Corn:
Long Term Studies

- Long-Term Fertilizer Program Comparison in Corn (1996-2003)
- Long-Term Effects on Soil Tests
- Long-Term Effects of Different Fertilizer Programs in Corn (2005)
- What is the Effect of Planter Fertilizer Rates on Ultimate Corn Yield? (1996-2003)
- Manure Applications and Fertilizer Rates on Corn (2008)

Experiment: Long-Term Fertilizer Program Comparisons In Corn (96-05 to 03-05)

Agro-Culture Liquid Fertilizers utilizes high-performance concepts that enable increased fertilizer efficiency. Greater fertilizer efficiency enables reduced fertilizer inputs to get the same results as higher rates of fertilizers with lower efficiency. However, there may be concern over long-term use of a reduced input program on crop yield and soil test levels. In 1996 an experiment was initiated to evaluate different fertilizer programs for long-term effects on crop and soil. The experiment was established as a corn-soybean rotation, with half the area planted to corn and half planted to soybeans. Corn fertilizer rates were based on a field soil test taken in the fall of 1995, and consisted of a conventional dry and a conventional liquid program, and an Agro-Culture Liquid Fertilizers. In soybeans, the conventional plots used broadcast 100 lb/A of 0-0-60 and the Liquid plot used 5 gal/A of Sure-K.

Corn fertilizer recommendations for 150 Bu/A. 170-30-60-2 zinc.

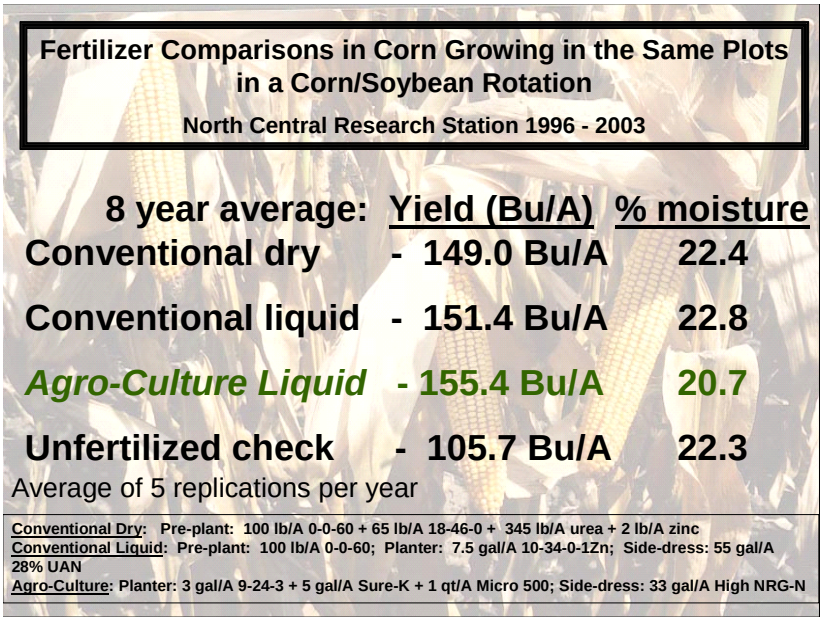
Conventional dry: 100 lb/A 0-0-60 + 65 lb/A 18-46-0 + 345 lb/A urea + 2 lb/A zinc as zinc oxy-sulfate applied pre-plant broadcast.

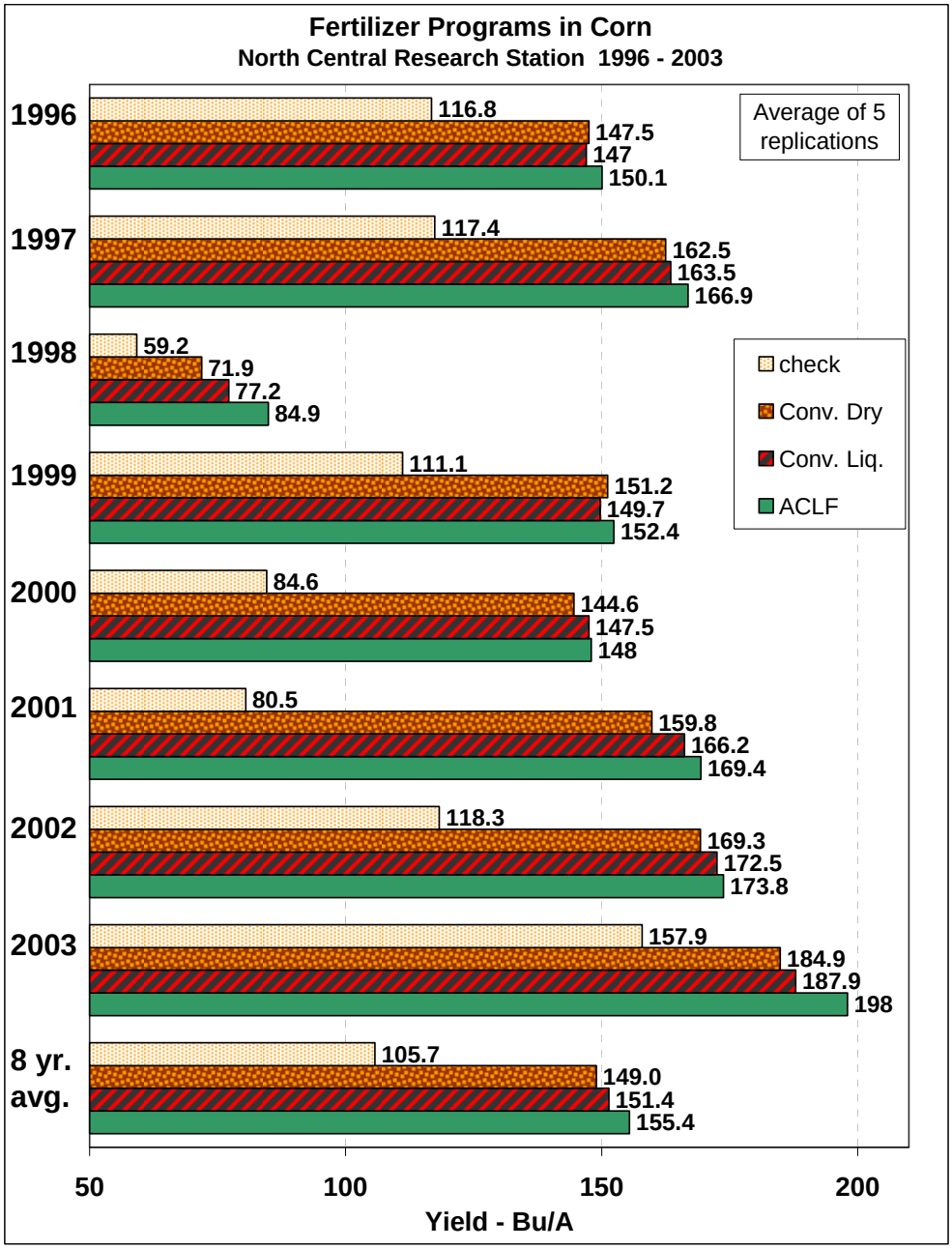
Conventional liquid: 100 lb/A 0-0-60 applied pre-plant broadcast. 7.5 gal/A 10-34-0 + 1 qt/A 9% zinc planter-applied; 55 gal/A 28% UAN sidedress.

Agro-Culture Liquid Fertilizers: 3 gal/A Pro-Germinator 9-24-3 + 5 gal/A Sure-K + 1 qt/A Micro 500 planter-applied; 33 gal/A High NRG-N sidedress (for a total of 112 lb/A primary nutrients vs. 260 lb/A for conventional.)

Each treatment was replicated five times in 4 row by 100 foot plots.

Eight year yield and grain moisture averages appear in the following chart, and yields by year are on the next page.





Note: Supplemental irrigation from an irrigation gun was added in 2001 and 2002.

- Over the eight years of the experiment, the Agro-Culture Liquid Fertilizers treatment compared favorably to the conventional treatments even though less than half of the amount of primary nutrients were applied each year.
- In most years the yields are near the yield goal of 150 Bu/A, except in 1998 which was a dry year. Especially under moisture stress conditions, the low salt Agro-Culture Liquid Fertilizers is better able to feed the crop.
- Having drier average grain moisture with Agro-Culture Liquid Fertilizers is an indication of less stress and better fertilizer utilization as the crop was able to reach maturity quicker.

Long term effects on soil test.

Using a reduced-fertilizer input program may cause concerns about “mining” the soil. As part of this experiment, plots were soil sampled on alternate even years following corn harvest. Ten 8 inch cores were collected: five from the row and five from between the row. Samples were analyzed by plot and compiled for treatment average. Sample results over eight years are in the following chart.

								Base Saturation		
Year		% OM	P1	P2	K	pH	CEC	%K	%Mg	%Ca
1995	whole field	2	57	76	138	6.6	6.6	5.3	17.6	70.1
1997	ACLF	2	67	78	156	6.3	6.2	6.5	14.2	68.8
	Conv. Liquid	2.1	71	83	149	6.8	6.2	6.2	14.1	76.7
	Dry	2.3	63	70	139	6.5	5.5	6.5	13.6	72.5
	Check	1.7	62	74	143	6.6	5.8	6.3	15	72.7
1999	ACLF	2	53	71.4	136.2	6.8	4.7	7.8	15.3	73
	Conv. Liquid	2	51.2	71.8	143.8	6.6	5	7.6	14.6	71.2
	Dry	1.9	52.6	72.6	167.6	6.5	5	8.7	14.5	70
	Check	2	48.2	68.2	131.6	6.8	4.9	7	15.5	74.8
2001	ACLF	2	50.2	68	166.4	6.6	6.4	6.8	14.4	73.7
	Conv. Liquid	2.1	51	66.6	208.8	6.4	7	7.8	13.5	68.3
	Dry	2	47	66.8	203.4	6.6	6.7	7.8	13.8	72.8
	Check	1.9	48.4	68.4	156.2	6.7	6.6	6.1	14.7	75.9
2003	ACLF	2.3	51.2	67.4	159	6.7	6.9	6	14.6	73.4
	Conv. Liquid	2.1	52.4	69.2	184.2	6.6	6.9	6.9	14.7	71.3
	Dry	2	55.4	69.4	184.4	6.7	6.6	7.2	15	75
	Check	2.2	44.8	62	146.2	6.8	6.6	5.7	15.6	76.2

Treatments:

ACLF	Planter: 3 gal/A 9-24-3 + 5 gal/A Sure-K + 1 qt/A Micro 500; Sidedress: 33 gal/A High NRG-N
Conv. Liquid.	Preplant broadcast: 100 lb/A 0-0-60; Planter: 7.5 gal/A 10-34-0 + zinc; Sidedress: 55 gal/A 28%
Dry	Preplant broadcast: 100 lb/A 0-0-60 + 65 lb/A 18-46-0 + 345 lb/A urea + 2 lb/A zinc

- Soil test levels for phosphorus have not decreased over 8 years with any of the fertilizer treatments.
- Soil potassium levels have actually increased for all treatments. However, the ACLF treatment did not increase as much as the conventional treatments. But the Liquid treatment applied fertilizer in a band each year, and so soil samples were collected between the rows where no fertilizer has been applied. The advantage of banding with the row is that the plants roots can more easily access the fertility. Even though the soil test K levels ended up higher, it did not result in higher yield compared to the ACLF treatment.
- This shows that soil test levels will not be decreased with use of Liquid. However, if soil test levels have been built up through years of dry fertilizer application, there may be some dropping of those levels in some cases. But feeding of the crop will be maintained through band placement of the Liquid.

Experiment: Long-Term Effects of Different Fertilizer Programs in Corn
Year (Experiment Number): 2005 (05-05)
Date of Planting/Harvest: May 5 / October 14
Hybrid: Pioneer 37R71
Plot Size (replications): 4 row x 100 ft. (5)

In the fall of 1995, a soil test was taken in a field at the North Central Research Station. Based on the results, an experiment was designed to evaluate long-term effects of four different fertilizer programs on yield and soil test levels. The same treatments were applied to the same plots in the corn years of a corn-soybean rotation. The 2005 growing season was the tenth year of this experiment. Fertilizer programs appear in the following table.

Long-Term Fertilizer Programs Compared. *North Central Research Station* 1996 - 2005		
1. Agro-Culture Liquid Fertilizers (ACLF)	Corn:	Planter: 3 gal/A Pro-Germinator 9-24-3 + 5 gal/A Sure-K + 1 qt/A Micro 500 Sidedress: 33 gal/A High NRG-N
	Soybeans:	Planter: 5 gal/A Sure-K + 1 qt/A Micro 500
2. Conventional liquid	Corn:	Preplant: 100 lb/A 0-0-60, broadcast and incorporated Planter: 7.5 gal/A 10-34-0 + 1 qt/A 9% zinc Sidedress: 55 gal/A 28% UAN
	Soybeans	Planter: 5 gal/A 3-18-18 in 1996 & 1998 Preplant: 100 lb/A 0-0-60, broadcast and incorporated in 2000, 2002 & 2004
3.Conventional dry	Corn:	Preplant: 100 lb/A 0-0-60 + 65 lb/A 18-46-0 + 345 lb/A urea + 2 lb/A zinc, broadcast and incorporated
	Soybeans:	Preplant: 100 lb/A 0-0-60, broadcast and incorporated
4. Unfertilized check	Corn:	No fertilizer
	Soybeans:	No fertilizer

In this experiment, the plots had soybeans in the even years and corn in the odd years. Fertilizer application rates varied widely between the conventional and Agro-Culture Liquid Fertilizers treatments, especially in corn. The conventional application in corn was 170-30-60 lb/A for N-P_2O_5-K_2O, for a total of 260 lb/A of applied nutrition. With the Agro-Culture Liquid Fertilizers treatment, the total was 112 lb/A, or 43% of the conventional rate.

During the 2001 through 2004, the ability to apply supplemental irrigation through a traveling gun was introduced. Thus, irrigation was applied during dry periods in mid-season (July and August). Amounts appear in the following table.

Supplemental Irrigation with Traveling Gun (applied in mid-season)		
Year	# applications	total inches
2001	3	4.5
2002	3	2.25
2003	4	5.0
2004	2	2.75

Soybean and corn yields appear in the following tables.

Soybean yields by year and treatment. *North Central Research Station*						
Fertilizer	1996	1998	2000	2002	2004	**5 yr avg.**
1. ACLF	51.0	31.2	42.9	46.2	48.0	**43.9**
2. Conv. Liquid	46.1	30.4	43.4	45	42.4	**41.5**
3. Conv. Dry	48.2	28.7	43.2	45.2	42.4	**41.5**
4. Check	44.4	30.7	38.9	43.7	40.9	**39.7**
LSD (0.2):	2.6	n.s.d.	4.9	6.2	3.6	

Corn yields by year and treatment. *North Central Research Station*						
Fertilizer	1997	1999	2001	2003	2005	**5 yr avg.**
1. ACLF	166.9	152.4	169.4	198.0	153.7	**168.1**
2. Conv. Liquid	163.5	149.7	166.2	187.9	150.3	**163.5**
3. Conv. Dry	162.5	151.2	159.8	184.9	138.5	**159.4**
4. Check	117.4	111.1	80.5	157.9	101.8	**113.7**
LSD (0.2):	7.9	8.5	7.3	6.0	6.8	

- In soybeans, there was a slight numerical advantage for the Agro-Culture Liquid Fertilizers program of Sure-K and Micro 500. The yield advantage over the check is not as large as anticipated likely due to the relatively high soil potassium level, shown in the next section.
- In corn, again there is a numerical advantage to the Agro-Culture Liquid Fertilizers program, even though it applied only 43% of the amount of nutrients of the conventional programs.
- The conventional dry is lower due to lower performance of broadcast fertilizer, especially in dry years. Also, banded nutrition is more efficient.

Corn grain moisture at harvest is shown in the following table.

Corn harvest grain moisture by year and treatment. *North Central Research Station*						
Fertilizer	1997	1999	2001	2003	2005	**5 yr avg.**
1. ACLF	29.2	16.8	15.9	21.0	15.3	**19.7**
2. Conv. Liquid	32.9	17.3	16.1	23.8	16.0	**21.2**
3. Conv. Dry	32.3	17.7	16.0	22.1	16.0	**20.8**
4. Check	31.2	17.8	16.2	22.3	16.2	**20.7**

- In each of the five years, the driest corn was from the Agro-Culture Liquid Fertilizers treatment. This would indicate better early nutrition and less early stress from encountering the fertilizer which enabled faster maturity in the end.
- (At this time I'm not sure why we harvested at such high moisture in 1997, although the harvest date was October 30, and it was a relatively wet year.)

Following corn harvest and prior to any fall tillage, soil samples were collected to measure long-term program effects on soil test levels. Since all of the Agro-Culture Liquid Fertilizers are banded at planting, and portions of the conventional plots are broadcast, sampling method could influence results. It was decided to collect 10 samples per plot:

five from in the row and five from midway between the rows. Thus, in the Agro-Culture Liquid Fertilizers plots, half of the samples are collected from an area that has not had fertilizer applied. But the conventional programs have broadcast potash each year, and the conventional dry program has broadcast 18-46-0 (DAP) in the corn year. So there is fertilizer distributed over the entire plot and not just in the row. But this would still give a good indication of effects on soil.

In the fall of 1995 before the experiment started, a composite soil sample was collected over the entire plot area. This would serve as the starting point for soil test levels in the experiment. (The fertilizer history of this field prior to 1994 is not known. That was the year it was acquired for the establishment of the North Central Research Station.) In the fall of 1997, the samples from each plot in each treatment were compiled into a single treatment sample for analysis. In hindsight, we should have kept the replications separate as was done in 1999, 2001, 2003 and 2005. In those years, data presented is an average of the five replications, and ten cores per replication.

Soil test summary of sampling by treatment and year appear in the following chart.

Effect of long-term use of different fertlizer programs on soil test levels.
North Central Research Station

			ppm					Base Saturation		
Year		% OM	P1	P2	K	pH	CEC	%K	%Mg	%Ca
1995	whole field	2	57	76	138	6.6	6.6	5.3	17.6	70.1
1997	ACLF	2	67	78	156	6.3	6.2	6.5	14.2	68.8
	Conv. Liquid	2.1	71	83	149	6.8	6.2	6.2	14.1	76.7
	Dry	2.3	63	70	139	6.5	5.5	6.5	13.6	72.5
	Check	1.7	62	74	143	6.6	5.8	6.3	15	72.7
1999	ACLF	2	53	71.4	136.2	6.8	4.7	7.8	15.3	73
	Conv. Liquid	2	51.2	71.8	143.8	6.6	5	7.6	14.6	71.2
	Dry	1.9	52.6	72.6	167.6	6.5	5	8.7	14.5	70
	Check	2	48.2	68.2	131.6	6.8	4.9	7	15.5	74.8
2001	ACLF	2	50.2	68	166.4	6.6	6.4	6.8	14.4	73.7
	Conv. Liquid	2.1	51	66.6	208.8	6.4	7	7.8	13.5	68.3
	Dry	2	47	66.8	203.4	6.6	6.7	7.8	13.8	72.8
	Check	1.9	48.4	68.4	156.2	6.7	6.6	6.1	14.7	75.9
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	Conv. Liquid	2.1	52.4	69.2	184.2	6.6	6.9	6.9	14.7	71.3
	Dry	2	55.4	69.4	184.4	6.7	6.6	7.2	15	75
	Check	2.2	44.8	62	146.2	6.8	6.6	5.7	15.6	76.2
2005	ACLF	1.8	52	66	149.6	6.3	7.2	5.5	13.9	69.8
	Conv. Liquid	1.8	50.6	63.6	221.4	6.3	8.1	7.3	13.2	69.2
	Dry	1.8	51.6	65.8	208.8	6.2	7.4	7.3	13.5	67.2
	Check	1.8	45.6	59.6	143.8	6.7	7.1	5.3	15.8	75.8

- Soil test phosphorus levels in the treated plots have not changed appreciably in the ten years since the start of this experiment. The P level for the check has decreased.
- Soil test potassium levels have increased appreciably for the conventional treatments due to the annual broadcast of 0-0-60. The K level for the Agro-Culture Liquid

Fertilizers treatment has not decreased below the start level. In fact it is slightly elevated after ten years.

- Even though the conventional treatments elevated the soil K levels, the yield has not increased above that of the Agro-Culture Liquid Fertilizers treatment, where considerably less fertilizer potassium is applied. Thus, the Sure-K appears to be adequately feeding the crop while not depleting existing soil K levels.

Experiment: What Is the Effect of Planter Fertilizer Rate on Ultimate Corn Yield? (North Central Research Station. 1996 – 2003)

Agro-Culture Liquid Fertilizers is confident in the ability to recommend the proper planter fertilizer rate for yield goal. Starting with a soil test, a complete nutrient program can be developed. Since the high performance characteristics of Agro-Culture Liquid Fertilizers enables lower than normal rates of nutrient application, it may appear that more fertilizer should be applied. Conversely, it may be tempting to apply less than the recommended rate for cost savings. An eight year experiment evaluated three different planter fertilizer rates for effects on a 150 Bu/A yield goal.

1. Recommended rate based on soil test: 3 gal/A 9-24-3 + 5 gal/A Sure-K
2. Higher than recommended rate: 5 gal/A 9-24-3 + 7 gal/A Sure-K
3. Half of the recommended rate: 1.5 gal/A 9-24-3 + 2.5 gal/A Sure-K

All of the above treatments included 1 qt/A Micro 500. All of the treatments were sidedressed with 33 gal/A of High NRG-N. Each treatment was replicated five times per year in 4-row by 100 foot plots. Yield results appear in the following table.

Effect of planter fertilizer rate of 9-24-3 and Sure-K on corn yield.
North Central Research Station 1996 - 2003.

	Yield - Bu/A. Average of 5 replications								
9-24-3 + Sure-K (gal/A)	1996	1997	1998	1999	2000	2001	2002	2003	**Avg.**
1.5 + 2.5	142.9	151.0	82.3	143.5	148.4	167.9	161.5	191.5	**148.6**
3 + 5	150.1	166.9	84.9	152.4	148.0	169.4	173.9	198.0	**155.5**
5 + 7	151.1	175.3	77.1	146.3	150.5	161.9	173.0	192.5	**153.5**
Unfertilized check plot	116.8	117.4	59.2	111.1	84.6	80.5	118.3	157.9	**105.7**

Planter applications also received 1qt/A Micro 500 in 1996-2000, and 1 qt/A in 2001-2003.
Treated plots were side-dressed with 33 gal/A High NRG-N.

- Over the eight years of the experiment, there was a yield decrease with the low rate, but no increase with the high rate. This indicates that the standard Agro-Culture Liquid Fertilizers rate for this soil is correct.
- If the Agro-Culture Liquid Fertilizers treatment is under-applying nutrients, as conventional wisdom would suggest, then there should be a yield increase with the higher rate. But this has been proven not to be the case.
- There was only one year (1997) out of eight where the average yield was higher with the higher rate. Otherwise it is equal to lower. Under dry planting conditions, the 12 gal/A may be on the high side for in-furrow application, although stand counts have not shown a reduction compared to the lower rates.

Experiment: Manure Applications and Fertilizer Rates on Corn
Year (Experiment Number): 2008 (08-507)
Date of Planting/Harvest: May 1 / October 17
Variety: DEKALB 5044
Plot Size: 15 ft. x 135 ft. (2 replications)

Soil Test Levels (ppm)

See Text

Objective: Determine the best fertilizer program for soils with long term dairy manure applications.

The addition of animal manures can play a huge roll in an overall fertility program. The North Central Research Station has been working on plots with annual applications of dairy manure for the past 10 years (2008 being the 11th year). This field is divided into 4 sections, 2 sections have never received manure, 1 section receives 20 tons/A each fall and the last section receives 20 ton/A every fall and spring (40 ton/A total). Some may think that this is an over application of manure; however, this dairy manure comes directly from the barns and contains high amounts of straw and other bedding materials. The manure is sampled on regular basis and sent to Midwest Laboratories in Omaha, Nebraska for analysis. See Table 1 below for the most recent Bio-Solids Analysis Report.

Table 1.

Bio-Solids Analysis Report

			Est. First Year
	Analysis	Nutrients	Availability
Parameters	as Received	lbs/ton	lbs/ton
Ammonium Nitrogen (N)	0.09 %	1.9	1
Organic Nitrogen (N)	0.64 %	12.8	4
Total Nitrogen (N)	0.73 %	14.7	5
Phosphorus (P_2O_5)	0.14 %	2.9	2
Potassium (K_2O)	0.42 %	8.3	7
Sulfur (S)	0.05 %	1.0	0
Calcium (Ca)	0.19 %	3.7	3
Magnesium (Mg)	0.07 %	1.4	1
Sodium (Na)	0.04 %	0.8	1
Copper (Cu)	3 ppm	0.01	0.00
Iron (Fe)	138 ppm	0.28	0.19
Manganese (Mn)	22 ppm	0.04	0.03
Zinc (Zn)	15 ppm	0.03	0.02
Moisture	82.7 %		
Total Solids	17.3 %	346.0	
Total Salts		16.1	
pH	7.8		

n.d. Non Detect

As shown in the Bio-Solids report, this manure has a low analysis for nutrients. Below is a breakdown the primary nutrients applied through manure per section.

<u>Fall only (20 ton/A)</u>
N: 100 lbs/A
P_2O_5: 40 lbs/A
K_2O: 140 lbs/A

<u>Fall and spring (40 ton/A)</u>
N: 200 lbs/A
P_2O_5: 80 lbs/A
K_2O: 280 lbs/A

Soil test are taken every year from each section of manure application. Fertilizer programs are then established for each manure section and applied accordingly. See the fall 2007 sample used for establishing this experiments fertilizer rates in Table 2 below.

Table 2. Soil test report from Midwest Laboratories for Manure Applications and Fertilizer Rates on Corn (08-507).

Grower: NCRS
Field ID: Manure Plots

Sampled: October 31, 2007
Analyzed: November 5, 2007

										NEUTRAL AMMONIUM ACETATE (EXCHANGEABLE)															
SAMPLE ID	LAB #	ORGANIC MATTER WALKLEY BLACK		PHOSPHORUS						POTASSIUM		MAGNESIUM		CALCIUM		SODIUM		pH		CATION EXCHANGE CAPACITY	PERCENT BASE SATURATION (COMPUTED)				
				P_1 (WEAK BRAY) 1:07		P_2 (STRONG BRAY) 1:07		BICARBONATE P OLSEN		K		Mg		Ca		Na		SOIL	BUFFER						
		%	RATE	ppm	RATE	ppm	RATE	ppm	RATE	ppm	RATE	ppm	RATE	ppm	RATE	ppm	RATE	pH 1:01	INDEX	C.E.C. meq/100g	% K	% Mg	% Ca	% H	% Na
Fall Only	7940528	2	L	61	VH	76	VH	28	VH	131	H	244	VH	1368	H	29		7.1		9.3	3.6	21.9	73.1		1.4
Fall and Spring	7940529	2.7	M	72	VH	100	VH	34	VH	297	VH	223	VH	1203	H	25		7.4		8.7	8.8	21.4	68.6		1.2
No Manure - East	7940530	1.9	L	39	VH	66	VH			85	L	190	VH	1201	H	29		6.8		7.9	2.8	20	75.6		1.6
No Manure - West	7940531	2.3	L	49	VH	67	VH			48	VL	149	VH	992	H	30		6.5	7	7	1.8	17.7	70.9	7.7	1.9

													DTPA Extraction											
Sample ID	NITRATE-N (FIA)										SULFUR S (ICAP)		ZINC Zn		MANGANESE Mn		IRON Fe		COPPER Cu		BORON B		EXCESS LIME RATE	SOLUBLE SALTS 1:01
	Surface			Sub 1			Sub 2			Total lbs/A														
	ppm	lbs/A	depth IN	ppm	lbs/A	depth IN	ppm	lbs/A	depth IN		ppm	lbs/A	ppm	lbs/A	ppm	lbs/A	ppm	lbs/A	ppm	lbs/A	ppm	lbs/A		mmhos/c	RATE
Fall Only	5	12	0-8							12	13	M	1	L	12	M	20	H	0.3	VL	0.7	L	L	0.1	L
Fall and Spring	15	36	0-8							36	20	H	1.2	M	12	M	16	M	0.4	L	0.7	L	L	0.3	L
No Manure - East	10	24	0-8							24	16	M	1	L	12	M	21	H	0.4	L	0.6	L	L	0.2	L
No Manure - West	6	14	0-8							14	12	L	0.9	L	11	M	21	H	0.3	VL	0.6	L	L	0.1	L

As shown in the soil test on Table 2 above, there have been some significant changes in soil test levels from the previous 10 years of manure applications.

Phosphorus (P1, weak bray):
Although the levels in the no manure sections are high, 39-49 ppm, there has been in increase to even higher levels of 61 ppm in fall only (20 ton/A) manure and 72 ppm in the spring and fall (40 ton/A) manure sections. All four of these sections are high enough in phosphorus that the soil test recommends no additional phosphorus applications.

Potassium:
The greatest change in soil test values seen over the previous 10 years has been in the potassium levels. In general the North Central Research Station is low to very low in potassium. The 2007 soil test shows that the no manure (west) section has the lowest potassium levels of 48 ppm with 1.8% K base saturation. The other no manure section (east) is also low with 85 ppm and 2.8% K base saturation. A huge increase in the potassium level with the fall only manure application has been attained, increasing levels to 131 ppm which is considered high and base saturation of potassium of 3.6%. Increasing the potassium levels even further, as expected, is the fall and spring manure applications (40 ton/A). Very high levels of 297 ppm with 8.8% K base saturation were found. It is easy to see why these levels have increased so much if you look back at the Bio-Solids report on *Table 1*, where it shows that 140 pounds of K_2O are applied with every 20 ton/A of manure.

Nitrate Nitrogen:
Surprisingly, little to no difference was seen in nitrate nitrogen rates between the manure applications. This may be due to the samples being taken in the fall (before fall manure applications) when high yielding corn has just been removed. It can be expected that the corn has used most of the nitrogen throughout its growing season.

Organic Matter:
Again surprisingly, the organic matter levels are nearly the same amongst all treatments ranging between 1.9 and 2.7. These levels are no different than other areas of the North Central Research Station (see Soil Test Report in the introduction for more information).

pH:
There has been an increase in soil pH where manure has been applied; this is directly related to the high pH of the manure as seen in *Table 1*. The Bio-Solids report showed a manure pH of 7.8. The no manure sections have a soil pH of 6.5 and 6.8; fall only manure had an increased pH of 7.1 and ever greater the fall and spring manure section has a pH of 7.4.

Calcium:
Although 60 pounds of calcium are being added for every 20 ton of manure applied per acre, no change has been seen in the soil calcium levels, which are naturally high. The no-manure west side is lower; however, the percent base saturation of calcium is similar for all four manure treatments.

Magnesium:
Most of the soils at the North Central Research Station are high in magnesium. Soil test shows there was an increase in the magnesium levels where manure was applied. The no manure sections are between 149 and 190 ppm (17.7-20.0% base sat. Mg) and fall manure only 244 ppm (21.9% base sat. Mg) and fall and spring manure 223 ppm (21.4% base sat. Mg).

Micronutrients:
No changes were seen in any of the soil micronutrient levels.

Fall applied manure is moldboard plowed after application and spring applied manure is disked and field cultivated along with the entire field in preparation for planting.
Base planter fertilizer recommendations were made for each manure section based on the above soil test (*Table 2*). According to the soil test, the high phosphorus levels do not require additional phosphorus fertilizer applications. However, years of research has shown that low rates of phosphorus close to the seed in cold soils increase plant growth and gives it a quicker stronger start and ultimately, a better yield. Therefore, it is a standard recommendation to always apply 3 gal/A Pro-Germinator at planting with a yield goal over 150 bu/A (2 gal/A if less than 150 bu/A yield goal). This experiment was irrigated corn with a yield goal of 200 bu/A. The research planter has the ability to dual place fertilizer at planting. With separate tanks and pumps fertilizer can be placed both in-furrow and 2x2 at the same time. Planter treatments, based on Midwest Laboratories recommendations were as followed:

Planter applied treatments for each manure section.

Fall Manure (20 ton/A):
3 gal Pro-Germinator + 8 gal Sure-K + 2.5 qt Micro 500 + 1 qt Boron (In-furrow)
15 gal/A 28% + eNhance (2 x 2)

Fall and Spring Manure (40 tons/A):
3 gal Pro-Germinator + 2.5 qt Micro 500 + 1 pt Boron (In-furrow)
15 gal/A 28% + eNhance (2 x 2)

No Manure (east):
3 gal Pro-Germinator + 7 gal Sure-K + 2.5 qt Micro 500 + 1 qt Boron (In-furrow)
3 gal Sure-K + 15 gal/A 28% + eNhance (2 x 2)
Note: *moved 3 gal of Sure-K to the 2 x 2 placement to keep in-furrow application under 10 gal/A as recommend by ACLF. This was tested against the no manure west section that had the entire rate of Sure-K applied in-furrow totaling 15 gal/A.*

No Manure (west):
3 gal Pro-Germinator + 12 gal Sure-K + 2.5 qt Micro 500 + 1 qt Boron (In-furrow)
15 gal/A 28% + eNhance (2 x 2)

Nitrogen applications were also established based off of the above soil test (*Table 2*) with a corn yield goal of 200 bu/A. Three different nitrogen products were used in this experiment. First is eNhance, a nutritional supplement that combines proprietary chemistry with a proper balance of micronutrients and nitrogen stabilizers to produce better nitrogen response. It does this by amending the urea and ammonium portions of the UAN solutions reducing volatility and denitrification; causing the nitrogen to be available as the plant needs it. When mixed with 28% UAN, 2 gal of eNhance is added per ton of 28% and applied at 80% of the standard nitrogen rate. Next is an experimental product HN-07. Agro-Culture Liquid Fertilizers is always developing and testing new products to add to our current line. This product is added to conventional nitrogen solutions at 20 gal per ton and used on soils with a pH above 7.0. Containing 20% sulfur and trace amounts of other nutrients; this product helps increase the uptake and usability of the nitrogen in the plant. Recommended rate is 20% of conventional nitrogen rate. The last nitrogen source is 28% UAN, a conventionally used nitrogen source. Keep in mind 15 gal/A (56 lbs/A equivalent nitrogen) was applied 2 x 2 at planting in each treatment. Sidedress nitrogen treatments and rates are listed below:

Nitrogen application for each manure section.

***Note:* Total lbs nitrogen/A is on an "equivalent" basis based upon Agro-Culture Liquid Fertilizers higher usability.**

Fall Manure (20 ton/A): 230 lbs nitrogen/A *(56 lb*s 2x2 + 174 lbs sidedress)*
47 gal/A 28% + eNhance *(141 lbs actual N/A)*
59 gal/A 28% *(177 lbs actual N/A)*
47 gal/A 28% + HN-07*(141 lbs actual N/A)*

Fall and Spring Manure (40 ton/A): 200 lbs nitrogen/A (*56 lbs* 2x2 + 144 lbs sidedress)*
38 gal/A 28% + eNhance *(114 lbs actual N/A)*
38 gal/A 28% HN-07*(114 lbs actual N/A)*

No Manure (east): 215 lbs nitrogen/A *(56 lbs* 2x2 + 159 lbs sidedress)*
42 gal 28% + eNhance*(126 lbs actual N/A)*
52 gal 28%*(156 lbs actual N/A)*
42 gal 28% + HN-07*(126 lbs actual N/A)*

No Manure (west): 225 lbs nitrogen/A *(56 lbs* 2x2 + 169 lbs sidedress)*
45 gal 28% + eNhance *(135 lbs actual N/A)*
56 gal 28% *(168 lbs actual N/A)*
45 gal 28% + HN-07 (135 lbs actual N/A)

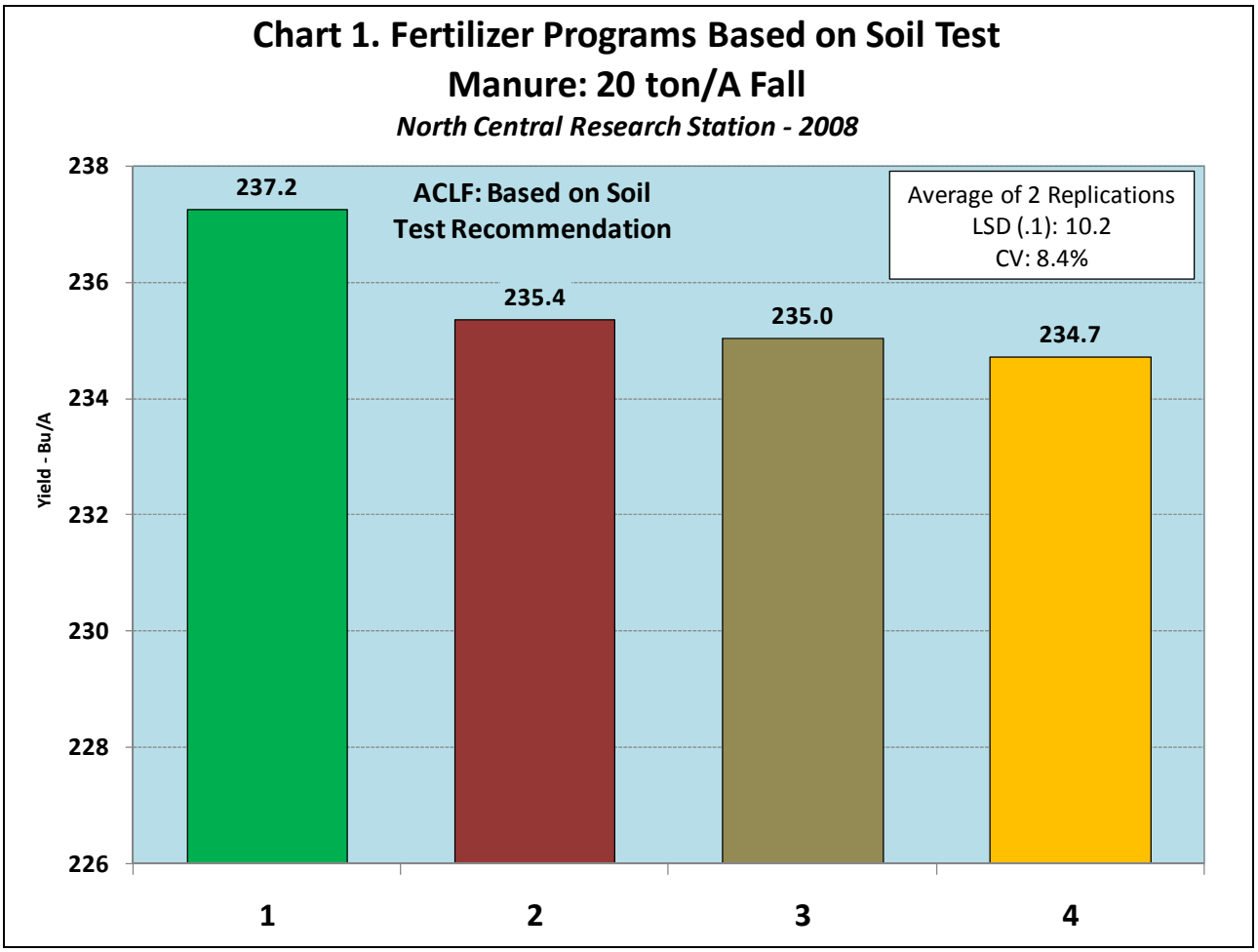
15 gal/A 28% + eNhance applied 2x2 provided 56 equivalent lbs N/A and 45 lbs actual N/A

Yield Results appear on the charts 1-4 below.

Treatments (Chart 1): Fall Manure (20 ton/A)

Trt. #	Planter: In-furrow	Planter: 2 x 2	Sidedress
1.	8 gal SK + 2.5 qt Micro-500 + 1 pt B	15 gal 28% + eNhance	47 gal 28% + eNhance
2.	3 gal PG + 8 gal SK + 2.5 qt M500 + 1 pt B	15 gal 28% + eNhance	47 gal 28% + eNhance
3.	3 gal PG + 8 gal SK + 2.5 qt M500 + 1 pt B	15 gal 28% + eNhance	59 gal 28% UAN
4.	3 gal PG + 8 gal SK + 2.5 qt M500 + 1 pt B	15 gal 28% + eNhance	47 gal 28% + HN-07

**** rates per acre***



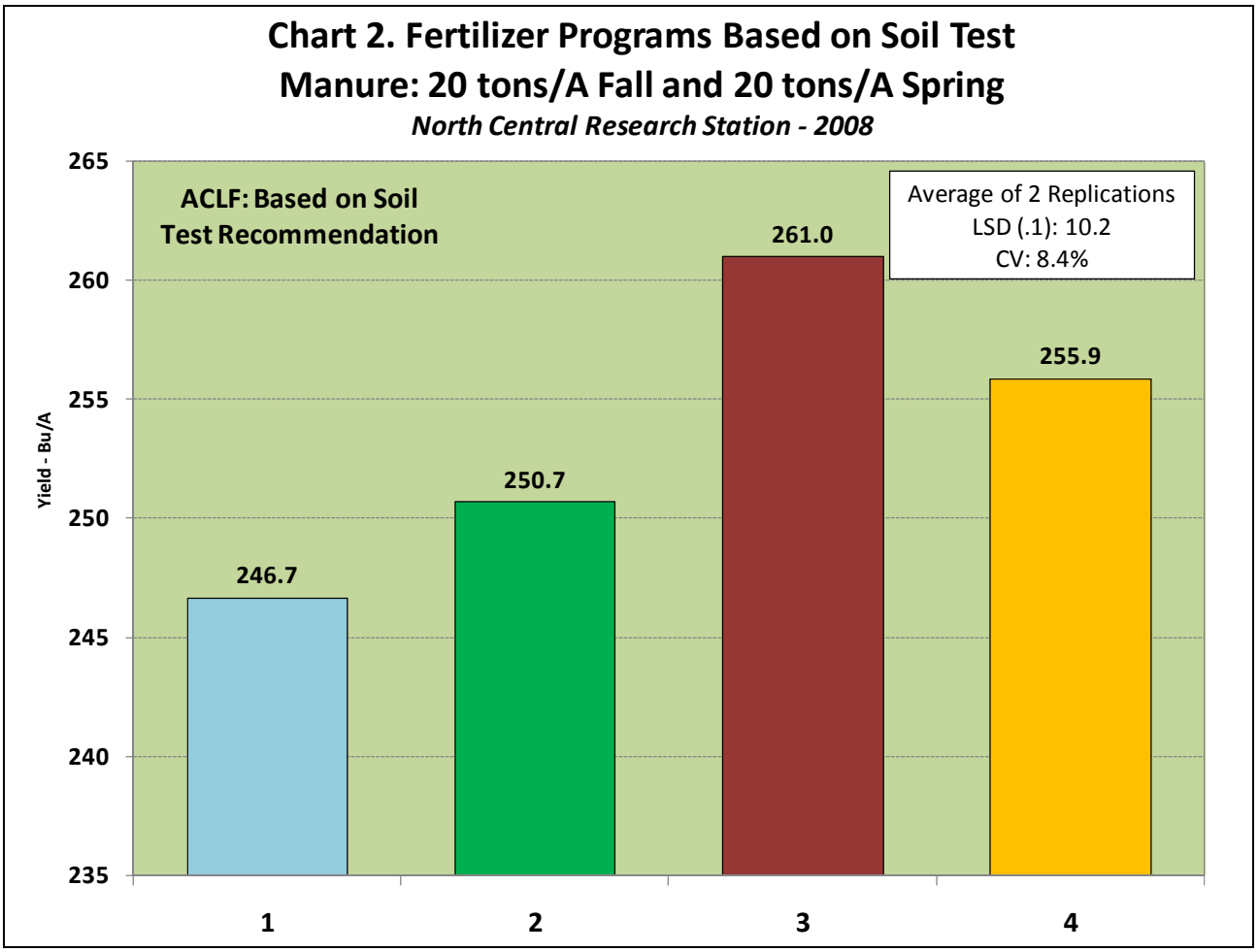
Results - Fall Only Manure (20 ton/A):

- No yield increase was seen with the addition of 3 gal/A Pro-Germinator.
- No significant difference was seen between the three nitrogen sources, numerically 28% + eNhance was the highest with 235.4 bu/A.
- Use of the nitrogen additives eNhance or HN-07 applied 12 gal of nitrogen less per acre, yet still produced equal yields.
- Average stand count for this total section: 34,936 plants per acre.

Treatments (Chart 2): Fall and Spring Manure (40 ton/A)

Trt. #	Planter: In-furrow	Planter: 2 x 2	Sidedress
1.		15 gal 28% + eNhance	32 gal 28% + eNhance
2.	2.5 qt M500 + 1 pt B + 15 gal 28% + eNhance		32 gal 28% + eNhance
3.	3 gal PG + 2.5 qt M500 + 1 pt B	15 gal 28% + eNhance	32 gal 28% + eNhance
4.	3 gal PG + 2.5 qt M500 + 1 pt B	15 gal 28% + eNhance	32 gal 28% + HN-07

** rates per acre*



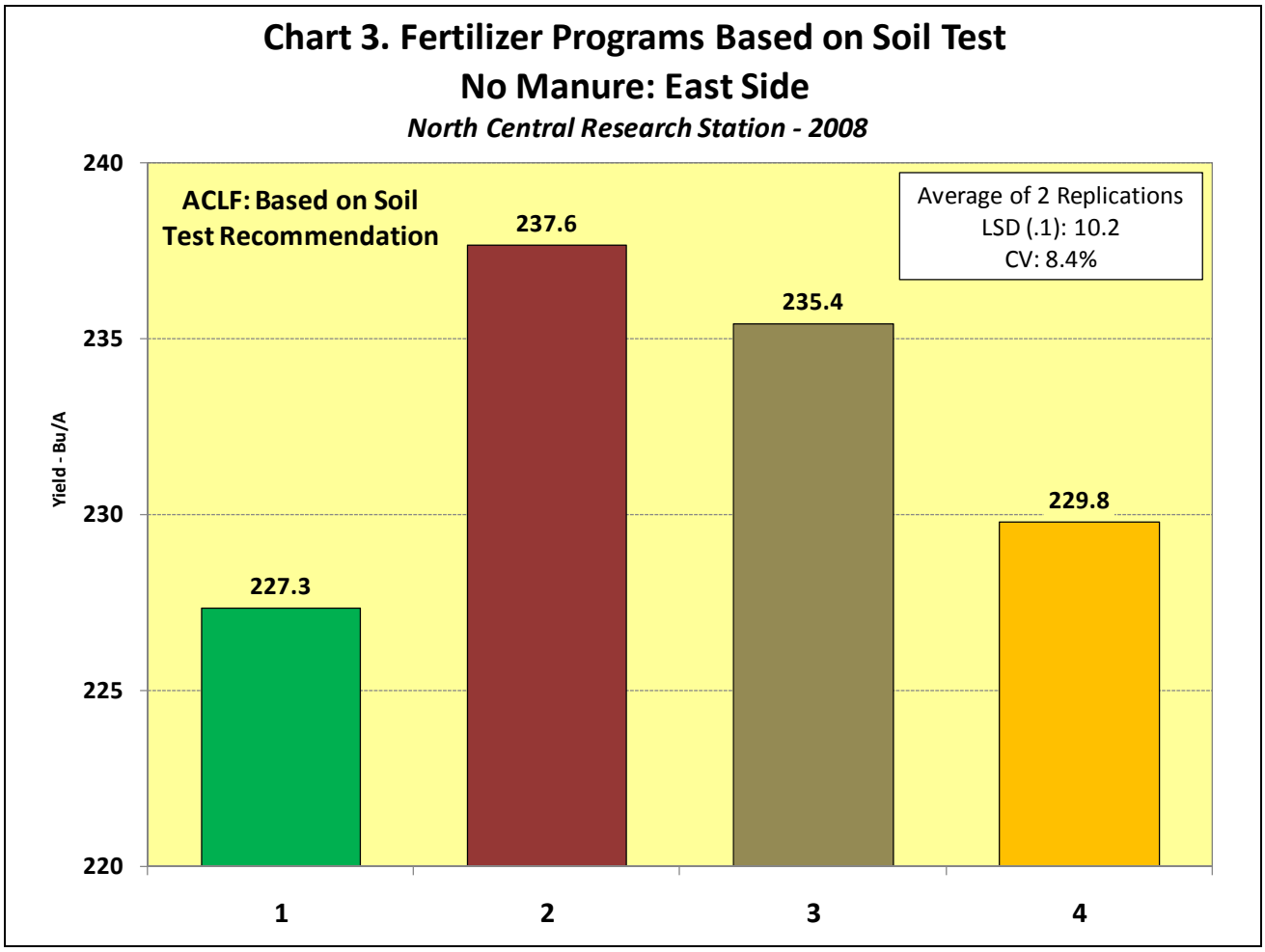
Results - Fall and Spring Manure (40 ton/A):

- With the high fertility levels from 10 years of manure applications, no additional phosphorus and potassium were recommended. The first bar shows nitrogen only applications, which yielded 4 bu/A lower than the addition of micronutrients.
- Over a 10 bu/A yield increase was achieved with the addition of 3 gal/A Pro-Germinator.
- Two nitrogen sources were compared in the manure section, 28% + eNhance yielded over 5 bu/A higher than the 28% with the experimental additive HN-07.
- Average stand count for this total section: 33,572 plants per acre.

Treatments (Chart 3): No Manure (east)

Trt. #	Planter: In-furrow	Planter: 2 x 2	Sidedress
1.	7 gal SK + 2.5 qt Micro-500 + 1 pt B	3 gal SK + 15 gal 28% + eN	42 gal 28% + eNhance
2.	3 gal PG + 7 gal SK + 2.5 qt M500 + 1 pt B	3 gal SK + 15 gal 28% + eN	42 gal 28% + eNhance
3.	3 gal PG + 7 gal SK + 2.5 qt M500 + 1 pt B	3 gal SK + 15 gal 28% + eN	52 gal 28% UAN
4.	3 gal PG + 7 gal SK + 2.5 qt M500 + 1 pt B	3 gal SK + 15 gal 28% + eN	42 gal 28% + HN-07

** rates per acre*

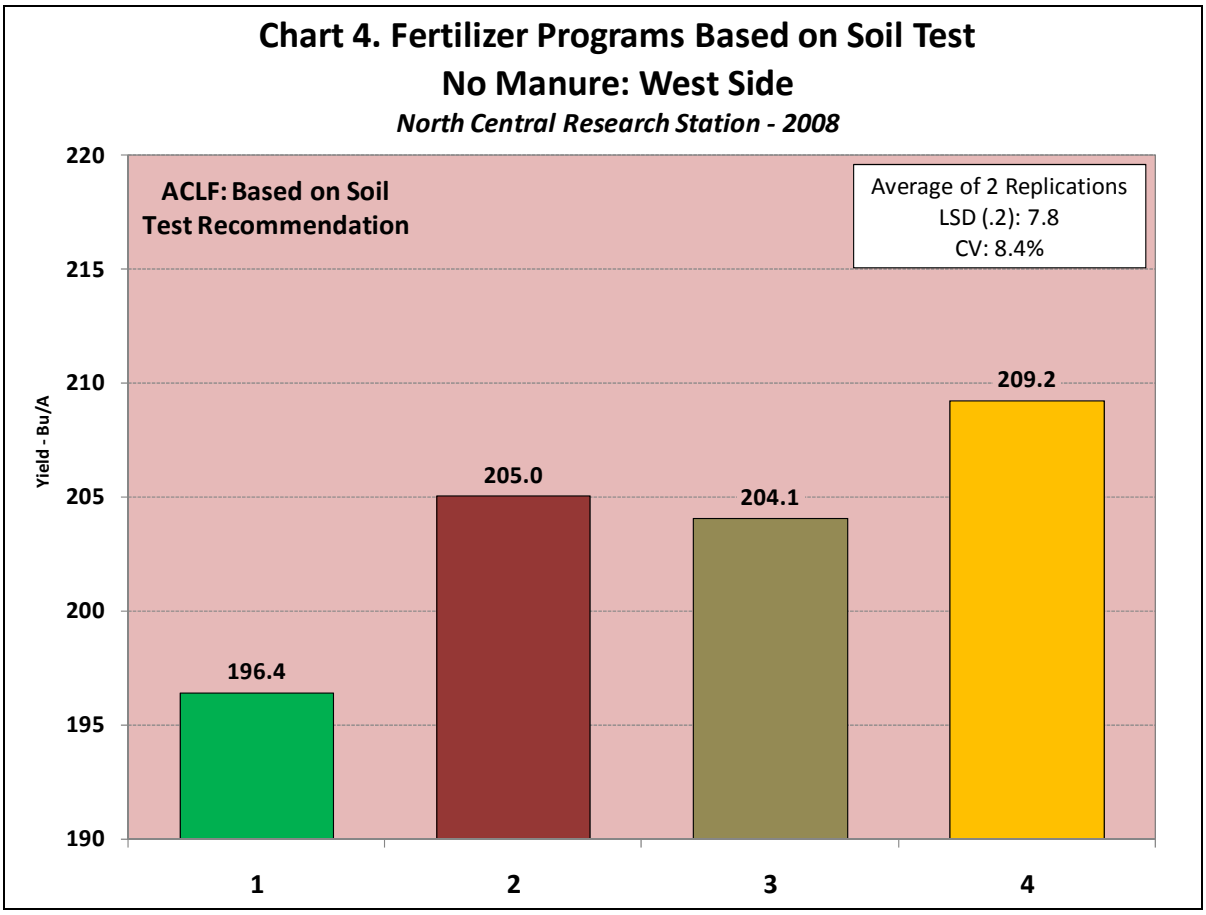


Results – No Manure (east):

- Addition of Pro-Germinator applied in-furrow resulted in over a 10 bu/A yield increase.
- There was no statistical difference between the three nitrogen sources used. However, 28% + eNhance yielded the highest with 237.6 bu/A.
- The addition of eNhance to 28% increased yield by 2 bu/A with 10 less gallon per acre than the full rate of 28% UAN alone.
- Traditionally the no manure (east) section out yields the no manure (west) section, as shown this year.
- Average stand count for this total section: 33,352 plants per acre.

Treatments (Chart 4): No Manure (west)

Trt. #	Planter: In-furrow	Planter: 2 x 2	Sidedress
1.	12 gal SK + 2.5 qt Micro-500 + 1 pt B	15 gal 28% + eNhance	45 gal 28% + eNhance
2.	3 gal PG + 12 gal SK + 2.5 qt M500 + 1 pt B	15 gal 28% + eNhance	45 gal 28% + eNhance
3.	3 gal PG + 12 gal SK + 2.5 qt M500 + 1 pt B	15 gal 28% + eNhance	56 gal 28% UAN
4.	3 gal PG + 12 gal SK + 2.5 qt M500 + 1 pt B	15 gal 28% + eNhance	45 gal 28% + HN-07



Results - No Manure (west):

- Over an 8 bu/A yield increase was achieved with the addition of 3 gal/A Pro-Germinator in the high phosphorus soils (205 bu/A vs. 196.4 bu/A).
- No significant difference was seen within the three different nitrogen sources; numerically the experimental additive HN-07 with 28% yielded the highest.
- Traditionally the no manure (east) section out yields the no manure (west) section, and shown this year.
- Average stand count for this total section: 34,584 plants per acre.
- Although this no manure (west) section yielded lower than the no manure (east) section, it was not due to fertilizer injury. This section did have the higher rate of fertilizer applied in-furrow (15 gal/A). But as seen with the stand counts fertilizer did not cause injury to the stand.
- However, it is still recommended not to applied over 10 gal/A in-furrow

The next table (*Table 3*) summarizes the advantages of using low rates of Pro-Germinator, in this case 3 gal/A, in high phosphorus soils. For each manure section, all other fertilizer rates including Sure-K, Micro 500, Boron, and nitrogen were the same.

Table 3. Advantages of Pro-Germinator in High-Phosphorus Soils

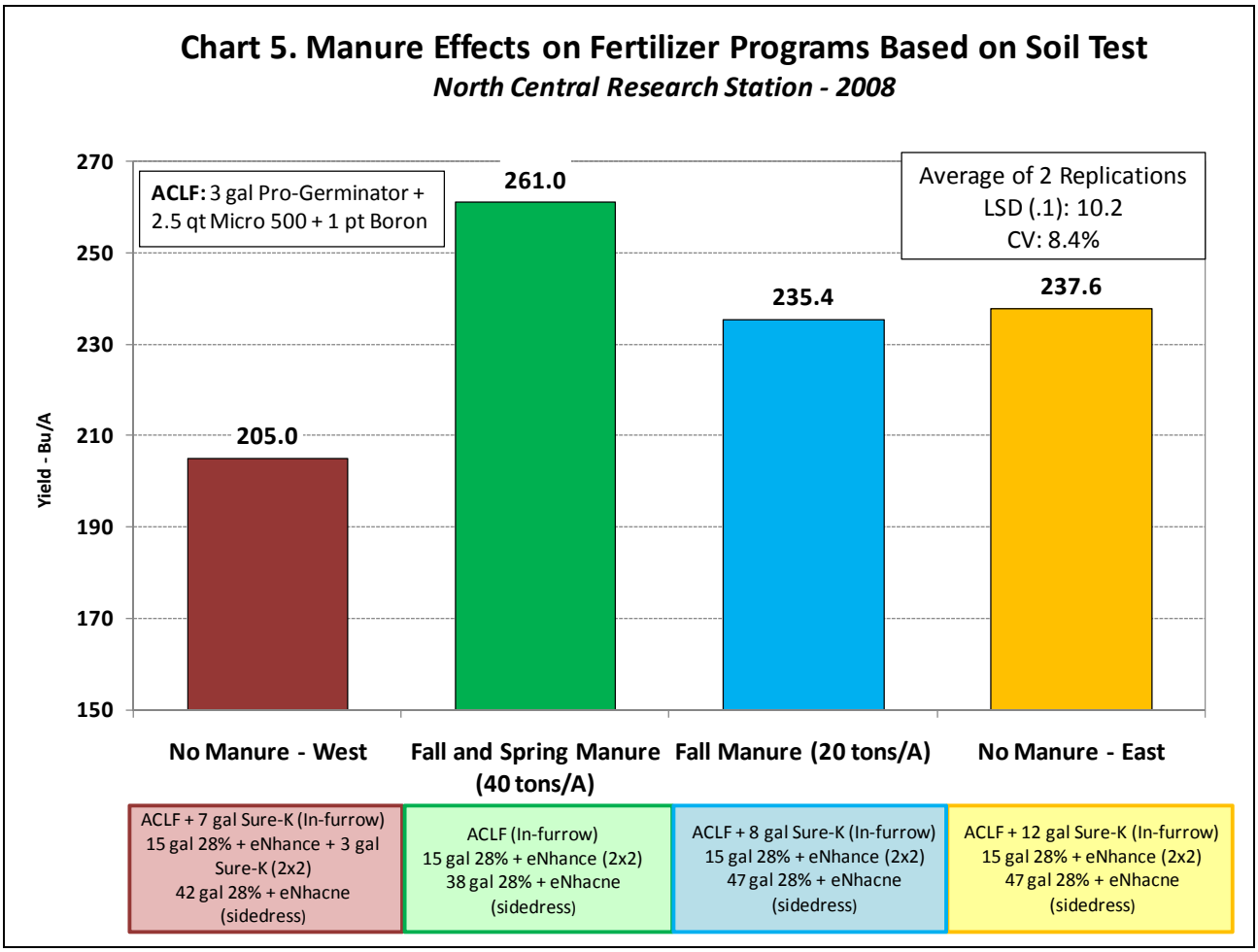
Manure Applied	No Pro-Germ.	3 gal/A Pro-Germ.	Yield Differences
	---------- bu/A ----------		
Fall Only	237.2	235.4	-1.8
Spring and Fall	250.7	261.0	+10.3
No Manure - East	227.3	237.6	+10.3
No Manure - West	196.4	205.0	+8.6
Average Amongst Manure Applications:			***+6.9***

* Treatments received the same rates of Sure-K, micronutrients and nitrogen for each manure application

Results:

- In all manure sections but one, there was a strong response to the addition of 3 gal/A Pro-Germinator at planting.
- It is unclear why the Fall Only manure section did not see a response to Pro-Germinator at planting as the other manure sections did. Looking back to *Chart 1*, all four treatments yielded nearly the same within this manure section.
- When averaged over the four different manure applications, nearly a 7 bu/A yield increase was achieved with the addition of Pro-Germinator.

The above charts and data give a lot of information. In conclusion, the best recommendation if any animal manure is being applied is to keep up on soil testing as levels can change dramatically from year to year. Use the current soil test to make fertilizer recommendations and follow them. Keep in mind that in cooler soils, the addition of Pro-Germinator is still beneficial even if the soil levels are high. Chart 5 summarizes the four manure sections each with the fertilizer program based on the current soil test listed above *(Table 2).*



- *ACLF: 3 gal/A Pro-Germinator + 2.5 qt/A Micro 500 + 1 pt/A Boron*

Summary:

The use of animal manures can greatly benefit a cropping system along with saving money on fertilizer expenses. It is very important however, to know nutrient levels in the manure so proper rates can be applied. It is also critical to monitor changes in the soil levels so the correct rates and sources of fertilizer can be applied.
These experiment was designed with a yield goal of 200 bu/A, but actually got well over that. Maybe in 2009 just focusing on nitrogen rates to match yield goal will be tested. Who knows maybe 300 bu/A corn is achievable.