NEWS & VIEWS

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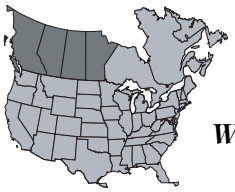

Dr. Adrian Johnston, Western Canada Director

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Phosphorus Nutrition of Canola

CANOLA (*Brassica napus* and *B. rapa*) is the main oilseed crop grown in rotation with cereals and grain legumes on the Northern Great Plains. Originating in southern Europe and Asia, the rapeseed plant was improved through plant breeding to reduce erucic acid in the oil and glucosinolates in the meal. The result was a new rapeseed called canola, an edible oil and valuable high protein livestock meal. While national average yields for canola are 24 bu/A in Canada and 26 bu/A in the U.S., top growers consistently achieve yields of 40 to 50 bu/A under optimum management.

Phosphorus (P) fertilization is a major input in crop production on the Great Plains, because many soils lack sufficient P to optimize crop yields and quality. Effective nutrient management requires that nutrients be available in adequate amounts when needed by the plant. Ensuring that P is plant-available early in the growing season is of particular importance. Phosphorus is critical in the metabolism of plants, playing a role in cellular energy transfer, respiration, and photosynthesis.

Canola takes up P throughout the growing season, with total uptake of about 1.5 lb P_2O_5/bu in the seed and straw (**Figure 1**). Harvesting seed removes P from a field at a rate of about 0.7 to 0.9 lb P_2O_5/bu. This nutrient removal is considerably greater than spring wheat, illustrating the large nutrient demand of this high protein, oilseed crop.

Using canola seed with a good P concentration can help in early plant growth. However, the small seed size of canola means that the support for early growth from seed P reserves is limited. Relative to wheat, where seed P reserves can support seedling growth for 2 weeks, canola seed supports seedling development for about 1 week before needing an external P source from the soil or applied fertilizer.

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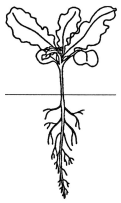
Attention Crop Advisers:

Are you looking for a current resource on P management of canola? If so, we encourage you to review and download the PowerPoint presentation "Phosphorus Nutrition of Canola", available on the PPI/PPIC website. This comprehensive presentation reviews the role of P in building canola yields, P uptake, soil testing, and fertilizer management approaches. Notes and references included will help you build knowledge for working with clients. Go to:

>www.ppi-ppic.org/pcanola<



Plants differ in their ability to take up P from the soil. Canola has been found to release large amounts of organic acids from an area just behind the root tip. These acids increase the availability of P compounds in the soil, in a way similar to the release of plant-available P from mined phosphate rock when treated with sulfuric acid. Root surface area is critical to the absorption of soil P by plants, and canola has been shown to produce longer root hairs than many other plants. In addition, these root hairs respond to a deficiency of P by increasing in length and density. This allows the plant to expand even further the soil volume from which it can acquire P.

Canola has a large appetite for P. It has adapted not only root development to help acquire P, but also has an

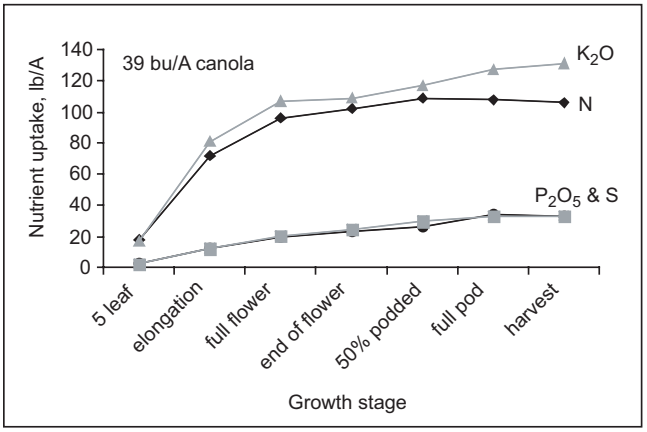


Figure 1. Nutrient uptake by canola growth stage.

affinity for efficient uptake of fertilizer P (**Figure 2**). As plant growth proceeds through the season and soil volume occupied by roots increases, the role of fertilizer P in plant uptake declines relative to the soil supply. Pot studies have shown that canola absorbs more fertilizer P than oats, soybeans, and flax when banded 0.5 in. below the seed at planting. The investigation of plant roots has revealed that while all plants display the ability to proliferate root growth in the P fertilizer band area, canola shows the greatest root response to the fertilizer P zone in a P-deficient soil. Early season uptake is particularly significant, with 12% of the fertilizer P applied in the study shown in **Figure 2** found in the plant in the first rosette sampling stage. This compares with 1% for flax, the least efficient in fertilizer P recovery.

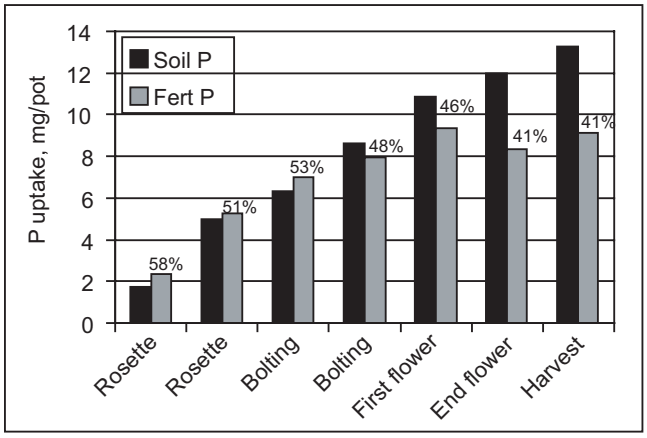


Figure 2. Proportion of canola P uptake from fertilizer and soil by growth stage.

Soil test calibration research has been conducted in the Northern Great Plains to establish the general relationship between relative yield (percent of yield attainable when P is sufficient) and soil test levels. These data come primarily from studies examining seed row and band applications of P. Canola yield is optimized when soils are in the 20 to 25 parts per million (ppm) range (Kelowna), or 40 to 50 lb P/A (**Figure 3**). If soil fertility is built to these levels, continued applications of P will be necessary to maintain soil fertility. As a first approximation, apply a rate equal to crop removal, then check periodically to see if soil tests are staying in the desired range.

Although higher soil fertility levels are important for season-long P nutrition, early season P supplies must be accessible to the limited root system of the young canola plant. For this reason, P placed near the seed at planting (starter P) has proven effective, especially in cold soils. The response of canola to low rates of starter P is often referred to as the "pop-up effect", and is marked by improved leaf and root growth and seed yield.

A well-managed fertility program must consider the complete nutritional needs of canola. Consider how canola responds to both nitrogen (N) and P, shown in **Figure 4**. In the absence of supplemental fertilizer P, the canola response to N was very limited. Increasing the N rate

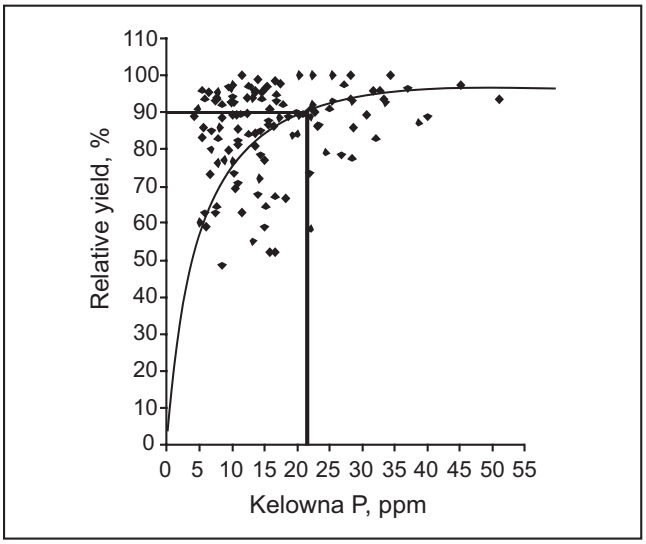


Figure 3. Critical soil test P level to optimize canola yield is 20 to 25 ppm (40 to 50 lb P/A).

increased the crop P requirements. Yields were optimized when the added N was balanced with 36 lb P_2O_5/A. **This response to P illustrates the interaction between N and P: fully attainable yield response to N is achieved only when accompanied by sufficient P.**

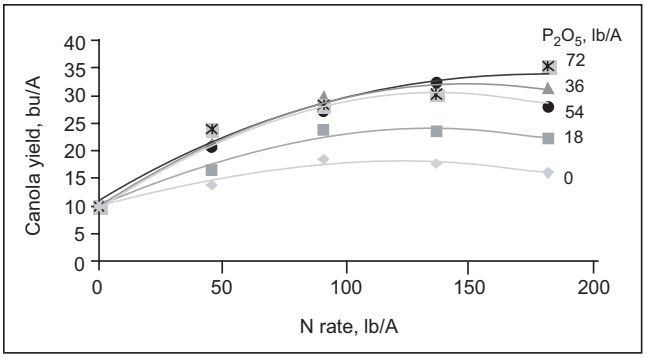


Figure 4. Optimizing canola yield requires balancing N and P additions.

Summary

Management of P plays a significant role in optimizing canola production. Key points are:

- Phosphorus nutrition is critical to reaching the attainable yield potential of canola.
- While canola accumulates P through the entire growing season, early season P deficiencies can be more detrimental than those occurring later;
- Canola responds to P deficiencies by changing its root development, forming more root hairs and concentrating its roots in the area of P fertilizer bands, increasing fertilizer recovery.
- Phosphorus nutrition must be part of a management strategy that considers the importance of other nutrients. ■