# Spring Wheat Seed Treatment Demonstration-Dunn and Stark Counties, North Dakota

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**Summary**

Three experimental products at three different rates and two registered products at labeled rates were evaluated at two southwest North Dakota locations 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 an untreated check plot at two southwest North Dakota locations.

**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.

Soil-borne fungi and seed treatments are affected by individual or local soil environments 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 a continuous wheat rotations.

**Methods**

The demonstrations were conducted on the Jay Elkin Farm near Taylor, ND, (Stark County) at a site that had been in continuous wheat for the previous five years and on the Larry Pavlicek Farm near Dickinson, ND (Dunn County) at a site that had been in wheat the previous year. At the Stark County site winter wheat was seeded in the fall of 2003 and eliminated from the plot area on 9 Apr with an application of Roundup Ultra Max at the rate of 20 fl oz/acre + 40 fl oz/acre Actamater (ammonium sulfate) spray adjuvant. The soil is a Morton silty clay loam. The soil was sampled on 2 Apr 2004 and analyzed at the NDSU Soil Testing Laboratory. The soil analysis indicated the soil contained 15 lbs/acre $NO_3$-N, 7 ppm P, 380 ppm K, 48 lbs/acre $SO_4$-S and 139 lbs/acre Cl. Organic mater content at the site was 3.9% and pH was 6.0. Urea at the rate of 220 pounds per acre was broadcast applied on 16 Apr 2004. Significant rainfall occurred the following day.

The Dunn County site was seeded on a Regent silty clay loam. The soil was sampled on The soil was sampled on 7 Apr 2004 and analyzed at the NDSU Soil Testing Laboratory. The soil analysis indicated the soil contained 63 lbs/acre $NO_3$-N, 16 ppm P, 290 ppm K, 24 lbs/acre $SO_4$-S and 75 lbs/acre CL. Ammonium sulfate at the rate of 150 pounds per acre was broadcast when the crop was at the three-leaf stage on 2 Jun.

A randomized complete block design with four replications was used at each location. Plots were 10 feet wide by 45 feet long with a four-foot buffer of winter wheat seeded between each plot.

Parshall hard red spring wheat was treated with one of three experimental seed treatment fungicides at three different rates prior to planting (Table 1) or one of two registered products at the labeled rate. Seed planted in the check (CHECK) plot was untreated. No-till production practices were used at each location. Seed was planted with a Cross-Slot no-till drill on 27 Apr at the Stark County site and on 29 Apr at the Dunn County site at the rate of 1.5 million seed per acre.

One post-emergent herbicide application was used to control weeds in the crop. This application was made on 8 Jun 2004 with a tank mix of 0.5 oz/acre of Harmony GT XP + 0.66 pt/acre of Puma. In addition to the herbicides 2 fl oz/acre of Tilt was applied at the same time for foliar disease control.

Emergence evaluations were conducted when approximately 50% of the plants had emerged in the untreated plot on 19 May 2004 and the emergence completed count was may on 26 May 2004. Plant counts in three 4.9 m sections of row were collected and plants per square meter were calculated.

Root and crown samples from four plots per treatment were evaluated twice during the growing season. The first evaluation occurred between Zadoks 24 and 28 (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 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, and root mass were examined.

During Zadoks 85 (soft dough), soil from each of the untreated CHECK plots was sampled by discarding the first 5 cm of soil from the surface and retaining the next 5 cm of soil for the sample. These samples were then combined, mixed and a subsample placed in a plastic bag and submitted to Ribeiro Plant Lab, Inc., Bainbridge Island, WA for analysis of Pythium, Fusarium, and Rhizoctonia propagules. Pythium presence and levels were determined using a modification of the PARPH medium published by Jeffers and Martin (1986); Fusarium presence and levels were determined using Komada's medium (Komada, 1975); and Rhizoctonia presence and levels were determined using MKH at 1:1000 dilution (Sneth, 1991). Propagule counts for *Bipolaris sorokiniana*, the cause of common root rot, were not done.

Prior to harvest, mature plant height and head densities were determined. The Taylor plots were harvested on 24 Aug and the Dickinson Plots were harvested on 30 Aug with a Massy Ferguson 8XP combine, which measured grain weight harvested, percent moisture of harvested grain, and grain test weight. Harvested area was measured and yields were calculated. Protein was determined at Southwest Grain Inc., Dickinson, ND. Grain yield, test weight, and protein were adjusted to 12% moisture basis (Hellevang, 1986).

All data were statistically analyzed using SAS Statistical software version 8.2.

**Results and Discussion**

*Emergence*

No significant differences in emergence were detected at either location (Table 2). As the application rate for KNF 2829 increased, stand counts tended to decrease.

*Grain Yield, Test Weight, Protein and Head Density*

KNF 2826 at 400 ml/100 Kg of seed produced the highest grain yield of any seed treatment in this trial and was significantly higher than the untreated CHECK (Table 3). All grain test weights were considered low and no significant differences in protein were detected. Rainfall was 43% of normal for the entire growing season. June was the second driest ever recorded in the 108 year history of the Dickinson weather station with only 12% of normal or 0.46 inches of rainfall measured for that month. August precipitation was 36% of normal and was probably not sufficient to produce normal test weight grain. Head densities for KNF 2826 significantly decreased as application rates increased for this product. The other experimental products did not exhibit a change in head density as application rates changed.

*Root Evaluations*

During the initial root evaluation, plant length and crop development stage tended to decrease as application rates of KNF 2826 and KNF 2827 increased, although not significantly (Table 4). Seminal root counts decreased as application rates increased for KNF 2827.

The subcrown internode ratings in the second evaluation were lower for all seed treatments, except KNF 2826 at the 300 ml/Kg rate (Table 5). Root mass tended to be larger but not significantly larger than the check for all seed treatments except Dividend XL, which was lower than the CHECK.

Propagule counts (Ribeiro 2004) were noted at medium levels for *Pythium* spp (250 ppg), *Fusarium* spp (520 ppg) and *Rhizoctonia* spp (20 ppg) at the Taylor site. Propagule counts at the Dickinson site for *Pythium* spp. were high (490 ppg), *Fusarium* spp. were medium (600 ppg) and no *Rhizoctonia* spp. were detected. This may explain some of the treatment by location and location interactions found in this trial.

**Implications of Demonstration**

KNF 2826 applied at the rate of 400 ml/100 Kg had a significantly better subcrown internode rating at the soft dough stage and higher yield than the CHECK. In addition to these ratings, KNF 2826 tended to produce higher test weight grain, improved tiller counts, subcrown internode ratings, seminal root counts and crown root counts at the Zadoks 24, and improved root color and root mass at Zadoks 85 when compared to the CHECK. However, this product decreased the number of heads produced per unit area as application rates increase.

The KNF 2826 fungicide seed treatment appears to provide some protection from *Pythium* spp. and *Biolaris sorokiniana* and provides better protection from soil-borne pathogens than the currently registered products used in this demonstration.

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Table 1. Active ingredients of seed treatments used on Parshall hard red spring wheat, Dunn County and Stark County sites, ND, 2004.

| Treatment | Status | Active ingredient and (percent concentration in product) | Product AI Rate | Active on disease[1] |
|---|---|---|---|---|
| Raxil MD | Registered | Tebuconazole (0.48)<br>Metalaxyl (0.64) | 324 ml/100 Kg | Seedling Blight, Pythium, Common Root Rot, Loose Smut |
| Dividend XL 1.67FS | Registered | Difenoconazole (16.5)<br>Mefenozam (1.38) | 63.4 ml/100 Kg | Common Root Rot, Pythium, Seedling Blight, Loose Smut |
| KNF 2829 | Not Registered | NA[2] (41.0) | Rate varies with treatment | NA[2] |
| KNF 2826 | Not Registered | NA[2] (34.2) | Rate varies with treatment | NA[2] |
| KNF 2827 | Not Registered | Thiram (15.0 – 40.0)<br>NA[2] ( 0.02) | Rate varies with treatment | NA[2] |

[1] Registered seed treatment for wheat has activity on seed-borne and/or soil-borne pathogen that causes these diseases.

[2] NA = Information is not available. Experimental products from Crompton Uniroyal Chemical Company.

Table 2. Stand counts for Parshall hard red spring wheat with varous seed treatments, combined analysis of the Dunn County and Stark County sites, ND, 2004.

| Treatment | Rate | Initial count | Second count |
|---|---|---|---|
| | ml/100Kg | no $m^{-2}$ | no $m^{-2}$ |
| Untreated | | 123.1 | 247.7 |
| KNF 2829 | 50 | 109.7 | 269.2 |
| KNF 2829 | 75 | 102.9 | 254.3 |
| KNF 2829 | 100 | 99.9 | 253.7 |
| KNF 2826 | 200 | 133.0 | 272.2 |
| KNF 2826 | 300 | 96.8 | 253.2 |
| KNF 2826 | 400 | 117.2 | 273.9 |
| KNF 2827 | 100 | 119.2 | 256.3 |
| KNF 2827 | 150 | 102.4 | 230.2 |
| KNF 2827 | 200 | 111.7 | 250.5 |
| Raxil MD | 324 | 86.1 | 241.2 |
| Dividend XL | 63.4 | 113.7 | 253.3 |
| Mean | | 109.6 | 254.6 |
| CV% | | 30.4 | 14 |
| $LSD0_{.05}$ | | NS | NS |
| Treatment F Prob | | 0.3483 | 0.4566 |
| Rep F Prob | | <0.0001 | <0.0001 |
| Location F Prob | | 0.3361 | 0.0820 |
| Treatment * Location F Prob | | 0.3065 | 0.5258 |

Table 3. Grain yield, test weight, protein, height, and head dnesity at harvest of Parshall hard red spring wheat grown under various seed treatements, combined analysis of the Dunn County and Stark County sites, ND, 2004.

| | | | | ---------- Grain[1] ---------- | | |
|---|---|---|---|---|---|---|
| Treatment | Rate | Head density | Mature plant height | Test weight | Yield | Protein |
| | ml/100Kg | no m-2 | mm | lb/bu | bu/acre | % |
| Untreated | | 295.1 | 732.7 | 55.9 | 28.4 | 16.0 |
| KNF 2829 | 50 | 290.8 | 736.5 | 56.8 | 27.3 | 15.7 |
| KNF 2829 | 75 | 313.3 | 729.4 | 55.9 | 28.5 | 15.9 |
| KNF 2829 | 100 | 292.1 | 731.9 | 55.8 | 29.6 | 16.0 |
| KNF 2826 | 200 | 316.9 | 737.9 | 55.4 | 29.7 | 15.9 |
| KNF 2826 | 300 | 294.2 | 727.3 | 58.6 | 28.2 | 15.8 |
| KNF 2826 | 400 | 284.2 | 725.2 | 58.0 | 32.8 | 15.7 |
| KNF 2827 | 100 | 307.4 | 740.1 | 54.5 | 28.1 | 16.1 |
| KNF 2827 | 150 | 291.1 | 723.8 | 57.7 | 27.9 | 15.9 |
| KNF 2827 | 200 | 299.4 | 725.4 | 57.9 | 29.3 | 16.1 |
| Raxil MD | 324 | 293.8 | 735.4 | 55.2 | 29.9 | 15.9 |
| Dividend XL | 63.4 | 285.5 | 734.6 | 57.2 | 27.7 | 16.0 |
| Mean | | 297.0 | 731.7 | 56.6 | 28.9 | 15.9 |
| CV% | | 7.6 | 2.9 | 3.5 | 8.5 | 2.9 |
| LSD0.05 | | 22.5 | NS | 2.0 | 2.5 | NS |
| Treatment F Prob | | 0.0077 | 0.8838 | 0.0006 | 0.0043 | 0.8537 |
| Rep F Prob | | 0.1020 | 0.0031 | 0.0221 | 0.9221 | <0.0001 |
| Location F Prob | | 0.0005 | <0.0001 | 0.9706 | 0.5939 | 0.0083 |
| Treatment * Location F Prob | | 0.5024 | 0.0747 | 1.0000 | 1.0000 | 0.0012 |

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

Table 4. Initial root and plant evaluations of Parshall hard red spring wheat with variuos seed treatments, combined analysis of the Dunn County and Stark County sites, ND, 2004.

| Treatment | Rate | Plant length[1] | Plant development stage | Tillers | Subcrown internode[2] | Seminal roots | Crown roots |
|---|---|---|---|---|---|---|---|
| | ml/100Kg | mm | | no plant$^{-1}$ | | no plant$^{-1}$ | no plant$^{-1}$ |
| Untreated | | 321.9 | 24.7 | 1.8 | 1.15 | 3.13 | 6.85 |
| KNF 2829 | 50 | 284.1 | 25.1 | 2.1 | 1.15 | 2.60 | 6.77 |
| KNF 2829 | 75 | 310.9 | 23.6 | 2.0 | 1.03 | 3.20 | 6.53 |
| KNF 2829 | 100 | 301.5 | 23.8 | 1.7 | 1.07 | 3.04 | 5.55 |
| KNF 2826 | 200 | 321.8 | 24.7 | 2.0 | 1.04 | 3.25 | 6.88 |
| KNF 2826 | 300 | 313.2 | 24.1 | 2.1 | 1.17 | 3.32 | 6.90 |
| KNF 2826 | 400 | 301.6 | 23.4 | 1.9 | 1.03 | 3.53 | 6.18 |
| KNF 2827 | 100 | 313.4 | 23.9 | 1.8 | 1.08 | 2.84 | 5.98 |
| KNF 2827 | 150 | 293.7 | 22.9 | 1.9 | 1.01 | 3.36 | 5.98 |
| KNF 2827 | 200 | 295.2 | 23.2 | 1.9 | 1.03 | 3.57 | 5.59 |
| Raxil MD | 324 | 302.2 | 23.6 | 1.6 | 1.04 | 3.28 | 5.75 |
| Dividend XL | 63.4 | 310.0 | 24.8 | 2.0 | 1.03 | 3.42 | 6.54 |
| Mean | | 305.8 | 24.0 | 1.9 | 1.06 | 3.21 | 6.29 |
| CV% | | 10.7 | 9.2 | 22.1 | 15.7 | 17.6 | 20.9 |
| LSD0.05 | | NS | NS | NS | NS | 0.56 | NS |
| Treatment F Prob | | 0.4652 | 0.6089 | 0.4698 | 0.5504 | 0.0458 | 0.2913 |
| Rep F Prob | | 0.0026 | 0.1754 | 0.1427 | 0.0356 | 0.0804 | 0.1506 |
| Location F Prob | | 0.0027 | <0.0001 | 0.0666 | 0.1682 | 0.1139 | 0.0004 |
| Treatment * Location F Prob | | 0.0822 | 0.4385 | 0.7506 | 0.1903 | 0.1286 | 0.5237 |

[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.

Table 5. Root ealuation at soft dough of Parshall hard red spring wheat treated with various seed treatments, combined analysis of the Dunn County and the Stark County sites, ND, 2004.

| Treatment | Rate | Subcrown internode rating[1] | Root color[2] | Root mass[3] |
|---|---|---|---|---|
| | ml/100Kg | | | |
| Untreated | | 1.27 | 1.52 | 2.54 |
| KNF 2829 | 50 | 1.09 | 1.54 | 2.73 |
| KNF 2829 | 75 | 1.09 | 1.33 | 2.83 |
| KNF 2829 | 100 | 1.09 | 1.34 | 2.82 |
| KNF 2826 | 200 | 1.10 | 1.42 | 2.64 |
| KNF 2826 | 300 | 1.20 | 1.46 | 2.71 |
| KNF 2826 | 400 | 1.13 | 1.39 | 2.65 |
| KNF 2827 | 100 | 1.09 | 1.44 | 2.85 |
| KNF 2827 | 150 | 1.11 | 1.37 | 2.78 |
| KNF 2827 | 200 | 1.08 | 1.41 | 2.55 |
| Raxil MD | 324 | 1.08 | 1.46 | 2.72 |
| Dividend XL | 63.4 | 1.09 | 1.27 | 2.50 |
| Mean | | 1.12 | 1.41 | 2.69 |
| CV% | | 10.7 | 14.9 | 10.5 |
| LSD0.05 | | 0.12 | NS | NS |
| Treatment F Prob | | 0.0499 | 0.3877 | 0.1817 |
| Rep F Prob | | 0.1042 | 0.0003 | <0.0001 |
| Location F Prob | | 0.0070 | 0.0000 | 0.7012 |
| Treatment * Location F Prob | | 0.9857 | 0.1690 | 0.2083 |

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

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