FLUID DIGEST

Research Update from the Fluid Fertilizer Foundation

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Corn and wheat

Mixed N diet increases yields

While researchers have identified some corn hybrids that respond well to high fertility levels and take up a significant portion of their nitrogen (N) requirement after midsilk, they are also learning that the *form* of N supplied can have a profound effect on corn yield.

A recent FFF study by Jones of the University of Georgia clearly demonstrates the benefit of a mixed N diet for corn (Figure 1). In this experiment, maintaining a consistent mixture of ammonium and nitrate-N during the growing season resulted in the highest yield by 5 bu/A (or $12.50/A). The usefulness of late-season N application was also demonstrated. No N after tasseling resulted in a 43% yield reduction!

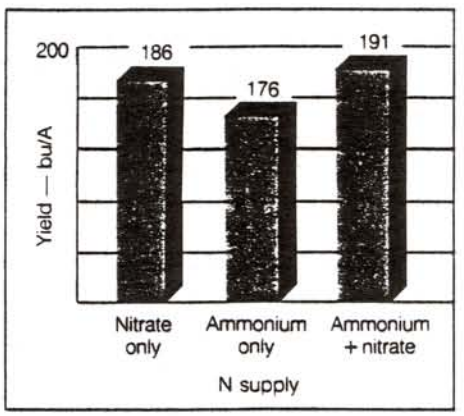

Figure 1. Effect of nitrogen supply on corn yield (Jones, University of Georgia, 1988)

The same combination of ammonium/nitrate-N (when compared to nitrate-N applications only) also produced corn yield increases of 8 to 13% in research conducted by F. E. Below at the University of Illinois. The higher yields were due to an increase in number of kernels.

Mixed N diet regimes could also produce favorable economic returns in wheat. Bock of the Tennessee Valley Authority has reported spring wheat yield increases of 19 to 47% using basal nitrate and supplemental ammonium combinations, compared with nitrate alone.

Ideal for providing mixed N diets to crops are urea ammonium nitrate (UAN) solutions. Coupled with the use of correct timing and possible use of N stabilizers, UAN can provide the right chemistry for crops.

Yield Unaffected by Leaf Burn

A recent Idaho study by Mahler, using UAN sprays at 90 to 120 lbs/A N, showed moderate levels of leaf burn (vs low/negligible levels of burn at 15 to 60 lbs/A), *but* symptoms disappeared within 4 weeks after application and there was no suggestion that the earlier leaf burn adversely affected wheat yield.

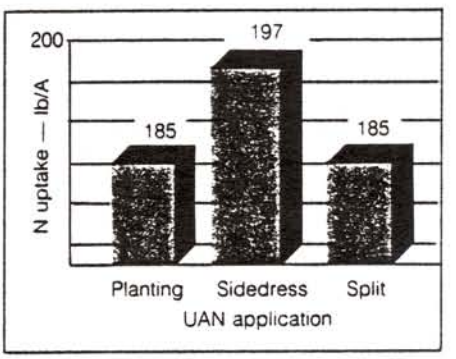

Figure 2. Influence of UAN application method on corn nitrogen uptake (Fox, Penn State University, 1985)

Can it work for you?

Sidedressing boosts N uptake

Protecting the environment and good economics are powerful incentives for maximizing nitrogen (N) use efficiency. In many situations, a program approach involving sidedressing of UAN can be beneficial, as indicated in Eckert's work (see December issue of the *Fluid Digest*).

Another recent example is research by Fox of Penn State University showing that sidedressing also improves N uptake by corn (Figure 2). In this study, sidedressing UAN up to 198 lbs/A clearly demonstrates that greatest N uptake was achieved by delaying application until the 4-leaf stage. In many situations, delayed N will coincide with plant's high N demand at a time when a more developed root system is better able to intercept applied N to reduce N loss and maximize uptake.

Research is showing that sidedressing N will produce more profitable crop yields on light soils prone to early N leaching, heavy soils prone to waterlogging and loss of gaseous N by denitrification and compacted soils.

Sidedressing N also offers management flexibility by correcting early-season N losses, supplementing weed and feed programs and matching N application to plant stand and planting date.

INSIDE:

Foundation News
from your Research Director, Julian Smith

One of the most important decision times lies ahead for the upcoming farm year: how much nitrogen (and when!) do I apply to my crops? N, as applied through fluid fertilizers, is a vital profit-making tool. Responsible use of this resource will maximize profits while maintaining a safe environment.

In this edition of *Fluid Digest*, a variety of information is presented relating to economical and environmentally sound ways to use nitrogen. Ideally suited for achieving this in modern crop production is the use of nitrogen solutions. The versatility and agronomic effectiveness of solutions allow for better nitrogen planning based on tillage, residue, use of weed and feed, application technique and timing. Nitrogen decisions are no longer just a matter of rate! Significantly, most nitrogen regimes can be drastically improved by simple, no-cost fine tuning in the areas mentioned above.

One fast-developing research area is that of stabilized nitrogen solutions. Current and future FFF research in this area will enhance practical field advice for minimizing N loss through leaching and ammonia volatilization.

Another exciting area is matching hybrid and nutrient to maximize fertilizer-use efficiency.

Our success as food producers will continue as more new and developing agronomic research reaches the field. Make no mistake. Farm profitability has and will continue to rely on just *how* nitrogen and all other essential nutrients are applied to the growing crop. From the economic and environmental standpoint, we must stack the odds in favor of the plant. Ultimately, maximizing crop nitrogen-use efficiency through the application of nitrogen solutions will preserve the environment as well as *your profits*.

J. Julian Smith, PhD.
Executive Vice President, Research Director

Sorghum
Banding nearly doubles yield

In a 1984 Texas A & M University study by Matocha, knifing produced a 27-bu/A increase in grain sorghum yields (Figure 3). Note, however, that splitting applications between knife/starter or knife/sidedress produced virtually no yield differences over knifing alone.

Other benefits produced by banding were:

- improved test weight (important quality consideration)
- reduced moisture content (saves drying costs)

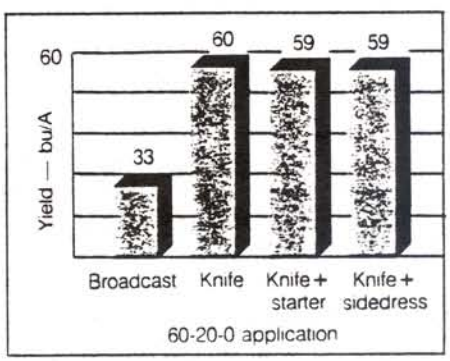

Figure 3 Banding vs broadcasting on grain sorghum yield (Matocha, Texas A & M, 1984)

Critical: How and when N is applied

Placing N to maximize uptak timing N application at right rate to match crop needs and formulating in right combinations all work to ensure optimal return on N fertilizer inputs. Some examples:

Placement. Recent University of Arkansas data (Table 1) compiled by Wells show a 9-bu+/A yield increase in winter wheat when UAN is banded (vs broadcasting). This translates into a $38/A advantage! In this study, 50 lbs/A N was either broadcast or dribble banded.

Table 1

Effect of UAN placement on winter wheat yields, Wells, University of Arkansas, 1987.

Application Method	Yield (bu/A)	Crop value ($/A)
Broadcast	41.1	$164.40
Dribble band	50.6	$202.40
Advantage	+9.5	+$ 38.00

Timing/rate. Alley's work in the September 1988 issue of *Fluid Digest* (page 1) shows the advantages of splitting N applications on winter wheat. The 10-bu/A increase, wor $40/A, was made possible by a significant improvement in N efficiency, as indicated by crop uptake values (Figure 4).

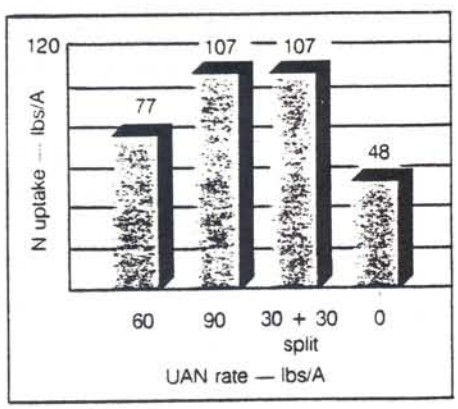

Figure 4. Effect of UAN rate and timing on N uptake of winter wheat, (Alley, Virginia Polytechnic Institute, 1986).

Combinations. Investigations of applying UAN/broadleaf herbicide mixtures on wheat by Mahler of the University of Idaho, versus applyi dry ammonium nitrate fertilizer separately from herbicides, has demonstrated the following benefits:

- improved yields
- improved stand vigor
- improved weed control

Up to 22-bu/A increases

Spoke wheel promising

Though there's no question that fluid fertilizers are unmatched for highly profitable techniques of precision nutrient placement, agronomic advances must be matched by progress in application technology. Most recent among a number of exciting and promising developments is the spoke wheel, which applies fertilizer through point injection. It has demonstrated excellent potential for improved UAN application in no-till fields where high residue cover often limits efficiency of surface-applied UAN.

Essentially, the spoke wheel is a ported axle that allows fluid fertilizer to flow down spokes as they rotate around a hub. It allows nutrient placement with minimal soil and residue disturbance. Application is made in the active root zone to maximize uptake by the crop.

Studies in 1986-87 by Baker of Iowa State University on no-till corn show spoke wheel injections of 156-40-98 producing up to 19 bu/A more than knifed applications (Figure 5).

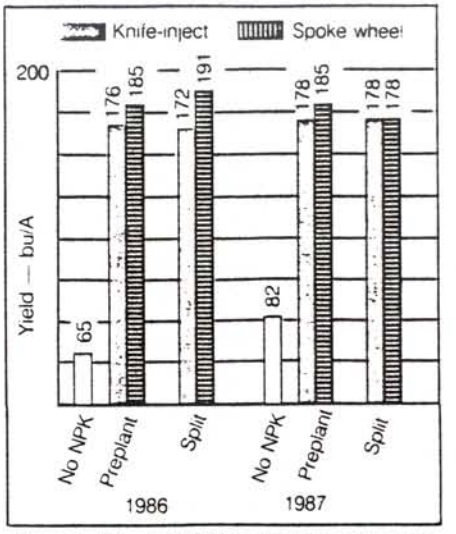

Figure 5. Effect of NPK application method on yield of no-till corn (Baker, Iowa State University, 1986-87).

Varsa at Southern Illinois University reports spoke wheel injections of 150 lbs/A N in no-till corn produced up to 22-bu/A more than broadcast or dribble band applications (Figure 6).

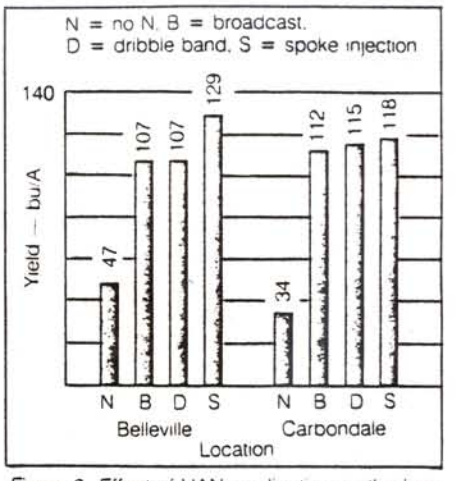

Figure 6. Effect of UAN application method on yield of no-till corn (Varsa, Southern Illinois University, 1988).

A number of FFF projects will continue to evaluate the spoke wheel in 1989, including fluid fertilizer applications on corn and wheat. Watch for them in future issues of *Fluid Digest*!

Good N response not just a function of rate

In deciding upon a sound N regime for your situation, be sure to take into account tillage, residue, soil type and timing. Tillage and residue management can have important bearings on the effectiveness of nitrogen fertilizer. Ammonia volatilization from surface-applied urea or N tie-up can be a problem — particularly where residue is high on light soils.

For example, in a study where nitrogen as UAN was applied at the rate of 150 lbs/A, data compiled by Malzer at the University of Minnesota show the influence of soil type, tillage system and application method on corn yield (Figure 8). While on the silt loam soil, injected or dribble-banded UAN produced higher corn yields than broadcast, the distinction became clearest as residue level increased (no-till). On sand, the results were different. Injected UAN stood out alone by producing the greatest yield difference over band or broadcast when residue level was high. On the other hand, all treatments were equally effective in the absence of high residue levels (moldboard).

Another example showing the influence of residue level and application method (150 lbs/A N) on corn yield is the work of Eckert of Ohio State University. In high residue, continuous no-till corn, dribble banding produced the highest yield (Figure 7). However, also note that splitting the application into 100 lbs/A N as broadcast (weed and feed) and 50 lbs/A N as sidedress at the 4-leaf stage tended to produce higher yields than one broadcast application. Similar to the Minnesota work above, UAN applied into minimal residue (after soybeans in this study) produced little yield difference between broadcast and dribble applications. Note, however, the good response to the split application.

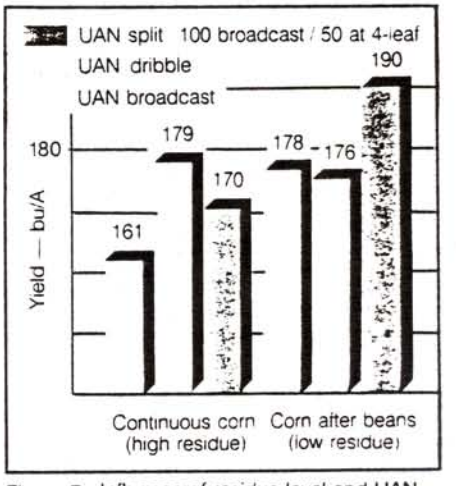

Figure 7. Influence of residue level and UAN application method on yield of no-till corn (Eckert, Ohio State University, 1985).

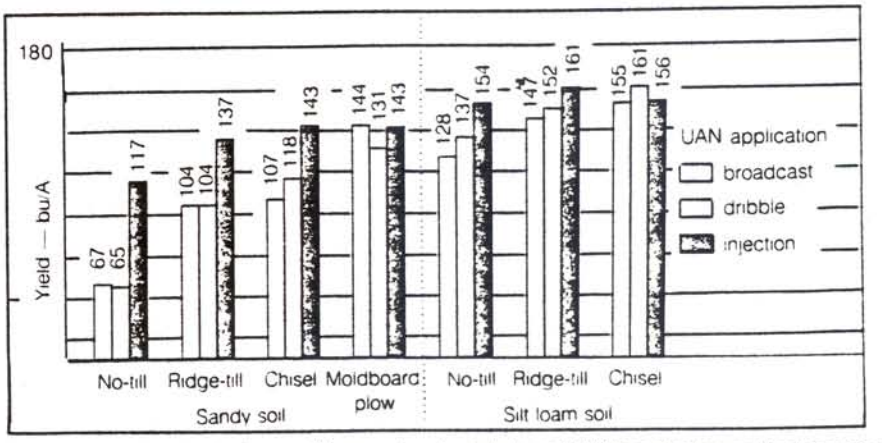

Figure 8. Influence of soil type, tillage system (residue), and UAN application method on corn yield (Malzer, University of Minnesota, 1984-85).

Soybeans

K boosts yields 4 bu/A

A three-year study (1985-87) by Buchholz of the University of Missouri, using fluid fertilizers containing K on soybeans, produced up to 4 bu/A increases in yields.

The study examined broadcast, dribble band and knife injection methods of application (Figure 9). Yield data indicate a trend toward a higher yield response using knifed applications.

Buchholz concludes that soybeans do respond to K placement and that potential exists for improved K efficiency by injecting K fertilizer into the root zone.

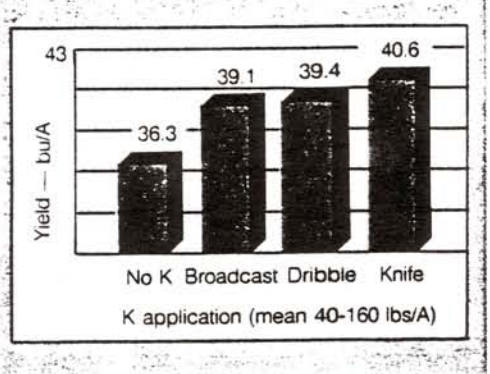

Figure 9. Response of soybeans to K fertilizer and placement (Buchholz, University of Missouri, 1985-87).

Continuing research

More on N stabilizers...

Research continues to focus on means of reducing N losses, including studies on the coincident agronomic benefits of maintaining the right form of N for crops via UAN (see related story, "Mixed N diet increases yields").

Research by Gascho of the University of Georgia has produced reductions in ammonia losses from 20 to 4% by the addition of KCl and ATS. Additional field studies have demonstrated the effectiveness of ATS, KCl, UAN combinations as N stabilizers in bermudagrass (Figure 10).

In attempts to unravel the mystery of how ATS stabilizes N solutions, Goos of North Dakota State University indicates that ATS inhibits the enzyme urease that controls the conversion of urea to ammonium in the soil. Furthermore, both ATS and the increasing size of the UAN droplet slow the conversion of urea. Varsa of Southern Illinois University has shown the effectiveness of ATS/UAN combinations as N stabilizers in no-till corn (Figure 11), where residue is high and S fertility is non-limiting — i.e., a sulfur yield response to S in the ATS would not be expected.

The agronomic benefits of using recognized nitrogen stabilizers such as N-Serve and dicyandiamide (DCD) were discussed in the September 1988 issue of *Fluid Digest*. Research in 1988 by Kissel of Kansas State University

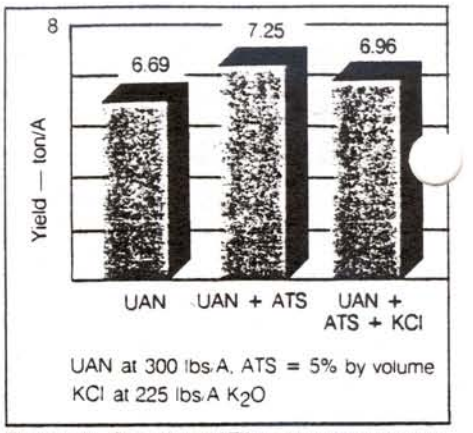

Figure 10. Response of Tifton 44 bermuda grass to dribbled UAN, KCl and ATS (Gascho, University of Georgia, 1985).

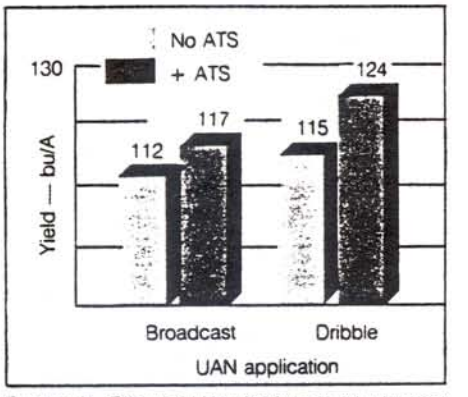

Figure 11. Effect of UAN (150 lbs/A N) with and without ATS (5% by volume) on yield of no-till corn (Varsa, Southern Illinois University, 1988).

shows that both compounds successfully maintained ammonium-N levels in upper soil layers following UAN applications, compared with high nitrate fertilizers. Such data make a strong environmental case for stabilized N use.