

by Dr. Paul E. Fixen and Dr. Raun D. Lohry

# Multi-crop Responses To Starters Vary

Researchers report on yield responses to starters applied on soybeans, canola, sorghum, potatoes, and sugar beets

In this final of a three-part series on the use of fluid starters in conservation tillage, we will take a look at their use on soybeans, canola, sorghum, potatoes, and sugar beets. The use of starters is advantageous, especially in reduced-till environments, because they perform well in cooler temperatures, offer precise placement and higher efficiency, plus reduce weed pressure, stratification, and nutrient tie-up. Regions covered in this report are Alabama, Kansas, Nebraska, North Carolina, Florida, Minnesota, and Canada.

## Soybeans

Most studies in the Midwest have shown soybeans to be less responsive to starter than corn. The early-season inflow (uptake per unit of root length) requirements of soybeans are considerably lower than for corn and the physiological traits of soybean roots lessen their ability to use nutrients in a concentrated band. Unlike corn, soybeans are traditionally planted later when soil temperatures are more favorable for nutrient uptake.

*North Carolina.* In 1989 North Carolina experiments at four sites by Kamprath, soybeans failed to respond to a PKS starter on Coastal Plain soils. Starter materials were concentrated superphosphate, KCl, and calcium sulfate. Rate of application for the PKS starter was 20 lbs/A. Soil test P and K both ranged from medium to high at all sites. Kamprath indicated that the lack of S response was likely due to adsorbed S in the B horizon of one of

the soils and high amounts of S in the Ap horizon of the other soil. Leaf concentrations of P, K, and S were all in the sufficiency range at flowering.

*Alabama.* In a 1986 study on the effects of NPK starters on soybeans in the Coastal Plains of Alabama, Touchton and Rickerl concluded that the primary yield response was to K. The P, K, NK, and PK starters increased yields 46 percent when residual P, K, or both were low, and 26 percent when the residual P and K were high. The N, NP, and NPK relative importance of specific nutrients appears to vary with geography and cropping system, making summarizing starters resulted in less response. Applied rates were: N at 14 lbs/A, phosphate at 38 lbs/A, and potash at 47 lbs/A. The starter was placed in a vertical band, extending to a depth of six to eight inches immediately below the row in a subsoiler channel.

The researchers suggest that poor performance of NP and NPK starters may have been due to damage from the

diammonium phosphate source used in these treatments.

In another study by Touchton (1984), application of starters on southern Coastal Plain soils testing high in P and K resulted in increased yields in two of three years. Placement was two to four inches to the side or eight to ten inches deep in the in-row subsoil track. Starter applied was a 20-18-0 solution at a rate of 100 lbs/A, formulated from UAN and ammonium polyphosphate (APP).

Although yields were increased, the in-row application reduced plant stand by 29 percent in one year. Yields averaged 14 percent higher for the three-year period when starters were used.

## Canola

Balanced, effective fertility management is essential for producing quality, high-yielding canola. Canola uses more nitrogen than most other cereals. A 60 bu/A crop will require approximately 180 lbs/A of N, 80 lbs/A of phosphate

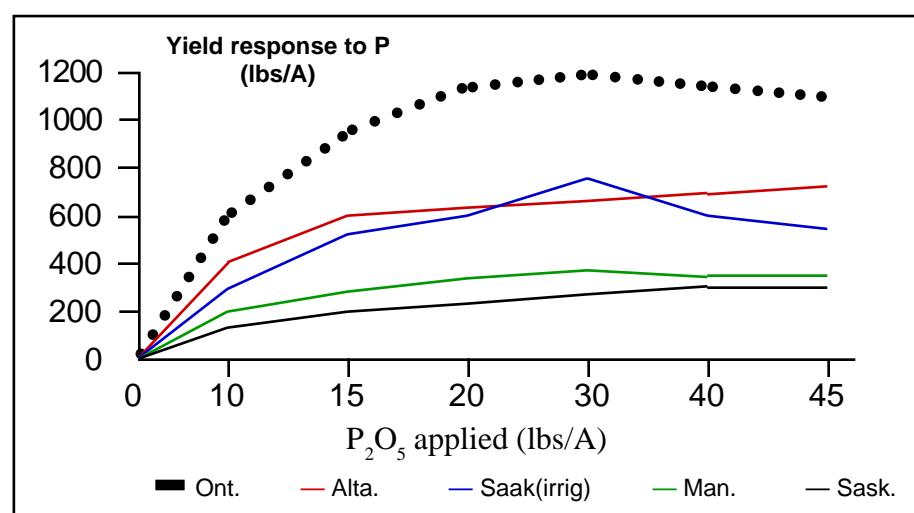
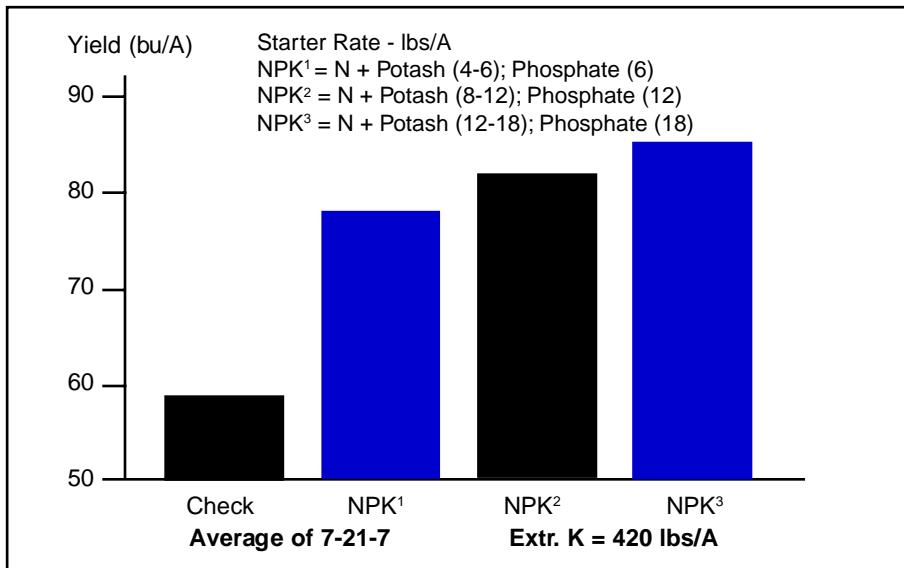


Figure 1. Canola response to side-banded P in Canada.



**Figure 2.** Effect of starter rates on grain sorghum yield in Kansas, Lamond and Whitney, 1984-86

(P<sub>2</sub>O<sub>5</sub>), 140 lbs/A of potash (K<sub>2</sub>O), and 35 lbs/A of S. Canola is extremely sensitive to seed placed nitrogen. For example, 1993 starter studies by Bailey and Grant on the Canadian Prairies showed that as little as 20 lbs/A of N placed directly on the seed at planting significantly reduced stand and yield on both sandy loam and silty clay loam soils. The opposite occurred when a year earlier the researchers banded N at 60 lbs/A and phosphate at 20 lbs/A just before seeding. Yields were optimized.

At low to moderate rates, phosphate is most efficiently used when placed in a band with or close to the seed. Band phosphate placement with or near the seed promotes crop utilization early in the growing season. Seed-placed phosphate recommendations of 15-20 kg/ha (13-18 lbs/A) are common in the Canadian Prairies. Greater amounts may reduce stand and yield. However, phosphate placement 2.5 cm below and 2.5 cm beside (1 in. x 1 in.) the seed at 40 kg/ha (36 lbs/A) increased yield without significant stand reduction. Off-seed placement is recommended where high phosphate rates are needed.

Other Canadian research also has

shown that canola is very responsive to starter P, producing large yield increases on low P soils (Figure 1). Response varies, depending on soil type, soil moisture, and the amount of available soil P. Studies have also shown good responses from starter P on soils testing high in available P.

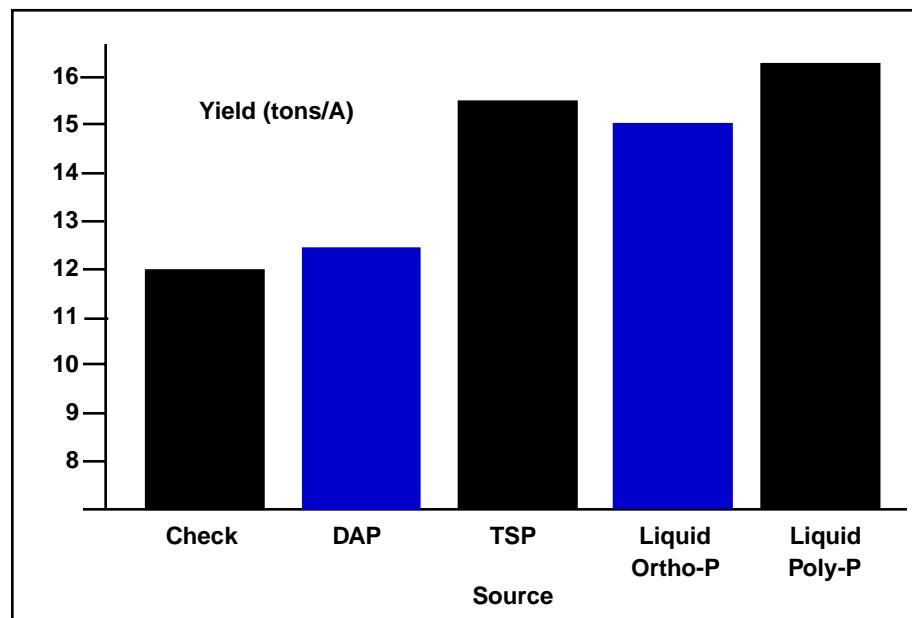
### Sorghum

*Alabama.* Three-year studies run by Touchton, et. al., (1986-88) on the Coastal Plains of southeast Alabama

resulted in inconsistent response by grain sorghum. At a high soil test P level, starter responses were +12, +2, and -7 bu/A across the three years. The starter was formulated from ammonium polyphosphate and UAN (18-15-0) and applied at a rate of 110 lbs/A. Placement was two inches to the side and below the seed.

*Kansas.* Dramatic responses were achieved in three-year tests run by Lamond and Whitney (1984-86) on low P clay loam soils, using 30-inch row spacing. Bray P1 was 11 lbs/A. A 9-18-9 starter (containing orthophosphate), or a 7-21-7 starter (containing polyphosphate) was placed with the seed. Both performed similarly, resulting in five- to ten-fold increases in early plant growth and a 29 bu/A average yield increase across three years (Figure 2).

*Nebraska.* In 1988 research by Penas, et al., response of grain sorghum to starter was minimal across eight sites. Bray P1 varied from 8 to 96 ppm, with six of the eight sites between 17 and 42 ppm. Early growth increased at four of eight sites, but the maximum increase was only 20 percent. Grain yield was



**Figure 3.** Effect of P source on marketable yield of potatoes in Florida, Locascio and Rhue, 1980-81

not significantly affected ( $P = 0.10$ ) at any site; however, the eight-site average response was 2 bu/A, suggesting that a slight positive response may have occurred. Data were generated by requesting that growers using starters leave check strips in their fields. Growing conditions in 1988 were generally abnormally hot early in the season and dry later.

### Potatoes

In Florida (1980-81) Locascio and Rhue examined the effects of starter P sources and micronutrients on potato growth and marketable yield. Adding Cu, Fe, Mn, Zn, B, and Mo did not increase yield over treatments without micronutrients. *Soil.* To evaluate the effects of four P sources and four micronutrient sources on yield, potatoes were grown at two sites consisting of St. John's fine sandy loam soils.

*P source.* Phosphate sources were liquid ortho-P (10-34-0), liquid poly-P (10-34-0), dry diammonium phosphate

(DAP 18-46-0), and dry triple super phosphate (TSP 0-46-0). The starters were formulated as 8-18-9 (percent N,  $P_2O_5$ ,  $K_2O$ ).

*Placement/rate.* The starters were applied in two bands, three inches to the side of the bed center and two inches below the seed piece level at the rate of 1,000 lbs/A. Approximately six weeks later, the crop was sidedressed at a rate of 80 lbs/A nitrogen and 80 lbs/A potassium. Banding was on one side of the bed, ten inches from the bed center. Irrigation supplemented rainfall. Phosphate application significantly increased potato tuber yields in both seasons. Soil P tests on the experimental site predicted a positive yield response. Average yield responses to the different phosphate sources are shown in Figure 3. As can be seen, marketable potato yields were highest with liquid poly-P and lowest with DAP.

### Sugar beets

Research by Smith (1983-84) in

Crooks-ton, Minnesota, examined the effects of starters on sugar beet yield and quality. Starters used were 9-18-9 or 10-34-0 at rates varying from 3 to 12 gal/A. Largest yield increase over check was 3.6 tons/A, using 10-34-0 at rate of 6 gal/A. Studies in previous years showed mixed results. Environmental conditions after planting had a large influence on the response.

The Crookston study produced the following trends over its six-year duration: 1) final yield increased significantly two out of six years, 2) salts over 5.5 lbs/A reduced stand, and 3) starter increased early-season growth and vigor five out of six years. The researcher concluded that reducing applied nitrogen may trigger better early-season growth and vigor due to starters.

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*Dr. Fixen is North Central director for the Potash & Phosphate Institute, Brookings. SD and Dr. Lohry is agronomist/br NutraFlo Company in Sioux City, IA. □*