Benefit of Pulses in Rotation

Donna Fleury, P.Ag

Pulses are an important part of crop rotation planning, providing both nitrogen (N) fertility and other non-N benefits to the cropping system. Understanding where those benefits come from is necessary to help plan a good fertility program for pulses and subsequent crops.

Dr. Jeff Schoenau, Professor and Ministry of Agriculture Strategic Research Chair at the University of Saskatchewan, explains the goal of crop rotation planning is to maintain soil fertility as efficiently and effectively as possible. The contribution of pulses is an important part of that strategy. In pulse crops, about 70 to 80 per cent of N comes from the atmosphere through biological fixation in nodules that form on the pulse crop roots. However, the amount of the N benefit (or N credit) can be variable, and depends on the success of nodulation, soil and environmental conditions, available N, and other nutrients like phosphorus.

The big benefit for pulse crops is that the N removed in the harvested pulse seed is obtained from fixation, compared to non-legume crops where the N has to come from soil and commercial fertilizer. For the following crop, typically there is not a huge N credit because about 70 per cent of the N in the pulse crop is removed at harvest in the grain. Generally, the benefit of N in pulse seed harvested is about equal to the amount of N fixed from the atmosphere. For example, a 35 bushel per acre (bu/ac) pea crop can fix 100 pounds per acre (lbs/ac) of N. At harvest, 70 lbs of the fixed N is removed, leaving only about 30 lbs of fixed N per acre on the field.

Peas generally fix more N than lentils, but that depends on yield, which is a good indicator of N fixation. Research has reported the N credit from pea stubble may vary from 0.5 to 1 lbs/ac of N for every bu/ac of peas harvested. Some soil fertilizer recommendations provide a credit for N based on the previous year's pulse yield, with higher yields providing higher credits.

"Estimates of a direct N benefit from a pulse crop to the following crop are variable and can be difficult to predict," says Schoenau. "Do not expect miracles, but there is a benefit from the N left behind." The N derived specifically from pulse crops is primarily available to the following crop by microbial decomposition of root exudates, below ground roots, and old nodules, after harvest or early spring, and during the following growing season. Generally less than 10 per cent of N in pulse residue is made available to the following crop. That amount can be found more in situations where a crop ends up as green manure (hailed out possibly or for some other reason), then all of the fixed N in the crop will be returned to the soil.

Research has also shown that the N uptake by crops grown on pulse stubble is typically enhanced by a greater amount than what can be attributed to coming directly from pulse crop residue alone. This is related to the non-N benefits of growing pulses such as better conditions for root growth, improved soil biological activity after pulses, and increased colonization of roots by beneficial arbuscular mycorrhizae (AM) fungi. Other benefits include improved soil tilth and moisture utilization, and a break in pest and disease cycles. For example, adding a pulse crop into a more continuous cereal rotation where root diseases are a problem can be a particular benefit. Pulses also promote improved uptake of other nutrients such as phosphorus (P). Earlier

research found that the crop following pulses showed an increased uptake of phosphorus even though soil tests could not detect higher P levels.

Schoenau has a new project underway comparing soybeans, peas, and lentils at four locations in Saskatchewan to determine nutrient uptake, amount of N fixed, and amount released to the subsequent crop. He expects the results of that study will contribute to a greater understanding of direct N benefits and other benefits from pulse crops to following crops in rotation over the long term.