

Wheat Seed Germination as Influenced by Fertilizer Rate, Fertilizer Source, and Spreader Type with One-Pass Pneumatic Seeding-Fertilizing

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Production costs and erosion concerns have shifted planting systems toward reduced tillage. This shift has expanded development of multiple use tillage-planting equipment that will operate in large quantities of residue. Pneumatic or air seeders were developed as attachments to chisel plows and field cultivators for tillage and seeding in the same operation. The pneumatic seeder also offers the advantages of large hoppers, wide machines for covering a large number of acres and folding wing sections for rapid transport. Pneumatic seeders, although designed for seeding, can also serve as fertilizer application equipment. Many questions remain relative to fertilizer application methods, rates and sources with these new seeding-fertilizing machines.

Normally, low fertilizer rates, especially nitrogen (N), are recommended for direct application with the seed using conventional seeding equipment because extreme seed germination damage occurs when N rates exceed 15 to 20 pounds nitrogen per acre. These low N rates do not meet the crop requirements in today's high yield production programs. Higher rates of commercially available fertilizer materials would require a second field operation. Seed germination problems can be overcome to some degree with pneumatic seeders by dispersing seed and fertilizer with various spreader types. There is no information on specific rate limits for application of fertilizers directly with the seed using pneumatic seeders. This project was undertaken to study wheat seed germination with various spreader types as influenced by high rates of commercially available fertilizer materials and new experimental fertilizers being developed by the TVA National Fertilizer Development Center.

PROCEDURE:

The study was conducted on a Bearden silty clay soil (pH 7.9) at the Agronomy Seed Farm near Casselton, North Dakota. The pneumatic seeder was a 24-foot Wil-Rich 4153 chisel plow (12-inch shank spacing) pulled with an International 5288 tractor with dual rear wheels. Four spreader or seeding types were evaluated; however, the data reported include only three since two

types gave similar results. The spreader types are shown in Figure 1 and include:

- A - **Maximum spread** was achieved with a 12-inch sweep shovel and deflector that spread the seed and fertilizer in a 12-inch band.
- B - **Minimum spread** was achieved with a 12-inch sweep shovel and deflector that spread the seed and fertilizer in a 6-inch band.
- C - **No spread** was achieved with a narrow spear point that placed the seed and fertilizer in a single row or 1-inch band.

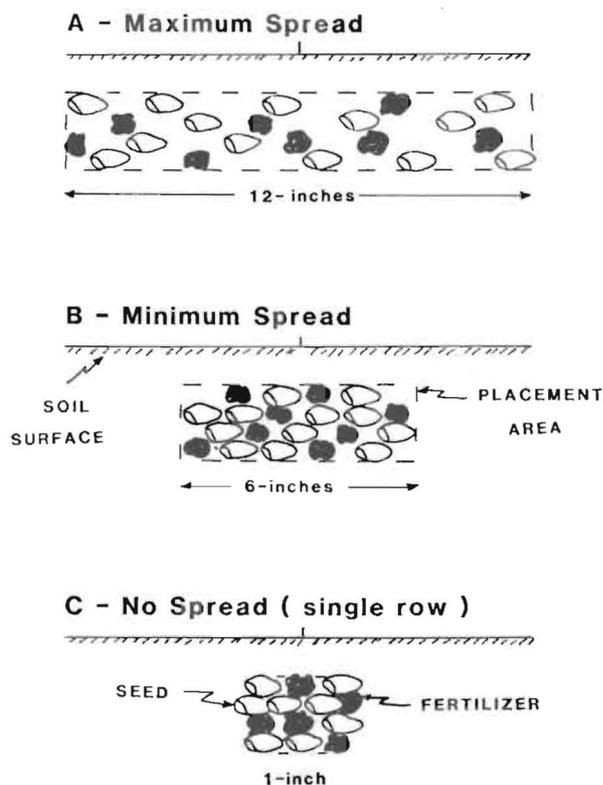


Figure 1. Diagram of Seed-Fertilizer Placement For Three Spreader Types Used With Pneumatic Seeding-Fertilizing Equipment.

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The fertilizer materials used in the study, along with the rates applied and nutrient grades for each product are identified in Table 1. The Wil-Rich pneumatic fertilizer unit was calibrated for accurate delivery of the various rates and sources. All fertilizer material was applied with the seed at planting. The trial was set up with three replications in a randomized complete block design with the spreader types as subplots.

Table 1. Rate and Source of Fertilizer Applied in One Pass Pneumatic Seeding-Fertilizer Application Trial at Casselton, North Dakota.

Fertilizer Rate ¹			Fertilizer Source ²
N + P + K			
lb/acre			
0	0	0	Check
40	0	0	Urea (46-0-0)
80	0	0	Urea (46-0-0)
40	0	0	Ammonium Nitrate (33-0-0)
80	0	0	Ammonium Nitrate (33-0-0)
40	0	0	Sulfur Coated Urea (37-0-0) 18% 7-day Dissolution
80	0	0	Sulfur Coated Urea (37-0-0) 18% 7-day Dissolution
40	17	0	Urea Plus Diammonium Phosphate (18-46-0)
80	17	0	Urea Plus Diammonium Phosphate (18-46-0)
40	17	0	Urea Plus Monoammonium Phosphate (11-55-0)
80	17	0	Urea Plus Monoammonium Phosphate (11-55-0)
40	17	0	Urea-Urea Phosphate (28-28-0)
80	17	0	Urea-Urea Phosphate (35-17-0)

¹ All fertilizer applied with the seed at planting.

² Urea (U), Ammonium Nitrate (AN), Diammonium Phosphate (DAP), and Monoammonium Phosphate (MAP) were obtained from commercially available sources, Urea-Urea Phosphate (UUP) and Sulfur Coated Urea (SCU) are experimental materials that were supplied by the TVA-National Fertilizer Development Center.

The test site (previous crop soybean) was planted the first week in May with the variety Wheaton (Vitavax treated with 95 percent germination) at a measured rate of 63 pounds per acre. Plots 100 feet long were seeded at a speed of approximately 3-4 mph. Plant emergence or seedling counts were collected three weeks after planting. Results are reported as a percent reduction in stand based on the plots receiving no fertilizer (check).

RESULTS:

The effect of fertilizer rate on seed germination may vary from year to year depending on such things like soil

moisture and soil temperature (which affect seed germination rate and biological or chemical reaction of fertilizer in the soil) or quality of fertilizer material with respect to size (coarse vs. fine) and form (prills vs. granules). The results presented are based on the second years data from an ongoing three-year project.

Soil moisture at the test site was adequate at planting; .71 inch of precipitation was received the week following planting. Soil temperatures at seeding depth average 51°F this same week. These conditions provided excellent conditions for testing the effect of the fertilizer materials on germination. Stand reduction data is shown in Figure 2 for N materials and Figure 3 for N and P materials.

The reduction in stand with urea (U) and spreader Type A (maximum spread) was 15 percent at the 40 pound N per acre rate and increased to 30 percent at the 80 pound N per acre rate. Adding diammonium phosphate (DAP) or monoammonium phosphate (MAP) with U reduced stand further by about 5 percent. The ammonium nitrate (AN), sulfur-coated urea (SCU), and urea-urea phosphate (UUP) showed stand losses of less than 10 percent irrespective of N rate.

Stands were reduced further when using spreader Type B (minimum spread). Urea caused a 30 percent and 50 percent stand reduction with the 40 and 80 pound N per acre rate respectively. The AN, SCU, and UUP materials caused less than 10 percent reduction at the 40 pound N per acre rate and 20 or less stand reduction at the high N rate. Stand reduction with U + DAP or U + MAP was similar to that with U alone; stand reduction with U + DAP was only slightly less than U + MAP.

Placing all fertilizer with the seed in a single row (spreader Type C) caused the most stand reduction, as might be expected. Fertilizer source influenced the degree of damage. The U, U + MAP, and U + DAP caused stand reductions of 60 to 75 percent at the 40 pound N per acre rate and 75 to 90 percent reduction with 80 pound N per acre. The two experimental materials (SCU and UUP) and AN showed less damage at both rates. The SCU showed only 15 percent damage at the higher N rate.

Tillering was inversely related to stand loss; more tillers were produced as stand reduction increased. The increased tillering caused a delay in heading and crop maturity which is potentially detrimental if flowering or grain filling periods are delayed to a time period where hot dry conditions occur. In many cases where stand reduction exceeded 50 percent, the number of heads produced was inadequate for maximum yield.

Grain yield, although affected in some cases by stand loss, is probably more closely related to soil test levels, the response to applied fertilizer and climatic and soil moisture conditions that occur during the grain flowering and grain-filling periods. Yield data must be collected for several years for reliable interpretation of cause-effect between stand loss in relation to fertilizer rates and sources. Results so far indicate that once stand

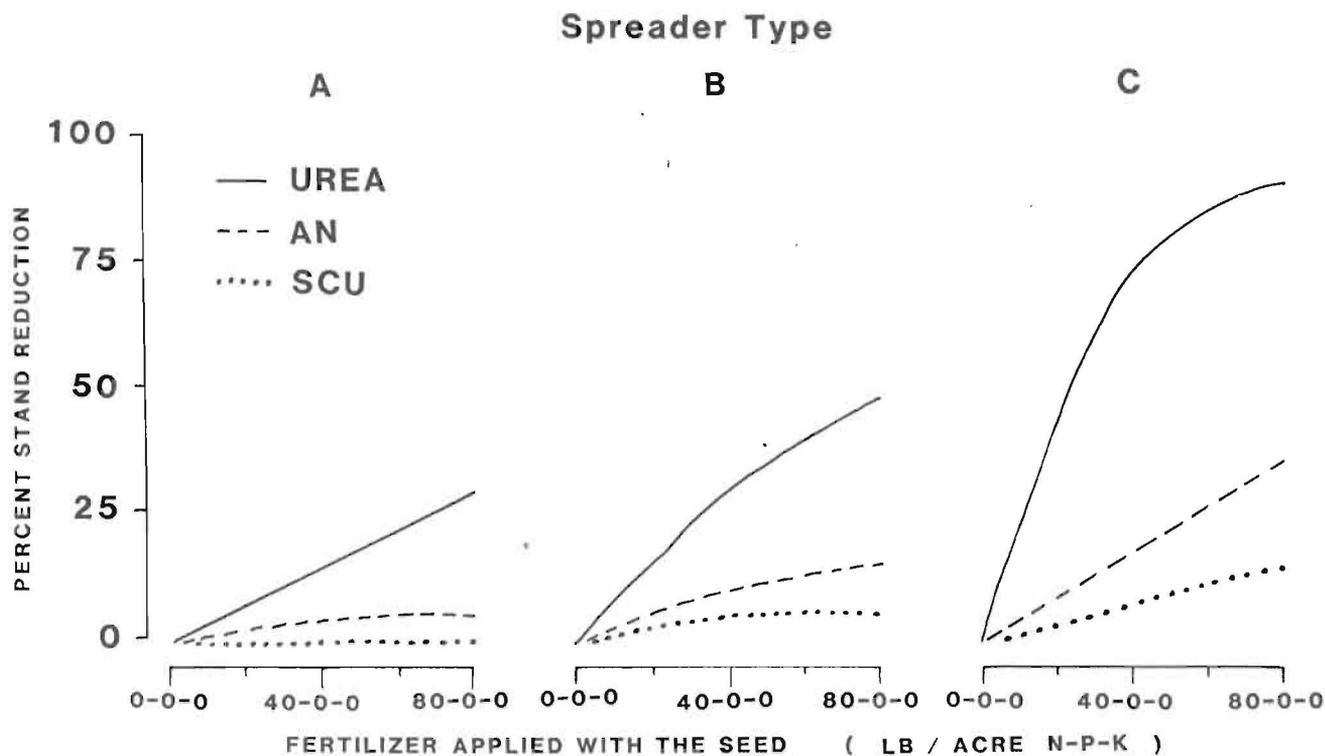


Figure 2. Spring Wheat Stand Reduction As Influenced By Nitrogen Fertilizer Source and Rate For Three Pneumatic Seeding-Fertilizing Spreader Types.

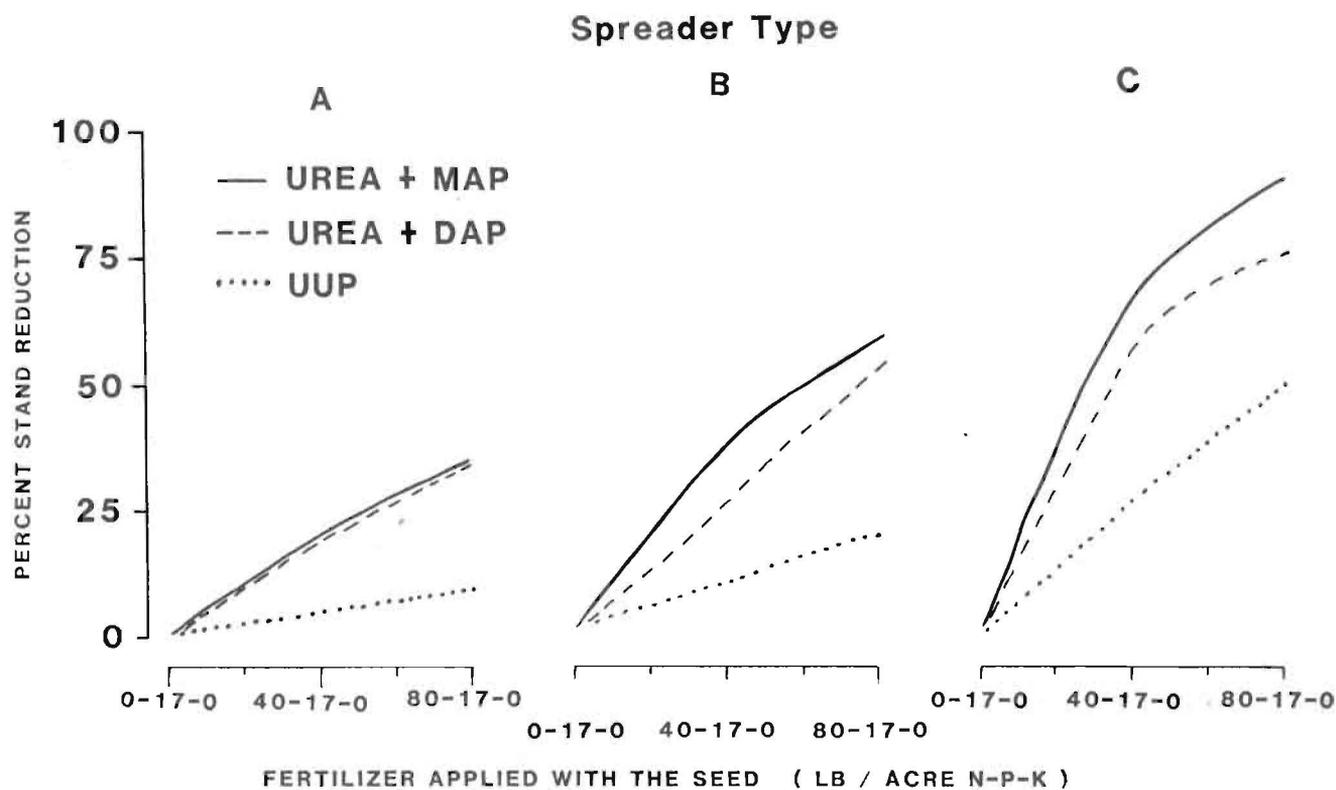


Figure 3. Spring Wheat Stand Reduction As Influenced By Nitrogen And Phosphorus Fertilizer Source And Rate For Three Pneumatic Seeding-Fertilizing Spreader Types.

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some North Dakota growers, having noted the high yield potential of semidwarf winter wheats from the Central Great Plains, have seeded them and risked the greater potential for winterkill. Results of a recent unpublished NDSU study indicated tillage selection accounted for eight times more of the variation in winter survival than variety selection. For example, there was a 70 percent difference in the survival of Roughrider under conventional and no-till conditions while there was only a 9 percent difference in survival of Centurk 78 and Roughrider when both were planted into stubble. Snow trapping has significantly increased the likelihood of the survival of winter wheat. However, the minimum snow cover required to ensure winter survival is greater for the less winterhardy varieties.

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reductions exceed 30 to 35 percent, either no yield increase or a reduction in yield from fertilizer applied with the seed can be expected. Fertilizer rate, fertilizer source and type of spreader will influence yields. This information should give some basic guidelines for applying various fertilizer rates and materials with the seed when using pneumatic seeders. The experimental materials SCU and UUP, are not commercially available but show promise as fertilizer sources for direct application with the seed using pneumatic seeders or other reduce tillage equipment.

SUMMARY:

Plant stand measurements indicate that fertilizer rates, fertilizer source, and degree of spread (spreader type) influence the stand reduction and yield potential when fertilizer is placed with the seed. Placing fertilizer with the seed in a single row or narrow band causes the greatest stand reduction. Conversely, spreading fertilizer and seed over a wide (12-inch) spacing causes least damage. Stand and emergence damage increased progressively as N fertilizer rates (40 pound increments) increased, but the degree of damage varied considerably with fertilizer source and spreader type. Most fertilizer materials showed minimal damage at the 40 pound N per acre rate unless fertilizer and seed were placed in a single row. When fertilizer rates were increased to 80 pound N per acre, stand reduction increased, especially

with U, U+DAP and U+MAP. The AN, SCU, and UUP materials showed less damage at the higher N rate, even with single row placement. Stand reduction in relation to fertilizer source followed the sequence $U > U + DAP = U + MAP > UUP > AN > SCU$ for all spreader types. Crop maturity was delayed by fertilizer rates that caused stand loss and increased tillering. Wheat yields were reduced when stand reduction exceeded 35 percent.

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