Project Title: Flax Cultivar Evaluation for Tolerance and Fungicide and Application Timings for Management of Pasmo Disease.

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OBJECTIVES

Studies were initiated in 2004 to 1) Evaluate the tolerance of flax cultivars to pasmo disease, *Septoria linicola* (Speg.) Garassini, and 2) Evaluate fungicide applications and timings to control the disease.

MATERIALS AND METHODS

Two studies were conducted that were designed as a randomized complete block (RCBD) to evaluate 10 cultivars ('Carter-formerly N0010, Cathay, CDC Bethune, Neche, Nekoma, Omega, Pembina, Rahab 94, Selby, and York') for tolerance to pasmo. The first study compared the disease under conditions where infection levels were entirely natural. For the second and third studies, a small quantity of 2003 straw infected with pasmo was placed between the plots to provide inoculum for pasmo infection. The third study, arranged as a 4 x 5 factorial RCBD, was initiated to evaluate four fungicide application timings, 7, 14, 21, and 7 + 21 days after flower initiation (DAF) and five fungicides, Headline, Bayer experimental JAU 6476, Penncozeb, Quadris, and Stratego for pasmo reduction. All the studies had four replicates. The fungicides were shown to have some affect on pasmo in preliminary study. The studies were planted in early spring on fields previously fallowed. The two cultivar studies were placed in different areas of the Langdon Research Extension Center to minimize air movement and spore transfer between the trials. Flax production recommendations for northeast North Dakota from the North Dakota State University Extension Service were followed. Cultivar 'York' was planted for the fungicide/timing study.

Disease levels were evaluated using three methods of comparison. In the fungicide study, the distance in inches above the soil line that the leaves had senesced was measured, called leaf necrosis. This mean comparison represents a measurement of early season infection. The height above the soil line that lesions were visible on the leaves was also determined. This measurement, called pasmo disease severity, quantifies the season long effect of the cultivar, fungicide, or application timing on pasmo. A leaf index was determined to account for different heights among cultivars and will be used to compare disease levels across environments when plant heights are different. A third measurement, the percent of stem area infected was also determined. The fungicide applications were made with a CO_2 backpack sprayer with XR8002 nozzles applying 18.4 GPA at 40 psi. All the trials were planted with an Almaco double disk drill and harvested with a Hege plot combine. Yield, lodging, and test weight were determined to compare treatment effects on all studies. Additionally, days to flower were measured on the cultivar evaluation without additional inoculum study and oil percentage was measured on the cultivar study with additional inoculum and the fungicide timing study. SAS ANOVA was used to analyze the data and Fischer's Lads were used to determine mean separation (Table 3).

RESULTS AND DISCUSSION

The growing season in 2004 was much colder than normal. Average temperatures, May – August, were more than 1.5 degrees less than the previously recorded low. Additionally, a light frost occurred on August 20. This was the earliest recorded freeze at Langdon and it visibly affected some but not all crops.

Lodging in the cultivar study affected yields. This was probably a result of over application of nitrogen fertilizers. The horizontal orientation of the stems of lodged flax creates a great target for the rapid developing pasmo disease which quickly decimates the stem. Only standing stems were evaluated for tolerance. The lodging was different among several cultivars; most notably Omega and Selby, and a smaller yield was reflected in both of these crops (Table 1). CDC Bethune had significantly greater stem pasmo than all other cultivars except Rahab 94. The least stem pasmo was recorded on Carter, a new yellow type cultivar and York. Interestingly, yield and test weight were significantly correlated with days to flower, -.44901 and -.47118 respectively. This shows that the environment or possibly the frost may have affected the yield and test weight.

In the cultivar study with additional inoculum CDC Bethune and Cathay had the greatest levels of stem pasmo (Table 2). Notable differences between the cultivars were that York had the lowest levels of pasmo and Carter fit in the middle of the range. Pasmo severity on the leaves was greatest on Rahab 94 followed by Nekoma and Carter. Cultivars Omega, Selby, Cathay, and Neche had the smallest leaf severity levels. Percent oil was greatest on CDC Bethune and Pembina and much lower on York. Lodging levels were much lower on this study except for the cultivar York. The lodging likely caused the low yield on York. The low level of lodging on the Omega was likely a result of the reduced stand. Omega has not performed well at times in northeast North Dakota. However, Omega typically has the lowest levels of pasmo infection and may represent a source of tolerance to the disease.

In the fungicide/timing study, Headline and Quadris, had the smallest levels of pasmo stem infection (Figure 1). Disease levels of single application Penncozeb and one of the application timings of JAU 6476 fungicides were generally greater than other treatments. This may be related to the systemic action of the Headline and Quadris as opposed to the protectant type action of Penncozeb. The stem is very difficult to get good fungicide coverage on with typical spray application equipment. Yields were increased with 14 and 21 day timings of Headline compared to most other treatments (Figure 2). The lowest yield occurred with timings that occurred shortly after flowering except for the Penncozeb treatment and multiple application timings of Quadris. The JAU 6476 that included 14 DAF timings had the lowest yields as did a 7 DAF Headline application. Leaf necrosis and pasmo severity were less with Penncozeb compared to Headline, JAU 6476, and Stratego (Figure 3 & 4). Application timings of 14 and 21 DAF had greater levels of leaf necrosis compared to multiple fungicide application timings. The studies will be repeated in 2005.

Table 1. Flax cultivar evaluations without additional inoculum for pasmo disease, 2004.

Cultivar	Plant Height	Yield	Test Weight	Pasmo Stem Area Infected	Pasmo Leaf Severity	Leaf Index	Lodging	Days to Flower
	Inches	Bu/a	Lb/bu	%	inches		%	
Carter	29.3	26.7	52.8	7.8	18.3	6.2	30.0	72.8
Cathay	31.1	23.7	52.6	30.3	20.5	6.6	17.5	71.3
CDC Bethune	29.3	27.9	52.4	61.3	19.3	6.6	25.0	71.0
Neche	31.0	25.7	52.9	23.8	18.8	6.1	27.5	71.0
Nekoma	29.7	23.3	53.4	25.0	17.8	6.0	27.5	71.0
Omega	29.5	16.8	50.9	33.8	19.5	6.6	57.5	74.0
Pembina	30.3	27.2	53.1	15.0	17.3	5.7	10.0	71.3
Rahab 94	28.6	32.3	53.1	41.3	17.0	6.0	2.5	71.0
Selby	31.5	16.7	51.9	16.3	18.5	5.9	60.0	71.8
York	29.7	23.7	53.1	9.3	20.8	7	17.5	72.5
LSD *P*=0.05	1.3	5.9	1.2	31.1	NS	NS	22.6	0.6
% C.V.	3	17	2	81	17	17	56	1

Table 2. Flax cultivar evaluations with additional inoculum to promote pasmo disease, 2004.

Cultivar	Plant Height	Yield	Test Weight	Pasmo Stem Area Infected	Pasmo Leaf Severity	Leaf Index	Oil	Lodging	Population
	Inches	Bu/a	Lb/bu	%	inches		%	%	Plants/acre
Carter	25.5	33.1	51.0	61.3	17.3	6.8	43.2	21.3	3,194,400
Cathay	29.0	38.6	51.9	87.5	13.9	4.8	43.7	3.8	1,687,950
CDC Bethune	27.0	38.3	50.4	92.0	16.3	6.1	44.3	11.3	2,090,880
Neche	28.0	32.0	52.5	47.5	13.9	5.0	43.0	5.5	2,392,170
Nekoma	26.8	36.6	52.3	41.3	17.5	6.6	43.4	2.5	1,851,300
Omega	28.3	26.9	50.3	41.3	11.3	4.0	43.8	1.3	337,590
Pembina	28.0	35.0	52.1	33.8	16	5.8	44.3	5.0	1,727,880
Rahab 94	26.3	37.0	51.4	63.8	18.3	6.9	43.6	3.8	1,822,260
Selby	25.0	32.2	52.1	56.3	13.3	5.4	43.1	33.8	2,758,800
York	24.8	29.9	52.9	20.0	15.3	6.2	41.9	51.3	2,392,170
LSD *P*=0.05	1.4	5.2	1.0	26.7	4.1	1.5	0.5	21.9	582,975
% C.V.	4	11	1	34	19	18	1	108	20

Table 3. Sources of variation and confidence levels for significant differences among yield, test weight, disease, and lodging parameters.

	Yield	Test Weight	Pasmo Stem Area Infected	Leaf Necrosis	Leaf Severity	Lodging
Timing	0.9440	0.6168	0.2569	0.0287	0.3652	0.9555
Fungicide	0.0492	0.6730	<0.0001	0.0009	0.0018	0.6133
Tim*Fung	0.0409	0.4656	0.0300	0.8167	0.1137	0.4786
% C.V.	11	1	51	29	15	214

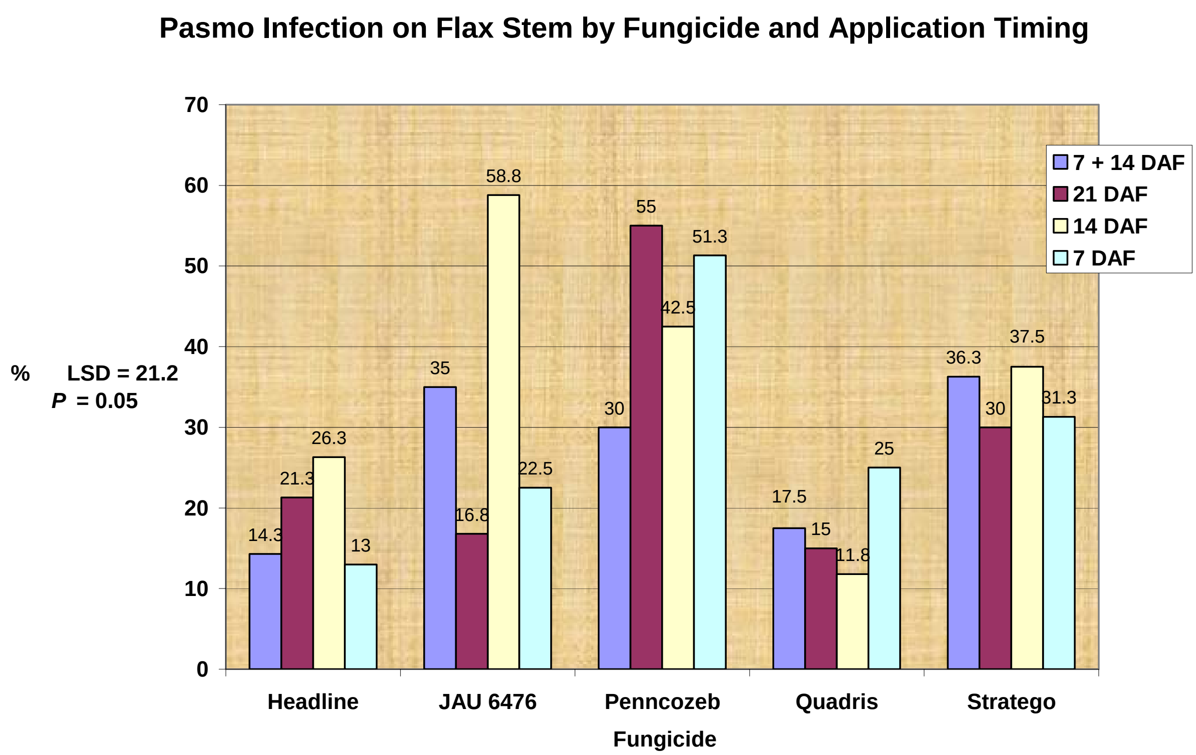

Figure 1. Flax stem pasmo infection by fungicide and timing, 2004.

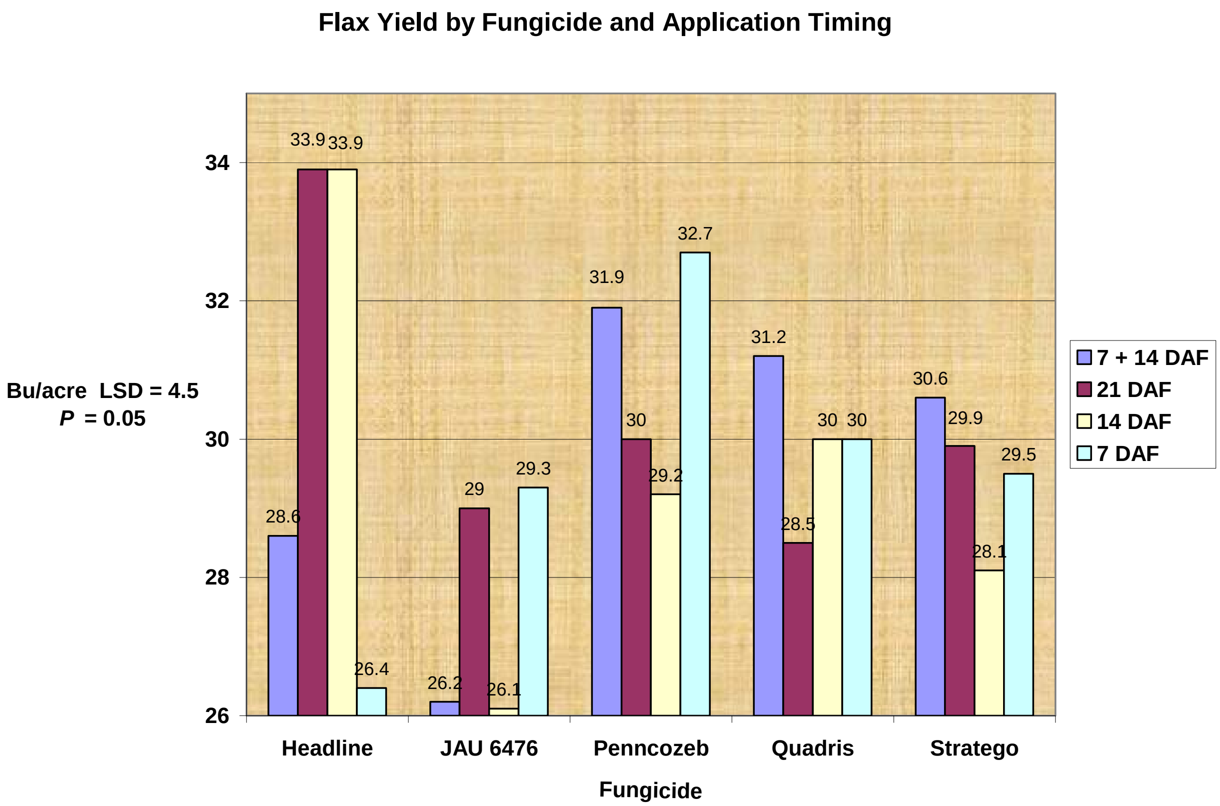

Figure 2. Flax yield by fungicide and timing, 2004.

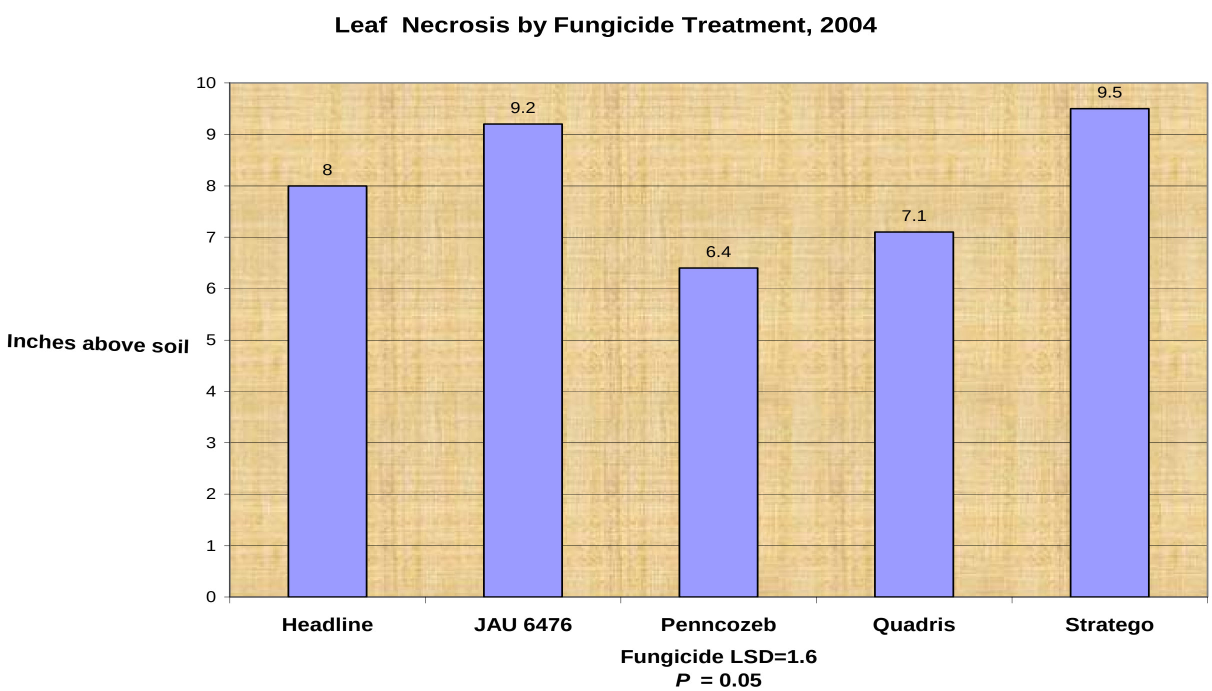

Figure 3. Flax leaf necrosis from pasmo infection by fungicide, 2004.

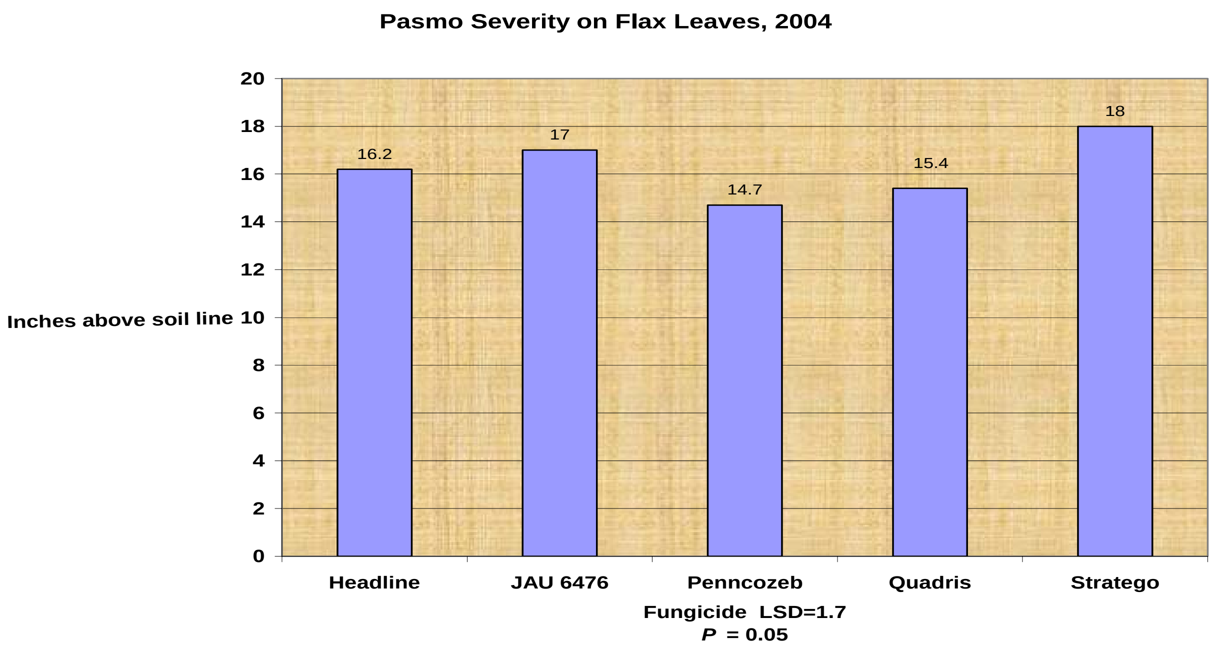

Figure 4. Flax leaf necrosis from pasmo infection by fungicide, 2004.

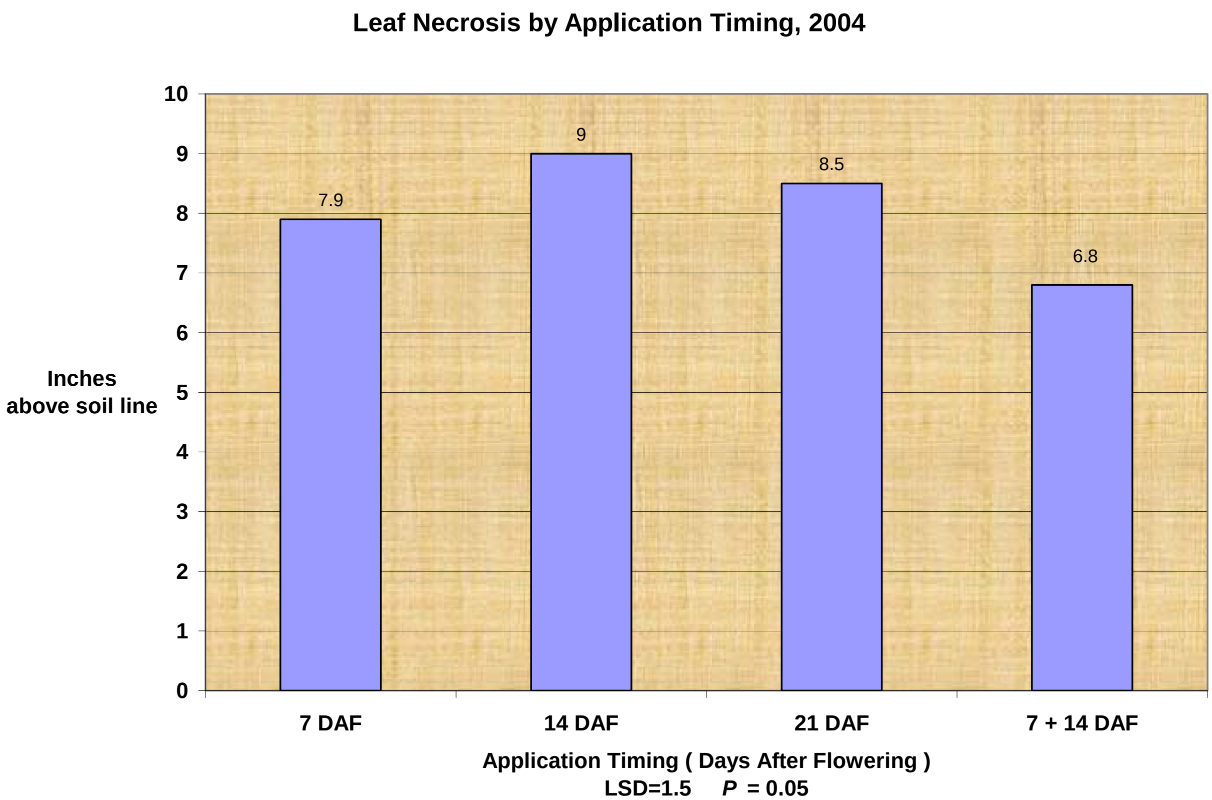

Figure 5. Flax leaf necrosis from pasmo infection by application timing, 2004.