Spring Wheat Seed Treatment Demonstration – Taylor, ND 2003

R.O. Ashley, and G. Martin

Summary

Eight registered and experimental fungicide seed treatments were evaluated for the control of fungal root and crown diseases on hard red spring wheat (*Triticum aestivum* L. c.v. Parshall) by comparing disease, growth, and yield parameters of treated plots to those of an untreated check and a fumigated soil check in southwest North Dakota. Raxil MD + Gaucho 480FS seed treatment increased grain yield significantly over the untreated check plot but was not significantly greater than Raxil MD. Parshall hard red spring wheat is sensitive to methyl bromide soil fumigant and/or its metabolites.

Introduction

Seeds may be treated with fungicides for various reasons. These reasons include: 1) prevention of disease development because of seed-borne infection by pathogenic microorganisms; 2) protecting seeds and seedlings from invasion by soil-borne seedling invaders; and 3) protecting the plant from specific soil-borne pathogens that cause root and crown rots. 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.

Some producers believe the use of fungicide seed treatments is not necessary in late-planted spring wheat. Results from several seed treatment trials tend to support this belief.

Soil-borne fungi and seed treatments are affected by individual or local soil environments so field demonstrations under local conditions are prudent. Knowing the yield potential of a system allows an individual to optimize the inputs of a system. Inclusion of a fumigated check plot provides the opportunity to evaluate the yield potential as fumigation reduces root pathogen populations. The purpose of this study was to demonstrate the ability of fungicide seed treatments to control root and crown pathogens in a continuous hard red spring wheat rotation.

Methods

The demonstration was conducted on the Jay Elkin Farm near Taylor, ND, at a site that has grown continuous wheat since 1996. The soil was a Regent silty clay loam. The producer applied 106 lbs nitrogen and 30 lbs P_2O_5 and 12.5 lbs of Fargo herbicide per acre on 25 Oct 2002. The soil in the plot area was sampled on 21 Apr 2003 and sent to the NDSU soil laboratory for analysis. The analysis found 104 lbs/acre of NO3-N, 17 ppm P (Olsen), 375 ppm K, 32 lb/acre sulfate sulfur, 79 lbs/acre Cl. Organic mater was 3.1% and the soil pH was 6.3. No additional fertilizer was applied to the plot area during the growing season.

An application of Roundup UltraMax (glyphosate) at the rate of 1 pt/acre + 2 qt/acre of ActaMaster Spray Adjuvant was applied on 3 May 2003 to control volunteer spring wheat and emerged weeds. Parshall hard red spring wheat was treated with various seed treatment fungicides prior to planting (Table 1). Seed that was planted in the check (CHECK) plot and in the fumigated soil plot were untreated. Precipitation delayed seeding for 18 days. A Hege no-till double disc plot drill was used to seed the plots into stubble on 23 May 2003.

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 spring-sown winter wheat between each plot. Plots to be fumigated were covered with a six-mil clear plastic sheet, edges buried in trenches four to six inches deep to seal the covered area, and methyl bromide was metered through plastic hoses at the rate of one pound per 100 ft^2 (50 g m-2), on 30 Apr 2003. The fumigated plots remained covered for 48 hours after which time the plastic was removed.

A post emergence weed control application was made using a tank mix of 0.4 oz/acre Harmony Extra + 1 pt/acre Buctril, 0.66 pt/acre Puma on 21 Jun 2003. Tilt fungicide was tank mixed with the post emergent herbicide and applied at the rate of 2 fl oz per acre.

Emergence counts were made on 2 Jun and again on 12 Jun 2003 on the entire six plots per treatment. Plant counts in two eight-foot sections of row were collected and plants per square meter calculated.

Wireworm damage on leaves were noted but not rated.

Root and crown samples from six plots per treatment were examined in the first evaluation and samples from three plots per treatment were examined for the second evaluation. The first evaluation occurred between Haun 4.5 and Haun 5.5 and the second evaluation occurred at Haun 14.5. In 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 plant measured 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, root mass, and crown rot were examined. The crown rot rating examined each plant in the sample for dark brown to black colored stems that extended from the crown of the plant to at least the first node. If the plant exhibited this symptom, the plant was counted as having crown rot.

Prior to harvest, mature plant height and head densities were determined. The plots were harvested on 25 Aug 2003 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 three replications were used in the analysis of root and crown evaluation at the soft dough stage.

Results and Discussion

Emergence

Raxil MD, Raxil MD+Gaucho480FS, Raxil+L1194-A1(50ppm)+Allegiance, Raxil+L1194-A1(10ppm)+Allegiance, Dividend XL 1.67FS, Dividend Extreme, and RTU Vitavax-Thiram treated plots had significantly improved emergence compared to the CHECK plot (Table 2). The FUMIGATED soil plot had the highest emergence counts of any of the treatments in this trial. Warm, moist soil conditions were present from planting through early growth, which should have been ideal for stand establishment.

Grain Yield, Test Weight, Protein, Head Density, and Mature Plant Height

Raxil MD+Gaucho 480FS, a fungicide and insecticide containing seed treatment, produced a significantly higher grain yield than the CHECK treatment though not significantly different from the fungicide seed treatment Raxil MD (Table 3). Raxil MD, Raxil+L1194-A1(10ppm)+Allegiance, Dividend XL 1.67FS, Dividend Extreme, an RTU Vitavax-Thiram produced grain yields higher than the CHECK but not significantly higher. Grain yield of Parshall hard red spring wheat grown on FUMIGATED soils was lower than the CHECK.

There were no significant differences between the CHECK and seed treatments for grain weight or protein in this trial. Grain weight for grain grown in the FUMIGATED treatment was significantly higher than the CHECK.

The number of heads per unit area was not statistically greater than the CHECK treatment but mature plant height of Raxil MD + Gaucho 480FS was significantly taller than the CHECK. Parshall hard red spring wheat grown on the FUMIGATED soil produced the shortest plants in this trial.

Root Evaluations

Seed treatments neither delayed nor increased the rate of development of Parshall spring wheat in this trial (Table 4). However, many of the seed treatments delayed development in comparison to plants grown in the FUMIGATED soil plots. Seed treatments did not increase or decrease the number of tillers per plant significantly compared to plants grown in the CHECK treatment in this trial. This trial was planted using a high seeding rate. Establishing high numbers of plants per unit area reduces tillering (Carr, Horsley, and Poland 2003).

No significant differences in seminal root and crown root numbers were noted in this study (Table 4). In earlier studies where FarGo herbicide was used no significant difference were detected in root numbers.

No significant differences were noted in the subcrown internode ratings, root mass, or root color during the root and crown evaluation at the soft dough stage. However, the crown rot rating indicated that nearly all seed treatments exhibited significantly lower rates of discolored stems than the CHECK. The exception was the seed treatment Raxil MD+Gaucho FS but this seed treatment was not significantly lower than where only the fungicide, Raxil MD, was applied.

Implications of Demonstration

Fungicides applied to seed will improve emergence and establishment of plant stands in late May plantings. Though yield was not significantly increased by fungicides alone, the combination of a fungicide and an insecticide seed treatment did increase yields. Parshall hard red spring wheat is sensitive to methyl bromide and its metabolites.

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Table 1. Active ingredients of seed treatments used on Parshall hard red spring wheat, Taylor, ND, 2003

Treatment	Status	Active ingredient and (percent concentration in product)	Product AI Rate	Active on disease[1]
Raxil MD	Registered	Tebuconazole (0.48) Metalaxyl (0.64)	5.0 fl oz/cwt	Seedling Blight, Pythium, Common Root Rot, Loose Smut
Raxil MD + Gaucho 480FS	Registered	Tebuconazole (0.48) Metalaxyl (0.64) Imidacloprid[2] (40.7)	5.0 fl oz/cwt	Seedling Blight, Pythium, Common Root Rot, Loose Smut
Raxil MD Extra	Registered	Tebuconazole (0.48) Metalaxyl (0.58) Imazalil 1.0)	5.0 fl oz/cwt	Loose smut, early season septoria complex, Pythium, Rhizoctonia, common root rot, Fusarium
L1291-A1	Not Registered	NA[3]	5.3 fl oz/cwt	NA[3]
Raxil + L1194-A1 (50 ppm) + Allegiance	Not Registered	Tebuconazole NA Metalaxyl (28.35)	10 ppm AE+ 50 ppm AE+ 0.1 fl oz/cwt	NA[3]
Rail + L1194-A1 (100 ppm) + Allegiance	Not Registered	Tabuconazole NA Metalaxyl (28.35)	10 ppm AE+ 10 ppm AE+ 0.1 fl oz/cwt	NA[3]
Dividend XL 1.67FS	Registered	Difenoconazole (16.5) Mefenozam (1.38)	1.0 fl oz/cwt	Common Root Rot, Pythium, Seedling Blight, Loose Smut
Dividend Extreme	Registered	Difenoconazole (7.73) Mefenoxam (1.87)	2.0 fl oz/cwt	Common Root Rot, Rhizoctonia Root Rot, Penicillium, Aspergillus, Fusarium Seed Scab, Pythium Damping-off
RTU Vitavax-Thiram	Registered	Carboxin (10) Thiram (10)	5.0 fl oz/cwt	Loose smut, seedling blight

[1] Registered seed treatment for wheat has activity on seed-borne and/or soil-borne pathogen that causes these diseases.
[2] Gaucho 480 FS is an insecticide.
[3] NA = Information is not available.

Table 2. Stand counts for Parshall hard red spring wheat with various seed treatments, Jay Elkin Farm, Taylor, ND, 2003.

Treatment	2 Jun 2003 plants m^{-2}	12 Jun 2003 plants m^{-2}
CHECK	33.6	262.1
FUMIGATED	54.2	327.7
Raxil MD	38.3	288.4
Raxil MD + Gaucho 480FS[1]	36.5	309.1
Raxil MD Extra	39.0	274.6
L1291-A1	28.4	267.5
Raxil + L1194-A1(50ppm) + Allegiance	36.1	295.2
Raxil + L1194-A1(10ppm)+ Allegiance	34.1	286.4
Dividend XL	51.9	292.2
Dividend Extreme	55.3	294.8
RTU Vitavax Thiram	42.3	286.6
Mean	40.9	289.4
CV %	37.6	6.2
$LSD_{.05}$	17.8	20.9
Reps	6	6

[1] Gaucho 480FS is an insecticide.

Table 3. Grian yield, test weight, protein, height, and head density at harvest of Parshall hard red spring wheat grown under various seed treatments, Jay Elkin Farm, Taylor, ND, 2003.

Treatment	Head density	Height	Grain[1] Yield	Grain[1] Test weight	Grain[1] Protein
	no m^{-2}	mm	bu/a	lbs/bu	%
CHECK	291.0	549.0	30.8	59.9	15.0
FUMIGATED	332.5	525.3	24.2	61.0	14.8
Raxil MD	306.8	566.4	31.5	60.0	14.9
Raxil MD + Gaucho 480FS[2]	329.0	591.1	32.8	60.2	14.8
Raxil MD Extra	307.7	571.1	30.0	60.1	14.8
L1291-A1	307.2	549.0	30.6	60.3	14.9
Raxil + L1194-A1(50ppm) + Allegiance	299.9	561.6	30.3	60.3	15.0
Raxil + L1194-A1(10ppm)+ Allegiance	292.9	583.6	31.9	59.9	14.9
Dividend XL	323.9	579.9	31.8	59.8	14.9
Dividend Extreme	318.6	570.5	31.6	60.1	14.9
RTU Vitavax Thiram	298.4	562.0	31.7	60.0	15.0
Mean	309.8	565.3	30.6	60.2	14.9
CV %	9.2	5.4	5.0	0.9	1.3
$LSD_{.05}$	NS	35.5	1.8	0.6	NS
Reps	6	6	6	6	6

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

[2] Gaucho 480FS is an insecticide.

Table 4. Initial root and plant evaluations of Parshall hard red spring wheat with various seed treatments, Jay Elkin Farm, Taylor, ND, 2003.

Treatment	Development sage	Length[1]	Tillers	Subcrown internode rating[2]	Seminal roots	Crown roots
	Haun	mm	no plant^{-1}		no plant^{-1}	no plant^{-1}
CHECK	5.1	276.3	2.2	1.0	4.2	4.4
FUMIGATED	5.3	274.7	2.6	1.0	4.5	4.8
Raxil MD	5.0	243.5	2.1	1.1	4.5	4.6
Raxil MD + Gaucho 480FS[3]	4.9	246.0	1.9	1.0	4.4	3.8
Raxil MD Extra	5.2	259.6	2.0	1.0	4.4	4.2
L1291-A1	4.9	255.0	2.1	1.0	4.2	4.3
Raxil + L1194 (50 ppm) + Allegiance	4.7	257.6	2.0	1.0	4.2	3.9
Raxil + L1194 (10 ppm) + Allegiance	5.0	256.0	1.8	1.0	4.4	4.0
Dividend XL	4.9	258.1	2.1	1.0	4.5	4.3
Dividend Extreme	4.8	265.7	2.1	1.0	4.4	3.9
RTU Vitavax-Thiram	4.9	260.1	2.2	1.0	4.1	4.4
Mean	5.0	259.3	2.1	1.0	4.3	4.2
CV%	5.7	7.5	16.5	7.6	6.5	17.8
LSD .05	0.3	NS	0.4	NS	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, 1-4. 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 is an insecticide.

Table 5. Root and crown evaluation at the soft dough stage, Jay Elkin Farm, Taylor, ND, 2003.

Treatment	Subcrown internode rating[1]	Root mass[2]	Root color[3]	Crown rot[4]
CHECK	1.5	2.3	2.1	9.7
FUMIGATED	1.4	2.7	2.0	1.7
Raxil MD	1.6	2.1	2.4	5.3
Raxil MD + Gaucho 480FS[5]	1.6	2.0	2.2	6.7
Raxil MD Extra	1.5	2.5	2.2	2.0
L1291-A1	1.5	2.1	2.2	5.3
Raxil + L1194 (50 ppm) + Allegiance	1.6	2.0	2.2	5.7
Raxil + L1194 (10 ppm) + Allegiance	1.4	2.3	2.2	4.7
Dividend XL	1.6	2.1	2.3	4.3
Dividend Extreme	1.5	2.2	2.2	1.3
RTU Vitavax-Thiram	1.6	2.3	2.3	3.7
Mean	1.5	2.2	2.2	4.6
CV%	7.7	9.8	7.4	50.4
LSD .05	NS	0.4	NS	3.9
Reps	3	3	3	3

[1] 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, muliple lesions, and 4 = 75-100% of the internode infected, lesions coalesced.

[2] Root mass rating 1-4. 1 = few roots, 4 = many roots.

[3] Root color rating 1-4. 1=white roots, 4 = dark roots.

[4] Number of plants in 25 per plot exhibiting dark brown stem to first node.

[5] Gaucho 480 is an insecticide.