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Effects of Application Parameters on Control of Fusarium Head Blight with Fungicides

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OBJECTIVES

To find fungicide application techniques that will improve control of Fusarium head blight in spring wheat, durum wheat, and spring barley.

INTRODUCTION

Success with fungicides in reducing Fusarium head blight (FHB) is dependent on a number of factors, including efficacy of the fungicide, appropriate timing of application, and deposition and retention of the fungicide on the grain head (Halley et al., 1999). A number of fungicides have been evaluated since the late 1970s (Wilcoxson, 1996). Folicur (tebuconazole) has shown consistency in reducing levels of FHB over a number of locations in the US in recent years (McMullen et al., 1999).

In addition to fungicide efficacy, timing of application needs to be optimal. In early studies, fungicides were applied at early or partial head emergence or at early grain fill (Milus and Parsons, 1994; Wilcoxson, 1996). Studies in Europe indicate that the flowering period is the optimum growth stage for fungicide application on wheat (Mauler-Machnik and Zahn, 1994). For barley, which flowers when the heads are still in the boot, early results in North Dakota indicate that optimum fungicide application on barley is shortly after head emergence.

Adequate deposition and retention of fungicide on grain heads also is needed for optimum FHB control. Adjuvants have been shown to have positive effects in improving fungicide deposition and retention on grain heads, resulting in enhanced FHB control (Lukach et al., 1999). Recent studies in greenhouse and field environments also have indicated that spray systems that direct the fungicide spray toward the grain head at an angle rather than vertical to the grain head provide better fungicide deposition and FHB control (Lukach et al., 1999). Our objective was to further evaluate the impact of application timing and the impact of adjuvant types and rates on fungicide effectiveness in controlling FHB.

MATERIALS AND METHODS

Application timing - Folicur fungicide was applied at various growth stages of spring wheat and barley in the greenhouse and field in 2000.

In the greenhouse, 'Grandin' spring wheat, 'Munich' durum, and 'Robust' barley were sown separately into artificial potting mix in 6" by 12" plastic trays at a seeding rate equal to one million seeds/acre. Five trays of each crop were treated with Folicur (4 fl oz + 0.06% v/v Induce in 9 gpa) at three separate

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growth stages (Feekes 10.3 = one-half head emerged; Feekes 10.5 = full head emergence in barley; Feekes 10.51 = flowering in wheat; Feekes 10.54 = kernel developing and watery ripe). Fungicides were applied with a track sprayer using two XR8001 flat fan nozzles oriented forward and backwards towards the grain heads at 30⁰ from horizontal. Grain heads were inoculated at Feekes 10.51 using an atomizer with 5000 spores/ml of *Fusarium graminearum*. Plants were placed under intermittent mist for two days following inoculation.

In the field, 'Russ' hard red spring wheat was planted into barley stubble that had been chiseled the prior fall, and 'Stander' barley was planted into corn stubble that had been chiseled the prior fall. Fungal inoculum came from natural sources in the barley field, while natural sources were augmented with inoculated grain spawn spread among rows in the wheat field. Four replicated plots (9' x 20') per treatment were sprayed with Folicur fungicide (4 fl oz/acre + 0.06% Induce in 18 gpa) using the same nozzle type and orientation as in the greenhouse. FHB was evaluated at soft dough stage of kernel development. Data was statistically analyzed using ANOVA.

Adjuvants - Various adjuvants were tested in conjunction with Folicur or Tilt fungicide to determine their effects on efficacy of these products. Experiments were conducted in field trials at Fargo with Stander barley and Grandin hard red spring wheat, both planted into corn stubble. Adjuvants tested included two rates of a non-ionic surfactant (Induce), two rates of an organosilicone adjuvant (Silwet), and two humectants, L64 and L88. Humectants, such as glycerol and sorbitol, are substances that enhance retention of moisture. Fungicides + adjuvants were applied with a hand held boom equipped with forward/backward flat fan nozzles, as described above. FHB was evaluated at soft dough stage of kernel development. Data was statistically analyzed using ANOVA.

RESULTS AND DISCUSSION

Application timing - Optimum growth stage for fungicide application for FHB control was at Feekes growth stage 10.51 for spring wheat and durum (Table 1). In barley, FHB field severity did not differ significantly among application timings, but was numerically lower when fungicide was applied either at Feekes 10.3 or Feekes 10.5 than at Feekes 10.54 (Table 1). Optimum timing of application resulted in 73-92% reduction in FHB field severity in spring wheat, 89% in durum wheat, and 59-63% in barley.

Adjuvants - With Folicur fungicide on barley and wheat, Induce adjuvant at 0.06% v/v consistently resulted in lower FHB field severity ratings than at 0.03% v/v, although differences were not statistically significant (Table 2). Over all of the treatments with Folicur or Tilt, the lowest FHB field severity ratings were with Folicur + 0.06% v/v Induce. A comparison of Silwet rates with Tilt indicated that the 0.03% v/v rate of Silwet gave a significantly lower FHB field severity rating than use of the 0.06% v/v rate. Results indicate that benefits with adjuvants may be rate dependent. Addition of humectants resulted in similar FHB field severity ratings as with the Induce or Silwet, but slightly lower wheat leaf disease levels than with other adjuvants.

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Table 1. Field severity of Fusarium head blight (FHB) following application of Folicur fungicide (4 fl oz/acre + 0.06% v/v Induce) at various growth stages, Fargo, 2000.

Feekes growth stage* at fungicide application	% FHB Field Severity (Field Severity = Incidence x Head Severity)				
	'Grandin' HRSW greenhouse	'Russ' HRSW field	'Munich' Durum greenhouse	'Robust' Barley greenhouse	'Stander' Barley field
Untreated	7.0	23.4	32.1	3.2	8.7
10.3	1.6	11.2	16.4	1.5	3.2
10.5-10.51	0.5	6.3	3.5	1.3	4.1
10.54	7.0	8.8	22.5	1.9	4.5
LSD P= 0.05	3.9	4.6	17.2	2.8	2.8

* Feekes 10.3 = head half emerged; Feekes 10.5 = full head emergence; Feekes 10.51 = early flowering in wheat; Feekes 10.54 = kernel watery ripe

Table 2. Effects of adjuvants on efficacy of Folicur and Tilt fungicides in reducing FHB in two field experiments with barley, one field experiment with spring wheat, Fargo 2000.

Cultivar	Fungicide	Adjuvant and rate	FHB Field Severity (%)	Barley Yield (bu/ac)
Stander barley	Untreated		6.1	83.6
	Folicur 4 fl oz/A	Induce 0.03% v/v	4.4	87.9
	Folicur 4 fl oz/A	Induce 0.06% v/v	3.7	90.1
LSD P = 0.05			1.5	ns
Stander barley	Untreated		9.4	84.0
	Folicur 4 fl oz/A	L64 1% v/v	5.0	87.1
	Folicur 4 fl oz/A	L88 1% v/v	4.5	86.5
	Folicur 4 fl oz/A	Induce 0.03% v/v	4.7	83.9
	Folicur 4 fl oz/A	Induce 0.06% v/v	3.8	89.5
	Folicur 4 fl oz/A	Silwet 0.03% v/v	4.0	86.5
	Tilt 4 fl oz/A	Silwet 0.03% v/v	4.1	82.4
	Tilt 4 fl oz/A	Silwet 0.06% v/v	6.2	86.9
	Tilt 4 fl oz/A	Induce 0.03% v/v	4.8	86.3
	Tilt 4 fl oz/A	Induce 0.06% v/v	5.7	84.1
LSD P = 0.05			2.1	ns
% Leaf necrosis				
Grandin HRS	Untreated		39.5	60.3
	Folicur 4 fl oz/A	L64 1% v/v	15.1	5.2
	Folicur 4 fl oz/A	Induce 0.03% v/v	17.0	8.5
	Folicur 4 fl oz/A	Induce 0.06% v/v	11.8	8.7
	Folicur 4 fl oz/A	Silwet 0.03% v/v	11.9	7.5
	Tilt 4 fl oz/A	Induce 0.06% v/v	13.1	11.8
LSD P = 0.05			7.1	6.1

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