

Responses of winter wheat cultivars to fungicide application for control of stripe rust in 2015.

To determine the responses of winter wheat cultivars with various levels of stripe rust resistance grown in the U.S. Pacific Northwest to fungicide application for control of stripe rust, this study was conducted in a field near Pullman, WA. Urea (46N-0P-0K) 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 2014 or new releases. The 24 entries were arranged in a randomized complete block design with a split block based on spray or not spray and with four replications. They were seeded in rows spaced 14-in. apart at 60 lb/A (99% germination rate) with a drill planter on 17 Oct 14. The plots were 4.5 ft in width and 13.0 to 17.0 ft in length. Urea (46N-0P-0K) at 100 lb/A was applied on 1 May 15 at the early stage (Feekes 4 to 5) and herbicides (Huskie 15.0 fl oz/A + Axial XL 16.4 fl oz/A + M-90 10.4 fl oz/A) were applied on 7 May when wheat plants were at the early jointing stage (Feekes 5). Fungicide, Quilt 1.66 SE, was sprayed at the rate of 11.0 fl oz/A mixed with M-90 at the rate of 1% v/v in 16 gallon water/A on 6 May when most plants were at the early jointing stage (Feekes 5) and stripe rust appeared in the spreader rows of PS 279 surrounding the plots. 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 6 May at early jointing stage, 26 May at heading stage, 12 Jun at milk stage, and 27 Jun at soft dough stage or 0, 20, 37, and 52 days after the fungicide application. Plots were harvested on 5 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 three 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 reduction and test weight and yield increases for each cultivar was determined by Fisher's protected LSD test.

A natural infection of stripe rust was first observed on PS 279 on 28 Apr, approximately two weeks earlier than normal for the area. The disease reached 5 to 30% severity in the non-sprayed susceptible check plots on 26 May (heading stage), 20 days after the fungicide was applied, and 100% on 12 Jun (milk stage) in the plots of the susceptible check without fungicide application. The single, early fungicide application protected the wheat for approximately one month, but did not provide an adequate control for the susceptible check as stripe rust developed to 80 to 90% severity in the PS 279 plots even following the fungicide application. The fungicide application significantly reduced the rAUDPC for the susceptible check, but the reduction was only 24.8%. The fungicide application also significantly reduced rAUDPC for cultivars Xerpha, Tubbs 06, Mary, and ORCL-103, but the reductions were not significant for the remaining 19 cultivars with greater levels of resistance as rust severity was low in both non-sprayed and sprayed plots. For test weight, none of the cultivars, including the susceptible check, had a significant increase as a result of the fungicide application. The fungicide application increased yield by 1.05 to 28.81 bu/A in 18 cultivars, but only significant for the susceptible check. The fungicide application decreased yield by 1.5 to 5.9% in the remaining six cultivars (ARS-Amber, Cara, Madsen, Otto, Skiles, and Norwest 553), but none of the yield reductions were significant. Based on the yield data of the non-sprayed and sprayed plots, stripe rust caused yield losses from -5.85 to 28.81 bu/A (-4.45 to 27.63%), and fungicide application increased yield by -4.26 to 38.18%. This study indicated that under the stripe rust severity level in 2015, resistance in most cultivars was adequate.

Wheat cultivar ^z	rAUDPC (%) ^y			Test weight (lb/bu) ^x			Yield (bu/A) ^x		
	No spray	Spray ^w	Reduction ^v	No spray	Spray ^w	Increase ^v	No spray	Spray ^w	Increase ^v
PS 279	100.0	75.2	24.8** ^u	52.9	54.6	1.7 ^u	75.5	104.3	28.8** ^u
Eltan	11.9	7.3	4.6	55.5	56.8	1.2	121.8	134.2	12.3
Xerpha	26.4	14.3	12.1*	54.3	55.5	1.2	123.2	135.6	12.4
Tubbs 06	21.7	11.7	10.0*	52.3	53.8	1.5	122.1	136.4	14.3
ORCF-102	18.6	11.6	7.0	54.3	55.3	1.0	124.0	135.8	11.8
ARS-Amber	5.8	4.0	1.9	55.8	55.8	0.0	145.9	144.4	-1.5
ARS-Crystal	11.1	9.1	2.0	54.4	55.2	0.9	130.0	137.0	7.0
Mary	23.3	9.3	14.0*	54.3	55.9	1.6	140.6	149.9	9.3
Bauermeister	20.8	14.5	6.3	55.2	56.6	1.4	115.2	125.8	10.7
Stephens	17.2	15.1	2.1	54.0	55.7	1.7	132.1	133.4	1.3
Westbred 528	5.7	2.8	2.9	58.3	58.5	0.3	146.8	149.7	2.9
Puma	12.8	7.0	5.8	54.8	56.1	1.3	134.0	139.4	5.5
Cara	2.6	2.6	0.0	54.0	55.0	1.0	148.6	144.1	-4.5
AP700CL	2.8	3.1	-0.2	56.4	55.8	-0.6	144.7	148.9	4.2
ORCF-103	21.3	13.0	8.3*	53.9	54.8	1.0	119.9	122.5	2.6
Farnum	3.5	2.8	0.6	55.8	56.2	0.3	108.3	110.9	2.6
Chuckar	2.8	2.8	0.0	52.6	53.0	0.4	141.6	146.6	5.0
Madsen	2.8	3.1	-0.2	56.0	56.1	0.1	132.9	130.4	-2.5
LCS-Artdeco	3.8	3.0	0.8	56.2	57.2	1.0	165.5	166.6	1.1
Bruehl	2.8	2.6	0.2	52.0	52.4	0.4	136.6	139.6	2.9
Otto	3.7	2.6	1.1	55.5	55.9	0.4	137.3	131.5	-5.9
Skiles	4.6	3.8	0.9	57.0	56.1	-0.8	149.1	147.1	-2.0
ARS-Crescent	8.6	4.7	3.9	54.7	54.8	0.1	136.2	148.5	12.3
Norwest 553	4.1	2.6	1.5	60.5	60.3	-0.3	142.1	138.9	-3.2
R ²	0.9			0.7			0.6		
CV	45.1			2.7			10.2		
P-value	<0.0001			<0.0001			<0.0001		
LSD (<i>P</i> ≤ 0.05)	7.5			2.1			19.3		

^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 2014, 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 early jointing stage (6 May), heading stage (26 May), milk (12 Jun), and soft dough stage (27 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 (lb/A) based on 3 to 5% kernel moisture.

^w Fungicide, Quilt 1.66 SE, was sprayed at the rate of 11.0 fl oz/A mixed with surfactant M-90 at the rate of 1% v/v on 6 May when the plants were at the early jointing stage (Feekes 5) and stripe rust just appeared in the spreader rows of the susceptible check PS 279 surrounding the plots.

^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 increase 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.