FUNGICIDE APPLICATION FOR REDUCING THE NEGATIVE EFFECTS OF PASMO DISEASE ON FLAX, 2010

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OBJECTIVE

The principal objective of this project was to screen additional fungicide chemistries for efficacy of pasmo disease on flax with emphasis on improved agronomic components that will economically benefit growers.

MATERIALS AND METHODS

These studies were designed as a randomized complete block with four replicates and were conducted at the NDSU Carrington Research Extension Center at Carrington, North Dakota and the NDSU Langdon Research Extension Center at Langdon, North Dakota. In Carrington, plots were 25 feet long and consisted of seven rows, each 7 inches apart; in Langdon, plots were 20 feet long and consisted of seven rows, each 6 inches apart. Planting was conducted with a double disk plot drill at both locations, and seeding was conducted 3 May in Carrington and 9 May in Langdon. Cultivar 'CDC Bethune' was seeded at a rate of 2.8 million pure live seeds per acre. An untreated plot was planted as a buffer between treated plots to minimize spray drift between treatment plots. Crop production practices recommended by North Dakota State University Extension Service were followed (Kandel, 2007).

Naturally infested flax straw collected from flax production fields in 2009 was used to artificially inoculate plots with pasmo. Approximately 75 grams of straw were distributed per plot 6-8 days prior to the initiation of flowering; straw was placed between plots. Eleven fungicide treatments and a non-treated control were evaluated (Table 1). At Langdon, fungicides were applied 6 July at early bloom (wind speed 10 MPH from the W and air temperature 66° F at 9:30 a.m.) and 14 July at late bloom (wind speed 2 MPH from the SW and air temperature 66° F at 9:00 a.m.). Fungicides were applied with a CO_2 backpack spray unit equipped with a three-nozzle boom with Spraying Systems XR8001 nozzles oriented vertically delivering 9.2 GPA operated at 40 psi. At Carrington, fungicides were applied on 2 July at mid-bloom and 7 July at late bloom in 17.5 gal water/ac at 35 PSI; a 60-inch hand boom with four equally spaced XR TeeJet 8001VS nozzles was used for applications.

The soil type at Langdon was a Barnes/Svea complex (fine-loamy, mixed superactive Frigid, Calcic Hapludolls/mixed superactive Frigid, Pachic Hapludolls), and the soil type at Carrington was a Heimdal-Emrick Loam. Hard red winter wheat was produced on the Langdon site in 2009.

Pasmo disease was assessed on leaves on 6 July and 3 Aug and the stems on 19 Aug at Langdon. On 20 and 28 Jul disease on leaves were assessed and stems on 28 Jul at Carrington. The leaves were assessed using the 1-9 scale with 1 = no sign of disease and 9

= high disease severity and leaf death. Stem severity was assessed using the 1-9 scale with 1 = no sign of disease and 9 = high disease severity and plant death. The assessment dates represent pasmo disease levels at an early infection period near the time of first fungicide treatment and a later disease development period after which the fungicide efficacy would be expected to be reduced. The plots were harvested on 24 Aug and 25 Aug at Carrington and Langdon, respectively, with a plot combine and the threshed sample collected. Yield, test weight, seed weight and oil concentration were determined. Area under disease progress curve (AUDPC) was calculated for each location. The data were analyzed with analysis of variance separating means with Fischer's protected least significant differences ($P \leq 0.01$) with SAS (SAS, 1999).

RESULTS

Leaf disease severity. A supplemental watering system was not used at Langdon 2010 due to excessive distance from the water source. Pasmo disease developed less intensely in 2010 and matured sooner at Langdon compared to flax in 2009, Halley and Misek, 2009. An additional disease assessment was made at both locations but pasmo disease had overcome all plots and no differentiation could be made so data are not presented. An interaction was measured between environment (Carrington vs. Langdon) and leaf disease severity at the first disease evaluation (6 July in Langdon, 20 July in Carrington; Table 1). At date 1 the 3 oz. Quash treatment, late application timing, and Vertisan were not different from the untreated at Carrington. At Langdon the Luna Privilege treatment was numerically greater than the untreated. Treatments with less severity at the early sample date included Vertisan and Aproach, early application timing. Both treatments include the fungicide chemistry penthiopyrad. The Headline treatment was the most effective treatment overall at Langdon at the early assessment date. At Carrington the most effective treatment at the early sample date for reducing leaf severity was the Penncozeb/ Proline combination. This treatment was included as a control because it has previously been very effective, Halley and Misek 2009. The 3 oz. Quash treatment was not as effective as the four oz. treatment at the early date. Significant differences were measured for leaf disease severity on the second evaluation date 3 Aug in Langdon, 28 July in Carrington (Table 1). At the second assessment date Headline, Penncozeb/Proline, Vertisan and both Aproach treatments had lower severity than Luna Privilege and the experimental Q8X63. None of the treatments had less leaf severity than the untreated.

Yield. All treatments except Quash (3 oz. /ac.) applied at early to mid-bloom and Vertisan (24 fl. oz. /ac.) applied at late bloom improved yield over the non-treated control (Table 1). A two-application strategy involving Penncozeb (2 lb. /ac) applied at early to mid-bloom and Proline (5.7 fl. oz./ac) applied at late bloom resulted in significantly higher yields relative to all single-application strategies except Stratego Yld (4.65 fl. oz. /ac.) applied at late bloom and Aproach (4 fl. oz. /ac.) applied at early or mid-bloom (alpha = 0.05). Among single-application strategies, applications of Stratego Yld (4.65 fl. oz. /ac) made at late bloom resulted in higher yields than ProPulse (10.26 fl. oz. /ac.) applied at late bloom, Quash (3 or 4 oz. /ac.) applied at either early or late bloom, Vertisan (24 fl. oz. /ac.) applied at late bloom, and Q8X63 (19.2 fl. oz. /ac.) applied at late bloom. The Headline control increased yields by 5.5 bu/ac (Table 1).

Test weight. Relative to the non-treated control, test weight was increased in all fungicide treatments except Quash (3 oz/ac) applied at early to mid-bloom, Vertisan (24 fl. oz. /ac.) applied at late bloom, and Aproach (6 fl. oz. /ac.) applied at late bloom (Table 1). The Headline control and the Penncozeb/Proline combination increased test weight by 0.9 and 1.0 lbs. /bu. ProPulse, Luna Privilege and the late application timing of Quash were not different in test weight from Headline. Greatest test weight was obtained from the Q8X63 treatment, the mid-bloom application timing of Aproach and Stratego Yld.

Oil. No statistical differences in oil concentration were detected.

DISCUSSION

The fungicide treatments produced similar yield, test weight, and disease control (as measured at the second evaluation) results in Carrington and Langdon. At both sites, fungicides with a QoI active ingredient performed particularly well; Aproach and Stratego Yld provided strong increases in yield and test weight, and Headline provided good results. Stratego Yld is a pre-mix with both QoI and triazole chemistries, and future research will include the evaluation of several tank-mixes of other QoI and triazole chemistries. Although previous studies have indicated that the use of fungicides to control pasmo can result in increased oil content, no differences in oil content were detected across treatments in this study, and additional work is needed to understand under what conditions improved pasmo control may lead to higher oil yields. Similar numerical leaf severity differences between Quash treatments at both locations indicate that further investigation into the interaction between timing and rate are needed. The results of these studies have been provided to the fungicide registrants and will be used to support the registration of one or more of the fungicides for use on flax.

REFERENCES

Halley, S. and K. Misek. 2009. Accessed on 01-31-11.
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ACKNOWLEDGEMENT

This project was supported by a grant from Pesticide Harmonization Board of the North Dakota State Agriculture Department and supporting funds from Bayer CropScience, DuPont and Valent.

Table 1. Pasmo disease assessment (leaves), yield, test weight and seed oil concentration by fungicide (compound), application timing and fungicide rate averaged across both environments and confidence levels by source of variation Carrington and Langdon, 2010.

			Pasmo Disease [2]			Test	
			Date 1	Date 2	Yield	Weight	Oil
Fungicide [1]	Chemical name	Fungicide Rate	Severity (1-9)		(bu/a)	(lb./bu)	%
Non-treated control			2.8	5.1	35.7	52.2	41.7
Headline (B)	Pyraclostrobin	6 fl. oz./ac	1.5	4.3	41.2	53.1	42.8
Penncozeb (A) / Proline (B)	Mancozeb /prothioconazole	2 lb./ac/ 5.7 fl. oz./ac	1.6	4.4	44.6	53.2	43.1
Stratego Yld (B)	Trifloxystrobin/prothioconazole	4.65 fl. oz./ac + 0.125% v/v NIS	2.3	4.8	43.1	53.4	43.2
ProPulse (B)	Proline / fluopyram	10.26 fl. oz./ac + 0.125% v/v NIS	2.1	4.9	39.7	53.1	42.4
Luna Privilege (B)	Fluopyram	6.84 fl. oz./ac + 0.125% v/v NIS	2.4	5.4	40.1	53.1	42.6
Quash (B)	Metconazole	3 oz./ac	2.6	4.8	39.3	53.1	42.5
Quash (A)	Metconazole	4 oz./ac	2.1	4.9	37.9	52.9	43.4
Vertisan (B)	Penthiopyrad	(LEM 17) 24 fl. oz./ac	2.1	4.4	38.3	52.5	42.6
Aproach (B)	Picoxystrobin	(YT669) 6 fl. oz./ac	1.9	4.4	40.0	53.0	42.9
Q8X63 (B)	Penthiopyrad/picoxystrobin	19.2 fl. oz./ac	2.3	5.4	39.7	53.3	43.1
Aproach (A)	Picoxystrobin	(YT669) 4 fl. oz./ac	1.9	4.3	42.0	53.4	43.0
LSD $_{(0.05)}$			1.0	1.0	3.2	0.9	NS
Source of variation							
Fungicide			0.0008	0.0086	0.0022	0.0206	0.2358
Environment*Fungicide			0.0055	0.1362	0.8518	0.0857	0.4235
% C.V.			26.57	15.34	9.5	1.2	2.7

[1] Application timing A = early flowering (7 days after flower initiation); B = late flowering (7 days after early flowering application).

[2] Leaf assessments.

Table 2. Pasmo disease assessment (leaves), yield, test weight and seed oil concentration by fungicide (compound), application timing and fungicide rate at Carrington and Langdon, 2010.

Fungicide [1]	Fungicide Rate	Pasmo Disease [2] Date 1	Date 2	Yield	Test weight	Oil
Carrington		Severity (1-9)		(bu/a)	(lb./bu)	%
Non-treated control		3.3	6.8	43.2	52.5	42.9
Headline (B)	6 fl. oz./ac	1.5	5.0	48.1	53.0	42.9
Penncozeb (A) / Proline (B)	2 lb./ac. /5.7 fl. oz./ac	1.0	5.3	50.5	52.9	43.3
Stratego Yld (B)	4.65 fl. oz./ac. + 0.125% v/v NIS	2.0	6.5	47.5	53.2	43.2
ProPulse (B)	10.26 fl. oz./ac + 0.125% v/v NIS	2.0	6.5	46.0	52.7	43.0
Luna Privilege (B)	6.84 fl. oz./ac + 0.125% v/v NIS	2.0	6.8	45.8	53.0	43.2
Quash (B)	3 oz./ac	2.8	6.3	45.3	53.0	43.0
Quash (A)	4 oz./ac	2.3	6.0	42.9	53.2	43.4
Vertisan (B)	(LEM 17) 24 fl. oz./ac	2.5	6.0	45.3	52.8	43.0
Aproach (B)	(YT669) 6 fl. oz./ac	1.5	6.0	47.3	52.4	43.5
Q8X63 (B)	19.2 fl. oz./ac	2.0	6.8	44.5	52.9	42.8
Aproach (A)	(YT669) 4 fl. oz./ac	2.0	5.8	48.6	52.9	43.0
Langdon						
Non-treated control		2.3	3.5	28.2	52.0	40.4
Headline (B)	6 fl. oz./ac	1.5	3.5	34.4	53.2	42.7
Penncozeb (A) / Proline (B)	2 lb./ac /5.7 fl. oz./ac	2.3	3.5	38.6	53.6	43.0
Stratego Yld (B)	4.65 fl. oz./ac + 0.125% v/v NIS	2.5	3.0	38.7	53.6	43.2
ProPulse (B)	10.26 fl. oz./ac + 0.125% v/v NIS	2.3	3.3	33.3	53.5	41.8
Luna Privilege (B)	6.84 fl. oz./ac + 0.125% v/v NIS	2.8	4.0	34.5	53.2	42.1
Quash (B)	3 oz./ac	2.5	3.3	33.3	53.3	42.0
Quash (A)	4 oz./ac	2.0	3.8	32.9	52.6	43.4
Vertisan (B)	(LEM 17) 24 fl. oz./ac	1.8	2.8	31.4	52.2	42.2
Aproach (B)	(YT669) 6 fl. oz./ac	2.3	2.8	32.7	53.5	42.3
Q8X63 (B)	19.2 fl. oz./ac	2.5	4.0	35.0	53.6	43.3
Aproach (A)	(YT669) 4 fl. oz./ac	1.8	2.8	35.4	53.8	43.1
LSD $_{(0.05)}$		0.8	NS	NS	NS	NS

[1] Application timing A = early flowering (7 days after flower initiation); B = late flowering (7 days after early flowering application).

[2] Leaf assessments.