FLAX FUNGICIDE APPLICATION FOR REDUCING THE EFFECTS OF PASMO DISEASE

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MATERIALS AND METHODS

This study was designed as a randomized complete block with four replicates, and was conducted at the Langdon Research Extension Center, NDSU at Langdon, North Dakota (N48° 45.3', W98° 17.5') and conducted in 2008. Plots were 7 rows wide with 6 inches between rows and 20 ft row length and were planted with a double disk Almaco plot drill. Seeding rate was 2.8 million PLS^{-acre}. An untreated plot was planted between treated plots to collect and minimize spray drift to the adjacent plots. Crop production practices recommended by North Dakota State University Extension Service were followed (Kandel, 2007). The trial was seeded on 9 May and was harvested in the last week of September.

The Canadian cultivar CDC Bethune was used in this study. The plots were artificially inoculated with pasmo by spreading infected straw collected from 2007 in the center of each plot 6-8 days prior to flowering at the rate of 80 grams of straw. Treatments are listed in Table 1. Treatments with the commercial fungicide Headline (Pyraclostrobin, BASF Corporation, Agricultural Products 26 Davis Drive, Research Triangle Park, NC 27709) were included as a subset of the study in a factorial arrangement at three application rates (6, 9, and 12 fl oz/ acre) and three timings (early, late and post bloom growth stage). Early flower growth stage application was made on 16 July, late bloom growth stage application on 23 July and post bloom application on 30 July. A sequential application at early flower and late bloom growth stage was included for some treatments and an untreated check as a control (Table 1). Fungicide was applied with a CO_2 backpack spray unit equipped with a three nozzle boom operated at 40 psi with Spraying Systems XR8001 nozzles oriented vertically delivering 9.2 gpa.

The soil type was a Barnes/Svea complex (fine-loamy, mixed superactive Frigid, Calcic Hapludolls/mixed superactive Frigid, Pachic Hapludolls) (Soil Survey Staff, 2008). Hard red spring wheat was produced on this site in 2007. The soil was tilled in the fall with a chisel plow with attached spring tooth harrows three times. In spring prior to planting and tilling, N fertilizer (28-0-0) was broadcast on the site to bring the soil and applied N level to 40 lb $acre^{-1}$**.** The site was tilled with a spring tooth cultivator equipped with 23 cm sweeps on 18 cm spacing with attached spring tooth harrows immediately before planting.

An impact-type sprinkler system was installed with orifices spaced 30 x 40 feet, and was operated after the inoculum was applied to wet the residue. The sprinklers were manually operated for about 2 hours on three additional dates to create a favorable environment for disease infection and development. Soil water was increased as a result of the irrigation. Care was taken to minimize the amount of water applied so lodging did not occur. Pasmo disease was assessed on leaves on 29 July and the stems on 29 Aug. The leaves were assessed for severity by

measuring the distance in inches above the soil line that the disease had advanced. Stem severity was assessed using the 1-9 scale with 1 = no sign of disease and 9 = high disease severity and plant death. The plot was harvested with a Hege plot combine and the threshed sample collected. Yield, test weight, seed weight and oil concentration were determined. 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).

DISCUSSION

Pasmo disease development was at a later in 2008 than in previous years. No phytotoxicity was observed at any growth stage by the treatments. Late bloom application timings were more effective in 2008 than previous year's studies. Leaf disease was reduced by treatments that were applied at early and late bloom growth stage with the exception of single timing Proline. Post bloom growth stage applications did not reduce leaf disease. In contrast late and post bloom growth stages were generally more effective in reducing stem severity than early applications. The confidential treatments A-D were not different from the untreated in stem disease severity. All treatments increased yield compared to the untreated except for the early bloom growth stage Proline treatment. Test weight was increased by all treatments except for a single application of confidential treatment B-D. Oil concentration was increased by all treatments except Headline 12 fl oz/acre applied early bloom, confidential treatments A-D and the Proline early bloom treatment.

When the Headline was analyzed with the factorial arrangement, differences among rates were not significant (Table 2). Early application timing was more effective in reducing leaf disease severity but less effective in reducing stem disease severity. The late application timing had greater yield that the early timing. Test weight was not affected by timing. Oil concentration was greatest with the late and post bloom application timing. In general, it appears that several fungicides are very effective in reducing the effects of pasmo and offering substantial economic value to producers.

Kandel, H. 2007. Crop Production Guide 2008. Crop Production Guide No. 18. North Dakota State University Extension Service and North Dakota Agricultural Experiment Station. Fargo, ND. 58105.

SAS Institute, 1999. SAS/STAT User's Guide, Releases: 8.2, 8.1, and 8.0. SAS Institute, Inc., Cary, NC.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Series Classification Database [Online WWW]. Available URL: "http://soils.usda.gov/soils/technical/classification/scfile/index.html" [Accessed December 9, 2007].

Table 1 Pasmo disease, yield , test weight and oil concentration by fungicide, fungicide rate and application timing Langdon , 2008.

			Disease Severity				
	Fungicide	Fungicide Timing	Leaf	Stem	Yield	Test Wt	Oil
Fungicide	Rate	Growth stage	Inches	0-9	Bu/a	Lb/bu	%
Headline	12 fl oz	early bloom (7)	4.5	1.5	40.55	53.77	39.97
Headline	12 fl oz	late bloom (9)	5.5	0.0	43.22	53.99	42.27
Headline	12 fl oz	post bloom	12.0	0.3	41.20	53.97	42.18
Headline	6 fl oz	early bloom	4.0	2.0	40.56	53.52	41.22
Headline	6 fl oz	late bloom	6.8	1.0	42.57	53.86	42.11
Headline	6 fl oz	post bloom	7.8	0.3	42.20	54.09	41.70
Headline	9 fl oz	early bloom	4.8	1.8	40.75	54.01	41.75
Headline	9 fl oz	late bloom	5.5	0.0	42.59	54.00	42.17
Headline	9 fl oz	post bloom	8.3	0.5	41.87	54.06	42.33
Headline	6 + 6 fl oz	7 + 9	4.5	1.5	42.48	53.8	42.08
Confidential A			6.3	3.5	36.77	53.31	41.13
Confidential B			6.3	4.3	36.22	53.08	41.03
Confidential C			5.3	4.5	37.42	53.15	40.63
Confidential D			8.3	4.8	37.72	53.12	40.74
Penncozeb	1 lb + 1 lb	7 + 9	6.0	3.8	40.40	53.37	41.53
Penncozeb + Proline	2 lb.+ 5.7 fl oz	7 + 9	5.8	2.0	40.71	53.51	41.48
Proline	5 fl oz	7 + 9	6.3	2.0	40.60	53.32	41.77
Proline	5.7 fl oz	early bloom	8.5	3.5	36.22	53.39	40.72
Untreated	na	na	9.5	5.0	33.28	52.76	39.64
Confidential E			4.0	3.3	39.72	53.38	41.55
LSD $_{(P>0.05)}$			2.7	1.6	3.1	0.5	1.5
%C.V.			29.41	48.63	5.54	0.61	2.49

Table 2. Pasmo disease, yield , test weight and oil concentration by Headline rate and application timing and confidence intervals by source of variation Langdon , 2008 (Subset of Table 1).

		Disease Severity				
Fungicide	Fungicide Timing	Lea f	Stem	Yield	Test Wt	Oil
Rate	Growth stage	Inches	0-9	Bu/a	Lb/bu	%
6 fl oz		6.2	1.1	41.74	53.80	41.7
9 fl oz		6.2	0.8	41.74	54.02	42.1
12 fl oz		7.3	0.6	41.66	53.90	41.5
	Early	4.4	1.8	40.6	53.77	40.98
	Late	5.9	0.3	42.8	53.95	42.18
	Post	9.3	0.3	41.8	54.04	42.07
LSD		1.6	0.4	1.3	NS	0.97
Rate		0.2367	0.0615	0.9893	0.3482	0.4255
Timing		<0.0001	<0.0001	0.0089	0.1442	0.0311
Rate*Timing		0.0584	0.1629	0.8564	0.5768	0.4286
% C.V.		28.8	61.8	3.8	0.6	2.8