

BARLEY (*Hordeum vulgare*, 'ND Genesis', 'Newdale', 'AAC Synergy', 'KWS Tinka')
Fusarium head blight (scab); *Fusarium graminearum*
Spot blotch; *Bipolaris sorokiniana*
Net blotch; *Pyrenophora teres*
Leaf rust; *Puccinia hordei*
Scald; *Rhynchosporium commune*

J.A. Cummings, K.L. Myers, G.C. Bergstrom, Plant Pathology and Plant-Microbe Section, School of Integrative Plant Science, and P.J. Stachowski, Cornell Agricultural Experiment Station, Cornell University, Ithaca, NY 14853

Evaluation of integrated methods for management of Fusarium head blight and foliar diseases of spring malting barley in New York, 2017.

The trial was conducted at the Musgrave Research Farm in Aurora, NY in a Lima silt loam soil planted with four spring malting barley varieties, 'ND Genesis' (2-row), 'Newdale' (2-row), 'AAC Synergy' (2-row), and 'KWS Tinka' (2-row) on 28 Apr. The experiment was set up as a completely randomized block design with a split-plot arrangement, with cultivar as the main plot and the fungicide treatments as subplots, randomized in six replicated blocks. Main plots were sown at 100 lb/A with a commercial grain no-till drill into disked corn stubble. Subplots were 20 × 10 ft including 15 rows with 7.5-in. row spacing. The plots were fertilized at planting (200 lb/A of 10-20-20) and topdressed on 23 May (60 lb/A of urea, providing an additional 27.6 lb/A of nitrogen). The ND Genesis barley heads emerged significantly earlier than the barley heads of the other three varieties, and therefore the first fungicide application and inoculation for ND Genesis occurred 6 days before that of the other varieties, and the second ND Genesis applications occurred six days later when the first round of applications occurred for the other three varieties. Fungicides were applied to ND Genesis plots at head emergence (Feekes growth stage, FGS 10.5) on 22 Jun and 28 Jun, and to Newdale, AAC Synergy and KWS Tinka plots on 28 Jun and 5 Jul. Fungicide applications included the surfactant Induce at 0.125% v/v. After the fungicides had dried, plots were spray-inoculated with a conidial suspension of *F. graminearum* (40,000 conidia/ml) to augment the development of Fusarium head blight (FHB). Fungicide treatments and *F. graminearum* inoculum were applied by a tractor-mounted sprayer with TJ-AI3070 nozzles, 18-in. apart, pressurized at 32 psi, and calibrated to deliver 20 gal/A. Incidence and severity (percent of symptomatic spikelets on symptomatic heads) of FHB in each plot were rated on 18 Jul and used to calculate FHB Index, where FHB index = (FHB severity * FHB incidence)/100. Primarily spot blotch, caused by *Bipolaris sorokiniana*, and some net blotch, caused by *Pyrenophora teres*, were rated collectively as 'leaf blights' on 18 Jul as percent disease severity on flag leaves and one leaf below flag leaf (average rating for whole plot). Leaf rust, caused by *Puccinia hordei*, and scald, caused by *Rhynchosporium commune* were similarly rated on 18 Jul. Grain was harvested from a 20 × 5 ft area in each subplot using an Almaco plot combine on 2 Aug. Grain moisture, plot yield, and test weight was recorded from each plot. Yield and test weight was adjusted to bu/A at 14.5% moisture. Deoxynivalenol (DON) concentration (ppm) in grain was analyzed at the Mycotoxin Analysis Laboratory at the University of Minnesota, St. Paul, MN. Treatment means were calculated, subjected to analysis of variance, and separated by Tukey-Kramer HSD test ($P = 0.05$).

The 2017 growing season resulted in fairly low levels of foliar diseases, and moderately high concentrations of DON. When the results of all cultivars were combined, all fungicide treatments significantly reduced leaf rust, leaf blights and scald, but had no effect on yield, as compared to the non-treated control. Though only the double fungicide application of Prosaro followed by Caramba resulted in significantly lower FHB index than the non-treated control, all fungicide treatments resulted in significantly lower DON. However, all treatments resulted in grain with DON greater than the acceptable 1 ppm threshold. The single Caramba application was the only treatment that did not result in significantly greater test weight than the non-treated control. When the results of all treatments were combined, there were no significant differences among varieties for leaf rust or scald, but AAC Synergy had the lowest levels of leaf blights. According to visual ratings, ND Genesis resulted in the greatest FHB index, but KWS Tinka had significantly greater DON than all other varieties. The yield was similar for all varieties, but test weight was significantly greatest for ND Genesis. However, when the cultivars were analyzed separately, the FHB index and DON for the non-treated control was significantly greater for ND Genesis, Newdale and AAC Synergy, whereas the FHB index did not correlate well to the DON for KWS Tinka. Overall, these results indicate that any of these fungicide treatments can significantly reduce leaf rust, leaf blights, scald, and DON. These results also indicate that all of these varieties are susceptible to FHB, but that KWS Tinka is significantly more susceptible to FHB and accumulation of DON than the other varieties. The DON for each variety was above the 1 ppm threshold even with the double fungicide application of Prosaro at FGS 10.5 followed by Caramba a week later. This indicates that none of these varieties may be well adapted for production in NY in years of moderately high FHB disease pressure. Furthermore, since the DON results did not closely match the FHB index for the cultivars, visual ratings of FHB incidence and severity for malting barley may not be adequate predictors of DON in the final grain.

Cultivar, treatment, and amount/A	Leaf rust (%) ^z	Leaf blights (%)	Scald (%)	FHB Index	DON (ppm)	Test weight (lb/bu)	Yield (bu/A)
ND Genesis							
Non-sprayed, inoculated control	0.4 a	11.0 a	4.3 a	7.4 a	4.8 a	43.5	75.0
Prosaro 421SC (8.2 fl oz) and inoculated FGS 10.5	0.1 ab	3.7 b	3.3 a	4.1 b	3.1 b	44.6	68.8
Caramba 0.75EC (17.0 fl oz) and inoculated FGS 10.5	0.0 b	3.3 b	2.9 a	5.2 b	3.1 b	43.9	57.2
Prosaro 421SC (8.2 fl. oz) and inoculated FGS 10.5, followed by Caramba 0.75EC (17.0 fl oz) and inoculated 7 days later	0.0 b	2.3 b	0.9 a	3.6 b	1.7 c	44.6	69.4
HSD (<i>P</i> =0.05)	0.29	5.87	4.05	1.88	1.09	NS	NS
CV (%)	190.4	102.1	94.9	51.2	40.8	2.7	23.3
Newdale							
Non-sprayed, inoculated control	0.3 a	5.2 a	3.2 a	1.8 a	4.7 a	41.6	64.6
Prosaro 421SC (8.2 fl oz) and inoculated FGS 10.5	0.1 ab	2.7 b	1.3 ab	0.7 b	2.6 b	43.2	71.9
Caramba 0.75EC (17.0 fl oz) and inoculated FGS 10.5	0.0 b	2.2 b	0.7 b	0.6 b	2.9 b	40.8	72.3
Prosaro 421SC (8.2 fl. oz) and inoculated FGS 10.5, followed by Caramba 0.75EC (17.0 fl oz) and inoculated 7 days later	0.2 ab	1.8 b	0.7 b	0.4 b	1.6 b	43.0	68.9
HSD (<i>P</i> =0.05)	0.29	2.44	2.07	0.68	1.26	NS	NS
CV (%)	159.2	74.3	105.0	87.2	45.7	4.1	17.4
AAC Synergy							
Non-sprayed, inoculated control	0.1	4.3 a	1.9	1.2 a	6.3 a	41.2 b	58.7
Prosaro 421SC (8.2 fl oz) and inoculated FGS 10.5	0.1	1.7 b	0.9	0.6 b	3.5 b	42.6 ab	63.7
Caramba 0.75EC (17.0 fl oz) and inoculated FGS 10.5	0.0	1.5 b	0.8	0.5 b	4.4 b	43.0 ab	67.1
Prosaro 421SC (8.2 fl. oz) and inoculated FGS 10.5, followed by Caramba 0.75EC (17.0 fl oz) and inoculated 7 days later	0.0	1.8 b	1.2	0.4 b	1.4 c	43.5 a	62.0
HSD (<i>P</i> =0.05)	NS	1.23	NS	0.50	1.79	1.81	NS
CV (%)	338.8	60.2	75.3	80.5	54.7	3.3	25.1
KWS Tinka							
Non-sprayed, inoculated control	0.3	9.7 a	6.5 a	1.4 a	11.5 a	42.2	57.6
Prosaro 421SC (8.2 fl oz) and inoculated FGS 10.5	0.0	2.0 b	1.2 b	0.4 b	8.1 b	42.5	62.2
Caramba 0.75EC (17.0 fl oz) and inoculated FGS 10.5	0.1	3.8 b	1.3 b	0.5 ab	6.5 b	42.8	59.7
Prosaro 421SC (8.2 fl. oz) and inoculated FGS 10.5, followed by Caramba 0.75EC (17.0 fl oz) and inoculated 7 days later	0.0	1.4 b	0.5 b	0.5 ab	3.0 c	44.0	62.4
HSD (<i>P</i> =0.05)	NS	4.80	4.64	0.92	2.91	NS	NS
CV (%)	228.4	104.1	155.3	105.4	46.9	3.0	17.9
Cultivar mean							
ND Genesis	0.1	5.1 a	2.9	5.0 a	3.2 b	44.1 a	68.2
Newdale	0.1	3.0 ab	1.5	0.9 b	3.0 b	42.1 b	69.2
AAC Synergy	0.0	2.3 b	1.2	0.7 b	3.9 b	42.6 b	63.3
KWS Tinka	0.1	4.2 ab	2.4	0.7 b	7.4 a	42.9 b	60.4
HSD (<i>P</i> =0.05)	NS	2.66	NS	0.95	1.72	1.04	NS
CV (%)	206.7	102.6	127.1	128.9	65.5	3.7	21.6
Treatment mean							
Non-sprayed, inoculated control	0.3 a	7.5 a	4.0 a	2.9 a	6.8 a	42.1 c	64.3
Prosaro 421SC (8.2 fl oz) and inoculated FGS 10.5	0.1 b	2.5 b	1.7 b	1.4 ab	4.3 b	43.2 ab	66.8
Caramba 0.75EC (17.0 fl oz) and inoculated FGS 10.5	0.0 b	2.7 b	1.4 b	1.7 ab	4.2 b	42.6 bc	64.0
Prosaro 421SC (8.2 fl. oz) and inoculated FGS 10.5, followed by Caramba 0.75EC (17.0 fl oz) and inoculated 7 days later	0.0 b	1.9 b	0.8 b	1.2 b	1.9 c	43.7 a	65.7
HSD (<i>P</i> =0.05)	0.13	2.14	1.66	1.68	1.71	1.10	NS
CV (%)	206.7	102.6	127.1	128.9	65.5	3.7	21.6

^z Column numbers followed by different letters are significantly different at *P*=0.05 as determined by Tukey-Kramer HSD.