

Fusarium Head Blight (scab) of Wheat and Barley

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Fusarium head blight is a disease of wheat and barley. The pathogen reduces yield, seed quality and produces a vomitoxin called DON.

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FUSARIUM HEAD BLIGHT (FHB) (SCAB) IS A

destructive disease of wheat and barley in Montana and in most wheat-growing regions around the world. The primary symptom of the disease is bleaching of some of the florets in the head before maturity. Severe infections can cause premature blight or bleaching of the entire spike or head (Figure 1). Other symptoms include tan to brown discoloration at the base of the head (Figure 2), a pink or orange colored mold at the base of the florets under moist conditions, and kernels that are shriveled, white, and chalky in appearance ('tombstones' in Figure 3). Visible expression of FHB is observed in heads during the soft to hard dough growth stage as premature ripening accompanied by dark brown discoloration of the peduncle and shriveled kernels with a chalky (tombstone) appearance (Figure 3). The disease is caused by the fungi in the genus *Fusarium* with the following species being most commonly involved: *F. graminearum*, *F. pseudograminearum*, *F. avenaceum* and *F. culmorum*.

The disease causes yield loss, low test weights, low seed germination and contamination of grain with mycotoxins. A vomitoxin called deoxynivalenol (DON) is considered the primary mycotoxin associated with FHB and is subject to regulatory limits by the U.S. Food and Drug Administration (FDA). There is a 1 ppm limit for DON in all finished wheat products (flour, bran and germ) that may be consumed by humans. Limits of 5-10 ppm have been set for animals. Animals with simple stomachs such as dogs or swine are more sensitive than ruminant animals. There is a zero tolerance for DON in malt barley. All these toxins are highly stable and levels will remain unchanged for years in storage. Producers should not mix clean grain with grain identified to have greater than 1 ppm of DON to achieve a lot that will be accepted by the elevator. This is considered to be adulteration of grain by the FDA and is subject to criminal penalties.

Symptoms can be confused with various root and crown diseases which cause entire heads to bleach. Premature blight symptoms can also be confused with black chaff and glume blotch which cause discoloration of the glumes and seed. These diseases will not cause tombstone grain or stem (peduncle) discoloration.

Currently no barley or durum varieties are available with tolerance to the disease. Head blight symptoms and scabby grain in durum are similar to those found in bread spring and winter wheats. Barley with severe scab will have a premature blight or bleaching of the head. Initial infection is characterized as a discolored lesion on the base of the glume and rachis that then spreads in both directions of the barley spike. Salmon pink to reddish mycelium may be seen



FIGURE 1. Partial bleaching of the wheat head due to Fusarium head blight.

TABLE 1. Reaction of spring wheat varieties in Montana to *Fusarium* head scab in an irrigated nursery, 2006-2007.* Data presented is an average of two years.

	Head scab Reaction	Yield Bu/ac	Test weight Lb/bu	DON ppm	Diseased heads percent
Choteau	Susceptible	77.9	60.8	2.83	21.5
Espresso	Susceptible	76.6	59.8	3.30	26.9
Vida	Susceptible	69.5	57.6	1.41	19.7
Howard	Susceptible	66.0	60.1	1.08	22.2
Hank	Susceptible	57.3	53.6	8.76	23.6
Explorer	Susceptible	54.3	55.6	2.11	14.8
Volt	Tolerant	87.4	62.3	0.43	6.2
Freyr	Tolerant	87.2	61.3	0.25	9.0
Kuntz	Tolerant	86.5	61.2	0.36	13.9
Knudson	Tolerant	83.3	60.1	0.36	8.1
Kelby	Tolerant	80.5	61.6	0.36	15.9
Alsen	Tolerant	70.6	62.0	0.11	6.3
Glenn	Tolerant	70.2	63.8	0.14	3.3
Mean		75.3	59.8	1.88	17.6
LSD (P<0.05)		5.8	1.6	0.68	0.1
CV %		7.0	2.3	40.0	48.6

*Fungicide was applied at flowering.

along the edges of the glumes or at the base of the infected spikelet under moist conditions. Kernels infected during development are shrunk and grayish brown towards the base. The kernel interior may be floury and discolored. Head scab in barley has been reported rarely in Montana.

Disease development

The causal agents of scab can overwinter on crop stubble such as wheat, barley and corn, and as soilborne inoculum. Scab is introduced into a field through infected seed or wind-borne inoculum. The disease is spread rapidly by rain splash and wind. The head, and in particular the open female flower during anthesis, is most susceptible to infection by *Fusarium* spores. Some infection can occur during kernel development. Moist environmental conditions favor spore (inoculum) production and infection, including rain, irrigation, fog and long evening dew periods. Recent models have suggested that three or more rain or irrigation events from anthesis until 3-5 days post-anthesis will result in severe scab if inoculum is present and the variety is susceptible. Forecasting models are available for other wheat-growing areas, but have not been widely used or validated in Montana (for more information, see the US Wheat and Barley Scab Initiative, <http://scabusa.org>).

Cultural Management Practices

Tolerant wheat varieties are available in Montana, including those with Sumai 3 resistance (Table 1). No tolerant barley or durum varieties are currently available. Best management practices for FHB include:

1. Use a tolerant variety (Table 1). New varieties are in development for wheat, barley and durum.
2. Under severe disease conditions even tolerant varieties will need fungicide application to achieve acceptable control. Protect the flower from spore (conidia) infection by using a fungicide applied as directed on fungicide labels.
3. Suspend irrigation prior to flowering until after anthesis. This reduces spore dissemination from in-crop residue.
5. Use tillage to incorporate the infected straw and destroy residue-borne inoculum.
6. If grain lots are identified with DON levels greater than 1 ppm, removal of the light weight infected kernels will often reduce DON levels by 50 percent or more. Screen sizes or airflow can remove the tombstone kernels and reduce DON levels.

Other practices to reduce FHB include the use of certified seed that is conditioned with a fungicide seed treatment. Crop rotation to a non-cereal crop or soil incorporation of cereal stubble will reduce inoculum. A corn, wheat or barley rotation is at high risk for FHB and should be avoided. Destroy corn stubble by tillage to reduce the risk of FHB. Tolerant varieties will need to be sprayed with a fungicide following corn if there is significant residue.

Fungicide Program

Apply a fungicide to the crop at flowering when planting susceptible varieties. If the field has a history of scab and a large amount of cereal crop residue, then a tolerant variety with a fungicide application will reduce the risk of scab. In addition, avoid irrigation during flowering to reduce the infection period. Foliar sprays must be applied at the first sign of anthers extruding from the wheat head or before barley head emergence. Timing of application is crucial for the control of FHB. The use of nozzles that provide good coverage of the spike is essential, since fungicide products are 'locally systemic' and protect the tissue to which they are applied. Fungicides must be applied in at least 10 gallons of water per acre (ground) or five gallons per acre (air) with a 300-350 micron droplet size, whether ground or aerial, to provide optimal coverage and disease control (McMullen 2012). Planes must fly within 8-10 feet of the canopy for smaller (slower) planes and 10-12 feet for larger (faster) planes (McMullen 2012). Dryland fields can be at risk for scab if the weather is moist during the flowering period, so a fungicide application should be considered. Best efficacy against FHB is provided by the Demethylation Inhibitor (DMI) fungicides (Group 3). The best products provide about 50 percent control compared to untreated cereals (Paul, 2008). Fungicides work better in spring wheat than winter wheat crops, likely due to the shorter flowering period (McMullen, 2012).

Chemical options

Always check the label before application for the most current rates and application restrictions. Strobilurin fungicides are not recommended for management of FHB, since they can increase the DON content of FHB-infected grain. The following chemicals are labeled for disease suppression only:

Metconazole (Caramba) is labelled for FHB suppression at 13.5 to 17 fl oz./A. Efficacy is good. On barley, apply at the beginning of anthesis. Do not make more than two applications of Caramba or other DMI (Group 3) fungicides per season for resistance management.

Propiconazole (Tilt and generics) is labeled for use to control FHB, but efficacy is poor. Apply at a 4.0 fl. oz./A rate. Barley and wheat should be sprayed at 50 percent flowering, and not after Feekes 10.5. Do not apply more than 8 fl. oz/A per season. There is a 30-day preharvest interval.

Prothioconazole (Proline 480 SC) is labelled for FHB suppression. On barley, the application rate for FHB is 5.0 to 5.7 fl oz./A at Feekes 10.5, when barley heads on the main stem are fully emerged. On wheat, the rate is the same but the crop should be sprayed at early flower (Feekes 10.51). Spray equipment should provide good coverage. When using ground rigs, forward and backward-mounted nozzles or nozzles that have a two-directional spray should be used for optimal coverage of the head.



FIGURE 2. Discoloration of the stem (left) due to Fusarium head blight.



FIGURE 3. Wheat kernels that are shriveled, white and chalky in appearance, called 'tombstones' are on the bottom versus healthy seed on the top.

Tebuconazole and Prothioconazole can be applied as a mixture with the trade name Prosaro. Efficacy of this product is good for FHB suppression. The rate of application to barley and wheat is labeled at 6.5 to 8.2 fl oz./A. Barley should be sprayed at Feekes 10.5 and wheat at Feekes 10.51 with bi-directional nozzles (see Prothiconazole). There is a 30-day PHI.

Tebuconazole (Folicur, Orius, TebuStar, other generics).

Rate labelled for FHB suppression is 4 fl oz/A. Optimal timing of application for barley is when the main stem heads have fully emerged (Feekes 10.5) on 50 percent of the plants. In wheat, optimal timing for FHB suppression is the beginning of flowering on main stem heads (Feekes 10.51). There is a limit of 4 oz/A per season, preharvest interval is 30 days. Efficacy is fair.

Is my crop at risk for getting Fusarium head blight?

The primary concern when you consider whether or not your fields are at risk of getting FHB should be whether there is a history of scab in your field. Dryland crops are at a reduced risk compared to irrigated crops because moisture is required for infection of the spikes. But if the weather is moist at flowering, even dryland fields may be at risk. Scab is primarily residue-borne, or lives on cereal stubble including wheat, barley, and corn. If your field has contaminated residue you should consider the disease management techniques described above. If you till or rotate crops to reduce residue this reduces your risk. If the previous crop was corn you could be at high risk – if wheat and barley, a moderate risk. If the previous crop was not a cereal you will be at a lower risk.

How can I get my seed tested for DON?

Call the North Dakota State University Veterinary Diagnostic Lab at 701-231-8309 for sampling and submission instructions. There is a charge for this test. There are several commercially available test kits for DON analysis. See the MSU Extension Publication, *Mycotoxins and Mycotoxicoses* (EBO174), for more information.

Where can I get more information on Fusarium head blight and DON?

For more information on FHB, visit the US Wheat and Barley Scab Initiative Web site at <http://www.scabusa.org>.

For more information on mycotoxins associated with FHB, see MSU Extension Publication EBO174, *Mycotoxins and Mycotoxicoses*.

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