# Section 2: Barley Scab Research

One of the primary research objectives of the Virginia Tech barley breeding program is to identify and develop cultivars possessing resistance to Fusarium head blight (FHB) or scab. Each year all barley and hulless barley entries in Virginia's Official State Variety Trials are evaluated for FHB resistance in an inoculated, irrigated nursery at a Mount Holly test site. This year, due to irrigation difficulties, the nursery was not irrigated. Insignificant scab data was collected, so data from last year and 2014 are being presented instead to aid producers in the selection of cultivars on the basis of FHB resistance. Cultivars possessing complete resistance or immunity to FHB have not been identified and resistance levels in currently available cultivars vary from moderately resistant to highly susceptible.

A major goal of the breeding program is to identify and incorporate unique and complementary types of FHB resistance into cultivars to enhance the overall level of resistance. Incorporating multiple resistance genes having additive effects on FHB resistance into cultivars will enhance the overall level of resistance. Because the individual resistance genes are located on different barley chromosomes and each gene confers only partial resistance to FHB, identifying lines having multiple resistance genes is difficult using traditional breeding techniques. To overcome this limitation, our program will incorporate the available markers to help select FHB resistant cultivars.

Entries were inoculated by spreading scabby corn seeds in plots at the booting stage. A high level of FHB infection was obtained in 2015. Among 21 hulless lines and varieties tested in 2015, the FHB index ranged from 35 to 75 with FHB incidence ranging from 95% to 100% and FHB severity from 35% to 75% (Table 17). One two-row hulless line (VA12HFHB-89(2R)) had a similar FHB Index to the resistant variety 'Eve'. Two two-row hulless lines (VA09H-110(2R) and VA10H-79WS(2R)) showed FHB index lower than moderately resistant variety 'Dan'. However, VA10H-79WS(2R) had a DON content of 14.7 ppm higher than Eve (4.3 ppm) and Dan (6.2 ppm) averaged over 2013 and 2014. Based on two year mean data for 2014 and 2015 (Table 18), four lines and two varieties had FHB index values lower than the test mean (<30.6). Eve had the lowest DON content (4.6 ppm) followed by VA12FHB-89(2R) (4.6 ppm), Dan (8.6 ppm) and VA09H-110(2R) (6.8 ppm).

A high FHB infection level was obtained for hulled barley in 2015. Among 34 barley lines and varieties tested in 2015, the FHB index varied from 37.5 to 72.5. Thirteen lines and five varieties had FHB index values lower than the mean (<52.5) in 2015 (Table 19). Based on two year mean data for 2014 and 2015 (Table 20), seven lines and four varieties had FHB index values lower than the test mean (<27.8) and DON content values lower than the test mean (15.3 ppm) averaged over 2013 and 2014 (except for VA12B-8 and Violetta which had DON content values only from 2014).

**Table 17. Summary of reaction of entries in the Virginia Tech State Hulless Barley Test to Fusarium head blight (scab), 2015 harvest.**

| LINE | FHB Incidence[1] (%) | FHB Severity[2] (%) | FHB Index[3] (0-100) | Rank FHB Index | Date Headed (Julian) |
|---|---|---|---|---|---|
| VA12HFHB-89(2R) | 100.0 | 35.0 - | 35.0 - | 1 | 118.0 |
| **Eve** | 100.0 | 35.0 - | 35.0 - | 2 | 117.0 |
| VA09H-110(2R) | 95.0 - | 37.5 - | 35.8 - | 3 | 120.0 |
| VA10H-79WS(2R) | 100.0 | 40.0 - | 40.0 - | 4 | 119.0 |
| **Dan** | 100.0 | 45.0 | 45.0 | 5 | 119.5 |
| VA08H-79WS | 100.0 | 47.5 | 47.5 | 6 | 121.5 |
| VA13H-49 | 100.0 | 47.5 | 47.5 | 7 | 117.5 |
| VA12H-84 | 100.0 | 52.5 | 52.5 | 8 | 116.5 |
| VA08H-65 | 100.0 | 55.0 | 55.0 | 9 | 119.0 |
| VA13H-38 | 100.0 | 55.0 | 55.0 | 10 | 117.5 |
| VA13H-34 | 100.0 | 57.5 | 57.5 | 11 | 118.5 |
| VA13H-39 | 100.0 | 57.5 | 57.5 | 12 | 115.5 |
| VA13H-25 | 100.0 | 60.0 | 60.0 | 13 | 120.0 |
| **Amaze 10** | 100.0 | 60.0 | 60.0 | 14 | 119.5 |
| VA06H-25 | 100.0 | 62.5 | 62.5 | 15 | 120.5 |
| VA06H-79 | 100.0 | 62.5 | 62.5 | 16 | 119.5 |
| VA10H-33 | 100.0 | 62.5 | 62.5 | 17 | 117.5 |
| VA10H-57 | 100.0 | 65.0 | 65.0 | 18 | 118.5 |
| VA11H-34 | 100.0 | 67.5 + | 67.5 + | 19 | 116.0 |
| VA07H-35WS | 100.0 | 72.5 + | 72.5 + | 20 | 119.0 |
| **Doyce** | 100.0 | 75.0 + | 75.0 + | 21 | 117.0 |
| Average | 99.8 | 54.9 | 54.8 | | 118.4 |
| LSD (0.05) | 3.2 | 11.1 | 11.1 | | 4.6 |
| C.V. | 1.5 | 9.7 | 9.7 | | 1.9 |

Released cultivars are shown in bold print. Varieties are ordered by ascending index averages.

A plus or minus sign indicates a performance significantly above or below the average.

Entries were planted in 6-row plots, 13 ft in length cut back to 9 ft at Mt. Holly, VA and were inoculated at 50% and 100% heading stages with Fusarium graminearum spore suspension (50,000 spores/ml).

[1]Scab Incidence (%): Percentage of infected spikes among 10 randomly selected spikes.

[2]Scab Severity (%): Percentage of infected spikelets among 10 infected spikes.

[3]Scab Index = Incidence X Severity/100 (overall indicator of scab resistance/susceptibility level.)

**Table 18. Two-year average summary of reaction of entries in the Virginia Tech State Hulless Barley Tests to Fusarium head blight (scab), 2014 and 2015 harvests.**

| LINE | FHB Incidence[1] (%) | FHB Severity[2] (%) | FHB Index[3] (0-100) | Rank FHB Index | Date Headed (Julian) | DON[4] (ppm) |
|---|---|---|---|---|---|---|
| VA12HFHB-89(2R) | 62.5 - | 20.0 - | 18.1 - | 1 | 116.5 | 4.6‡ |
| **Eve** | 71.3 - | 20.0 - | 18.6 - | 2 | 114.0 - | 4.3 |
| VA09H-110(2R) | 80.0 | 22.5 - | 20.3 - | 3 | 118.0 | 6.8 |
| VA10H-79WS(2R) | 66.3 - | 22.5 - | 20.8 - | 4 | 118.5 | 14.7 |
| **Dan** | 81.3 | 25.0 - | 24.1 - | 5 | 117.8 | 6.2 |
| VA08H-79WS | 75.0 | 26.3 | 25.0 | 6 | 120.3 + | 17.1 |
| VA08H-65 | 90.0 | 31.8 | 30.9 | 7 | 116.5 | 13.9 |
| VA06H-25 | 80.0 | 34.3 | 33.1 | 8 | 119.0 | 37.7 |
| **Amaze 10** | 85.0 | 36.3 | 34.4 | 9 | 118.3 | 19.9 |
| VA11H-34 | 83.8 | 38.8 + | 37.1 + | 10 | 115.5 | 11.6‡ |
| VA06H-79 | 90.0 | 38.8 + | 37.3 + | 11 | 118.0 | 30.1 |
| VA07H-35WS | 88.8 | 38.8 + | 38.2 + | 12 | 119.3 | 36.8 |
| VA10H-57 | 92.5 + | 42.5 + | 41.0 + | 13 | 117.3 | 21.3 |
| **Doyce** | 96.3 + | 50.0 + | 49.1 + | 14 | 115.3 | 18.6 |
| Average | 81.6 | 31.9 | 30.6 | | 117.4 | 17.4 |
| LSD (0.05) | 8.7 | 5.8 | 5.6 | | 2.2 | |
| C.V. | 7.3 | 12.5 | 12.6 | | 1.3 | |

Released cultivars are shown in bold print. Varieties are ordered by ascending index averages.

A plus or minus sign indicates a performance significantly above or below the average.

Entries were planted in 6-row plots, 13 ft in length cut back to 9 ft at Mt. Holly, VA and were inoculated at 50% and 100% heading stages with Fusarium graminearum spore suspension (50,000 spores/ml).

[1]Scab Incidence (%): Percentage of infected spikes among 10 randomly selected spikes.

[2]Scab Severity (%): Percentage of infected spikelets among 10 infected spikes.

[3]Scab Index = Incidence X Severity/100 (overall indicator of scab resistance/susceptibility level.)

[4]DON values were measured (pooled over replications) from the 2013 and 2014 harvest year.

‡DON values were measured (pooled over replications) from the 2014 harvest year.

**Table 19. Summary of reaction of entries in the Virginia Tech State Barley Test to Fusarium head blight (scab), 2015 harvest.**

| LINE | FHB Incidence[1] (%) | FHB Severity[2] (%) | FHB Index[3] (0-100) | Rank FHB Index | Date Headed (Julian) |
|---|---|---|---|---|---|
| VA11B-141 | 100.0 | 37.5 | 37.5 | 1 | 116.0 |
| VA11B-143 | 100.0 | 37.5 | 37.5 | 2 | 114.5 |
| **Nomini** | 100.0 | 40.0 | 40.0 | 3 | 115.0 |
| VA13B-35 | 100.0 | 40.0 | 40.0 | 4 | 112.0 |
| VA12B-8 | 100.0 | 42.5 | 42.5 | 5 | 115.5 |
| **Wysor** | 100.0 | 45.0 | 45.0 | 6 | 116.0 |
| VA08B-95 | 100.0 | 45.0 | 45.0 | 7 | 113.0 |
| VA13B-25 | 100.0 | 45.0 | 45.0 | 8 | 112.0 |
| VA11B-126 | 100.0 | 45.0 | 45.0 | 9 | 111.5 |
| **Barsoy** | 100.0 | 45.0 | 45.0 | 10 | 111.0 - |
| VA11B-130 | 100.0 | 45.0 | 45.0 | 11 | 111.0 - |
| VA92-42-46 | 100.0 | 47.5 | 47.5 | 12 | 119.5 |
| VA11B-102 | 100.0 | 47.5 | 47.5 | 13 | 117.5 |
| VA13B-48 | 100.0 | 47.5 | 47.5 | 14 | 117.0 |
| VA13B-37 | 100.0 | 47.5 | 47.5 | 15 | 113.5 |
| **Violetta** | 100.0 | 50.0 | 50.0 | 16 | 120.0 |
| VA12B-129 | 100.0 | 50.0 | 50.0 | 17 | 117.5 |
| **Callao** | 100.0 | 50.0 | 50.0 | 18 | 110.5 - |
| VA13B-15 | 100.0 | 52.5 | 52.5 | 19 | 122.0 + |
| VA08B-84 | 100.0 | 52.5 | 52.5 | 20 | 117.5 |
| VA08B-108 | 100.0 | 52.5 | 52.5 | 21 | 113.5 |
| VA13BFHB-23 | 100.0 | 55.0 | 55.0 | 22 | 119.0 |
| VA09B-34 | 100.0 | 55.0 | 55.0 | 23 | 114.0 |
| VA13B-30 | 100.0 | 57.5 | 57.5 | 24 | 117.0 |
| **Thoroughbred** | 100.0 | 60.0 | 60.0 | 25 | 121.0 + |
| **Secretariat** | 100.0 | 60.0 | 60.0 | 26 | 115.5 |
| VA12B-56 | 100.0 | 60.0 | 60.0 | 27 | 110.5 - |
| VA12B-30 | 100.0 | 62.5 | 62.5 | 28 | 120.0 |
| VA11B-4 | 100.0 | 65.0 | 65.0 | 29 | 119.0 |
| **Atlantic** | 100.0 | 65.0 | 65.0 | 30 | 110.0 - |
| **Price** | 100.0 | 67.5 | 67.5 | 31 | 113.5 |
| VA11B-41 | 100.0 | 70.0 + | 70.0 + | 32 | 121.0 + |
| VA12B-41 | 100.0 | 70.0 + | 70.0 + | 33 | 118.5 |
| VA10B-43 | 100.0 | 72.5 + | 72.5 + | 34 | 118.5 |
| Average | 100.0 | 52.5 | 52.5 | | 115.7 |
| LSD (0.05) | 0.0 | 17.1 | 17.1 | | 4.5 |
| C.V. | 0.0 | 16.1 | 16.1 | | 1.9 |

Released cultivars are shown in bold print. Varieties are ordered by ascending index averages.
A plus or minus sign indicates a performance significantly above or below the average.
Entries were planted in 6-row plots, 13 ft in length cut back to 9 ft at Mt. Holly, VA and were inoculated at 50% and 100% heading stages with Fusarium graminearum spore suspension (50,000 spores/ml).
[1]Scab Incidence (%): Percentage of infected spikes among 10 randomly selected spikes.
[2]Scab Severity (%): Percentage of infected spikelets among 10 infected spikes.
[3]Scab Index = Incidence X Severity/100 (overall indicator of scab resistance/susceptibility level.)

**Table 20. Two-year average summary of reaction of entries in the Virginia Tech State Barley Tests to Fusarium head blight (scab), 2014 and 2015 harvests.**

| LINE | FHB Incidence[1] (%) | FHB Severity[2] (%) | FHB Index[3] (0-100) | Rank FHB Index | Date Headed (Julian) | DON[4] (ppm) |
|---|---|---|---|---|---|---|
| VA11B-143 | 82.5 | 20.5 | 19.9 | 1 | 114.5 | 12.4 |
| VA11B-141 | 91.3 | 21.0 | 20.5 | 2 | 116.5 | 10.6 |
| **Nomini** | 78.8 | 21.0 | 20.6 | 3 | 113.5 | 9.2 |
| VA12B-8 | 85.0 | 23.8 | 23.0 | 4 | 115.3 | 3.8‡ |
| VA11B-130 | 85.0 | 25.0 | 24.3 | 5 | 111.3 - | 6.0 |
| **Barsoy** | 86.3 | 25.0 | 24.3 | 6 | 110.8 - | 11.8 |
| VA11B-126 | 87.5 | 25.0 | 24.4 | 7 | 110.8 - | 5.5 |
| **Wysor** | 90.0 | 25.0 | 24.5 | 8 | 115.8 | 13.7 |
| VA11B-102 | 80.0 | 25.5 | 24.9 | 9 | 116.5 | 24.2 |
| VA08B-95 | 95.0 + | 25.5 | 25.2 | 10 | 113.0 | 9.3 |
| VA92-42-46 | 82.5 | 26.3 | 25.4 | 11 | 117.3 | 9.5 |
| **Violetta** | 65.0 | 27.5 | 25.8 | 12 | 116.5 | 14.4‡ |
| **Callao** | 90.0 | 26.8 | 26.5 | 13 | 110.8 - | 16.0 |
| VA09B-34 | 78.8 | 28.5 | 28.1 | 14 | 113.3 | 18.4 |
| VA08B-108 | 88.8 | 28.8 | 28.2 | 15 | 113.5 | 14.7 |
| VA08B-84 | 96.3 + | 29.3 | 29.0 | 16 | 115.8 | 16.6 |
| **Thoroughbred** | 87.5 | 31.3 | 30.9 | 17 | 119.3 + | 21.5 |
| **Secretariat** | 85.0 | 32.5 | 31.8 | 18 | 114.3 | 17.5 |
| **Atlantic** | 87.5 | 35.0 | 34.4 | 19 | 111.5 - | 18.7 |
| VA11B-4 | 95.0 + | 35.8 | 35.4 | 20 | 118.3 + | 29.0 |
| **Price** | 87.5 | 36.8 + | 36.0 + | 21 | 114.0 | 21.6 |
| VA11B-41 | 87.5 | 37.5 + | 36.9 + | 22 | 118.3 + | 14.8‡ |
| VA10B-43 | 92.5 | 39.3 + | 38.8 + | 23 | 117.5 + | 31.5 |
| Average | 86.3 | 28.4 | 27.8 | | 114.7 | 15.3 |
| LSD (0.05) | 8.1 | 8.0 | 8.0 | | 2.7 | |
| C.V. | 6.6 | 19.8 | 20.1 | | 1.7 | |

Released cultivars are shown in bold print. Varieties are ordered by ascending index averages.

A plus or minus sign indicates a performance significantly above or below the average.

Entries were planted in 6-row plots, 13 ft in length cut back to 9 ft at Mt. Holly, VA and were inoculated at 50% and 100% heading stages with Fusarium graminearum spore suspension (50,000 spores/ml).

[1]Scab Incidence (%): Percentage of infected spikes among 10 randomly selected spikes.

[2]Scab Severity (%): Percentage of infected spikelets among 10 infected spikes.

[3]Scab Index = Incidence X Severity/100 (overall indicator of scab resistance/susceptibility level.)

[4]DON values were measured (pooled over replications) from the 2013 and 2014 harvest year.

‡DON values were measured (pooled over replications) from the 2014 harvest year.