

Corn Response to Phosphorus Starter Fertilizer in North Dakota



Greg Endres

Area Extension Cropping Systems Specialist

Dave Franzen

Extension Soil Science Specialist

Hans Kandel

Extension Agronomist

Mike Ostlie

Research Agronomist

Blaine Schatz

Carrington Research Extension Center Director and Agronomist

The acres of corn planted in North Dakota for grain increased from about 1 million in 2000 to more than 3 million in recent years. With the exception of nitrogen, corn plant nutrition research in North Dakota has been limited until recently. Field trials in North Dakota were initiated in 2007 to evaluate starter fertilizer recommendations derived from other north-central U.S. land-grant universities.

NDSU recommends phosphorus (P) starter fertilizer be placed within 2 inches of the seed in-furrow (also called “pop-up”) or banded away from the seed at planting time (Franzen, 2014). The P starter fertilizer provides the potential to increase early season plant growth by increasing nutrient uptake, and ultimately increase grain yield and test weight, plus decrease grain harvest moisture content.

This publication summarizes results of NDSU P-based starter fertilizer trials conducted in east-central North Dakota that evaluated corn grain yield response, primarily with liquid 10-34-0 applied using different methods and rates.

(Greg Endres, NDSU)

NDSU EXTENSION SERVICE

North Dakota State University, Fargo, North Dakota

May 2017

Materials and Methods

Location and years: NDSU Carrington Research Extension Center; 2007-16

Soil: Heimdal-Emrick and Fram-Wyard loams; 2.6 to 3.8 percent organic matter; 5.9 to 8.2 pH; 3 to 20 parts per million (ppm) P (Olsen test; most sites in the low to medium recommendation ranges, with P levels less than 7 ppm)

Standard treatments: 10-34-0 applied in a 2- by 0-inch band (2 inches horizontally placed from planted seed) with a single-disk coultter or in-furrow with seed (Photo 2). P application rates were based on NDSU corn fertilizer recommendation tables (Franzen, 2014).

Experimental design: Randomized complete block with four replications

General: The dryland trials were conducted using strip- or conventional-tillage systems. Responses did not appear to relate to the tillage system used. Corn row spacing was 22 or 30 inches. Low amounts of nitrogen were included with the starter fertilizer treatments. No additional fertilizer P was applied to supplement P in the starter treatments. Best management practices, including providing adequate levels of plant nutrients besides P, were used for corn production.



Photo 2. Planter set for in-furrow fertilizer placement. (Greg Endres, NDSU)

Results and Discussion

In individual trials (site-years), corn grain yield response did not always occur among fertilizer treatments.

Averaged across eight site-years, band- and in-furrow-applied 10-34-0 increased yield 5 to 7 bushels per acre (4 to 5 percent), compared with the untreated check (Figure 1). Yield between the two starter fertilizer application methods was statistically similar. Yield increased with starter fertilizer, compared with the untreated check, in two of eight of the trials.

Plant stand was similar between band (30,100 plants per acre) and in-furrow (28,800 plants per acre), with 10-34-0 application rates ranging from 2.5 gallons per acre (gpa) up to 6 gpa. Averaged across five site-years with 10-34-0 rates of 5 to 6 gpa, the number of days from corn seed planting to plant emergence was similar among the untreated check, and band and in-furrow application of fertilizer (data not shown).

Also, ear silks emerged slightly earlier (one to two days) with starter fertilizer application, compared with the untreated check. Averaged across 11 site-years, grain harvest moisture was similar and test weight increased slightly with band applications of 10-34-0, compared with the untreated check (Table 1).

Averaged across three site-years, yield tended to increase, although the increases were not statistically

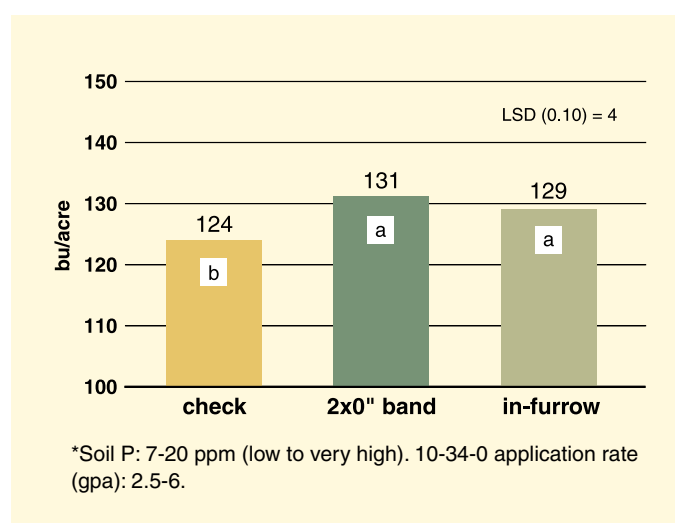


Figure 1. Corn grain yield between band and in-furrow application of 10-34-0, Carrington, 2008-16 (8 site-years).*

Table 1. Corn grain harvest moisture and test weight with 10-34-0 starter fertilizer, Carrington, 2008-16 (11 site-years).*

10-34-0 application method	Grain harvest moisture	Test weight
	%	lb/bushel
Untreated check	20.6	54.6
2- x 0-inch band	20.1	55.0
LSD (0.10)	NS	0.1

*Soil P: 3-20 ppm (very low to very high). 10-34-0 application rate (gpa): 2.5-12.

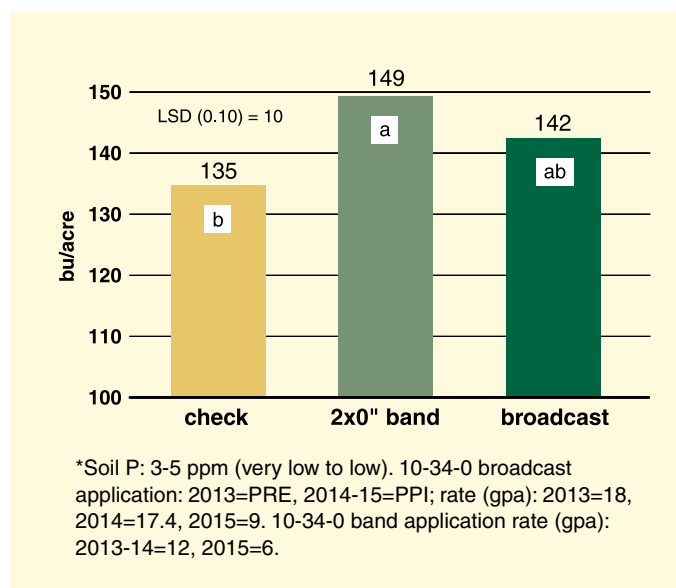


Figure 2. Corn grain yield between 10-34-0 application methods, Carrington, 2013-15 (3 site-years).*

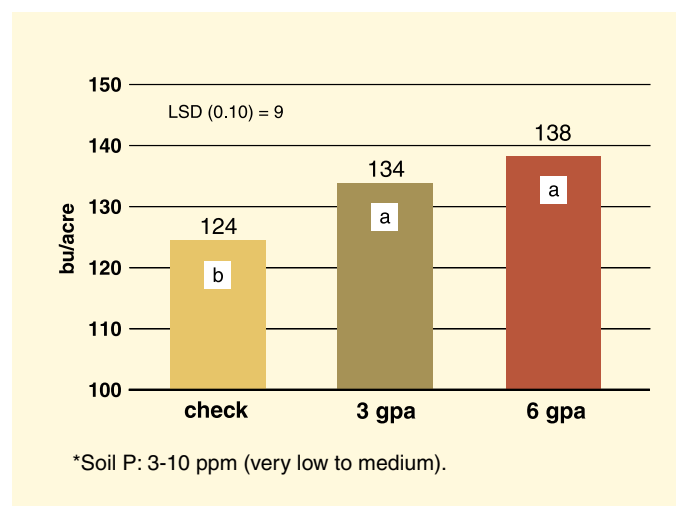


Figure 3. Corn grain yield between rates of in-furrow applied 10-34-0, Carrington, 2007-16 (6 site-years).*

significant, with banded 10-34-0, compared with broadcast application (Figure 2). This supports the recommendation that banded P applications are more efficient in producing yield, compared with broadcast P applications for corn.

The banded fertilizer rate was one-third less (with reduced cost), compared with the broadcast rate in the trials. The broadcast fertilizer was applied immediately after planting without mechanical incorporation in 2013. The broadcast fertilizer was preplant applied and incorporated in 2014-15.

Yield increased with 3 and 6 gpa of in-furrow-applied 10-34-0, compared with the untreated check, averaged across six site-years (Figure 3); however, yield was similar between fertilizer rates.

Averaged across three site-years, yield did not improve with a split application of 10-34-0 using band plus in-furrow placement, compared with similar rates of only band or in-furrow application of fertilizer (Figure 4).

Averaged across three site-years, a yield advantage did not occur with deep-band- or deep-band plus in-furrow-applied 10-34-0, compared with band-applied fertilizer at planting (Table 2). The deep-banded fertilizer was applied at the 5- to 6-inch depth in a 0.75-inch band in October or November 2010 and 2012,

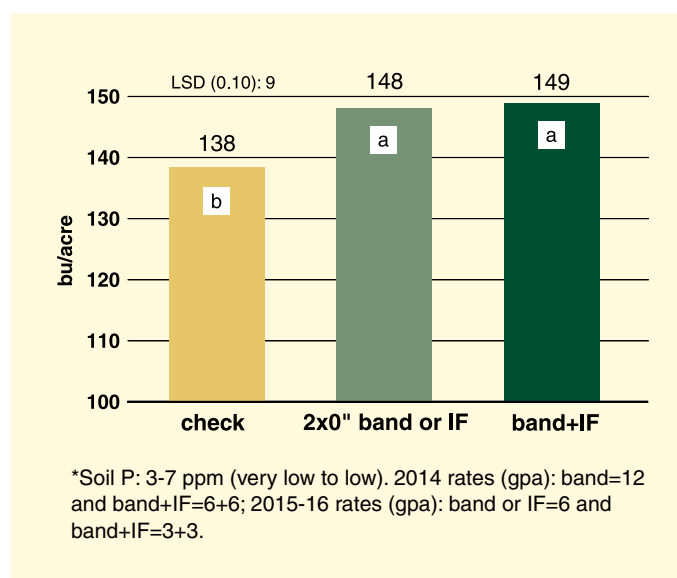


Figure 4. Corn grain yield between 10-34-0 fertilizer application methods, Carrington, 2014-16 (3 site-years).*

and May 2013 using strip tillage. Deep-banded plus in-furrow-applied 10-34-0 rates were one-half of total P for other treatments.

At similar rates of in-furrow-applied P, the three site-year yield average with low-salt fertilizer 6-24-6 was similar to 10-34-0 (Figure 5). Also, plant stands were similar between the two fertilizers. Potassium (K) soil levels in the trials were high to very high.

Table 2. Corn grain yield with deep-band (5-6 inches deep) applied 10-34-0, Carrington, 2010 and 2012-13 (3 site-years).*

10-34-0 application	Grain yield bu/acre
Untreated check	170
Deep band	172
Deep band followed by in-furrow	171
2- x 0-inch band	176
LSD (0.10)	NS

*Soil P: 5-10 ppm (low to medium). 10-34-0 total application rate (gpa): 2010=6, 2012-13=12.

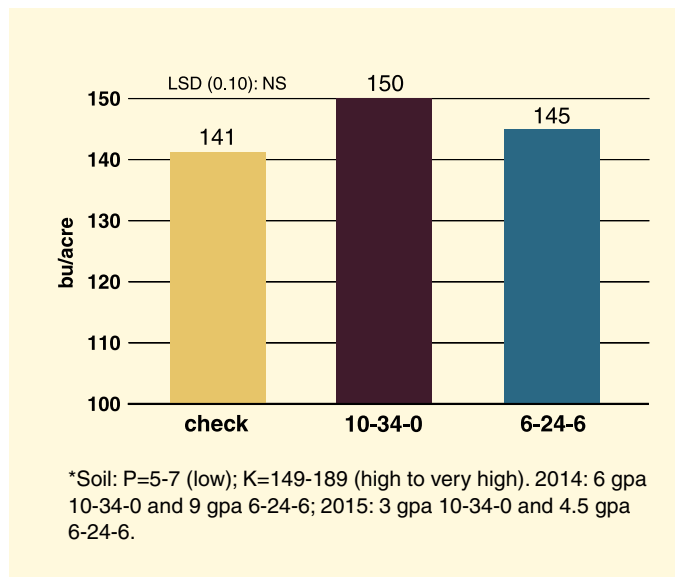


Figure 5. Corn grain yield between in-furrow applied 10-34-0 and 6-24-6 fertilizer, Carrington, 2014-16 (3 site-years).*

The NDSU Extension Service does not endorse commercial products or companies even though reference may be made to tradenames, trademarks or service names. NDSU encourages you to use and share this content, but please do so under the conditions of our Creative Commons license. You may copy, distribute, transmit and adapt this work as long as you give full attribution, don't use the work for commercial purposes and share your resulting work similarly. For more information, visit www.ag.ndsu.edu/agcomm/creative-commons.

For more information on this and other topics, see www.ag.ndsu.edu

County commissions, North Dakota State University and U.S. Department of Agriculture cooperating. NDSU does not discriminate in its programs and activities on the basis of age, color, gender expression/identity, genetic information, marital status, national origin, participation in lawful off-campus activity, physical or mental disability, pregnancy, public assistance status, race, religion, sex, sexual orientation, spousal relationship to current employee, or veteran status, as applicable. Direct inquiries to Vice Provost for Title IX/ADA Coordinator, Old Main 201, NDSU Main Campus, 701-231-7708, ndsu.eoaa@ndsu.edu. This publication will be made available in alternative formats for people with disabilities upon request, 701-231-7881.

Summary

- Corn grain yield was similar with band and in-furrow 10-34-0 application, and starter fertilizer increased yield, compared with the untreated check. Also, test weight increased slightly with band application of 10-34-0, compared with the untreated check.
- Yield was similar between the 3- and 6-gpa rates of in-furrow-applied 10-34-0.
- Yield did not improve with a split application of 10-34-0 using band plus in-furrow placement, compared with similar rates of only band- or in-furrow-applied fertilizer.
- Deep-band- (5 to 6 inches deep, fall or spring placed) or deep-band plus in-furrow-applied 10-34-0 had similar yield as the planting-time band-applied fertilizer.
- Yield was similar between in-furrow-applied 10-34-0 and the low-salt fertilizer 6-24-6.

Reference

Franzen, D.W. 2014. Soil fertility recommendations for corn. NDSU Extension Service publication SF722 (Revised). <http://tinyurl.com/NDSUCornFertility>

Research was partially supported by the North Dakota Corn Utilization Council.