Fungicides Applied at Four Application Timings to Two Field Pea Cultivars with Differing Flower Durations for White Mold Disease Control.

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INTRODUCTION

Field peas are one of the fasting growing crops in North Dakota. The planted North Dakota acreage has grown from 66,000 acres in 2000 to 808,000 acres in 2005 easily surpassing Montana at 135,000 acres as the number one producer of field peas in the United States. The current high energy and fertilizer costs make it likely that planted acreages will increase again in 2006. Field peas, canola, sunflowers, and soybeans fit well into rotations that include small grains due to different pathogen susceptibility of the grass type species. Field pea, canola, sunflower, and soybean and several hundred other broadleaf crops and many weed species are susceptible to white mold disease caused by the pathogen *Sclerotinia sclerotiorum* (Lib.) de Bary. The most common mode of infection of the disease is the emergence of apothecia from sclerotia deposited in the soil from previous years' infections. These sclerotia can live in the soil for more than five years and expel spores airborne. The spores are very small and can travel great distances with the prevailing winds. Field pea has a very dense canopy that creates an environment conducive to spore germination and infection when precipitation is abundant. Research studies conducted in 2003 indicated that some fungicides and timings may provide control of the disease. These studies initiated in 2004 will qualify some of the 2003 findings and determine differences in susceptibility between two cultivars with determinate and indeterminate type of flowering.

Table 1. Source of variation and confidence levels for significant differences among disease incidence, quality factors, and yield on field pea, 2004 and 2005.

Source of Variation	Disease Incidence[x] Stem (Plants10 ft.$^{-1}$)	Disease Incidence[x] Branch (Plants10 ft.$^{-1}$)	Protein[x] (%)	Seed Weight[y] (250 sds)	Test Weight[z] (Lb/bu)	Yield[z] (Bu/a)
Environment	<0.0001	<0.0001	<0.0001	<0.0001	0.1148	<0.0001
Fungicide	0.2231	0.0132	0.0215	0.0060	0.9226	<0.0001
Env*Fung	0.1710	0.0051	0.0144	0.0679	0.0301	0.0010
Timing	0.0749	0.0034	0.3277	0.0087	0.4188	0.0027
Env *Tim	0.5293	0.9900	0.9810	0.0773	0.0115	0.2753
Fung*Tim	0.2674	0.6993	0.7530	0.0866	0.8037	0.9313
Env *Fung*Tim	0.6505	0.8432	0.0843	0.7566	0.4093	0.3316
Cultivar	0.2578	0.0011	0.0321	<0.0001	0.8424	<0.0001
Env *Cult	0.9074	0.0177	<0.0001	<0.0001	<0.0001	<0.0001
Fung*Cult	0.1993	0.0921	0.3525	0.7431	0.0832	0.1344
Env *Fung*Cult	0.9786	0.8498	0.9412	0.3615	0.9931	0.7699
Tim*Cult	0.2491	0.6388	0.3071	0.8984	0.6390	0.2766
Env *Tim*Cult	0.3501	0.1239	0.6633	0.5650	0.9637	0.2703
Fung*Tim*Cult	0.5805	0.2644	0.4380	0.2470	0.4672	0.9030
Env *Fung*Tim*Cult	0.6953	0.8184	0.2507	0.2914	0.7134	0.3460
% C.V.	111	110	6	7	1	18

[xyz] Three (Langdon 2004, Carrington 2004 and 2005), Two (Carrington 2004 and 2005), and Four years data respectively

Table 2. Disease incidence and test weight by fungicide and cultivar averaged across timings.

Fungicide	Cultivar	Disease Incidence Branch (Plts 10 ft.$^{-1}$)	Test Weight (Lb/bu.)
Endura	Eclipse	2.3	63.2
	Integra	4.4	63.1
JAU 6476	Eclipse	1.8	63.1
	Integra	2.4	63.1
TopsinM	Eclipse	2.5	63.1
	Integra	3.3	63.2
LSD $_{(0.1)}$		1.8	0.2

MATERIALS AND METHODS

Trials were conducted at the Carrington and Langdon Research Extension Centers, east central and northeast North Dakota, respectively, in 2004 and 2005 to evaluate fungicides, application timings, and field pea cultivars. The studies were designed as a randomized complete block arranged as a 3x4x2 factorial with four replicates. The fungicides were Bayer experimental JAU 6476 (prothioconazole), Endura (boscalid), and Topsin M (thiophanate methyl) and were applied at 10, 40, 100, and 10 + 100% flowering stage of growth to an indeterminate 'Eclipse' and a determinate 'Integra' flowering type cultivars. Sites with a history of white mold disease were selected. In addition, at some locations sclerotia were incorporated into the soil before crop emergence and ascospores applied after flower initiation to improve chance of disease infection. Supplemental water was applied by overhead sprinkler to improve chance of sclerotia germination and subsequent disease infection by the ascospores. Crop production practices for field pea for the respective regions of the state as recommended by the North Dakota State University Extension Service were followed. The cultivars were planted with double disk drills, 6-inch row spacing. After flowering ceased the incidence of disease was determined by visual estimation of 10 feet of row. The location of the infection was recorded when it infected the main stems or the branches. The studies were harvested with small plot type combines and processed to determine yield, test weight, 250 seed weight, and protein. Data was analyzed with the general linear model (GLM) in SAS. Least significant differences (LSD) were used to compare means at the 5% probability level (Table 1).

Table 3. Disease incidence, protein, 250 seed weight and yield by fungicide and environment averaged across timings and cultivars.

Locations (Year)	Fungicide	Disease Incidence Branch (Plts 10 ft.$^{-1}$)	Protein (%)	250 Seed Weight (g)	Yield (Bu/a)
Carrington 2004	Endura	1.7	19.8	66.2	77.1
	JAU 6476	1.2	19.9	66.8	78.9
	TopsinM	1.4	19.9	66.1	76.9
Langdon 2004	Endura	3.4	23.4		47.2
	JAU 6476	3.5	22.1		46.4
	TopsinM	3.0	23.4		43.6
Carrington 2005	Endura	5.1	22.6	59.7	51.0
	JAU 6476	1.6	22.5	63.3	59.5
	TopsinM	4.3	22.6	58.9	47.2
Langdon 2005	Endura				25.9
	JAU 6476				24.5
	TopsinM				24.4
LSD $_{(0.05)}$		1.5	0.6	2.3	4.5

Table 4. Disease incidence, protein, 250 seed weight, and yield by cultivar and environment averaged across fungicides and timings.

Locations (Year)	Cultivar	Disease Incidence Branch (Plants 10 ft.$^{-1}$)	Protein (%)	250 Seed Weight (g)	Yield (Bu/a)
Langdon 2004	Eclipse	2.0	22.7		37.2
	Integra	4.6	23.2		54.4
Carrington 2004	Eclipse	1.3	20.4	61.6	76.6
	Integra	1.6	19.3	71.1	78.7
Langdon 2005	Eclipse				24.2
	Integra				25.7
Carrington 2005	Eclipse	3.3	22.7	60.3	51.3
	Integra	4.0	22.5	61.1	53.8
LSD $_{(0.05)}$		1.2	0.5	1.9	3.7

RESULTS

A wide range of environmental conditions occurred during the trials. A dry environment during flowering occurred in 2004 at Carrington where exceptionally large yields were recorded. The growing season in 2004 was cool climaxed by a killing frost on 20 August at Langdon damaging many susceptible crops. The field peas were not visibly damaged but may have been affected. In contrast, the 2005 environment at Langdon included excessive precipitation in June, greater than seven inches, and left soils water logged so that root disease inhibited crop growth and caused a premature ripening of the plants.

- **Disease incidence** on the stems was reduced by 28% when fungicide application included timing at 100% flowering growth stage. A late flowering timing reduced branch disease incidence compared to 10% and 40% bloom timings. Disease incidence on the branches was reduced on Integra cultivar when JAU 6476 fungicide was applied compared to Endura on Integra cultivar but was not different on Eclipse (Table 2). Eclipse had less incidence of disease than Integra when Endura was applied.
- **Protein** was not different among fungicide applications at Carrington in 2004 or 2005 (Table 3). Protein was reduced at Langdon in 2004 with the JAU 6476 treatment compared to Endura and Topsin M. Protein of all treatments in the high yield 2004 season at Carrington were less than the other two environments indicating that full yield potential may still not have been attained. Protein was less on Eclipse at Langdon in the cool summer of 2004, greater at Carrington on Eclipse in the high yielding growing season of 2004, but not different under severe disease infections at Carrington in 2005 (Table 3).
- **Two hundred fifty seed weight** was less in 2005 in Carrington when disease pressure was severe compared to 2004 regardless of fungicide type (Table 3). However in 2005 the fungicide JAU 6476 had significantly greater seed weight than Endura or Topsin M fungicide. Test weight was increased slightly on Eclipse cultivar by Endura fungicide but reduced slightly on Eclipse by Topsin M fungicide (Table 2).
- **Yields** were not different among fungicides in 2004 at Carrington or at Langdon in either environment. Yields were increased by an application of JAU 6476 at Carrington in 2005 when disease pressures were high by 8.5 bu/acre compared to Endura and 12.3 bu/acre compared to Topsin M (Table 3). Yields were much less in some environments. Yield averaged over fungicide and cultivars was 2.6 bu/a greater at 40% timing compared to 100% timing. Yield differences among cultivars were not different in Carrington in either year or at Langdon in 2005 but were 17.2 bushels less in 2004 at Langdon due to the different flowering duration and the cool environment.

DISCUSSION

The results of this study concur with a prior study indicating field peas can be severely affected by sclerotinia disease. Results of some fungicides applications reduced incidence of disease, improved some quality factors and increased yield. There was a definite advantage to the determinant type cultivar in improving quality factors in some environments. Further evaluations should be made to identify the most resistant cultivars to select for planting. An effort should be made to obtain a label for one or more of the fungicides by state agencies and commodity organizations. Spray coverage was not addressed in these studies but may be a consideration for improving upon these results considering the dense crop canopy produced in some environments.

White mold infection

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