METHODS OF APPLYING AMMONIUM PHOSPHATE FERTILIZER IN A CONTINUOUS WHEAT ROTATION IN SOUTHWEST SASKATCHEWAN

by

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ABSTRACT

A field experiment was conducted in the Brown soil zone comparing three methods of fertilizer placement -- deep banding, side banding and with the seed, using ammonium phosphate fertilizer in a zero-till continuous wheat rotation. Placement with the seed was found to produce the highest yield and had the lowest cost of production.

INTRODUCTION

Fertilizer placement in a zero-till system has been a concern of producers and researchers alike, particularly for a continuous cropping rotation where high rates of nitrogen may be required. In the conventional cropping system, banding fertilizer has been recommended as the best method of application (Harapiak 1982); however, the comparison has usually been made to broadcast applications, often to fall broadcasting, which is the least efficient of all application methods (Selles et al. 1986). Broadcasting nitrogen fertilizers in a zero-till system is considered undesirable because it feeds shallow-rooted weeds (Payton et al. 1985; Veseth et al. 1986) like green foxtail and may get tied up in surface residue. Under dry conditions it may also not get dissolved and carried down into the root zone to become available to the plant. Therefore, seed placement and banding were considered to be the best available options. A field experiment was set up to determine which treatment would give the better results. Ammonium phosphate fertilizer was chosen because higher rates of nitrogen could be seed placed. The experiment was done in a zero-till system; however, the equipment used and the costs noted are also suitable for a minimum or conventional tillage system.

EXPERIMENTAL PROCEDURE

A randomized plot design of 6 treatments and 4 replicates was used for a continuous cropping experiment with zero-till seeding. Weed control was achieved with a pre-seeding chemical burn-off and conventional in-crop spraying. Fertilizer was applied in accordance with soil test recommendations for nitrogen and phosphorus. Plots were seeded with Leader, hard red spring wheat.

Treatments

1. Spring deep banding of all fertilizer 12.5 cm deep, 30-cm shank spacing. Seeded with a Versatile Noble hoe drill with zero-till points at 20-cm spacing.

2. Spring deep banding of all fertilizer 12.5 cm deep, 30-cm shank spacing. Seeded with a Versatile Noble disc drill at 20-cm spacing.

3. Seeded with a Versatile Noble 2000 hoe drill with the banding boot which placed all the fertilizer 2.5 cm below a split seed row (5 cm apart) in one operation.

4. Seeded with a Versatile Noble 2000 disc drill (prototype) which placed all the fertilizer 2.5 cm below a split seed row 5 cm apart in one operation.

5. Seeded with a Versatile Noble 2000 hoe drill. Fertilizer was all placed with the seed. Row spacing was 20 cm.

6. Seed with a Versatile Noble 2000 disc drill. Fertilizer was all placed with the seed. Row spacing was 20 cm.

A cost analysis for the seeding and fertilizer placement operations was prepared. Table 1 lists equipment and associated cost of operation. Table 2 shows the treatment cost but does not include the cost of seed and fertilizer and of preseeding chemical burnoff.

Table 1. Summary of Economic Assumptions

Implement	Replacement Cost*	Fixed Costs		Variable Cost	Total Cost
		Implement	Tractor		
	($)	----------	$/ha	----------	
Hoe press drill	38,120	6.35	3.08	8.43	17.86
Hoe press drill, w/banding boots	39,475	6.58	3.08	10.18	19.84
Disc press drill	40,560	6.76	3.08	8.43	18.27
Disc press drill, w/banding attachment	41,910	6.99	3.08	10.18	20.25
Fertilizer bander	25,200	4.20	3.08	10.18	17.46

* Replacement costs are for 9 m equipment.

For zero-till, a disk and hoe drill require approximately equal draft. For side banding, power requirements are 50% higher due to the extra depth required to get the seed to moisture.

Table 2. Summary of Seed and Fertilizer Placement Costs

Treatment	Total Cost	
	$/ha	$/acre
With the seed	18.00	7.30
Side banding	20.00	8.10
Deep banding	35.30	14.25

RESULTS AND DISCUSSION

The results of the years of testing are shown in Tables 3 and 4 as follows:

Table 3. Fertilizer Placement Test 1983-1987

Year	Treatment	Plants/ m^2	Seed Depth (cm)	Stnd. Dev. of Seed Depth	Yield kg/ha	Yield bu/acre
1983	Deep banded hoe	126.4a	4.8de	.92a	1605.90	23.89a
	Deep banded disc	129.7a	3.7ab	1.11ab	1689.99	25.13a
	Side banded hoe	135.3a	5.2e	1.28b	1745.83	25.97a
	Side banded disc	119.4a	4.1bc	1.86c	1645.57	24.47a
	With seed hoe	122.1a	4.6cd	.95a	1589.74	23.64a
	With seed disc	119.1a	3.3a	.86a	1605.22	23.88a
Seeded May 23, 168 kg/ha 26-30-0 was applied; 43.7 kg/ha (38.9 lb/acre) N						
1984	Deep banded hoe	149.1b	4.2a	.90a	212.92	3.16a
	Deep banded disc	141.8ab	6.5c	1.28bc	169.87	2.52a
	Side banded hoe	141.3ab	5.2b	.93ab	169.53	2.52a
	Side banded disc	137.3ab	5.6b	1.50c	199.48	2.98a
	With seed hoe	129.9a	4.1a	.97a	237.15	3.53a
	With seed disc	141.1ab	5.3b	1.14ab	359.61	5.35b
Seeded May 26, 174 kg/ha 26-13-0 was applied; 45.2 kg/ha (40.3 lb/acre) N						
1985	Deep banded hoe	190.9b	4.8b	.78a	767.34	11.42ab
	Deep banded disc	151.9a	6.8d	1.28bc	711.61	10.58ab
	Side banded hoe	185.5b	4.4ab	1.10ab	664.09	9.87a
	Side banded disc	148.9a	5.7c	1.59c	668.20	9.93a
	With seed hoe	148.2a	4.1a	.78a	888.66	13.22b
	With seed disc	152.8	5.4c	1.21b	813.12	12.09ab
Seeded May 15, 125 kg/ha 26-13-0 was applied; 32.5 kg/ha (28.9 lb/acre) N						

... continued

Table 3 (continued)

Year	Treatment	Plants/ m^2	Seed Depth (cm)	Stnd. Dev. of Seed Depth	Yield kg/ha	Yield bu/acre
1986	Deep banded hoe	170.9c	4.0a	.79a	2673.59	39.76a
	Deep banded disc	128.9b	5.9cd	1.31bc	2592.85	38.57a
	Side banded hoe	132.5b	6.0d	1.13b	2748.93	40.88a
	Side banded disc	105.3a	5.6c	1.31bc	2526.90	37.58a
	With seed hoe	178.7c	4.1a	0.82a	2728.74	40.57a
	With seed disc	117.6ab	5.2b	1.52c	2701.82	40.19a
Seeded May 14, 45 kg/ha 23-24-0 was applied; 10.35 kg/ha (9.2 lb/acre) N						
1987	Deep banded hoe	157.3a	4.67b	0.93ab	1408.80	21.0c
	Deep banded disc	131.8ab	5.9a	0.90b	1731.70	25.80ab
	Side banded hoe	148.9ab	4.6b	1.01ab	1558.80	23.20abc
	Side banded disc	131.1ab	4.6b	1.15a	1513.10	22.50bc
	With seed hoe	121.9b	4.2c	0.85b	1832.60	27.30a
	With seed disc	123.8b	4.5bc	0.79b	1722.9	25.60ab
Seeded May 5, 155 kg/ha 26-13-0 was applied; 40.3 kg/ha (35.9 lb/acre) N						
1983-87 Avg.	Deep banded hoe				1331.3	19.7ab
	Deep banded disc				1376.9	20.4ab
	Side banded hoe				1375.3	20.4ab
	Side banded disc				1308.5	19.4b
	With seed hoe				1452.6	21.6a
	With seed disc				1438.0	21.3ab
1983-1987	With seed hoe - disc avg.				1445.3	21.5a
	Deep banded hoe - disc avg.				1354.1	20.1b
	Side banded hoe - disc avg.				1341.9	19.9b

Means with the same letter are not significantly different (5% significance level).

Table 4. Dry Year (1984-85) Yield Data

Treatment	kg/ha	bu/acre
With seed hoe - disc avg.	567.9	8.4a
Deep banded hoe - disc avg.	459.6	6.8ab
Side banded hoe - disc avg.	420.1	6.2b

In the data (Table 3) there is little difference between hoe and disc drill treatments. Therefore, the two were averaged (Table 3 last part and Table 4) for part of the analysis.

At all times it was possible to seed place the required fertilizer without serious injury to the seed. Plant counts were never seriously affected, even in the dry years of 1984 and 1985.

Yields were somewhat better (about 100 kg/ha) for the seed placed treatment, on the average, and for the dry years 1984 and 1985 (Tables 3 and 4). The possible reason may be the loss of soil moisture due to deep banding (5" deep) and side banding, which requires extra depth to get the seed to moisture.

Since yield differences are not great, the cost of the treatments and time required to perform them are the main factors to be considered. The extra cost of side banding is not great ($2/ha), but the extra cost of deep banding is very significant ($17/ha). On the other hand, the extra time and inconvenience of handling larger volumes of fertilizer at seeding time is a factor many producers do not like.

In terms of optimizing profit (or minimizing loss), placing the fertilizer with the seed is the preferred treatment for the Brown soil zone. In areas where moisture is more abundant and greater amounts of nitrogen are required, the side banding treatment may be worth considering.

CONCLUSIONS

Seed placement of fertilizer is the most profitable method of placing fertilizer in the Brown soil zone. It produced the highest yield, particularly in dry years, and has the lowest cost of operation.

For a continuous wheat rotation in southwest Saskatchewan, the amount of nitrogen and phosphorus required by soil test recommendations can usually be seed placed without loss of yield if ammonium phosphate fertilizers are used.

REFERENCES

1. Harapiak, J. 1982. Fertilizer Forum #67. The Country Guide, March, 1982.

2. Payton, D.M., Hyde, G.M. and Simpson, J.B. 1985. Equipment and methods for no-till wheat planting. Transactions of ASAE 28(5): 1419-1429.

3. Veseth, R., McDole, R., Engle, C. and Vomocil, J. 1986. Fertilizer band location for cereal root access. Pacific North West Extension Publication PNW283.

4. Selles, F., Campbell, C.A., Zentner, R.P. and Dyck, F.B. 1986. Effect of fertilizer nitrogen on spring wheat production on a zero-tillage snow trap system in the Brown Soil Zone. In Proc., 1986 Soils & Crops Workshop, Univ. of Saskatchewan, Saskatoon, Sask.