SUNFLOWER (*Helianthus annuus* proprietary inbred lines)
White mold; *Sclerotinia sclerotiorum*

J. M. Weber and L. J. du Toit,
Washington State University Mount Vernon NWREC,
Mount Vernon, WA 98273-4768.

Efficacy of fungicides for control of *Sclerotinia sclerotiorum* in a hybrid sunflower seed crop in the Columbia Basin of central Washington, 2016.

Hybrid sunflower seed production has expanded rapidly in the Columbia Basin of central Washington from ~50 acres in 2008 to >5,000 acres in 2014. The only economically important disease affecting these crops is white mold, caused by the fungus *Sclerotinia sclerotiorum*. Foliar applications of fungicides were evaluated for control of head rot and midstalk rot caused by *S. sclerotiorum* in a grower-cooperator's hybrid sunflower seed crop planted with proprietary male and female inbred lines near Ephrata, WA, using a randomized complete block design with five replications of four treatments: i) no fungicide application (control treatment), ii) Rovral Brand 4 Flowable Fungicide, iii) Topsin 4.5FL, and iv) Omega 500F. Each fungicide was applied at pre-bloom on 12 Jul, 50% bloom on 26 Jul, and petal fall on 6 Aug. Each fungicide was applied in 40 gal water/acre with 3 oz/acre of the surfactant Syl-Tac, using a 100-ft wide, tractor-mounted, spray boom. Each plot was 100 ft × 100 ft, with a 100 ft wide border on all four sides. A Burkard 7-day volumetric spore trap was used to trap ascospores of *S. sclerotiorum* on Melinex tape covered with 100:18 (w:w) petroleum jelly:paraffin wax adhesive mixture. Ascospores were detected from 12-h tape sections by extraction of ascospore DNA using a phenol:chloroform DNA extraction protocol (Europ. J. Plant Pathol. 108:877-886), followed by a real-time PCR assay for this pathogen (Plant Dis. 100:984-990). The 20 plots were surveyed weekly for apothecia in three random sections between two rows of sunflowers (each 3 m long for an area of 1.7 m^2/section). On 13 Sep, 200 contiguous sunflower plants of the center-most two female rows in each of the 20 plots were rated for white mold incidence, for a total of 400 plants/plot. At the time of rating, the male line had been removed and the female line was senescing. Each plant was rated for the presence or absence of basal stalk rot, midstalk rot, and head rot caused by *S. sclerotiorum*, and the incidence (%) of plants with each type of symptom was calculated for each plot. The total incidence of white mold was estimated by adding the incidences of basal stalk rot, midstalk rot, and head rot since infection of any one plant at more than one of the three locations was minimal to non-existent. On 13 Sep, 10 sunflower heads of the female line were harvested from each plot by harvesting the head from every fifth plant in one of the centermost female rows rated for white mold incidence. After drying, cleaning, and sizing the seed, a seed germination assay was completed for seed harvested from each plot to assess potential phytotoxicity of the fungicide treatments. For each plot, 100 seed were placed on moist blotter paper and incubated at 20ºC for 7 days in the dark in accordance with the blotter protocol of the Association of Official Seed Analysts. Counts of normal seed germination were made after 4 and 7 days, and the incidence of non-germinated, decayed, and abnormally germinated seed were counted at 7 days. Following observation of white mycelium and sclerotia on a few seed in the assay, the germination assay was repeated to quantify the number of seed infected with *S. sclerotiorum* after 7 days. Statistical analyses of the data were performed in R using the *aov* function for analysis of variance (ANOVA), and descriptive statistics (means, ranges, and standard errors) were calculated in Excel. Replications (blocks) were treated as random effects and fungicide treatments as fixed effects in the ANOVA model. Data were transformed by rank transformation and square root transformation, as needed to meet assumptions of parametric analysis.

Total white mold incidence averaged 7.5 ± 1.2% over all 20 plots, and ranged from 1.5 to 21.8%/plot, with an average of 4.9 ± 0.5% basal stalk rot incidence (1.5 to 11.8%/plot), 0.6 ± 0.3% midstalk rot incidence (0 to 4.5%/plot), and 2.1 ± 0.7% head rot incidence (0 to 9.5%/plot) for the 8,000 plants rated for white mold. The ANOVA revealed no significant foliar fungicide application effects on basal stalk rot incidence ($P = 0.1174$), midstalk rot incidence ($P = 0.1478$), head rot incidence ($P = 0.2278$), aerial (midstalk rot + head rot) disease incidence ($P = 0.1999$), or total white mold incidence ($P = 0.1072$). However, the very limited amount of white mold in this growers' seed crop prevented effective differentiation of fungicide treatment effects. The real-time PCR assays with DNA extracted from each 12-h section of Burkard spore trap tape revealed the presence of ascospores of *S. sclerotiorum* from 14 Jul to 10 Aug, which was corroborated by observation of apothecia of this fungus in the plots from 26 Jul to 9 Aug. Sunflowers are most susceptible to head rot from the beginning of bloom through two weeks after flowering, petal fall, and the beginning of seed set. Therefore, fungicide applications during that period may prove efficacious at controlling head rot if effective coverage of the face of the sunflower heads can be achieved. The seed germination assays showed that none of the fungicides had phytotoxic effects on the harvested seed. *S. sclerotiorum* was observed on 5 of 2,000 harvested seed assayed (0.25%), despite the seed being harvested from asymptomatic sunflower heads. This demonstrated the importance of treating sunflower seeds with a fungicide effective against *S. sclerotiorum* prior to planting in order to minimize the risk of introducing *S. sclerotiorum* into fields on sunflower seed.

Treatment and rate/A	Incidence of white mold (%)				
	Basal stalk	Midstalk	Head	Aerial	Total
Control	4.90	0.40	2.05	2.45	7.35
Topsin 4.5FL, 25 oz	5.10	0.10	2.05	2.15	7.25
Rovral Brand 4 Fl. Fungicide, 24 oz/A	3.05	0.00	0.10	0.10	3.15
Omega 500F, 8 oz	6.50	1.70	4.20	5.90	12.40
P value	0.12	0.15	0.23	0.20	0.11

	Germination assay of harvested seed (% of seed)				
	Normal germination	Abnormal germination	Decayed	Non-germinated	Infected with *S. sclerotiorum*
			First assay		
Control	86.6 ab[z]	7.4	1.0	5.0 ab	-[y]
Topsin 4.5FL, 25 oz/A	82.2 b	6.8	2.0	9.0 b	-
Rovral Brand 4 Fl. Fungicide, 24 oz/A	92.2 a	4.2	1.4	2.2 a	-
Omega 500F, 8 oz/A	87.2 ab	5.2	1.4	6.2 ab	-
P value	<0.01	0.23	0.72	0.05	
			Second assay		
Control	84.6	6.0	8.6	0.8	0.0
Topsin 4.5FL, 25 oz/A	83.6	7.0	8.2	1.2	0.0
Rovral Brand 4 Fl. Fungicide, 24 oz/A	90.6	3.0	6.2	0.0	0.0
Omega 500F, 8 oz/A	89.0	6.0	3.2	1.8	1.0
P value	0.20	0.34	0.06	0.14	0.10

[z] Means followed by same letter within each column for each dependent variable measured are not significantly different based on Tukey's honestly significant difference ($P < 0.05$).

[y] The incidence of seed infected with *S. sclerotiorum* was not measured in the first seed germination assay.