Control of Foliar Diseases of Field Pea in Southern Brazil

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Abstract

Field pea fits well in the grain production systems of southern Brazil, where two crops are produced annually, and has the potential to contribute to increased diversification and sustainability of the cropping systems. Foliar diseases are the main limiting factor to field pea production in this region and disease control is essential to maintain field pea productivity in this humid environment. The objective of this study was to search for suitable fungicides to reduce disease severity, particularly of Ascochyta blight and anthracnose.

Our study demonstrated that fungicide application effectively reduced disease severity and maintained yield and quality. A single application of a combination of active ingredients (pyraclostrobin and epoxiconazole) appeared to result in a synergy that proved to be the most effective treatment evaluated. Therefore, use of fungicides with other integrated disease management practices, such as early seeding and cultivar choice, should help to maintain yield and quality of field pea in southern Brazil.

Media summary

This study demonstrated that a fungicide not previously recommended for peas effectively reduced severity of symptoms and maintained yield and seed quality in high rainfall areas.

Key Words

Mycosphaerella pinodes, *Phoma medicaginis*, *Ascochyta pisi*, *Colletotrichum pisi*

Introduction

Field pea is susceptible to a number of fungal diseases, the most damaging of which is generally Ascochyta blight. This disease is usually a complex of two fungal species *Mycosphaerella pinodes* (Berk. & Blox.) and *Phoma medicaginis* var. *pinodella* (Jones) Boerema. Under some climatic conditions a third species *Ascochyta pisi* Lib., may also be involved (Hagedorn 1984). The disease complex is favored by moist conditions during plant development. In southern Brazil field pea is cultivated in a high rainfall environment and consequently suffers frequently from Ascochyta blight. Anthracnose, caused by *Colletotrichum pisi* Pat., is field pea disease which is considered of minor importance as it normally only occurs sporadically and in localized areas (Hagedorn 1984). However under climatic conditions like those of southern Brazil (frequent precipitation, high humidity, and warm temperatures) this disease may be severe. Wounding of pea plants, caused by infection by *M. pinodes* or *P. medicaginis* var. *pinodella* has been reported to facilitate infection of plants by *C. pisi*, especially on pea stems (Hagedorn 1984).

Work has been conducted at Embrapa Trigo to determine if foliar diseases of field pea can be managed by manipulating seeding date and choice of cultivar. Study of the effect of these factors on disease development will allow the development of an Integrated Disease Management (IDM) package for field pea production in southern Brazil. The objective of this study was to evaluate fungicides for their effectiveness to reduce the severity of pea diseases, particularly Ascochyta blight and anthracnose, in the humid environments of southern Brazil.

Methods

This study was conducted at sites located within 60 km distance of Passo Fundo, in the state of Rio Grande do Sul (RS) in southern Brazil (28^{0}15'S, 52^{0}24'W). Average annual rainfall is 1763 mm with 944 mm from June through November (pea growing season). The month with the lowest precipitation is usually May (~100 mm), while the highest is September (~200 mm). The highest mean monthly maximum temperature is 28.4^{0}C in January and the lowest mean minimum is 9.0^{0}C in July. Precipitation and temperature data for this study are summarized in Table 1. The soil at the experimental sites was a dystrophic dark red latosol (Haplorthox), mapping unit Passo Fundo, predominantly clay. Rolling topography combined with highly erosive rains is common in the state of Rio Grande do Sul (RS) and most of Southern Brazil. These environmental conditions favour many plant diseases.

Field experiments were established as randomized complete block design in solid blocks of field pea cv. Dileta (in 2001) and cv. Marjoret (in 2002) seeded under no-tillage during late June with a commercial seed drill adjusted for a target plant population of 80 plants/m^2. Fertilizer, including 20 kg of N/ha, was applied at seeding according to soil test. At each site the seeded area was divided into 4 replicates of 2.4 x 5 m plots in 2001, and 5 replicates of 3 x 5 m plots in 2002. In 2001, fungicide applications on the three experiments (Table 2) were made on August 21-23, (first disease symptoms, at flowering onset) followed by an identical application on September 14-17. In 2002, fungicides were applied on the two experiments either singly or in combination once at the early flowering stage of plant development and for some treatments a second fungicide application was made 19 days after the first application (Tables 3 and 4). One treatment consisted of three fungicides (mancozeb, chlorothalonil, pyraclostrobin) applied on September 26, October 3 and October 15.

Table 1. Precipitation (mm) and temperature (^{o}C) at Passo Fundo, RS, Long term average (LTA. 30 year mean) and during 2001 and 2002.

	Monthly precipitation			Mean monthly temperature		
	LTA	2001	2002	LTA	2001	2002
June	129	106	242	12.7	13.5	13.2
July	153	104	146	12.8	13.3	12.4
August	166	28	234	14.0	16.6	15.2
September	207	240	254	14.8	15.5	14.1
October	167	276	372	17.7	18.6	18.8
November	141	117	205	19.8	20.9	20.1
Total/year	963	871	1453	15.3	16.4	15.6

Source of information: http://www.cnpt.embrapa.br/agromet.htm

In 2002, ten plants per plot were evaluated at BBCH (BASF, Bayer, Ciba-Geigy and Hoechst) decimal growth stage 75 (50% of pods have reached final length, Lancashire *et al*. 1991). Two disease assessment were made, the first assessed the amount of leaf and stem tissue with disease symptoms on a 0-9 scale (0 = no symptoms, 9 = all leaves and stems covered with symptoms and necrotic tissue, Xue et al.1997), and a second assessed the amount of damage only on the lower stem of each plant, again using a 0-9 scale with 0=no symptoms (Wang 1998). Experiments were hand harvested on October 23, 2001 at Quatro Irm?os (low and higher laying areas), November 19, 2001 at Coxilha, and November 5- 6, 2002, and threshed after drying.

Results

Precipitation during the growing season was 92 mm below and 490 mm above long term average in 2001 and 2002 respectively, while monthly temperatures were 1.1 and 0.3 above the long term average respectively (Table 1). These data suggests that environmental conditions were more favorable for disease development and therefore for fungicide response in 2002 than in 2001.

Hail damage at Coxilha in 2001 reduced yields (Table 2) and increased variation leading to non significant yield and thousand seed weight (TSW) differences among treatments. No clear differences due to treatments were visible in any of the foliage and stem visual assessments in any of the three 2001 trials.

In 2002 both experiments only showed trace levels of Ascochyta blight at time of first fungicide application (early flower, decimal growth stage 61) on September 25, 2002. However, at the time of disease evaluation (October 18, 2002) Ascochyta blight infection was very high and symptoms of anthracnose were also readily observed.

Visual assessment of field plots on October 17th indicated that only one treatment at either experimental site had a consistent and marked effect on the diseases. This treatment consisted of a single application of the combined active ingredients pyraclostrobin and epoxiconazole. The application of pyraclostrobin or epoxiconazole singly did not appear to be as effective at reducing disease symptoms as the combined use of the chemicals. In Brazil, the trade name of this product is Opera (BASF), and is registered for control of foliar diseases of wheat and soybean. Active ingredients registered for use on field pea or used experimentally in the Canadian prairies (mancozeb, chlorothalonil and azoxystrobin) appeared to have limited impact on Ascochyta blight or anthracnose under the experimental conditions near Passo Fundo during 2002. However, in 2001 at the low lying area of Quatro Irm?os azoxystrobin led to the highest absolute yield, which was statistically similar to pyraclostrobin + epoxiconazole. Statistical analyses of 2002 data confirmed most of the visual field observations. At Coxilha the combined single application of pyraclostrobin + epoxiconazole dramatically reduced the symptoms of disease on both the foliage and the lower stem of each plant compared to the check or any other treatment (Table 3). None of the other treatments by either assessment method were different from the check. Results at the Passo Fundo site were not quite as dramatic but again the pyraclostrobin + epoxiconazole treatments were less severely diseased than the check (Table 4). At Passo Fundo the single application of pyraclostrobin alone was similar to the combined pyraclostrobin + epoxiconazole treatment.

Table 2 . Effect of fungicides on grain yield and thousand seed weight (TSW) of pea (cv. Dileta) at a low laying area of Quatro Irm?os, at a higer laying area of Quatro Irm?os, and at Coxilha, RS, Brazil, 2001.

Treatment	Rate (g a.i./ha)	Quatro Irm?os (Low)		Quatro Irm?os (High)		Coxilha	
		Yield (kg/ha)	TSW (g)	Yield (kg/ha)	TSW (g)	Yield (kg/ha)	TSW (g)
Azoxystrobin	25	2,647ab	193bc	2,683	216ab	1,848	133

Azoxystrobin	50	2,383b	198abc	2,350	196bc	1,714	133
Tebuconazole+Tryfloxystrobin	125+75	2,338b	203abc	2,466	222a	1,373	129
Propiconazole+Azoxystrobin	125+25	2,534ab	205abc	2,326	201bc	1,888	130
Piraclostrobin+Epoxiconazole	133+50	3,670a	226a	2,645	216ab	1,817	132
Propiconazole	125	1,893b	194bc	1,977	195c	1,515	127
Tebuconazole	125	1,818b	193bc	2,070	205abc	2,154	130
Epoxiconazole	125	2,420b	211ab	2,301	215abc	1,907	130
Chlorothalonil	1125	1,735b	178c	2,059	194c	1,991	131
Check	0	2,127b	197abc	2,297	206abc	1,595	127

Means followed by the same letters within columns are not significantly different at P=0.05 by Tukey's test.

Table 3. Effect of fungicide treatments on foliar disease symptoms, yield, and thousand seed weight (TSW) of field pea (cv. Marjoret) , 2002, at Coxilha, RS, Brazil. Data are means of 5 replicates.

First fungicide application		Second fungicide application[1]		Disease assessment of		Yield (kg/ha)	TSW (g)
Fungicide	Rate (g a.i./ha)	Fungicide	Rate (g a.i./ha)	Foliage (0-9)	Lower stems (0-9)		
Azoxystrobin	100	-		8.2 a	7.3 a	571 a b	149 a b
Pyraclostrobin	100	-		6.8 a b	5.4 a b	661 a b	168 a b
Tryfloxystrobin	100	-		7.2 a	5.9 a b	701 a b	158 a b
Tryfloxystrobin + Propiconazole	62.5 + 62.5	-		8.3 a	7.8 a	288 b	137 b
Mancozeb	1875	Pyraclostrobin	100	7.4 a	6.4 a b	778 a b	169 a b

Difenconazole	75	Azoxystrobin	100	7.0 a b	6.2 a b	653 a b	160 a b
Tebuconazole	125	Tryfloxystrobin	100	7.3 a	6.0 a b	709 a b	171 a b
Epoxiconazole	94	-		7.5 a	6.4 a b	760 a b	165 a b
Chlorothalonil	1126	Pyraclostrobin	100	7.1 a	5.9 a b	721 a b	167 a b
Pyraclostrobin + Epoxiconazole	100 + 37.5	-		4.5 b	3.0 b	1028 a	191 a
Mancozeb / Chlorothalonil[2]	1875 / 1126	Pyraclostrobin	100	7.3 a	6.7 a b	639 a b	163 a b
Check		-		8.3 a	7.3 a	650 a b	161 a b

[1]At 19 days after the first application. [2]Chlorothalonil was applied 8 days after mancozeb for this treatment.

Means followed by the same letters within columns are not significantly different at P=0.05 by Tukey's test.

In terms of yield and thousand seed weight (TSW) analysis of variance revealed a high degree of variation in the data of the 5 site-years but a trend was present for greater yield and TSW with the pyraclostrobin + epoxiconazole treatment compared to other single application treatments (Tables 2, 3, and 4).

The data suggests a synergistic effect between the combined active ingredients pyraclostrobin + epoxiconazole when applied in a single application. The trend in both experiments was for less disease development, increased yield and higher TSW in the combined treatment compared to the check or to application of either product alone. This synergistic effect has also been noted in the control of leaf spot diseases of wheat at Passo Fundo.

Table 4. Effect of fungicide treatments on foliar disease symptoms, yield, and thousand seed weight (TSW) of field pea (cv. Marjoret) at Passo Fundo, RS BRAZIL. Data are means of 5 replicates.

First fungicide application		Second fungicide application[1]		Disease assessment of		Yield (kg/ha)	TKW (g)
Fungicide	Rate (ga.i./ha)	Fungicide	Rate (ga.i./ha)	Foliage (0-9)	Lowerstems (0-9)		
Azoxystrobin	100	-		7.3abc	6.1abc	824ab	157c

Pyraclostrobin	100	-		5.8bc	4.4c	948ab	175ab
Tryfloxystrobin	100	-		7.2abc	6.2abc	952ab	166abc
Tryfloxystrobin+ propiconazole	62.5 +62.5	-		7.7a	6.9a	919ab	157c
Mancozeb	1875	Pyraclostrobin	100	7.4ab	6.7ab	703b	155c
Difenconazole	75	Azoxystrobin	100	6.3abc	5.1abc	1004ab	176a
Tebuconazole	125	Tryfloxystrobin	100	7.1abc	6.0abc	880ab	168abc
Epoxiconazole	94	-		7.0abc	5.8abc	1014ab	168abc
Chlorothalonil	1126	Pyraclostrobin	100	7.8a	6.6abc	743b	159bc
Pyraclostrobin+ epoxiconazole	100 +37.5	-		5.6c	4.6bc	1147a	180a
Mancozeb/ chlorothalonil[2]	1875/ 1126	Pyraclostrobin	100	7.4abc	6.3abc	1029ab	166abc
Check				7.9a	7.0a	724b	152c

[1]At 19 days after the first application. [2]Chlorothalonil was applied 8 days after mancozeb for this treatment.

Means followed by the same letters within columns are not significantly different at P=0.05 by Tukey's test.

The use of the contact fungicide chlorothalonil as a first fungicide application, followed by a second application with a partially systemic product such as pyraclostrobin was not effective in reducing disease symptoms or increasing yield or quality compared to the untreated check in either experiment (Tables 3 and 4). Similarly, the application of 3 different fungicides in 3 applications, using contact fungicides as the first two applications (mancozeb and chlorothalonil) and pyraclostrobin as the third did not reduce disease symptoms or improve yield or quality. Use of a semi-systemic product (pyraclostrobin or pyraclostrobin + epoxiconazole) before significant disease development appeared to be the best strategy under the experimental conditions in this study. Application of semi-systemic products as a second fungicide application appeared too late to control disease progression.

Conclusion

This study demonstrated that fungicide application to field pea in southern Brazil is effective for reduction of foliar diseases and for maintenance of yield and seed quality. The use of fungicides with other integrated pest management practices such as early seeding and choice of a disease tolerant or less susceptible cultivar should help to maintain yield and quality of field pea in southern Brazil.

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