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Inside:

Legume Inoculant Quality

Nitrogen is a key element in all living things and while our atmosphere is 78% nitrogen gas, it is not in a form that is readily available. The two nitrogen atoms (N_2) that are bound together in nitrogen gas are very stable, and must be transformed into a form, usually ammonia (NH_3) or nitrate (NO_3), that can be used by plants. Splitting nitrogen molecules apart and converting them to ammonia or nitrate requires a huge amount of energy. This energy can be supplied through industrial processes to make fertilizers such as ammonium nitrate or biologically to form ammonia that is used by plants.

Most biological nitrogen fixation occurs in legumes that have a unique ability to form a symbiotic relationship with rhizobia (*Rhizobium* and *Bradyrhizobium*) bacteria. The bacteria invade plant root hairs, multiply and, through interaction with the plant, form root nodules. Within these nodules the plant provides glucose from photosynthesis that the rhizobia use as an energy source to fix nitrogen gas obtained from the air. In biological energy currency, called ATP (adenosine triphosphate), it takes about 50 ATP to convert one molecule of nitrogen into two molecules of ammonia.

Legumes will vary in how much nitrogen they fix symbiotically and how much nitrogen they will garner from soil sources. The balance is dependent on a number of factors, such as the level of nitrogen in the soil, effectiveness and number of root nodules, type of legume, plant growth stage and soil temperature. The benefits of legume crops, as measured by crop yield of cereals and grasses, often persist for several years.

Each legume requires a specific species of rhizobia to form nodules that are effective in fixing nitrogen. If a legume was grown in a field previously, there is a good chance that the correct rhizobia species is present to nodulate the plants. However, a native rhizobial population, made up of organisms that are poor nitrogen fixers, or types that infect the plant but never form nodules, may also be present. The effective and less effective strains will compete with each other in the soil for entry into legume roots.

Commercial inoculants are composed of rhizobial strains selected for maximum nitrogen fixation potential. It is good practice to apply an inoculum, especially if the legume has never or not recently been grown in that field. The use of commercial strains does not assure that these superior rhizobia will outcompete native strains that might be present to form root nodules. Never-the-

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Points of Interest

Among the vegetables tested at the Lacombe Research Centre in 1908 were some that are still used today: Beans - Golden Wax - rated the best tested; Carrots-Improved Nantes; and Cauliflower-Early Snowball.

Also mentioned in Mr. G. H. Hutton's report to Dr. Wm. Saunders was "This season produced the finest pansies we have had. The varieties worthy of special mention are Lord Beaconsfield, Giant Trimardeau and Giant Hercules."

For more information about any of the articles in this publication contact: Dr. E.A. de St. Remy, Phone: (403) 782-8126 E-mail: destremya@em.agr.ca.

Inoculant Tips

Purchase the correct inoculum for the legume species you plan to grow.

Purchase fresh product, and no more than is needed for one season.

Store inoculum in a refrigerator or a cool, dark place.

Sow inoculated seed as soon as possible. If seeding is delayed more than 1 day, consider reinoculating the seed.

Fungicide-treated seed requires 2-3 times the usual inoculation rate because the fungicide reduces the rhizobial population.

Rhizobia survive poorly in acid soils. Consider liming if the soil pH is low. Soils below pH 6.0 often have low molybdenum availability. Molybdenum is an important micronutrient for nitrogen fixation.

Make sure that you have adequate levels of phosphorous (P) and potassium (K) and low levels of nitrogen (N) in your soil. P and K impact the number and fresh weight of nodules and the amount of N fixed per nodule. If the soil N level is too high the plants will stop fixing N and utilize soil N.

Sow seed into evenly moist soil. Extremely dry or wet soils reduce rhizobial numbers.

Check to see that your plants are fixing nitrogen by looking to see that the root nodules are pink or red inside.

less, commercial inoculation of seed or soil is a good insurance policy when the farmer has confidence in the quality of the product.

Many factors contribute to high quality legume inoculant products. Most important is that they contain high numbers of live rhizobia that can nodulate and fix nitrogen on the target host legume, and that the inoculum has little or no contamination by other organisms.

Contamination of inoculum can occur if the "mother" cultures of rhizobia used to produce larger batches of rhizobia are not maintained properly. Inoculants are either applied to seeds using peat-based or liquid carrier, or soil applied using granules or in-furrow liquid systems. Sterile carriers generally produce better inoculant products. Rhizobial numbers can decline rapidly in non-sterile carriers during storage because of competition with contaminating organisms, and there is a possibility that the non-sterile carrier may also carry opportunistic human, animal or plant pathogens.

The number of *Rhizobium* cells that are viable in the inoculant is critical. World-wide minimum standards range from $5x10^7$ to $1x10^9$ cells per gram of freshly prepared inoculant. We are fortunate in Canada that we do have regulations under the Fertilizer Act that govern legume inoculant quality. In many other countries, quality control is left up to the manufacturers.

Various methods, including microscopic examination; plate counts of viable cells; most probable number (MPN) plant infection assay that relies on positive or negative nodulation responses; and immunological tests, can be used to evaluate inoculant products to ensure that they meet quality standards. The methods to produce and assure inoculant quality have been identified, and the adoption of an international standard for quality would benefit all users.

Further details can be found in: *Field Crops Research* 2000 Vol. 65 Pages 259-270.

Canadian Fertilizer Act Facts

Rhizobium inoculants must contain sufficient viable cells of nodule-producing species to provide the following number of viable cells per seed:

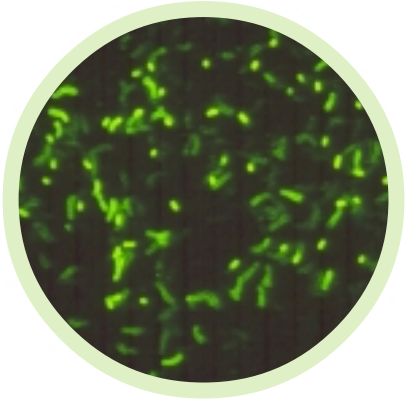
Small seeded legumes such as alfalfa, birdsfoot trefoil, clover - 1000

Medium seeded legumes such as sainfoin - 10,000

Large-seeded legumes such as beans, peas, soyabeans - 100,000

The minimum number of viable, nodule-producing *Rhizobium* cells adhered to pre-inoculated seeds is the same as above. The product must not contain any substances that would inhibit nodulation or nitrogen fixation.

Inoculant must be prepared so that the number of viable cells of other non-*Rhizobium* species are at a level that will not affect the viability or performance of the desired species.



Rhizobium are gram-negative, typically motile, aerobic bacteria. They are rod-shaped 0.5 to 0.9 μm wide and 1.2 to 3.0 μm long.

One method of determining the identity of rhizobia in broth cultures is by indirect fluorescent antibody identification. The target rhizobia will glow green when exposed to near-ultra-violet light when viewed through a properly equipped microscope.

Getting to the Root of the Matter

Brown Girdling Root Rot (BGRR) is a widespread and serious problem of *Brassica rapa* (Polish canola) in the Peace River Region of northern Alberta and British Columbia where yield losses of up to 58% on individual fields have been recorded.

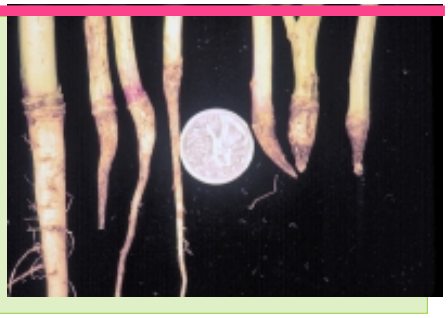
The organism most often associated with the disease is *Rhizoctonia solani*. In most of western Canada, *R. solani* usually causes seedling blight, but in the Peace River region it causes both seedling blight and much more serious BGRR.

There is some indication that poor soil fertility may be related to the higher incidence of the disease. Approximately 31% of cultivated land in the Peace River Region has a pH of 6.0 or less. Liming has been shown to reduce the incidence of BGRR.

Screening potential parent lines for resistance to disease is an important part of any breeding program. Researchers at the Beaverlodge Research Farm developed a new field screening technique of planting alternate rows with a check that is susceptible to BGRR. This minimizes the variation of the disease across the field and reliably identifies resistant lines.

Of 260 *B. rapa* lines screened, five lines with partial resistance to BGRR were identified. While no lines were immune to the disease, these lines do provide a starting point for the development of BGRR resistant parent lines.

Further details can be found in the *Canadian Journal of Plant Science* 2000 Vol. 80 Pages 199-202.



Healthy canola root (far left), three canola roots with intermediate BGRR symptoms (left of coin), and three canola roots with severe BGRR symptoms (right of coin).

AC Morgan Oat

A milling oat cultivar, tested as OT792, received support for registration in February of 1999. This variety, bred by Dr. Solomon Kibite, will be marketed by SeCan as AC Morgan.

AC Morgan has high yield, especially on Black and Grey-Wooded soils of Alberta where it is best adapted.

AC Morgan has good milling quality which is important as there is a premium for oats used for milling. At the same time, the high percentage of plump kernels make it an attractive feed oat as well.

AC Morgan has very good lodging resistance and matures, on average, in 101 days.

AC Morgan is susceptible to both crown and stem rust so it will not be recommended for Manitoba or eastern Saskatchewan where these diseases are prevalent.

A limited quality of Certified seed will be available for spring of 2001. It is anticipated that the variety will be more widely available for the 2002 cropping year.

Performance of AC Morgan compared to check varieties on Black and Grey-Wooded soils of Alberta.

	Grain Yield ('00 kg/ha)
AC Morgan	63.7
AC Medallion	56.6
CDC Pacer	61.6

	Lodging Resistance*
AC Morgan	2.2
AC Medallion	4.2
CDC Pacer	3.7

*1=no lodging; 9=completely lodged.

	Plump Kernels (%)
AC Morgan	76.4
AC Medallion	72.0
CDC Pacer	67.7

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Forage/Beef Work Recognized

2000 Premier's Award *of* Excellence

The Western Forage/Beef Group was very pleased to have their work recognized by both the federal and provincial governments. The Mission of the Group, comprised of staff from both Agriculture and Agri-Food Canada and Alberta Agriculture, Food and Rural Development is to *"improve the profitability and sustainability of the forage-based beef industry through development, integration and transfer of knowledge and technology"*.

The Western Forage/Beef Group received an Agri-Food Sector Agcellence Award from Agriculture and Agri-Food Canada for their work in reducing the winter feeding costs and extending the grazing season, thus improving the profitability and sustainability of the forage-based beef industry in western Canada.

This Award is given to a team or an individual (includes private sector members or teams) for completion of a project or work activity that results in a significant contribution to the agriculture and agri-food sector. The work must display a combination of:

- contributing to the safety, quality, and marketability of agricultural and food products;
- promoting self-reliance and stability, building on regional strengths and diversity;
- protecting agricultural resources and the environment;
- encouraging market responsiveness; and
- living up to the Departmental values.

Dr. Brian Morrissey, Assistant Deputy Minister, Research Branch and Dr. Gordon Dorrell, Director, Western Region, Research Branch of Agriculture and Agri-Food Canada presented the Agcellence Awards to the recipients at a reception at the Lacombe Research Centre on June 9th, 2000.

The Western Forage/Beef Group also received a Silver Premier's Award of Excellence from the Hon. Ralph Klein at a ceremony held June 19th, 2000 in Edmonton.

The Award criteria are based on quality management principles articulated by the National Quality Institute that key on leadership and people focus, client and stakeholder focus, and process management.

To be considered for an award, teams prepare a detailed submission. An external review team of quality management experts from the private sector reviews a short list of submissions, and makes recommendations on bronze, silver and gold awards to the Premier, who then makes the final selection.

Edited, designed and produced by E.A. de St. Remy