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Best Methods for Applying Fungicide to Grain Heads Using Air-assist Sprayers

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Fusarium head blight (FHB) has caused considerable crop loss in small grains during the past two decades. Serious yield and quality losses from FHB happen when wet weather occurs during heading and flowering of hard red spring wheat (HRSW) and spring barley. The flowering wheat head or fully emerged barley head is the site of the Fusarium fungus infection. Inoculum of the Fusarium disease organism is present in nearly every small-grain and corn field in the northern Plains or can come from a nearby source, so risk of infection from FHB is almost always present.

An important management strategy to suppress FHB is the application of fungicides. The traditional method of spraying herbicide to grain fields through a vertically oriented orifice is not the most effective method for applying fungicide on small-grain heads. The most effective method deposits fungicide on the sides of grain heads to maximize protection from FHB. A sprayer configured with flat fan nozzles oriented forward to the direction of travel and angled 30 degrees down from horizontal with an air velocity of 50 mph is the most effective. This configuration deposits greater quantities of fungicide on the side of the grain head. When applying the labeled fungicide rates, greater fungicide deposition and better coverage results in increased efficacy and less FHB. Studies using air-assist sprayers have shown excellent results for applying fungicide to the sides of grain heads when correct sprayer operating procedures are used.

Recent Studies

Studies were conducted during 2007, 2008 and 2009 using air-assist sprayers. The objective of the studies was to determine the most effective operating parameters of air-assist sprayers that reduce the effects of FHB. The spray studies were completed on both hard red spring wheat and six-row barley at the recommended application stage for both crops.

Air-assist sprayers have three adjustable parameters that can affect the deposition and coverage on the grain head. The three parameters are air stream velocity, orifice delivery angle and drop size. The sprayers were tested at three air stream velocities: 24, 50 and 72 mph. The velocities were measured about 2 inches from the air stream orifice.

The orifice exit velocity of the air stream was determined with the use of a hand-held anemometer. A hand-held anemometer is reasonable in price, available from many spray equipment suppliers and adequately will measure the air velocity coming from the air-assist sprayer.

To operate, set the meter to read in mph and start the fan. We recommend you run the fan at a moderate speed. Hold the anemometer about 2 inches from the orifice. Adjust the air speed until you have about a 50 mph exit velocity. Mark your air speed adjustment lever or gauge so you can reset to this air speed.

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The second parameter that can be adjusted is the orifice delivery angle. All trials were completed with the air orifices and spray nozzles directed forward. The tested angles were 30 degrees down from horizontal, 60 degrees down from horizontal and near vertical.

The third parameter that can be selected is the spray nozzle orifice, with 80-degree flat-fan nozzles performing the best. Orifice size can be changed by purchasing larger or smaller nozzles from your sprayer equipment supplier. Orifice pressure also can be increased or decreased, which will affect deposition and coverage by reducing or increasing drop size. Most spray nozzle manufacturers provide information on drop size production.

Two air-assist sprayers are marketed in the region. Both systems use spray nozzles mounted outside the air stream and direct the spray into the air stream. This nozzle arrangement allows for adjustment of the flow rate and drop size. One system (Spray-Air*) can create drops from an orifice mounted in the air stream. It produces spray drops that are very small.

Very small drops are not recommended because they do not deposit and do not provide good coverage on the developing grain kernels. Very small drops collect on the grain awns, and spray on the awns does nothing to control FHB. The air stream needs to be at a sufficient speed and directed forward so the grain heads are pushed forward for best spray deposition and coverage (Figure 1). This causes the grain heads to be almost perpendicular to the air stream and spray drops. The crop, air delivery speed, orifice orientation and drop size all affect the efficacy of the fungicide.

In the three years of tests using air-assist sprayers for suppression of FHB in spring wheat and barley, several combinations of sprayer configurations proved to be successful in reducing FHB. **The recommendations on the top of Pages 2 and 3 have been found to provide the most consistent and effective FHB suppression in most conditions.**

The fungicide used in the trials was Prosaro™ applied with a quality adjuvant at label recommended rates. Prosaro is marketed by Bayer CropScience.

*Spray-Air is owned by Miller, which is based in St. Nazianz, Wis.

Spring Wheat
Spray Recommendations

- Direct the air stream 30 degrees down from horizontal and toward the direction of travel.
- Produce a drop size of a large fine or small medium (300 to 350 microns).
- Use 80-degree flat-fan nozzles that apply fungicide at 10 gallons per acre (gpa).
- Direct the spray into the air stream so spray patterns overlap when entering the air stream.
- Operate the spray boom 10 inches above the grain heads.
- Use an air exit velocity of 50 mph. Air speed may be slightly less in wind-free conditions.
- Increase the drop size and air stream speed when operating in wind conditions of 8 to 10 mph to reduce spray drift.

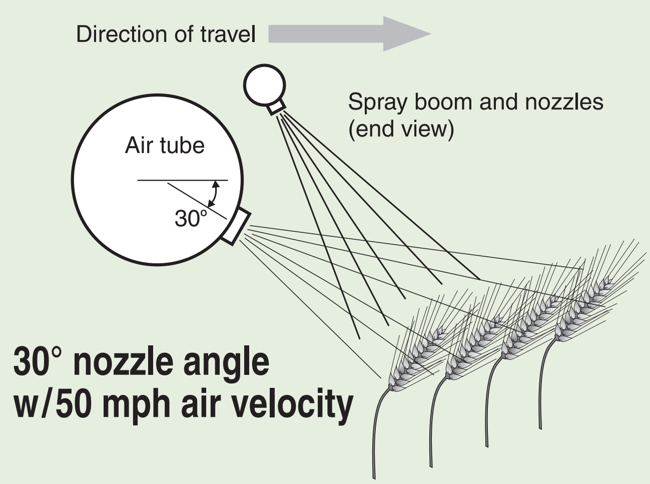

Figure 1

Barley
Spray Recommendations

- Barley has longer awns and provides a slightly different head orientation than HRSW, which requires a slightly different spray configuration.
- Direct the air stream 30 degrees down from horizontal and toward the direction of travel.
- Select a nozzle and operate at a pressure that produces a large fine to a small medium drop size (300 to 350 microns). A coarse drop size and higher air stream speed may be more effective when wind velocities are 8 to 10 mph.
- Use 80-degree flat-fan nozzles that apply fungicide at 10 gpa.
- Direct the spray into the air stream so the spray patterns overlap when entering the air stream.
- Operate the spray boom 10 inches above the grain heads.
- Use an air exit velocity of 50 mph.

Droplet Size

Research with airplane and hydraulic ground spraying systems has found the most effective drop size for deposition on small-grain heads. This drop size is one that produces a large fine- to small medium-sized (300 to 350 micron) drop. This can be determined by referring to the drop size charts provided by most nozzle manufacturers. For example, a Spraying Systems Co. extended-range flat-fan 80-degree nozzle discharging 0.2 gallon per minute (gpm) at 40 pounds per square inch (psi) will produce a large fine-sized drop. An 80-degree flat-fan nozzle discharging 0.3 gpm at 40 psi will produce a small medium-sized drop. This is the preferred drop size because it resists evaporation and deposits well on the grain kernels to provide good head coverage.

Nozzles with other flow rates can be selected, but applicators should refer to the drop size chart provided by the nozzle manufacturer. Different nozzles may require different operating pressures and travel speeds to deliver similar volumes and drop sizes. **Do not use an air-induction flat-fan nozzle because it produces very large drops. Very large drops do not provide good head coverage.**

Water Volume

NDSU research for controlling FHB has shown that equal or better fungicide efficacy was achieved at spray volumes of 10 gallons per acre (gpa) as compared with 20 gpa. Previous studies have shown that while a 10 gpa application rate provides less coverage than 20 gpa, the actual quantity of fungicide deposited on the grain head is greater due to the concentration of fungicide in the spray drop. Five gallons per acre was studied but did not provide the head coverage as compared to 10 gpa.

Air-assist Spray Boom Adjustment

Some air-assist spray booms may not be adjusted easily to direct the air flow forward at a 30-degree angle down from horizontal. An applicator will need to loosen clamps around the air tube (Spray-Air*) and rotate the air orifices forward to obtain 30 degrees down from horizontal. If 30 degrees down from horizontal is not possible, rotate the orifices as far forward as possible.

The other brand of air-assist sprayer (Hardi) may allow you to direct the air stream only 50 degrees down from horizontal. This setting is less than recommended, but it is as far forward as this sprayer will allow. These settings will allow the air stream and spray drops to contact the grain heads as perpendicularly as possible. More or less angle and air speed will change the orientation of grain heads so they may not be at a perpendicular angle to the air stream and result in less fungicide deposition on the head.

Spray Drop Size Classification

The American Society of Agricultural and Biological Engineers (ASABE) developed a spray drop size classification system. The classification system places spray drops into one of six drop size categories. They range from very fine (less than 180 microns) to very coarse (greater than 655 microns).The classification system is helpful to the applicator in selecting a nozzle so the drop size is in the proper size range.

For application to suppress FHB, a large fine- to small medium-sized drop is desired. Some pesticide manufacturers are recommending one of the six spray drop sizes on the chemical label to produce the best results. More information about the drop size classification system can be found in NDSU publication FS-919, "Selecting Drift-reducing Nozzles." The publication is available at North Dakota county Extension offices or on the NDSU website at www.ag.ndsu.edu/pubs/ageng/machine/fs919.pdf.

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