Fertility Trials

In 2003, the **Dordt College Ag Stewardship Center** completed a trial begun the year before, when oats was seeded with and without red clover. In 2003, corn was planted on these plots, either with additional nitrogen fertilizer or without. Consequently the trial treatments made a 2x2 grid, (called a 2x2 "factorial") consisting of the four combinations of nitrogen and clover.

The goal was to determine whether clover would supply sufficient N to the corn. Statistically speaking it did, because there was enough variability in the field that the 9 bushel spread among the treatments could not be distinguished from a random occurrence. Neither the nitrogen factor nor the clover one was significant (Table 2, click to view). Even if the yield differences were "real," their value would be less than the additional fertilizer and seed costs involved, even at current high grain prices. A similar trial by the Dordt College Ag Stewardship Center in 2000-2001 gave a similar result.

Discussion at the Mugge field day

Sustainably-minded producers will probably look at these results and say, "Sure, if the next year's corn yield is all you look at, seeding red clover doesn't pay. But..." But the red clover builds soil nitrogen for future years. It suppresses weeds. And a late summer cutting or grazing can easily pay for the seed. Iowa's rich, prairie soils got that way from centuries of "cover crops." Keeping those soils productive requires some attention to the crops that feed them.

Paul and Karen Mugge, of Sutherland, decided to put to the test a product that is said to increase soil nitrogen biologically. Enzone® contains microorganisms in the genus *Azotobacter*. This group turns atmospheric nitrogen into plant-available N, just as do bacteria in the *Rhizobia* group. However, while *Rhizobia* do their work from inside the root nodules of a legume, *Azotobacter* are free living.

The limitation on biological nitrogen fixation is energy. In a legume, that energy is supplied by the plant in the form of sugars and starches translocated to the root nodules. Over the course of a growing season as much as 10% of these "photosynthates" may be used by the *Rhizobia*, at a rate of 4-10 units of carbohydrates per unit of nitrogen fixed. Free-living bacteria such as *Azotobacter* do not enjoy such a plentiful source of energy. Some research in tropical soils suggests that under certain conditions, root exudates may supply energy to free-living N fixers. But the phenomenon has not yet been shown to be important in temperate agriculture.

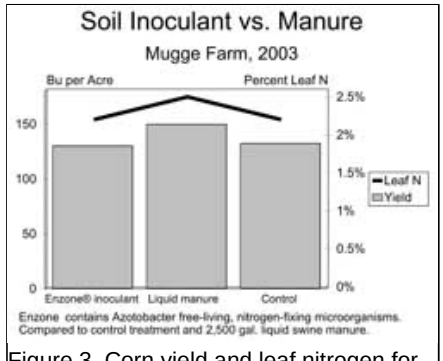

Figure 3. Corn yield and leaf nitrogen for liquid manure treatment, control, and Enzone soil inoculant.

The trial by the Mugges was no exception (Table 2, Figure 3). The soil inoculant did not increase corn yield or leaf nitrogen compared to the control treatment. Liquid swine manure, on the other hand, did increase corn yield and leaf N, showing that the crop would respond to additional nitrogen. The table shows that the inoculant also cost nearly $20 per acre, while the swine manure, an on-farm resource, was a relative bargain. A 2002 trial by Mugge also found no difference between Enzone and a control treatment that received no nitrogen.

Table 2. Multiple-Treatment Fertility Trials

COOPERATOR	CROP	PREVIOUS CROP	YIELD SIGNIFI-CANCE	TREATMENT "A" DESCRIPTION	TREATMENT "A" YIELD (bu. or T)	TREATMENT "A" STAT.	TREATMENT "A" TRT COSTS	TREATMENT "A" $ BENEFIT	TREATMENT "B" DESCRIPTION	TREATMENT "B" YIELD (bu. or T)	TREATMENT "B" STAT.	TREATMENT "B" TRT COSTS	TREATMENT "B" $ BENEFIT	TREATMENT "C" DESCRIPTION	TREATMENT "C" YIELD (bu. or T)	TREATMENT "C" STAT.	TREATMENT "C" TRT COSTS	TREATMENT "C" $ BENEFIT	OVERALL COMMENTS
DORDT COLLEGE	CORN	OATS	N.S.	OATS ONLY	183.5	a	$20.01	$51.95	NITROGEN	187.6	a	$56.16	$15.80						NO DIFFERENCE IN LEAF SPAD NITROGEN
				RED CLOVER	188.8	a	$35.81	$36.15	CLOVER + N	192.7	a	$71.96	$0.00						
		NITROGEN FACTOR:		NITROGEN	190.1	a	$36.15												
				NO NITROGEN	186.2	a	$0.00												
		CLOVER FACTOR:		CLOVER	190.8	a	$15.80												
				NO CLOVER	185.5	a	$0.00												
MUGGE	CORN	SOYBEAN	**	ENZONE INOCULANT	129.2	b	$19.67	$0.00	LIQUID MANURE	148.9	a	$3.62	$56.40	CONTROL	131.5	b	$0.00	$19.67	
				LEAF N:	2.2	b				2.5	a				2.2	b			