Pulse Advisor
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Pulse Nodulation—What is needed for best results?

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Pulse crops and soybeans rely on nitrogen fixation from rhizobia to meet their nitrogen needs. When properly inoculated, pulse crops can fix a large portion of their nitrogen requirements, and often extend those benefits to the next crop. Supplemental inoculation can increase nodulation, nitrogen fixation, and yield.

The most important consideration for selecting an inoculant is matching the correct strain of the *Rhizobium* species to each crop. Pulse crops each require a specific *Rhizobium* species for nodulation, so check product labels before selecting a particular inoculant or combination product and follow label directions. The *Rhizobium* species required for individual pulse and soybean crops include:

- Peas, lentils, and faba beans — *Rhizobium leguminosarum*
- Chickpeas — *Rhizobium cicero*
- Dry beans — *Rhizobium phaseoli*

Inoculants

There are various types of inoculants available, each with different handling and application requirements. Recent research in Saskatchewan and Manitoba did not show any significant differences between various inoculant treatments. Inoculants are available in different formulations, however effectiveness is mostly related to environmental factors and conditions at seeding.

Granular inoculants tend to have a higher cost, but perform the best across a range of environments, including dry or low soil moisture conditions or lower soil organic matter. The survivability of *Rhizobium* is better when placed in the ground, and the carrier of the granule can actually hold some moisture to help improve viability. In a dry environment, granular inoculants are usually the most effective, followed by peat-based inoculants (seed-applied), and then liquid inoculants (seed- or in-furrow applied). If soil moisture is good, there generally is little difference between the different formulations.

Inoculants are living organisms and must be treated carefully. Factors like heat, sunlight, and certain chemicals such as seed treatments and fertilizers can kill the rhizobia, and storage conditions can also impact the life of the inoculants. Follow manufacturer’s recommendations and label direction for application rates, row spacing, care, and handling.

Peas, Lentils, and Chickpeas

John Ippolito, Regional Crop Specialist with the Saskatchewan Ministry of Agriculture provides some recommended strategies for peas, lentils, and chickpeas. For fields with a history of peas or lentils grown in rotation, a single inoculation is recommended. However, for new fields that do not have a history of those crops being grown, a double inoculation is regularly recommended in the first crop to ensure there are adequate populations of *Rhizobium*. Double inoculation is a combination of
a seed-placed and soil-placed inoculant at manufacturer recommended rates.

For fields where soil test nitrogen is below 10 or 15 pounds per acre (lbs/ac), then a starter nitrogen application of a similar amount should be made. The target is 25-35 lbs/ac of soil test and fertilizer applied nitrogen. It takes three or four weeks for nodulation and the fixation process to begin, so having adequate nitrogen to get the plant starting is important. There is no benefit to nitrogen levels above 35 lbs/ac, and the nitrogen fixation process can be negatively impacted at higher levels.

For chickpeas, the recommendations for inoculation are similar. However, some growers may choose to not use inoculants, but use starter nitrogen instead, as a crop maturity management tool. If there is moisture in the fall, the chickpea crops can take longer to mature, so using starter nitrogen only can speed up maturity.

Dry Beans

Dry beans are not as effective at fixing nitrogen compared to most other pulse crops. Therefore, dry beans should be properly inoculated with *Rhizobium phaseoli*, and a starter nitrogen rate of 50 lbs/ac broadcast or side-banded. An old rule of thumb has been used to ensure that soil nitrogen plus fertilizer nitrogen equals 80 lbs/ac.

Soybeans

Soybeans, which are high nitrogen users, require the rhizobium *Bradyrhizobium japonicum*, a non-native species, for adequate nodulation and nitrogen fixation. Researchers Chris Holazpfel at the Indian Head Research Foundation and Garry Hnatowich with the Irrigation Crop Diversification Corporation have been leading research projects since 2014 to look at soybean inoculation and fixation under Saskatchewan conditions.

Similar to Manitoba Pulse and Soybean Growers (MPSG), most field trials in Saskatchewan have shown significant benefits to double inoculation for new soybean fields that have no prior history of soybean production. Dual inoculation includes a seed applied inoculant in conjunction with a granular inoculant at the recommended rate, or slightly higher. After two rotations of soybeans, a single application may be adequate under good growing conditions and with fresh, properly handled products. While the research did not find any differences in products, growers should follow manufacturer’s recommended rates, and note that granular product rate recommendations may be affected by row spacing. Always assess nodulation, regardless of field history or inoculation methods, and look for at least five healthy nodules/plant at the R1 (first flower) growth stage.

For more information on soybean inoculation, click on MPSG’s *Soybean Fertility Fact Sheet*. 
Faba Beans

Hnatowich is also leading a three-year, seven-site research project, comparing peat-based and granular inoculants at various rates for zero-tannin and tannin varieties of faba beans. Similar to peas and lentils, faba beans require the strain *Rhizobium leguminosarum* for fixation, and in most locations peas and lentils have been grown in rotation for the past several years.

The results to date were very consistent across all sites and did not show any significant response to inoculation at any rates. All plots, including the control plots, formed good nodulation and achieved high yields. Researchers suspect that the lack of response may be because the *Rhizobium* strain for faba beans is native to Saskatchewan soils, and all of the field sites have had a previous history of peas and lentils. For now, growers are recommended to consider a single inoculant treatment for faba beans, similar to what they would use for peas or lentils on their farm.

Nodulation Assessment

For all pulse and soybean crops, growers should assess nodulation at the early flowering stage regardless of field history or inoculation methods. The number of nodules is important as well as where the nodules are located. Seed-placed inoculants typically form nodules close to the seed, granular formulations often produce nodulation further out on the lateral roots. Look for at least five nodules per plant.

For crops like soybeans, effective nodulation is critical to meeting the nitrogen demands.

Poor nodulation is most common in new soybean fields, cold/saturated soils, coarse soils, soils with high residual nitrogen (pH <5.7 or >7.3), or compacted soils. If nodulation is poor in soybeans, then a 50 lbs/ac nitrogen applied at the R3 (pod initiation) stage can help mitigate yield loss. However, yields are rarely recovered to the potential that could have been achieved with good nodulation.

Typically, most other pulse crops with not require additional nitrogen at this stage.

For more information on nodulation assessment visit Saskatchewan Ministry of Agriculture’s *Nodulation and Nitrogen Fixation Field Assessment Guide*. 