



Building phosphorus fertility

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Over six years the highest wheat yields were achieved where a medium-high soil phosphorus (P) level (15 ppm) was achieved with an initial broadcast application of 327 pounds P_2O_5 per acre. On soils with very low P fertility, yields were four to five bushels lower than on soils testing 15 ppm, even with annual seed placed applications of 40 lbs. P_2O_5 /acre.

The study was initiated to assess the effectiveness of broadcasting a single large fertilizer phosphorus (P) application and to compare this with the effect of continual annual seed-placed applications. The research started in 1979 and ran for five years. The lessons learned are still valuable today.

The research was conducted on a Dark Brown Chernozemic soil at the University of Saskatchewan Kernen Farm near Saskatoon. The Olsen soil test plant-available P was very low at less than 3 ppm. A single broadcast application of 0, 41, 82, 163, 327 lbs. P_2O_5 /ac (0, 20, 40, 80 and 160 kg P/ha) of triple superphosphate (0-45-0) was applied on the major plots and incorporated in the spring of 1979 prior to the seeding of the first wheat (Neepawa) crop. Wheat was seeded on seven inch (18 cm) row spacing.

Each major plot had annual seed-placed treatments of 0, 5, 10, 20, 40 lbs. P₂O₅/ac (0, 2.5, 5, 10 and 20 kg P/ha) applied as mono-ammonium phosphate (11-51-0) to subplots. In each year, another set of seed-placed plots was created while treatments were repeated on existing seed-placed plots. Five sets of seed-placed plots were created over the first five years of the study, with the first set created in 1979 receiving five consecutive applications of seed-placed P.

Annual soils tests indicated that only nitrogen (N) was required to supplement the P applications.

One large annual P application improved yield

Olsen soil test levels were taken six years after the initial broadcast application. Earlier research suggests that approximately 10 ppm Olsen test P would be required to sustain yields. Today, that level is thought to be 10 to 20 ppm using the Olsen extraction or 15 to 30 ppm using the Kelowna extraction.

Only the Broadcast (B) 327 lbs. P₂O₅/ac plots reach sufficient levels to maintain yield at 14.6 ppm Olsen over the six years. B163 tested 8.0 ppm, B82 at 3.8 ppm, B41 at 3.7 ppm, and the control at 4.9 ppm.

When no seed-placed P was applied, the six-year average yield increase over the control for the B327 treatment was 35%, followed by 33% for B163, 24% for B82. The B41 treatment did not produce a statistically significant yield increase over the control. The B82 treatment produced significant yield increases until the 5th year, while the B163 and B327 treatments produced significant increases over the six years of cropping.

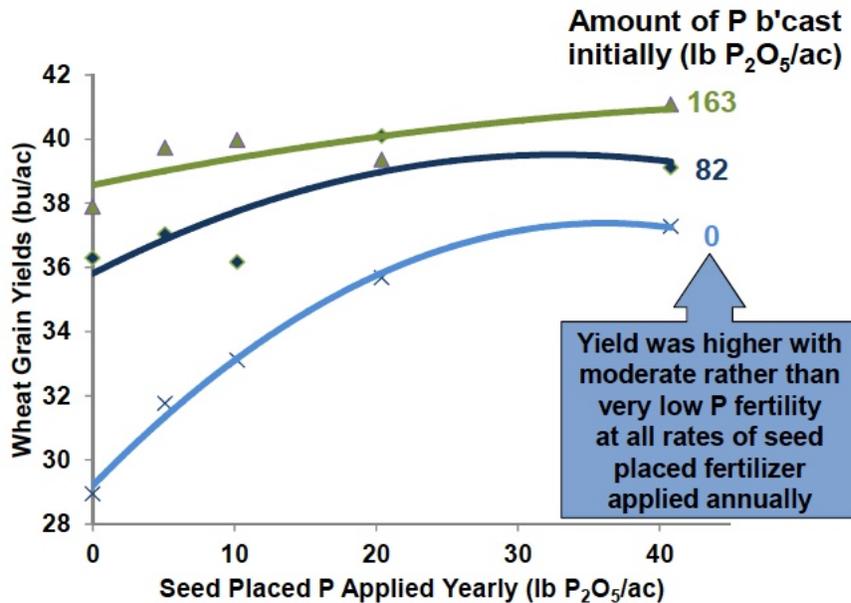
Seed-placed P yield effects

Single seed-placed P treatments had a significant effect on yield in the three years (1979, 1982 and 1983) when there was sufficient moisture to produce average or better crops. Multiple consecutive seed-placed applications without broadcast P also produced significant yield increases in 1982 and 1983. The average five-year yield increases from the multiple seed-placed treatments exceeded the control (29 bu/ac yield) ranging from 10% (2.9 bu/ac) on the 5 lbs. P₂O₅/ac treatment to 29% (8.4 bu/ac) on the 40 lbs. P₂O₅/ac treatment.

Seed-placed versus broadcast P

Average yields from the first five years of the study on plots receiving only broadcast P or only consecutive seed-placed P were compared. The B327, B163, B82, S40 and S20 yields were statistically similar. This indicates a single broadcast P application can produce yields comparable to annual seed-placed P applications without requiring additional fertilizer inputs.

The research also shows the importance of maintaining P fertility at or above the critical level for optimum yields. On soils with very low P fertility (control: 5 ppm), yields were about four bushels lower than on soils testing 8 ppm (B163), even with annual seed placed applications of 40 lbs. P_2O_5 /acre. While yields were also four to five bushels higher with the B327 application (15 ppm), this high rate also caused a zinc deficiency that possibly limited an even higher yield response.



Source: Flaten, U of M, adapted from Wagar et al.

Broadcast and seed-placed P combinations

Many combinations of broadcast and seed-placed P produced similar yields. At this site a combination of moderate amounts of residual and seed-placed P produced high yield with a smaller fertilizer input than required of either applied alone.

For example, only two combinations attained greater than 95% of maximum yield over the five-year period while requiring a total application of less than 205 lbs. P_2O_5 /ac over the six years.

Broadcasting 82 lbs. P_2O_5 /ac followed with annual seed-placed applications of 20 lbs. P_2O_5 /ac produced 98.3% of the highest yield with a total application of 185 lbs. P_2O_5 /ac. The B163+S5 treatment produced 96.6% of the highest yield and required 190 lbs./ P_2O_5 /ac.

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Wagar, B. I., Stewart, J. W. B., Henry, J. L. 1986. Comparison of single large broadcast and small annual seed-placed phosphorus treatments on yield and phosphorus and zinc contents of wheat on Chernozemic soils. Can. J. Soil Sci. 66:237-248.

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