

Winter Wheat Seed Treatment Demonstration - Dickinson, ND 2002

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Summary

Six registered and experimental fungicide seed treatments were evaluated for the control of fungal root and crown diseases on hard red winter wheat (*Triticum aestivum* L. c.v. Roughrider) by comparing disease, growth, and yield parameters of treated plots to those of an untreated check in southwest North Dakota. Raxil XT, Raxil MD, and Dividend Extreme + Adage 5FS seed treatments increased grain yield significantly over the check plot.

Introduction

Winter wheat is commonly seeded into spring wheat stubble for protection against temperature extremes which often occur during winter and early spring. In addition to the stress on plants produced by these extreme conditions soil-borne pathogens may affect the ability of hard red winter wheat to survive the dormant period into the following spring (Cook and Veseth, 1991). A number of protectant or systemic seed treatments are registered for wheat seed treatment. Some are specific for certain seed or soil-borne fungi; others are wider spectrum. Often several products are used in combination or are formulated to provide control of a wider spectrum of diseases.

Soil-borne fungi and seed treatments are affected by individual or local soil environments and planting dates (Piccinni, Shriver, and Rush, 2001) so field demonstrations under local conditions are prudent. The purpose of this study was to demonstrate the ability of fungicide seed treatments to control root and crown pathogens in hard red winter wheat and improve the survival of winter wheat through the winter.

Methods

The demonstration was conducted on the Ryan Kadmas Farm near Dickinson, ND, at a site where the previous crops were spring wheat in 1998 followed by corn in 1999, sunflower in 2000, and spring wheat in 2001. The soil was a Lawther silty clay (pH 5.9, O.M. 2.8%, N 109 lb/acre, P 32 PPM, K 440PPM, S 70 lbs/acre, Cl 43 lb/acre).

An application of Roundup Ultra Max (glyphosate) at the rate of 1 pt/acre + 2 qt/acre of ActaMaster Spray Adjuvant was applied on 4 September 2002 to control volunteer spring wheat and emerged weeds. Roughrider hard red winter wheat was treated with

various seed treatment fungicides prior to planting (Table 1). Seed that was planted in the check (CHECK) plot was untreated. A Hege double disc plot drill was used to seed the plots into stubble on 28 September 2001.

A randomized complete block design with six replications was used in this demonstration. Plots were 10 feet wide by 45 feet long with a four foot buffer strip of bare soil between each plot.

Ammonium sulfate (21-0-0-24 S) was applied at the rate of 370 pounds per acre on 16 April 2002. No additional fertilizer was applied to the plot area. A post emergence weed control application was made using a tank mix of 0.4 oz/acre Harmony Extra + 1pt/acre Buctril on 15 May 2002.

Emergence counts and vigor ratings were made on 11 October, 2001; 15 November 2001; and 14 May 2002 on six plots per treatment. Plant counts in two eight foot sections of row were collected and plants per square foot calculated. Vigor scores were a subjective rating where the evaluator compared the appearance of plant density and leaf width of the treatment with the CHECK plot.

Root and crown samples from four plots per treatment were evaluated twice during the growing season. The first evaluation occurred between Zadoks 24 and 26 (tillering) and the second evaluation occurred at Zadoks 85 (soft dough). For the first evaluation, 15 plants were carefully dug from each plot and excess soil gently shaken from the roots. Samples were stored with the soil still on the roots in plastic bags and refrigerated until washed and analyzed. Plants selected for the first evaluation were evaluated for stage of development, length of the plant measure from the crown to the tip of the last fully extended leaf, extent of lesions on the subcrown internode, and counts of both seminal and crown roots. Twenty-five plants for the second evaluation were carefully dug and excess soil gently shaken from the roots. The samples were stored with the soil still on the roots and refrigerated until the roots were washed and evaluated. For the second evaluation subcrown internode, root color, and root mass were examined.

Prior to harvest, mature plant height and head densities were determined. The plots were harvested on 14 August 2002 with a Massy Ferguson 8XP combine, which measured grain weight harvested, percent moisture of harvested grain, and test weight. Harvested

area was measured and yields calculated. Protein was determined at Southwest Grain, Inc., Dickinson, ND. Grain yield, test weight, and protein were adjusted to a 12% moisture basis (Hellevang, 1986).

All data except where noted were statistically analyzed using SAS Statistical software version 8.2. Only four repetitions were used in the analysis of the root data taken at Zadoks 85 and at harvest.

Results and Discussion

Emergence and Vigor

Raxil XT + Gaucho counts were significantly lower than the plant counts for the CHECK though plant vigor for all seed treatments except Dividend XL was greater than the CHECK (Table 2). No significant differences were detected in the November and May stand evaluations. However, plant stands declined by 15% from November 2002 to May 2002. No differences in plant vigor were detected during the November and May evaluations. Very dry conditions following seeding and well into May caused stressed conditions.

Grain Yield, Test Weight, and Protein

Grain yields for seed treated with Raxil XT, Raxil MD, and Dividend Extreme + Adage were significantly higher compared to the CHECK (Table 3). Products labeled for the control of root pathogens tended to produce higher yields than the CHECK. Gaucho and Adage are insecticides used for the control of wire worm. No differences in grain yields were noted between Raxil XT with the insecticides and without the insecticide yet Dividend Extreme performance in terms of yield was significantly greater with the insecticide than without. Wireworms and wireworm damage was not found during any of the field or lab evaluations of plants from the plots. Aphids were not reported to be a problem.

Grain test weights for Dividend Extreme and Dividend Extreme + Adage were significantly heavier than the CHECK but no differences in test weight were detected between Dividend Extreme treatments with and without thiamethoxam.

No differences were noted in grain protein, plant height or plant density in this trail.

Root Evaluations and Soil Propagule Counts

No significant differences were noted in any of the characteristics evaluated in the initial root and plant evaluation (Table 4) or the root evaluation at the soft dough stage (Table 5) when comparing the CHECK

with the fungicide seed treatments. Yield increases can not always be explained in terms of differences among treatments in plant stands or in other estimates of the amount of plant growth (Davis and Bockus, 2001). However seminal and crown root counts tended to be greater than the counts for the CHECK.

Dry weather conditions occurring at the time of sampling and hard cloddy soil conditions made the recovery of root and crown material difficult and the value of root rating questionable for this particular study.

Implications of Demonstration

Seed treatments do provide some protection against root pathogens that infect wheat as evidenced by yield data in this demonstration. Fungicidal seed treatments with activity against Fusarium, Pythium, and common root rot tended to promote healthier root systems.

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Table 1. Active ingredients of seed treatments used on Roughrider hard red wheat, Dickinson, ND, 2002.

Treatment	Status	Active ingredient and (percent concentration in product)	Product AI Rate g/100 kg seed	Active on disease ¹
Dividend XL 1.67 FS	Registered	Difenoconazole (16.5) Mefenoxam (1.38)	9.75	Common Root Rot, Pythium, Seedling Blight, Loose Smut
Dividend Extreme	Registered	Difenoconazole (7.73) Mefenoxam (1.87)	11.25	Common Root Rot, Rhizoctonia Root Rot, Penicillium, Aspergillus, Fusarium Seed Scab, Pythium Damping-off
Raxil XT 35WP	Registered	Tebuconazole (15.0) Metalaxyl (20.0)	3.5	Seedling Blight, Pythium, Common Root Rot, Loose Smut
Raxil MD	Registered	Tebuconazole (0.48) Metalaxyl (0.64)	3.5	Seedling Blight, Pythium, Common Root Rot, Loose Smut
Raxil XT 35WP + Gaucho 480 FS	Registered	Tebuconazole (0.43) Metalaxyl (0.58) Imidacloprid ² (40.7)	3.5 31.0	Seedling Blight, Pythium, Common Root Rot, Loose Smut
Dividend Extreme + Adage 5FS	Registered	Difenoconazole (7.73) Mefenoxam (1.87) Thiamethoxam ² (47.6)	11.25 39.0	Common Root Rot, Rhizoctonia Root Rot, Penicillium, Aspergillus, Fusarium Seed Scab, Pythium Damping-off

¹ Registered seed treatment for wheat has activity on seed-borne and/or soil-borne pathogen that causes these diseases.² Gaucho 480 FS and Adage 5FS are insecticides.

Table 2. Stand counts for Roughrider hard red spring wheat with various seed treatments, Ryan Kadrmas Farm, Dickinson, ND, 2002.

Treatment	--- 11 Oct 2001 ---		--- 15 Nov 2001 ---		--- 14 May 2002 ---	
	Count	Vigor ¹	Count	Vigor ¹	Count	Vigor ¹
	Plants ft ⁻²	%	Plants ft ⁻²	%	Plants ft ⁻²	%
CHECK	10.8	100	18.0	100	15.2	100
Dividend XL 1.67FS	12.1	107	19.1	103	15.6	100
Dividend Extreme	11.2	140	20.9	102	14.9	99
Raxil XT 35WP	11.1	137	19.1	100	16.2	99
Raxil MD	9.1	130	17.6	99	16.8	105
Raxil XT 35WP + Gaucho 480FS ²	8.1	130	16.9	98	15.7	101
Dividend Extreme + Adage 5FS ²	11.5	127	17.9	101	15.9	102
Mean	10.6	124	18.5	100	15.7	101
CV%	20.3	11.9	18.7	5.9	10.2	4.5
LSD .05	2.5	17	NS	NS	NS	NS
Reps	6	6	6	6	6	6

¹ Vigor is a subjective rating where the evaluator compares the appearance of plant density and leaf width of the treatment with the CHECK plot.

² Gaucho 480FS and Adage 5FS are insecticides.

Table 3. Grain yield, test weight, protein, height, and head density at harvest of Roughrider hard red winter wheat grown under various seed treatments, Ryan Kadrmas Farm, Dickinson, ND, 2002.

Treatment	Head density	Height	----- Grain ¹ -----		
			Yield	Test weight	Protein
	no/yd ²	inches	bu/a	lbs/bu	%
CHECK	314.4	31.2	46.2	59.2	13.9
Dividend XL 1.67FS	316.8	31.0	47.3	59.3	13.8
Dividend Extreme	344.9	31.3	46.5	60.3	13.7
Raxil XT 35WP	341.5	32.4	49.7	59.2	13.9
Raxil MD	328.4	31.8	50.4	59.7	13.7
Raxil XT 35WP + Gaucho 480FS ²	337.0	31.4	46.9	59.8	13.8
Dividend Extreme + Adage 5FS ²	324.7	31.6	51.5	60.7	13.9
Mean	329.6	31.8	48.3	59.7	13.8
CV%	11.6	3.0	4.6	0.9	1.4
LSD .05	NS	NS	3.3	0.8	NS
Reps	4	4	4	4	4

¹ All grain yields, test weights, and proteins are adjusted to a 12% moisture basis.

² Gaucho 480FS and Adage 5FS are insecticides.

Table 4. Initial root and plant evaluations of Roughridger hard red winter wheat for various seed treatments, Ryan Kadrmas Farm, Dickinson, ND, 2002.

Treatment	Development		Tillers no plant ⁻¹	Subcrown rating ²	Seminal roots no plant ⁻¹	Crown roots no plant ⁻¹
	stage Zadoks	Length ¹ mm				
CHECK	25.2	281	5.3	1.0	3.9	12.7
Dividend XL 1.67FS	26.0	266	6.3	1.0	4.1	13.4
Dividend Extreme	25.9	267	6.0	1.0	4.0	14.1
Raxil XT 35WP	25.5	277	5.5	1.0	4.0	11.8
Raxil MD	25.8	269	5.9	1.0	3.9	13.5
Raxil XT 35WP + Gaucho 480FS ³	25.4	267	5.5	1.0	4.2	12.5
Dividend Extreme + Adage 5FS ³	24.9	266	4.8	1.0	4.1	11.5
Mean	25.5	270	5.6	1.0	4.0	12.8
CV%	2.6	6.1	13.7	-	9.0	13.7
LSD .05	NS	NS	0.9	-	NS	NS
Reps	6	6	6	6	6	6

¹ Length measured from the crown to the tip of the last fully extended leaf of the plant.

² Subcrown internode rating, 0-4. 0 = no infection, 1 = less than 25% of the internode infected, 2 = 25 – 50% of the internode infected, 3 = 51 – 75% of the internode infected, multiple lesions, and 4 = 75-100 % of the internode infected, lesions coalesced.

³ Gaucho 480FS and Adage 5FS are insecticides.

Table 5. Root evaluation at the soft dough stage, Roughridger hard red winter wheat, Ryan Kadrmas Farm, Dickinson, ND, 2002.

Treatment	Subcrown		
	internode rating ¹	Root mass ²	Root color ³
CHECK	1.3	2.2	1.9
Dividend XL 1.67FS	1.1	2.2	1.9
Dividend Extreme	1.1	2.1	2.0
Raxil XT 35WP	1.2	2.0	2.1
Raxil MD	1.2	2.1	2.0
Raxil XT 35WP + Gaucho 480 FS ⁴	1.2	2.2	2.0
Dividend Extreme + Adage 5FS ⁴	1.2	2.2	2.0
Mean	1.2	2.1	2.0
CV%	8.5	11.5	7.2
LSD .05	NS	NS	NS
Reps	4	4	4

¹ Subcrown internode rating, 0-4. 0= no infection, 1 = less than 25% internode infected, 2 = 25-50% of internode infected, 3 = 51-75% of internode infected, multiple lesions, and 4 = 75-100% of internode infected, lesions coalesced.

² Root mass rating, 1 to 4. 1 = few roots and 4 = substantial root system.

³ Root color index, 1 to 4. 1 = white, 4 = dark brown.

⁴ Gaucho 480FS and Adage 5FS are insecticides.