Cooperative Study for Improved Management of Fusarium Head Blight Using Aerial Application of Fungicide

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Introduction

Most fungicides are diluted and applied in solution volumes from 3 to 7 gallons per acre (gpa) when sprayed by aircraft, according to product label requirements. Ground application water volumes are generally larger, ranging from 10 to 20 gpa. If fungicides can be applied at reduced water volumes without a loss of efficacy, more fields could be sprayed at an optimum crop growth stage to more effectively manage Fusarium head blight (FHB) of spring wheat.

Low spray volumes are achieved with several types of nozzles and nozzle placements. Many aerial applicators use the CP-type nozzle which has several sizes of orifices. Nozzle angle adjustments and changes in air speed also affect droplet size. Initial studies have not indicated improved droplet coverage on wheat heads with a change in droplet size (Kirk et al. 2003; Hofman et al. 2003; McMullen et al. 2004).

Objectives

Establish whether aerial fungicide application technologies can be modified in such a way as to increase fungicide deposition on plant tissues by adjusting droplet sizes and fungicide dilution volumes for increased disease control using fungicide.

Materials & Methods

- Aerial application of Folicur (tebuconazole) fungicide (4 fl oz acre^{-1}) at 3 locations using moderately susceptible to moderately resistant hard red spring wheat cultivars ('Polaris' cv at Crookston in northwest MN, 'Briggs' cv at Hunter in east central ND, 'Reeder' cv at St. Thomas in northeast ND).
- Commercial fields (approx 160 acres in size) were planted in late April of 2005. Plot lengths ranged from 700 to 1000 ft. and widths of 150 ft.
- Randomized complete block design analyzed as a combined factorial. Factors were 'location' & 'treatment' (dilution x droplet size).
- Fungicide was applied in 50 ft swaths by a commercial aircraft during the early-flowering growth stage (Feekes 10.51), using a Cessna Ag Truck aircraft equipped with CP-03 nozzles (**Figure 1**).
- Each test site included five fungicide treatments and a nontreated control (**Table 1**). A common industry standard treatment (5 gpa, 275 µm) was included for comparison purposes.
- Plant pathologists recorded FHB disease symptom levels approximately 3 wks after application (soft dough stage). Data were collected from center swaths of plots to avoid drift and uneven overlap issues.
- The research team assisted grower cooperators during harvest to measure yield using commercial combines and weigh wagons (**Figure 2**). Grain weight from a single combine swath per plot was recorded.
- Sub-samples from the harvested grain were collected from weigh wagons to determine grain moisture and quality. DON analyses were done by NDSU Vet. Science Toxicology and Univ. of MN Mycotoxin labs using gas chromatography and electron capture techniques.

Figure 1. Cessna Ag Truck aircraft with CP-03 nozzles used by a commercial North Dakota aerial applicator for fungicide application on spring wheat in ND and MN, 2005.

Table 1. Fungicide dilution and spray droplet size combinations of treatments applied by aircraft. Treatment #3 is the current industry standard.

Trt #	Dilution (gpa)	Droplet size (µm)
1	3	200
2	3	350
3	5	275
4	7	200
5	7	350
6	Nontreated	

Figure 2. MN grower using his tractor, grain cart, and combine to assist with research during harvest. One combine swath from each plot was made. Grain was transferred to the weigh wagon (white) and yield was determined.

Results & Discussion

- FHB incidences ranged from 16.0 to 89.2% across all locations and treatments. FHB indexes ranged from 2.0 to 31.8%, DON levels ranged from 1.0 to 11.8 ppm, and yields ranged from 38.9 to 63.6 bushels acre^{-1}.
- FHB incidence, severity and index were decreased, and yield and test weight were increased, with fungicide treatments.
- Location differences were significant across all parameters measured (**Table 2**).
- Location x treatment interactions occurred for FHB incidence and FHB index at differing levels of significance (**Table 2**).
- Across all locations:
  1. Treatment #4 was significantly better at controlling FHB severity compared with treatment #1 (**Figure 3**).
  2. Treatment #1 was less effective at reducing FHB index values compared with treatments #3 and #4 (**Figure 4**).
  3. Treatment differences were not significant for DON (ppm).

Overall, the industry standard treatment (5 gpa, 275 µm) and treatment #4 (7 gpa, 200 µm) offer a significantly greater level of FHB control using aerial application on hard red spring wheat.

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Table 2. Source of variation and confidence levels for significant differences among Fusarium head blight symptoms, grain yield and quality parameters.

Source of variation \ Parameter	FHB Incidence	FHB Severity	FHB Index[a]	DON (ppm)	Yield (bu/a)	Test Weight[b]
Location	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Treatment	<0.01	<0.01	<0.01	0.14	<0.01	<0.01
Location*treatment	0.06	0.42	<0.01	0.60	0.14	0.53
LSD (0.05)	7.1	5.8	3.0	NS	2.2	0.6
% CV	26	19	33	41	6	1

[a] Fusarium head blight index = (incidence x severity)/100
[b] test weight in pounds/bushel

Indicates 99% confidence interval
Indicates 90% confidence interval

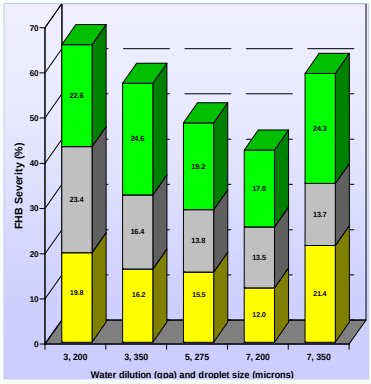

Figure 3. FHB severity by location (yellow=Crookston, MN; gray=St. Thomas, ND; green=Hunter, ND) and treatment (Table 1).

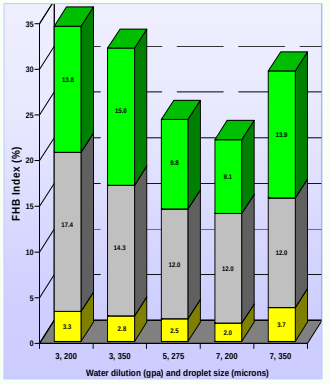

Figure 4. FHB index by location (yellow=Crookston; gray=St. Thomas; green=Hunter) and treatment (Table 1).

References

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