Alberta

Wheat, Barley and Canola Response to Phosphate Fertilizer

By R.H. McKenzie, L. Kryzanowski, K. Cannon, E. Solberg, D. Penney, G. Coy, D. Heaney, J. Harapiak and N. Flore

Extensive phosphorus (P) fertilizer calibration trials with wheat, barley and canola suggest almost 75 percent of Alberta's soils are marginally to highly responsive to P fertilization.

CANADIAN PRAIRIE SOILS tend to be naturally low in plant available P. The benefits of seed-placing phosphate fertilizer with wheat grown on fallow soils were first observed in western Canada in the mid 1940s. However, use of phosphate fertilizer did not become common until the 1950s and dramatically increased from the 1960s to 1980s. Phosphate fertilizer purchases in the three prairie provinces now exceed 300 million dollars annually.

In the 1980s, agronomists began noting that crops did not always respond to added phosphate on soils that tested low in plant available P. Some agronomists felt that residual phosphate build-up over a period of years resulted in reduced crop response to phosphate fertilizer. This led to questioning of the accuracy of P soil tests used by laboratories as well as questioning the need for phosphate fertilizer.

A research project to assess crop responsiveness to P fertilizer on a wide range of soil types across Alberta was conducted from 1991 to 1993. Replicated field trials with spring wheat, barley and canola evaluated P response using four application rates (0, 13, 27, and 40 lb P_2O_5/A) in six major soil zones across the province. Banded and seed-placed P were compared at several locations. During the three-year study, 450 sites were established, of which 427 sites were taken to completion and harvested.

Table 1 shows the numbers of sites that statistically responded to applied P. In summary, 50 percent of wheat sites, 55 percent of barley sites and 34 percent of canola sites significantly responded to added phosphate fertilizer at the 427 research sites. However, statistical analysis likely underestimated the real response to phosphate fertilizer.

Table 1. Sites showing a statistically significant response to P fertilization (1991-1993).

		Soil Zones						
Crop	Response	Brown	Dark Brown	Thin Black	Black	Gray Wooded (Central)	Gray Wooded (Peace R.)	Total Sites
Wheat	Response	9	14	12	22	9	8	72
	No Response	7	14	14	13	10	13	73
Barley	Response	8	14	19	27	10	10	88
	No response	8	12	18	12	9	12	71
Canola	Response	6	5	5	12	5	9	42
	No response	10	20	13	17	10	11	81

Dr. McKenzie is a Research Scientist with Alberta Agriculture, Lethbridge, Alberta; Mr. Kryanowski, Ms. Cannon, Mr. Solberg, Mr. Penny and Mr. Heaney are Soil Fertility Specialists with Alberta Agriculture, Edmonton, Alberta; Mr. Coy is Agronomist with the Canola Council of Canada, Wanham, Alberta, and Mr. Harapiak and Mr. Flore are Agronomists with Western Co-operative Fertilizers, Calgary, Alberta.

Table 2. Sites showing at least a two bushel yield response to P fertilization (1991-1993).

Crop	Response, bu/A	Soil Zones: Brown	Dark Brown	Thin Black	Black	Gray Wooded (Central)	Gray Wooded (Peace R.)	Total Sites
Wheat	>5	9	10	14	21	10	10	74
	2-5	1	10	9	8	6	9	43
	<2	6	8	3	6	3	2	28
Barley	>5	9	14	19	32	14	13	101
	2-5	5	12	14	3	2	6	42
	<2	2	0	4	4	3	3	16
Canola	>5	3	2	1	9	6	8	29
	2-5	8	14	11	12	8	7	60
	<2	5	9	6	8	1	5	34

Table 2 summarizes the numbers of responsive and unresponsive sites based on a yield increase of at least 2 bu/A. Yield increases of 2 to 5 bu/A occurred at 145 sites and increases greater than 5 bu/A occurred at 204 sites. This suggests about 82 percent of all sites responded to applied P. By crop, P fertilization increased yields in 81 percent of wheat trials, 90 percent of barley trials and 72 percent of canola trials.

Seed-placed P was compared to banded P at 55 sites in central and southern Alberta. Placing the phosphate in the seedrow produced a better yield than banding in 33 of the 55 responsive sites. Banding was superior to seed-placed P in only 8 trials. **Figure 1** shows a typical yield response for wheat and barley. Whether seed-placed or banded, P fertilization is essential to optimize crop production in prairie soils.

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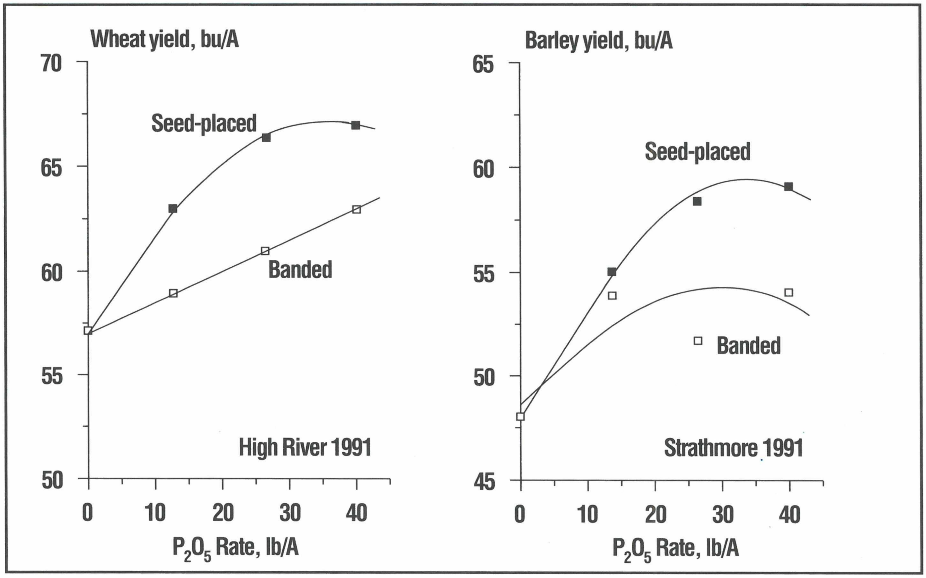

Figure 1. Response of wheat and barley to seed-placed and banded P in Alberta.

WHEAT GROWTH RESPONSE to P fertilization is demonstrated here. Plot at right received 40 lb/A P_2O_5, while plot at left received none (gray wooded soil near Grand Prairie, AB).

Summary

Alberta soils are deficient in available P and will respond to P fertilization. From 1991 to 1993, P fertilization of spring wheat, barley and canola was evaluated in 427 field trials scattered across six different soil zones in the province. Yield responses of at least 2 bu/A occurred in about 75 percent of the trials.

The crop response data generated in this study are currently being correlated with various P soil test methods in use in the prairies. This extensive data base will improve soil testing laboratory recommendations for prairie farmers and should increase farmer confidence in profitability of P fertilization. ■

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applied 2 inches to the side and 2 inches below the seed at planting. Liquid ammonium polyphosphate (10-34-0) and UAN were used as the starter fertilizer sources. Nitrogen was knife applied as UAN immediately after planting in order to supply a total of 160 lb N/A to all plots. Grain sorghum was planted no-till on May 18 at the rate of 50,000 seed/A into residue from a previous corn crop.

Results of this 1994 study are summarized in **Table 2**. Starter fertilizer improved dry matter production and P uptake at the 6-leaf stage in all hybrids. When averaged over hybrids, 6-leaf dry matter production was 20 percent greater with starter than without. Hybrids differed in the amounts of dry matter and P uptake at the 6-leaf stage. When averaged over all hybrids, starter fertilizer decreased the time from emergence to mid-bloom by 6 days. Starter fertilizer hastened maturity in Dekalb 40Y by 9 days and in Dekalb 48 and Pioneer 8505 by 5 days. Starter fertilizer improved total P uptake (grain plus stover) in three of the five hybrids. Grain yields also were improved by starter fertilizer in three of the five hybrids, one response being 20 bu/A. Yields of Dekalb 40Y were 20 bu/A greater with starter than without. However, yields of Pioneer 8310 and Dekalb 48 were not improved with starter fertilizer.

Summary

Results show that some corn and grain sorghum hybrids respond dramatically to N-P starter fertilizer while others do not. This work suggests that responses to starter fertilizer can be very economical even on high P soils—at least with some hybrids, particularly when corn or grain sorghum is planted early in high residue production system. Other aspects of this work emphasize the importance of high $N:P_2O_5$ ratios (1:1) in the starter fertilizer. The impact of starter fertilizer in conservation tillage systems for corn and grain sorghum suggests that starter use should be considered regardless of the soil test value for P. ■