

AE1314 (Revised)

# Ground Application of Fungicide for the Suppression of Fusarium Head Blight in Small Grains



Reviewed by

**John Nowatzki**

Ag Machine Systems Specialist,  
North Dakota State University,  
Fargo, N.D.

## Introduction

Fusarium head blight (FHB) has caused considerable income loss for wheat and barley growers during the past 15 years. Estimates of crop loss to growers in North Dakota, South Dakota and Minnesota are significant. Serious yield and quality losses from FHB occur whenever wet weather coincides with the heading and flowering stages of the crop. One of the management strategies to suppress FHB is to use fungicides, but traditional methods of fungicide application for leaf disease management have proven ineffective for control of this disease. The flowering wheat head or fully emerged barley grain head is the site of the Fusarium fungus infection. If fungicides are applied with nozzles that direct the spray downward or nearly vertical, most of the fungicide misses the targeted grain head and is deposited on the leaves or ground. The most effective FHB management strategy occurs when fungicide is applied to the sides of the grain head. The challenge is to find the most effective ground application techniques to achieve maximum fungicide deposition, resulting in improved efficacy for FHB suppression.

**NDSU** EXTENSION  
SERVICE

North Dakota State University  
Fargo, North Dakota

Reviewed August 2013

# Recommended Fungicide Application Techniques

## for FHB Suppression in Small Grains with Ground Applicators

- **Produce a fine- to medium-sized drop (300 to 350 microns) with an 80-degree flat-fan nozzle.**
- **Angle all (flat-fan) nozzles forward 30 to 45 degrees down from horizontal. Thirty degrees is preferred over 45 degrees.**
- **Apply fungicide at 10 gallons per acre for controlling FHB.**
- **Position angled spray nozzles 8 to 10 inches above the grain heads.**

### Early Studies and Recommendations

Original 1990s NDSU studies indicated fungicide deposition on the grain head was most effective if the spray was directed at a nearly horizontal angle both forward and backward to the direction of travel with flat-fan (FF) nozzles mounted 8 to 10 inches above the heads. Most of these studies were conducted with backpack-type application equipment traveling at speeds less than 4 mph. These same studies used a fluorescent tracer dye, which showed that increasing spray volumes increased dye coverage on the grain head. The result was a recommendation for FHB suppression: applying fungicide by ground application using forward/backward nozzle configurations delivering up to 20 gallons per acre (gpa).

### Recent Studies

#### Nozzle orientation

Recent studies since 2002 with tractor-mounted ground application equipment using flat-fan nozzles traveling at speeds of 6 mph or faster have shown that the increased travel speed reduces the effectiveness of the backward-facing nozzle. The faster speed reduces the velocity of the backward-directed droplets, causing them to move almost vertically downward.

The forward motion of the vehicle at speeds of 6 mph or greater improves fungicide deposition on the head with a single forward-facing FF nozzle. These studies showed that a single, forward-facing FF nozzle, angled 30 to 45 degrees from the horizontal (30 degrees preferred), provided equal or sometimes even slightly better spray deposition and disease management, compared with the combination of forward and backward-facing nozzles.

A forward-directed spray configuration also can be obtained with an air-assist spray system by angling the air orifices forward near 45 degrees. The air-assist air stream changes the vertical orientation of the grain head by pushing the grain heads forward so they are nearly perpendicular to the air stream. Preliminary results indicate that spray added to the airstream provides good deposition on the grain heads. The awns will collect some spray, but the high air velocity helps move the spray past the awns to the glumes to provide good FHB suppression.

#### Droplet size

Recent NDSU studies using ground application equipment traveling at speeds of 6 mph or greater have found that a large fine to a small medium-sized drop

## Adapting Spray Applicators to Recommendations

(300 to 350 microns) provides more consistent suppression than very fine (less than 200 microns) or coarser (larger than 400 microns) spray drops. The 300- to 350-micron-sized droplets are sufficiently fine for even distribution on grain heads and sufficiently large to resist drift or movement away from the grain head. Also, the 300- to 350-micron droplet has shown the most consistent results of moving past the awns and depositing on the grain spikelets.

### Water volume

NDSU research also has shown that equal or better efficacy was achieved at volumes of 10 gpa with a single set of flat-fan nozzles directing the spray forward at 30 to 45 degrees from the horizontal. While the coverage with a 10 gpa application is less than a 20 gpa volume, the actual quantity of fungicide measured on the grain head increases because the concentration of fungicide in the 10 gpa volume is double the concentration in a 20 gpa volume.

Based on the results of the most recent studies, NDSU provides the following recommendations to reduce application cost, improve efficiency because less water is needed in the field and reduce damage to nozzles (nozzle angle extensions are smaller in size). Flat-fan nozzles can be damaged by dragging in the crop and breaking, compared with the back and forward nozzle design.

Some spray booms are not modified easily to direct the spray pattern forward at the recommended 30 degrees down from the horizontal. But most spray equipment suppliers will be able to supply a nozzle body adapter, 45-degree nozzle cap or single-swivel nozzle adapter (Figures 1, 2 and 3) that can produce the recommended forward angle for the spray pattern. They are available with quick-disconnect nozzle caps so nozzles can be changed or cleaned easily and are reasonable in cost.

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 classifications. They range from very fine (less than 180 microns) to extremely coarse (greater than 655 microns).

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 Service offices or on the NDSU Web site at [www.ag.ndsu.edu/pubs/ageng/machine/fs919.pdf](http://www.ag.ndsu.edu/pubs/ageng/machine/fs919.pdf).

The same publication also is available on the South Dakota State University publications Web site at <http://agbiopubs.sdstate.edu/articles/FS919.pdf>.

Spray drop size is determined by nozzle type, orifice size and operating pressure. The information for a fine to medium drop size is available from most nozzle manufacturers. The manufacturers have charts that indicate the drop size each of their nozzles produces at a particular pressure. Applicators need to select a nozzle to give the

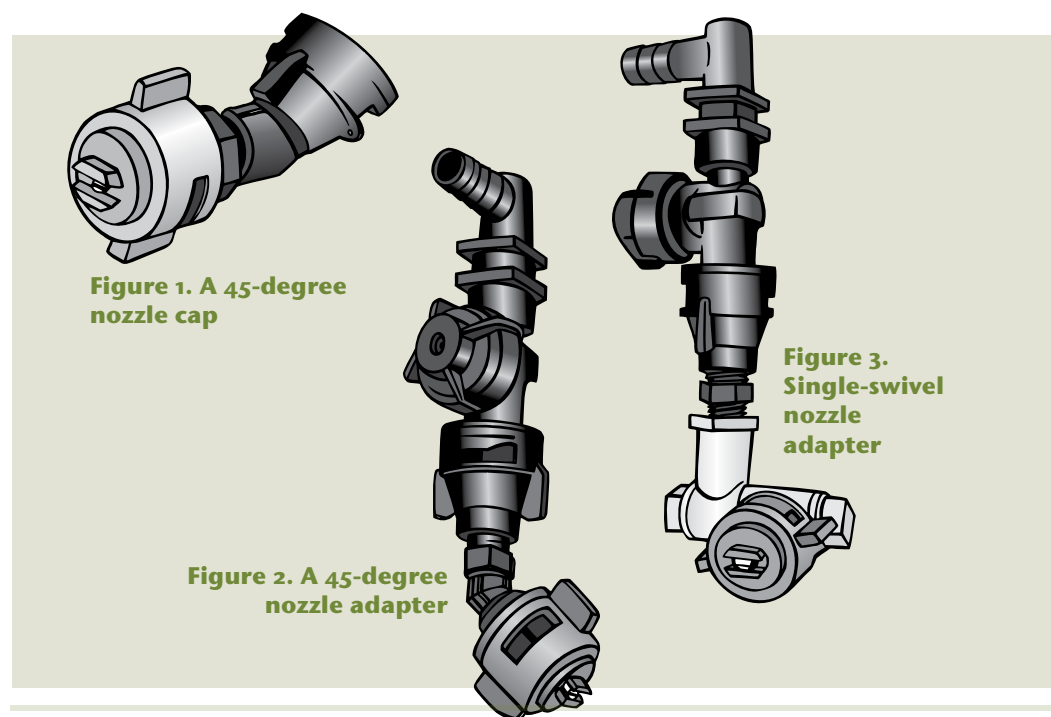


Figure 1. A 45-degree nozzle cap

Figure 2. A 45-degree nozzle adapter

Figure 3. Single-swivel nozzle adapter





**Test results indicate air assist sprayers provide good head coverage.**

**Collecting wheat heads for spray coverage analysis.**



desired drop size at the desired application rate, travel speed and operating pressure.

For example, if an application of 10 gpa is desired at 10 mph, a flat-fan nozzle with an 80-degree spray angle discharging 0.3 gallon per minute would need to operate at nearly 50 pounds per square inch (psi). This combination produces a small medium-sized drop. A nozzle with a 110-degree discharge angle would need to discharge 0.4 gallon per minute and would need to operate at only 30 psi. A 110-degree FF nozzle produces a smaller droplet than an 80-degree nozzle when operated at the same pressure. The previous two examples are for sprayers with a 20-inch nozzle spacing.

Different nozzle manufacturers may have slightly different drop size classifications for their nozzles. Follow their recommendations to produce a fine- to medium-sized (300 to 350 microns) drop.

## References

- Halley, S., G. Van Ee, V. Hofman, S. Panigrahi, H. Gu. 2008. "Fungicide Deposition Measurement by Spray Volume, Drop Size, and Sprayer System in Cereal Grains." *Applied Engineering in Agriculture* Vol. 24(1): 15-21. American Society of Agricultural and Biological Engineers, St. Joseph, Mich.
- Wilson, J., J. Nowatzki, V. Hofman. 2008. "Selecting Drift Reducing Nozzles." FS-919 Revised, South Dakota Cooperative Extension Service and NDSU Extension Service. Brookings, S.D., and Fargo, N.D.
- Fritz, B.K., I.W. Kirk, W.C. Hoffmann, D.E Martin, V.L. Hofman, C. Hollingsworth, M. McMullen, S. Halley. 2006. "Aerial Application Methods for Increasing Spray Deposition on Wheat Heads." *Applied Engineering in Agriculture* Vol. 22(3): 357-364. American Society of Agricultural and Biological Engineers, St. Joseph, Mich.
- Halley, S., G. Van Ee, V. Hofman. 2005. "Effect of Nozzles on Fungicide Efficacy for Control of Fusarium Head Blight." Pages 194 to 197. U.S. Wheat and Barley Scab Initiative, Michigan State Univ., East Lansing, Mich.
- Van Ee, G., S. Halley and V. Hofman. 2004. "Significant Accomplishments and Future Endeavors in Chemical Application." Page 378. U.S. Wheat and Barley Scab Initiative, Michigan State Univ., East Lansing, Mich.
- Hooker, D.C., H. Spieser and A.W. Schaafsma. 2004. "Effective Application of Fungicides on Wheat Heads: What's the Best?" Page 330. U.S. Wheat and Barley Scab Initiative, Michigan State Univ., East Lansing, Mich.
- Halley, S., G. Van Ee, V. Hofman, S. Panigrahi and D. Gu. 2004. "Effect of Application Technology Parameters on Spray Volume and Drop Size on Fungicide Efficacy for Control of Fusarium Head Blight." Pages 306 to 310. U.S. Wheat and Barley Scab Initiative, Michigan State Univ., East Lansing, Mich.

This publication was authored by Scott Halley, Crop Protection Scientist, North Dakota State University, Langdon Research Extension Center, Langdon, N.D.; Gary Van Ee, Retired Agricultural Engineer, Biosystems and Agricultural Engineering, Michigan State University, East Lansing, Mich.; Vern Hofman, Professor Emeritus, North Dakota State University, Fargo, N.D.; Marcia McMullen, Extension Plant Pathologist, North Dakota State University, Fargo, N.D.; Charla Hollingsworth, Extension Plant Pathologist, University of Minnesota, Crookston, Minn.; Brad Ruden, Interim Manager, South Dakota State University Plant Diagnostic Clinic, Brookings, S.D. 2006.

The NDSU Extension Service does not endorse commercial products or companies even though reference may be made to tradenames, trademarks or service names. NDSU encourages you to use and share this content, but please do so under the conditions of our Creative Commons license. You may copy, distribute, transmit and adapt this work as long as you give full attribution, don't use the work for commercial purposes and share your resulting work similarly. For more information, visit [www.ag.ndsu.edu/agcomm/creative-commons](http://www.ag.ndsu.edu/agcomm/creative-commons).

For more information on this and other topics, see [www.ag.ndsu.edu](http://www.ag.ndsu.edu)

County commissions, North Dakota State University and U.S. Department of Agriculture cooperating. North Dakota State University does not discriminate on the basis of age, color, disability, gender expression/identity, genetic information, marital status, national origin, public assistance status, race, religion, sex, sexual orientation, or status as a U.S. veteran. Direct inquiries to the Vice President for Equity, Diversity and Global Outreach, 205 Old Main, (701) 231-7708. This publication will be made available in alternative formats for people with disabilities upon request, (701) 231-7881. 3M-6-06, 2.5M-1-07, 3M-11-08