

Effects of fungicide application on control of stripe rust on spring wheat cultivars in 2014.

To determine the effects of fungicide application on control of stripe rust on individual spring wheat cultivars with various levels of resistance grown in the U.S. Pacific Northwest, this study was conducted in a field near Pullman, WA in 2014. Fertilizer urea (46N-0K-0K) was applied at 125 lb/A at the time of planting on 6 May, which was later than the normal planting in April. Spring wheat genotype 'Avocet S' was used as a susceptible check and 15 spring wheat cultivars, which accounted for more than 95% of the total spring wheat acreage in the State of Washington in 2013, were selected based on their previous acreage. These genotype and cultivars were seeded in rows spaced 14-in. apart at 80 lb/A (99% germination rate) with a drill planter. The plots were 4.5 ft in width and 13.6 to 17.5 ft in length. Herbicides (Curtail 78 fl oz/A; Huskie, 32 fl oz/A; Axial, 40 fl oz/A; and M-90, 20 fl oz/A) were applied on 22 May when wheat plants were at late tillering stage (Feekes 3). As stripe rust was predicted to be low in 2014, the field was inoculated with a mixture of urediniospores of locally predominant races PSTv-14 and PSTv-37 of *Puccinia striiformis* f. sp. *tritici* on 27 May when plants were at early jointing stage (Feekes 4). Fungicide Quilt 1.66 SE was sprayed at the rate of 14.0 fl oz/A mixed with surfactant M-90 at the rate of 1% v/v in 16 gallon water/A on 30 Jun when most plants were at heading stage (Feekes 10.1) and stripe rust was 25 to 30% severity on the susceptible check Avocet S. 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. A randomized complete block design was employed with a split block based on spray or not spray and with four replications. Disease severity (percentage of diseased foliage per whole plot) was assessed for each plot on 1 Jul at heading stage, 14 Jul at milk stage, 21 Jul at soft dough stage, and 6 Aug at dough stage or one day after the fungicide application and 14, 21, and 36 days after application. Plots were harvested on 29 Aug when kernels had 3 to 5% kernel moisture and test weight of kernels was measured. Area under 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.

The artificial inoculation of the experimental field resulted in an adequate level of stripe rust for differentiating resistance levels of wheat cultivars and determining fungicide effects. The disease reached 25 to 30% severity on 1 Jul at heading stage and 100% on 14 Jul at milk stage in the plots of the susceptible check without fungicide application. The fungicide application in this field was later than normally recommended application of 5% disease severity. Despite the delayed application, fungicide protected the varieties throughout the remaining growing season as no obvious re-development of stripe rust in the sprayed plots up to dough stage was observed. The fungicide application significantly reduced rAUDPC for the susceptible check Avocet S and all cultivars, except Expresso. For susceptible cultivars (Avocet S, Nick, WB Fuzion, WB-1035CL+, SY605CL, and Jefferson), rAUDPC was reduced by 70.07 to 82.37%. For test weight, five cultivars (Avocet S, Nick, WB Fuzion, WB-1035CL+, and Babe) had significant increases in sprayed plots compared to the no-sprayed plots, while the remaining eleven cultivars did not show significant differences in test weight between the spray and non-spray plots. The fungicide application significantly increased grain yield for the susceptible check (14.89 bu/A, or 60.38%) and seven commercially grown cultivars 7.82-13.21 bu/A, 15.60 to 28.75%). Based on the yield data of the no-sprayed and sprayed plots, stripe rust caused yield losses from 0.53 to 14.89 bu/A (0.96 to 37.65%) with a mean of 6.73 bu/A (12.03%), and fungicide application increased yield by 0.97 to 60.38% with a mean of 13.68%. If only commercially grown cultivars are considered and weighted by their planted acreages in WA, the mean yield loss is estimated as 8.16%. Due to the hot and drought conditions during the summer, the yield of spring wheat was much lower than those of the recent years. As stripe rust was low in commercial field, fungicides were not needed in most spring wheat fields in 2014. These data can be used in the future to guide stripe rust management based on individual cultivars.

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
Avocet S	100.00	23.62	76.38*^u	52.76	58.61	5.85*^u	24.66	39.55	14.89*^u
Nick	95.26	16.57	78.69*	54.94	58.01	3.07*	45.94	59.15	13.21*
WB Fuzion	95.54	13.17	82.37*	55.30	56.81	1.51*	41.90	53.87	11.97*
WB-1035CL+	98.94	23.60	75.34*	54.20	55.97	1.77*	38.57	48.38	9.81*
SY605CL	91.24	23.14	68.10*	59.00	60.02	1.02	42.03	51.53	9.50*
Babe	27.14	6.25	20.89*	56.14	58.01	1.87*	39.79	47.79	8.00*
Solano	7.49	2.24	5.25*	59.56	59.45	-0.11	54.06	62.56	8.50*
Jefferson	93.39	23.32	70.07*	57.87	58.57	0.70	50.12	57.94	7.82*
Diva	14.28	8.16	6.12*	57.38	57.83	0.45	50.95	57.34	6.39
Whit	24.68	17.80	6.88*	57.91	58.93	1.02	56.04	60.92	4.88
Cabernet	15.02	5.03	9.99*	58.96	59.66	0.70	50.15	53.34	3.19
BR-7030	13.65	4.73	8.92*	58.93	59.70	0.77	64.89	68.69	3.80
Espresso	1.42	1.16	0.26	58.57	57.94	-0.63	55.98	58.95	2.97
Buck Pronto	9.86	4.55	5.31*	57.76	58.40	0.64	64.74	66.46	1.72
Kelse	22.35	12.13	10.22*	58.40	58.82	0.42	53.40	53.97	0.57
Louse	15.43	7.99	7.44*	55.82	56.56	0.74	54.53	55.06	0.53
<i>R</i> ²	0.99			0.78			0.81		
CV	9.38			1.80			9.80		
<i>P</i> -value	<0.0001			<0.0001			<0.0001		
LSD (<i>P</i> ≤ 0.05)	3.78			1.46			7.24		

^z Wheat genotype Avocet S was used as a susceptible check, and the remaining 15 cultivars were selected based on their planted acreages, which were planted in 93.95% of the total spring wheat acreage (519,860 acres) in Washington in 2013 and were also major spring wheat cultivars planted in Idaho.

^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 heading stage (1 Jul), milk stage (14 Jul), soft dough stage (21 Jul), and dough stage (6 Aug). 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 3-5% kernel moisture.

^w Fungicide Quilt 1.66 SE was sprayed at the rate of 14.0 fl oz/A mixed with surfactant M-90 at the rate of 1% v/v on 30 Jun when most cultivars were at heading stage and stripe rust was 25 to 30% severity on the susceptible check Avocet S.

^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.