

Evaluation of spring wheat cultivars to fungicide application for control of stripe rust in 2016.

A study was conducted in a field near Pullman, WA to evaluate the control of stripe rust with fungicide applications on spring wheat cultivars and assess their yield loss caused by the disease. Spring wheat genotype 'Avocet S' (AvS) was used as a susceptible check, and 15 spring wheat cultivars were selected based on their acreage planted in the state of Washington in 2015 or new releases. The 16 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 3 May 16. The plots were 4.5 ft in width and 15.0 to 16.9 ft in length. Urea (46N-0P-0K) was applied at 100 lb/A on 27 May when plants were at tillering stage (Feekes 2). Herbicides (Huskie 15.0 fl oz/A + Axial XL 16.4 fl oz/A + M-90 10.4 fl oz/A) were applied on 30 May when wheat plants were at the tillering stage (Feekes 2-3). Fungicide, Quilt 1.66SE, was sprayed at the rate of 14.0 fl oz/A mixed with M-90 at the rate of 14.0 fl oz/A in 16 gallon water/A on 7 Jun when most plants were at the early jointing stage (Feekes 4) and the susceptible check had 5-10% severity of stripe rust. Plants were sprayed again at the same rate on 22 Jun (15 days after the first application) when the plants were at the late jointing stage (Feekes 8-9) and stripe rust reached 40-60% severity in the non-treated susceptible check 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 8 Jun at the tillering stage, 20 Jun at the jointing stage, 5 Jul at the flowering, and 18 Jul at the soft dough stage or at 1, 13, 28, and 41 days after the first fungicide application. Plots were harvested on 23 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 AvS in late May when plants were at the early tillering stage (Feekes 2). The disease reached 90-95% severity in the non-sprayed susceptible check plots on 5 Jul at the flowering stage, 31 days after the first fungicide application, and 100% on 18 Jul at the soft dough stage in the plots of the susceptible check without fungicide application. The two applications of Quilt at 14 fl oz/A controlled 92% of the stripe rust based on the susceptible check AvS. The fungicide applications significantly reduced the rAUDPC for all cultivars, except cultivars Espresso and JD that were highly resistant to stripe rust. The fungicide applications significantly increased grain test weight of the susceptible check (AvS), but not of any of the commercially grown cultivars. The fungicide applications significantly increased the grain yields of the susceptible check and eight of the commercially grown cultivars (Babe, Alpowa, Jefferson, WB-1035CL+, Nick, Whit, WB Fuzion, and Louise), and the increases ranged from 14.9 to 41.4 bu/A (17.8-73.9%), whereas the seven remaining cultivars (Kelse, Solano, Buck Pronto, Espresso, Glee, Diva, and JD) did not have significant yield increases by the fungicide applications. These data indicate stripe rust caused yield loss of 40.9 bu/A (54.5%) on the susceptible check and 19.9% on average across the commercially grown cultivars, excluding the susceptible check. This study indicated that under the severe stripe rust epidemic in 2016, about 50% of the spring wheat cultivars had adequate levels of resistance and the other 50% of the cultivars needed two applications of fungicides to protect yield.

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
AvS	100.0	7.9	92.2* ^u	56.2	61.6	5.4* ^u	34.1	75.0	40.9* ^u
Babe	33.9	6.8	27.1*	59.1	60.2	1.1	56.0	97.4	41.4*
Alpowa	34.0	6.8	27.2*	59.5	58.1	-1.4	60.0	97.6	37.6*
Jefferson	38.3	5.3	33.0*	61.3	61.0	-0.3	65.5	98.1	32.7*
WB-1035CL+	37.8	9.9	27.8*	59.5	61.2	1.7	47.2	75.1	27.9*
Nick	37.4	8.4	29.0*	60.0	61.8	1.8	54.5	81.2	26.7*
Whit	25.6	6.7	19.0*	61.0	61.3	0.3	70.2	93.6	23.4*
WB Fuzion	41.7	4.8	36.9*	60.2	61.7	1.5	53.4	74.8	21.4*
Louise	21.3	5.5	15.8*	60.5	59.7	-0.8	84.0	99.0	14.9*
Kelse	25.7	6.2	19.5*	61.1	61.0	-0.1	67.9	81.2	13.3
Solano	18.7	5.9	12.9*	60.4	59.1	-1.4	68.2	80.7	12.5
Buck Pronto	27.2	9.3	17.9*	60.8	61.2	0.4	57.4	63.6	6.2
Expresso	13.3	5.6	7.7	57.5	57.1	-0.5	92.6	97.6	5.0
Glee	17.0	8.5	8.5*	62.4	62.5	0.1	82.7	83.8	1.1
Diva	17.5	6.9	10.6*	60.0	60.0	0.0	89.9	90.8	0.9
JD	5.0	4.2	0.8	61.6	61.7	0.1	82.4	80.0	-2.5
R ²	0.9			0.5			0.8		
CV	30.2			2.9			13.9		
P-value	<0.0001			<0.0001			<0.0001		
LSD ($P \leq 0.05$)	8.0			2.5			14.9		

^z Wheat genotype 'Avocet S' (AvS) was used as a susceptible check, and the remaining 15 cultivars were selected based on their planted acreage in the State of Washington in 2015, which were also major cultivars planted in Idaho and Oregon.

^y AUDPC is area under disease progress curve, = $\sum[\text{rust severity (i)} + \text{rust severity (i+1)}]/2 * \text{days}$, calculated using severity data recorded four times at the tillering stage (8 Jun), jointing stage (20 Jun), flowering (5 Jul), and soft dough stage (18 Jul). 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 1.66 SE, was sprayed at the rate of 14.0 fl oz/A mixed with surfactant M90 at the rate of 14.0 fl oz/A on 7 Jun when most cultivars were at the early jointing stage (Feekes 4) and susceptible check AvS plants had 5-10% severity and sprayed again at the same rate on 22 Jun (15 days after the first application) when the plants were mostly at the late jointing stage (Feekes 8-9) and stripe rust reached 40-60% severity in the non-treated susceptible check 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.