FLUID DIGEST®

Research Update from the Fluid Fertilizer Foundation

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Up to 62 bu/A over check

N in starter produces big boost in corn yields

Traditionally, we think of phosphorus as the nutrient that triggers yield response in starters. Some interesting questions have been opened in FFF research conducted by Anderson et al. of North Carolina State University that challenge this concept. Anderson and his associates have produced dramatic evidence showing that starters containing 30 lbs/A N can support ample plant growth for six weeks until sidedressing time, with further implication that N beyond that supplied by the starter would be available for denitrification or offsite movement.

Tests run on two farms in Bertie County show as high as a 62 bu/A jump in corn yield when a 1:1 starter containing 30 lbs/A N + 28 lbs/A P_2O_5 is compared with a starter having no N (Figure 1). The tests also show the value of split applications, with optimum yields obtained using an NP starter + 120 lbs/A of N at sidedress time (Figure 1).

Another objective of the study was to determine N input levels that both protect water quality and are environmentally safe. The sidedress application of an additional 75 lbs/A N beyond the amount required to produce an optimum yield (Figure 1) makes the potential environmental consequences of excessive N clearly evident.

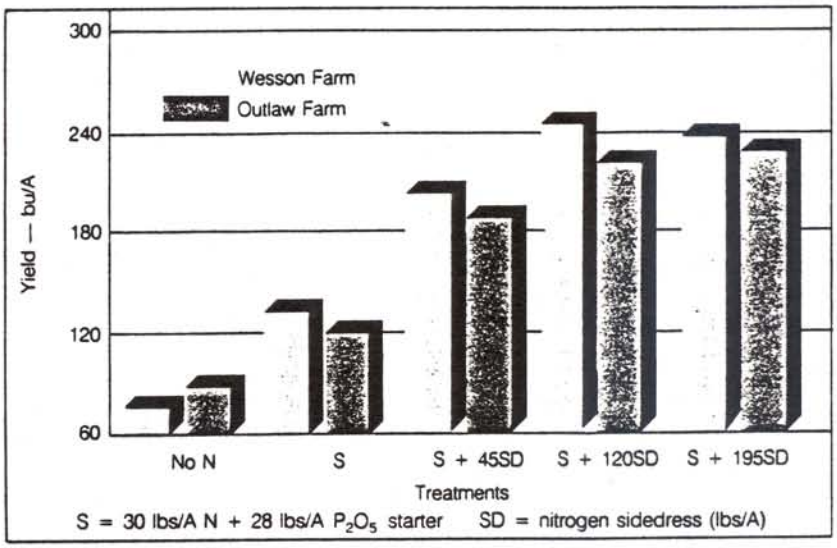

Figure 1. Response of irrigated corn to starters using N, plus effects of sidedress applications on yields (Anderson et al., North Carolina State University, 1990).

Figure 2 dramatically shows the small plant dry weight response produced by an additional 120 lbs/A UAN broadcast. Again, a practice that should be avoided to protect water quality and the environment. Note, however, the dramatic jump in dry weight when the 1:1 starter (30 lbs/A N + 28 lbs/A P_2O_5) alone is applied.

All the experiments were irrigated. Soil types on the two farms were Altavista sandy loam (Outlaw Farm) and Norfolk loamy sand (Wesson Farm). Previous crops were peanuts. Soil P was in the very high range at both sites. All treatments were replicated four to five times in either randomized complete block or split-plot designs. Pioneer hybrid 3140 was used in all tests. Laboratory analyses and evaluations of these experiments are continuing and additional results should be available at this year's FFF symposium and in future issues of the *Fluid Digest*.

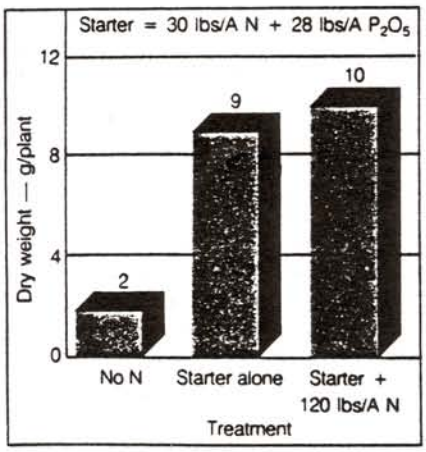

Figure 2. Corn response to starters using N, measured in dry weight (Anderson et al., North Carolina State University, 1990).

INSIDE:

On farm

Less N in starter produces same corn yield

Less overall nitrogen, placed closer to corn roots at planting, has cut costs and reduced chances of nitrogen leaching into groundwater, with no sacrifice in yields at the McCotter Farm in North Carolina.

Bill Peele of Peele Agricultural Service talked the McCotters into using a 1:1 NP starter, applying 30 lbs/A N near the seed in a 17-17-0-3 starter. Another 120 lbs/A N was applied at sidedress to maintain corn yields at 125 bu/A.

Formerly, the McCotters were broadcasting 80 lbs/A N preplant and following with a sidedress application of 120 lbs/A N. The net N saved by substituting the NP starter for preplant was 50 lbs/A, producing the same yield (Figure 3). Peele also notes residual N was reduced by 40 lbs/A.

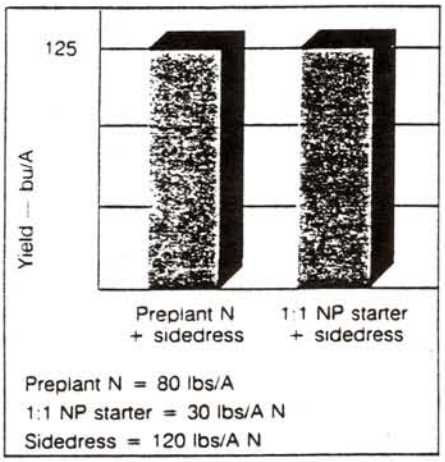

Figure 3. Maintaining corn yield with 50 lbs/A less N applied as a 1:1 NP starter instead of preplant (McCotter Farm, North Carolina, 1990).

Residue protects against compaction?

Could be, speculates Varsa of Southern Illinois University after reviewing results of UAN injections on no-till plots as part of a four-year best management practice study. Noting that highest yields were obtained on plots with the most residue, Varsa concludes that heavy spring rains compacted soils in residue-free plots to the point that it was detrimental to yields.

Cultural practice packages promoted incorporate nitrogen starter concept

Anderson of North Carolina State University also reports that nitrogen in starter is a key component in three cultural practice packages described below and being promoted to encourage best management practices in specific cropping systems and geographical areas.

Irrigated corn. Package, developed between 1982-85, was designed to improve irrigation scheduling and includes:

- Planting medium-maturing hybrids at 29,000 per acre, plus selecting leaf-disease-tolerant hybrids
- Applying 200 lbs/A N in multiple applications — 40/120/40 at planting, sidedress and pre-tassel
- Applying moderate P rate, depending on soil test, in 1:1 starter containing S, plus additional NS (12:1) at side-dressing
- Banding or broadcasting pesticides according to field history
- Watering heavily between V12 and black layer formation.

Dryland corn. Package was designed to reduce financial exposure in drought-prone soils and includes:

- Matching tillage system to soil type
- Planting alternate 4-6 row strips of two compensating hybrids four days apart to tasseling
- Applying 130 lbs/A N, with two-thirds applied 4-6 weeks after planting
- Applying low P rate, depending on soil test, in 1:1 NP starter containing S
- Banding herbicides over corn row and cultivating row middles
- Applying insecticides only when field history justifies use.

Dryland corn — estuarine areas. Package was developed for environmentally-sensitive areas and includes:

- Rotating crops annually, using corn hybrids with good seedling vigor
- Applying 50 lbs/A N, plus P in starter containing S
- Applying no pesticides at planting (but using insecticides with conservation-till)
- Scouting for cutworms and billbugs
- Using postemergent herbicides on weedy fields
- Sidedressing with 75-100 lbs/A N placed in front of cultivator (dribbling or injecting if using conservation-till).

Note that in both the irrigated and dryland corn packages a 1:1 NP starter containing S is recommended. However, in the environmentally-sensitive package, recommendation is 50 lbs/A nitrogen, plus P in starter containing S. This package is designed for areas where environmental concerns call for reduced applications of N, emphasizing the need for improved N and P use to avoid yield reductions.

Each package uses split applications of N, with sidedress following the starter N application. In the case of irrigated corn, where yields of 250 bu/A are attainable, higher N rates are used.

The *Fluid Digest* has focused on only the NP fertilizer component of the three-production package. There is much more involved and each component was put into practice make the whole successful. Farmers are now employing the production packages with good results. Similar packages are being studied in other states and, no doubt, some modifications will be required to fit site specific conditions.

Interestingly enough, the practice we fine-tune today dates all the way back to the Mayflower, when American Indians taught pilgrims to place fertilizer (fish) near the corn seed.

Versatility big plus in fluid starters

Fluid fertilizers such as 10-34-0 are excellent carriers for secondary and micronutrients. Potassium, sulfur, boron, zinc or any other nutrients recommended by a soil test can be easily mixed with phosphate solut to formulate prescription mixes th meet the needs of any particular field. Fluids also provide virtually trouble-free handling — an important consideration in both custom and farmer application.

Multi-studies support use of N in starters

Nitrogen again was responsible for most of the starter response in tests observed by Purdue University scientists, the greatest response being in no-till (Figure 4). Soils on the test plots tested high to very high in P. The data summarized were the mean of six studies conducted by using 2 x 2 placement from 1985 to 1987.

Results from other states were similar.

Zublena of North Carolina State University states that much of the response to starter fertilizers in studies from the Southeast over the past eight years has appeared to be from the nitrogen component. However, even though N is a key input, phosphorus is considered important enough to be included as a standard component in starters. The nutrient ratio (N/P) most often cited for corn, grain sorghum and cotton is 1:1.

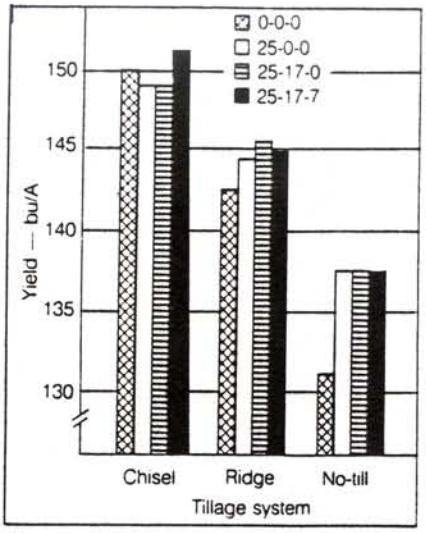

Figure 4. Response of corn to starters using N (Purdue University, 1985-87).

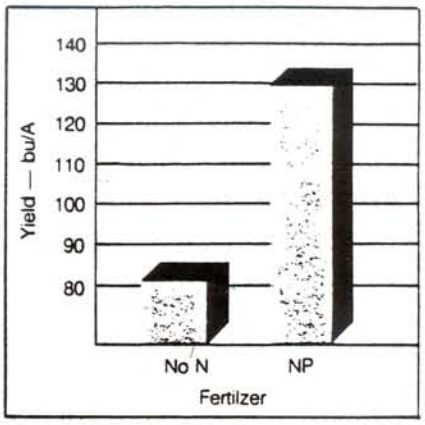

Figure 5. Effect of an N starter on corn yield, using 30 lbs/A N and 28 lbs/A P_2O_5 (North Carolina State University, 1990).

In one 1990 study on corn at North Carolina State, zero N treatment produced a yield of 80 bu/A, compared to 130 bu/A when a 1:1 NP starter was applied in 2x2 placement at a rate of 30 lbs/A N and 28 lbs/A P_2O_5 (Figure 5).

North Carolina scientists report that although their data show phosphorus may be less important than nitrogen, the highest yields are almost always recorded from treatments where both N and P have been applied. Additionally, studies in Minnesota and Wisconsin have shown a large response to K, especially in conservation-till fields.

Studies focus on corn

Fluid starters tailor-made for no-till

Especially so for undisturbed soils because they are cooler in the spring, taking longer than conventionally tilled soils to warm up and dry (Figure 6).

Net effect can be a boost in yield and final stand as typically shown by the research on no-till corn planted by the University of Kentucky (Table 1). Note that in "row cleaner" plots with "row fertilizer," yield increased by 6 bu/A. Stand also improved by 1,650 stalks/A. Similarly, row fertilizer improved yield 9 bu/A and stalk count 1,200/A in plots without row cleaner.

The response of starters in a no-till environment also showed favorably in recent comparison studies conducted by Purdue University. Starters applied in conventional-till corn plots, testing high in P and K, produced a yield increase in only 1 of 11 sites. By contrast, starters used in no-till plots showed yield increases on 8 of 11 sites. Average yield increase on the no-till plots was 10 bu/A, an overall yield response more than 8 times that produced on conventional-till plots (Table 2).

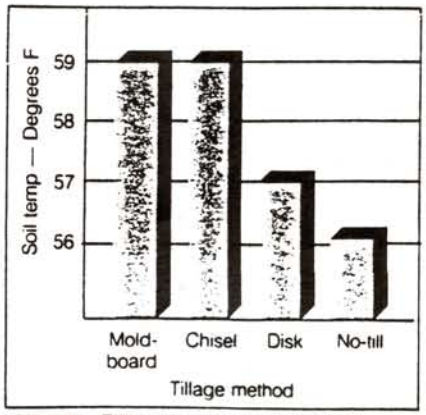

Figure 6. Effect of tillage on spring soil temperature (April 30 to May 30, Illinois).

The value of placing relatively small amounts of fertilizer in a concentrated band near the seed at planting has been well documented by research conducted on a wide range of crops throughout the United States.

Focus most recently has shifted to crops grown in conservation or no-till systems, with corn getting the most attention. Corn is generally the first row crop planted in the spring and it's not unusual for soils in corn fields to be cold when seedlings begin their growth cycle.

Table 1

Effect of row fertilization in no-till systems on corn yield and stands (University of Kentucky).

Tillage	Treatment Row Cleaner	Row Fertilizer	Final Row[1] Temp °F	Stand Stalks/A	Yield Bu/A
No-till	yes	yes		19,600	137
No-till	yes	no	82.7	17,950	131
No-till	no	yes		15,400	123
No-till	no	no	80.3	14,200	114
Chisel/Disk	no	no	85.2	16,100	132

[1] Avg. maximum daily soil temperature May 15 through June 1.

Table 2

Starter response in different tillage environments (Purdue University, 1982 to 1987).

Type of tillage	Number of responses	Avg. yield yield increase —all responses bu/A	Overall yield response bu/A
Conventional	1 in 11	12	0.9
No-till	8 in 11	10	7.8

Mean of 11 studies using at least 100 lbs/A starter fertilizer placed 2 inches to the side and 2 inches below the seed with direct tillage comparisons.

Up 10 bu/A

Split N produces superior corn yields

A University of Nebraska study by Hartwell et al. has shown split N applications to be superior to preplant and sidedress applications. At four of five locations, split produced higher corn yields than sidedress. Split exceeded preplant at all locations. At the Hamilton County plot shown in Figure 7, corn yield responses to split applications exceeded responses to sidedress applications by as much as 10 bu/A.

Soil type at the Hamilton County site was Holder silt loam. Irrigation was gravity fed. Soil samples were taken on April 28 and June 15. N was applied preplant on April 28 and sidedressed on June 20. Irrigation totaled 14 inches; rainfall 6.75 inches. N in water was 4 ppm.

All sites were irrigated. Enough water was supplied to fill the soil profile to a depth of 5 feet, then additional water was applied for some leaching effect. Six rates of N were applied: 0, 40, 80, 120, 160 and 200 lbs/A. Split applications were 40 lbs/A prior to planting with the balance applied at sidedress.

Two objectives of the study noted by Hartwell were 1) increasing cost effectiveness via improved N management and 2) reducing environmental hazards. He also noted that N recommendations were generally lower than levels needed to obtain optimum yields.

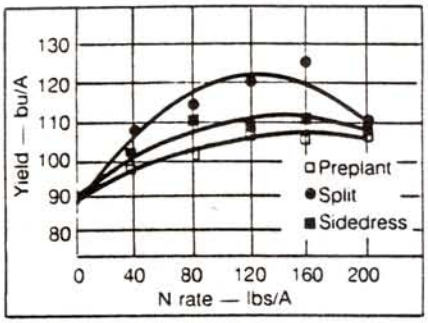

Figure 7. Comparison of three methods of applying N and their effect on corn yields (University of Nebraska, Hamilton County, 1989).

Are you overlooking soil testing?

Mengel of Purdue University cites soil testing as "the first step in developing a fertilizer program."

It is important, he says, to develop a proper soil sampling program because soils in a field can vary widely in physical makeup and chemical properties.

Two approaches Mengel describes for measuring soil spatial variability are 1) grid sampling and 2) soil surveys.

Grid sampling includes setting up rows 300 feet apart and taking composite samples (8 to 10 cores) every 100 yards on each row. The farmer ends up with a 100-yard by 100-yard grid map of soil fertility patterns.

In soil surveys, soil maps are superimposed on aerial photographs, generally resulting in a single composite soil sample representing a 10- to 25-acre area of similar soils.

When N fertilizers such as UAN are applied directly to the surface in no-till systems, where the surface few inches of soil can be acidified quickly, sampling should occur on a regular basis to detect changes in pH, Mengel cautions. Low pH can adversely affect plant growth and herbicide activity.

Don't overdo liming in conservation-till

Mengel of Purdue further cautions that volume of lime applied in conservation-till systems must be reduced to prevent overliming the surface and micronutrient deficiencies such as zinc in corn o. manganese in soybeans. Frequency of liming is usually increased in conservation-till since the volume of soil that acidifying fertilizers react with is also reduced. In continuous corn no-till systems, this normally means soil sampling and liming every two or three years, but with lime rates of about half those normally used in conventional plowing systems.

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