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Starters Show The Way In Minnesota Studies

Yields 10 to 15 bu/A higher than in no-starter control plots.

Summary: *When averaged across the six starter fertilizer treatments, yields in 2008 with moldboard plow tillage (185.0 bu/A) were not different from chisel/rip tillage (182.5 bu/A) even though dry matter (DM) yield at the V7 stage averaged 36 percent larger for the moldboard plowed plots. Late-season moisture stress due to greater evapotranspiration (ET) demand for the larger plants on the moldboard plow plots may have limited yields and kept them from achieving their earlier high potential. All starter fertilizer treatments produced 10 to 15 bu/A higher yields than the no-starter control plots when averaged across tillage systems, but yields were not different among the five starter treatments. Uptake of nitrogen (N) into the grain was greater for moldboard plow tillage and was influenced by starter fertilizer treatment. Interactions between tillage and starter fertilizer treatment were not observed for any of the measured parameters.*

Crop rotations in the Midwest are changing markedly due to rapid expansion of the biofuel industry. Because of increased demand for corn to supply the ethanol industry and increasing insect and disease challenges facing soybean producers, some farmers are switching to a corn-corn-soybean rotation and other corn intensive rotations. These rotations produce large amounts of biomass (corn stover) that often remains on the soil surface with present-day tillage systems.

Farmers who have switched to rotations where corn follows corn are concerned about yield reductions, especially when surface residue levels are high and soil temperatures are cooler with their current conservation-till systems. Farmers are facing a dilemma. Should they revert back to moldboard plow tillage, which greatly increases the potential for erosion but will lead to greater yields, or can they overcome the yield penalty associated with conservation-till by using combinations of nitrogen (N) and phosphorus (P) fluid starters?

The objectives of this research were to:

- Determine the effects of fluid starter placement and combinations of 10-34-0 and 28-0-0 on second-year corn production under reduced-till/high-residue conditions
- Provide management guidelines on placement and rates of APP and UAN combinations for crop consultants, local advisors, and the fertilizer industry as they serve corn producers trying to meet the growing needs for corn grain by the ethanol industry and livestock producers.

Plant growth

Early plant growth on June 26 (V7 stage) was affected by both tillage and starter fertilizer placement on this very high-testing soil during a cool spring (Table 1). Plant height, dry matter, and uptake of N and P (due primarily to greater DM) were significantly greater for the moldboard plowed plots than the chisel/ripped plots. Concentrations of N in the whole-plant tissue were not affected by tillage ($p = 10\%$ level), but P was significantly lower in the larger plants obtained with moldboard plow tillage.

The in-furrow placed, popup treatment (10-34-0 @ 5 gal/A) produced greater plant height, DM yield, and NP uptake compared to the no-starter control (Table 1). When the APP rate was dribbled on the soil surface within 2 inches of the

seed row, early DM yield and uptake of N and P were not different from the no-starter control. However, when 15 lbs/A of N was added to the surface-dribbled APP treatment, plant height, early DM yield, and uptake of N and P were similar to the in-furrow, popup treatment. Adding 30 or 45 lbs/A of N to the surface-dribbled APP treatment increased plant height, early DM yield, and uptake of N and P (due mostly to greater DM) over the 15-lb/A N rate. This UAN rate effect was not found in 2007 when May soil temperatures were warmer. Less N was likely mineralized from the soil under the cool conditions in May 2008. Thus greater plant growth was obtained due to an N response to the larger application rate of starter N. Although N and P concentrations were not greatly different among treatments, they tended to be lowest for the treatments producing larger plants, probably due to dilution.

Interactions

Interactions between tillage and starter treatments were not significant (P≤0.10) for any of the early growth parameters. But it is interesting to note that early DM yield, N uptake, and P uptake were increased over the no-starter control by 74, 40, and 41 percent, respectively, for the in-furrow, popup placement of APP when using chisel plow tillage and by only 27, 4, and 16 percent, respectively, when using moldboard plow tillage. This highlights the need for a small amount of popup-placed APP or other fluid fertilizer even at a very high soil test P level (26 ppm) under reduced tillage if the genetic potential for very high yields is to be realized. Under these conditions, plants without an intimate placement of starter fertilizer would have considerably less early growth and reduced yield potential than those plants receiving starter fertilizer.

Grain moisture at harvest and plant population were not affected meaningfully by either tillage or starter fertilizer (Table 2).

Yield

Corn grain yield was not affected significantly (P = 0.10% level) by tillage, but was increased 10 to 15 bu/A across both tillage systems when fluid starter fertilizers were used (Table 2). Yield differences among the starter fertilizer placement positions (popup vs 2 x 0) and starter N rates were not significant, however. The fact that tillage did not affect corn yield and that an interaction between tillage and starter fertilizer was not found is surprising considering observations of the plots during the year. Early in the growing season (June and July) corn grown on the moldboard plow plots was considerably larger (35% larger on June 26) than corn on the chiseled plots. In addition, tasseling occurred about seven days earlier on the larger, robust corn from the moldboard plots.

The yield potential around August 10 was outstanding. It is our opinion that the rainfall shortage (4.15 inches) from mid-August through September placed greater moisture stress on the larger corn because the ET to maintain the larger plants was greater, thereby depleting more soil water than for the smaller, less robust corn from the chiseled plots. This stress negated the greater yield potential observed for the moldboard plowed corn, resulting in no yield and grain moisture differences between the two tillage systems.

				Whole Plant Samples at V7 (June 26)					
	Starter Fertilizer Treatments			Plant	DM	Concentration		Uptake	
Tillage	Placement	10-34-0	28-0-0	height	yield	N	P	N	P
		gal/A	lb N/A	inch	lb/A	%	%	--lb/A--	
Chisel	None	0	0	21.8	312	3.15	0.458	9.9	1.43
Chisel	Pop-up	5	0	28.2	542	2.59	0.383	13.9	2.02
Chisel	2 x 0	5	0	25.1	422	2.76	0.408	11.7	1.68
Chisel	2 x 0	5	15	28.3	504	2.49	0.365	12.6	1.83
Chisel	2 x 0	5	30	30.5	610	2.69	0.330	16.4	2.02
Chisel	2 x 0	5	45	31.4	708	2.73	0.333	19.3	2.36
Moldboard	None	0	0	27.6	576	2.97	0.373	17.0	2.15
Moldboard	Pop-up	5	0	32.4	730	2.41	0.343	17.6	2.49
Moldboard	2 x 0	5	0	29.3	580	2.77	0.360	16.1	2.09
Moldboard	2 x 0	5	15	32.2	690	2.63	0.333	18.0	2.29
Moldboard	2 x 0	5	30	33.3	750	2.64	0.318	19.5	2.38
Moldboard	2 x 0	5	45	33.9	852	2.75	0.328	23.3	2.78
Stats for RCB Design (All Treatments)									
P>F:				0.001	0.001	0.001	0.001	0.001	0.001
LSD (0.10):				1.6	122	0.24	0.035	2.9	0.41
CV (%)				4.7	16.8	7.4	8.2	14.6	16.0
Stats for Split-Plot Design (All Treatments)									
Tillage									
Chisel				27.5	516	2.73	0.379	14.0	1.89
Moldboard				31.4	696	2.69	0.342	18.6	2.36
P>F:				0.015	0.042	0.751	0.033	0.018	0.077
Starter Treatments									
None				24.7	444	3.06	0.415	13.5	1.79
Popup: 5, 0				30.3	636	2.50	0.363	15.7	2.25
2 x 0: 5, 0				27.2	500	2.77	0.384	13.9	1.88
2 x 0: 5, 15				30.2	596	2.56	0.349	15.3	2.06
2 x 0: 5, 30				31.9	680	2.66	0.324	18.0	2.20
2 x 0: 5, 45				32.6	780	2.74	0.330	21.3	2.57
P>F:				0.001	0.001	0.001	0.001	0.001	0.001
LSD (0.10):				1.0	76	0.14	0.025	1.9	0.25
Interaction Tillage x Starter treatment									
P>F:				0.108	0.762	0.364	0.118	0.529	0.858

Table 1. *Whole plant growth and nutrient uptake by corn at the V7 stage as affected by primary tillage and starter fertilizer placement and rate in 2008.*

The moisture stress described above may also have penalized the yield potential of the treatments receiving 45 lbs/A of N with the surface-dribbled 2 x 0 band treatment; these were the largest plants on June 26 but yielded 4 to 5 bu/A less than the lower starter N rate treatments.

Summing up

Primary conclusions are:

- Early plant growth and uptake of N and P at the V7 stage were greater for moldboard plow tillage than for chisel/rip tillage
- Starter fertilizer (10-34-0), either placed in the seed furrow as a popup or combined with UAN and dribbled on the soil surface next to the seed row, increased early plant growth and uptake of N and P
- Nitrogen and P concentrations in small plants were correlated negatively with plant size due to dilution
- Grain yields were not different between moldboard plow and chisel/rip tillage, probably due to the greater ET and moisture stress associated with the larger plants with moldboard plow tillage
- All starter fertilizer treatments, averaged across tillage systems, produced greater corn yields (10 to 15 bu/A) than the no-starter control treatment. Yields were not significantly different among the placement methods (in-furrow vs. 2 x 0) and UAN rates (N at 0, 15, 30, and 45 lbs/A)
- An interaction between tillage system and starter fertilizer treatment did not occur for any of the measured parameters
- Grain moisture at harvest and plant population were not affected by tillage or starter fertilizer.

	Starter Fertilizer Treatments			Grain		Initial Plant	Final Plant
Tillage	**Placement**	**10-34-0**	**28-0-0**	**Yield**	**H_20**	**Stand**	**Popl'n**
		gal/A	**lb N/A**	**bu/A**	**%**	**---plants*10^3/A---**	
Chisel	None	0	0	174.2	23.6	35.9	34.2
Chisel	Pop-up	5	0	183.9	25.4	34.3	33.8
Chisel	2 x 0	5	0	181.5	24.6	35.0	34.0
Chisel	2 x 0	5	15	188.0	24.2	35.2	34.2
Chisel	2 x 0	5	30	187.1	23.8	35.3	34.1
Chisel	2 x 0	5	45	180.5	24.1	34.7	34.0
Moldboard	None	0	0	172.8	23.5	34.9	33.6
Moldboard	Pop-up	5	0	184.4	25.0	35.8	34.2
Moldboard	2 x 0	5	0	186.8	23.2	34.7	33.7
Moldboard	2 x 0	5	15	189.8	23.4	35.2	34.2
Moldboard	2 x 0	5	30	190.4	23.2	35.6	34.0
Moldboard	2 x 0	5	45	186.0	22.4	34.9	34.0
Stats for RCB Design (All Treatments)							
P>F:				0.104	0.294	0.359	0.345
LSD (0.10):				NS	NS	NS	NS
CV (%)				4.7	6.3	2.5	1.0
Stats for Split-Plot Design (All Treatments)							
Tillage							
Chisel				182.5	24.3	35.1	34.0
Moldboard				185.0	23.4	35.2	33.9
P>F:				0.470	0.364	0.557	0.391
Starter Treatments							
None				173.5	23.5	35.4	33.9
Popup: 5, 0				184.1	25.2	35.1	34.0
2 x 0: 5, 0				184.1	23.9	34.9	33.9
2 x 0: 5, 15				188.9	23.8	35.2	34.2
2 x 0: 5, 30				188.8	23.5	35.5	34.0
2 x 0: 5, 45				183.3	23.2	34.8	34.0
P>F:				0.011	0.082	0.630	0.605
LSD (0.10):				7.1	1.1	NS	NS
Interaction Tillage x Starter treatment							
P>F:				0.953	0.838	0.181	0.184
CV (%)				4.5	5.6	2.6	1.0

Table 2. *Corn production as influenced by primary tillage and starter fertilizer placement and rate at Waseca in 2008.*

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