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Case Study 4.5-2 Maintaining soil test phosphorus for wheat in Saskatchewan depends on right rate. A crop adviser from central Saskatchewan, Canada, asked for advice about interpreting soil sampling results on a family farm where a recently available liquid seed-row fertilizer (product analysis 6-24-6)—containing some nitrogen (N), mostly phosphorus (P) and some potassium (K)—was used for the past 5 years to replace the previously used granular mono-ammonium phosphate (analysis 11-52-0). This type of liquid fertilizer was developed as a starter fertilizer for use in the Corn Belt, and complemented the diammonium or monoammonium sources of P fertilizer that are commonly broadcast applied and incorporated. This seed-row fertilizer works well as a starter fertilizer in the Corn Belt, and can work well as a starter in the spring planted, small grain-cropped areas of the Northern Great Plains.

However, even though these liquid fertilizers were developed and initially sold as starter fertilizers, they were presented to the two brothers and a son—who farm together on this family corporate farm—as a replacement to the regular phosphate fertilizer program. The challenge wasn't the form of P fertilizer used, but that the rate of actual P_2O_5 was about one third the regular amount of P_2O_5. The rate for the liquid fertilizer worked out to 8 lb P_2O_5/A, contained in a 3 US gal/A application, compared to a regular 26 lb P_2O_5/A seed-row application normally applied as 50 lb/A of 11-52-0. An average yielding crop of spring wheat (35 bu/A) for this area of Saskatchewan will remove close to 27 lb P_2O_5/A, assuming 0.76 lb P_2O_5 per bushel content of spring wheat.

Under the previous program using the granular ammonium phosphate, P addition was 98% of P removal, but the system used for P addition the last 5 years was only 30% of P removal. After five years of applying only 8 lb P_2O_5/A using the liquid starter, the one brother managing the farm was concerned about decreasing soil test P levels. Of 10 fields sampled and tested the average Bray P1 equivalent soil test level average was close to 7 ppm P, compared to a Saskatchewan average soil test of 14 ppm P, and an estimated critical soil test level of 25, suggested for optimum crop production in Saskatchewan (IPNI, 2010). The net removal of P was 18.6 lb P_2O_5/A/yr. Research in north central Iowa showed that a 12 lb P_2O_5/A net addition could increase soil test P by 1 ppm at an initial rate of 299 P_2O_5/A (Webb et al., 1992), and so conversely it could be reasoned that net removal of 12 lb P_2O_5/A, could reduce soil test P by 1 ppm, but this can vary somewhat from soil to soil. However, using this value of 12 lb P_2O_5 for each ppm of soil test P, the net removal of 18.6 lb P_2O_5 per year over 5 years would be a total of 93 lb of P_2O_5, potentially to reduce soil test P by 8 ppm P. Assuming the soil test level of the fields was close to the average Saskatchewan soil test level of 14 ppm P, so a 14 ppm P possible average, minus a calculated 8 ppm equals 6 ppm P. The results from the set of soil samples taken on the farm averaged 7 ppm as shown above. The recommendation to the farmer was to consider increasing P applications on the fields to 45 lb P_2O_5/A/yr. It is estimated that this would add on average about 18.4 lb P_2O_5 per year above average crop removal rates, and within 5 years soil test values should be raised slightly above the Saskatchewan average soil test level of 14 ppm P, and within 12 years raise the soil test values to reach 25 ppm P, the level recommended to optimize crop growth and yield under Saskatchewan conditions.

This case study shows that P additions that are less than one third of P crop removal will lower soil test P levels, even when used for as little as 5 years. However, using a soil test P building approach, annual additions of P fertilizer at rates of 12 lb P_2O_5/A greater than average crop P removal in grain, soil test levels could be restored to the previous average levels within 7 years.

Reference

IPNI, 2010. Soil Test Levels in North America, Publication 30-3110, Peachtree Corners, GA, USA.

Webb, J.R., A.P. Mallarino, and A.M. Blackmer. 1992. J. Prod. Ag. Vol. 5 (1):148-152.

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