FLUID DIGEST®

Research Update from the Fluid Fertilizer Foundation

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FFF research

Ongoing studies show N on soybeans pays

This topic is not new to the *Fluid Digest*, but here are some interesting updates from different geographic regions.

Georgia. Gascho, University of Georgia at Tifton, is finding that highest pod count occurs when N fertilization is introduced during late August. In a study on Tifton loamy soil, where soybeans were planted on June 1, up to 6 bu/A increases in yield over check were found when UAN + Solubor was fertigated at the R5 or pod-filling stage (August 29) at the rate of 40 lbs/A nitrogen and 0.4 lb/A boron (Figure 1). Fertigation was through a center pivot. Gascho also suggests variety may have affected yield outcome, Northrup King Coker 6727 being the highest yielding of three varieties used. In another study, fertigation took place at either the R3 or R5 stage with virtually the same results (Figure 2). Note, however, the 6-bu/A increase at the R5 stage was achieved with only *half* the N required at the R3 stage! Estimates in Gascho's study, spread over three center pivots and 110 small plots, show it required an investment of less than $10/A to obtain an average return of about $30/A. "N must be sufficient for sustaining high metabolic activity during the entire pod-filling period," Gascho states in one of his conclusions.

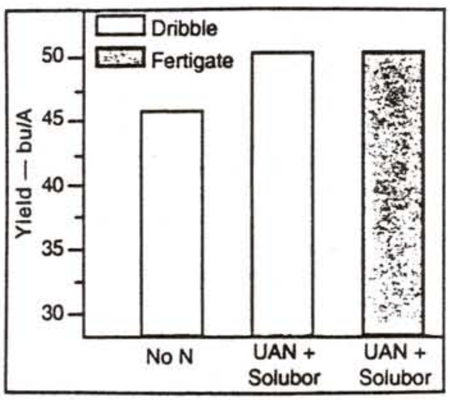

Figure 1. Soybean response to N treatment (40 lbs/A) at R5 stage, boron rate 0.4 lbs/A, Tifton, GA (Gascho, University of Georgia, 1990).

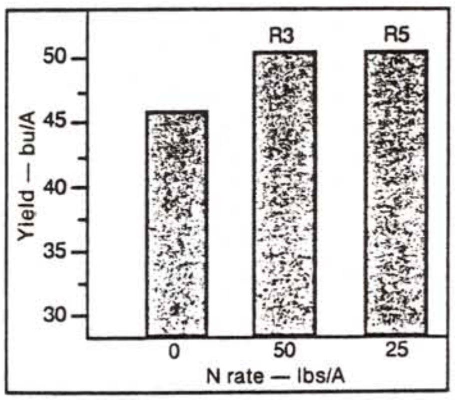

Figure 2. Soybean response to N fertigation at different growth stages and different N rates, Tifton, GA (Gascho, University of Georgia, 1988).

Ohio. In another FFF study, Cooper, USDA-ARS, of Ohio State University, found yield increases as high as 5 to 10 bu/A from supplemental nitrogen applied on soybeans grown under a subirrigation/drainage system. Yields were in the 80— to 90— bu/A range. These findings were part of a 3-year research project conducted at the Ohio Agricultural Research and Development Center at Wooster, Ohio. He also reports similar success in his recent research in Australia where soybeans were grown under a continuous furrow irrigation system. Yield increases of up to 20 bu/A were obtained from supplemental nitrogen.

Missouri. Blevins of the University of Missouri has been showing some interesting yield responses from foliar-applying boron and magnesium on soybeans. Watch for data from these results in a future issue of the *Fluid Digest!*

Cotton

10-34-0 plus insecticide boost yield

Tracy of the University of Missouri, Delta Center, has produced yield increases of cotton (Table 1) by using a 10-34-0 starter in a 3-inch band on the soil surface over the planted seed with nitrogen and phosphate rates of 15 and 51 lbs/A, respectively. Temik-TSX was applied at 12 lbs/A. N was applied preplant at 45 lbs/A and also sidedressed at first bloom at 40 lbs/A. These results are similar to those obtained by Mississippi and Louisiana researchers.

Table 1

Effect of starter and in-furrow insecticide on cotton yields (Tracy, University of Missouri).

Starter	Insecticide	Seed lbs/A	Lint lbs/A
None	None	1,578	566
None	Temik-TSX	1,784	642
APP	None	1,669	631
APP	Temik-TSX	2,061	744
LSD .05		NS	102

INSIDE:

Foundation News
from your Research Director, Bob Munson

There is never a dull moment being part of the NFSA/FFF team. After getting acclimated at the office, I began traveling to visit many of our 29 project researchers. I visited their experimental sites and talked with them about their studies. I found that even though such things as excess early rainfall — followed in some cases by drought — caused late planting and shallow rooting and cut potential yields, most of the studies were yielding interesting results. In some cases, hail also cut yields.

We are always looking for new, researchable ideas that will help to increase the market for fluid fertilizers. We try to keep the results or outgrowth of such research "flowing" to you through the *Fluid Digest*. The FFF will continue to be unceasing in its search for well-documented data on fluids and soil fertility so it can put them into the informational stream for you to use and help make you money. For example, among the interesting projects we visited this fall was one using subsoil plastic piping to irrigate and provide a programmed combination of fluid nutrients to corn and soybeans. Dr. Jay Johnson of Ohio State University and researchers in other states are working on this. While this and similar material may reach the informational channels, it is well to remember that such results may be from only a one- or two-year study, not from long-term results. Be cautious until more results are in.

In mid-October, I attended the Southern Soil Fertility Conference in Memphis, Tennessee. There was a lot of discussion about best management practices (BMPs) and the environment. Based on the evidence presented, it is clear that in most cases the soil fertility practices that are agronomically and economically sound are also those that are environmentally sound. And at the top of the BMPs list as keys in achieving profitable operating levels and protecting the environment are placement, timing and proper amounts of applied nutrients. In other words, encourage use of BMPs!

I recently returned from meetings in Denver, Colorado, of the American Society of Agronomy, the Soil Science Society of America and the Crop Science Society of America. One of the most frequently discussed topics there was the pre-sidedress nitrogen soil test as a tool to improve nitrogen recommendations in humid regions. The nitrate-nitrogen test has been used for years, along with soil profile moisture information, to make N recommendations for wheat and small grain in subhumid and semi-arid regions of the United States and Canada. These and other tests will become a key part of future nitrogen management programs. Both field nitrate electrode and lab tests will be used by dealers in the future.

Remember again: Best management practices harmonize agronomics, economics and the environment!

Bob Munson, Ph.D.
Vice President Research, Education and Market Development

Grain-to-straw ratios constant as yields increase

Koehler of Washington State University, using increasing rates of N on wheat, has shown that the relationship between increased dry matter in the straw and grain has remained roughly constant — even though the straw increased 67.4% and grain yield was increased 74.2%. Proportion of grain dry matter to total dry matter was 50% on the N control and 51% at the highest N rate. This is contrary to what some have proposed.

Reminder about liming

With fluid lime, that is. You have t' distinct advantage of quicker respon. in pH adjustment as Figure 3 shows. Small particle size aids in rapid soil reactions because of the large amount of surface area given per unit of mass.

Lime can also be used in combination with UAN, TVA research has shown. NK-lime solutions have all been used successfully. Mixing lime with P has been a questionable practice. Such a combination may cause phosphate insolubility and suspension thickening, lowering the availability of phosphorus and causing application and handling problems. Polyphosphate solutions are particularly subject to undesirable reactions, forming insoluble calcium ammonium pyrophosphates.

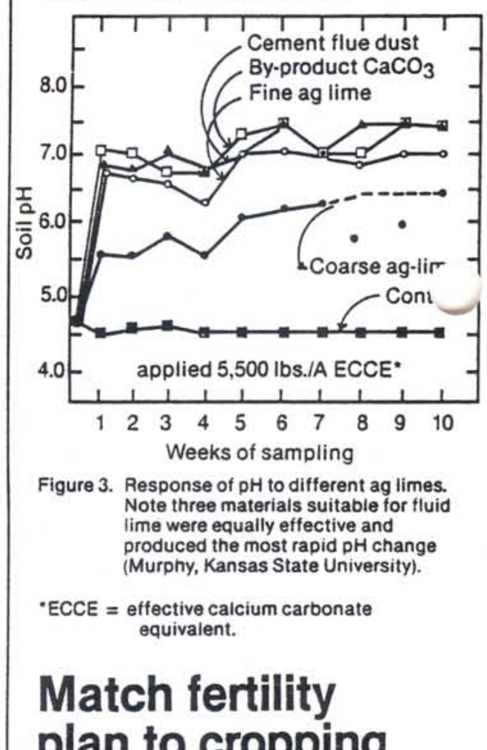

Figure 3. Response of pH to different ag limes. Note three materials suitable for fluid lime were equally effective and produced the most rapid pH change (Murphy, Kansas State University).

*ECCE = effective calcium carbonate equivalent.

Match fertility plan to cropping system

A good example is work by Mulford of the University of Maryland. Here, in a multiple-cropping system, wheat yields averaged over 100 bu/A, soybean yields 44 bu/A and corn yields 187 bu/A. Under such a cropping system, N removal per bushel for hard red spring and hard red winter wheat is greater than for soft winter wheat. Potash removals by soybeans are much grea than for either corn or wheat.

Rule of thumb to apply in any multiple-cropping system is to have a fertilization plan tailored to meet the needs of the cropping system.

Effects on nutrient uptake studied

N boosts winter wheat yields more than 40 bu/A

Nearly equal 20-bu/A yield increases were found on winter wheat for each of the first two 60-lb/A increases of N as Figure 4 shows from work completed by Koehler of Washington State University. Grain yields are based on 12.5% moisture. The study, conducted in the Palouse region of Washington, was designed to measure the effects of supplementing a basic fertility program with added nitrogen, as well as test the precept that improving one nutrient level improves the uptake of all other nutrients in combination. Up to the 111.4-bu/A yield level, it took an average of 2.88 lbs/A of applied N to produce a bushel of wheat. Fall and spring rainfall were heavy, which leached sulfate sulfur from the profile. The N source was treated with N-Serve, which reduced N losses. Koehler indicated the wheat in the spring was sulfur deficient and the deficiency seemed to increase with N rate.

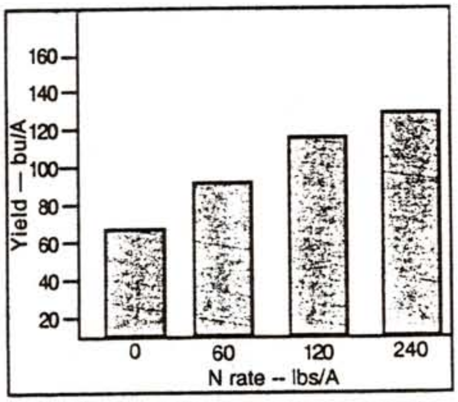

Figure 4. Effect of N rates on wheat yields (Koehler, Washington State University).

Though the data are not perfect, the yields achieved are respectable and may be useful in evaluating nutrient uptake with increasing N rates as shown in Table 2. Average yield of 98.2 bu/A in this study compares favorably with the average 1990 statewide Durum wheat yields in California and Arizona of 99 and 94 bu/A, respectively.

From a slightly different perspective, internal uptake of nutrients by the plant can be viewed in terms of how many pounds of nutrient are needed to produce a bushel of grain (Table 3). You will notice some variations for NPK, but the values for the secondary and micronutrients are essentially the same.

Or one can take the reciprocal of the values and readily obtain the bushels of grain produced per pound of nutrient taken up by the plant. This can be looked upon as an efficiency factor (output per unit of nutrient or input taken up).

Another important measure is nutrient removal from the soil by the crop per bushel of harvested grain as shown in Table 4. In looking at these removal values, remember that normal cropping systems in many areas would be corn-wheat-soybeans, getting three crops in two years.

Finally, the economics. Boosting wheat yields over check by 41.6 bu/A, by using 120 lbs/A of N, increased net return or profit from N use by $94.80/A (Table 5). That's not a bad net return on a $30/A investment. And remember, these results were obtained despite an S deficiency in early spring! The return per dollar invested was $4.04 for the first 60-lb/A increment and $4.28 for the second 60-lb/A increment. The 240-lb/A rate increased yields by 10.1 bu/A, but the net return was only 20 cents per acre — a poor return for an additional $30/A investment.

Table 2

Effect of N rates on maximum seasonal nutrient uptake of wheat (Koehler, Washington State University).

N rate lbs/A	N	P_2O_5	K_2O	S	Ca	Mg	Cu	Mn	Zn
	Nutrient uptake lbs/A								
0	74	59	60	5.2	8.3	7.6	.022	.21	.14
60	85	66	99	5.9	13.7	9.5	.023	.27	.19
120	109	83	88	7.7	11.8	11.9	.031	.29	.24
240	158	99	144	10.2	20.4	12.6	.030	.36	.25

Table 3

Nutrient uptake by plant per bushel of wheat grain produced (Koehler, Washington State University).

N rate lbs/A	N	P_2O_5	K_2O	S	Ca	Mg	Cu	Mn	Zn
	Nutrient uptake by plant lbs/bu								
0	1.06	.85	.86	.07	.12	.11	.0003	.003	.002
60	.94	.74	1.10	.06	.15	.10	.0002	.003	.002
120	.98	.75	.79	.07	.11	.11	.0003	.003	.002
240	1.30	.96	1.19	.08	.17	.10	.0002	.003	.002
Avg.	1.07	.83	.99	.07	.14	.11	.00025	.003	.002

Table 4

Nutrient removal from soil by grain per bushel of harvested wheat grain for two N levels (Koehler, Washington State University).

N rate lbs/A	N	P_2O_5	K_2O	S	Ca	Mg	Mn	Zn
	Nutrient removal from soil by grain lbs/bu							
0	.89	.72	.21	.05	.001	.069	.002	.001
240	.87	.65	.20	.06	.0012	.067	.001	.001

Table 5

Economics of dollar return on N rate investment on winter wheat (Koehler, Washington State University).

N rate lbs/A	Wheat yield bu/A	Added yield bu/A	Added cost* $	Added return** $/A	Net return from N $ per N increment	ROI $/$	Total net return $/A
0	69.8	—	—	—	—	—	—
60	90.0	20.2	15	60.60	45.60	4.04	45.60
120	111.4	21.4	15	64.20	49.20	4.28	94.80
240	121.5	10.1	30	30.30	.20	1.01	95.00

*Using price of $0.25 per pound of N.
**Using $3.00 per bushel of wheat.

Following basics key to profitable wheat grazing and grain production

In areas where climate is favorable for winter grazing, wheat and other fall-seeded small grains are often managed for both forage production and grain. Fain of Oklahoma State University, an authority on managing wheat for livestock grazing, cites five basics that must be observed to successfully manage forage: 1) picking right variety, 2) timing planting date right, 3) applying nutrients at proper rates, 4) favorable climate and 5) utilization. He recommends:

- planting about one month earlier than optimum planting date for grain production
- increasing seed rate above that normally recommended for grain production
- applying all of the fertilizer needed before seeding.

Fain further notes that fall forage can remove close to 100 lbs/A of nitrogen in a good year. In most years, a second N application in early spring will be beneficial.

Growing wheat as forage can have a definite economic impact. Using the mean yield of dry matter produced near Enid, OK, by the six different varieties shown in Table 6, forage value would have exceeded $200 per acre at '86-'87 stocker cattle prices. At the same time, grain yields for the six varieties averaged 29 bu/A (see "Low P and grass tetany related?" article).

Table 6

Winter wheat forage yield, 1986-87 (Fain, Oklahoma State University).

Variety	Dry matter (lbs/A)
P2157	3,642
Chisholm	3,607
Dodge	3,483
Stallion	3,310
Tam W101	3,241
Century	3,178
Mean	3,410

Low P and grass tetany related?

Could be. Reinbott and Blevins of the University of Missouri have found clues in their hydroponic and greenhouse research indicating that lack of available phosphorus was probably decreasing uptake and transport of calcium and magnesium in grasses. When P was added, they found that "tetany ratio" (K/Ca + Mg) decreased from 2 to 1.2, indicating a decrease in the likelihood the grass would produce tetany.

Field Trials

Leaf phosphorus, as well as magnesium and calcium, was greatly increased in 1990 field trials on fescue when phosphate was applied on soils testing 5 to 7 lbs/A.

While research will continue, the researchers meanwhile recommend:

- soil testing pastures and following phosphate recommendations
- keeping soil's pH up by applying Mg-containing dolomitic limestone
- including in grass pastures some legumes that are naturally higher in calcium and magnesium.

The law and BMP

Laws that govern the control of nonpoint pollution sources in agriculture (PL92-500, 1972 and PL195-217, 1977) embrace the best management practice (BMP) concept.

Dr. R. A. Wiese, agronomist who serves as a four-state area extension liaison to Region 7 EPA, says that there are five criteria that must be met for a practice to qualify as a BMP. It must be 1) agronomically sound, 2) implementable, 3) economically achievable, 4) environmentally effective and 5) socially acceptable.

N benefits corn yield

Funderburg and Normand of Louisiana State University found clearly evident yield responses (Figure 5) in 1991 experiments comparing surface-applied Urea and Super U (urea with a urease inhibitor) and knifed-in or injected UAN.

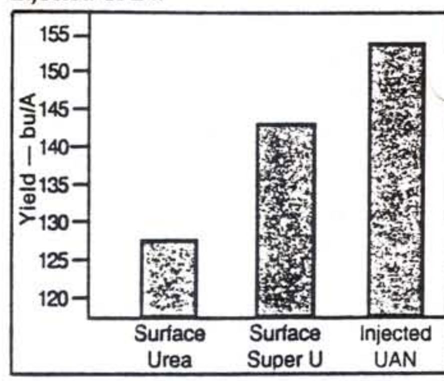

Figure 5. Corn response to N (Funderburg and Normand, LSU, 1991).

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