

FLUID DIGEST®

Research Update from the Fluid Fertilizer Foundation

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Up to 53 bu/A

Micronutrients provide added kick in fluid starter fertilizers

Besides the obvious concern for highly water-soluble phosphates in fluid starters, recent investigations at various research locations have pointed out the yield benefit possibilities of including additional nutrients besides nitrogen and phosphorus in the starter band.

In addition to all P or K applied as a starter, research is showing that inclusion of micronutrients in multi-nutrient combinations can substantially boost yields in corn. The cumulative effects of adding nutrients to basic starters are illustrated in Figure 1 in research conducted in Iowa by Twin-State Engineering & Chemical. The highest corn yields (10 bu/A above check) were achieved where potassium, sulfur and zinc were added to an NP starter.

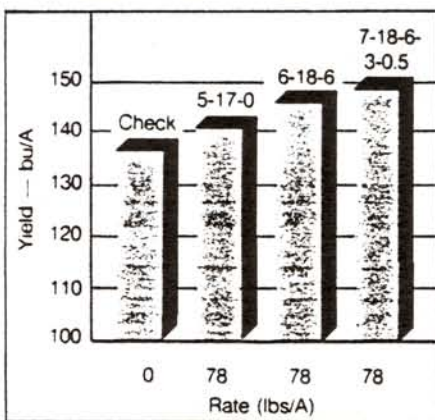


Figure 1. Influence of varying combinations of starters vs no starter (check) on corn yields (Twin-State, Iowa, 1983-84).

Tests in Nebraska have also shown the tremendous increase in fertilizer efficiency possible by banding a fluid starter that includes zinc. Note in Figure 2 how just one-tenth of a pound of zinc ($ZnNH_3$) increased yields by 37 bushels per acre and went as high as 53 bu/A above check.

Researchers caution, however, that amount of materials or combinations

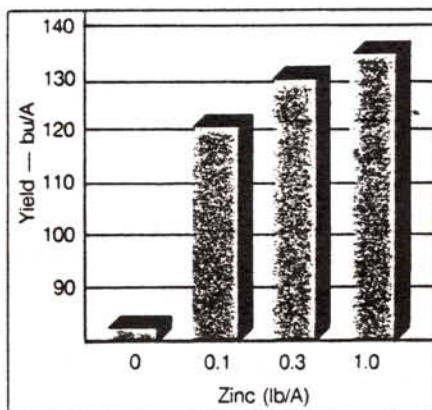


Figure 2. Influence of zinc in fluid starters on corn yields (Nebraska experiments).

used as a starter fertilizer may differ widely due to the effects that unique circumstances or varying geographical or climatic conditions can have on crop yields.

Why fluid starters?

A fluid starter program should play an instrumental role in a progressive, demanding, high-yield environment for a number of reasons:

- Helps combat plant stress, assuring proper development
- Speeds development of secondary root system
- Creates high demand for nutrients relative to developed root surface
- Offers economy of operation
- Advances maturity five to ten days
- Produces drier corn

Fluid starters effective in high-P soils

Research in Wisconsin has shown that banding P_2O_5 (2 x 2 distance from corn seeds) increased yields and decreased kernel moisture on soils testing both low and high in P (Figure 3). Note how banding 70 lbs/A of P_2O_5 in low-P soils increased yields 34 bu/A, but also how banding the same rate on high-P soils continued to show a response, increasing yields 11 bu/A over check.

Similarly, studies conducted in Kansas on corn have shown that the addition of K on soils testing high in K increased yields and response to nitrogen. Yield advantages using K starters were as high as 18 bu/A over checks using N only.

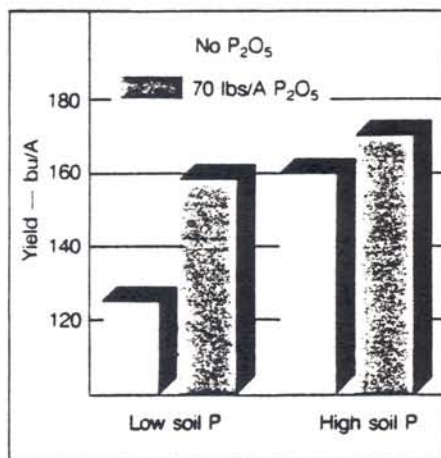


Figure 3. Response of corn to P_2O_5 banded on soils testing both low and high in P (Wisconsin).

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Key to optimum wheat yields: correct soil P test levels

A recent summary of soil P test levels to produce optimum wheat yields under good management is shown in Table 1. Once soil P tests reach optimum levels, phosphate should be applied only at rates required to maintain those soil test levels. Remember, as soil P test levels

increase the advantages of phosphate placement *decrease*. Adequate phosphorus also helps nitrogen-use efficiency — and profit.

Researchers have estimated it takes 8 to 10 lbs per acre of applied P_2O_5 to increase the Olsen extractable P by 1 ppm. Usually, the higher the initial test level, the lower the amount to accomplish the change.

For more details, read Havlin and Halvorson, 1990, *In Proceedings*, pp 82-95: MEY Wheat Management Conference, March 7-9, Denver, Colorado.

Table 1

Phosphorus soil test levels needed to produce near optimum wheat yields.

Range of optimum soil P tests for extracts			
Sodium bicarbonate (Olsen) extract	Bray P extract		Mehlich III extract
	Calcareous soils	Acid soils	
ppm	ppm		ppm
21-26	23	25-50	25

How efficient?

Just how much fertilizer (and dollars) can be saved by using the fluid starter concept of banding near the seed has been amply demonstrated in a test run on wheat in low P soils in Shawnee County, Kansas (Figure 4). Note how it took *twice* the amount of broadcast P (9-18-0) to achieve the same yield level as achieved by starter P.

Achieving such efficiency should always include a reliable soil test and an accounting for weather conditions, both of which can affect P performance.

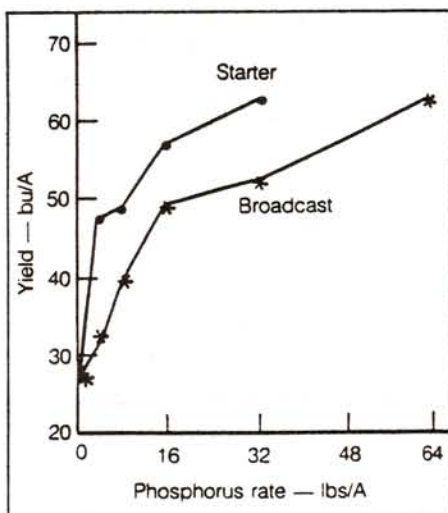


Figure 4. Efficiency achieved in low P soils by applying P as a starter on wheat (Shawnee County, Kansas, 1984).

How great is N recovery?

Greater than many would lead you to believe.

Four-year studies in England at Rothamsted (oldest known experimental station) indicate that an average of 81% of N applied was accounted for where N^{15} (isotopic nitrogen) was used to trace N fertilizer applied on wheat (Table 2).

Additional studies made on winter wheat at the same location (Table 3) also showed excellent yields, good response to N and high apparent nitrogen recovery. Note that as yields increased for the three experiments, N efficiency (bu/lb of applied N) in-

Up to 20 bu/A Residual K Boosts Soybean Yields

Applying *unstingy* amounts of K to corn on a high K-testing soil not only boosted corn yields an average 25 bu/A, while building K soil tests even higher, but also benefited following soybean crops by producing an additional 20 bu/A in the bin (Figure 5).

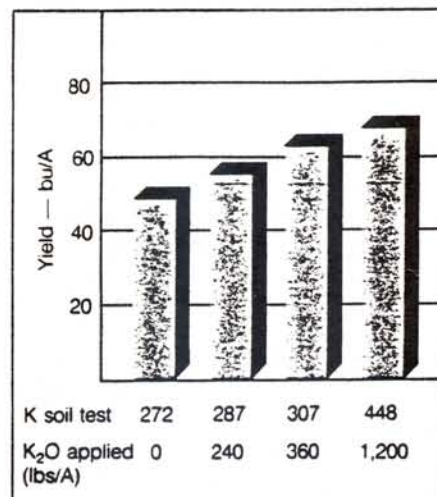


Figure 5. The effects of residual K on soybean yields, following K applications preceding corn crop in a high K-testing soil (Illinois).

A sound fertilizer program is one of the key management inputs in any successful production system. Proper fluid fertilization has a positive influence on yield, quality and, of course, *profits*.

creased and the apparent N recovery by the crop was nearly constant.

Table 2

Percentages of N found in wheat crop by year and averages over four seasons.

Year	Percent of 128 lbs/A nitrogen			N accounted for in system %
	Grain	Straw	Soil	
1980	55	13	17	85
1981	37	16	20	73
1982	45	23	24	92
1983	45	13	16	73
Mean	45	16	19	81

Table 3

Winter wheat yield, N applied, N uptake and N recovery observed after N application (Johnston, June 1989, *In Proceedings* of the Sanborn Field Centennial, University of Missouri).

Yield bu/A	N applied lb/A	N efficiency bu/lb of N	N uptake		Apparent N recovery %	N uptake lb/bu
			without N lb/A	with N lb/A		
114	171	0.67	20.5	139	69	1.22
122	171	0.71	45.0	166	71	1.36
165	156	1.06	86.0	194	69	1.18

Illinois experiments show importance of placement and use of micronutrients

Work by Atkinson Grain and Fertilizer of Atkinson, Illinois, has shown the importance of proper placement and the role of micronutrients in producing high-yielding crops.

The superiority of surface banding over broadcasting is obvious in Figure 6. Why the 22-bu/A yield difference in corn? Reasons are several:

- Tie-up of broadcast P in the low-pH soil by Fe lowered yields (most soils in northern and central Illinois have an excess of soluble Fe)
- Micronutrients, especially Zn, used in the band application increased yields. Site had a DTPA Zn test of 1.0 ppm.
- Banding reduced volume of soil contacted by P, thereby reducing tie-up. This process could have been further enhanced had proper rates

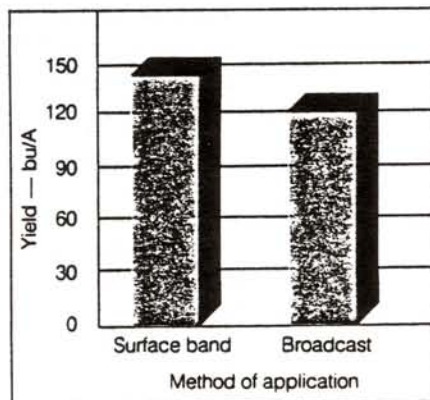


Figure 6. Effect of method of NPK application on corn yield, giving a 22-bu/A yield difference (Neponset, IL).

and quality of lime been applied. Liming acid soils reduces P tie-up, increasing P efficiency.

Regarding tie-up, soluble Fe reacts with broadcast P to lower P solubility, which reduces uptake by plant roots. The lower the soil pH, the greater the soluble iron. When soil pH is high (not the case here) it results in broadcast P being tied up by Ca and Mg. Even at optimal soil pH (6.5), broadcast P is not as effective as banding.

The effect of secondary nutrients and micronutrients on no-till corn yield is also readily apparent in Figures 7 and 8.

The UAN application at the Aledo site (Figure 7) dramatizes what a micronutrient application costing only \$16/A can produce in yield return. The

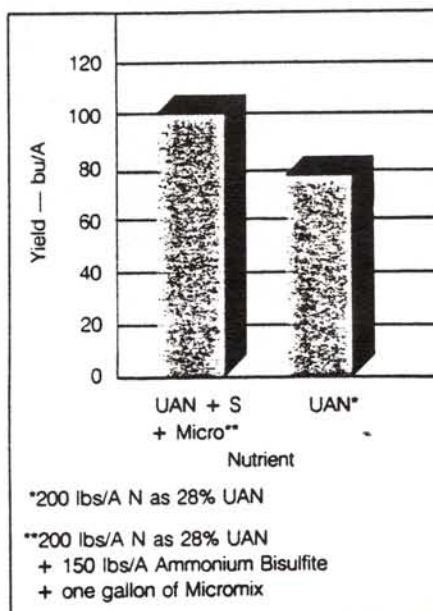


Figure 7. Effect of sulfur and micronutrients on corn yield (Aledo, IL).

grower reported that the corn remained green all summer where micronutrients and sulfur were applied but turned brown where they weren't. Since this was not a randomized replicated research test, it shouldn't be assumed that a 21-bu/A increase would be produced every time it was tried. However, even half the yield response would still have been profitable!

The fluid starter applied at the Atkinson site (Figure 8) incorporated a micronutrient containing mostly zinc, which was applied at the rate of 2 quarts per acre. Although the test was one strip in a field and not a randomized replicated research trial, the yield increase must be attributed to nutritional effects, not enzyme inhibition. The yield increase of 26 bu/A was a hefty return on an investment of only \$3.50/A for the micronutrient.

As to the effect of micronutrients, many of the soils in northern and central Illinois are low enough in zinc to give an economic response to applications of 2 to 5 pounds of zinc/A. Addition of Mn may be important also in these soils because of an apparent imbalance between Mn and Fe. The excess of Fe noted earlier interferes with Mn uptake by plant roots, accentuating true Mn deficiency and inducing Mn insufficiency in borderline Mn soils. While Mn

applications are difficult to justify when the latter condition exists, plant growth and development are better when Mn is applied. Admittedly, more research is needed to identify yield responses in the gray areas of Fe-induced Mn insufficiency and to measure the benefits of applying combinations of micronutrients (Zn, Mn, Cu instead of just Zn) on these very high Fe soils.

In attempting to duplicate any of these efforts, remember that there are huge differences between sources of

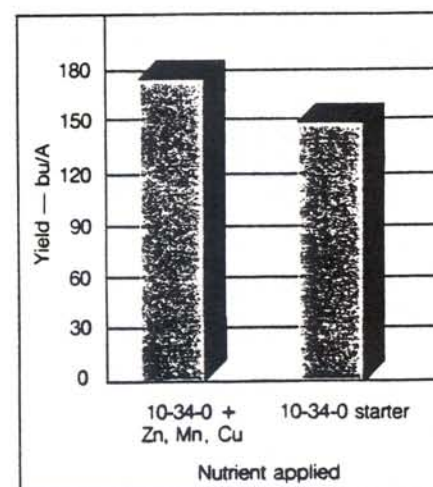


Figure 8. Effect of micronutrients on yield of no-till corn planted in soybean stubble (Atkinson, IL).

micronutrients in terms of uptake by plant roots. Applying a micronutrient simply does not ensure that the plant will use it. Interactions between nutrients (Zn, Fe, Mn) make it imperative that proper ratios be used or you can end up with yields lower than if no micronutrients had been used.

Nutrient availability counts

And that's where fluid starters excel. Precise placement assures that the first roots to develop will make immediate contact with a highly available supply of concentrated nutrients to feed seedlings during the crucial first three to four weeks of growth. Assured also is availability even when climatic conditions are less than ideal.

Apply nutrients when needed

It's another key in the equation of gaining fertilizer-use efficiency. For maximum yield response, each nutrient should be in place to meet peak plant demands. One look at Flannery's work at Rutgers on nutrient uptake by stage of growth in corn (Figure 9) should dramatize the importance of properly timing nutrient applications, especially N. Note that high-yielding corn takes up over half of its nutrients *after* silking. However, if inadequate levels of P, K and micronutrients are present early, late applications will not correct the shortage in the plant.

By relating nutrient uptake to recovery value (or % of applied

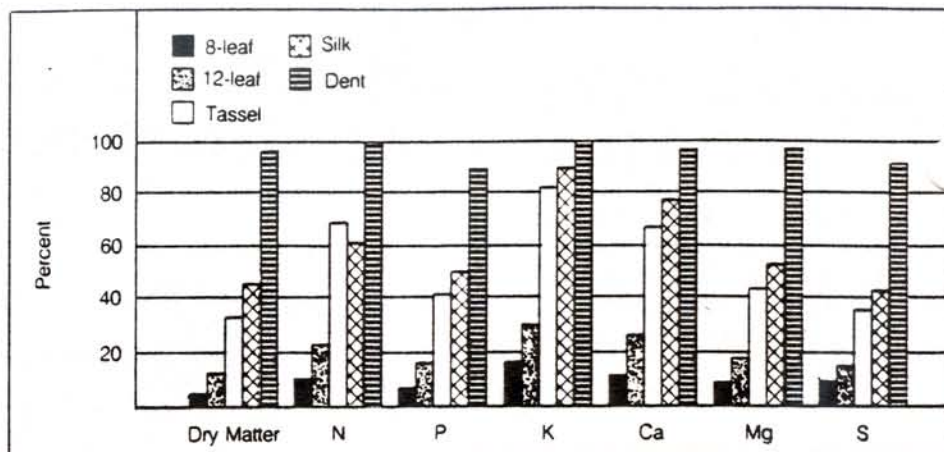


Figure 9. Corn nutrient uptake by growth stage (Flannery, Rutgers University).

nutrient supplied by roots), the amount of nitrogen needed to supply the plant can be calculated. However, remember that nitrogen and sulfur,

which are mobile nutrients and subject to leaching and denitrification losses, must be applied at or near the time of plant uptake.

90-lb/A jump Cotton responds to fluid NP starters

Lint cotton yield responses to fluid starters on soils testing very high in P in Mississippi and Louisiana look promising. Funderburg of Louisiana State University reports that results from 25 demonstration sites over several years are showing excellent profitability when "an amount of nitrogen-phosphate is banded near, but not on, the seed at the time of planting." The starter was sprayed in a 3- to 4-inch band behind the packer at seeding.

The average lint cotton yield increase from 12 gallons (150 lbs/A) of 10-34-0 or 11-37-0 was 90 lbs/A. With starter at \$15.11/A and lint at 71 cents/lb, net income was \$48.82/A or a net return of \$3.25 for each dollar invested in the starter.

A summary of '87 to '89 results indicates that the responses observed in 18 of the 25 sites were statistically significant at the 1 or 5% level, meaning that only 1 or 5 times in 100 would you have a response as great as those observed and not have it due to the starter treatment.

Early 1990 reports indicate that lower in-furrow rates of 11-37-0, banded at 12 gallons per acre, are

producing impressive yield increases. Funderburg states he and his colleagues are working with Kovar of Louisiana State University who is conducting phosphorus root studies on cotton to model, evaluate soils and predict P recovery as part of an FFF project.

Advantages stressed by Funderburg of using starter fluids in cotton are:

- Improved root development
- Early adverse conditions overcome
- Earlier fruiting
- Maturity hastened
- Yields increased
- Greater profits!



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RE: Fluid Digest, Volume 3, #4, December 1990

We Made an Error:

Please attach this correction to your Fluid Digest for future reference.

In the most recent issue of Fluid Digest, Volume 3, #4, December 1990, there is an error in the article entitled, "90-lb/A jump Cotton responds to fluid NP starters." The first sentence in the fourth paragraph reads: "Early 1990 reports indicate that lower in-furrow rates of 11-37-0, banded at 12 gallons per acre, are producing impressive yield increases." The number of gallons per acre should read 1.5, rather than 12.

We apologize for the error. It is important for Fluid Digest readers to know that Dr. Funderburg recorded a significant stand reduction where 2.5 gallons of 11-37-0 per acre was applied in-furrow in his 1990 study. The greatest yield increase was obtained from a treatment of 12 gallons of 11-37-0 applied in a 3-inch surface band over the row after the seed furrow was closed.

Results of the 1990 study, as reported at the Southern Soil Fertility Conference, are as follows:

Treatment	Seed Cotton Yield (lb/ac)
Check	3586 B
1.5 gallons 11-37-0 in furrow	3999 A
2.5 gallons 11-37-0 in-furrow	3724 B
12 gallons 11-37-0 surface banded	4124 A

Means followed by the same letter do not differ significantly (0.05)