

Control of stripe rust of winter wheat with foliar fungicides in 2016.

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 12 Oct 15. Ammonia 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 22 Apr 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 15.3 to 16.6 ft in length by eliminating plants between plots by spraying herbicide (Alecto, 24 fl oz/A) on 5 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 10 May when stripe rust was 2 to 5% severity in the field. The second application was done at the boot stage (Feekes 10) on 24 May when stripe rust in the plots without first fungicide application reached 80% severity. The third application was done at the heading stage (Feekes 10.2) on 31 May when stripe rust in the plots without previous fungicide applications reached 95% 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 10 May, 23 May, 6 Jun, 15 Jun (data not presented), and 29 Jun or 0, 13, 27, 36, and 50 days after the first fungicide application timing, respectively. Plots were harvested on 15 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 late April when plants were at the early jointing stage (Feekes 4) and reached 80% and 100% severity at the boot and flowering stages, respectively in the non-treated check plots. The rAUDPC values of all treatments were significantly less than the non-treated check, except treatment A21573A at 11.4 fl oz/A applied at Feekes 10.2. Four treatments, Trivapro 9.4 fl oz/A applied at Feekes 5 followed by Trivapro 13.7 fl oz/A at Feekes 10, Quilt Xcel 7.0 fl oz/A 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 Quilt Xcel 10.5 fl oz/A at Feekes 10, and Quilt Xcel 10.5 fl oz/A applied at Feekes 5 followed by Quilt Xcel 10.5 fl oz/A at Feekes 10 provided the best control of stripe rust. Only treatments applied at the early jointing stage (Feekes 5) had significantly low test weight compared to those with the later applications. The treatments that provided the best control of stripe rust did not significantly increase test weight compared to the untreated check, likely due to the fact that the small kernels increased density. Except the treatment of Preemptor 6.0 fl oz/A applied at Feekes 10 and A21573A 11.4 fl oz/A applied at Feekes 10.2, all treatments significantly increased yield compared with the non-treated check, and the significant increases ranged from 19 bu/A (164%) by the treatment of Topguard 10.0 fl oz/A applied at Feekes 10 to 91 bu/A (797%) by the treatment of Trivapro 9.4 fl oz/A applied at Feekes 5 followed by Quilt Xcel 10.5 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)
		10 May Jointing	23 May Boot	6 Jun Flowering	29 Jun dough			
Non-treated	---	2.0 b ^v	80.0 a	100.0 a	100.0 a	100.0 a	58.7 ab	11.5 k
Topguard 1.04SC, 6.0 fl oz ^s	5	2.5 ab	15.0 de	90.0 a-d	100.0 a	75.8 cd	56.2 de	39.2 g-i
Preemptor 3.22SC, 3.0 fl oz	5	2.0 b	12.5 d-f	95.0 ab	100.0 a	76.3 cd	56.2 de	43.7 g-i
Topguard 1.04SC, 3.0 fl oz	5	2.3 ab	15.0 de	95.0 ab	100.0 a	77.2 cd	53.5 f	48.6 fg
Quilt Xcel 2.2SE, 7.0 fl oz ^t	5	2.3 ab	11.3 d-g	95.0 ab	100.0 a	75.6 cd	55.3 ef	63.8 c-e
Trivapro 2.2SE, 9.4 fl oz ^t	5	2.3 ab	3.5 g	92.5 a-c	100.0 a	72.7 d	54.9 ef	60.3 d-f
Trivapro 2.2SE, 13.7 fl oz ^t	5	2.3 ab	7.5 e-g	87.5 b-d	100.0 ab	71.6 d	54.8 ef	71.3 cd
Alto 100SL, 4.0 fl oz ^t	5	2.8 ab	8.8 e-g	95.0 ab	100.0 a	75.2 cd	55.8 e	59.6 d-f
Tilt 3.6EC, 4.0 fl oz ^t	5	3.0 ab	17.5 d	92.5 a-c	100.0 a	77.1 cd	56.3 c-e	52.4 e-g
Topguard 1.04SC, 10.0 fl oz	10	2.0 b	75.0 ab	87.5 b-d	67.5 c	83.0 bc	58.5 ab	30.3 ij
Preemptor 3.22SC, 6.0 fl oz	10	2.8 ab	65.0 c	82.5 cd	72.5 c	78.5 cd	58.5 ab	22.0 jk
Topguard 1.04SC, 6.0 fl oz	10	2.5 ab	80.0 a	85.0 b-d	80.0 bc	88.2 b	58.1 a-d	32.4 i-j
Twinline 210EC, 9.0 fl oz	10	2.0 b	72.5 a-c	22.5 fg	22.5 d	40.7 fg	59.0 ab	39.8 g-i
Trivapro 2.2SE, 13.7 fl oz ^t	10	2.3 ab	80.0 a	20.0 f-h	20.0 de	43.2 f	58.6 ab	47.2 f-h
A21461A 300SE, 13.7 fl oz ^t	10	3.5 a	80.0 a	17.5 gh	20.0 de	43.7 f	59.8 a	47.9 fg
A21573A 125/150SE 11.4 fl oz ^t	10	2.8 ab	70.0 bc	10.0 hi	17.5 d-g	34.3 g	59.7 ab	32.4 h-j
A21573A 125/150SE 11.4 fl oz ^t	10.2	2.3 ab	75.0 ab	100.0 a	100.0 a	98.4 a	59.1 ab	23.6 jk
Preemptor 3.22SC, 3.0 fl oz fb ^u Preemptor 3.22SC, 6.0 fl oz	5 fb ^u 10	2.8 ab	7.5 e-g	30.0 f	30.0 d	24.9 h	58.3 ab	52.5 e-g
Topguard 1.04SC, 3.0 fl oz fb Topguard 1.04SC, 10.0 fl oz	5 fb 10	2.3 ab	10.0 d-g	42.5 e	18.8 d-f	26.2 h	57.6 b-d	76.4 bc
Trivapro 2.2SE, 9.4 fl oz ^t fb Trivapro 2.2SE, 13.7 fl oz ^t	5 fb 10	2.8 ab	3.5 g	5.0 i	5.0 g	5.6 i	59.1 ab	102.4 a
Quilt Xcel 2.2SE, 7.0 fl oz ^t fb Trivapro 2.2SE, 13.7 fl oz ^t	5 fb 10	3.3 ab	7.5 e-g	5.0 i	7.5 e-g	7.8 i	59.1 ab	92.8 a
Trivapro 2.2SE, 9.4 fl oz ^t fb A21573A 125/150SE 11.4 fl oz ^t	5 fb 10.2	2.3 ab	5.5 fg	80.0 d	87.5 ab	63.2 e	58.5 ab	72.2 cd
Trivapro 2.2SE, 9.4 fl oz ^t fb Quilt Xcel 2.2SE, 10.5 fl oz ^t	5 fb 10	3.0 ab	6.3 fg	10.0 hi	6.3 fg	8.9 i	58.1 a-c	102.8 a
Quilt Xcel 2.2SE, 7.0 fl oz ^t fb Quilt Xcel 2.2SE, 10.5 fl oz ^t	5 fb 10	3.0 ab	5.5 fg	5.0 i	7.5 f	7.8 i	59.3 ab	90.5 ab
CV	---	40.1	16.4	14.5	14.7	9.7	2.3	16.4
<i>p</i> -value	---	0.8	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
LSD (<i>P</i> ≤ 0.05)	---	1.4	7.9	12.3	12.6	7.8	1.9	15.0

^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 10 May when wheat plants were at the early jointing stage; the second application at Feekes 10 was done on 24 May when wheat plants were at the boot stage; and the last application at Feekes 10.2 was done on 31 May when wheat plants were at the heading 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 Crop oil concentrate (COC) SL 1% v/v mixed with the fungicide.