

Edible Beans



- Navy Bean Fertilizer Programs (2003)
- Black Bean Fertility Programs (2006)
- Black Bean Fertility Programs (2007)
- Advantages of Complete Fertilizer Programs in Black Beans (2007)
- Fertilizer Programs for Black Beans (2008)
- Navy Bean Fertility Programs (2009)

Experiment: Navy Bean Fertilizer Program

Year: 2003 (03-23)

Date of Planting/Harvest: June 16 / October 6

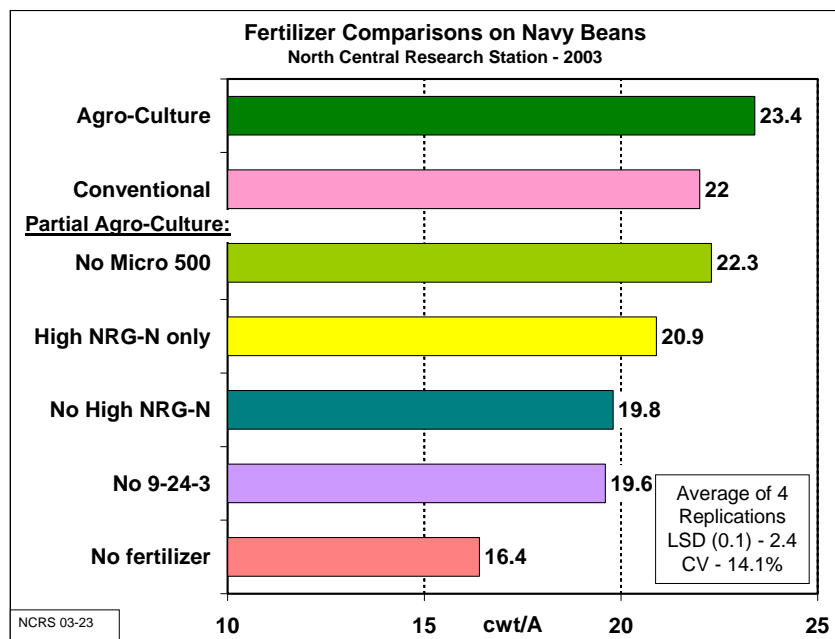
Plot Size: 10' x 100'

Soil Test Levels (ppm)

pH ~ 6.8 P1 ~ 52

CEC ~ 9.6 K ~ 64

OM ~ 2.5% (1.7% K)



Agro-Culture

10 gal/A High NRG-N
(preplant)
4 gal/A 9-24-3
9 gal/A Sure-K
1 qt/A Micro 500
(planter)

Conventional

16 gal/A 28% UAN
200 lbs/A 0-0-60
(preplant)
10 gal/A 10-34-0 w/Zn
(planter)

- Navy bean seed is extremely sensitive, all fertilizer applications are made 1 inch to the side of the seed.
- All fertilizer applications increased the yield over the untreated check.
- The complete Agro-Culture Liquid Fertilizers program produced the highest yield. (1.4 cwt/A higher than the conventional program and 7 ton/A higher than the untreated check.)
- Highest yield potential was not reached with removal of any of the individual nutrients. This shows why it is important to have a soil test and know what your soil needs to produce the highest possible yield. Limiting any of the required nutrients greatly decrease the crops yield potential.

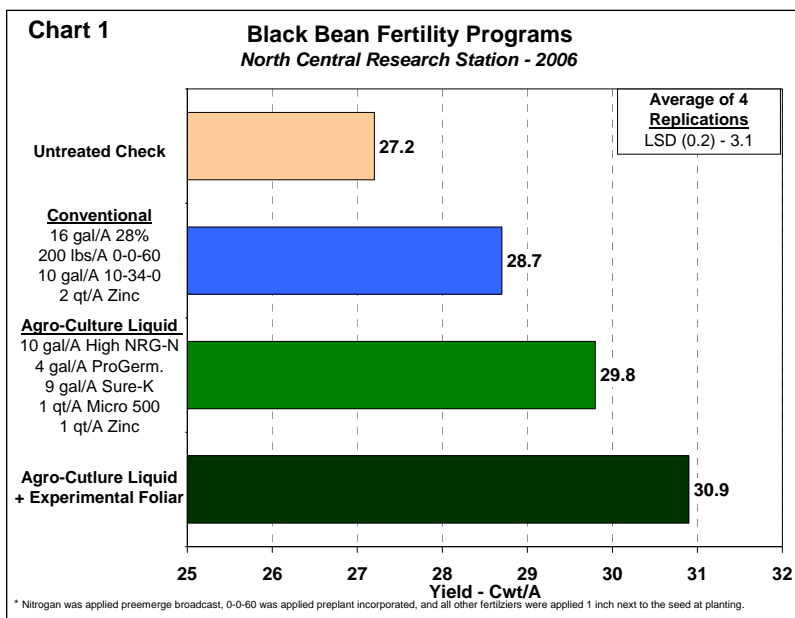
Experiment: Black Bean Fertility Programs
Year (Experiment Number): 2006 (06-516)
Date of Planting/Harvest: 6-6-06 / 9-21-06
Variety: Jaguar
Plot Size (replications): 15 ft x 50 ft (4 reps)

<u>Soil Test Levels (ppm)</u>	
pH: 6.9	C.E.C.: 13
OM: 2.7%	P1: 30 ppm
K: 101 ppm (2.0% BS)	

Objective: Determine effects of reduced inputs from Agro-Culture Liquid Fertilizers on black bean yields compared to conventional fertilizer.

The 2006 black bean experiment evaluated complete fertilizer programs using 28% UAN, potash, and 10-34-0 as a conventional program and compared that to an equal Agro-Culture Liquid Fertilizers program. The Agro-Culture Liquid Fertilizers program consisted of High NRG-N, Pro-Germinator, Sure-K, Micro 500, and Zinc. Both programs were compared to a no fertilizer check treatment. The nitrogen application for both programs was applied broadcast after planting. Liquid fertilizers were applied in a band 1 inch to the side of the seed. Dry potash in the conventional program was broadcast and incorporated before planting.

An additional foliar treatment was also added to this experiment to see if there was any benefit to additional fertilizer later in the growing season. An experimental fertilizer source was applied in mid July when the beans were at the 3rd trifoliolate stage. This application was made in addition to the Agro-Culture Liquid Fertilizers program listed above. Yield results for all treatments are shown on chart 1.



Conclusion:

- All fertilizer treatments increased black bean yields over the untreated check.
- The Agro-Culture Liquid Fertilizers program yielded 1.1 cwt per acre higher than the conventional program.
- The addition of the experimental foliar treatment increased dry bean yields 1.1 cwt per acre over the Agro-Culture Liquid Fertilizers program along and increased yields 3.7 cwt per acre over the untreated check.

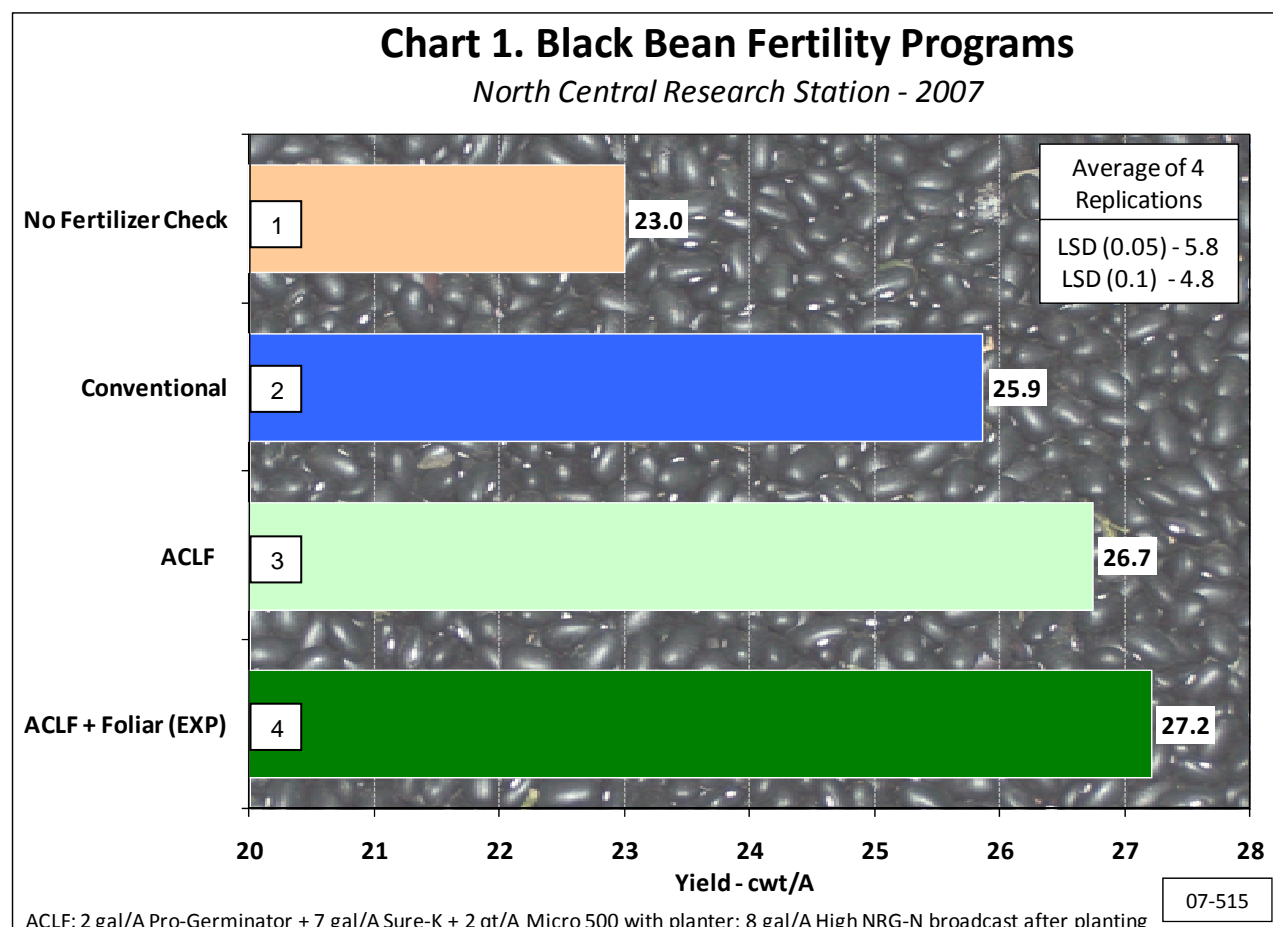
Experiment: Black Bean Fertility Programs
Year (Experiment Number): 2007 (07-515)
Date of Planting/Harvest: 6-13-07 / 10-4-07
Variety: Midnights
Plot Size (replications): 6 rows x 100 ft (4 reps)

Soil Test Levels (ppm)	
pH: 6.8	C.E.C.: 9.6
OM: 2.5%	P1: 52
K: 64 ppm (1.7% K)	

Dry edible beans are grown in 19 states across the United States, primarily in the western half and northern part of the country. In the US over 1 million metric tons of dry beans are produced annually. More specifically, over 75,000 metric tons of black beans are grown in the US, with Michigan being the lead producer, followed by North Dakota and Colorado.

In 2007 the North Central Research Station, evaluated different fertilizer programs for effect on yield of edible black beans. The standard Agro-Culture Liquid Fertilizers (ACLF) program consisted of 2 gal Pro-Germinator + 7 gal Sure-K + 2 qt Micro 500 applied in a 2 x 2 band at planting. A broadcast application of 8 gal of High NRG-N was applied to the surface immediately after planting. An equal conventional program of 150 lb potash broadcast and incorporated, 7 gal of 10-34-0 at planting, and 13 gal of 28% broadcasted after planting was also applied. Yield results appear on the chart 1 below.

Agro-Culture Liquid Fertilizers continues to develop and test new products to prosper the farmer. The black bean experiment also evaluated an experimental foliar fertilizer applied pre-bloom in addition to the standard ACLF program.



Conclusion:

- All Fertilizer treatments increased yield over the untreated Check.
- The ACLF program produced the highest yield at 26.7 cwt/A, 370 pounds higher than the no fertilizer check (23.0 cwt/A) and 80 pounds higher the conventional program (25.9 cwt/A).
- An 18% yield increase was seen with the ACLF program over the untreated check.
- The ACLF program with the addition of the experimental foliar was the highest yielding in this experiment, yielding 27.2 cwt/A, 50 pounds higher than without the foliar application.

Another way of evaluating yield is comparing the yield increase per nutrient applied. This is done by dividing the actual pounds of nutrients applied by the yield increase. In this soybean experiment, highest yield per nutrient applied was seen with the single foliar application, although highest yield was with two foliar applications more nutrients were applied lowering the yield per nutrient applied. Table 1 below shows increases.

**Table 1. Yield Per Pound of Nutrient Applied
07-515 Black Beans**

	Fertilizer Treatment	Pounds of Nutrients Applied	Yield Increase Per Nutrient Applied
1	Check	0	0.0 bu
2	Conventional	163	1.8 bu
3	ACLF	38	9.7 bu
4	ACLF + Foliar	38	11.1 bu

Conclusions:

- The highest increase in yield per nutrient applied was seen with the ACLF + Foliar program (trt 4).
- The conventional program (trt 2) with high rates of dry fertilizers produced the lowest increase per nutrient applied.

Experiment: Advantages of Complete Fertilizer Programs in
Black Beans

Year (Experiment Number): 2007 (07-515)

Date of Planting/Harvest: 6-13-07 / 10-4-07

Variety: Midnights

Plot Size (replications): 6 rows x 100 ft (4 reps)

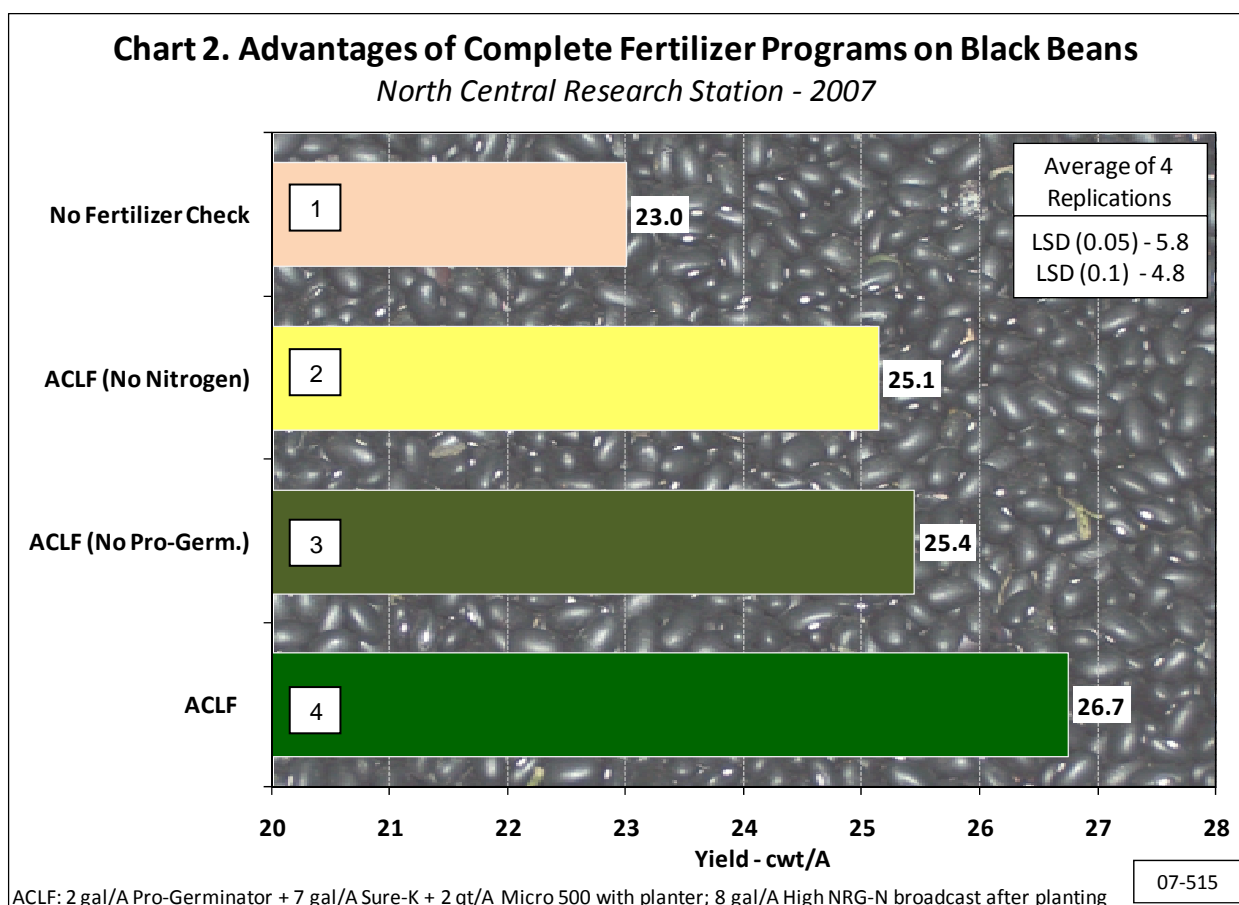
Soil Test Levels (ppm)

pH: 6.8 C.E.C.: 9.6

OM: 2.5% P1: 52

K: 64 ppm (1.7% K)

With the increasing costs of fertilizer inputs, it may be tempting to cut back on nutrients to help increase the bottom line. As shown on other crop in past years at the North Central Research Station, lowering recommended rates or removing nutrients all together can be detrimental on yield. Part of the 2007 black bean experiment was looking at the yield effects of individual nutrients that go into a complete fertility program. The standard Agro-Culture Liquid Fertilizers (ACLF) program consisted of 2 gal Pro-Germinator + 7 gal Sure-K + 2 qt Micro 500 applied in a 2 x 2 band at planting. A broadcast application of 8 gal of High NRG-N was applied to the surface immediately after planting. Because of the high soil phosphorus levels found at the North Central Research Station (52 ppm P1), it may be tempting to remove the Pro-Germinator from the program. Similarly, because edible beans are legumes with the ability to produce nitrogen it may also be considered to skip the broadcast application of High NRG-N. Just as it was shown on other crops, a complete fertility program produced the highest yield of black beans. Yields appear on Chart 2 below.



Conclusions:

- Yield increases were seen with all fertility programs compared to the no fertilizer check.
- Removing High NRG-N from the ACLF program lowered yield 160 pounds/A.
- Eliminating the Pro-Germinator from the ACLF program reduced yields by 130 pounds/A.
- Highest yield was achieved with the complete fertilizer program. Even with the increased cost of fertilizer inputs, it is still more economical to spend the money for the required nutrients and produce high yielding black beans to market.

Another way of evaluating yield is comparing the yield increase per nutrient applied. This is done by dividing the actual pounds of nutrients applied by the yield increase. In this soybean experiment, highest yield per nutrient applied was seen with the single foliar application, although highest yield was with two foliar applications more nutrients were applied lowering the yield per nutrient applied. Table 2 below shows increases.

**Table 2. Yield Per Pound of Nutrient Applied
07-515 Black Beans**

	Fertilizer Treatment	Pounds of Nutrients Applied	Yield Increase Per Nutrient Applied
1	Check	0	0.0 bu
2	ACLF	38	5.5 bu
3	ACLF (No N)	14	17.1 bu
4	ACLF (No P)	30	12.3 bu

Conclusions:

- The highest increase in yield per nutrient applied was seen with the no nitrogen program (trt 3).
- The complete ACLF program (trt 2) produced the lowest increase per nutrient applied.

Experiment: Fertilizer Effects on Navy Bean Yields
Year (Experiment Number): 2007 (07-309)
Date of Planting/Harvest: 6-13-07 / 10-3-07
Variety: Vista
Plot Size (replications): 6 rows x 210 ft / 130 Ft

Soil Test Levels (ppm)	
pH: 7.6	C.E.C.: 8.8
OM: 2.3%	P1: 42 ppm
K: 111 ppm (3.2% BS)	

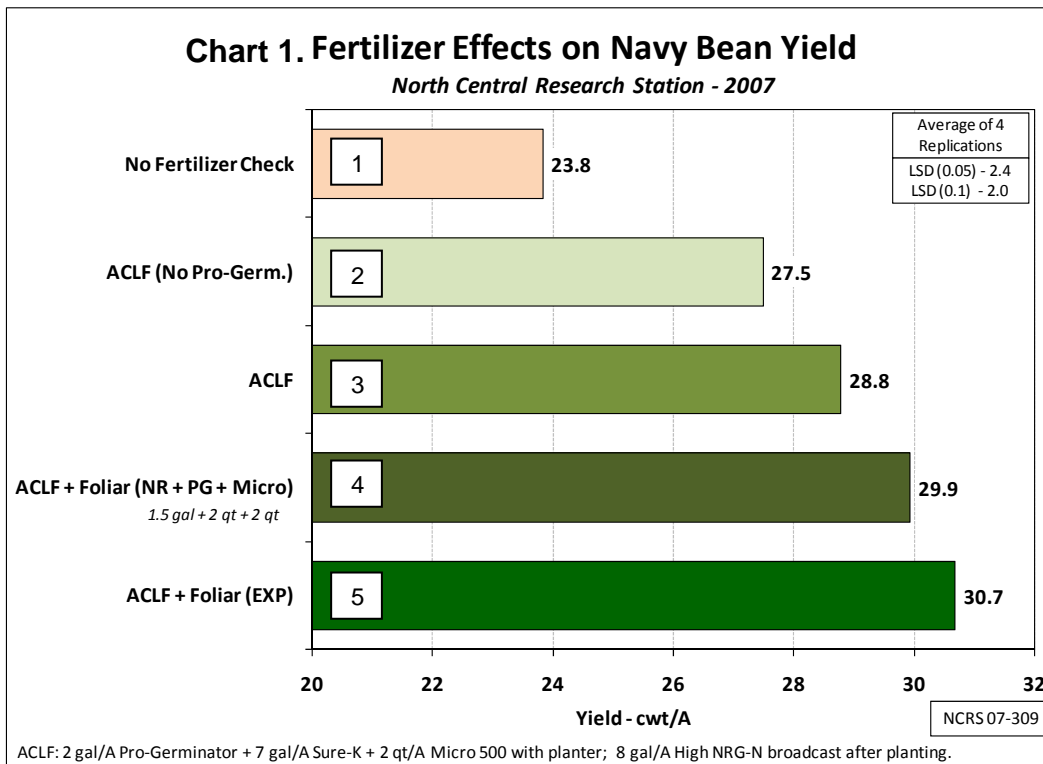
The United States is the sixth leading producer of dry edible beans in the world, behind Brazil, India, China, Burma, and Mexico. Within the United States, North Dakota and Michigan account for nearly half of the total production. (USDA website) Within the US, navy beans are the 2nd most produced edible bean, coming in second to Pinto Beans.

A navy bean experiment was established in 2007 to determine fertilizer effects on crop yield. The standard Agro-Culture Liquid Fertilizers (ACLF) program consisted of 2 gal Pro-Germinator + 7 gal Sure-K + 2 qt Micro 500 applied in a 2 x 2 band at planting. A broadcast application of 8 gal of High NRG-N was applied to the surface immediately after planting. The site of this study had relatively high (P1 - 42 ppm) phosphorus levels. With the high soil levels and the fact that navy beans are planted in June when soil temperatures have warmed up, the addition of phosphorus fertilizer is not usually recommended. Testing this logic, a treatment without Pro-Germinator was evaluated to see if there was yield benefit to phosphorus application in high phosphorus soils.

Work has been done in the past looking at foliar response on navy beans. With their short growing season, there is a small window for foliar applications to be made. It is critical to treat the crop when there is enough plant matter to take in the nutrients, but avoid damaging the plants. Two different foliar treatments were also compared in this experiment. First was a combination of current Agro-Culture Liquid Fertilizers products: 1.5 gal High NRG-NR + 2 qt Pro-Germinator + 2 qt Micro 500. The second foliar treatment was an experimental product which was applied at 3 gal per acre. Both foliar treatments were applied with a Hagie sprayer when the beans were 21 inches tall and just beginning to set vines. Fertilizer was mixed with water and applied at a total spray volume of 10 gal/A at 50 psi. Treatment results appear on the chart below.



Edible Bean plots at the North Central Research Station are direct cut with the new John Deere Combine. Harvest ran smoothly and quickly with the improved equipment. Rainfall in late season combined with mild fall temperatures did cause the dry beans to hold their leaves longer than normal. Although some plants were still green, moisture was 18%.



Conclusions:

- All fertilizer treated plots increased yield over the no fertilizer check.
- Removing the Pro-Germinator from the fertilizer mix reduced navy bean yields 130 pounds per acre compared to the complete Agro-Culture Liquid Fertilizers program. This again proves that even with high phosphorus levels, there is an advantage to the addition of phosphorus fertilizer when placed in a seed zone band.
- The addition of a foliar treatment of High NRG-NR, Pro-Germinator and Micro 500 increased navy bean yield 110 pounds over the complete ACLF program.
- Highest yield was achieved with the standard Agro-Culture Liquid Fertilizers program (30.7 cwt/A) with the addition of an experimental foliar. An increase of 690 pounds over the no fertilizer check and 190 higher than the standard ACLF program. (A 29.9% increase)

Another yield comparison that can be done is looking at the increase in yield over pounds of nutrient applied. See Table 1 below for increase responses. Highest response was seen with the ACLF + Foliar (trt 5).

Table 1. Yield Per Pound of Nutrient Applied
07-309 Navy Beans

Fertilizer Treatment	Pounds of Nutrients Applied	Yield Increase Per Nutrient Applied
1 Check	0	0.0 bu
2 ACLF (No PG)	30	12.3 bu
3 ACLF	38	13.2 bu
4 ACLF + Fol.	38	16.1 bu
5 ACLF + Exp. Fol.	38	18.2 bu

Experiment: Fertilizer Programs for Black Beans
Year (Experiment Number): 2008 (08-517)
Date of Planting/Harvest: June 6 / September 23
Variety: Black Velvet
Plot Size: 15 ft. x 130 ft. (4 reps)

Soil Test Levels (ppm)	
pH: 7.3	C.E.C.: 11
OM: 2.3%	P1: 33 ppm
K: 95 ppm (2.1% BS)	

Objective: Compare fertilizer programs based on soil test for black bean.

Michigan is the largest producers of edible black beans in the United States. Fertilizer programs were set up using a current soil test and the Tri-State formulas for a recommendation of 108-0-114-7 Zn for 25 cwt black bean. When looking at the recommendation, two questions came to mind. First, with the high phosphorus soils, no additional phosphorus is recommended. However, in other crops such as corn, there has been a consistent benefit to small amounts of phosphorus at planting. Edible beans are planted later, when the soils are warmer. However, three different phosphorus sources were evaluated. Second, most edible bean growers are applying some nitrogen, usually around 50 pounds/A for early growth of the beans, therefore 108 pounds as recommended by the Tri-State formula, is much higher than most growers would apply.

Addition of phosphorus fertilizers and program comparison.

Using the recommendation of 108-0-114-7 Zn, two main programs were established for comparison. (Note: these comparisons used the more typical nitrogen application of around 50 lbs/A.)

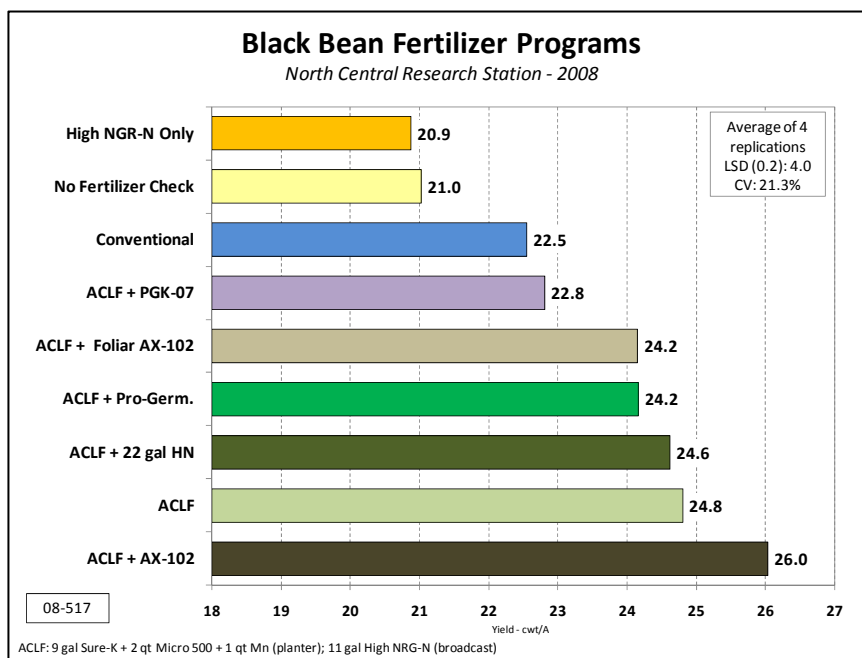
ACLF: 9 gal/A Sure-K + 2 qt Micro 500 + 1 pt/A Mn (2x2); 11 gal/A High NRG-N (broadcast after planting).

Conventional: 189 lbs 0-0-62 (preplant broadcast incorporated); 18 gal 28% UAN (broadcast after planting).

Also part of this comparison was the addition of phosphorus fertilizers to the ACLF treatment.

The addition of 3 gal/A of Pro-Germinator or the experimental PGK-07 and 6 gal/A of the experimental AX-102 were compared to the ACLF program.

In addition there was an untreated check and a nitrogen only application which consisted of 11 gal/A High NRG-N broadcasted after planting. Yields appear in chart 1 above.



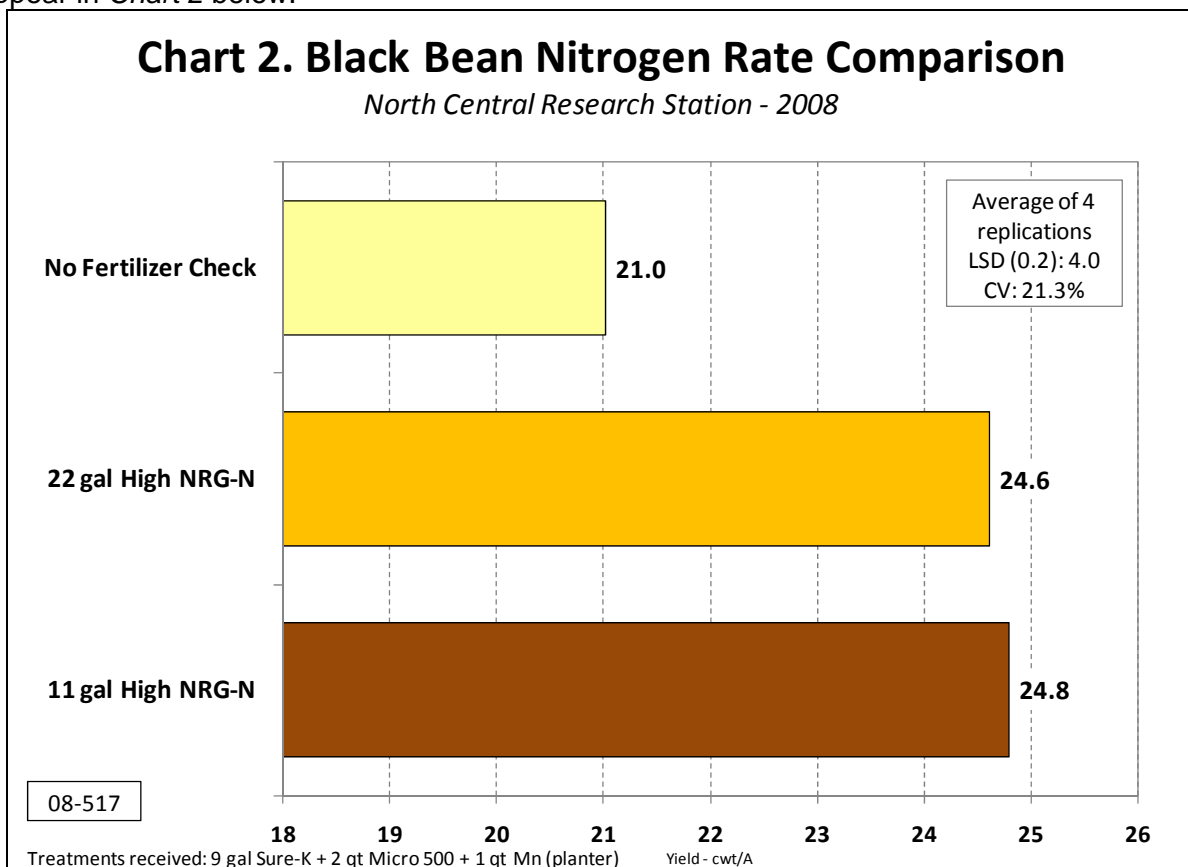
Results:

- No significant difference in yield was seen between the untreated check and the nitrogen only application.
- A yield increase of 150 pounds was seen with the conventional program compared to no fertilizer; however an additional 230 pound yield increase was achieved with the ACLF over the conventional (370 lbs greater than the untreated check).

- The best treatment in the phosphorus comparison was with the AX102, which was also the highest yield overall.
- The addition of 3 gal/A of Pro-Germinator or PGK-07 to the ACLF program did not significantly increase yield above the ACLF program alone. This could be due to the high phosphorus soils (33 ppm P1) and having warm soils to plant into.

Nitrogen rate comparison on black bean yields.

The Tri-State Recommendation Guide recommended 108 pounds of nitrogen to be applied for a yield goal of 2500 pounds of black beans. After researching current growers programs, it was found that most growers are applying between 40 and 60 pounds of nitrogen. For this comparison two nitrogen rates were compared. The first, 22 gal/A High NRG-N (110 equivalent pounds) as recommended and second, 11 gal/A High NRG-N (55 equivalent pounds), which is half the amount of recommended nitrogen and closer to what growers are applying. Results appear in *Chart 2* below.



Results:

- Both nitrogen rates numerically increased yields over the untreated check.
- There was no significant difference between the 22 gal/A and 11 gal/A rate of High NRG-N. This is probably due to the fact that edible beans have the ability to make their own nitrogen and we a healthy growing plant, enough nitrogen was supplied to support growth.
- In the past, applications of High NRG-N to treatments in edible beans resulted in an average yield increases of 2.6 cwt/A.

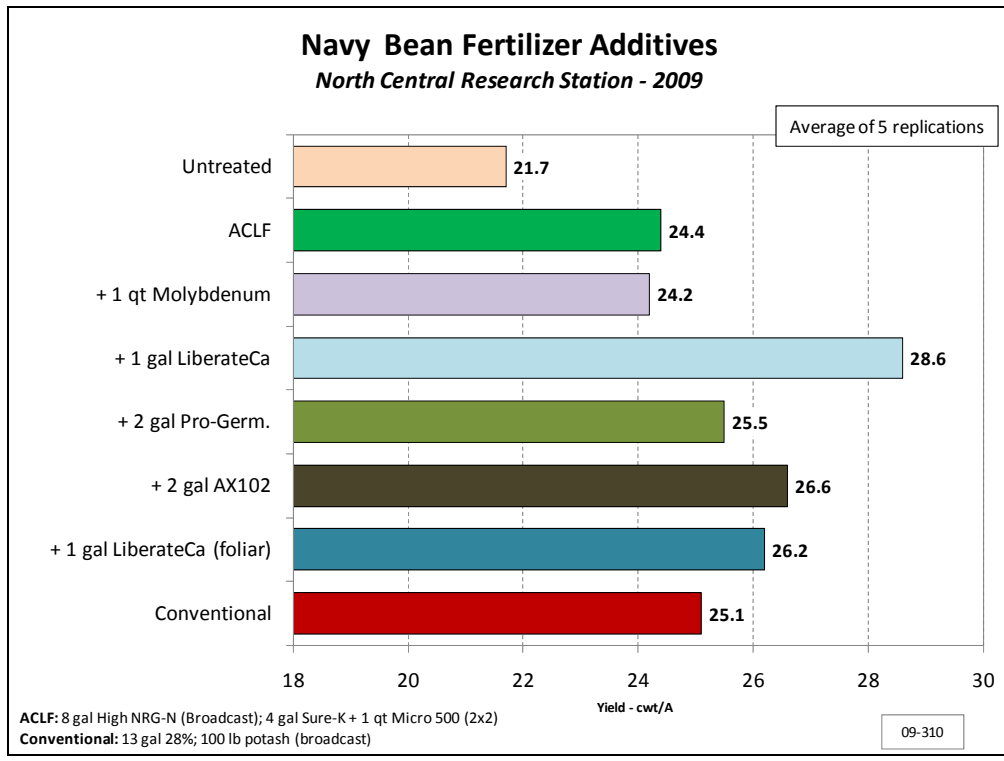


Experiment: Navy Bean Fertility Programs (09-310)

Planted: 6/15/09	Variety: Vista	Population: 140,000
Plot Size: 15 x 210/130	Replications: 5	Harvested: 9/24/09
Broadcast N: 6/16/09	Foliar: 8/5/09	

Soil Test Values (ppm):													
pH	CEC	% OM	Bicarb	K	S	% K	% Mg	% Ca	% H	% Na	Zn	Mn	B
7.5	7.4	1.6	11	103	9	3.6	17.1	78.5	0	0.8	1.1	25	0.5

Objectives: This year's navy bean experiment was evaluating additives to the standard ACLF edible bean program.



Yield Response per pound of nutrient applied.

Yield	Lbs nutrient applied	Yield/lb nutrient applied
ACLF		
24.4	26.5	0.92
Conventional		
25.1	98.6	0.25

LSD (0.1): 2.3 CV: 12.9%

Conclusions:

- All fertility programs increased yield over the untreated check.
- Highest yield response was seen with 1 gal/A of LiberateCa applied at plating.
- LiberateCa (planter and foliar), Pro-Germinator and AX102 all increased yield above the standard ACLF program. Molybdenum did not result in a yield increase.
- There was no significant difference in yield between the standard ACLF program and the conventional program, however, the ACLF program was more efficient with its nutrient resulting in more yield for each pound of nutrition applied.

*See Product Descriptions in the introduction for more information on ACLF products used.