Spray Application Technology

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Ground Application of Fungicides for Fusarium Head Blight Management

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Fusarium head blight (FHB, often called scab) remains the most significant disease for wheat and barley in North Dakota. Serious yield and quality losses from FHB may occur when favorable weather conditions for disease development coincide with the heading and flowering crop stages.

Research conducted in the mid- to late-2000s informed NDSU Extension recommendations for the proper ground application procedures for FHB suppression using fungicides. This publication updates these recommendations by summarizing research from 18 publications.

Summary of Recommendations

- Use a dual-angled spray, with a steeper angled forward-facing spray (e.g., 30 degrees from vertical) and a shallower backward-facing spray (e.g., 70 degrees from vertical).
  - An angled spray is essential to optimize coverage.
  - An asymmetrical dual spray provides better coverage than a symmetrical dual spray or a single forward-facing spray (Figure 1).
  - A single nozzle producing an asymmetrical dual spray provides greater operational simplicity than other possible configurations.

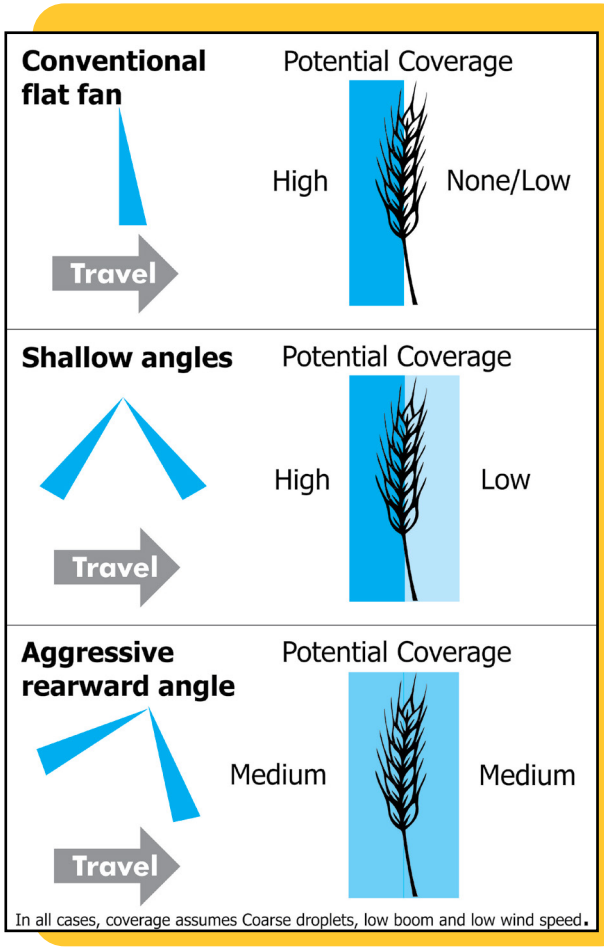

Figure 1. Simplified depiction of potential spray coverage from a single forward-facing spray (top panel), a symmetrical dual spray (middle panel), and an asymmetrical dual spray (bottom panel).
(Photo: Jason Deveau, Sprayers101)

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- Use a coarse spray quality (i.e., droplet size). See NDSU Extension publication "Spray Application Technology: Selecting Spray Nozzles with Drift-Reducing Technology" (AE1246) for details on the spray quality classification system.
  - Relative to finer sprays, the larger droplets from a coarse spray better maintain their momentum and better resist evaporation.
  - Larger droplets are better able to keep their desired trajectory, hit the targeted head and move past the awns to deposit on the spikelets.
- Apply 10 to 20 gallons of water per acre.
  - 10 gallons per acre (gpa) is the minimum acceptable water volume for most fungicides labeled for FHB suppression.
  - If you are willing to accept lower operational efficiency, due to hauling more water, applying fungicide with water volumes of 15-20 gpa will significantly improve coverage. This might give more consistently effective FHB suppression.
  - Remember, any water volume increase above the minimum will offer a coverage benefit. Water volumes of 12-13 gpa may offer a more acceptable balance between coverage and operational efficiency.
- Position spray nozzles as low as possible above the grain heads without dragging through the crop.
  - Ideally 9-12 inches above the heads
  - No higher than 24 inches above the heads
  - Excessive boom height will greatly decrease coverage.
- Ground speeds up to 12-15 miles per hour (mph) are acceptable as long as proper boom height, boom stability and spray pattern are maintained.
  - Spray deposit will be slightly less uniform between the front and back of the head at these speeds but with no negative impact on overall coverage.
  - These recommendations assume a coarse spray. Finer sprays would be negatively impacted by these faster ground speeds.
  - The most important impact of ground speed may be on boom height and stability. If you cannot maintain a stable boom height 24 inches or less above the heads, consider slowing down.
  - Watch your spray pattern leaving the boom. If wind turbulence behind the boom is compromising the spray pattern, consider slowing down.

Consider these important points along with the general recommendations:

- **Fungicide application settings are important for FHB suppression, but product selection and application timing have a greater influence.** A perfectly executed fungicide application will not make up for poor application timing or the selection of an ineffective fungicide product. For more information, consult the NDSU Extension publication "Fusarium Head Blight (Scab) of Small Grains" (PP804).
- **The recommended application settings will provide better coverage under breezy conditions.** Wind is the environmental variable most challenging to spray applications in North Dakota. Properly timed fungicide applications are unlikely to be conducted entirely under calm conditions. Using a coarse spray quality will help maximize coverage when using an angled spray in breezy conditions.
- **Spray application research studies often show differences in coverage among treatments, but rarely show differences in yield or FHB suppression among treatments.** This publication highlights research results showing coverage benefits from the recommended application settings. The 11 studies investigating application effects on yield or disease rarely showed changes in yield or disease that could be validated through statistical analysis and often featured treatments applied at a ground speed (2.7-6.0 mph) or water volume (27-32 gpa) inconsistent with the recommendations.

Use an Angled Spray of Coarse Quality

Vertical targets, such as wheat and barley heads, present a more challenging spray target than horizontal targets, such as leaves. Research supports using an angled spray for FHB suppression. An angled spray (a single spray angled forward or a dual spray angled forward and backward) provides equivalent or better coverage of vertical targets compared to a vertical (i.e., straight down) spray of an identical water volume and spray quality, increasing coverage by 15% to 74%.

Do not use a fine spray due to its high drift potential. Use a coarse spray rather than a medium spray due to the wind conditions commonly encountered in North Dakota and the ground speeds and water volumes commonly used by applicators. Research results illustrate an important point: at faster ground speeds (e.g., 8-15 mph) and lower water volumes (e.g., 10-12 gpa), the larger droplets provided by a coarse spray quality are essential for optimum coverage. These larger droplets better maintain their momentum and resist evaporation, increasing the likelihood of target impact, and are better able to move past the awns

and deposit on the grain spikelets for proper FHB suppression. These advantages also apply under breezy conditions, where the larger droplets from a coarse spray quality will impact the targeted heads more effectively than the smaller droplets from a medium spray quality.

An indirect benefit of a fungicide application for FHB is protection against leaf spotting fungal pathogens on the flag leaf. Although flag leaf coverage from an angled spray will be less than a vertical spray, adequate coverage and disease suppression are still achieved.

One spray? Two spray? Angled which way?

The recommendation to use a dual-angled spray, with a steeper forward-facing spray and a shallower backward-facing spray, is a change from previous NDSU recommendations to use a single forward-facing spray. There are two reasons for this change. First, a review of the literature supports that a dual-angled spray provides better and more uniform coverage than a single forward-facing spray, especially as ground speeds increase, and this improved coverage may sometimes be associated with improved disease suppression. Second, nozzle technology has improved. Asymmetrical dual-spray nozzles (Figure 2), which are more effective than the older symmetrical dual-spray nozzles, are now available. These nozzles to not require cumbersome nozzle extensions, which would have been required in the past to produce an asymmetrical dual-spray.

Asymmetrical dual-spray nozzles are purpose-built for spraying fungicides on cereal crops. Among their features is a shallower angle in the backward-facing spray to more effectively deposit droplets on the back side of the head. At 11 gpa water volume and coarse spray quality, a TeeJet AI3070 nozzle, which features a 30-degree forward-facing angle and a 70-degree backward-facing angle, improved overall deposit by 40% and deposit uniformity by 33% relative to a symmetrical twin fan nozzle with each spray angled 30 degrees from vertical. Do not confuse these newer asymmetric twin fan nozzles with older symmetrical options, as symmetrical twin fan nozzles are not your best option for FHB suppression.

When using a coarse spray quality along with ground speeds and water volumes typical of North Dakota operations, there is likely to be a coverage benefit from dual forward-and backward-facing sprays. A single nozzle that provides asymmetrically angled forward- and backward-facing sprays, such as the TeeJet AI3070, seems to provide the best balance between effective FHB suppression and operational simplicity. An asymmetrical dual-spray fan nozzle does not require sprayer boom modifications, and its coarse to very coarse spray quality should provide good performance across the entire range of recommended water volumes.

Figure 2. TeeJet AI3070, an asymmetrical twin fan nozzle recommended for FHB suppression.
(Photo: Tom Wolf, Sprayers101)

Use 10-20 gpa water volume

Three of the reviewed studies tested lower (10-16 gpa) versus higher (20-38 gpa) water volumes while holding other variables constant. There was a consistent coverage benefit to higher water volumes. This coverage benefit was sometimes, but not always, associated with higher yields or improved disease suppression.

Lower the spray boom

Low boom height is essential for good coverage from angled sprays.

- In tests of the TeeJet AI3070, raising the boom height from 15 inches above a vertical target (the ideal) to 20 inches above target reduced spray deposit by 19%. Raising the boom height to 30 inches above target reduced deposit by 60%.
- In tests of six nozzle configurations, but excluding the TeeJet AI3070, excessive heights for the two best options reduced overall coverage by 52% and 50%.

Maintain the lowest operable boom height to achieve optimum coverage, no greater than 24 inches above the highest wheat heads if you cannot maintain the optimum boom height recommended by the nozzle manufacturer.

Monitor ground speed effects on boom stability and spray pattern

In a range from 4.7 mph to 12 mph, studies have shown no negative effect of increased ground speed on the overall coverage achieved with coarse angled sprays.

- In tests of dual-nozzle configurations, vertical target coverage increased by 4% to 19% as ground speed increased from 4.7 mph to 9.4 mph at 19 gpa water volume, and vertical target coverage was identical at 6 mph and 12 mph ground speeds and 20 gpa water volume.
- In tests of the TeeJet AI3070, which produces asymmetrical dual sprays from a single nozzle, spray deposit on vertical targets did not change when applying 11 gpa water volume at ground speeds from 5 mph to 10 mph.

However, spray coverage may be less uniform as ground speed increases. This does not have a clear impact on FHB control.

- The average spray coverage on the back of a vertical target, across five different nozzle configurations including the TeeJet AI3070, was decreased when applying 12-13 gpa water volume at increasing ground speeds.
- Coverage decreased by 9.9% when ground speed increased from 8 mph to 12 mph and by an additional 11% as ground speed increased from 12 mph to 15 mph.
- However, relative FHB control with the AI3070 was not affected by increased ground speed.

Considering the evidence, ground speeds of up to 12 mph, and perhaps 15 mph, should be suitable for coarse angled sprays as long as the sprayer boom remains stable and wind turbulence behind the boom does not compromise the spray pattern.

For more information on this and other topics, see www.ndsu.edu/extension

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