

Evaluation of foliar fungicide treatments for control of stripe rust on winter wheat in 2017.

The study was conducted in a field with Palouse silt loam soil near Pullman, WA. Stripe rust susceptible 'PS 279' winter wheat was seeded in rows spaced 14-in. apart at 60 lb/A (99% germination rate) with a drill planter on 19 Oct 16. Urea fertilizer (46-0-0) was applied at the rate of 100 lb/A at the time of planting. Herbicides (Huskie, 15 fl oz/A, Axial XL, 16.4 fl oz/A, and M-90, 10.4 fl oz/A) were applied to the entire field to control weeds on 21 Apr 17 when wheat plants were at the early jointing stage (Feekes 4). Before the first fungicide application, the field was divided into individual plots of 4.5 ft (4 rows) in width and 15.1 to 17.2 ft in length by eliminating plants between plots by spraying herbicide (Glystar, 88.7 ml/gal plus M-90 0.25% v/v) on 10 May. Fungicides were applied in 16 gal water/A on different dates and stages depending upon the treatment. The first fungicide application timing at the early jointing stage (Feekes 5) was made on 19 May when stripe rust was 5 to 15% severity in every plot. The second application timing at the boot stage (Feekes 10) was conducted on 2 Jun when stripe rust in the plots without first fungicide application reached 90% severity. A 601C backpack sprayer was used with a CO₂-pressurized spray boom at 18 psi having three operating 0.25-in. nozzles spaced 19-in. apart. A randomized complete block design was used with four replications. Disease severity (percentage of diseased foliage per whole plot) was assessed from each plot on 18 May, 30 May, 12 Jun, 27 Jun (data not presented), and 3 Jul or 1 day before and 11, 24, 39, and 45 days after the first fungicide application timing, respectively. Plots were harvested on 8 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 five sets of severity data. Relative AUDPC (rAUDPC) was calculated as percent of the non-treated check. Rust severity, rAUDPC, test weight, and yield data were subjected to analysis of variance and means were separated by Fisher's protected LSD test.

Stripe rust from natural infection started developing in the plots in early April when plants were at the early jointing stage (Feekes 4) and reached 90% and 100% severity in late May at the boot and middle Jun at flowering stages, respectively in the non-treated check plots. The rAUDPC values of all treatments were significantly less than the non-treated check. Eight treatments (Quilt Xcel 7.0 fl oz/A applied at Feekes 5 followed by Quilt Xcel 14.0 fl oz/A applied at Feekes 10, Trivapro 9.0 fl oz/A applied at Feekes 5 followed by Trivapro 13.7 fl oz/A at Feekes 10, Trivapro 9.4 fl oz/A applied at Feekes 5 followed by Trivapro 13.7 fl oz/A at Feekes 10, Topguard EQ 7.0 fl oz/A applied at Feekes 5 followed by Topguard EQ 7.0 fl oz/A applied at Feekes 10, Topguard 10.0 fl oz/A applied at Feekes 5 followed by Topguard EQ 14.0 fl oz/A applied at Feekes 10, Aproach 3.0 fl oz/A applied at Feekes 5 followed by Aproach 6.0 fl oz/A applied at Feekes 10, Aproach Prima 5.5 fl oz/A applied at Feekes 5 followed by Aproach 6.0 fl oz/A plus Tilt 4.0 fl oz/A applied at Feekes 10, and Tilt 4.0 fl oz/A at Feekes 5 followed by Quilt Xcel 14.0 fl oz/A at Feekes 10) provided the best control of stripe rust. Ten treatments had significantly greater test weight than the non-treated check, and all seven treatments with only an early application and six treatments with both early and late applications did not have significantly greater test weight than the non-treated check. All treatments significantly increased yield compared with the non-treated check, and the significant increases ranged from 19.5 bu/A (89%) by the treatment of Tilt 2.0 fl oz/A applied at Feekes 5 to 53.5 bu/A (243%) by the treatment of Trivapro 9.4 fl oz/A applied at Feekes 5 followed by Trivapro 13.7 fl oz/A applied at Feekes 10.

Treatment, rate/A	Growth stage ^y (Feekes)	Stripe rust severity (%) ^z					Relative AUDPC ^x	Test weight ^w (lb/bu)	Yield ^w (bu/A)
		18 May Jointing	30 May Boot	12 Jun Flowering	3 Jul dough				
Non-treated	---	11.3 a ^v	87.5 a	100.0 a	100.0 a	100.0 a	56.7 g-i	22.0 k	
Tilt 3.6EC, 2.0 fl oz ^t	5	10.0 ab	13.8 fg	45.0 bc	100.0 a	52.7 b	56.9 f-i	41.5 j	
Alto 100SL, 4.0 fl oz ^t	5	8.8 ab	17.5 ef	40.0 b-d	100.0 a	52.6 b	56.5 hi	38.4 gh	
Quilt Xcel 2.2SE, 7.0 fl oz ^t	5	10.0 ab	11.3 f-h	42.5 b-d	97.5 a	48.8 b-e	58.4 b-i	44.4 h-j	
Trivapro 2.2SE, 9.0 fl oz ^t	5	7.5 ab	6.3 hi	47.5 b	100.0 a	57.7 b-d	55.8 i	48.2 gh	
Trivapro 2.2SE, 9.4 fl oz ^t	5	8.8 ab	7.5 g-i	45.0 bc	100.0 a	51.1 b-d	57.8 c-i	48.0 g-i	
Alto 100SL, 4.0 fl oz ^t fb ^u Trivapro 2.2SE, 13.7 fl oz ^t	5 fb ^u 10	11.3 a	15.0 ef	18.8 f-h	15.0 c-f	18.9 g-i	58.3 b-i	65.2 bc	
Quilt Xcel 2.2SE, 7.0 fl oz ^t fb Quilt Xcel 2.2SE, 14.0 fl oz ^t	5 fb 10	8.8 ab	4.3 i	10.0 hi	13.8 c-g	10.5 k	59.5 a-f	64.6 bc	
Trivapro 2.2SE, 9.0 fl oz ^t fb Trivapro 2.2SE, 13.7 fl oz ^t	5 fb 10	7.5 ab	7.5 g-i	12.5 g-i	13.8 c-g	12.9 jk	62.2 a	64.5 bc	
Trivapro 2.2SE, 9.4 fl oz ^t fb Trivapro 2.2SE, 13.7 fl oz ^t	5 fb 10	7.5 ab	7.5 g-i	8.8 i	8.8 fg	9.8 k	59.9 a-e	75.5 a	
Topguard EQ, 7.0 fl oz fb Topguard EQ, 7.0 fl oz	5 fb 10	6.3 ab	13.8 fg	15.0 g-i	10.0 e-g	14.9 i-k	60.1 a-d	68.2 b	
Topguard 1.04SC, 10.0 fl oz fb Topguard 1.04SC, 14.0 fl oz	5 fb 10	8.8 ab	17.5 ef	12.5 g-i	11.3 d-g	15.1 i-k	58.3 c-i	58.9 de	
Topguard EQ, 7.0 fl oz fb Topguard 1.04SC, 14.0 fl oz	5 fb 10	10.0 ab	21.3 de	21.3 fg	17.5 cd	22.1 f-h	59.2 b-h	62.7 cd	
F9654-1, 5.54 fl oz fb Topguard EQ, 7.0 fl oz	5 fb 10	7.5 ab	28.8 c	17.5 f-i	10.0 e-g	20.8 gh	59.9 a-e	63.9 b-d	
F9654-1, 3.0 fl oz fb Topguard 1.04SC, 14.0 fl oz	5 fb 10	5.0 b	27.5 cd	25.0 ef	17.5 cd	23.2 fg	57.4 d-i	51.2 fg	
F9654-1, 5.54 fl oz fb F9654-1, 5.54 fl oz	5 fb 10	7.5 ab	26.3 cd	12.5 g-i	37.5 b	26.5 f	58.2 ci	55.7 ef	
Tilt 3.6EC, 4.0 fl oz ^t fb Tilt 3.6EC, 4.0 fl oz ^t	5 fb 10	10.0 ab	11.3 f-h	15.0 g-i	18.8 c	17.1 h-j	59.4 b-g	58.5 de	
Approach 2.08SC, 3.0 fl oz ^t fb Approach 2.08SC, 6.0 fl oz ^t	5 fb 10	7.5 ab	6.3 hi	11.3 hi	16.3 ce	12.5 jk	59.8 a-e	63.2 b-d	
Approach Prima 280SC, 5.5 fl oz ^t fb Approach 2.08SC, 6.0 fl oz + Tilt 3.6EC, 4.0 fl oz ^t	5 fb 10	8.8 ab	6.3 hi	8.8 i	7.5 g	10.5 jk	60.4 a-c	61.9 cd	
Tilt 3.6EC, 4.0 fl oz ^t	5	7.5 ab	13.8 fg	42.5 b-d	97.5 a	51.9 bc	57.2 e-i	42.6 ij	
Tilt 3.6EC, 4.0 fl oz ^t	10	7.5 ab	70.0 b	42.5 b-d	18.8 c	44.9 e	60.0 a-e	43.0 ij	
Quilt Xcel 2.2SE, 14.0 fl oz ^t	5	6.3 ab	7.5 g-i	33.8 de	97.5 a	46.6 c-e	58.6 b-h	46.4 g-j	
Quilt Xcel 2.2SE, 14.0 fl oz ^t	10	8.8 ab	75.0 b	37.5 cd	17.5 cd	46.3 de	60.1 a-d	45.6 hj	
Tilt 3.6EC, 4.0 fl oz ^t fb Quilt Xcel 2.2SE, 14.0 fl oz ^t	5 fb 10	6.3 ab	12.5 f-h	12.5 g-i	7.5 g	13.1 jk	61.0 ab	60.6 ce	
CV	---	45.1	20.8	25.1	10.4	11.7	3.3	7.1	
<i>p</i> -value	---	0.8	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
LSD (<i>P</i> ≤ 0.05)	---	5.3	6.3	10.0	6.3	5.3	2.7	5.4	

^z Stripe rust severity was recorded as percentage of whole plot leaf area with disease.

^y The first application at Feekes 5 was done on 19 May when wheat plants were at the early jointing stage; and the second application at Feekes 10 was done on 2 June when wheat plants were at the boot stage.

^x AUDPC is area under the disease progress curve, = $\sum[\text{rust severity (i)} + \text{rust severity (i+1)}]/2 \times \text{days}$. Relative AUDPC was calculated for each treatment as the percent of the AUDPC (as 100%) of the nontreated.

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

^v Column numbers followed by the same letter are not significantly different at *P* = 0.05 as determined by LSD test.

^u fb, followed by.

^t Nonionic surfactant (NIS) M-90 was mixed with the fungicide at 0.25%.