

### Evaluation of foliar fungicides for control of stripe rust on winter wheat in 2020.

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 31 Oct 19. Urea fertilizer (46-0-0) was applied at the rate of 100 lb/A at the time of planting and at the same rate on 22 Apr 20 when plants at the late tillering stage (Feekes 3). Herbicides (Huskie, 15 fl oz/A, Axial XL, 16.4 fl oz/A, Starane Flex, 13.5 fl oz/A, and M-90, 10.4 fl oz/A) were applied to the entire field to control weeds on 8 May 20 when wheat plants were at the late tillering to early stem elongation stage (Feekes 5-6). Before the first fungicide application, the field was divided into individual plots of 4.5-ft (4 rows) in width and 15.5 to 16.4-ft in length by eliminating plants between plots by spraying herbicide (Glystar, 88.7 ml/gal plus M-90 0.25% v/v). Fungicides were applied in 16 gal water/A on different dates and stages depending upon the treatment. The first fungicide application timing at the late jointing stage (Feekes 8) was made on 28 May when stripe rust was just appearing (1-2% severity) in all plots. The second application timing at the boot-heading stage (Feekes 10.1) was conducted on 11 Jun when stripe rust was 10% severity in unsprayed plots. A 601C backpack sprayer was used with a CO<sub>2</sub>-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 for each plot on 27 May, 10 Jun, 24 Jun, and 30 Jun or 1 day before and 13, 27, and 33 days after the first fungicide application timing, respectively. Plots were harvested on 11 Aug when kernels had 13 to 15% kernel moisture, and test weight of kernels was measured. Area under disease progress curve (AUDPC) was calculated for each plot using the four 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 was observed as 1-2% severity in all plots on 27 May 20, one day before the first fungicide application, and reached 100% severity at the milk stage in the non-treated check plots by 30 Jun. The rAUDPC values of all fungicide treatments were significantly less than the non-treated check. Six treatments (Proline 5.0 fl oz/A at Feekes 8 followed by Proline 5.0 fl oz/A at Feekes 10.1, Tilt 4.0 fl oz/A at Feekes 8 followed by Tilt 4.0 fl oz/A at Feekes 10.1, Topguard EQ 7.0 fl oz/A followed by Lucento 5.5 fl oz/A at Feekes 10.1, Trivapro 9.4 fl oz/A at Feekes 8 followed by Trivapro 13.7 fl oz/A at Feekes 10.1, Quilt Xcel 14.0 fl oz/A at Feekes 8 followed by Quilt Xcel 14.0 fl oz/A at Feekes 10.1, and Trivapro 13.7 fl oz/A at Feekes 8 followed by Trivapro 13.7 fl oz/A at Feekes 10.1) provided the best control of stripe rust. All treatments had higher test weight than the non-treated check, and the treatments of two applications had higher test weight than those of one application except Quilt Xcel 14.0 fl oz/A at Feekes 10.1. All treatments produced yield higher than the non-treated check with nine treatments (Lucento 5.5 fl oz/A at Feekes 8 followed by Topguard EQ 7.0 fl oz/A at Feekes 10.1, Tilt 4.0 fl oz/A at Feekes 8 followed by Tilt 4.0 at Feekes 10.1, Alto 4.0 at Feekes 8 followed by Trivapro 13.7 fl oz/A at Feekes 10.1, Topguard EQ 7.0 fl oz/A at Feekes 8 followed by Lucento 5.5 fl oz/A at Feekes 10.1, ADA 77906 – H 26.6 fl oz/A at Feekes 8 followed by ADA 77906 – H 26.6 fl oz/A at Feekes 10.1, ADA 77906 – L 22.8 fl oz/A at Feekes 8 followed by ADA 77906 – L 22.8 fl oz/A at Feekes 10.1, Trivapro 9.4 fl oz/A at Feekes 8 followed by Trivapro 13.7 fl oz/A at Feekes 10.1, Quilt Xcel 14.0 fl oz/A at Feekes 8 followed by Quilt Xcel 14.0 fl oz/A at Feekes 10.1, and Trivapro 13.7 fl oz/A at Feekes 8 followed by Trivapro 13.7 fl oz/A at Feekes 10.1) producing the highest yields. The significant yield responses ranged from 21.8 bu/A (42.1%) by the treatment of Lucento 5.5 fl oz/A at Feekes 10.1 to 59.7 bu/A (115.3%) by the treatment of Trivapro 13.7 fl oz/A at Feekes 8 followed by Trivapro 13.7 fl oz/A at Feekes 10.1.

Treatment, rate/A	Growth stage <sup>y</sup> (Feekes)	Stripe rust severity (%) <sup>z</sup>				Relative AUDPC <sup>x</sup>	Test weight <sup>w</sup> (lb/bu)	Yield <sup>w</sup> (bu/A)
		27 May L. joint.	10 Jun Heading	24 Jun Flower.	30 Jun Milk			
Non-treated	---	1.0 a <sup>v</sup>	10.0 a	98.8 a	100.0 a	100.0 a	52.7 g	51.8 g
Lucento 4.17SC, 5.5 fl oz	10.1	1.0 a	10.0 a	78.8 b	88.8 b	83.7 b	57.5 f	73.6 f
Tilt 3.6EC, 4.0 fl oz <sup>u</sup>	10.1	1.0 a	10.0 a	78.8 b	82.5 c	82.4 bc	59.6 de	80.6 e
Quilt Xcel 2.2SE, 14.0 fl oz <sup>u</sup>	10.1	1.0 a	9.8 ab	71.3 c	76.3 d	75.6 d	60.5 b-e	82.2 e
Topguard EQ 4.29SC, 7.0 fl oz	10.1	1.0 a	8.8 ab	73.8 bc	76.3 d	76.4 cd	59.6 e	85.2 e
Lucento 4.17SC, 5.5 fl oz fb <sup>t</sup> Lucento 4.17SC, 5.5 fl oz	8 fb 10.1	1.0 a	4.0 e-h	12.5 d-f	26.3 e	18.6 e	61.5 a-c	97.4 d
ADA 77901, 9.5 fl oz fb ADA 77901, 9.5 fl oz	8 fb 10.1	1.3 a	7.3 b-d	7.5 fg	12.5 gh	15.5 ef	61.4 a-c	100.0 cd
Topguard EQ 4.29SC, 7.0 fl oz fb Topguard EQ 4.29SC, 7.0 fl oz	8 fb 10.1	1.3 a	2.3 d-i	7.5 fg	11.3 g-i	10.4 fg	61.3 a-c	101.5 b-d
ADA 77906 – M, 24.7 fl oz fb ADA 77906 – M, 24.7 fl oz	8 fb 10.1	1.0 a	8.0 a-c	8.0 e-g	12.5 gh	16.5 e	62.3 a	101.9 b-d
Tilt 3.6EC, 4.0 fl oz <sup>u</sup> fb QUILT XCEL 2.2SE, 14.0 fl oz <sup>u</sup>	8 fb 10.1	1.3 a	2.3 d-i	5.0 g	5.0 j	7.4 h	62.3 a	103.0 b-d
Proline 480SC, 5.0 fl oz fb Proline 480SC, 5.0 fl oz	8 fb 10.1	1.5 a	4.8 d-g	8.8 e-g	11.3 g-i	13.8 e-g	61.1 a-c	103.5 b-d
Lucento 4.17SC, 5.5 fl oz fb Topguard EQ 4.29SC, 7.0 fl oz	8 fb 10.1	1.0 a	3.3 e-i	16.3 d	20.0 f	19.2 e	61.3 a-c	105.4 a-c
Tilt 3.6EC, 4.0 fl oz <sup>u</sup> fb Tilt 3.6EC, 4.0 fl oz <sup>u</sup>	8 fb 10.1	1.0 a	2.5 f-i	5.5 g	8.8 h-j	8.6 gh	61.0 a-d	105.6 a-c
Alto 100SL, 4.0 fl oz <sup>u</sup> fb Trivapro 2.2SE, 13.7 fl oz <sup>u</sup>	8 fb 10.1	1.3 a	2.3 g-i	13.8 de	15.0 fg	15.5 ef	61.8 a-c	105.7 a-c
Topguard EQ 4.29SC, 7.0 fl oz fb Lucento 4.17SC, 5.5 fl oz	8 fb 10.1	1.0 a	2.3 g-i	3.8 g	11.3 g-i	7.6 h	60.4 c-e	106.2 a-c
ADA 77906 – H, 26.6 fl oz fb ADA 77906 – H, 26.6 fl oz	8 fb 10.1	1.0 a	5.5 c-e	4.3 g	5.0 j	9.9 fg	61.8 a-c	107.4 ab
ADA 77906 – L, 22.8 fl oz fb ADA 77906 – L, 22.8 fl oz	8 fb 10.1	1.0 a	5.0 d-f	4.3 g	6.3 ij	9.6 fg	61.8 a-c	107.5 ab
Trivapro 2.2SE, 9.4 fl oz <sup>u</sup> fb Trivapro 2.2SE, 13.7 fl oz <sup>u</sup>	8 fb 10.1	1.3 a	1.3 i	3.3 g	4.5 j	5.1 h	61.8 a-c	110.4 a
Quilt Xcel 2.2SE, 14.0 fl oz fb Quilt Xcel 2.2SE, 14.0 fl oz	8 fb 10.1	1.5 a	2.5 f-i	4.0 g	5.0 j	7.0 h	61.8 a-c	110.6 a
Trivapro 2.2SE, 13.7 fl oz fb Trivapro 2.2SE, 13.7 fl oz	8 fb 10.1	1.0 a	1.5 hi	3.0 g	3.3 j	4.8 h	61.9 ab	111.5 a
CV	---	32.3	35.1	17.0	13.7	14.6	1.7	4.7
<i>p</i> -value	---	0.6	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
LSD ( $P \leq 0.05$ )	---	0.5	2.6	6.1	5.6	6.1	1.4	6.4

<sup>z</sup> Stripe rust severity was recorded as percentage of whole plot leaf area with disease.

<sup>y</sup> The first application at Feekes 8 was done on 28 May when wheat plants were at the late jointing stage; and the second application at Feekes 10.1 was done on 11 Jun when wheat plants were at the boot-heading stage.

<sup>x</sup> 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 non-treated.

<sup>w</sup> Test weight (lb/bu) and yield (bu/A) based on 13 to 15% kernel moisture.

<sup>v</sup> Column numbers followed by the same letter are not significantly different at  $P = 0.05$  as determined by Fischer's Protected LSD test.

<sup>u</sup> Non-ionic surfactant (NIS) M-90 was mixed with the fungicide at 0.25% v/v.

<sup>t</sup> fb, followed by.