

Managing Sunflower Rust (*Puccinia helianthi*) in Early Onset Epidemics with Fungicides in North Dakota: 2011

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MATERIALS AND METHODS

Sunflower rust fungicide trials were conducted in 2010 and 2011 to develop management recommendations for early onset high severity rust epidemics. The data in 2010 was previously presented. Therefore, this report will present data from the 2011 trials.

Twelve to twenty fungicide programs and timings were evaluated for efficacy of early onset sunflower rust management at three locations in ND; namely, Carrington Research Extension Center (CREC), Cenex Harvest States in Grandin (CHS), and Langdon Research Extension Center (LREC). Fungicide treatments were divided into two categories: timing treatments and fungicide programs. The timing treatments comprised of two fungicides; pyraclostrobin (Headline, BASF) and tebuconazole (Folicur, Bayer CropScience). These two fungicides were applied singularly or sequentially at three timings; V8-V12, R1, or R5.2-R5.5. Pyraclostrobin was incorporated at every location, while Tebuconazole was only included at CHS. The fungicide programs involved a series of two fungicide applications applied at R1 and R5.2-R5.5. Additionally, at least one non-treated control was included at each location to serve as basis of comparison. All experimental trials were arranged in a randomized complete block design. Four-row plots were sown with a susceptible confection hybrid at CREC (7 June), CHS (May 25), and LREC (30 May). Row width was 30 inches and row length was 15 ft at the LREC and 25 ft at CREC and CHS. Fertilizers, herbicides, and/or insecticides were used as needed according to recommended sunflower production practices (Berglund, 2007).

Urediniospores of *Puccinia helianthi* isolate ND07-01 (race 336) were produced on susceptible sunflower hybrids grown in greenhouse conditions and harvested in May and June 2011, ensuring fresh viable spores. Urediniospores were quantitated to approximately 275,000 spores/ml in a soltrol 170 suspension and inoculated at CREC, CHS and LREC using a modified leaf blower. All treatment rows were inoculated on July 12 at CREC, July 8 at CHS, and June 29 at LREC. Moisture was applied as needed in the form of pivot irrigation at CREC. CHS and LREC did not use any form of irrigation. During mid-season, a hail storm severely damaged the CREC research plot and no data was obtained. Disease was evaluated as the average percent leaf area covered by pustules, with the aid of assessment diagrams (Gulya et al. 1990), on the upper four leaves of ten randomly selected plants in each plot according to Shtienberg (1995). For analysis purposes, 'trace' levels of rust (>0 to 0.1%) were considered zero. Disease was evaluated at approximately R1, R5.5, R7 at CHS, and R1, R2-3, R5.8, and R6 at LREC. Yield data was obtained from the center two rows of each plot during harvest.

Fungicide Timing Treatments. To assess effectiveness of fungicide timings, both singular and sequential applications were compared. A total of seven timing applications were used; three singular applications and four sequential applications. Fungicides were applied singularly at three growth stages: V8-V12, R1, or R5.2-R5.5. Sequential treatments consisted of applications completed at V8-V12 and R1, V8-V12 and R5.2-R5.5, R1 and R5.2-5.5, or at all three growth stages. Additionally, 0.25% NIS was incorporated into each fungicide application. At all locations, 6.0 fl oz/A of Headline was used, while 4.0 fl oz/A of Folicur was used at CHS. Fungicide application dates were 14 July, 26 July, and 12 August at CHS, 18 July, 22 July, and 9 August at LREC.

Fungicide Programs. The efficacy of multiple spraying programs was evaluated at each test plot location. Two different fungicides were applied sequentially at R1 and R5.2-R5.5. Spraying programs were designed to protect the upper leaf canopy of the sunflower plant. Programs evaluated are listed below:

- 1) 4.0 fl oz/A tebuconazole (Folicur, Bayer CropScience) and 10.3 fl oz/A prothioconazole + prothioconazole & fluopyram (Propulse, Bayer CropScience)
- 2) 6.0 fl oz/A pyraclostrobin (Headline, BASF) and 6.75 or 5.5 fl oz/A pyraclostrobin + fluxapyroxad (Priaxor, BASF)
- 3) 20.0 fl oz/A penthiopyrad (Vertisan, DuPont) and 9.0 fl oz/A picoxystrobin (Approach, DuPont)
- 4) 6.0 fl oz/A pyraclostrobin (Headline, BASF) and 3.0 dry oz/A metconazole (Quash, Valent)
- 5) 4.0 fl oz/A propiconazole (Tilt, Syngenta) and 6.2 fl oz/A azoxystrobin (Quadris, Syngenta)
- 6) 4.0 fl oz/A tebuconazole (Folicur, Bayer CropScience) and 6.0 fl oz/A pyraclostrobin (Headline, BASF)
- 7) 9.0 fl oz/A picoxystrobin (Approach, DuPont) and 20.0 fl oz/A penthiopyrad (Vertisan, DuPont)

Each location incorporated at least 5 of these programs. All fungicide timings and programs were applied with backpack sprayers at 20 gpa at CHS and 9.2 gpa at LREC. Application dates were 26 July and 12 August at CHS, 22 July and 9 August at LREC.

Data analysis. Area under disease progress curve (AUDPC) and relative area under disease progress curve (rAUDPC) were calculated for each location. PROC GLM in SAS v. 9.2 was used for each rating date, AUDPC, rAUDPC, and yield. LSD mean separations were obtained at $P \leq 0.05$.

RESULTS

Disease progression varied among each location, however no location exhibited an “early” disease onset epidemic. Low levels of rust were first recorded on the lower leaves on 22 July for CHS and 11 July for LREC. Disease intensity was greater at LREC than at CHS. A significant amount of disease pressure remained in the middle canopy of the sunflowers. However, severities rarely exceeded 5% on the upper four leaves of the plants.

CHS Location. The trials conducted at CHS observed the timing effects of both Headline and Folicur, in addition to multiple spraying programs. Efficacy of Headline and Folicur did not differ, however some fungicide timings were significantly different from each other. A single application of a fungicide at V8-12 had statistically the highest AUDPC value and yield was among the lowest. Sequential applications of fungicides had lower AUDPC values than singular applications. For both AUDPC and yield, all sequential two fungicide applications were statistically equivalent to three sequential fungicide applications. Regardless of which spraying program was used, all programs had statistically lower AUDPC values than the non-treated control, but often were statistically equivalent to each other.

LREC Location. Singular and sequential timing applications of Headline and several spraying programs were evaluated at LREC. Most Headline applications produced statistically lower AUDPC values than the non-treated control. Sequential applications of Headline at V8-12, R1 and R1, R5.5 had AUDPC values statistically the same as when three applications of Headline were used. With some exceptions, statistical differences for both AUDPC and yield were rarely observed among spraying programs. Test weight was significantly increased by most fungicide applications when compared to the non-treated control. In general, the highest test weight values were observed when fungicide applications included both R1 and R5.5.

DISCUSSION

Our data supports that a single fungicide application at V8-12 is not as effective as later fungicide applications. Based off the disease progression at CHS, the most effective singular application was ~R5. However, results at LREC suggested that an R5 application was better suited when a R1 application was employed as well. Spraying program results indicated rare differences between programs, but all had statistically lower disease values than the non-treated control.

Year end severity on the upper leaves did not portray a “high severity” situation. However, disease pressure was extensive in the middle canopy perhaps indicating that year-end environmental conditions did not stimulate the progression of rust onto the upper leaves. Results from the 2010 and 2011 trials will be compared to obtain more information on the management of sunflower rust with fungicides.

REFERENCES

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- Gulya et al. 1990. Sunflower Rust – NDSU Cooperative Extension Service Publication. PP-998
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Table 1. Sunflower Rust Fungicide Trial – Cenex Harvest States-Grandin

Fungicide Timing

ID	GRANDIN 2011 SF RUST FUNGICIDE TRIAL	Disease Severity			AUDPC	rAUDPC	Yield (lbs/A)
		7/22/2011	8/18/2011	9/9/2011			
		~R1	R5.5	R7			
	Timing	r0	r1	r2			
1	V8-V12	0 a	0.23 ab	2.35 a	31.52 a	0.0064 a	1660.2 c
2	V8-V12, R1	0 a	0.04 d	1.14 bc	13.47 bc	0.0027 bc	1938.3 ab
3	V8-V12, R5.2	0 a	0.17 bc	0.62 c	11.03 bc	0.0023 bc	1941.5 ab
4	V8-V12, R1, R5.2	0 a	0.02 d	0.60 c	7.09 c	0.0014 c	2152.5 a
5	R1	0 a	0.11 cd	1.45 b	18.55 b	0.0038 b	1863.9 bc
6	R1, R5.2	0 a	0.05 d	0.58 c	7.53 c	0.0015 c	2123.0 a
7	R5.2	0 a	0.33 a	0.80 c	16.94 b	0.0035 b	1640.7 c
LSD $P=0.05$		0	0.12	0.59	8.24	0.0017	239.3

-Data obtained from Pyraclostrobin (6 fl oz) and Tebuconazole (4 fl oz) applications

Spraying Programs

ID	GRANDIN 2011 SF RUST FUNGICIDE TRIAL	Timing	Disease Severity			AUDPC	rAUDPC	Yield (lbs/A)
			7/22/2011	8/18/2011	9/9/2011			
			~R1	R5.5	R7			
	Treatment		r0	r1	r2			
7	Headline @ 6.0 fl oz, Headline @ 6.0 fl oz	2,3	0 a	0.02 c	0.74 b	8.69 bc	0.0018 bc	2250.5 a
14	Folicur @ 4.0 fl oz, Folicur @ 4.0 fl oz	2,3	0 a	0.075 bc	0.41 b	6.38 bc	0.0013 bc	1995.5 ab
17	Headline @ 6.0 fl oz, Priaxor @ 5.5 fl oz	2,3	0 a	0.01 c	0.70 b	7.82 bc	0.0016 bc	2125.2 a
18	Picoxystrobin @ 9.0 fl oz, Vertisan @ 20.0 fl oz	2,3	0 a	0.15 b	1.09 b	15.57 b	0.0032 b	1783.1 b
19	Headline @ 6.0 fl oz, Quash @ 3.0 fl oz	2,3	0 a	0.04 c	0.47 b	6.00 c	0.0012 c	2074.4 ab
20	Tilt @ 4 fl oz, Quadris @ 6.2 fl oz	2,3	0 a	0.02 c	0.58 b	6.75 bc	0.0014 bc	2043.6 ab
21	Folicur @ 4.0 fl oz, Headline @ 6.0 fl oz	2,3	0 a	0.02 c	0.51 b	6.01 c	0.0012 c	2192.4 a
22	Non-treated Control		0 a	0.40 a	2.70 a	39.56 a	0.0081 a	1430.1 c
LSD $P=0.05$			0	0.09	0.78	9.50	0.0019	293.8

Table 2. Sunflower Rust Fungicide Trial – Langdon Research Extension Center

			Disease Severity							
	LANGDON 2011		7/11/2011	7/27/2011	8/11/2011	8/22/2011				
	SF RUST FUNGICIDE TRIAL		~R1	R2-R3	R5.8	R6				
ID	Treatment	Timing	r0	r1	r2	r3	AUDPC	rAUDPC	Yield (lb/A)	TW (lbs/bu)
1	Non-treated Control		0 a	0.06 ab	1.30 a	3.73 a	38.24 a	0.0091 a	1081.6 f	18.62 g
2	Headline @ 6 fl oz	1	0 a	0.01 d	0.57 bc	2.20 b	19.59 bcd	0.0047 bcd	1535.2 cdef	19.97 ef
3	Headline @ 6 fl oz	1,2	0 a	0 d	0.25 c	1.53 cde	11.64 cde	0.0028 cde	1831.7 abcde	21.09 cde
4	Headline @ 6 fl oz	1,3	0 a	0.05 abc	1.04 ab	1.55 cde	22.75 bc	0.0054 bc	1369.4 def	20.42 ef
5	Headline @ 6 fl oz	1,2,3	0 a	0 d	0.18 c	0.64 fg	5.86 e	0.0014 e	2193.7 abc	22.52 a
6	Headline @ 6 fl oz	2	0 a	0.003 d	0.46 bc	2.43 b	19.29 bcd	0.0046 bcd	1666.0 bcdef	19.63 fg
7	Headline @ 6 fl oz	2,3	0 a	0.013 cd	0.40 bc	0.86 efg	10.07 de	0.0024 de	2132.6 abc	21.74 abcd
8	Headline @ 6 fl oz	3	0 a	0.07 a	1.4 a	1.65 cd	28.32 ab	0.0067 ab	1177.5 ef	20.47 def
9	Folicur @ 4 fl oz / Propulse @ 10.3 fl oz	2,3	0 a	0.02 cd	0.21 c	0.44 g	5.36 e	0.0013 e	2485.9 a	22.64 a
10	Headline @ 6 fl oz / Priaxor @ 6.75 fl oz	2,3	0 a	0.01 d	0.33 c	0.70 fg	8.17 de	0.0019 de	2045.4 abcd	22.02 abc
11	Vertisan @ 20 fl oz / Picoxystrobin @ 9 fl oz	2,3	0 a	0.01 d	0.39 bc	1.33 def	12.48 cde	0.0030 cde	1744.5 bcdef	21.16 bcde
12	Headline @ 6 fl oz / Quash @ 3 oz dry	2,3	0 a	0.003 d	0.23 c	0.60 fg	6.33 e	0.0015 e	2342.0 ab	22.41 ab
13	Tilt @ 4 fl oz / Quadris @ 6.2 fl oz	2,3	0 a	0.03 bcd	0.39 bc	0.78 fg	9.76 de	0.0023 de	1962.6 abcd	21.76 abcd
14	Picoxystrobin @ 9 fl oz / Vertisan @ 20 fl oz	2,3	0 a	0.003 d	0.37 bc	1.09 defg	10.80 de	0.0026 de	1936.4 abcd	20.89 cdef
LSD $P=0.05$			0	0.037	0.6995	0.731	11.62	0.0028	694.36	1.31