

Evaluation of Pacific Northwest winter wheat cultivars to fungicide application for control of stripe rust in 2017.

This study was conducted in a field near Pullman, WA to evaluate the control of stripe rust with fungicide applications on major winter wheat cultivars grown in the U.S. Pacific Northwest and assess yield loss caused by the disease. Ammonium nitrogen fertilizer was applied at 100 lb/A at the time of planting. Winter wheat genotype 'PS 279' was used as a susceptible check, and 23 cultivars were selected based on their acreage planted in the state of Washington in 2016 or new releases. The 24 entries were arranged in a randomized split block design based on fungicide application, with four replications. They were seeded in rows spaced 14-in. apart at 60 lb/A (99% germination rate) with a drill planter on 23 Oct 16. The plots were 4.5 ft in width and 14.9 to 16.3 ft in length. Herbicides (Huskie 15.0 fl oz/A + Axial XL 16.4 fl oz/A + M-90 10.4 fl oz/A) were applied on 21 Apr 17 when wheat plants were at the early jointing stage (Feekes 4). On 8 May 17 when most plants were at the middle jointing stage (Feekes 6), Quilt Xcel 2.2SE was sprayed at the rate of 14.0 fl oz/A mixed with 0.25% v/v M-90 in 16 gallon water/A and stripe rust had started developing on the susceptible check PS 279 plants (2-5% severity). A 601C backpack sprayer was used with a CO₂-pressurized spray boom at 18 psi having three operating ¼ in. nozzles spaced 19-in. apart. Disease severity (percentage of diseased foliage per whole plot) was assessed from each plot on 9 May at the middle jointing stage (Feekes 6), 24 May at the late jointing stage (Feekes 8), 7 Jun at the flowering stage (Feekes 10.51), and 22 Jun at the soft dough stage (Feekes 11.1) or 1, 16, 30, and 45 days after the fungicide application. Plots were harvested on 10 Aug when kernels had 3 to 5% kernel moisture and test weight of kernels was measured. Area under the disease progress curve (AUDPC) was calculated for each plot using the four sets of severity data. Relative AUDPC (rAUDPC) was calculated as percent of the non-treated control. rAUDPC, test weight, and yield data were subjected to analysis of variance, and the effect of fungicide application on rAUDPC, test weight, and yield was determined in comparison with non-sprayed plots for each cultivar by Fisher's protected LSD test.

A natural infection of stripe rust was first observed on PS 279 in early May, approximately one week earlier than normal for the area. The disease reached 30% severity in the non-sprayed susceptible check plots on 24 May (Feekes 8), 16 days after the fungicide was applied; 90% severity on 7 Jun (Feekes 10.51), 30 days after the fungicide application; and 100% on 22 Jun (Feekes 11.1), 45 days after the fungicide application in the plots of the susceptible check without fungicide application. The application of Quilt Xcel at 14 fl oz/A reduced rAUDPC by 89% in the susceptible check (PS 279) plots. The fungicide application also significantly reduced rAUDPC of 18 commercial cultivars (Xerpha, ORCF-102, Eltan, SY 107; Keldin, Whetstone, Otto, UI Sparrow; SY Ovation; Westbred 528, ARS-Crescent, Jasper, Puma, Rosalyn, Skiles, Farnum, Madsen, and Legion), but the reductions were not significant for the remaining 5 cultivars (Norwest 553, LCS Jet, Bruehl, Cara, and Bobtail) as rust severity was low in both non-sprayed and sprayed plots. The fungicide application significantly protected grain test weight of the susceptible check (PS 279) and ten cultivars (Xerpha, ORCF-102, Eltan, SY 107, Keldin, Whetstone, UI Sparrow, Jasper, Puma, and Cara) by 1.5 to 5.1 lb/bu. The fungicide application made significant yield differences for the susceptible check (95.2 bu/A more in the sprayed plots) and 12 commercial cultivars (Xerpha, ORCF-102, Eltan, SY 107, Keldin, Whetstone, Otto, UI Sparrow, SY Ovation, Westbred 528, ARS-Crescent, and LCS Jet) with 16.5 to 87.7 bu/A more grain in the sprayed plots. The remaining 11 cultivars (Norwest 553, Jasper, Puma, Rosalyn, Skiles, Farnum, Bruehl, Madsen, Cara, Bobtail, and Legion) showed adequate levels of stripe rust resistance that had insignificantly low or no reduction on yield. These data indicated that stripe rust caused yield loss of 95.2 bu/A (74.7%) on the susceptible check and 13.7% yield loss on average across the commercially grown cultivars. This study indicated that more than 50% commercial cultivars needed fungicide application under the severe stripe rust epidemic in 2017.

Wheat cultivar ^z	rAUDPC (%) ^y			Test weight (lb/bu) ^x			Yield (bu/A) ^x		
	No spray	Spray ^w	Reduction ^v	No spray	Spray ^w	Protected ^v	No spray	Spray ^w	Protected ^v
PS 279	100.0	11.0	89.0* ^u	51.2	62.6	11.4* ^u	32.3	127.5	95.2* ^u
Xerpha	61.5	14.7	46.8*	56.2	60.5	4.3*	91.2	178.9	87.7*
ORCF-102	33.6	6.9	26.7*	57.3	62.4	5.1*	105.3	163.6	58.3*
Eltan	46.5	4.6	41.9*	58.7	61.1	2.4*	103.4	154.9	51.5*
SY 107	27.3	9.7	17.6*	59.3	61.7	2.4*	117.5	156.9	39.4*
Keldin	29.7	4.6	25.1*	61.8	63.4	1.6*	122.8	162.0	39.2*
Whetstone	18.0	5.6	12.4*	60.1	62.3	2.2*	121.2	155.4	34.2*
Otto	10.2	2.9	7.3*	59.2	60.2	1.0	144.7	175.1	30.4*
UI Sparrow	15.8	4.2	11.6*	58.9	60.4	1.5*	143.9	173.4	29.5*
SY Ovation	20.5	4.9	15.6*	60.2	61.3	1.1	153.2	175.6	22.4*
Westbred 528	10.8	2.5	8.3*	62.0	63.1	1.1	147.1	166.7	19.6*
ARS-Crescent	21.1	2.2	18.9*	60.2	61.3	1.1	156.0	172.5	16.5*
Norwest 553	10.7	8.2	2.5	61.6	62.0	0.4	142.4	157.0	14.6
LCS Jet	3.8	3.2	0.6	61.0	61.7	0.7	163.5	180.2	16.7*
Jasper	10.3	3.0	7.3*	59.5	61.3	1.8*	156.5	170.8	14.3
Puma	19.4	3.6	15.8*	60.4	61.9	1.5*	146.9	155.4	8.5
Rosalyn	11.5	4.7	6.8*	59.7	60.1	0.4	152.6	166.3	13.7
Skiles	10.8	4.2	6.6*	61.0	61.5	0.5	169.0	180.6	11.6
Farnum	8.3	3.0	5.3*	61.1	61.7	0.6	121.9	128.0	6.1
Bruehl	3.8	2.5	1.3	58.9	59.5	0.6	175.5	182.2	6.7
Madsen	7.0	3.6	3.4*	61.2	61.4	0.2	154.9	157.9	3.0
Cara	1.8	1.8	0.0	58.5	60.2	1.7*	174.8	174.5	-0.3
Bobtail	4.5	2.0	2.5	59.2	60.3	1.1	180.5	177.4	-3.1
Legion	8.1	3.3	4.8*	60.3	61.2	0.9	186.4	183.0	-3.4
<i>Mean (excl. PS 279)</i>	<i>17.2</i>	<i>4.6</i>	<i>12.6*</i>	<i>59.8</i>	<i>61.3</i>	<i>1.5*</i>	<i>145.9</i>	<i>168.8</i>	<i>22.9*</i>
<i>R²</i>	<i>1.0</i>			<i>0.8</i>			<i>0.9</i>		
<i>CV</i>	<i>18.8</i>			<i>1.6</i>			<i>7.0</i>		
<i>P-value</i>	<i><0.0001</i>			<i><0.0001</i>			<i><0.0001</i>		
<i>LSD (P ≤ 0.05)</i>	<i>3.4</i>			<i>1.4</i>			<i>15.0</i>		

^z Wheat genotype PS 279 was used as a susceptible check, and the remaining 23 cultivars were selected based on their planted acreage in the State of Washington in 2016, which were also major cultivars planted in Idaho and Oregon.

^y AUDPC is area under disease progress curve, = $\sum[\text{rust severity (i)} + \text{rust severity (i+1)}]/2 \times \text{days}$, calculated using severity data recorded four times at Feekes 6 (9 May), Feekes 8 (24 May), Feekes 10.51 (7 Jun), and Feekes 11.1 (22 Jun). Stripe rust severity was recorded as percentage of whole plot leaf area with disease. Relative AUDPC (rAUDPC) was calculated for each treatment as the percent of the AUDPC (as 100%) of the susceptible check without fungicide application.

^x Test weight (lb/bu) and yield (bu/A) based on 3 to 5% kernel moisture.

^w Fungicide, Quilt Xcel 2.2 SE, was sprayed at the rate of 14.0 fl oz/A mixed with surfactant M-90 0.25% v/v on 8 May when the plants were at the middle jointing stage (Feekes 6) and stripe rust started developing on the susceptible check PS 279 plants (2-5% severity).

^v The reduction value of rAUDPC (%) was calculated by subtracting the mean of the sprayed plots from the mean of the non-sprayed plots for each cultivar, and the protected or increased value of test weight (lb/bu) or yield (bu/A) was calculated by subtracting the mean of non-sprayed plots from the mean of the sprayed plots for each cultivar as the benefits of the fungicide application.

^u The “*” indicates that the value is significant at $P = 0.05$ as determined by LSD test.