Fertility Trials, Field Crops

Dave Struthers has used on-farm trials to evaluate corn N needs.

What is field history worth for fertility? Field history was important to several trials in 2002. The Dordt College Agricultural Stewardship Center raised corn on ground that in 2001 had grown either oats alone or oats with a red clover underseeding. To some of the 2002 corn they applied 197 lbs of anhydrous ammonia nitrogen, and the rest of the corn received no additional N. This gave them four different treatments based on the combination of the clover possibilities and the two fertilizer levels: no clover and no fertilizer (the control treatment); clover but no fertilizer; fertilizer but no clover; and both clover and fertilizer. Table 3, click to view, shows yields and economics for these four treatments as well as for the clover factor and the fertilizer factor separately. When no nitrogen fertilizer was applied, the previous year's red clover significantly increased yields and profitability. When nitrogen fertilizer was used, the history of red clover did not increase corn yields, but it increased fall corn stalk nitrate by 1,000 parts-per-million (ppm) nitrate-N (Figure 7), demonstrating that the red clover provided quantities of nitrogen to the following corn. The end-of-season stalk nitrate test is a tool that allows producers to balance fertilizer and other sources of N.

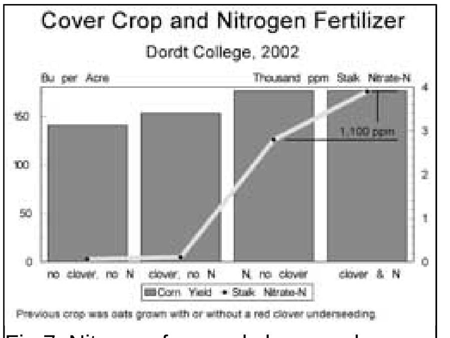

Fig 7. Nitrogen from red clover and anhydrous ammonia both increased corn yields and fall stalk nitrate.

Dave and Becky Struthers, Collins, used the late spring soil nitrate test before sidedressing corn in 2002. The 12 ppm nitrate-N result would usually suggest an additional 100 lbs N sidedress. ISU bulletin Pm-1714, Nitrogen Fertilizer Recommendations for Corn in Iowa, states that generally sidedress rates can be calculated by comparing the late spring soil test to the "critical level," which is usually about 25 ppm. Subtract the test level from the critical level and multiply the difference by the magic number 8 to derive the recommended sidedress rate.

Dave decided to compare 120 lbs and 150 lbs in the trial (Table 3, click to view). Overall yields were excellent, and not only did Dave see no yield difference in the trial, the fall stalk nitrate-N was sky high - 6,000 ppm at the 120 lb rate and 10,000 following 150 lbs N. The target zone for the stalk test is only 800-to-2,000 ppm nitrate-N.

But this field had received manure in 2001, 1999, and 1998. For fields with a manure history and a 12 ppm test, ISU would have recommended 0-60 lbs of sidedressed nitrogen. In this case, applying no sidedress N would have reduced the stalk nitrate-N by perhaps 1,000 ppm, and the corn crop would have still received more than enough nitrogen. The manure history provided an even greater margin of safety than predicted.

On their organic fields near Sutherland, **Paul and Karen Mugge** rely solely on manure and crop rotations to maintain corn yields. Paul was interested in trying a seed treatment that was said to contain bacteria that fix atmospheric nitrogen, turning it into biologically available N. The nitrogen-fixing rhizobia bacteria in the root nodules of legumes are well known. These microorganisms are symbiotic; they get energy from the legume, and the plant gets nitrogen from the rhizobia, a mutually beneficial exchange.

But corn does not have root nodules to shelter N-fixing bacteria. Presumably the product Paul tested contained nonsymbiotic microorganisms that live freely in the soil. The essential problem in utilizing non-symbiotic N-fixers is energy. With no host plant to provide sugars, the nonsymbiotic fixers simply don't have the power supply to fix useful amounts of nitrogen. Cuban scientists have done research on using root exudates for the energy supply, but success in temperate soils and crops has yet to be demonstrated.

Paul located the trial in one of his remaining non-organic fields. He compared the inoculant product Enzone to a sidedressing of 60 lbs of 28% UAN nitrogen, and he included a control treatment that received no amendments. Table 3, click to view, shows that the 28% nitrogen solution did increase corn yields significantly. The yield of the inoculant-treated corn averaged three bushels greater than the control. Does this mean it worked? Unfortunately no. The inoculated treatment needed to yield six-and-a-half bushels more than the control to be considered more than just a random difference. Even if the three bushel difference were an effect of the treatment, it would not have paid for the $15.80 cost of the product.

Table 3. Fertility Trials – Field Crops

				TREATMENTS "A, D"					TREATMENTS "B, F"					TREATMENT "C"					
COOPERATOR	CROP	PREVIOUS CROP	YIELD SIGNIFI-CANCE	DESCRIPTION	YIELD (bu or T)	STAT.	TRT COSTS	$ BENEFIT	DESCRIPTION	YIELD (bu or T)	STAT.	TRT COSTS	$ BENEFIT	DESCRIPTION	YIELD (bu or T)	STAT.	TRT COSTS	$ BENEFIT	OVERALL COMMENTS
DORDT	CORN	OATS/ CLOVER		OATS IN 2001, NO N IN 2002	140.8 (stalk nitrate-N: 67 ppm)	c	$28.86	$0.00	OATS IN 2001 + 197 LBS N IN 2002	176.2 (2,797 stalk nitrate)	a	$34.79	$71.90						WHERE N WAS APPLIED, STALK NITRATE WAS 1,100 PPM HIGHER IF AFTER CLOVER
				OATS + RED CLOVER IN 2001, NO N IN 2002	153.2 (stalk nitrate-N: 110 ppm)	b	$36.21	$19.85	OATS + RED CLOVER IN 2001 + 197 LBS N IN 2002	176.3 (3,898 stalk nitrate)	a	$42.14	$64.76						3,900 PPM VS. 2,800 PPM. SHOWS TRUE N CONTRIBUTION OF CLOVER.
FACTORIAL:		COVER FACTOR	N.S.	OATS/CLOVER	164.8	a	$39.18	$6.35	OATS ONLY	158.5	a	$31.83	$0.00						YIELD DIFFERENCE JUST SHORT OF SIGNIFICANT AT 95% CONFIDENCE.
		N LEVEL FACTOR	*	NO N	147.0	b	$32.54	$0.00	HIGH N	176.3	a	$41.43	$55.45						HIGHLY SIGNIFICANT YIELD DIFFERENCE.
MUGGE	CORN	SOYBEAN	*	ENZONE INOCULANT	96.9	b	$15.80	($15.80)	28% N	111.1	a	$13.59	$33.44	CONTROL TRT	93.4	b	$0.00	$0.00	INOCULANT CONTAINS NONSYMBIOTIC BACTERIA SAID TO FIX NITROGEN
STRUTHERS	CORN	CORN	N.S.	150 LBS N, SIDEDRESS	200.6	a	$39.21	-$6.80	120 LBS N, SIDEDRESS	199.8	a	$32.41	$0.00						SPRING NITRATE WAS 12PPM, SUGGESTING 100 LBS SIDEDRESS, BUT FIELD MANURED 2X IN 4 YRS. STALK NITRATE WAS 6,000 PPM AT 120 LB RATE, 10,000 PPM AFTER 150 LBS