



Nitrogen fixation and nutrient uptake in faba bean

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Average faba bean nitrogen (N) uptake was 205 pounds per acre (230 kg N/ha) and phosphorus (P) uptake was 23 lbs/ac (26 kg P/ha). Overall, faba bean fixed 88% of its nitrogen from the atmosphere.

Faba bean is a high-protein pulse crop that has the potential to derive much of its nitrogen (N) requirements through biological nitrogen fixation (BNF). The main objective of this research was to determine the effect of N and P fertilizer on faba bean yield, N and P uptake; and to also determine N and P concentrations in seed and straw at multi-field locations over multiple years. In addition, greenhouse trials looked at how P fertilization impacted faba bean yield, BNF, N and P uptake, and partitioning in seed and straw.

Field trials were conducted at Meath Park, Rosthern, Saskatoon, and Outlook, Saskatchewan in 2016 and 2017. Four low tannin faba beans were planted in the trial, including CDC Snowdrop, 219-16, Snowbird, and Tabasco. Seeds were double inoculated with a rhizobial seed treatment and a granular inoculant applied in the seedrow.

Two fertilizer treatments were applied. The first treatment had no fertilizer applied. The second treatment had a N-P-K-S blend of 10N-46P₂O₅-39K₂O-15S lbs/acre (11N-52P₂O₅-44K₂O-17S kg/ha). The fertilizer blend was broadcast and incorporated by light tillage prior to seeding. The fertilizer blend provided adequate fertility for faba bean growth and a small amount of starter N.

In the greenhouse study in 2017, three P fertilizer treatments of 0, 18, 36 lbs P₂O₅/ac (0, 20, and 40 kg P₂O₅/ha) were applied as triple super phosphate (0-45-0). CDC Snowdrop and Snowbird were grown in 5L pots in a P-deficient soil. Seeds were inoculated with a peat rhizobium inoculant. At the 3 to 4 leaf stage, N-15 enriched urea fertilizer was applied to the soil at a rate of 5 lbs/ac (5.6 kg N/ha) to determine BNF through isotope dilution.

High N and P uptake in the field

The average faba bean grain yield was 78 bu/ac (5,280 kg/ha) in the field experiments. This yield ranged from 15 to 146 bu/ac (980 to 9,790 kg/ha) in 2016 and from 36 to 145 bu/ac (2,410 to 9,760 kg/ha) in 2017. Straw yield ranged from 1148 to 9000 lbs/ac (1,290 to 10,110 kg/ha) in 2016 and from 2260 to 8036 lbs/ac (2,540 to 9,030 kg/ha) in 2017.

Average N uptake was 205 lbs/ac (230 kg N/ha) and P uptake was 23 lbs/ac (26 kg P/ha) with the majority of uptake of both nutrients found in the faba bean grain. The N harvest index (NHI) ranged from a low of 85% to a high of 95%. The P harvest index (PHI) ranged from 84 to 96%. These harvest indexes represent the proportion of above-ground P and N contained in the grain.

Nearly all applied P fertilizer moved to faba bean grain. This indicates that faba bean could rapidly deplete soil P reserves if no P was added back into the soil, because almost all of the P is exported from the field in the grain, with little P returned to the soil from straw residue.

High biological N fixation in the greenhouse study

Overall, the average %N derived from the atmosphere (%Ndfa) by faba bean was 88%. The mean %Ndfa by faba bean ranged from 81 to 93% depending on the cultivar and fertilizer treatment.

Fertilization with P had no significant effect on %Ndfa. However, there was greater N derived from fertilizer, P uptake and soil residual P as the rate of P fertilizer increased.

Overall, the results support the benefits of faba bean in crop rotations, which includes high levels of N fixation. However, the large amount of P exported in the seed means P fertility must be carefully managed to ensure the soil does not become depleted.

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