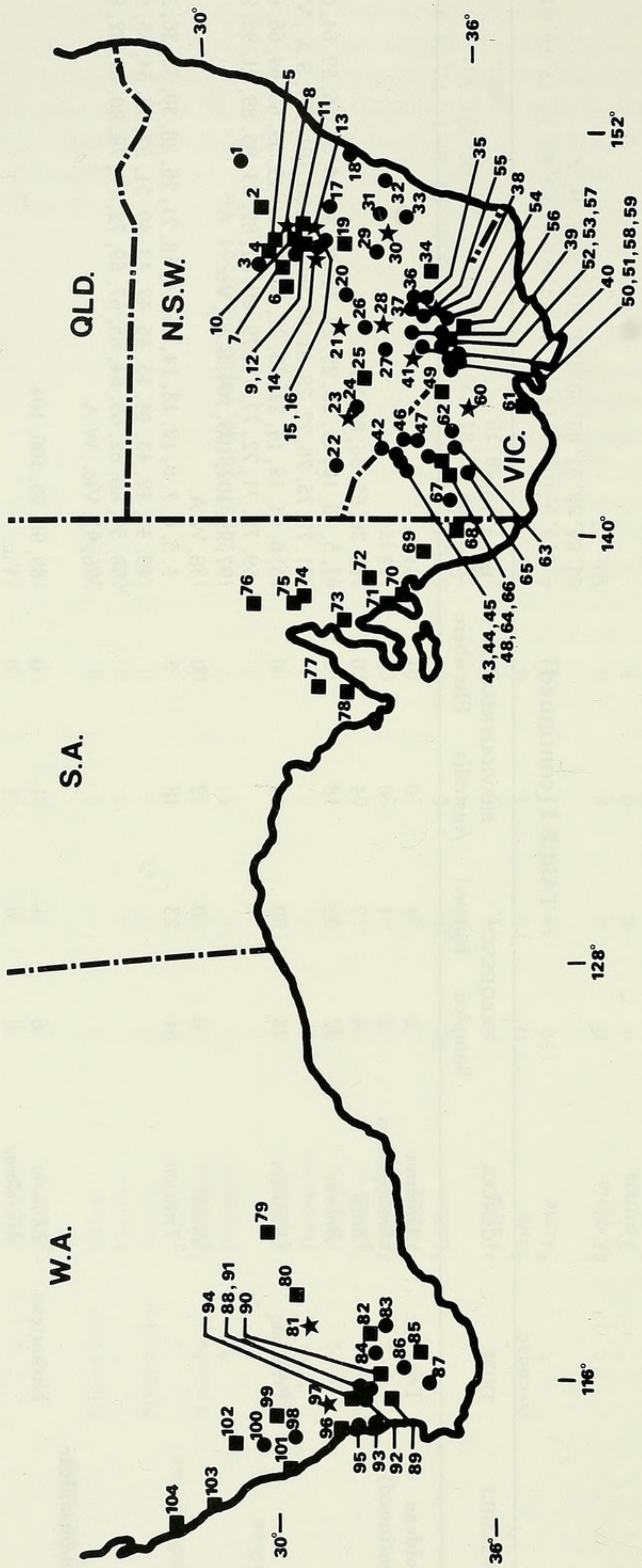
Incidence of Pyrenophora semeniperda *on members of Poaceae surveyed in Australia along with all previous records, organized by sub-families and tribes (Wheeler* et al., *1982)*

SUB-FAMILY	TRIBE	[1]GENERA	FREQUENCY Sampled	Isolated	PREVIOUS RECORDS Australia	Elsewhere	LOCATIONS (See Fig. 1)
Panicoideae							
	Paniceae	*Echinochloa*	0	0	1	0	Vic.
	"	*Paspalum*	7	1	0	0	41
	"	*Panicum*	2	1	0	0	64
Eragrostoideae							
	Chlorideae	*Chloris*	4	2	0	0	28, 94
	"	*Cynodon*	7	1	0	0	60
	Sporoboleae	*Astrebla*	0	0	1	0	Vic
Arundinoideae							
	Arundineae	[2]*Cortaderia*	0	0	2	0	18
	"	*Danthonia*	24	11	6	7	19, 22, 27, 28, 30, 49, 55, 60, 61, 64, Vic.
Pooideae							
	Agrosteae	*Deyeuxia*	0	0	1	0	Vic.
	"	*Dichelachne*	1	1	0	0	34
		Polypogon	1	0	1	0	91
	Poeae	[2]*Cynosurus*	2	1	0	0	55
	"	[2]*Dactylis*	0	0	2	0	17, 37
	"	[2]*Festuca*	0	0	1	0	1
	"	[2]*Lolium*	73	32	6	0	5, 6, 11, 12, 13, 28, 36, 49, 55, 60, 64, 68, 69, 71, 72, 74, 75, 76, 77, 78, 80, 81, 82, 92, 93, 94, 97, 99, 100, 103, Vic.
	"	[2]*Vulpia*	7	2	3	0	12, 21, 27, 38, 72
	Aveneae	[2]*Aira*	0	0	1	0	Vic.
	"	[2]*Avena*	132	19	11	1	4, 5, 8, 9, 10, 11, 14, 20, 24, 31, 50, 64, 68, 69, 72, 77, 78, 81, 82, 84, 86, 91, 92, 99, 103, S.A., Vic., W.A.
	'	[2]*Koeleria*	0	0	2	0	Vic.
	"	*Trisetum*	0	0	0	1	
	Phalarideae	[2]*Anthoxanthum*	6	0	1	0	Vic.
	"	[2]*Phalaris*	11	4	7	0	34, 35, 37, 56, 59, 64, 81, 98

TABLE 1 (continued)

SUB-FAMILY	TRIBE	[1]GENERA	FREQUENCY Sampled	FREQUENCY Isolated	PREVIOUS RECORDS Australia	PREVIOUS RECORDS Elsewhere	LOCATIONS (See Fig. 1)
Pooideae (continued)	Triticeae	*Agropyron*	2	1	0	1	34
	"	[2]*Brachypodium*	2	1	0	0	73
	"	[2]*Briza*	4	2	4	0	15, 30, 55, 56, 88, Vic.
	"	*Bromus*	82	29	18	9	3, 5, 15, 16, 21, 23, 25, 27, 32, 36, 38, 50, 55, 56, 59, 64, 68, 71, 72, 75, 76, 77, 78, 81, 82, 90, 91, 100, 101, 104, S.A., Vic.
	Triticeae	[2]*Hordeum*	73	39	18	0	5, 6, 11, 12, 14, 21, 25, 27, 28, 30, 41, 49, 59, 60, 64, 66, 68, 69, 70, 71, 72, 77, 78, 79, 80, 81, 82, 83, 85, 89, 91, 92, 94, 97, 99, 102, 103, 104, S.A., Vic.
	"	[2]*Secale*	0	0	2	0	38, W.A.
	"	[2]*Triticum*	54	23	48	3	4, 5, 6, 7, 8, 12, 13, 14, 15, 16, 18, 21, 26, 28, 30, 33, 36, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 55, 57, 58, 59, 60, 62, 63, 64, 65, 67, 69, 72, 77, 78, 80, 81, 82, 87, 96, 97, Vic., W.A.
Bambusoideae							
	Ehrharteae	[2]*Ehrharta*	6	4	1	0	69, 90, 95, 100, 104
	"	*Microlaena*	0	0	1	0	Vic.
	Stipeae	*Stipa*	14	2	1	0	27, 30, 56
	Oryzeae	*Oryza*	0	0	1	0	26
Unclassified	—	—	89	7	—	—	2, 5, 29, 30, 59, 61, 82

[1] Other genera collected in the survey yielding negative results were: *Agrostis* (5), *Amphibromus* (1), *Dicanthium* (2), *Enteropogon* (1), *Holcus* (16), *Poa* (2), *Setaria* (1) and *Themeda* (1). Numbers of samples collected in parentheses.
[2] Genera which are entirely exotic to Australia.


QLD.
N.S.W.
S.A.
W.A.
VIC.
30°
36°
152°
140°
128°
116°

Why the fungus has not been recorded from Tasmania is perplexing. Failure to observe the fungus is an unlikely possibility since it produces conspicuous stroma when present in germinating seed. Geographic isolation from a source of inoculum is a further unlikely explanation given that there are no quarantine restrictions on the importation of seed or other plant matter contaminated with the fungus. Climatic factors are also unlikely to be limiting its occurrence. Being at more southerly latitudes, the island's temperate climate differs, but not too dissimilarly, from parts of the mainland and is akin to areas of New Zealand where the fungus occurs (Sheridan, 1977; Hampton and Matthews, 1978).

Economic Significance

No serious losses from the fungus have been reported in Australia from any of the types of damage it may cause. The various manifestations of the fungus could cause either poor crop establishment, through effects on germination or seedling vigour, or reduce grain yields through damage to leaves.

The first reports of *P. semeniperda* causing a problem involved destruction of seeds along with seedling blight of wheat in North America and Australia (O'Gara, 1915; Brittlebank and Adam, 1924). This was of particular importance at that time since

Fig. 1. Locations (numbered in the key below) from where *Pyrenophora semeniperda* had previously been recorded (•), was newly recorded in this survey (■) or had previously been recorded with additional records from this survey (*).

1. Quirindi	2. Dunedoo	3. Trangie
4. Narromine	5. Dubbo	6. Condobolin
7. Trundle	8. Wellington	9. Parkes
10. Cumnock	11. Molong	12. Manildra
13. Orange	14. Forbes	15. Murga
16. Canowindra	17. Bathurst	18. Sydney-Dural, Kenthurst
19. Cowra	20. West Wyalong	21. Weethalle
22. Pooncarie	23. Oxley	24. Maude
25. Hay	26. Leeton	27. Coleambally
28. Narrandera	29. Binalong	30. Yass
31. Gurrundah	32. Kangaroo Valley	33. Bungendore
34. Tumbarumba	35. Holbrook	36. Cookardinia
37. Culcairn	38. Walla Walla	39. Oaklands
40. Berrigan	41. Finley	42. Manangatang
43. Sea Lake	44. Banyan	45. Hopetoun
46. Quambatook	47. Glenloth	48. Corack
49. Echuca	50. Ardmona	51. Pine Lodge
52. Tungamah	53. Esmond	54. Rutherglen
55. Albury	56. Milawa	57. Cosgrove
58. Goomalibee	59. Shepparton	60. Bendigo
61. Geelong	62. Inglewood	63. Bears Lagoon
64. Donald	65. Horsham	66. Dimboola
67. Winiam	68. Bordertown	69. Coonalpyn
70. Strathalbyn	71. Adelaide-Glen Osmond	72. Angaston
73. Crystal Brook	74. Peterborough	75. Orroroo
76. Wilpena	77. Kimba	78. Cleve
79. Kalgoorlie	80. Southern Cross	81. Merredin
82. Corrigin	83. Kulin	84. Bullaring
85. Katanning	86. Wagin	87. Muradup
88. Dale	89. Boddington	90. Brookton
91. Beverley	92. Avondale	93. Serpentine
94. York	95. Perth-Carlisle	96. Muchea
97. Goomalling	98. Moora	99. Caron
100. Cervantes	101. Three Springs	102. Morawa
103. Northampton	104. Kalbarri	

continuous cropping relied on the voluntary re-establishment of wheat. The seed rot problem apparently persisted in N. America, albeit rarely, at least until the late 1940's, presumably because the fungus was unaffected by organic mercury seed dressing (Wallace, 1959).

There are indications that the incidence of the fungus as a seed borne pathogen may be related to localized seasonal influences. For example, Shipton and Chambers (1966) found infestations as high as 36% among 277 samples from wheat grain silos in W.A.; the state average being approx. 3%. In contrast a survey of N.S.W. wheat grain by Shaw and Valder (1952) found little evidence of the fungus. A later study by Murray and Kuiper (1988) reported 2 to 4% incidence in weather-damaged wheat seed from southern N.S.W., although in this case its incidence may have been affected by the application of fungicidal dressings. It is unclear, however, if seed infection can be controlled with fungicides. Khan and Young (1989), for instance, found no difference between seedling emergence of untreated barley seed and that treated with a range of fungicidal dressings at a contaminated site in W.A. Damage due to seedling blight, which may likewise be suppressed by seed dressings, also appears to be of little importance. For example, plant pathogens were not implicated in the retarded early growth of wheat plants studied over several seasons in southern N.S.W. (Cornish and Lymbery, 1987), where the fungus is common. The lack of concern from industry with regard to crop establishment is a further indication that seed borne diseases, in general, cause insignificant problems in most years. However, susceptibility of the fungus to fungicidal dressings needs to be clarified to ensure that routine seed treatment practices provide adequate protection.

Farmers in southern N.S.W., Vic. and S.A. occasionally report leaf mottling of crops during early growth stages. Notwithstanding that such outbreaks have been attributed to leaf spot symptoms of *P. semeniperda*, the smallness and sparseness of lesions mostly cause insufficient leaf damage to affect later growth and grain yield (Brown, 1975; Murray and Brown, 1987; Khan, 1988; Brennan and Murray, 1989). This apparent status of the fungus as a foliar disease accords with the conclusion reached by Drechsler (1923), the first to describe leaf spots, who remarked 'The possible damage resulting to the host from the leaf spots would appear quite insignificant'.

Although the fungus currently has limited apparent importance, this may not be the case if more virulent forms appear and spread as a result of the possible host specific adaptations mentioned earlier. Given the lack of quarantine restrictions, it is also possible for more potent material to be imported. Furthermore, the fungus could become more prevalent as a result of recent changes in the cultural practices used in crop production. Burning of stubble is now discouraged and there has been a substitution of herbicides for tillage as a method of managing vegetation during fallowing. With the retention of stubble and other vegetative matter providing a more abundant source of inoculum, the fungus could proliferate. This has already occurred with other foliar (Rees, 1987) and root diseases (Rovira, 1987) of winter cereals.

Conclusion

On the basis of existing records and those of this survey, it is evident that *P. semeniperda* is a common and widespread fungus which infects a diverse range of grasses existing throughout southern Australia. It was frequently isolated from leaf spot lesions on many exotic winter annual species including winter cereal crops in the sub-family Pooideae. The fungus was not detected in northern N.S.W., and it is argued that its range in eastern Australia might be restricted by a combination of climatic factors and not by geographic isolation from inoculum or host species. Despite its apparent ubiquity throughout the wheat belt, there is little indication that the fungus is of more than minor economic importance as a seed pathogen, seedling blight or leaf spotting disease of wheat. Should the disease become more important due to a change in its virulence or levels of inoculum it is more likely to impact as a seed/seedling blight pathogen than as a leaf disease. For this reason it is desirable to establish how susceptible the fungus is to fungicides used for dressing seeds.

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Appendix

Material obtained during the field survey of Pyrenophora semeniperda

List of Specimens

[1]580469 ([2]DAR 64984), *Agropyron scabrum* var. *scabrum*, Tumbarumba NSW, 29/11/84, K. Jones; 580124, *Avena barbata*, Angaston SA, 8/11/84, R. Medd & A. Nikandrow; 580151, Bordertown SA, 9/11/84, R. Medd & A. Nikandrow; 580111, Cleve SA, 7/11/84, R. Medd & A. Nikandrow; 580143 & 580149 (DAR 62310), Coonalpyn SA, 9/11/84, R. Medd & A. Nikandrow; 580100 (DAR 62332) & 580101, Kimba SA, 7/11/84, R. Medd & A. Nikandrow; 580553, Caron WA, 19/8/86, R. Medd; 580531, Corrigin WA, 15/8/86, R. Medd; 580547, Northampton WA, 20/8/86, R. Medd; 580064 (DAR 62291), *Avena fatua*, Dubbo NSW, 17/10/84, K. Jones; 580516 (DAR 62302), Wellington NSW, 19/10/84, R. Medd; 580167, Donald SA, 9/11/84, R. Medd & A. Nikandrow; 580043, *Avena sativa*, Cumnock NSW, 17/10/84, K. Jones; 580148, Coonalpyn SA, 9/11/84, R. Medd & A. Nikandrow; 580567, Merredin WA, 19/8/86, R. Medd; 580421, *Avena* sp., Narromine NSW, 6/9/85, K. Jones; 580556, Caron WA, 19/8/86, R. Medd; 580119, *Brachypodium distachyon*, Crystal Brook SA, 7/11/84, R. Medd & A. Nikandrow; 580490 (DAR 64987), *Briza maxima*, Yass NSW, 30/11/84, K. Jones; 580448, Milawa Vic., 29/11/84, K. Jones; 580012, ex seed *Bromus arenarius*, Oxley NSW, 30/8/83, B. Semple; 580047, 580050 (DAR 62292) & 580068 (DAR 64978), *Bromus diandrus*, Dubbo NSW, 17/10/84, K. Jones; 580130, Adelaide SA, 8/11/84, R. Medd & A. Nikandrow; 580122, Angaston SA, 8/11/84, R. Medd & A. Nikandrow; 580112, Cleve SA, 7/11/84, R. Medd & A. Nikandrow; 580097, Kimba SA, 7/11/84, R. Medd & A. Nikandrow; 580087 (DAR 58948), Orroroo SA, 6/11/84, R. Medd & A. Nikandrow; 580088 (DAR 62304) & 580092, Wilpena SA, 6/11/84, R. Medd & A. Nikandrow; 580156, Bordertown Vic., 9/11/84, R. Medd & A. Nikandrow; 580163, Donald Vic., 9/11/84, R. Medd & A. Nikandrow; 580447, Milawa Vic., 29/11/84, K. Jones; 580211 & 580212 (DAR 62336), Shepparton Vic., 26/11/84, K. Jones; 580450, *Bromus hordeaceus* ssp. *hordeaceus*, Milawa Vic., 29/11/84, K. Jones; 580132, *Bromus hordeaceus* ssp. *molliformis*, Adelaide SA, 8/11/84, R. Medd & A. Nikandrow; 580127, Angaston SA, 8/11/84, R. Medd & A. Nikandrow; 580222 (DAR 62293), Shepparton Vic., 26/11/84, K. Jones; 580011, *Bromus rubens*, Hay NSW, 20/8/83, B. Semple; 580585, *Bromus* sp., Cervantes WA, 22/8/86, R. Medd; 580527 (DAR 62338) & 580538, Corrigin WA, 15/8/86, R. Medd; 580574, Merredin WA, 19/8/86, R. Medd; 580575, *Bromus sterilis*, Kalbarri WA, 21/8/86, R. Medd; 580048 (DAR 64977), *Bromus catharticus*, Dubbo NSW, 17/10/84, K. Jones; 580083, Orroroo SA, 6/11/84, R. Medd & A. Nikandrow; 580215, Shepparton Vic., 26/11/84, K. Jones; 580189 (DAR 62334), *Chloris acicularis*, Narrandera NSW, 10/11/84, R. Medd & A. Nikandrow; 580520, *Chloris truncata*, York WA, 15/8/86, R. Medd; 580246, *Cynodon dactylon*, Bendigo Vic., 27/11/84, K. Jones; 580207, *Cynosurus echinatus*, Shepparton Vic., 26/11/84, K. Jones; 580188 (DAR 64983), *Danthonia caespitosa*, Narrandera NSW, 10/11/84, R. Medd & A. Nikandrow; 580165, Donald Vic., 9/11/84, R. Medd & A. Nikandrow; 580172 (DAR 62313) & 580173 (DAR

64979), Echuca Vic., 10/11/84, R. Medd & A. Nikandrow; 580280, Geelong Vic., 27/11/84, K. Jones; 580242 & 580260, *Danthonia duttoniana*, Bendigo Vic., 27/11/84, K. Jones; 580205 (DAR 62328) & 580208, *Danthonia linkii*, Albury NSW, 26/11/84, K. Jones; 580502, Cowra NSW, 30/11/84, K. Jones; 580491 (DAR 64988), Yass NSW, 30/11/84, K. Jones; 580474 (DAR 64985), *Dichelachne micrantha*, Tumbarumba NSW, 29/11/84, K. Jones; 580150, *Ehrharta calycina*, Coonalpyn SA, 9/11/84, R. Medd & A. Nikandrow; 580526, Brookton WA, 15/8/86, R. Medd; 580582, *Ehrharta longiflora*, Cervantes WA, 22/8/86, R. Medd; 580577, Kalbarri WA, 21/8/86, R. Medd; 580554, *Hordeum glaucum*, Caron WA, 19/8/86, R. Medd; 580540, Kalgoorlie WA, 18/8/86, R. Medd; 580598, Katanning WA, 4/9/86, R. Medd; 580552, Morawa WA, 19/8/86, R.Medd; 580544 (DAR 62339), Southern Cross WA, 18/8/86, R. Medd; 580601, York WA, 4/9/86, R. Medd; 580193 (DAR 58952), *Hordeum hystrix*, Narrandera NSW, 10/11/84, R. Medd & A. Nikandrow; 580254, Bendigo Vic., 27/11/84, K. Jones; 580174 (DAR 64980), Echuca Vic., 10/11/84, R. Medd & A. Nikandrow; 580218 & 580231, Shepparton Vic., 27/11/84, K. Jones; 580017 (DAR 65002), *Hordeum leporinum*, Condobolin NSW, 19/9/84, A. Nikandrow & N. Fettell; 580052, Dubbo NSW, 17/10/84, K. Jones; 580180 (DAR 62306), Finley NSW, 10/11/84, R. Medd & A. Nikandrow; 580013 (DAR 64973), Hay NSW, 18/6/83, B. Semple; 580022 (DAR 64975), Manildra NSW, 5/10/84, R. Medd & A. Nikandrow; 580036 (DAR 64976), Molong NSW, 5/10/84, R. Medd & A. Nikandrow; 580496, Yass NSW, 30/11/84, K. Jones; 580133, Adelaide SA, 8/11/84, R. Medd & A. Nikandrow; 580128, Angaston SA, 8/11/84, R. Medd & A. Nikandrow; 580110, Cleve SA, 7/11/84, R. Medd & A. Nikandrow; 580142, Coonalpyn SA, 9/11/84, R. Medd & A. Nikandrow; 580099 (DAR 62314), Kimba SA, 7/11/84, R. Medd & A. Nikandrow; 580158, Dimboola Vic., 9/11/84, R. Medd & A. Nikandrow; 580161 (DAR 62307), Donald Vic., 9/11/84, R. Medd & A. Nikandrow; 580576, Kalbarri WA, 21/8/86, R. Medd; 580566 (DAR 62312), Merredin WA, 19/8/86, R. Medd; 580549, Northampton WA, 20/8/86, R. Medd; 580533, *Hordeum* sp., Corrigin WA, 15/8/86, R. Medd; 580565, Merredin WA, 19/8/86, R. Medd; 580155 (DAR 62308), *Hordeum vulgare*, Bordertown SA, 9/11/84, R. Medd & A. Nikandrow; 580104 & 580106, Kimba SA, 7/11/84, R. Medd & A. Nikandrow; 580139, Strathalbyn SA, 9/11/84, R. Medd & A. Nikandrow; 580170 & 580171, Donald Vic., 9/11/84, R. Medd & A. Nikandrow; 580006, Boddington WA, 23/9/83, Unknown collector; 580536, Corrigin WA, 15/8/86, R. Medd; 580564, Goomalling WA, 19/8/86, R. Medd; 580152 (DAR 62309), ex seed *Lolium loliaceum*, Bordertown SA, 9/11/84, R. Medd & A. Nikandrow; 580131 (DAR 62333), *Lolium perenne*, Adelaide SA, 8/11/84, R. Medd & A. Nikandrow; 580157, Bordertown SA, 9/11/84, R. Medd & A. Nikandrow; 580079, Peterborough SA, 6/11/84, R. Medd & A. Nikandrow; 580555, Caron WA, 19/8/86, R. Medd; 580550, Northampton WA, 20/8/86, R. Medd; 580569, *Lolium perenne* x *Lolium multiflorum*, Merredin WA, 19/8/86, R. Medd; 580542, Southern Cross WA, 18/8/86, R. Medd; 580602, York WA, 4/9/86, R. Medd; 580057, 580058 (DAR 62330) & 580063, *Lolium perenne* x *Lolium rigidum*, Dubbo, 17/10/84, K. Jones; 580194 (DAR 62335), Narrandera NSW, 10/11/84, R. Medd & A. Nikandrow; 580125, Angaston SA, 8/11/84, R. Medd & A. Nikandrow; 580102, Kimba SA, 7/11/84, R. Medd & A. Nikandrow; 580084, Orroroo SA, 6/11/84, R. Medd & A. Nikandrow; 580162, Donald Vic., 9/11/84, R. Medd & A. Nikandrow; 580018 (DAR 64974), *Lolium rigidum*, Condobolin NSW, 19/9/84, A. Nikandrow & N. Fettell; 580005 (DAR 65001), ex seed, Orange NSW, 16/12/83, K. Jones; 580116, Cleve SA, 7/11/84, R. Medd & A. Nikandrow; 580240 (DAR 62298), Bendigo Vic., 27/11/84, K. Jones; 580176 (DAR 65006), Echuca Vic., 10/11/84, R. Medd & A. Nikandrow; 580053 (DAR 65005), *Lolium rigidum* x *Lolium multiflorum*, Dubbo NSW, 17/10/84, K. Jones; 580066, *Lolium* sp., Dubbo NSW, 17/10/84, K. Jones; 580020 (DAR 62303), Manildra NSW, 5/10/84, R. Medd & A. Nikandrow; 580037, Molong NSW, 5/8/84, R. Medd & A. Nikandrow; 580147, Coonalpyn SA, 9/11/84, R. Medd & A. Nikandrow; 580107, Kimba SA, 7/11/84, R. Medd & A. Nikandrow; 580089 (DAR 62331), Wilpena SA, 6/11/84, R. Medd & A. Nikandrow; 580584, Cervantes WA, 22/8/86, R. Medd; 580532 (DAR 62311), Corrigin WA, 15/8/86, R. Medd; 580561, Goomalling WA, 19/8/86, R. Medd; 580159, *Panicum prolutum*, Donald Vic., 9/11/84, R. Medd & A. Nikandrow; 580179 (DAR 64982), *Paspalum* sp., Finley NSW, 10/11/84, R. Medd & A. Nikandrow; 580475 (DAR 64986), *Phalaris aquatica*, Tumbarumba NSW, 29/11/84, K. Jones; 580459 (DAR 62301), Milawa Vic., 29/11/84, K. Jones; 580223 (DAR 62337), Shepparton Vic., 26/11/84, K. Jones; 580164, *Phalaris minor*, Donald Vic., 9/11/84, R. Medd & A. Nikandrow; 580460, *Stipa neesiana*, Milawa Vic, 29/11/84, K. Jones; 580495, *Stipa scabra*, Yass NSW, 30/11/84, K. Jones; 580016, *Triticum aestivum*, Condobolin NSW, 19/6/84, A. Nikandrow & N. Fettell; 580046, Dubbo NSW, 17/10/84, K. Jones; 580178 (DAR 64981), Finley NSW, 10/11/84, R. Medd & A. Nikandrow; 580004, Forbes NSW, 14/9/83, G. Stovold; 580009 ex seed, 580010 (DAR 62290) ex seed & 580019 (DAR 62329), Manildra NSW, 6/1/84, K. Jones; 580423, Narromine NSW, 6/9/85, K. Jones; 580007, ex seed, Trundle NSW, 15/12/83, B. Milne; 580008, ex seed, Weethalle NSW, 8/12/83, N. Markham; 580126, Angaston SA, 8/11/84, R. Medd & A. Nikandrow; 580113, Cleve SA, 7/11/84, R. Medd & A. Nikandrow; 580144, Coonalpyn SA, 9/11/84, R. Medd & A. Nikandrow; 580098, Kimba SA, 7/11/84, R. Medd & A. Nikandrow; 580241, Bendigo Vic., 27/11/84, K. Jones; 580166, Donald Vic., 9/11/84, R. Medd & A. Nikandrow; 580216, Shepparton Vic., 26/11/84, K. Jones; 580534, Corrigin WA, 15/8/86, R. Medd; 580563 (DAR 62305), Goomalling WA, 19/8/86, R. Medd; 580568 & 580572, Merredin WA, 19/8/86, R. Medd; 580579, Muchea WA, 22/8/86, R. Medd; 580545, Southern Cross WA, 18/8/86, R. Medd; 580061 & 580062, Unknown grasses, Dubbo NSW, 17/10/84, K. Jones; 580305, Dunedoo NSW, 2/9/85, K.Jones; 580422, Narromine NSW, 6/9/85, K. Jones; 580498, Yass NSW, 30/11/84, K. Jones; 580279 (DAR 62299), Geelong

Vic., 27/11/84, K. Jones; 580227, Shepparton Vic., 27/11/84, K. Jones; 580585, Cervantes WA, 22/8/86, R. Medd; 580526 & 580607, Corrigin WA, 15/8/86, R. Medd; 580129 (DAR 58949), *Vulpia bromoides*, Angaston SA, 8/11/84, R. Medd & A. Nikandrow; 580023 (DAR 65003), *Vulpia* sp., Manildra NSW, 5/10/84, R. Medd & A. Nikandrow

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[1] Laboratory accession number
[2] NSW Agriculture Plant Pathology Branch Herbarium (DAR) accession number