Soybean Response to Prior-Year Application of Phosphorus Fertilizer

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A common strategy in eastern corn belt states is for preplant phosphorus (P) fertilizer application prior to the year of soybean production, typically on corn ground with one total application rate for corn and subsequent soybean production. Advantages include reducing fertilizer input costs with one less trip across the field, and possibly more flexibility with available fertilizer supply and prices. Is this strategy effective for North Dakota farmers instead of the common practice of in-season P application for crops including soybean?

A field study was conducted at the NDSU Carrington Research Extension Center and supported by the North Dakota Soybean Council to examine soybean response to preplant-applied P for corn plus soybean the year prior to soybean production versus P application for corn followed by P application the next year for soybean. Experimental design was a randomized complete block with four replications. Treatments: 1) untreated check, 2) P preplant broadcast-applied, based on soil analysis and NDSU fertilizer rate recommendations, for corn; followed by P application the following year for soybean, and 3) P applied the initial year for corn plus soybean. The dryland trials were established on conventionally tilled Heimdal-Emrick loam soil with 3.0-3.4% organic matter, 7.7-8.0 pH (0- to 6-inch depth) and 2-7 ppm P (very low-low soil level; Olsen test). Triple super phosphate (0-46-0) was preplant broadcast applied and incorporated prior to crop planting each year. P fertilizer application strategies and amounts are listed in the following table.

Table. P_2O_5 rates using preplant applied triple super phosphate fertilizer[1], Carrington, 2020-23.

P treatment		2020 corn	2021 soybean	2021 corn	2022 soybean	2022 corn	2023 soybean
No.	Application strategy	lb/A P_2O_5					
2	Yearly for each crop	67	15	67	26	104	52
3	Total for both crops during corn year	93	x	93	x	156	x

[1]Includes in-furrow applied 10-34-0 at 2.5-3 gpa for corn.

'DKC32-12RIB' corn was planted in 30-inch rows with the following planting and harvest dates: May 26 and October 7, 2020; May 10 and November 2, 2021; and May 26 and November 2, 2022. Corn grain yield averaged 66.5 bu/a in 2021 and 130.3 bu/a in 2022 with no differences among treatments for each trial. 'AG03X7' soybean were planted in 30-inch rows on May 18, 2021 resulting in established average stand of 123,500 plants/a and harvested September 23;

‘AG03XF2’ soybean were planted in 22-inch rows on June 2, 2022 resulting in 146,900 plants/a and harvested October 4; and ‘AG03XF2’ soybean were planted in 30-inch rows on June 2, 2023 resulting in 101,400 plants/a and harvested October 12.

Soybean plant development (emergence, flower and physiological maturity dates) were generally similar among treatments each year. Plant populations were similar among treatments. Plant canopy, measured mid-July to mid-August during the R2-6 growth stages, generally was slightly greater with sequentially applied P compared to the untreated check. Seed quality (test weight, seed count, and seed oil and protein content) generally were similar among treatments.

Soybean seed yield averaged among the three trials: 1) untreated check = 40.8 bu/a, 2) P application each year = 44.4 bu/a, and 3) Total P application during corn year = 43.8 bu/a. Yield increased with P application compared to the untreated check (LSD [0.10] = 2.8 bu/a) but was similar between the P application strategies. Under conditions of this study, including very low to low soil P levels and soil pH ranging from 7.7-8, the results indicate application of P fertilizer at NDSU recommended amounts in the preceding year of soybean production is an acceptable alternative strategy versus in-season P application for the crop.

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