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Automatic Guidance Systems Add Efficiency To Fertilizer Management

Most precise GPS guidance available is the RTK system.

Recent developments in GPS-guided automatic steering systems have opened up many new management options for corn producers. Automatic guidance devices have provided benefits in terms of improved timeliness of field operations, less operator fatigue, reductions in overlapping applications of pesticides and fertilizers, controlled traffic system opportunities, as well as reduction in capital expenses (such as the possible elimination of row markers on corn planters, or the use of strip tillage tools that are only half to two-thirds of the corn planter width). The economic merits of automatic steering devices are still being debated, as are the relative merits of automatic systems with various degrees of accuracy. Many farmers question the extra cost associated with the RTK system, which provides up to one inch of accuracy.

However, until now, there has been very little research or extension emphasis on the possible benefits of automatic steering systems for improved efficiencies in fertilizer application and crop use. About the only generalization to have emerged from the discussion thus far is that automatic guidance systems should lessen the total fertilizer applied because of less overlap (associated with more precision of the driving pat-

SUMMARY

The most precise GPS-controlled automatic guidance system currently available for agricultural equipment is the RTK system. In 2006, our first year of research at two locations in NC and NW Indiana, we determined that corn yields were enhanced by on-row or near-row seeding to the preplant UAN band at one location when no starter (10-34-0) was applied at planting. However, at another location, corn yields were reduced 22 percent at the 100-lb/A preplant N rate and 54 percent at the 200-lb/A preplant N rate with planting directly over the UAN band. Lower plant populations (aggravated by limited rainfall) seemed to be the primary cause of the latter yield reductions, though stunted early growth was also evident. We tentatively conclude that RTK guidance is advantageous when planting corn soon after banded UAN application and that the optimum corn row position for a "safe" response shortly after UAN application at high rates is about five inches from and parallel to the UAN band.

terns of wide applicators, especially in non-rectangular fields). Clearly, there are many more new opportunities to be explored as possible fertilizer efficiency gains and improved profitability for corn producers. They can purchase various GPS automatic guidance systems for their tractors (and soon for the implements that are pulled behind the GPS-guided tractors to correct for side slopes). They may also want the capability to integrate their corn planting row placement with their own, or custom band, fertilizer applications.

Our interest in combining no-till and strip tillage operations with liquid fertilizer banding grew over years of researching and promoting strip tillage and deep banding of dry fertilizers for high-yield corn production systems. When John Deere loaned us a tractor with RTK equipment that coincided with funding from both the Fluid Fertilizer Foundation and Mary S. Rice Farm Fund at Purdue University, we were able to initiate research related to fluid fertilizer placement and corn row position.

Objectives of this research were:

- Determine the realistic benefits associated with automatic guidance systems for both UAN banding and planting systems in no-till corn production
- Quantify the effects of various degrees of planter precision, relative to preplanting UAN bands, on corn nutrient uptake, growth, and yield
- Determine whether the combination of automatic guidance systems and preplant banded UAN would circumvent the need for fluid starter applicators on corn planters.

Agronomy Center

Yield. Corn row position compared to preplant UAN bands had large impacts on grain yields. Corn yields were highest when the rows were planted directly over N applied at 50 lbs/A, whether or not starter was applied (Table 1). Planting directly on-row after a UAN band application never lowered yield significantly at this location. In fact, sometimes there was a significant yield benefit from being on-row versus 10 inches away from the UAN band (for instance, when preplant UAN was banded at 50 and 100 lbs/A and when no starter was applied at planting). Average corn yields were increased about 13 bu/A by the starter applications. It is interesting to note that corn yields responded most positively to starter when preplant UAN was banded 10 inches away from the row. For the environment and year reported, it seems that there was a particular benefit to planting directly over a preplant UAN band and a yield disadvantage associated with planting 10 inches away from the UAN band, especially when starter was not applied, even though on-row planting caused some stunting of early plant growth at highest UAN rate.

Population. Corn plant populations were not significantly affected by preplant UAN rate or by row placement with either starter treatment (Table 1).

Plant growth. Early plant growth was very responsive to

Preplant N rate and placement	Stand 4 weeks	Plant Height V6	Harvest Moisture	Yield @ 15.5%
	ppa	inches	%	bu/A
No Starter				
0 Preplant UAN	30,556	27.0	30.5	200.4
50 lbs on row	30,111	31.8	29.3	208.0
50 lbs 5 inches	30,889	31.8	29.4	200.9
50 lbs 10 inches	30,167	30.3	30.2	186.8
100 lbs on row	31,333	32.1	29.3	205.7
100 lbs 5 inches	30,278	30.4	30.6	193.7
100 lbs 10 inches	30,278	31.1	28.9	199.4
200 lbs on row	31,500	29.8	30.1	198.8
200 lbs 5 inches	30,556	31.6	30.1	193.9
200 lbs 10 inches	30,167	30.5	30.1	183.7
With Starter				
0 Preplant UAN	30,111	34.7	28.8	205.2
50 lbs on row	29,667	35.5	28.2	216.7
50 lbs 5 inches	31,500	35.9	27.9	207.7
50 lbs 10 inches	30,222	35.6	28.8	207.5
100 lbs on row	30,667	34.9	28.2	213.3
100 lbs 5 inches	31,056	35.3	28.6	210.8
100 lbs 10 inches	30,389	36.2	28.3	213.5
200 lbs on row	30,444	34.3	29.0	208.6
200 lbs 5 inches	30,500	34.9	28.5	211.0
200 lbs 10 inches	30,055	35.1	28.9	205.7

Table 1 Corn response to preplant banded UAN application and RTK-guided corn row placement at Agronomy Center, 2006.

starter fertilizer at this site; plant heights with starter averaged 4.4 inches taller than those without starter.

Grain moisture. Corn row position compared to preplant UAN bands had no impact on grain moisture content at harvest. However, grain moisture content did decrease by 1.3 percent when preplant UAN was banded 10 inches away from the row.

Pinney-Purdue Center

Yield. Grain yields were dramatically affected by corn row position relative to the preplant UAN bands. At the N rate of 100 lbs/A, planting on-row reduced corn yields by an average of 38 bu/A relative to planting 5 or 10 inches from the preplant UAN bands (Table 2). At the N rate of 200 lbs/A, planting on-row reduced corn yields by an average of 79 bu/A relative to planting 5 or 10 inches from the preplant bands.

Plant growth. There was no negative effect of on-row planting on plant growth at the N rate of 50 lbs/A.

Grain moisture concentrations were highest with on-row planting at the N rate of 200 lbs/A, and this probably reflected delayed development of these stunted corn plants (Table 2). Grain moisture concentrations were lowest when corn rows were positioned 10 inches away from the preplant N rate of 100 lbs/A, but corn in this treatment was significantly drier than just two other treatments of N (100 and 200 lbs/A with on-row planting).

Row position. For this environment and year (sandy loam soil plus relatively dry conditions after planting), the best corn row positions were either 5 or 10 inches away from preplant UAN bands whenever N rate was above 50 lbs/A. Perhaps because starter fertilizer was applied to all treatments in this trial, there was no yield advantage to preplant banded applications of UAN.

Preplant N Rate and Placement	Stand 4 Weeks	Plant Height V8	Harvest Moisture	Yield @ 15.5%
	ppa	inches	%	bu/A
0 Preplant UAN	34,306	17.3	24.9	171.6
50 lbs on row	32,833	16.9	24.5	169.2
50 lbs 5 inches	34,417	17.8	24.6	171.6
50 lbs 10 inches	34,500	17.5	24.6	168.3
100 lbs on row	24,417	14.0	25.5	135.4
100 lbs 5 inches	33,861	17.0	24.7	174.0
100 lbs 10 inches	33,944	17.5	23.9	173.2
200 lbs on row	13,306	9.9	26.3	92.6
200 lbs 5 inches	34,556	17.1	24.8	172.0
200 lbs 10 inches	34,472	18.5	24.4	170.8

Table 2. Corn response to preplant banded UAN application and RTK-guided corn row placement, Pinney-Purdue Center, 2006.

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