

Control of stripe rust of winter wheat with various foliar fungicides, 2014.

The study was conducted in a field with Palouse silt loam soil near Pullman, WA. Fertilizer (Osmocota 14-14-14) was applied at 60 lb/A at the time of cultivation on 18 Oct 2013. 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 18 Oct 2013. Nitrogen fertilizer (46-0-0, 125 lb/A) and herbicides (Huskie, 15 fl oz/A, Axial, 12 fl oz/A, and M-90, 14 fl oz/A) were applied on 8 May 2014 when wheat plants were at the early jointing stage. 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 16 Apr 2014 when plants were at the late tillering stage (Feekes 3). Before the first fungicide application, the field was divided into individual plots of 4.5 ft (4 rows) in width and 11.5 to 16.5 ft in length by eliminating plants between plots with a rototiller. 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 13 May when stripe rust was 0 to 2% severity in the field. The second application was done at the late jointing stage (Feekes 8) on 30 May when stripe rust in the plots without first fungicide application reached 5 to 15% severity. 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 block design was used with four replications. Disease severity (percentage of diseased foliage per whole plot) was assessed from each plot on 27 May, 10 Jun, 24 Jun, 3 Jul (data not presented), and 14 Jul or 14, 28, 42, 51, and 62 days after the first fungicide application timing, respectively. Plots were harvested on 6 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 control. 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 reached 100% severity in the nontreated check plots approximately 78 days after inoculation or 51 days after the first application. Stripe rust developed slowly as the weather was hot and dry in June and July. All fungicide treatments significantly reduced rust severity compared to the nontreated at the flowering stage (Feekes 10.5). The rAUDPC values of all treatments were significantly less than the nontreated. Among all treatments, the treatment of Aproach 3.0 fl oz/A at Feekes 5 followed by Aproach 6.8 fl oz/A at Feekes 8 provided the best disease control, but all other treatments had similar control, except the three treatments with Equation and the treatment with Quadris 8.0 fl oz at Feekes 8. All treatments, except Quadris 8.0 fl oz/A at Feekes 8, significantly increased test weight compared to the nontreated. The treatment of A15457 2.74 fl oz/A + Tilt 2.72 fl oz/A + Quadris 4.1 fl oz/A at Feekes 5 followed by Quilt Xcel 10.5 fl oz/A at Feekes 8 produced the highest test weight, and the test weights of all other treatments, except the treatments of Equation 4.0 fl oz, Equation 8.0 fl oz, and Quadris 8.0 fl oz at Feekes 8, were not significantly different from one another. Except the treatment of CHA-073 10.5 fl oz, all treatments significantly increased yield compared with the nontreated, and the significant increases ranged from 24.68% by the treatment of Equation 16.0 fl oz/A at Feekes 8 to 54.30% by the treatment of Tilt 2.0 fl oz/A at Feekes 5 followed by Quilt Xcel 10.5 fl oz/A at Feekes 8. The yields of the treatments of Quilt Xcel 10.5 fl oz/A at Feekes 8 and of Aproach 3.0 fl oz/A at Feekes 5 followed by Aproach 6.8 fl oz/A at Feekes 8 were not significantly different from the highest yield.

| Treatment; rate [fl oz/A] | Growth stage ^y (Feekes) | Stripe rust severity (%) ^z | | | | | Relative AUDPC ^x | Test weight ^w (lb/bu) | Yield ^w (bu/A) |
|---|------------------------------------|---------------------------------------|-------------|------------------|--------------|----------|-----------------------------|----------------------------------|---------------------------|
| | | 27 May Jointing | 10 Jun Boot | 24 Jun Flowering | 14 Jul Dough | | | | |
| Nontreated | --- | 6.3 a ^v | 20.0 a | 83.8 a | 100.0 a | 100.0 a | 56.4 e | 63.9 g | |
| A15457 100 EC; 2.74 oz + Tilt 3.6 EC; 2.72 oz + Quadris 250 SC; 4.1 oz fb Quilt Xcel 2.2 SE; 10.5 oz ^u | 5 fb 8 | 0.0 b | 1.8 d | 4.3 ef | 4.3 e | 4.9 f | 59.3 a | 89.9 e | |
| Approach 2.08 SC; 3.0 oz fb Approach 2.08 SC; 6.8 oz ^s | 5 fb 8 | 0.0 b | 1.5 d | 3.5 f | 4.3 e | 4.5 f | 58.8 ab | 94.6 ab | |
| Approach 2.08 SC; 3.0 oz + Tilt 3.6 EC; 4.0 oz fb Approach 2.08 SC; 6.0 oz + Tilt 3.6 EC; 4.0 oz ^s | 5 fb 8 | 0.0 b | 2.5 cd | 5.0 ef | 5.0 e | 6.0 f | 58.6 ab | 87.5 b-f | |
| Tilt 3.6 EC; 2.0 oz fb ^t Quilt Xcel 2.2 SE; 10.5 oz ^u | 5 fb ^t 8 | 0.0 b | 2.5 cd | 5.0 ef | 5.0 e | 6.0 ef | 58.9 a | 98.7 a | |
| Tilt 3.6 EC; 2.0 oz fb Quilt Xcel 2.2 SE; 10.5 oz + A15457 100 EC; 4.1 ^u | 5 fb 8 | 0.0 b | 2.8 cd | 5.0 ef | 5.0 e | 6.1 f | 58.7 ab | 87.7 b-f | |
| A15457 100 EC; 2.74 oz + Tilt 3.6 EC; 4.0 oz ^u | 8 | 5.8 a | 5.0 bcd | 7.5 ef | 7.5 de | 11.0 ef | 58.9 a | 84.3 c-f | |
| A15457 100 EC; 4.1 oz + Tilt 3.6 EC; 4.0 oz + Quadris 250 SC; 6.0 oz ^u | 8 | 6.5 a | 5.0 bcd | 6.3 ef | 6.3 de | 9.9 f | 59.0 a | 85.3 c-f | |
| Approach Prima 2.34 SC; 6.8 oz ^s | 8 | 5.0 ab | 6.3 bcd | 8.8 ef | 8.8 de | 12.6 ef | 59.1 a | 81.0 ef | |
| CHA-073 2.2 SC; 7.0 oz | 8 | 6.8 a | 9.3 a-d | 13.0 c-f | 13.8 de | 18.9 d-f | 59.0 a | 87.4 b-f | |
| CHA-073 2.2 SC; 10.5 oz | 8 | 6.3 a | 8.8 a-d | 10.0 def | 8.8 de | 14.6 ef | 59.0 a | 67.9 g | |
| CHA-073 2.2 SC; 14.0 oz | 8 | 5.3 ab | 8.0 a-d | 8.8 ef | 6.3 de | 12.1 ef | 59.0 a | 88.2 b-f | |
| HM 0812; 10.5 oz | 8 | 6.3 a | 6.3 bcd | 12.5 c-f | 8.8 de | 14.4 ef | 59.2 a | 86.5 b-f | |
| HM 0812; 14.0 oz | 8 | 5.0 ab | 8.8 a-d | 12.5 c-f | 11.3 de | 16.7 def | 58.9 a | 88.7 b-e | |
| Equation 2.08 SC; 4.0 oz | 8 | 6.8 a | 18.0 ab | 21.3 bcd | 26.3 bc | 33.3 bc | 58.0 bc | 81.9 def | |
| Equation 2.08 SC; 8.0 oz | 8 | 6.3 a | 20.0 a | 26.3 b | 30.0 b | 38.3 bc | 57.3 cd | 80.7 ef | |
| Equation 2.08 SC; 16.0 oz | 8 | 6.8 a | 15.5 abc | 23.8 bc | 17.5 cd | 28.4 b-e | 58.8 ab | 79.7 f | |
| Quadris 2.08 SC; 8.0 oz | 8 | 6.5 a | 20.0 a | 27.5 b | 35.0 b | 41.6 b | 56.7 de | 83.8 c-f | |
| Quilt Xcel 2.2 SE; 10.5 oz ^u | 8 | 4.3 ab | 5.0 bcd | 8.8 ef | 8.8 de | 11.8 ef | 58.9 a | 91.6 abc | |
| Quilt Xcel 2.2 SC; 10.5 oz | 8 | 7.0 a | 11.3 a-d | 16.3 b-e | 12.5 de | 20.6 c-f | 58.6 ab | 88.9 b-e | |
| Quilt Xcel 2.2 SE; 10.5 oz + A15457 100 EC; 4.1 oz ^u | 8 | 5.8 a | 6.3 bcd | 7.5 ef | 7.5 de | 11.6 f | 59.1 a | 86.6 b-f | |
| Viathon 5.1 SC; 32 oz ^t | 8 | 8.0 a | 13.0 a-d | 16.3 b-e | 13.8 de | 22.3 c-f | 59.1 a | 82.3 def | |
| <i>R</i> ² | --- | 0.40 | 0.36 | 0.83 | 0.89 | 0.77 | 0.68 | 0.67 | |
| CV | --- | 79.38 | 104.13 | 57.50 | 53.09 | 63.86 | 1.06 | 7.20 | |
| <i>p</i> -value | --- | 0.01 | 0.04 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | |
| LSD (<i>P</i> ≤ 0.05) | --- | 5.31 | 13.18 | 12.30 | 11.79 | 13.25 | 0.88 | 8.62 | |

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

^z The first application at Feekes 5 was done on 13 May when wheat plants were at the early jointing stage and the second application at Feekes 8 was done on 30 May when wheat plants were at the late jointing 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 (lb/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 Crop oil concentrate (COC) SL 1% v/v mixed with the fungicide.

^t fb, followed by.

^s Non-ionic (NIS) 90% SL 25% v/v tank mixed with the fungicide.