Optimizing Fungicide Use for Fusarium Head Blight (Scab) and Associated Mycotoxins

Fusarium head blight — also called head scab or FHB — is a disease of small grain crops that can significantly affect grain yield and quality. The fungus that causes FHB can also produce mycotoxins, which are chemicals that are toxic to humans and livestock. In particular, FHB is often associated with the mycotoxin deoxynivalenol — also called vomitoxin or DON.

The best way to manage FHB and the associated mycotoxins is to integrate varietal, cultural, and chemical controls. Fungicides are critical tools in this management strategy. A number of factors influence the effectiveness of a fungicide application, including the fungicide's efficacy, when you apply the fungicide, the orientation of the sprayer nozzles, and water volume.

This publication reviews some of the most important factors to consider when applying a fungicide to manage FHB and mycotoxins.

Application Recommendations

Ground Applications

For ground applications of fungicides, we recommend:

- A spray volume of 10-20 gallons per acre (93.5-187 L/ha)
- Fine to medium-size droplets (approximately 300-350 microns)
- Nozzles positioned 8-10 inches (0.2-0.25 meters) above the grain spikes
- Forward and backward nozzles angled 30 to 45 degrees down from horizontal

The nozzle types commonly used for herbicide applications are less effective on small grain crops. That's because small grain spikes are a vertical target rather than a horizontal target (leaf). Therefore, it is important to select the right nozzle to adequately cover a spike.

If your spray rig will travel at less than 6 mph (9.7 kph), the most coverage will come from using forward- and backward-facing 80-degree flat-fan nozzles. Angle the nozzles 30-45 degrees down from horizontal.

If your spray rig will travel at 6 mph or faster (9.7 kph), adequate coverage will come from using a single, forward-facing nozzle. Angle the nozzle 30 degrees down from horizontal.

Aerial Applications

For aerial fungicide applications, we recommend:

- A spray volume of 4-5 gallons per acre (15-18.9 liters)
- Fine to medium-size droplets
- Positioning small aircraft 8-10 feet (2.4-3.0 meters) above the spray target
- Positioning larger aircraft 10-12 feet (3.0-3.7 meters) above the spray target
- Mount nozzles to cover 65 percent of the wingspan and mount them as low as possible

For nozzle spacing and placement, we recommend applicators conduct a pattern test to examine the uniformity of the spray pattern.

Select the Right Fungicide

The only group of fungicides labeled for adequate FHB and DON suppression is demethylation inhibitors — DMI/triazoles/Fungicide Resistance Action Committee (FRAC) Group 3. Within this fungicide class, there are differences in efficacy among products.

The United States Wheat and Barley Scab Initiative (USWBSI) funded multi-state field trials to evaluate the efficacy of labeled and soon-to-be-labeled fungicides. Trial data indicate that metconazole (Caramba®), prothioconazole (Proline®) and prothioconazole + tebuconazole (Prosaro®) suppressed DON production 45-60 percent. Tebuconazole (Folicur® and generic formulations of this active ingredient) suppressed DON production 20-30 percent. And propiconazole (Tilt® and generic formulations of this active ingredient) suppressed DON production 12-20 percent.

Do not use fungicides that contain a quinone-outside inhibitor (QoI/strobilurin/FRAC 11) to manage FHB and DON. QoI fungicides (such as Headline®, Quadris®, and Aproach®) have been shown to increase DON levels in finished grain compared to an untreated check.

For fungicide selection, see *Small Grain Disease Management: Fungicide Efficacy for Control of Wheat Diseases* (Purdue Extension publication BP-162-W), available from the Education Store, edustore.purdue.edu.

Apply the Proper Rate

The table below provides the recommended and maximum use rates for fungicides that are labeled for FHB and DON suppression. Before applying a fungicide, always read and follow the label. Research shows that tank-mixing an appropriate nonionic surfactant improves coverage.

Fungicide	Active Ingredient(s)	Recommended Rate (fl. oz./A)	Maximum Use Rate (fl. oz./A)
Caramba®	metconazole	13.5	34
Folicur® (generics)	tebuconazole	4	4
Proline®	prothioconazole	5.7	9.37
Prosaro®	prothioconazole + tebuconazole	6.5	8.2*

*Prosaro® at 8.2 fl. oz./A contains the maximum use rate of tebuconazole (4 fl. oz. per acre). You may also use a tank-mix of a tebuconazole (such as Folicur® at 3 fl. oz. per acre) and a prothioconazole (such as Proline® at 3 fl. oz. per acre).

Know When to Apply

Wheat

It is important to monitor the growth stage of your small grain crops, because the timing window is narrow for applying fungicides that suppress FHB. The best time to apply a fungicide for all classes of wheat is at early flowering stage (Feekes 10.5.1 or Zadoks 60). Early flowering is when yellow anthers (flowers) appear or extrude from the center of the wheat spike (Figure 1).

Applying fungicides earlier (at heading, Feekes 10-1-10.5) will not sufficiently suppress FHB and DON. However, recent studies have shown that delaying application 5-7 days after the start of flowering can still suppress FHB and DON — in other words, later fungicide applications can still be effective in case of delays (such as weather).

Figure 1. (From left) Wheat spikes at Feekes 10.4 (three-quarter of spike emerged), Feekes 10.5 (full spike emergence), Feekes 10.51 (early flowering), Feekes 10.51 + 2-4 days, and Feekes 4-6 days.

Spring Barley

Most spring barley varieties are closed-flowering types, so the best time to apply a fungicide is at full-head stage (Feekes 10.5 or Zadoks 59). Full-head is when the spike has completely emerged and is above the flag leaf collar (Figure 2).

Like in wheat, applying a fungicide late (3 to 7 days after heading) will suppress FHB and DON better than applying to growth stages prior to full-head.

Winter Barley

When anthers emerge in winter barley depends on variety and environment. USWBSI research shows that applying a fungicide at full-head stage (Feekes 10.5 or Zadoks 59) or up to 7 days after full-head will suppress FHB and DON the most. However, more research is needed on winter barley to strengthen timing recommendations.

Figure 2. (From left) A spring barley spike at Feekes growth stage 10.1 (awns visible), at Feekes 10.3 (half spike emergence), at Feekes 10.5 (full head emergence), at Feekes 10.5 + 2-3 days, and at Feekes 10.5 + 4-7 days.

Find Out More

Other publications in the *Small Grain Disease Management* series are available on the Crop Protection Network website (CropProtectionNetwork.org).

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