

# Field evaluation of fungicides for management of rust and Sclerotinia head rot on sunflowers

Carrington, ND (2013)

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## KEY FINDINGS:

**None of the fungicides evaluated in this trial showed efficacy against Sclerotinia head rot.** The poor disease control observed in this trial was likely due to the difficulty of achieving satisfactory fungicide coverage to desired target (the front of the sunflower head) when applying fungicides over the top of the sunflower canopy.

**Quash provided excellent control of sunflower rust at all application rates tested.** The relatively weak yield response to rust control observed in this trial was due to high levels of Sclerotinia head rot.

**Active ingredients of fungicides tested in this trial:**

- Approach: 250 grams picoxystrobin per liter
- Endura: 700 grams boscalid per kilogram
- Omega: 500 grams fluzazinam per liter
- Quash: 500 grams metconazole per kilogram
- Rovral: 480 grams iprodione per liter
- Switch: 250 grams fludioxonil + 375 grams cyprodinil per kilogram
- Topsin: 540 grams thiophanate-methyl per liter
- Vertisan: 200 grams penthiopyrad per liter.

**Topsin, Rovral, Omega, Switch, and Quash are not currently labeled for use on sunflowers and should not be used.** Results are provided for reference only.

## 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.

Treatment (application timing) <sup>2, y</sup>	Sclerotinia head rot					Sclerotinia head rot					Seed size			
	Sample size <sup>x</sup> Sept. 23 <sup>z</sup> plants	Incidence: <sup>w</sup> percent	Severity: <sup>v</sup> 1 to 5	Severity index: <sup>u</sup> 0 to 5	Rust severity: <sup>t</sup> percent	Sample size <sup>x</sup> Sept. 23 <sup>z</sup> plants	Incidence: <sup>w</sup> percent	Severity: <sup>v</sup> 1 to 5	Severity index: <sup>u</sup> 0 to 5	Yield 10% moisture lbs/ac	Test weight 10% moisture lbs/bu	percent >8.7 mm: <sup>q</sup>	percent >7.9 mm: <sup>q</sup>	percent >7.1 mm: <sup>q</sup>
1 Non-treated check (water, A,B)	209	61 a *	4.4 ab *	2.7 a *	1.87 b *	208	64 a *	4.8 a *	3.1 a *	1165 a *	21.9 a *	44 a *	32 a *	15 a *
2 Non-treated check (water, A,B)	202	59 a	4.2 ab	2.4 a	1.38 b	202	59 a	4.9 a	2.9 a	1236 a	22.2 a	55 a	24 a	14 a
3 Topsin 540FL 40 fl oz/ac (A,B)	220	66 a	4.3 ab	2.8 a	1.31 b	219	68 a	5.0 a	3.4 a	1278 a	22.1 a	44 a	31 a	15 a
4 Approach 250SC 20 fl oz/ac + NIS 0.25% v/v (A,B)	208	69 a	4.3 ab	2.8 a	1.02 b	208	73 a	4.9 a	3.5 a	1349 a	22.5 a	56 a	24 a	12 a
5 Endura 70WG 9 oz/ac (A,B)	215	71 a	4.2 ab	3.0 a	1.62 b	215	74 a	4.8 a	3.6 a	1403 a	21.3 a	54 a	29 a	10 a
6 Omega 500F 16 fl oz/ac (A,B)	206	73 a	4.5 b	3.3 a	1.37 b	207	74 a	4.9 a	3.6 a	935 a	21.8 a	38 a	32 a	19 a
7 Rovral 480F 2.0 pt/ac (A,B)	196	62 a	4.3 ab	2.7 a	1.17 b	196	63 a	4.8 a	3.1 a	1268 a	22.3 a	52 a	30 a	10 a
8 Switch 62.5WG 14 oz/ac (A,B)	217	63 a	4.3 ab	2.7 a	1.64 b	217	65 a	4.9 a	3.2 a	1245 a	22.2 a	54 a	28 a	11 a
9 Vertisan 200EC 20 fl oz/ac + NIS 0.25% v/v (A,B)	207	63 a	4.1 ab	2.6 a	1.52 b	208	65 a	4.8 a	3.1 a	1406 a	22.2 a	51 a	30 a	12 a
10 Quash 50WG 2 oz/ac + NIS 0.25% v/v (A,B)	217	60 a	3.9 a	2.4 a	0.12 a	217	63 a	4.8 a	3.0 a	1714 a	22.5 a	48 a	30 a	15 a
11 Quash 50WG 3 oz/ac + NIS 0.25% v/v (A,B)	211	58 a	4.5 b	2.6 a	0.10 a	211	60 a	4.8 a	2.9 a	1412 a	22.4 a	50 a	32 a	11 a
12 Quash 50WG 4 oz/ac + NIS 0.25% v/v (A,B)	206	62 a	4.3 ab	2.7 a	0.05 a	206	67 a	4.8 a	3.2 a	1406 a	21.7 a	58 a	25 a	10 a
<p><b>Fungicide application timing:</b> Application A: August 12 between 3:30 and 5:30 pm with a north wind of 7.5-9.5 mph, temperature of 77.1-74.8°, and a relative humidity of 39.8-47.2%. The sunflowers were at R5.4-R5.5. No sclerotinia was present at the time of application. Application B: August 22 between 9:00 am and 12:00 pm. Sunflowers were at R5.7 to R6.0, with no Sclerotinia head rot or stalk rot present.</p> <p><b>Inoculation:</b> Inoculations were conducted by applying 15,000 laboratory produced ascospores of <i>Sclerotinia sclerotiorum</i> to the front of each sunflower head at mid-bloom (R5.3 to R5.6) and again at late bloom (R5.7 to R5.9).</p> <p><b>Sample size:</b> The number of plants evaluated for Sclerotinia head rot and stalk rot in each treatment.</p> <p><b>Sclerotinia head rot incidence:</b> The percent of plants exhibiting Sclerotinia head rot. All plants in each plot were evaluated.</p> <p><b>Sclerotinia head rot severity:</b> Average Sclerotinia head rot severity across those plants exhibiting disease. Disease assessments were conducted on a 1 to 5 scale: 1 = 1 to 25% of head exhibiting symptoms of Sclerotinia head rot, 2 = 26 to 50% of head exhibiting symptoms of Sclerotinia head rot, 3 = 51 to 75% of head exhibiting symptoms of Sclerotinia head rot, 4 = 76 to 99% of head exhibiting symptoms of Sclerotinia head rot, and 5 = 100% of head exhibiting Sclerotinia head rot. All plants in each plot were evaluated.</p> <p><b>Sclerotinia head rot severity index:</b> Average Sclerotinia head rot severity across all plants, including those not exhibiting disease. Disease assessments were conducted on a 0 to 5 scale: 0 = no Sclerotinia head rot, 1 = 1 to 25% of head exhibiting symptoms of Sclerotinia head rot, 2 = 26 to 50% of head exhibiting symptoms of Sclerotinia head rot, 3 = 51 to 75% of head exhibiting symptoms of Sclerotinia head rot, 4 = 76 to 99% of head exhibiting symptoms of Sclerotinia head rot, and 5 = 100% of head exhibiting Sclerotinia head rot. All plants in each plot were evaluated.</p> <p><b>Rust severity:</b> Average percent of the leaf area covered by rust pustules on the top four leaves. In each plot, 10 plants were evaluated.</p> <p><b>Rust severity index:</b> Average percent of the leaf area covered by rust pustules on the top four leaves. In each plot, 10 plants were evaluated.</p> <p><b>On Sept. 19-20</b>, sunflowers were at the R7 growth stage (back of the head has started to turn a pale yellow color); on September 23, sunflowers were at the R8 growth stage (back of the head yellow but bracts still green); on October 8-9, sunflowers were at the R9 growth stage (physiological maturity).</p> <p><b>Seed size:</b> Calculating by evaluating the proportion of a 125-gram sample of cleaned seed that passed through sieves with 22/64-, 20/64-, and 18/64-inch diameter round holes.</p> <p><b>Within-column means followed by different letters are significantly different (<math>P &lt; 0.05</math>; Tukey multiple comparison procedure).</b></p>														
<p><b>F:</b> 0.62 3.28 1.39 31.70 0.62 1.39 0.91 0.98 1.14 0.73 1.16 0.68  <b>P &gt; F:</b> 0.7952 0.0073 0.2420 &lt;0.0001 0.7977 0.2420 0.5490 0.4899 0.3734 0.6992 0.3609 0.7469  <b>CV:</b> 19.4 4.2 1.9 19.2 19.6 1.9 20.0 28.3 3.0 27.2 20.0 50.0</p>														

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## METHODS:

- **Location of trial:** NDSU Carrington Research Extension Center, Carrington, ND      **GPS coordinates:** 47.508, -99.129
- **Soil type:** Heimdal-Emrick loam      **Soil preparation:** Disked once in October 2012, and cultivated on May 3 and May 8, 2013.
- **Fertilization:** 78 lbs of nitrogen were applied as urea (46-0-0) on May 8, 2013; the urea was incorporated to 2 to 3 inches with a cultivator within 3 hours of application.
- **Maintenance herbicide applications:** Spartan Charge (carfentrazone-ethyl, 3.53% by weight, and sulfentrazone, 31.77% by weight; FMC Corporation) was applied to the soil surface on May 8, 2013 at an application rate of 5 fl oz/ac in 10 gallons of water/ac. With the exception of the moderate soil disturbance caused by the double-disk drill at seeding, it was not incorporated. The soil was moist at the time of application, and rain (0.3 inches) fell early in the morning on May 9, 2013. Assure II (10 fl oz/ac; quizalofop p-ethyl, 10.3% and 0.88 lb ai/gal; DuPont Corp.) and crop oil concentrate (1% v/v; in Source COC, 83% paraffinic petroleum oil + 17% surfactant/emulsifier) were applied in 12.9 gallons of water/ac on June 26 at 9:15 to 10:30 pm to control foxtail barley and other grasses.
- **Completely randomized block design / Replicates:** 4
- **Planting date:** June 10, 2013      **Previous crop:** spring wheat      **Planting equipment:** Almaco double-disk drill
- **Hybrid:** Seeds 2000 'Jaguar' (a confection type)      **Seeding rate:** 3.44 seeds/linear foot of row = 60,000 seeds/ac
- **Final plant population:** 1 plant every 12 inches of row = 17,400 plants/ac
- \*\* The final plant population was achieved by manually thinning the sunflowers on July 1 at the V4 growth stage (four true leaves).
- **Row spacing:** 30 inches / **Rows per plot:** 2
- **Seeded plot size:** 33 feet x 5 feet      **Final plot size after alleys were cut:** approx. 29 ft x 5 ft
- **Buffer plots (2 rows wide x 33 feet long) were established between treatment plots.**
- **Maintenance insecticide applications:** To protect against damage from sunflower midge, the insecticides Cobalt Advanced (Dow Agrosiences; chlorpyrifos + lambda-cyhalothrin active ingredients; applied at 38 fl oz/ac) and Asana (DuPont; esfenvalerate active ingredient; applied at 9.6 fl oz/ac) were applied in rotation from the R1 to R4 growth stages (immature bud to early head development). Applications were made with 8003 flat-fan nozzles on July 24 (Cobalt Advanced), July 28 (Asana), and August 1 (Cobalt Advanced) in 10 gallons of water/ac at 45 psi.
- **Fungicide application methods:** Fungicides were applied with a 100-inch tractor-mounted boom equipped with five equally spaced TeeJet 8002VS nozzles at a spray volume of 14.5 gal water/A operated at 30 psi. Fungicides were applied to both rows of the treatment plot plus the outermost row of each of the adjacent buffer or guard plots (a total of four rows).
- **Fungicide application A:** August 12 between 3:30 and 5:30 pm with a north wind of 7.5-9.5 mph, temperature of 77.1-74.8°, and a relative humidity of 39.8-47.2%. The sunflowers were at R5.4-R5.5. No sclerotinia was present at the time of application.
- **Fungicide application B:** August 22 between 9:00 am and 12:00 pm. Sunflowers were at R5.7 to R6.0, with no Sclerotinia head rot or stalk rot present.
- **Inoculation methods:** \*\* Spore solutions were prepared by adding laboratory-grown ascospores of Sclerotinia sclerotiorum to 900 ml water and adding a one to two drops of Tween 20. The spore solutions were adjusted to 3,750 spores per ml. At each inoculation, 4 ml (15,000 spores) were delivered to the front of each head with a spray bottle. (A total of 30,000 spores were applied per head across both inoculation dates). The spray bottle was calibrated to deliver 4 ml per squirt. \*\* Inoculation 1 was conducted on August 14 at 8:15 to 9:15 am at R5.5 to R5.6 (50 to 60% of the disk flowers in bloom or completed bloom). \*\* Inoculation 2 was conducted on August 15 at 8:15 to 9:15 am at R5.5 to R5.7 (50 to 70% of the disk flowers in bloom or completed bloom). \*\* Inoculation 3 was conducted on August 16 at 8:30 to 9:15 am at R5.5 to R5.7 (50 to 70% of the disk flowers in bloom or completed bloom). \*\* Inoculation 4 was conducted on August 26 at 2:00 to 4:15 am at the R5.9 to R6 growth stage
- **Irrigation:** After each inoculation, the microsprinklers were run such that the heads remained wet for 24 hours subsequent to inoculation. During the daytime hours within this 24-hour period, water was applied 5 minutes every 30 minutes or continuously, as necessary; during the evening and early morning hours, water was applied 5 minutes every 30 minutes. During the remainder of the bloom period, sprinklers were run 5 minutes every 30 minutes either all day or during the evening, nighttime, and early morning hours (from approximately 8 pm until 8 am), depending on environmental conditions.
- **Seed size assessments:** Calculating by evaluating the proportion of a 125-gram sample of cleaned seed that passed through sieves with 22/64-, 20/64-, and 18/64-inch diameter round holes.
- **Sclerotinia head rot assessments:** Sclerotinia head rot assessments should be conducted at the R8 (back of the head is yellow but bracts remain green) and R9 (physiological maturity) growth stages. Evaluate all plants in both rows of each plot. Plants should be evaluated for Sclerotinia head rot on a 0 to 5 scale: 0 = no Sclerotinia head rot, 1 = 1 to 25% of head exhibiting symptoms of Sclerotinia head rot, 2 = 26 to 50% of head exhibiting symptoms of Sclerotinia head rot, 3 = 51 to 75% of head exhibiting symptoms of Sclerotinia head rot, 4 = 76 to 99% of head exhibiting symptoms of Sclerotinia head rot, and 5 = 100% of head exhibiting Sclerotinia head rot.
- **Harvest date:** October 10
- **Seed yield and quality:** Plot-level yield was assessed in pounds using the yield monitor in an Almaco plot combine, and, from each plot, subsample of approximately 400 to 600 grams of seed was collected. Seed moisture levels were determined for this sub-sample immediately after harvest. After determining seed moisture, the subsample was placed in a drier until the seed reached approx. 8% seed moisture; the subsample was weighed, cleaned to remove sclerotia and other debris, and weighed again. To account for differential levels of sclerotia and other debris across treatments, the original yield estimates from the combine's yield monitor were adjusted by multiplying by the ratio of the cleaned to uncleaned sub-sample weights. Test weight and seed size were determined using the cleaned sub-sample. Seed yield and test weight were reported at 10% seed moisture.

## FUNDING:

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