Field evaluation of fungicides for management of rust and Alternaria blight on safflower

Carrington, ND (2013)

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KEY FINDINGS:

- **When rust is at high levels early in the season, fungicide applications at 0.5% bloom (approx. 1 in 1000 plants with an open blossom) provide better results than fungicide applications at 95% bloom (approx. 95 in 100 plants with an open blossom).** Under the high rust disease pressure observed in this trial, it is unclear whether additional gains in disease control and yield may have been achieved by making the fungicide application prior to bloom.

- **When applied at 0.5% bloom, Headline (6 fl oz/ac), Priaxor (4 fl oz/ac), and Quadris (6 fl oz/ac) exhibited similar efficacy against rust and Alternaria in this trial.**

- **The efficacy of Priaxor, which is a premix of pyraclostrobin and fluxapyroxad, was conferred primarily by the pyraclostrobin component.** Applied alone as Xemium, fluxapyroxad did not provide satisfactory control of either rust or Alternaria; applied alone as Headline, pyraclostrobin provided excellent control of both diseases.

Active ingredients of fungicides tested in this trial:
Headline contains 250 grams pyraclostrobin per liter
Priaxor contains 333 grams pyraclostrobin + 167 grams fluxapyroxad per liter
Xemium contains 300 grams fluxapyroxad per liter
Quadris contains 250 grams azoxystrobin per liter

SUMMARY OF KEY RESULTS:

Xemium is not labeled as a solo product for use on safflower and should not be used.

Results are provided for reference only.

Treatment (application timing)[z]	Total necrosis[x] Aug. 15 percent	Rust - mid-canopy[w‡] Aug. 15 % of leaf area	Alternaria - mid-canopy[u‡] Aug. 15 % of leaf area	Yield: lbs/ac	Test weight: lbs/bu	Seeds per pound seeds/lb
				8% grain moisture		
1 **Non-treated check (**water; A**)**	33 a*	3.7 a*	1.7 a*	1657 c*	37.0 a*	16341 a*
2 **Priaxor 500SC** 4 fl oz/ac **(A)**	23 a	1.4 a	0.5 a	1955 ab	38.5 a	15057 a
3 **Headline 250SC** 6 fl oz/ac **(B)**	26 a	3.1 a	2.4 a	1725 bc	38.2 a	15440 a
4 **Headline 250SC** 6 fl oz/ac **(A)**	25 a	2.0 a	1.0 a	1889 abc	38.7 a	15537 a
5 **Xemium SC** 2.23 fl oz/ac **(A)**	26 a	2.6 a	1.5 a	1721 bc	36.7 a	17120 a
6 **Quadris 250SC** 6.0 fl oz/ac **(A)**	20 a	1.5 a	0.4 a	2024 a	36.9 a	16585 a
F:	1.01	1.02	2.80	3.19	1.90	1.61
$F > P$:	0.4440	0.4429	0.4590	0.0368	0.1548	0.2186
CV:	33.2	42.8	81.8	9.1	3.5	8.0

[z] **Fungicide application timing:**

Application A: July 23 at 8:45 to 9:05 am; safflower at 0.1% bloom, rust at high levels (95 to 100% up the height of the plant), Alternaria at moderate levels (25 to 50% up the height of the plant); wind = 1 to 2 mph out of the east, air temperature = 66 to 67°F, relative humidity = 65 to 69%

Application B: July 31 at 8:15 pm; safflower at 95% bloom (95% of plants with at least one open blossom), rust at high levels (95 to 100% up the height of the plant), Alternaria at moderate levels (50 to 75% up the height of the plant); wind = 1.5 mph, temperature = 72°F, relative humidity = 53%.

[y] **Phytotoxicity:** Percent crop injury compared to the non-treated check. A rating of zero indicates no crop injury.

[x] **Disease severity - total necrosis:** Percent of the canopy necrotic at the end of bloom on Aug. 15. Canopy necrosis was caused by a combination of rust and Atlernaria blight.

[x] **Disease severity - Rust, mid-canopy:** Percent of the leaf area covered by pustules of rust (caused by *Puccinia carthami*) in the middle of the canopy at the end of bloom on Aug. 15. From each plot, 20 arbitrarily selected leaves from the middle of the canopy were assessed.

[x] **Disease severity - Alternaria:** Percent of the leaf area exhibiting symptoms of Alternaria blight (caused by *Alternaria carthami* and *A. alternata*) at the end of bloom on Aug. 15. From each plot, 20 arbitrarily selected leaves from the middle of the canopy were assessed.

* **Within-column means followed by different letters are significantly different** (P < 0.05; Fisher's protected least significant difference).

[‡] In order to meet meet model assumptions of normality and homoskedasticity, analysis of variance was conducted on the natural-log transformation of disease severity [LN(x + 1) for data sets including values below 1]. For ease of interpretation, treatment means are reported as disease severity.

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METHODS:

- **Location of trial:** North Dakota State University Carrington Research Extension Center
- **GPS coordinates of research location:** 47.512, -99.129
- **Tillage:** Disked in October 2012. Cultivated twice (once deep, once shallow) on May 10.
- **Fertility:** 98 lbs/ac nitrogen, 6 ppm phosphorous, 131 ppm potassium, pH = 7.9, organic matter = 3.3%, 0.35 mmho/cm soluble salts at 0 to 6 inches depth, 0.32 mmho/cm soluble salts at 6 to 24 inches depth. No supplemental fertilization was conducted.
- **Soil type:** Heimdal-Emrick loam
- **Maintenance herbicide applications:** Sonalan HFP (ethalfluralin; Dow AgroSciences) was applied at 2 pts/ac in 11 gallons of water/ac at 8:45 am on May 10. It was manually incorporated twice on May 10, once with a deep cultivation and once with a shallow cultivation.
- **Variety:** Finch
- **Seed treatment**: No seed treatments were utilized.
- **Experimental design:** randomized complete block   **Replicates**: 4
- **Seeded plot size**: 5 feet (center-to-center) x 25 feet long
- **Harvested plot size**: 5 feet (center-to-center) x approx. 19 feet long
- **Untreated buffer plots were established between treatment plots.**
- **Row spacing:** 7 inches   **Rows per plot**: 7
- **Previous crop:** Spring wheat
- **Planting date:** May 12, 2013
- **Seeding rate:** 350,000 pure live seeds/ac. Seeds were planted 1 inch deep into moist soil.
- **Fungicide application A:** July 23 at 8:45 to 9:05 am; safflower at 0.1% bloom, rust at high levels (95 to 100% up the height of the plant), Alternaria at moderate levels (25 to 50% up the height of the plant); wind = 1 to 2 mph out of the east, air temperature = 66 to 67˚F, relative humidity = 65 to 69%
- **Fungicide application B:** July 31 at 8:15 pm; safflower at 95% bloom (95% of plants with at least one open blossom), rust at high levels (95 to 100% up the height of the plant), Alternaria at moderate levels (50 to 75% up the height of the plant); wind = 1.5 mph, temperature = 72˚F, relative humidity = 53%.
- **Fungicide application details:** Fungicides were applied with a 57-inch hand boom equipped with four equally spaced Spraying Systems TeeJet XR 8001VS flat-fan nozzles at a spray volume of 15 gal water/A operated at 35 psi.
- **Disease establishment:** Grain-based Alternaria inoculum was generated by soaking lentils, autoclaving the soaked lentils, and inoculating the autoclaved lentils with a spore solution harvested from 2-week-old cultures of Alternaria alternata isolated from discolored safflower seed. The grain was inoculated June 4. Grain-based Alternaria inoculum was applied to the buffer and guard plots at an application rate of 2.5 ml per square foot at 8:00 to 8:30 am on July 2, 2013 and again at an application rate of 2.5 ml per square foot at 8:30 to 9:00 pm July 13, 2013. On July 2, overhead irrigation commenced 15 minutes later; 1 inch of water was applied. On July 13, overhead irrigation commenced approx. 6 hours later; 0.5 inches of water were applied.
- **Disease assessment:** Disease assessments were conducted at the end of bloom on Aug. 15. Rust, caused by *Puccinia carthami*, and Alternaria blight, caused by *Alternaria carthami* and *A. alternata*, were important foliar diseases in this trial. Total necrosis was evalauted as the percent of the canopy necrotic. Rust was evaluated as the percent of the leaf area covered by pustules of rust at the top of the canopy and in the middle of the canopy; from each plot, 20 arbitrarily selected leaves from the top of the canopy (just below seed heads) and from the middle of the canopy were assessed. Alternaria was evaluated as the percent of the leaf area exhibiting symptoms of Alternaria blight in the middle of the canopy; from each plot, 20 arbitrarily selected leaves from the middle of the canopy were assessed.
- **Seed discoloration:** The incidence of seed discoloration was assessed by evaluating 250 seeds per plot.
- **Harvest date:** September 25
- **Statistical analysis:** Data were evaluated with analysis of variance. Seed moisture levels were assessed during grain processing after harvest, and seed yield and quality results were adjusted to 13.5% grain moisture. (1) The assumption of constant variance was assessed with Levene's test for homogeneity of variances and visually confirmed by plotting residuals against predicted values. (2) The assumption of normality was assessed the Shapiro-Wilk test and visually confirmed with a normal probability plot. (3) The assumption of additivity of main-factor effects across replicates (no replicate-by-treatment interaction) was evaluated with Tukey's test for nonadditivity. To meet model assumptions, a systematic natural-log transformation [LN(x+1) for data sets with values less than 1, otherwise LN(x)] was applied to the rust and Alternaria severity data. All other data met model assumptions without systematic transformation.   Single-degree-of-freedom contrasts were performed for all pairwise comparisons of isolates; to control the Type I error rate at the level of the experiment, Fisher's protected least significant difference was utilized. Analyses were conducted with replicate and treatment as main factor effects, and they were implemented in PROC UNIVARIATE and PROC GLM of SAS (version 9.3; SAS Institute, Cary, NC).

IMPORTANT NOTICE:

- Fungicide performance can differ in response to which diseases are present, levels of disease when products are applied, environmental conditions, plant architecture and the susceptibility to disease of the variety planted, crop growth stage at the time of fungicide application, and other factors.
- This report summarizes fungicide performance as tested at the NDSU Carrington Research Extension Center under the conditions partially summarized in this report. Fungicide efficacy may differ under other conditions; when choosing fungicides, always evaluate results from multiple trials.
- This report is shared for educational purposes and is not an endorsement of any specific products.