ONE-PASS PNEUMATIC FERTILIZING-SEEDING WITH VARIOUS N SOURCES AND N RATES

E. J. Deibert, Associate Professor, Soil Science Department,
North Dakota State University

ABSTRACT

Fertilizer rate, fertilizer source and spreader type influenced the degree of stand reduction and final yield obtained when spring wheat was planted in a one-pass operation utilizing a pneumatic fertilizing-seeding unit. Greatest stand reduction occurred when fertilizer and seed were placed in a single row and least when spread over a wide 12-inch band. Fertilizer rates above 40 lb N/acre increased the degree of stand reduction and lowered yield response unless SCU or AN were used as fertilizer sources. Stand reduction followed the sequence U $\geq$ U + DAP > U + UP $\geq$ UUP > AN > SCU with respect to source. Once stand reduction exceeded 35 percent, delays in crop maturity occurred and no yield response was obtained from the fertilizer applied. Crop maturity was delayed as much as 7 days with single row placement. Maturity was affected least when seed and fertilizer were spread in a wide band. AN and SCU sources caused the least stand reduction, the lowest tillering, thus the least effect on maturity compared to other sources.

OBJECTIVES

The expansion of reduced tillage in wheat production areas has raised questions relative to fertilizer management because normal fertilizer practices currently used under conventional tillage are not always compatible with high residue conditions. Such questions have directed new research emphasis in areas of fertilizer placement and fertilizer sources.

Pneumatic equipment attachments to tillage implements were developed for seeding and fertilizing in the same operation thus eliminating or reducing the number of field operations. Direct application of fertilizer with small grain seed, especially urea base fertilizers, can cause extreme germination damage when N rates exceed 20 lb/acre. This low N rate will not meet the requirements for producing maximum wheat yields and may require additional operations to supply the total fertilizer needs. The seed germination problem can be overcome to some degree with pneumatic seeders by dispersing the seed and fertilizer with deflectors on the tillage equipment. This tillage-seeding-fertilizing method and associated deflector or spreaders also provides greater mixing and distribution in the soil for less direct fertilizer-seed contact to reduce germination damage. Although some seed germination damage may occur, no specific rate limits have been established for this tillage-seeding-fertilizing management option.

The amount of seed germination damage, although controlled by soil properties, fertilizer rate and degree of soil mixing, can be modified by fertilizer source. Studies with "acid-based" urea-urea phosphate (UUP) fertilizers indicated that higher rates of these materials may be applied with the seed and cause less damage than with combinations of urea and/or ammonium phosphate (1). The decreased germination damage was associated with the capacity of the acid phosphorus to inhibit damage by retarding urea hydrolysis, neutralizing the products of urea hydrolysis and thus reducing free ammonia which damages the seed. Sulfur coated urea (SCU) a source that utilizes slow-release characteristics also showed promise as another approach to keep salt levels and free ammonia below damaging levels.

These new ideas and experimental materials need to be field tested to determine feasibility and/or establish recommendations for these fertilizer management practices in reduced tillage. The objectives of this study were to [1] determine the effects of various experimental N sources and rates on wheat seed germination with one-pass pneumatic seeders using various spreader types and [2] compare rates of experimental fertilizer materials with commercially available sources on seed germination, plant growth, nutrient uptake and yield.

MATERIALS AND METHODS

A field study was conducted to evaluate sources and rates of nitrogen fertilizer material applied with wheat seed at planting in a one-pass operation. A Wil-Rich pneumatic fertilizer-seeder unit on a 24-foot chisel plow with 12-inch spacing and an International 5288 tractor with dual rear wheels was utilized. Seeded plots were 100 feet long with data collected from the center 50 foot section. Four spreader types (attached to the chisel shanks) that distributed the seed and fertilizer in various patterns (shown in the diagram) were used. Spreader types A, B and C used 12-inch sweep shovels and various deflectors to achieve the desired pattern. Type D was achieved with a narrow spear point (no-till shoe) that placed seed and fertilizer in a single row. The study was conducted on a Bearden silty clay soil, previous crop soybeans, with three replications in a randomized complete block design with spreader types as 6-foot wide subplots. Plant counts, a measure of seed germination damage, and other growth parameters were collected from 2 by 2 foot squares randomly selected in the plot area after planting. Yields were determined after harvesting the mature grain from a 50 foot long area with a small plot combine. Preliminary information and results on this study were previously reported (2,3).

RESULTS AND DISCUSSION

Spring wheat stand reduction (Table 1) as influenced by fertilizer source, fertilizer rate and spreader type using an air seeder unit in a one-pass operation varied with treatments imposed but was fairly consistent across years. Stand reduction increased as the rate of N increased from 40 to 80 lb/acre irrespective of source. The greatest reduction occurred with U or U + DAP, least with AN or SCU and intermediate with experimental UP and UUP. Spreader type had the greatest influence on degree of stand loss. When all fertilizer was placed in a narrow band with the seed (Type D) reductions from 60 to 90 percent were obtained with U, U + DAP and U + UP. Reduction was only 20 to 30 percent when AN or SCU were applied. Spreading the fertilizer and seed over a 12-inch band (Type B and C) caused minimal stand losses of 15 to 30 percent with U, U + DAP and U + UP and only 0 to 10 percent with AN and SCU. The UUP caused stand reductions in the 5 to 20 percent range. Spreader type A (6-inch spread) had less stand reduction than type D, but higher than B or C. Excessive stand losses (greater than 35 percent) occurred with type A when rates exceeded 40 lb N/acre with the U, U + DAP, U + UP sources.

The stand reductions were compensated for by increased tillering (data not shown) but the increase also influenced crop maturity. The number of days to heading (Table 2) were recorded in 1985 and showed, on the average, a 1 to 4 day delay with all sources except SCU. The greatest delay, in some cases a week delay, occurred when all fertilizer was applied with the seed in one row (Type D). A delay in maturity was realized with the wide spread only when N rates exceeded 40 lb N/acre. In some cases, the wheat crop headed out earlier than the check, especially when SCU or AN were applied.

The relative change in yield, associated with both stand reduction and maturity, is summarized in Table 3. A consistent yield reduction was observed with spreader

Table 1. Spring wheat stand reduction as influenced by fertilizer source, fertilizer rate and spreader type in a one-pass pneumatic fertilizer-seeding. North Dakota.

Fertilizer				Spreader Type				
Source[1/]	Rate	N + P	Year	A	B	C	D	Ave.
lb/acre				percent[2/]				
U	40	0	1984	32	21	11	76	35
			1985	13	5	22	77	29
			Ave.	22	13	16	76	32
	80	0	1984	47	36	26	90	50
			1985	63	25	28	87	51
			Ave.	55	30	27	88	50
AN	40	0	1984	1	0	0	11	3
			1985	2	0	8	24	9
			Ave.	2	0	4	18	6
	80	0	1984	16	0	10	33	15
			1985	44	20	13	36	28
			Ave.	30	10	12	34	22
SCU	40	0	1984	10	0	0	12	5
			1985	16	5	10	37	17
			Ave.	13	2	5	25	11
	80	0	1984	15	3	0	5	6
			1985	15	14	3	43	19
			Ave.	15	8	1	24	12
U + DAP	40	17	1984	27	22	18	57	31
			1985	16	7	12	70	26
			Ave.	22	14	15	63	28
	80	17	1984	58	35	35	77	51
			1985	68	38	39	96	60
			Ave.	63	36	37	86	56
U + UP	40	17	1984	18	6	18	61	26
			1985	0	0	8	47	14
			Ave.	9	3	13	54	20
	80	17	1984	43	20	25	82	42
			1985	54	33	28	82	49
			Ave.	48	26	26	82	45
UUP	40	17	1984	10	0	0	7	4
			1985	37	19	12	74	36
			Ave.	24	10	6	40	20
	80	17	1984	22	13	4	56	24
			1985	31	27	13	86	39
			Ave.	26	20	8	61	32

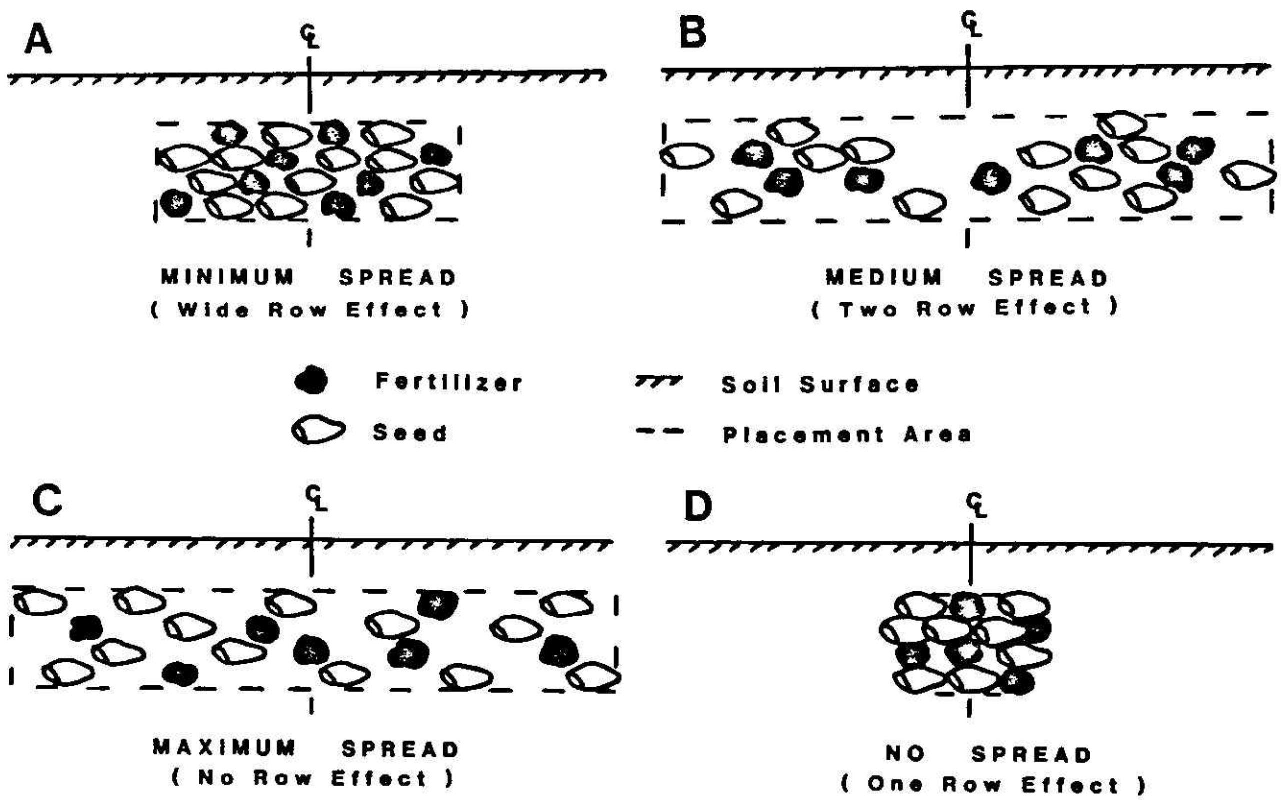
1/ Urea (U), ammonium nitrate (AN) and diammonium phosphate (DAP) were obtained from commercially available sources. Urea phosphate (UP), urea-urea phosphate (UUP) and sulfur coated urea (SCU) are experimental materials furnished by TVA-National Fertilizer Development Center.

2/ Relative change with respect to the check treatment with no fertilizer applied.

Table 2. Number of days to heading of spring wheat as influenced by fertilizer source, fertilizer rate and spreader type in a one-pass pneumatic fertilizer-seeding. North Dakota 1985.

Fertilizer			Spreader Type				
Source[1/]	Rate	N + P	A	B	C	D	Ave.
	lb/acre		number of days				
Check	0	0	69	65	65	66	66
U	40	0	70	67	67	72	69
	80	0	71	67	67	73	70
AN	40	0	68	64	64	70	67
	80	0	68	65	64	71	67
SCU	40	0	71	64	64	65	66
	80	0	69	64	64	67	66
U + DAP	40	17	68	64	64	72	67
	80	17	71	68	66	73	69
U + UP	40	17	67	64	64	71	66
	80	17	69	65	65	73	68
UUP	40	17	70	65	65	72	68
	80	17	70	68	67	73	69

[1/]Urea (U), ammonium nitrate (AN) and diammonium phosphate (DAP) were obtained from commercially available sources. Urea phosphate (UP), urea-urea phosphate (UUP) and sulfur coated urea (SCU) are experimental materials furnished by TVA-National Fertilizer Development Center.



PNEUMATIC SEEDER
FERTILIZER - SEED DISTRIBUTION
12-INCH SHOVEL SPACING

Table 3. Spring wheat yield change as influenced by fertilizer source, fertilizer rate and spreader type in a one-pass pneumatic fertilizer-seeding. North Dakota.

Fertilizer			Year	Spreader Type				
Source[1]	Rate	N + P		A	B	C	D	Ave.
	lb/acre			percent[2]				
U	40	0	1984	21	21	32	-24	13
			1985	12	18	27	-28	7
			Ave.	16	20	30	-26	10
	80	0	1984	2	16	17	-51	-4
			1985	-38	14	11	-55	-17
			Ave.	-18	15	14	-53	-10
AN	40	0	1984	9	17	24	14	16
			1985	27	34	42	15	29
			Ave.	18	26	33	14	22
	80	0	1984	25	28	25	0	19
			1985	25	26	34	0	21
			Ave.	25	27	30	0	20
SCU	40	0	1984	1	20	11	7	10
			1985	14	26	30	25	24
			Ave.	8	23	20	16	17
	80	0	1984	16	29	31	18	23
			1985	21	41	38	23	31
			Ave.	18	35	34	20	27
U + DAP	40	17	1984	21	23	26	-10	15
			1985	31	40	46	-6	28
			Ave.	26	31	36	-8	22
	80	17	1984	13	26	25	-76	-3
			1985	14	31	42	-78	2
			Ave.	14	28	34	-77	0
U + UP	40	17	1984	9	26	24	-9	12
			1985	31	31	39	7	27
			Ave.	20	28	32	1	20
	80	17	1984	12	13	18	-50	-2
			1985	26	37	44	-37	18
			Ave.	19	25	31	-44	8
UUP	40	17	1984	33	37	31	14	28
			1985	14	32	32	-12	16
			Ave.	24	34	32	1	22
	80	17	1984	14	31	30	-33	11
			1985	25	36	42	-27	19
			Ave.	20	34	36	-30	15

1/ Urea (U), ammonium nitrate (AN) and diammonium phosphate (DAP) were obtained from commercially available sources. Urea phosphate (UP), urea-urea phosphate (UUP) and sulfur coated urea (SCU) are experimental materials furnished by TVA-National Fertilizer Development Center.

2/ Relative change with respect to the check treatment with no fertilizer applied.

type D with U or U + DAP (both N rates) and with U + UP and UUP at the 80 lb N/acre rate. A yield increase was obtained with type D when AN at 40 lb N/acre rate and SCU at both N rates were applied. A yield increase was obtained with all sources and rates except 80 lb N/acre U with spreader type A. No yield reductions were observed with spreader type B and C, irrespective of rate or source. It is interesting to note that the maximum yield increase with SCU was obtained only at the higher rate (80 lb N/acre). Although yield response varied with source and rate, generally no yield response was obtained once stand reduction exceeded 35 percent. Thus the selection of fertilizer source and degree of spread influenced the response obtained on this silty clay soil. Responses obtained on other soils may be similar but may vary with soil properties like texture, moisture and pH.

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