2017

EFFICACY REPORT

FOR AGRICULTURE

PREMIER TECH

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PREMIER TECH

Premier Tech has been growing its leadership position globally for more than 95 years, driven by the collective power of its 3 800 team members in 24 countries. Leveraging its human capital as well as a deeply rooted Culture revolving around innovation and excellence, Premier Tech focuses its efforts in three core industries: Horticulture and Agriculture – greenhouse production, agriculture, and lawn and garden; Industrial Equipment – rigid and flexible packaging, material handling, and palletizing; and Environmental Technologies – wastewater treatment and rainwater harvesting. Committed to the long-term success of its clients and backed by its scientific and technical expertise in the production and use of biological active ingredients, combined with ongoing investments in its manufacturing capabilities, Premier Tech develops and continually improves the AGTIV® commercial offer for both field crops and specialty crops internationally.

90 years of history,
41 manufacturing facilities

Over 3 800 team members
in 24 countries

19 Business Units divided **into 3 groups**

THE POWER OF 3 GROUPS

GHA

HORTICULTURE AND AGRICULTURE

Consumer

Professional Horticulture

Agriculture

PRO-MIX Golfgreen C-I-L plant prod MYKE PREMIER Terreaux France ALASKAN wilson GreenEarth AGTIV

ETG

ENVIRONMENTAL TECHNOLOGIES

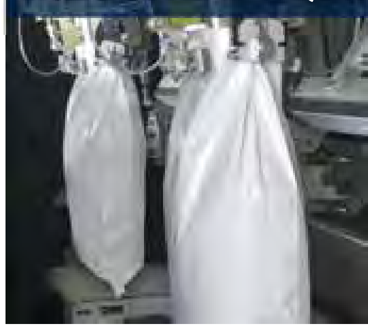
Residential

Municipal, Commercial, Communal, Institutional and Industrial (M2C2I)

Services Management Solutions

IEG

INDUSTRIAL EQUIPMENT



Flexible Packaging

Rigid Packaging

Bulk Processing and Peat Moss Field Equipment

INNOVATION:

AN INTEGRAL PART OF PREMIER TECH COLLECTIVE DNA

At Premier Tech, Innovation goes beyond the concept of research and development. More than a process leading to the creation of new products, it is a state of mind that is strongly embedded in our corporate DNA. Always seeking to create unique and addictive experiences for our clients, we simply never cease to push the boundaries of our abilities, competencies and technological platforms.

We first structured our Innovation efforts and approach back in 1983, driven by the ambition of developing value-added products derived from peat moss through technological advances. Today, more than 260 Premier Tech team members are devoted full-time to mastering the technologies behind the next leading-edge solutions that will make a difference to our clients, helping them stand out in their marketplaces.

In our state of the art labs and testing facilities, highly experienced and trained engineers, scientists, and specialists from various fields collaborate on a daily basis to maximize the outcomes of applied research and turn them into breakthrough products. However, whether it's in our World Headquarters in Rivière-du-Loup, Québec, or in one of the 24 countries around the world in which we operate, our innovative spirit spreads out further than our IR&D teams to resonate within all 3 800 Premier Tech team members.

Driven by a collective Culture and rooted in Values which revolve around our tradition of Innovation, the entire Premier Tech team holds a restless ambition to shake up the status quo and shift industry paradigms. This means that we are constantly challenging the way we do business and how we can improve everything we do.

This mindset is key to how we operate on a daily basis. Contributing to the loyalty of our clients around the world, it sets the ground rules for how collaborating with Premier Tech turns out to be a contagious experience they are willing to share with others.

We deeply believe that in order to continue to be sustainable and grow our market share, it is essential to never let our innovative spirit rest — to keep pushing forward and eliminate any barriers on the path to bringing new technologies, products and services to life in the marketplace. With the agility to truly make a difference by tapping into our full potential, we create value for our clients, and ultimately ensure our continued relevance as a strategic partner.

BIOLOGICAL ACTIVE INGREDIENTS

PREMIER TECH

Backed by more than 30 years of expertise in biological active ingredients, Premier Tech masters a unique large-scale manufacturing process that meets the highest quality control levels.

EXPERTISE OF 30 years IN ACTIVE INGREDIENTS

- ✓ No contamination
- ✓ Constant quality
- ✓ Industrial scale

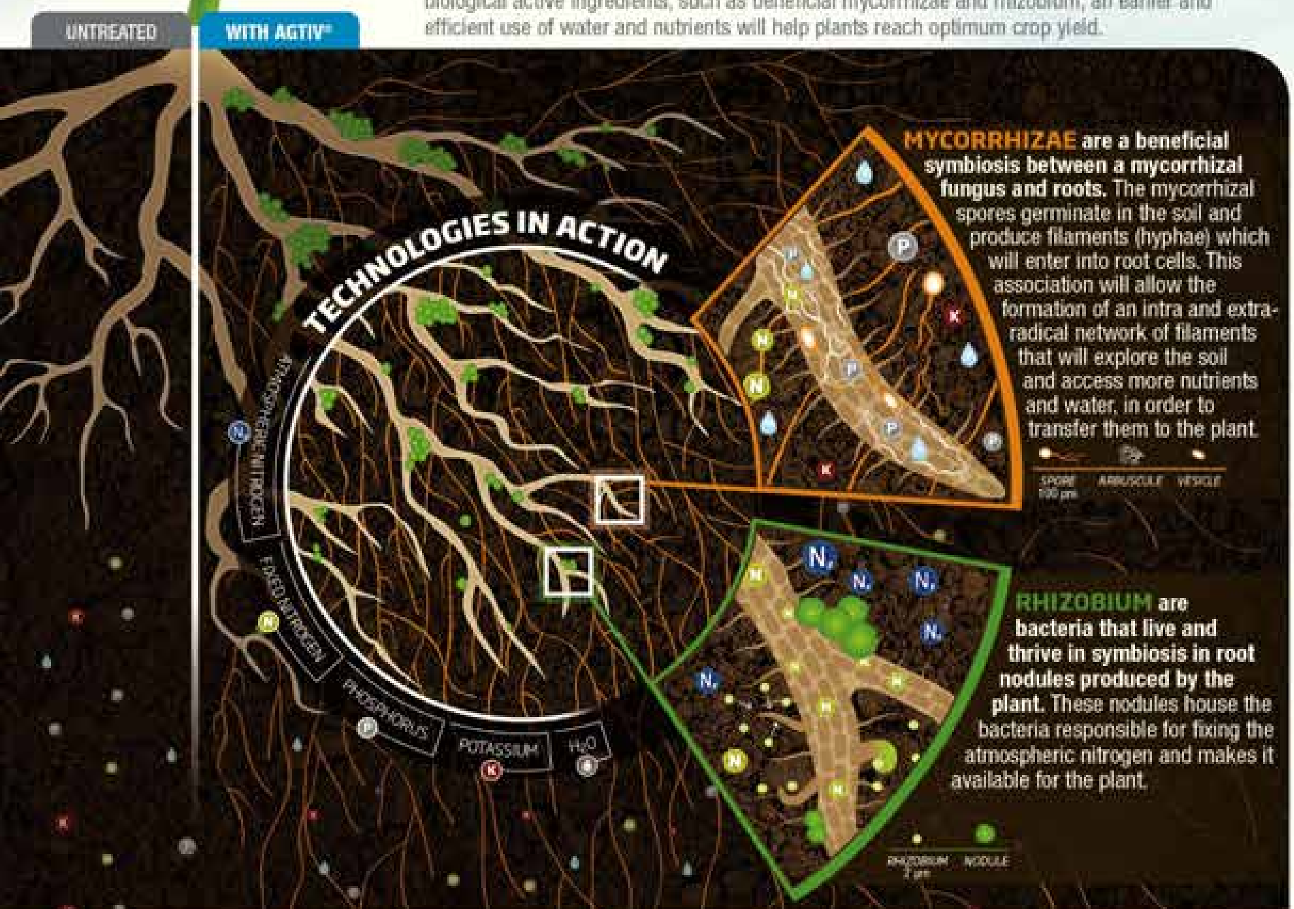
- ✓ Specialty products tailored to the clients' needs

- ✓ Easy-to-use products integrating mycorrhizae & rhizobium

BIOLOGICAL ACTIVE INGREDIENTS

PLANT

Nutrients and water are essential components for effective plant growth. By adding biological active ingredients, such as beneficial mycorrhizae and rhizobium, an earlier and efficient use of water and nutrients will help plants reach optimum crop yield.



TRIPARTITE SYMBIOSIS

is the biological interaction between MYCORRHIZAE, RHIZOBIUM and the PLANT. By enhancing root system growth and creating a network of filaments, mycorrhizae help plants to uptake more nutrients, such as phosphorus, and increase the nodulation process for the rhizobium.

GET AN EARLY START
+
REACH MORE NUTRIENTS
=
PROVEN RESULTS

M MYCORRHIZAE

ENDOMYCORRHIZAL INOCULUM – PTB297 Technology
Glomus intraradices

Production: An exclusive aseptic production process developed by Premier Tech using standards of the high-technology industry to obtain viable mycorrhizal spores of a consistent high quality.

- ✓ EXPAND ROOT SYSTEM GROWTH
- ✓ ENHANCE NUTRIENT & WATER UPTAKE
- ✓ INCREASE TOLERANCE TO STRESSES
- ✓ IMPROVE SOIL STRUCTURE

R RHIZOBIUM

RHIZOBIAL INOCULUM – Technologies: PTB160 (pulses), PTB162 (soybean)
Rhizobium leguminosarum biovar *viceae*, *Bradyrhizobium japonicum*

Production: Premier Tech's rhizobia technologies include a specific production process in a sterilized environment as well as a highly-efficient quality control process for superior inoculum.

- ✓ FIX NITROGEN & MAKE IT AVAILABLE TO THE PLANT

MYCORRHIZAE

EFFICACY | VERSATILITY | COLLABORATION

Mycorrhizal fungi have existed since the first plants appeared on dry land more than **450 million** years ago. AM (Arbuscular Mycorrhizae) symbiosis applies to over **80%** of all plants and plays a major role in plant nutrition and productivity. “Over the last 35 years, numerous scientific studies have clearly highlighted the fundamental role that mycorrhizal fungi play in natural eco-systems, and in those managed by man.”[I]

ABSORPTION CAPACITY

Premier Tech's mycorrhizal technology makes P more available in the soil, and actively absorbs and transfers it via its filament network (hyphae) directly to the root. The filaments in the soil also have the ability to absorb water and elements such as Cu, Zn, B, Fe, Mn which are important in nodule formation and filling of grain.

Mycorrhizae have been shown to improve soil structure by releasing a "biological glue" called glomalin and to increase the presence of other beneficial micro-organisms in the root environment.

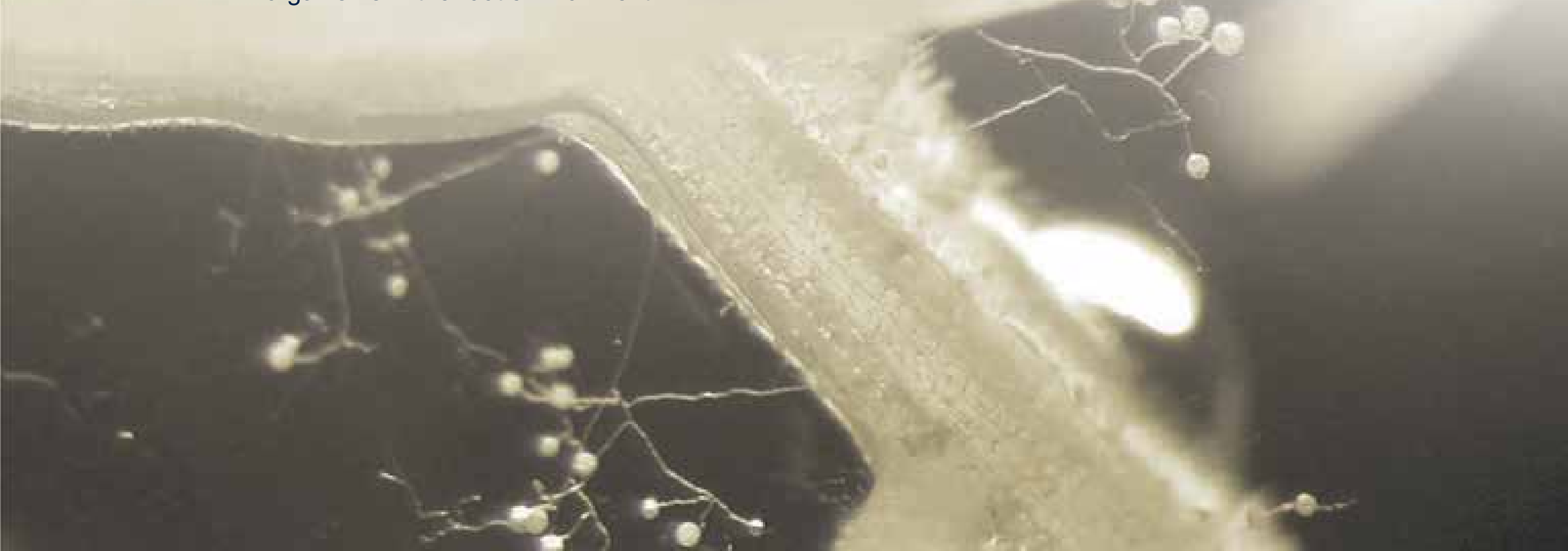
“Although mycorrhizal fungi do not fix nitrogen, they transfer energy, in the form of liquid carbon to associative nitrogen fixers.”[E]

“Mycorrhiza deliver sunlight energy packaged as liquid carbon to a vast array of soil microbes involved in plant nutrition and disease suppression.”[G]

“The absorptive area of mycorrhizal hyphae is approximately 10 times more efficient than that of root hairs and about 100 times more efficient than that of roots.”[E]

EFFICIENT P UPTAKE AND TRANSFER

Thonar et al. (2010)[M] compared three species of AMF and observed “*Glomus intraradices*, *Glomus claroideum* and *Gigaspora margarita* were able to take up and deliver P to the plants from maximal distances of 10, 6 and 1 cm from the roots, respectively. *Glomus intraradices* most rapidly colonized the available substrate and transported significant amounts of P towards the roots.” Caravagno et al. (2005)[N] found that “*Glomus intraradices* was found to be one of the arbuscular mycorrhizal fungi that was able to control nutrient uptake amounts by individual hyphae depending on differing phosphorus levels in the surrounding soils.”



Glomus intraradices' versatility in different conditions

There are more than 200 species of AMF (Arbuscular Mycorrhizae Fungi) and Premier Tech offers a versatile species. Selected more than 30 years ago, it has been tested continuously under various conditions and has performed well in a range of soil pH from 5.2 to 8.1.

"*G. intraradices* has turned out to be a "great fungus" in several surveys, and field trials so far has shown it to be equal or superior to mixtures of other fungi."[A]

Collaborating Species

The mycorrhizal species used in Premier Tech products *(Glomus intraradices)* is among the most 'collaborative' species in various articles.

"According to the article by Kiers et al.[B], it has been shown that the different species of mycorrhizae are not equally effective when it comes to transferring nutrients from the soil to the plant. Under controlled conditions, certain species of mycorrhizae have been shown to be more 'cooperative' and to transfer most of the phosphorus absorbed from the soil to the root, while other mycorrhizae species use it or store it as reserve.

"[…] Moreover, when host plants were colonized with three AM fungal species, the RNA of the cooperative species *(G. intraradices)* was again significantly more present than that of the two less-cooperative species *(G. aggregatum and G. custos)"* [B]. "This illustrates key differences in fungal strategies, with *G. intraradices* being a 'collaborator' and *G. aggregatum* a less-cooperative 'hoarder'."[B]

Indigenous Populations

Some articles demonstrate that mycorrhizal populations in agricultural soils are highly heterogeneous or not sufficient to have the desired beneficial effect.

A survey conducted by Hamel et al. (2008)[H] reported low biodiversity and occurrence of AM fungi in cultivated soils of Saskatchewan. The survey was conducted for 3 years. Dai, M. et. al. (2013)[J] noticed that the relative abundance as well as diversity of AM fungal communities is lower in cropland soils of the prairies compared to the roadsides environments which favors diversity.

The recommendation of Premier Tech, approved by Agriculture Canada, to add a mycorrhizal inoculant at the time of seeding stands on 4 points:

- **The right mycorrhizae for the plant**
  at least 80% of plants can be colonized with *Glomus intraradices*, a collaborative species
- **Available in the right place**
  on or close to the seed in order to trigger the symbiosis quickly
- **In the right quantity**
  The proven and registered mycorrhizal rate
- **At the right time**
  adding the mycorrhizae at seeding time to trigger the symbiosis quickly after seed germination

QUICK COLONIZER

It has been shown that plants favour certain species according to their effectiveness.

“We show that order of arrival can influence the abundance of AMF species colonizing a host. These priority effect can have important implications for AMF ecology and the use of fungal inoculant in sustainable agriculture.” [F]

Duan et al.[D] (2011) using our *Glomus intraradices* isolate (DAOM181602) with *G. margarita* (WFVAM 21), wrote “Furthermore, *G. margarita* developed slowly compared with *G. intraradices* when they were inoculated separately and it seems likely that the latter fungus dominated the symbiosis with medic when both fungi were inoculated together.” He adds “The positive effect of *G. intraradices* was probably enhanced by its ability to colonize quickly and it may well have contributed a much larger fraction of fungal biomass than *G. margarita*, when both were inoculated together”. In conclusion, he writes “When inoculated together *G. intraradices* may have dominated the activity of symbiosis, both in terms of rapidity of early colonization and functionality, including tolerance to disturbance.”

DROUGHT RESISTANCE

Mycorrhizae increase tolerance to various environmental stresses (diseases, drought, compaction, salinity, etc.), and play a major role in the soil particle aggregation process and contribute to improving soil structure which leads to better water penetration, better aeration, less erosion and leaching.

Benjamin Jayne and Martin Quigley of the University of Denver mentioned that “[…] our meta-analysis reveals a quantifiable corroboration of the commonly held view that, under water-deficit conditions, plants colonized by mycorrhizal fungi have better growth and reproductive response than those that are not.” [K] “Most measures of growth are augmented by the symbiosis when plants are subjected to water stress; […].” [K]

It has been found that plants with AMF association display greater hydraulic conductivity in roots and reduced transpiration rate under drought stress. This may be due to their capacity to regulate their ABA levels (abscisic acid – a plant hormone) better and faster than non-AM plants. This establishes a greater balance between leaf transpiration and root water movement in drought situations and drought recovery (Aroca et al. 2008). [L]

Sources:

[A] Trivedi et. al. 2007. Organic farming and mycorrhizae in agriculture.I.K. International Publishing House Ltd. New Delhi, pp.290.

[B] Kiers et. al. 2011. Reciprocal Rewards Stabilize Cooperation in the Mycorrhizal Symbiosis. Science 333:80-882.

[C] Waligora et. al. 2016. Mycorhizes connectés, bien avant tout le monde. Agron. Écol. & Inn. 89 :18-27. (free translation)

[D] Duan et. al. 2011. Differential effects of soils disturbance and plant resudue retention on function of arbuscular mycorrhizal (AM) symbiosis are not reflected in colonization of roots or hyphal development in soil. Soil Biol. & Bioch. 43:571-578.

[E] Jones, C. E. 2009. Mycorrhizal fungi -powerhouse of the soil. Evergreen Farming 8:4-5.

[F] Gisjbert et. al. 2014. Order of arrival structures arbuscular mycorrhizal colonization of plants. New Phytologist. pp. 10.

[G] Jones, C. E. 2014. Nitrogen: the double-edge sword. Amazing Carbon. pp. 8.

[H] Hamel, C. et. al. 2008. Mycorrhizal symbioses in soil-plant systems of the Canadian prairie. XVI International Scientific Congress of the National Institute of Agricultural Science, November 24-28, La Havana, Cuba.

[I] Fortin J. A, 2009. Mycorrhizae The new green revolution. Ed. MultiMondes. pp.140

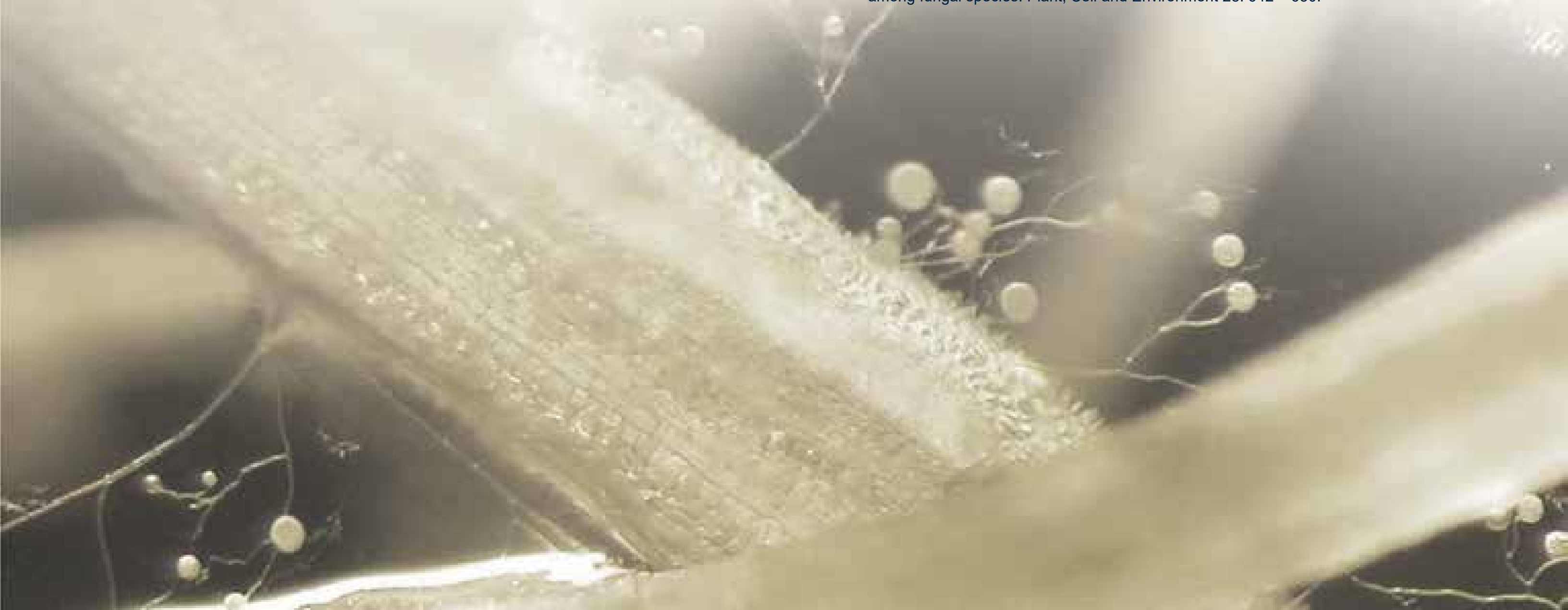
[J] Dai, M. et. al. 2013. Impact of Land Use on Arbuscular Mycorrhizal Fungal Communities in Rural Canada. Applied and Environmental Microbiology 79 (21):6719-6729

[K] Jayne B., Quigley M. (2013) Influence of arbuscular mycorrhiza on growth and reproductive response of plants under water deficit: a meta-analysis. Mycorrhiza (2014) 24:109-119

[L] Raviv M. (2010) The use of mycorrhiza in organically-grown crops under semi arid conditions: a review of benefits, constraints and future challenges. Symbiosis (2010) 52-65-74

[M] Thonar, C; A. Schnepf; E. Frossard; T. Roose; J. Jansa (2011) Traits related to differences in function among three arbuscular mycorrhizal fungi. Plant Soil. 339: 231 – 245

[N] Cavagnaro, T; F. Smith; S. Smith; I. Jakobsen (2005) Functional diversity in arbuscular mycorrhizas: exploitation of soil patches with different phosphate enrichment differs among fungal species. Plant, Cell and Environment 28: 642 – 650.



RHIZOBIUM

FERTILITY | PRODUCTIVITY | COLLABORATION

Peas, lentils and soybeans play a big role in a crop rotation by promoting nitrogen fixation (the conversion of nitrogen gas to plant-available ammonium) and returning some nitrogen to the soil.

However, these crops can't take all the credit: because it's only possible thanks to a symbiotic relationship between select legumes and rhizobium bacteria.

These bacteria can't fix nitrogen on their own. To do so, they need to colonize the root of a host plant. As in all symbiotic relationships, both the rhizobium and the pulse or soybean plant get something of value from the relationship.

For the legume, it is a readily available form of nitrogen (ammonium) as well as important amino acids.

The rhizobium get three things in return:

1. **A Home** – the bacteria inhabit the nodules formed by the plant
2. **Food / energy** – provided in the form carbohydrates (heterotrophic bacteria cannot create their own food through photosynthesis)
3. **Oxygen** – which is necessary for respiration

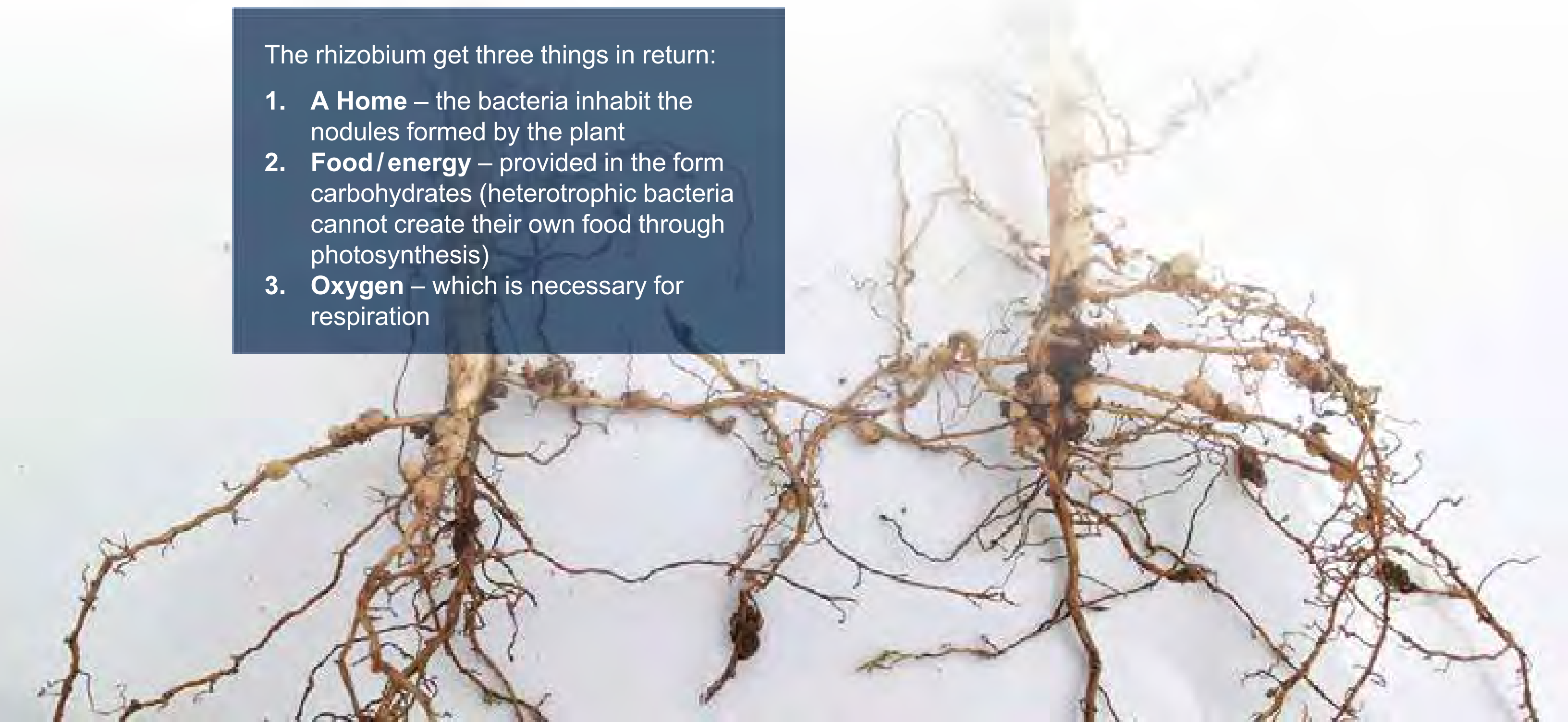
Roots of the rhizobium relationship

Approximately 20% [A] of all legumes form mutualistic relationships with rhizobium. Soybean, peas, clover, lentils and faba beans are among them. Interestingly, Rhizobium species are very plant specific. Pulses form relationships with a rhizobium called *Rhizobium leguminosarum*, while soybeans engage with another member of the family called *Bradyrhizobium japonicum*.

When a rhizobium and a host legume are present, the plant makes the rhizobium aware of its presence by sending out a chemical signal (via flavonoids and isoflavonoids) from the root. This attracts the rhizobium bacteria, which responds by sending out signals of its own, known as Nod factors.[B]

Nodule formation & nitrogen fixation

The bacteria start the "invasion process" by penetrating the root-hair wall and enter the plant cells. This primes a gene within the plant that initiates the root nodulation. Within these nodules, the rhizobium differentiate into a non-motile form, which go to work fixing the raw atmospheric nitrogen (N_2) into plant accessible ammonium. They achieve this by producing nitrogenase enzyme, which starts the conversion process, consuming a great deal of energy. Maximum N-fixation is reached when the plant is sufficiently nodulated.



Ammonium absorption / exchange of services

After the nodule formation, the plant converts the ammonium into amino acids which are exported throughout the plant. At this point, the plant releases the simple sugars and O_2 to the rhizobium bacteria, fulfilling its end of the bargain.

This last step is important, as the presence of oxygen can stop nitrogen fixation – and cause it to be lost to the atmosphere as a gas. Fortunately, the rhizobium take the oxygen and bind it using a protein called leghemoglobin (was first discovered in legumes and is very similar to the hemoglobin found in human blood). Like blood, leghemoglobins appear red in the nodules, due to the presence of iron molecules.

Legume plants are known to have a lower phosphorus use efficiency. This is a problem, because the process of nitrogen fixation is very energy-intensive for pulse and soybean plants. For this reason, they consume more phosphorus (P) than other plants.

The increased demand can be alleviated thanks to another symbiotic association, the mycorrhizal symbiosis. Mycorrhizae are symbiotic fungi that colonize the roots of most plants, and dramatically improve the plant's ability to absorb phosphorus. The plant will photosynthesize 51%[C] more and grow faster, and the rhizobium will fix more nitrogen if more phosphorus is available. For this reason, having a healthy mycorrhizal association is of particular benefit to pulses and soybeans.

What modulates / influences nodulation?

- Successful infection depends on the competitiveness, specificity, infectivity and effectiveness of the rhizobia [D]
- Infection rate & effectiveness of rhizobia are influenced by soil low N status and is a necessary requisite to trigger symbiosis [E]
- Successful infection requires the bacteria to actively colonize root-hair tips (motility) and reach the Quorum sensing of the rhizobium. [F]
- N fixation relies on a cascade of effector molecules – events in multi-steps series of reactions and depend on effector availability, concentration and localization, synchronization, host specificity and environmental factors.

Sources:

[A] Sprent, J.I., 2007. Evolving ideas of legume evolution and diversity: A taxonomic perspective on the occurrence of nodulation. New Phytol. 174:11-25

[B] Giller, K.E., 2001. Nitrogen Fixation in Tropical Cropping Systems 2nd ed. CABI

[C] Kaschuk et al. 2009. Soil Biol. Biochem. 41:1233-1244

[D] Peix A, Velázquez E., Silva L.R., Mateos P.F., 2010. Key Molecules Involved in Beneficial Infection Process in Rhizobia–Legume Symbiosis. In: Microbes for Legume Improvement, Chapter 3:55-80

[E] Bonilla, I. and L. Bolaños, 2010. Mineral nutrition for legume-rhizobia symbiosis: B, Ca, N, P, S, K, Fe, Mo, Co, and Ni: A review. In: Organic Farming, Pest Control and Remediation of Soil Pollutants, Sustainable Agriculture Reviews, pp. 253-274, E. Lichtfouse (ed.), Springer Netherlands.

[F] Miller LD, Yost CK, Hynes MF, Alexandre G (2007) The major chemotaxis gene cluster of Rhizobium leguminosarum bv. viciae is essential for competitive nodulation. Mol Microbiol 63:348-362

TRIPARTITE SYMBIOSIS

MYCORRHIZAE + RHIZOBIUM + PLANT = BIGGER YIELD

Studies regarding the addition of mycorrhizal and rhizobial inoculants, at the time of seeding, have clearly demonstrated that these microorganisms work in collaboration with legumes and play a major role in increasing crop productivity.

Mycorrhizae develop a network that explores the soil and accesses more nutrients and water to transfer to the plant; rhizobium fixes nitrogen and makes it available to the plant. By working together, they influence positively the plant for increased yield.

Help feed the plant

N and P are major nutrients for the plant. *"Tripartite associations of host plants with both rhizobia and AMF* [Arbuscular Mycorrhizal Fungi] *benefit the host plant by increased P uptake through the mycorrhizal association balancing the high input of N through rhizobial N-fixation."* [1] In addition, mycorrhizae reach more water and nutrients needed by legumes such as B, Ca, Cu, Fe, K, Mn, Mo and Zn, key components for energy production.

Higher photosynthesis

When used in combination, mycorrhizae and rhizobium increase the photosynthetic rate by 51%[2]. *"The rate of photosynthesis increased substantially more than the C* [Carbon] *costs of the rhizobial and AM* [Arbuscular Mycorrhizal] *symbioses."* [2] The total increased sugar production by the plant far outweighs the cost to "house" the partners.

Better productivity

Better nutrient use efficiency and bigger biomass result in higher yield from each legume plant (harvest index). For example, "[…] *it has been found that pea plants coinoculated with Rhizobium leguminosarum and AMF* [Arbuscular Mycorrhizal Fungi] *has shown best results regarding plant height, plant dry mass, nodule fresh weight, number of seeds, seed weight, seed yield, number of root nodules, number of pods per plant, average pod weight and pod length* […]".[3]

Each phase of the plant growth requires a lot of nutrients and energy to obtain higher yield. "[…] *the tripartite interactions between legumes, AMF* [Arbuscular Mycorrhizal Fungi] *and rhizobia cause increases in legume productivity, and the N:P:C supply ratio as influenced by the tripartite symbiotic associations plays a fundamental role in controlling the legume's photosynthetic rate and biomass productivity."* [1]

(1) Koele et al. 2014. VFRC Report 2014/1, pp. 1-57 (2) Kaschuk et al. 2009. Soil Biol. Biochem. 41:1233-1244
(3) Shinde et al. 2016. Int. J. Bioassays. 5:4954-4957

CANOLA ROTATION

EARLY START | BETTER NUTRIENT UPTAKE | EFFICACY

Growers and researchers have long observed that crops following canola in a rotation tend to demonstrate reduced yield, compared to results when seeded behind another crop. It can largely be explained by the relationship (or lack of relationship) between canola and certain fungal microorganisms in the soil. One of the major fungal groups negatively affected by canola are *Arbuscular Mycorrhizal Fungi*.

HOW CAN YOU IMPROVE CROP PERFORMANCE ON CANOLA STUBBLE?

CANOLA

Arbuscular mycorrhizae form a mutual beneficial association with the roots of nearly all crops, except canola, a major crop grown in Western Canada. Because canola does not form an association with mycorrhizae, and exude certain toxic compounds in the soil[1], fungal populations in the soil naturally decline. Once the mycorrhizae are gone, they take a sustained period to re-establish. A study by Gavito and Miller[2] examined the presence of mycorrhizae in a corn crop following canola. They discovered it took 62 days for the mycorrhizae population to return to the same level it was before the canola crop.

STUBBLE

Mycorrhizae create an intricate network of filaments (called hyphae) inside and outside the roots. These hyphae will explore and expand soil area beyond the roots to access even more nutrients (P, Cu, Zn) and water, and transfer them to the plant. In our short growing season, with low mycorrhizal presence after canola or tillage, that means there is two-whole months where the plant is not getting the full benefits of phosphorus uptake, which is necessary for optimal growth and development.

FOLLOWING CROP

Adding an inoculant containing mycorrhizae at seeding following a canola crop, will add life to the soil and benefit the plant immediately after germination and will continue to benefit the plant for the whole season. Third party trials comparing AGTIV®'s dual inoculant (rhizobium and mycorrhizae) to different inoculants on the market showed a significant positive impact of the mycorrhizae component on yield for soybeans, lentils and peas.

1 Ryan, M. H. (2001). The effect of Brassica crops on the level of mycorrhizal inoculum in soil. Proceedings of the Australian Society of Agronomy. 6 p.
2 Gavito, M. E. and M. H. Miller, 1998. Changes in mycorrhizal development in maize induced by crop management practices. Plant Soil. 198: 185-192.

SOYBEAN
EFFICACY DATA

EFFICACY REPORT
SUMMARY – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT & STRIP TRIALS

Research partners: ICMS, AgQuest, New Era research, Stoney Ridge Ag Services

Research sites: Portage La Prairie, Morden, Oakville, Swan River, and Binscarth (MB), Canada

Treatments: a) AGTIV® SOYBEAN • Granular*;
b) Leading inoculant competitor A*;
c) Leading inoculant competitor B*;
d) Leading inoculant competitor C*;

Experimental design: Total of 36 replicated plots per treatment in randomized complete block design, and one strip trial with 2 replicated strips.

*Granular products applied according to manufacturers recommended rate.

Figure 1. **Summary of Soybean yields per treatment, combined sites (36 reps) and years (3).**

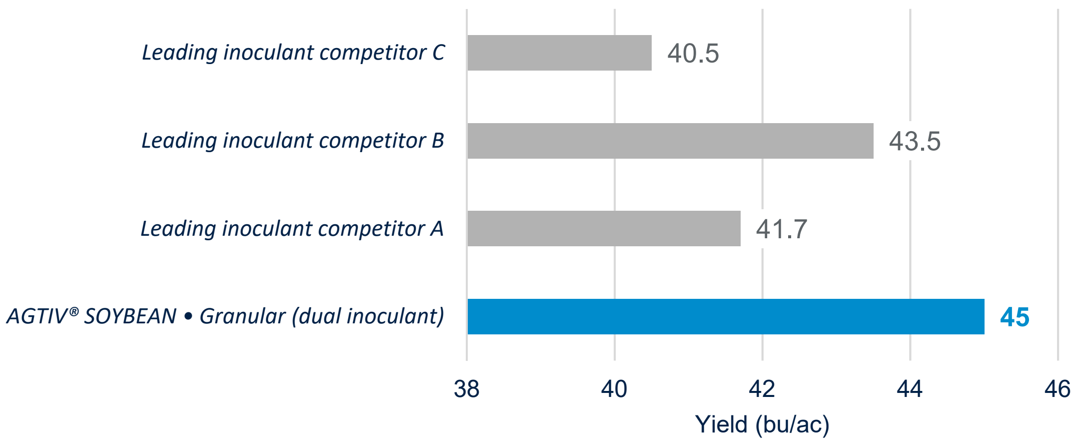


Table 1. **Summary of Soybean yields (bu/ac)[1] per trial.**

Location	Year	Seed variety	AGTIV® SOYBEAN • Granular	Leading inoculant competitor A	Leading inoculant competitor B	Leading inoculant competitor C
Morden (MB)	2015	Northstar, Anola	31.8 ^{a}	27.8 ^{b}	30.5 ^{a,b}	
Portage La Prairie (MB)	2015	Pride Seeds, PS0035	57.3	55.4	58.2	
Oakville (MB)	2016	Legend Seeds, Eclipse	79.7	77.8	77.7	
Swan River (MB)	2017	Prograin, Dario	40.7 ^{a}	35.0 ^{b,c}		32.5 ^{c}
Portage La Prairie (MB)	2017	Northstar, Richer	58.3	54.5	54.5	54.7
Binscarth (MB)	2017	Pioneer Ultra Early	30.11 ^{a}	27.71 ^{b}	28.99 ^{a,b}	28.46 ^{b}

[1] Average yields followed by different letters are significantly different at $p \leq 0.05$.

PREMIER TECH AGRICULTURE

2017 – MYCORRHIZAL & RHIZOBIAL INOCULANT

► STRIP TRIAL

Research partner: Stoney Ridge Ag Services

Research site: Binscarth (MB), Canada

Treatments: a) AGTIV® SOYBEAN • Granular applied at 5.0 lb/ac;
b) Leading inoculant competitor A; applied at 5.0 lb/ac;
c) Leading inoculant competitor B; applied at 5.0 lb/ac;
d) Leading inoculant competitor C; applied at 5.0 lb/ac;

Experimental design: 2 replicated strips of 1.36 acres per treatment

Soybean variety: Pioneer Experimental Ultra-Early variety, treated with Optimize St.

Previous crop: Canola

Seeding details: Seeded 20 May, at 180 000 seeds/ac at 15 in row spacing using DB60

Table 1. **Summary of Soybean yields per treatment.**

Inoculant	Yield (bu/ac)[1]
AGTIV® SOYBEAN • Granular	30.11 [a]
Leading inoculant competitor A	27.71 [b]
Leading inoculant competitor B	28.99 [a,b]
Leading inoculant competitor C	28.46 [b]

[1] Average yields followed by different letters are significantly different ($P < 0.05$, 1-way ANOVA + Tukey-Kramer Significance Test)

Plot operational notes and rain fall.

- A blend of 5-23-23-13 applied at 231 lb/ac fall broadcast and incorporated
- Preplant application of Roundup Weathermax + Express SG
- Incrop application of Roundup Transorb HC + Xtendimax and second incrop application of Roundup Weathermax + Pursuit.
- Combined on September 18th and weighed using J&M Speed Tender

2017 – MYCORRHIZAL & RHIZOBIAL INOCULANT

► STRIP TRIAL

Research partner: Down to Earth + PAMI

Research site: Saskatoon (SK), Canada

Treatments: a) AGTIV® SOYBEAN • Granular applied at 5.0 lb/ac + Taurus Advanced Acre (TAA) + fungicide application;

b) AGTIV® SOYBEAN • Granular applied at 5.0 lb/ac + Taurus Advanced Acre (TAA) & no fungicide application;

c) BRADYRHIZOBIUM INOCULANT for SOYBEAN by AGTIV® in granular form applied at 4.0 lb/ac + designed fertility

Experimental design: 2 replicated strips for a total of 540 ft^2 per treatment

Soybean variety: Syngenta, M2 variety, treated with 1.82 ml/kg Optimize St.

Previous crop: Canola / wheat / oats split

Seeding details: Seeded 20 May, at 180 000 seeds/ac at 10in row spacing using Seed Master plot Drill by Down to Earth

Table 1. **Summary of Soybean yields per treatment.**

Inoculant	Yield (bu/ac)
AGTIV® SOYBEAN • Granular + TAA + Fungicide	39.1
AGTIV® SOYBEAN • Granular + TAA & No Fungicide	41.1
BRADYRHIZOBIUM INOCULANT for SOYBEAN by AGTIV® in granular form + designed fertility	34.9

Plot operational notes and rain fall.

- Fertility - Seed placed 2-15-0 -0 actual lbs/ac
  - Side band 17-20-15-15 actual lbs/ac
- Viper+UAN applied at 400 ml/ac + 81 ml/ac at 2-3 trifoliate,
  - Roundup was applied at 0.67 L/ac at 3-4 trifoliate
- Combined on September 18th with a Wintersteiger and weighed & moisture averaged by PAMI
- Total rainfall: 100.4 mm

1. **Designed Fertility Program:** a calculated fertility program based on soil tests and targeted yield. Target yield for Soybean was 40 bushels/ac
2. **The Taurus Advanced Acre™:** Using the Designed Fertility Program with the addition of key Taurus solutions.
3. **The Taurus Advanced Acre™ with no Fungicide:** Using the Designed Fertility Program with the addition of key Taurus solutions without the addition of fungicide.

EFFICACY REPORT

2017 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: ICMS

Research site: Portage-La-Prairie (MB), Canada

Treatments:
a) AGTIV® SOYBEAN • Granular applied at 5 lb/ac*;
b) BRADYRHIZOBIUM INOCULANT for SOYBEAN by AGTIV® in granular form applied at 4 lb/ac*;
c) Leading inoculant competitor A; applied at 5.0 lb/ac*;
d) Leading inoculant competitor B; applied at 4.5 lb/ac*;
e) Leading inoculant competitor C; applied at 7 lb/ac*;
f) Leading inoculant competitor D; applied at 0.063 g/1000 seeds*.

Experimental design: 6 replicated plots per treatment in randomized complete block design

Soybean variety: Northstar Seeds, Richer

Previous crop: Canola

Seeding details: Seeded June 1st at 165 000 plants/ac with 15 cm row spacing using a cone planter

*Granular products applied according to manufacturers recommended rate.

Table 1. **Summary of Soybean yields per treatment.**

Inoculant	Yield (bu/ac)
AGTIV® SOYBEAN • Granular	58.3
BRADYRHIZOBIUM INOCULANT for SOYBEAN by AGTIV® in granular form	54.6
Leading inoculant competitor A	54.5
Leading inoculant competitor B	54.5
Leading inoculant competitor C	54.7
Leading inoculant competitor D	54.9

Plot operational notes and rain fall.

- 288 lb/ac of 0-80-40-20 N-P-K-S blend was applied and incorporated just before seeding
- Conventional tillage before spring
- Roundup TR 540 was applied at 0.7 L/ac on June 26th and July 14th. Cygon to control aphids was applied on August 8th.
- Combined on October 12th with Winterstieger plot combine

Month	Precipitation (mm)
May	26.8
June	69.9
July	29.4
August	8.8
September	83.8
TOTAL	**218.7**

EFFICACY REPORT

2017 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: New Era research

Research site: Swan River (MB), Canada

Treatments: a) AGTIV® SOYBEAN • Granular applied at 5.1 lb/ac*;
b) Leading inoculant competitor A; applied at 5.0 lb/ac*;
c) Leading inoculant competitor A; applied at 10 .0 lb/ac;
d) Leading inoculant competitor C; applied at 7.1 lb/ac*;
e) Leading inoculant competitor C; applied at 14.3 lb/ac.

Experimental design: 8 replicated plots per treatment in randomized complete block design

Soybean variety: Prograin, Dario, treated with 2 ml/kg CBMV and 1.82 ml/kg Optimize

Previous crop: Canola

Seeding details: Seeded 23 May, at 200 000 seeds/ac at 10 in row spacing using seedhawk air drill

*Granular products applied according to manufacturers recommended rate.

Table 1. **Summary of Soybean yields per treatment.**

Inoculant	Yield (bu/ac)[1]
AGTIV® SOYBEAN • Granular	40.7 [a]
Leading inoculant competitor A low rate	35.0 [b,c]
Leading inoculant competitor A high rate	36.5 [b]
Leading inoculant competitor C low rate	32.5 [c]
Leading inoculant competitor C high rate	35.3 [b,c]

[1] Average yields followed by different letters are significantly different ($P < 0.05$, Student-Newman-Keuls)

Plot operational notes and rain fall.

- A blend of 7-34-20-0 applied at 102 lb/ac spring broadcast
- Viper+UAN applied at 400 ml/ac + 81 ml/ac at 2-3 trifoliate,
  Roundup was applied at 0.67 L/ac at 3-4 trifoliate and Guardsman at 607 ml/ac at R8.
- Combined on October 10th with Hedge 140 plot combine
- Total rainfall: 197.1 mm

EFFICACY REPORT

2016 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: ICMS

Research site: Oakville (MB), Canada

Treatments: a) AGTIV® SOYBEAN • Granular applied at 5 lb/ac*;
b) Leading inoculant competitor A; applied at 5 lb/ac*;
c) Leading inoculant competitor B; applied at 4.5 lb/ac*;
d) Leading inoculant competitor C; applied at 7 lb/ac*.

Experimental design: 5 replicated plots per treatment in randomized complete block design

Soybean variety: Legend Seeds, Eclipse

Previous crop: Fallow

Seeding details: Seeded at 95 kg/ha with 15 cm row spacing using plot dill and double disc openers

*Granular products applied according to manufacturers recommended rate.

Table 1. **Summary of Soybean yields per treatment.**

Inoculant	Yield (bu/ac)[1]
AGTIV® SOYBEAN • Granular	79.7
Leading inoculant competitor A	77.8
Leading inoculant competitor B	77.7
Leading inoculant competitor C	75.7

[1] Average yields followed by different letters are significantly different using Duncan's multiple range test at p=0.05.

Plot operational notes and rain fall.

- The plot area was cultivated one week before planting
- Roundup TR 540 was applied at 0.66 L/ac one month after planting to control weeds.
- Combined with Winterstieger plot combine

Month	Precipitation (mm)
May	58.5
June	90.3
July	86
August	99.9
September	43.6
TOTAL	384.3

2015 – MYCORRHIZAL & RHIZOBIAL INOCULANT

► PLOT TRIAL

Research partner: AqQuest

Research site: Morden (MB), Canada

Treatments: a) AGTIV® SOYBEAN • Granular applied at 5 lb/ac*;
b) Leading inoculant competitor A: applied at 5 lb/ac*;
c) Leading inoculant competitor B: applied at 4.5 lb/ac*

Experimental design: 8 replicated plots per treatment in randomized complete block design

Soybean variety: NORTHSTAR genetics, ANOLA variety

Previous crop: Canola

*Granular products applied according to manufacturers recommended rate.

Table 1. **Summary of Soybean yields per treatment.**

Inoculant	Yield (bu/ac)[1]
AGTIV® SOYBEAN • Granular	31.8 [a]
Leading inoculant competitor A	27.8 [b]
Leading inoculant competitor B	30.5 [a, b]

[1]Yields followed by different letters are statistically different at alpha 0.05.

Plot operational notes and rain fall.

- Soybeans were planted on June 2nd 2015 at 18 cm row spacing and 100 kg/ha
- In season maintenance, Roundup TR 540 was applied at 0.61 L/ac
- Combined with Winterstieger plot combine on Sept 30th 2015.

Month	Precipitation (mm)
May	62.8
June	87.1
July	47.0
August	47.3
TOTAL	244.2

PREMIER TECH AGRICULTURE

2015 – MYCORRHIZAL & RHIZOBIAL INOCULANT

► PLOT TRIAL

Research partner: ICMS

Research site: Portage La Prairie (MB), Canada

Treatments: a) AGTIV® SOYBEAN • Granular applied at 5 lb/ac*;
b) Leading inoculant competitor A: applied at 5 lb/ac*;
c) Leading inoculant competitor B: applied at 4.5 lb/ac*

Experimental design: 7 replicated plots per treatment in randomized complete block design

Soybean variety: PRIDE SEEDS genetics, PS 0035 NR2 variety

Previous crop: Canola

*Granular products applied according to manufacturers recommended rate.

Table 1. **Summary of Soybean yields per treatment.**

Inoculant	Yield (bu/ac)[1]
AGTIV® SOYBEAN • Granular	57.3
Leading inoculant competitor A	55.4
Leading inoculant competitor B	58.2

[1] Average yields followed by different letters are significantly different using Duncan's multiple range test at p=0.05.

Plot operational notes and rain fall.

- Soybeans were planted on May 29th 2015 at 15.2 cm row spacing and 100 kg/ha
- In season maintenance, Roundup TR 540 was applied at 0.61 L/ac
- Combined with Winterstieger plot combine on Oct 6th 2015.

Month	Precipitation (mm)
May	76.2
June	52.6
July	176.7
August	64.2
September	18.4
TOTAL	388.1

SUMMARY – MYCORRHIZAL INOCULANT

► GROWER SPLIT FIELDS

Table 1. **Average yield increase with AGTIV® mycorrhizal inoculant in Canada (2014 to 2017).**

Number of sites	Average increase		Average increase (%)
57	2.5 bu/ac	167 kg/ha	5.3%

Figure 1. **Average yield increase with AGTIV® mycorrhizal inoculant in ONTARIO, Canada (2014 to 2016).**

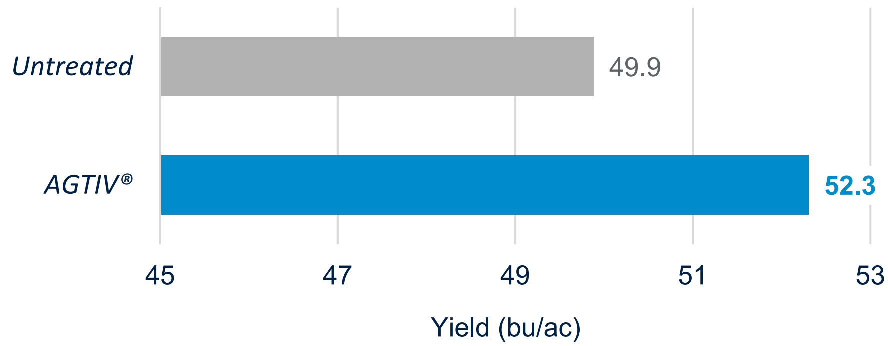
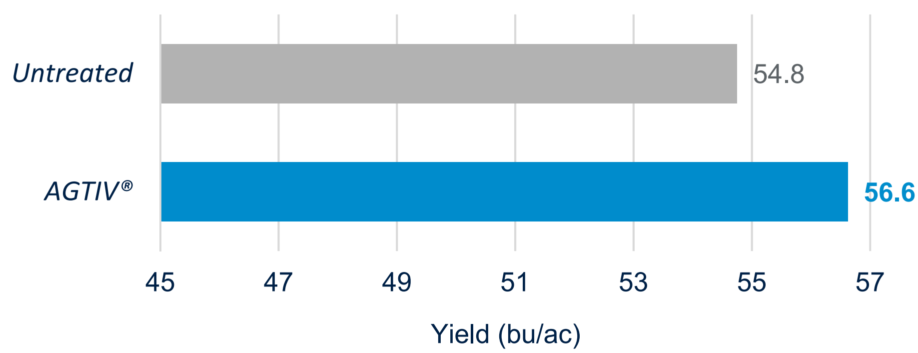


Figure 2. **Average yield increase with AGTIV® mycorrhizal inoculant in QUEBEC, Canada (2015 to 2017).**



EFFICACY REPORT
2017 – MYCORRHIZAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: Blackcreek Research

Research site: Bright (ON), Canada

Treatments: a) Seed without mycorrhizal inoculant
b) Seed applied mycorrhizal inoculant

Experimental design: 8 replicated plots per treatment in randomized complete block design

Soybean variety: ELITE SEED, Katonda R2

Previous crop: Winter Wheat

Seeding details: Seeded June 9 at 168 000 plants/ac with 38 cm row spacing using a cone planter

Table 1. **Soybean yields per treatment.**

Treatment	Yield (bu/ac)[1]
Seed without mycorrhizal inoculant	41.4[a]
Seed applied mycorrhizal inoculant	44.0[b]

[1]Average yields followed by different letters are significantly different (Tukey's test, $p \leq 0.05$)

Plot operational notes and rain fall.

- No fertilizer was applied
- Conventional tillage in spring
- Boundary Lqd applied à 2.47 l/ha, Broadstrike Rc at 87.5 g/ha, on June 10; Classic at 36 g/ha on June 29.
- Combined on October 19th with Winterstieger plot combine

Month	Precipitation (mm)
May	120.0
June	53.5
July	81.0
August	106.0
September	32.0
TOTAL	**392.5**

PREMIER TECH AGRICULTURE

EFFICACY REPORT
2017 – MYCORRHIZAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: Independent consultant

Research site: St-Simon – #1 (QC), Canada

Treatments: a) Seed without mycorrhizal inoculant
b) Seed applied mycorrhizal inoculant

Experimental design: 4 replicated plots per treatment in randomized complete block design

Soybean variety: ELITE SEED, Auriga

Previous crop: Corn

Seeding details: Seeded May 25 at 182 000 plants/ac with 33 cm row spacing using a cone planter

Table 1. **Soybean yields per treatment.**

Treatment	Yield (kg/ha)	Yield (bu/ac)
Seed without mycorrhizal inoculant	3119	46.8
Seed applied mycorrhizal inoculant	3280	49.9

Plot operational notes and rain fall.

- No fertilizer was applied
- Conventional tillage before spring. Vibro before seeding.
- Dual II Magnum at 1.75 l/ha, Firstrate at 20.8 g/ha and Pursuit at 0.312 l/ha on May 25.
- Combined on September 27 with Delta plot combine

Month	Precipitation (mm)
May	81.5
June	120.4
July	57.4
August	57.6
September	45.0
TOTAL	**361.9**

2017 – MYCORRHIZAL INOCULANT

► PLOT TRIAL

Research partner: Independent consultant

Research site: St-Simon – #2 (QC), Canada

Treatments: a) Seed without mycorrhizal inoculant
b) Seed applied mycorrhizal inoculant

Experimental design: 4 replicated plots per treatment in randomized complete block design

Soybean variety: ELITE SEED, Auriga

Previous crop: Corn

Seeding details: Seeded May 25 at 182 000 plants/ac with 33 cm row spacing using a cone planter

Table 1. **Soybean yields per treatment.**

Treatment	Yield (kg/ha)	Yield (bu/ac)
Seed without mycorrhizal inoculant	2953	44.3
Seed applied mycorrhizal inoculant	3058	45.9

Plot operational notes and rain fall.

- No fertilizer was applied
- Conventional tillage before spring. Vibro before seeding.
- Dual II Magnum at 1.75 l/ha, Firstrate at 20.8 g/ha and Pursuit at 0.312 l/ha on May 25.
- Combined on September 27 with Delta plot combine

Month	Precipitation (mm)
May	81.5
June	120.4
July	57.4
August	57.6
September	45.0
TOTAL	**361.9**

Soybean split field with AGTIV® SOYBEAN vs leading inoculant.
Plant growth and health is enhanced on the right,
and row closure occurs sooner in AGTIV® soybean fields.

AGTIV® soybean plants have a better developed root system
with more branching and more nodules.

PREMIER TECH
AGRICULTURE

Soybean split field with AGTIV® vs untreated.
Improved growth and quicker row closure on the right.

AGTIV® soybean plants have more branches, larger leaves and more nodules.
Increased root mass on the right with AGTIV®.

PREMIER TECH
AGRICULTURE

LENTILS

EFFICACY DATA

SUMMARY – MYCORRHIZAL & RHIZOBIAL INOCULANT

LENTILS

► PLOT & STRIP TRIALS

Research partners: GMAC's Ag Team, Wheatland Conservation Area, Prairie Ag research

Research site: Brock (SK), Swift Current (SK) and Coalhurst (AB), Canada

Treatments: a) AGTIV® PULSES • Granular*;
b) Leading inoculant competitor A*;
c) Leading inoculant competitor B*;
d) Leading inoculant competitor C*;

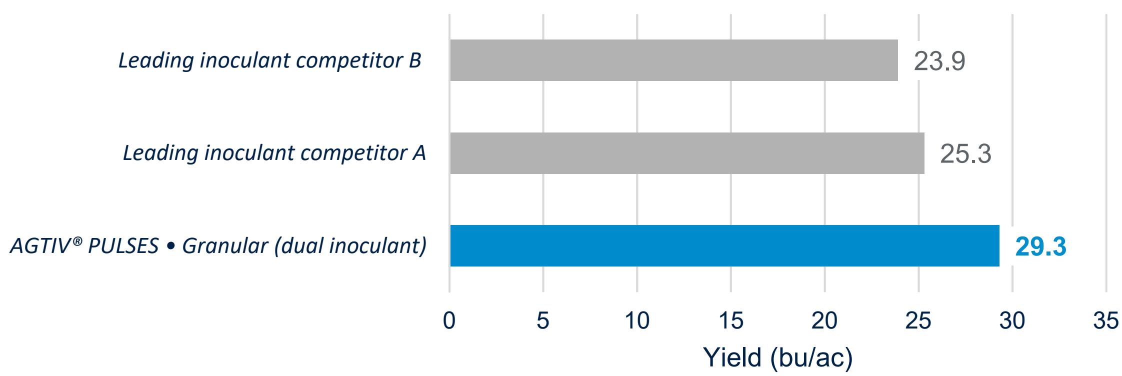
Experimental design: 17 replicated plots per treatment (one trial with 7, one with 8 and one strip trial with two replicated) in randomized complete block design

*Granular products applied according to manufacturers recommended rate.

Table 1. **Summary of Lentil yields (bu/ac) per trial.**

Location	Year	AGTIV® PULSES • Granular	Leading inoculant competitor A	Leading inoculant competitor B	Leading inoculant competitor C
Brock (SK)	2015	18.4	13.4	11.4	
Swift Current (SK)	2016	50.1	43.3	41.1	37.7
Coalhurst (AB)	2017	19.5	19.1	19.2	18.5

Figure 1. **Summary of Lentil yield average (bu/ac) for combined sites (17 reps) and years (3).**



► GROWER SPLIT FIELDS

Table 2. **Summary of Lentil grower split field trials in Canada (2010-2014).**

Number of sites	Average increase (bu/ac)	Average increase (%)
55	2.7 bu/ac	10%

PREMIER TECH AGRICULTURE

2016 – MYCORRHIZAL & RHIZOBIAL INOCULANT

LENTILS

► PLOT TRIAL

Research partner: Wheatland Conservation Area

Research site: Swift Current (SK), Canada

Treatments: a) AGTIV® PULSES • Granular applied at 5 lb/ac*;
b) RHIZOBIUM INOCULANT for PULSES by AGTIV® in granular form applied at 5 lb/ac*;
c) Leading inoculant competitor A: applied at 3.6 lb/ac*;
d) Leading inoculant competitor B: applied at 3.6 lb/ac*;
e) Leading inoculant competitor C: applied at 5.1 lb/ac*.

Experimental design: 8 replicated plots per treatment in randomized complete block design

Lentil variety: Small Red Lentils, Imax CL variety

Previous crop: Canola

Seeding details: Seeded at 68 lb/ac to obtain 12 plants/ft² using Fabro plot dill, Atomjet knife openers

Fertility: 98 lb/ac of 11-52-0 side banded

Data analysis: All data from replicate 7 was removed as this area was noted by Wheatland Conservation Area to be a lower part of the field and that the yield was significantly lower than the average in the affected plots. The lower part of the field also had a damaging effect on the first plot of replicate 8, which was the leading inoculant competitor B treatment, and that data point was also removed for the above analysis.

*Granular products applied according to manufacturers recommended rate.

Table 1. **Summary of Lentil yields per treatment.**

Inoculant	Yield (bu/ac)[1]
AGTIV® PULSES • Granular (dual inoculant)	50.1 [b]
RHIZOBIUM INOCULANT by AGTIV® (single inoculant)	46.6 [b]
Leading inoculant competitor A	43.3 [a,b]
Leading inoculant competitor B	41.1 [a]
Leading inoculant competitor C	37.7 [a2]

[1] Average yields followed by different letters are significantly different using Duncan's multiple range test at $p \leq 0.1$.
[2] The difference in yield is significant at $p = 0.012$, compared with AGTIV® PULSES • Granular (dual inoculant).

Plot operational notes and rain fall.

- Preseed burnoff with RT 540 @ .67 L/ac
- Applied Edge pre-seed @ 15 lb/ac
- Incrop with Odyssey @ 17.3 g/ac
  + Poast Ultra @ 190 ml/ac
  + Merge @ 0.5 L/100 L spray solution.
- Priaxor @ 180 ml/ac at 10% flower
- Dessicated with Reglone @ 700 ml/ac + agsurf adjuvant @ .1 L/100 L of spray solution
- Combined with winterstieger

Month	Precipitation (mm)
April	7
May	129.3
June	85.1
July	115
August	58
September	39
October until the 5th	58
TOTAL	491.4

PREMIER TECH AGRICULTURE

EFFICACY REPORT
2015 – MYCORRHIZAL & RHIZOBIAL INOCULANT

LENTILS

► STRIP TRIAL

Research partner: GMAC's Ag Team

Research site: Brock (SK), Canada

Objective: This field trial will evaluate the performance of leading inoculant brands with an emphasis on comparing granular formulations against the Leading inoculant competitor D liquid formulation on lentil.

Treatments: a) AGTIV® PULSES • Granular applied at 5 lb/ac*;
b) Leading inoculant competitor A: granular applied at 3.6 lb/ac*;
c) Leading inoculant competitor B: granular applied at 3.6 lb/ac*;
d) Leading inoculant competitor C: granular applied at 3.6 lb/ac*;
e) Leading inoculant competitor D: Liquid applied at 76 ml/bu*;
f) Leading inoculant competitor D: Liquid applied at 76 ml/bu
+ Leading inoculant competitor B: at 1.8 lb/ac*

Experimental design: Site at Brock was laid out using a completely randomized design (CRD) with a minimum of two treatment replicates. See field layout below.

*Products applied according to manufacturers recommended rate.

Table 1. **Summary of Lentil yields per treatment.**

Inoculant	Yield (bu/ac)
AGTIV® PULSES • Granular (dual inoculant)	18.4
Leading inoculant competitor A	13.4
Leading inoculant competitor B	11.4
Leading inoculant competitor C	11.8
Leading inoculant competitor D	11.3
Leading inoculant competitors D + B	11.1

Plot operational notes and rain fall.

Treatments were seeded on May 9th 2015, sprayed, and harvested on August 31st 2015, using the growers' existing machinery. Trial site were managed the same across all treatments, excluding the application of inoculant. In-season herbicide, fungicide, and insecticide, applications were all registered practices and made in accordance to product labels. Harvest data was scaled with weigh wagons then recorded.

Month	Precipitation (in)
May	0.8
June	1.43
July	2.31
TOTAL	4.54

Field layout

PREMIER TECH
AGRICULTURE

Lentil split field with AGTIV® PULSES vs leading inoculant.
Plant growth and health is enhanced on the right,
and row closure occurs sooner in AGTIV® lentil fields.

Enhanced root development leads to thicker stems,
which help lentils stand better and increases ease of harvest.

PREMIER TECH
AGRICULTURE

PEAS

EFFICACY DATA

EFFICACY REPORT
SUMMARY – MYCORRHIZAL & RHIZOBIAL INOCULANT

PEAS

► PLOT TRIALS

Research partners: ICMS, Wheatland Conservation Area

Research site: Fort Saskatchewan (AB) and Swift Current (SK), Canada.

Treatments: a) AGTIV® PULSES • Granular*;
b) Leading inoculant competitor A*;
c) Leading inoculant competitor B*;

Experimental design: 11 replicated plots per treatment (one trial with 6 and one with 5) in randomized complete block design

*Granular products applied according to manufacturers recommended rate.

Figure 1. **Summary of Pea yields per treatment, combined sites (11 reps) and years (2).**

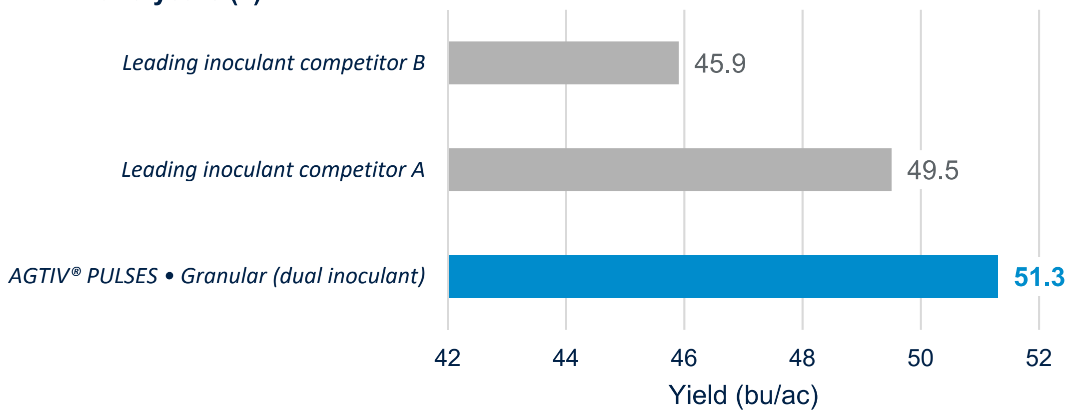


Table 1. **Summary of Pea yields (bu/ac) per trial.**

Location	Year	Seed variety	AGTIV® PULSES • Granular	Leading inoculant competitor A	Leading inoculant competitor B
Fort Sakatchewan (AB)	2015	Meadow	88.6	86.2	79.5
Swift Current (SK)	2017	Amarillo	14.0	12.7	12.4

► GROWER SPLIT FIELDS

Table 2. **Summary of Pea grower split field trials in Canada (2012-2017).**

Number of sites	Average increase (bu/ac)	Average increase (%)
18	3.3 bu/ac	5.9%

PREMIER TECH AGRICULTURE

2017 – MYCORRHIZAL & RHIZOBIAL INOCULANT

► STRIP TRIAL

Research partner: Down to Earth + PAMI

Research site: Saskatoon (SK), Canada

Treatments: a) AGTIV® PULSES • Granular applied at 5.0 lb/ac + Taurus Advanced Acre (TAA) + fungicide application;

b) RHIZOBIUM INOCULANT for PULSES by AGTIV® in granular form applied at 4.0 lb/ac + designed fertility

Experimental design: 2 replicated strips for a total of 610 ft^2 per treatment

Pea variety: Meadow variety seeded at 3 bu/ac

Previous crop: Canola / oats split

Seeding details: Seeded 20 May, at 3 bu/ac at 10 in row spacing using Seed Master plot Drill by Down to Earth

Table 1. **Summary of Pea yields per treatment.**

Inoculant	Yield (bu/ac)
AGTIV® PULSES • Granular (dual inoculant) + TAA + Fungicide	48.1
RHIZOBIUM INOCULANT by AGTIV® + designed fertility	35.8

Plot operational notes and rain fall.

- Fertility – seed placed 2-15-0 -0 actual lbs/ac

  - Side band 17-20-15-15 actual lbs/ac
- Viper+UAN applied at 400 ml/ac + 81 ml/ac at 5 node Stage
- Combined on August 25th with a Wintersteiger and weighed & moisture averaged by PAMI
- Total rainfall: 100.4 mm

1. **Designed Fertility Program:** a calculated fertility program based on soil tests and targeted yield. Target yield for Peas was 60 bushels/ac
2. **The Taurus Advanced Acre™:** Using the Designed Fertility Program with the addition of key Taurus solutions.

EFFICACY REPORT
2017 – MYCORRHIZAL & RHIZOBIAL INOCULANT

PEAS

► PLOT TRIAL

Research partner: Wheatland Conservation Area

Research site: Swift Current (SK), Canada

Treatments:
a) AGTIV® PULSES • Granular applied at 5 lb/ac*;
b) RHIZOBIUM INOCULANT for PULSES by AGTIV® in granular form applied at 4 lb/ac*;
c) Leading inoculant competitor A: applied at 3.6 lb/ac*;
d) Leading inoculant competitor B: applied at 3.6 lb/ac*;
e) Leading inoculant competitor C: applied at 4.0 lb/ac*;
f) Leading inoculant competitor E: applied at 5.0 lb/ac*.

Experimental design: 6 replicated plots per treatment in randomized complete block design

Pea variety: Amarillo, seeded at 200 lb/ac

Previous crop: Canola

*Granular products applied according to manufacturers recommended rate

Table 1. **Summary of Pea yields per treatment.**

Inoculant	Yield (bu/ac)
AGTIV® PULSES • Granular (dual inoculant)	14.0
RHIZOBIUM INOCULANT by AGTIV® (single inoculant)	13.1
Leading inoculant competitor A	12.7
Leading inoculant competitor B	12.4
Leading inoculant competitor C	13.2
Leading inoculant competitor E	12.3

Plot operational notes and rain fall.

- Peas were planted on May 24th, 2017 at 9 in row spacing using Fabro plot drill
- Preseed burnoff with Clean Start @ 1 L/ac and Aim @ 30 ml/ac
- Application of 98 lb/ac of 11-52-0 sidebanded
- In crop with Viper ADV @ 400 ml/ac + Poast Ultra @ 190 ml/ac + UAN @ 810 ml/ac spray solution.
- Combined on 17th August with winterstieger plot combine

Month	Precipitation (mm)
May	32.1
June	35
July	4
August	28
September	3
TOTAL	**102.1**

PREMIER TECH AGRICULTURE

EFFICACY REPORT

2015 – MYCORRHIZAL & RHIZOBIAL INOCULANT

PEAS

► PLOT TRIAL

Research partner: ICMS

Research site: Fort Saskatchewan (AB), Canada

Treatments: a) AGTIV® PULSES • Granular applied at 5 lb/ac*;
b) Leading inoculant competitor A: applied at 3.3 lb/ac*;
c) Leading inoculant competitor B: applied at 3.3 lb/ac*

Experimental design: 5 replicated plots per treatment in randomized complete block design

Pea variety: Meadows

Previous crop: Canola

*Granular products applied according to manufacturers recommended rate

Table 1. **Summary of Pea yields per treatment.**

Inoculant	Yield (bu/ac)[1]
AGTIV® PULSES • Granular (dual inoculant)	88.6
Leading inoculant competitor A	86.2
Leading inoculant competitor B	79.5

[1] Average yields followed by different letters are significantly different using Duncan's multiple range test at $p=0.05$.

One replication from the leading inoculant competitor B treatment yielded very low and has a negative impact on the treatment average. The data below represents the average of the leading inoculant competitor B treatment without the very low yielding rep for a total of four reps for the leading inoculant competitor B average yield.

Table 2. **Summary of Pea yields per treatment.**

Inoculant	Yield (bu/ac)[1]
AGTIV® PULSES • Granular (dual inoculant)	88.6
Leading inoculant competitor A	86.2
Leading inoculant competitor B	85.8

[1] Average yields followed by different letters are significantly different using Duncan's multiple range test at $p=0.05$.

Plot operational notes and rain fall.

- Peas were planted on May 21st 2015 at 15.2 cm row spacing
- In season maintenance with 17 g/ac Odyssey (35%), 67 ml/ac Equinox and 0.5% Edge
- Combined with Winterstieger Elite plot combine on Sept 25th 2015.

Month	Precipitation (mm)
May	37.3
June	59.7
July	108.6
August	10.3
September	71.1
TOTAL	287

Pea split field with AGTIV® PULSES vs leading inoculant.
Plant growth and health is enhanced on the right,
and row closure occurs sooner in AGTIV® pea fields.

AGTIV® pea plants have a better developed root system
with more branching, which leads to increased plant health and growth.

PREMIER TECH AGRICULTURE

FORAGES

EFFICACY DATA

SUMMARY – MYCORRHIZAL INOCULANT

► GROWER SPLIT FIELDS

Research sites: 15 farms (fields) in Quebec, Canada

Treatments: a) Untreated
b) AGTIV® mycorrhizal inoculant

Experimental design: Each data point per field consists of an average of 5 samples taken each from the treated and untreated side.

Table 1. **Increase in dry weight per cut over two years with AGTIV® mycorrhizal inoculant**

Cut	Yield increase 2016 season	Yield increase 2017 season
1st	17.5%	23.8%
2nd	20.8%	5.9%
3rd	12.7%	10.6%
Average	**18.7%**[1]	**13.5%**[1]

[1] Statistically significant at $p \leqslant 0.05$ using t-test for dependent samples.

Table 2. **Winter 2016 Alfalfa survival**

	Survival winter 2016
Untreated	86.4% [a]
AGTIV®	92.2% [b]
Survival increase	**+ 42.8%**

Averages followed by different letters are significantly different ($p \leqslant 0.05$, t-test for dependent samples).

Table 3. **Two-year summary of Alfalfa dry weight yield average (kg/ha)**

	AGTIV®	Untreated	Difference
2016	3910[b]	3295[a]	615
2017	4190[b]	3691[a]	499
2016 + 2017			**1 114**

Averages followed by different letters are significantly different ($p \leqslant 0.05$, t-test for dependent samples).

PREMIER TECH AGRICULTURE

Forage split field with AGTIV® FIELD CROPS • Powder vs untreated.

Greener and denser alfalfa. Alfalfa with AGTIV® is better established versus weeds and will therefore yield better.

More uniform and greener field with AGTIV® for better overall performance.

PREMIER TECH AGRICULTURE

DRY BEANS
EFFICACY DATA

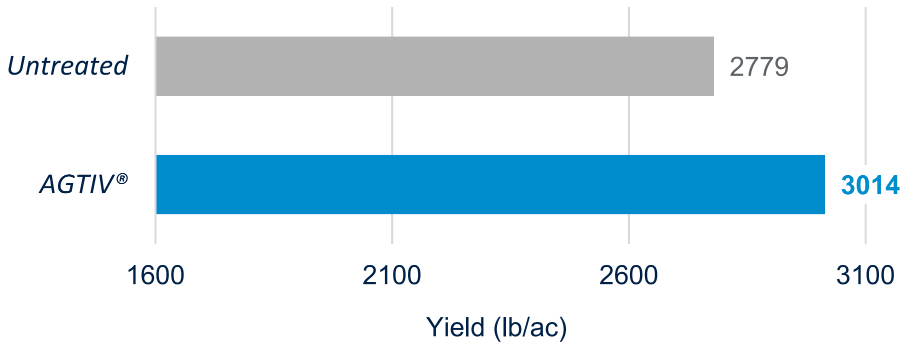
DRY BEANS

► GROWER SPLIT FIELDS

Table 1. **Average yield increase with AGTIV® mycorrhizal inoculant for different years (2014 to 2017) in ONTARIO, Canada.**

Year	Number of sites	Average increase (lb/ac)	Average increase (%)
2014	2	337.1	13
2015	2	422.8	17.3
2016	5	130.3	5.5
2017	2	146.0	5.1
Total	**11 sites**	**235 lb/ac**	**8.9%**

Figure 1. **Average yield increase with AGTIV® mycorrhizal inoculant in ONTARIO, Canada (2014 to 2017).**



Faster plant development, larger plants and quicker row closure with AGTIV®.

PREMIER TECH AGRICULTURE

Dry bean split field with AGTIV® vs untreated.
Faster plant development, larger plants and quicker row closure on the right.

AGTIV® dry bean plants are bigger with more branches and larger leaves. With AGTIV®, the root mass is increased with darker green plants (through more nutrient absorption).

DURUM WHEAT

EFFICACY DATA

► GROWER SPLIT FIELDS

Table 1. **Average yield increase with AGTIV® mycorrhizal inoculant in Canada and Europe (35 sites, 2012 to 2017).**

Number of sites	Average increase (%)
35	8.3%

Table 2. **Average yield increase with AGTIV® mycorrhizal inoculant in Western Canada (2012 to 2014).**

Number of sites	Average increase (bu/ac)	Average increase (%)
11	4.1 bu/ac	6.1%

Table 3. **Average yield increase with AGTIV® mycorrhizal inoculant in FRANCE, Europe (2014 to 2017).**

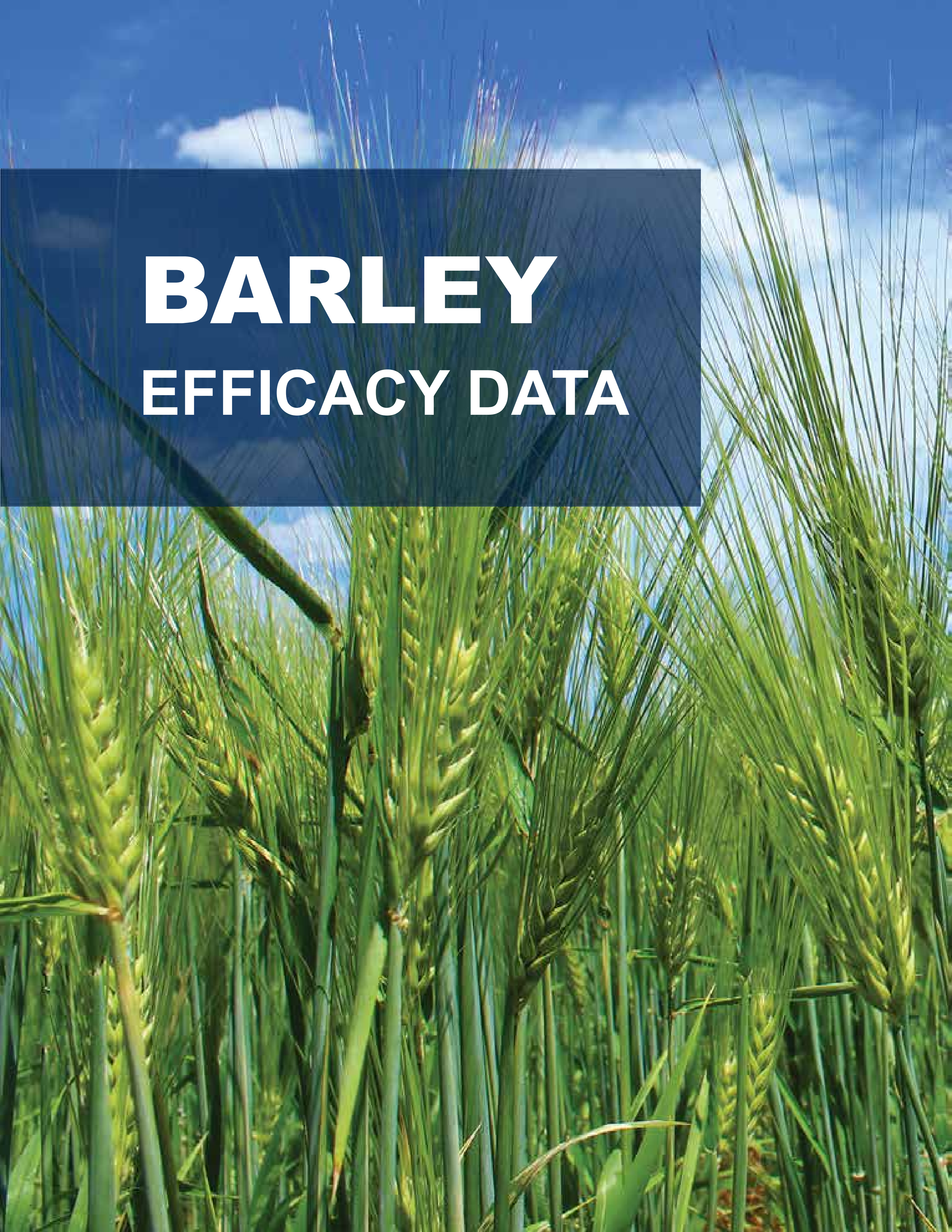
Number of sites	Average increase (bu/ac)	Average increase (%)
24	9.0 bu/ac	9.3%

Durum wheat split field with AGTIV® vs untreated.
More uniform field, head and spikes almost all out on the right.

Young wheat plants whose root systems show better growth with AGTIV® and the plants are stronger with more leaves. Better nitrogen absorption through the more developed root system.

PREMIER TECH
AGRICULTURE

BARLEY
EFFICACY DATA



SUMMARY – MYCORRHIZAL INOCULANT

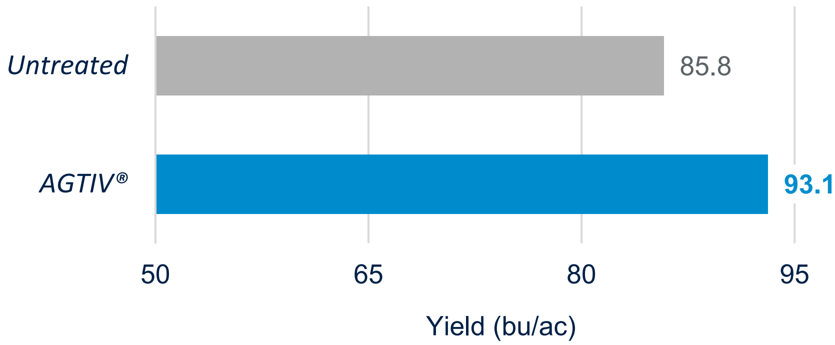
BARLEY

► GROWER SPLIT FIELDS

Table 1. **Average yield increase with AGTIV® mycorrhizal inoculant in Canada (2012 to 2016).**

Number of sites	Average increase (bu/ac)	Average increase (%)
26	7.0 bu/ac	10.6%

Figure 1. **Average yield increase with AGTIV® mycorrhizal inoculant in Canada and Europe (28 sites, 2012 to 2017).**



Barley plants have a increased root mass on the right with AGTIV®, which leads to enhanced plant health and growth.

PREMIER TECH AGRICULTURE

POTATOES

EFFICACY DATA

► GROWER SPLIT FIELDS

Table 1. **Average increase of marketable yield* with AGTIV® POTATO • Liquid for different territories (2011 to 2017).**

Territory	Number of sites	Yield increase (t/ha)	Yield increase (cwt/ac)	Yield increase (%)
Canada	444	3.2	28.8	9.9
United States	50	3.6	32	10.8
Mexico	4	2.3	20	8.6
France & Switzerland	354	4	36	10.0
Total	**852 sites**	**3.6 t/ha**	**32 cwt/ac**	**10.0%**

Table 2. **Average increase of marketable yield* with AGTIV® POTATO • Liquid for different years (2011 to 2017).**

Year	Number of sites	Yield increase (t/ha)	Yield increase (cwt/ac)	Yield increase (%)
2011	32	2.6	23.3	6.6
2012	33	3.2	28.5	9.0
2013	70	3.6	31.9	11.2
2014	116	4.5	40.3	12.8
2015	145	4.0	35.3	10.7
2016	243	3.9	34.8	10.5
2017	213	2.7	24.0	7.7
Total	**852 sites**	**3.6 t/ha**	**32 cwt/ac**	**10.0%**

** p< 0.001. Statistical analysis was performed with yield from each site used as a replicate.*

Potato split field with AGTIV® POTATO vs untreated.
Faster plant development and larger plants on the right,
and row closure occurs sooner with AGTIV®.

Increased tuber count per plant and marketable yield on AGTIV® side.

PREMIER TECH
AGRICULTURE

ONIONS

EFFICACY DATA

SUMMARY – MYCORRHIZAL INOCULANT

► PLOT TRIALS

Research partners: Black Creek Research and Prisme

Research sites: Bright (ON), Canada – Sandy loam soil
and Napierville (QC), Canada – Black soil, organic

Treatments: a) Untreated
b) AGTIV® Specialty Crops • Powder applied at 0.23 g / 1000 seeds*

Experimental design: Randomized complete block design, 8 replicates.

*Product applied according to manufacturers recommended rate.

Table 1. **2017 summary of onion yield (kg/plot) and % difference**

Location	Year	Variety	Untreated	AGTIV® SPECIALTY CROPS • Powder	% Yield difference
Ontario	2017	Frontier	14.6	15.4	+5.5%
Quebec	2017	Trailblazer	10.8	11.5	+6.3%
Average	**2017**		**12.7**	**13.5**	**+6.2%**

Onion split field with AGTIV® vs untreated. Improved growth on the right.

► GROWER SPLIT FIELDS

Table 2. **Average onion yield increase with AGTIV® mycorrhizal inoculant in Canada and Europe (2013 to 2017).**

Number of sites	Average increase (bu/ac)	Average increase (%)
12	82 bu/ac	9.1%

Onion split field with AGTIV® vs untreated.
Plant growth and health is enhanced on the right.

More developed root system on the right,
and plants are larger with AGTIV®.

PREMIER TECH
AGRICULTURE

CARROTS
EFFICACY DATA

SUMMARY – MYCORRHIZAL INOCULANT

CARROTS

► PLOT TRIALS

Research partners: Black Creek Research and Prisme

Research sites: Bright (ON), Canada – Sandy loam soil
and Napierville (QC), Canada – Black soil, organic

Treatments: a) Untreated
b) AGTIV® Specialty Crops • Powder applied at 0.23 g / 1000 seeds*

Experimental design: Randomized complete block design, 8 replicates.

*Product applied according to manufacturers recommended rate.

Table 1. **Summary of carrot yield (T/ha) and % difference**

Location	Year	Variety	Untreated	AGTIV® SPECIALTY CROPS • Powder	% Yield difference
Ontario	2017	Bolero	41.0	43.2	+5.3%
Quebec	2017	Olympus	32.3	38.6	+19.5%
Average	**2017**		**36.6**	**40.9**	**+11.7%**

Picture 1. **Bright Site (ON), Canada**

► GROWER SPLIT FIELDS

Table 2. **Average carrot yield increase with AGTIV® mycorrhizal inoculant in Canada and Europe (2014 to 2017).**

Number of sites	Average increase (lb/ac)	Average increase (%)
6	2709 lb/ac	7.6%

Carrot split field with AGTIV® vs untreated.
Bigger plants and quicker row closure on the right.

Bigger and straighter carrots on the right with AGTIV®,
and improved uniformity of carrots.

PREMIER TECH
AGRICULTURE

STRAWBERRIES
EFFICACY DATA

EFFICACY REPORT
SUMMARY – MYCORRHIZAL INOCULANT

STRAWBERRIES

► PLOT TRIALS

Research site: Saint-Eustache (QC), Canada

Treatments: a) Untreated
b) AGTIV® mycorrhizal inoculant

Experimental design: 3 fields. 3 plots of 7 plants per field. – New strawberry establishment

Table 1. **Strawberry yields (number of fruits) per treatment**

	Untreated	AGTIV® mycorrhizal inoculant	% difference AGTIV® vs untreated
Ripe fruits	16.0	18.4	+15%
Marketable fruits	13.6	17.1	+26%
Unmarketable fruits	2.4	1.3	47% reduction

Larger and bigger plants with AGTIV® on the right.

► GROWER SPLIT FIELDS

Table 2. **Average strawberry yield increase with AGTIV® mycorrhizal inoculant in Canada (1999 to 2016).**

Number of sites	Average increase (%)
13	14.0%

PREMIER TECH
AGRICULTURE

GREEN PEAS

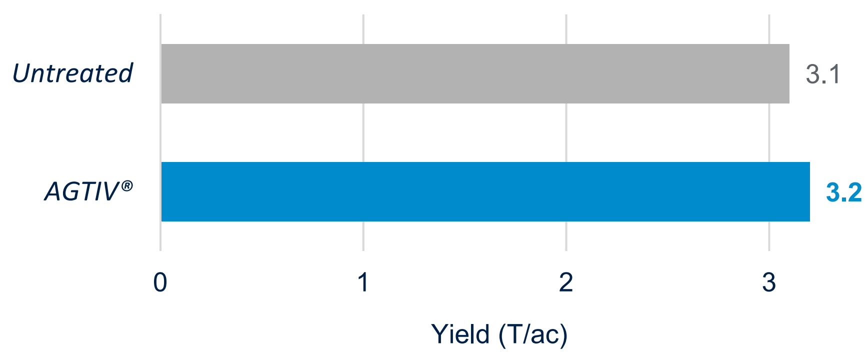
EFFICACY DATA

► GROWER SPLIT FIELDS

Table 1. **Average yield increase with AGTIV® SPECIALTY CROPS – PEA • Powder for different years (2015 to 2017) in ONTARIO, Canada.**

Year	Number of sites	Average increase (T/ac)	Average increase (%)
2015	4	0.31	23.3
2016	7	0.08	3.5
2017	1	0.12	3.7
Total	**12 sites**	**0.16 T/ac**	**10.1%**

Figure 1. **Average yield increase with AGTIV® SPECIALTY CROPS – PEA • Powder in ONTARIO, Canada (2015 to 2017).**



The root mass is increased with larger leaves on AGTIV® side.
Better nitrogen absorption through the more developed root system.

Plant growth and health is enhanced on the right, and the leaf area is increased with AGTIV®.

PEPPERS

EFFICACY DATA

E F F I C A C Y   R E P O R T
SUMMARY – MYCORRHIZAL INOCULANT

PEPPERS

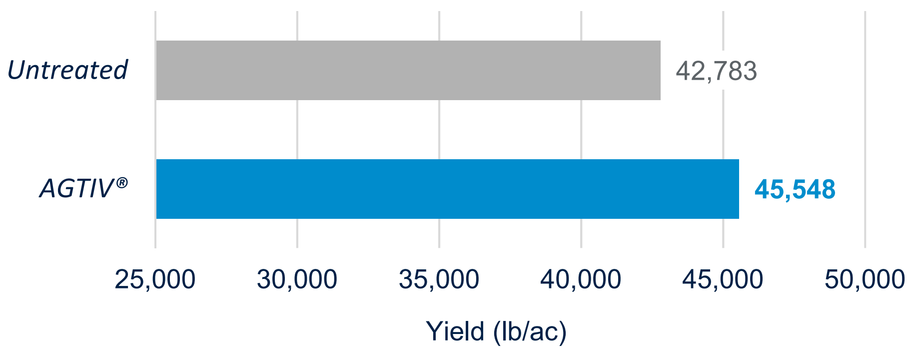
► GROWER SPLIT FIELDS

Table 1. **Average yield increase with AGTIV® mycorrhizal inoculant for different years (2002 to 2016) in ONTARIO & QUEBEC, Canada.**

Year	Number of sites	Average increase (lb/ac)	Average increase (%)
2002	2	*	5.1
2015	2	2840	10.0
2016	1	2617	3.7
Total	**5 sites**	**2766 lb/ac** **	**6.8%**

* Plot trial data for 2002: average increase of 95 g/plant.
** The 2766 lb/ac average refers only to 2015-2016 data.

Figure 1. **Average yield increase with AGTIV® mycorrhizal inoculant in ONTARIO, Canada (2015 to 2016).**



More developed root system, more leaves and bigger fruits with AGTIV®.

PREMIER TECH AGRICULTURE

Pepper split field with AGTIV® vs untreated.
Plant growth and health is enhanced, and row closure occurs sooner on the right.

Bigger root system with more fibrous roots, and more fruits per plant with AGTIV®.

PREMIER TECH
AGRICULTURE

PRODUCT
OFFER

The rising worldwide demand for food requires that we all find ways to increase crop productivity, while thinking of the next generation. Premier Tech Agriculture helps you lead the way and puts its expertise at the service of agriculture. Our goal is to offer a wide range of biological active ingredients providing sustainable results in the field and better return on your investment. Technology and science are key elements to consider in agriculture. Premier Tech has been working on mycorrhizae and its unique, proprietary mycorrhizal manufacturing process for over three decades, and continues to invest in the production of mycorrhizae, rhizobium and other active ingredients in order to meet market needs in high-quality inoculants.

EFFECTIVE

AGTIV® delivers stronger growth through better plant resistance to stresses and diseases, higher yields and superior crop quality.

EASY TO USE

Each AGTIV® product integrates easily into your farming practices allowing you to fully benefit of the power of our biological active ingredients.

PROVEN RESULTS

Since 2010, growers have increased their profitability with our inoculants for many crops such as potatoes, soybeans, peas, lentils, dry beans, forages and specialty crops.

LEAD THE WAY
BIOLOGICAL ACTIVE INGREDIENTS

SOYBEAN | FIELD CROPS | PULSES

ON-FARM MIXING WITH SEEDS

AGTIV® SOYBEAN • Powder

D: Mycorrhizal inoculant & *Bradyrhizobium*
F: Powder (peat)
C: Soybean

SIZE	COVERS	AI
10.3 lb (4.7 kg) – pail	40 acres (16 ha)	M+R

AGTIV® FIELD CROPS • Powder

D: Mycorrhizal inoculant
F: Powder (diatomaceous earth)
C: Forages, dry beans, cereals and flax

SIZE	COVERS	AI
4.4 lb (2 kg) pail	Dry beans, cereals & flax: 40 acres (16 ha) Alfalfa, mix forages & grass: 20 acres (8 ha)	M

AGTIV® PULSES • Powder

D: Mycorrhizal inoculant & rhizobium
F: Powder (peat)
C: Peas, lentils and faba beans

SIZE	COVERS	AI
10.3 lb (4.7 kg) pail	Peas & faba beans: 40 acres (16 ha) Lentils: 60 acres (24 ha)	M+R

GRANULAR IN-FURROW APPLICATION

AGTIV® SOYBEAN • Granular

D: Mycorrhizal inoculant & *Bradyrhizobium*
F: Granules (peat)
C: Soybean

SIZE	COVERS	AI
40 lb (18.2 kg) – bag	8 acres (3.2 ha)	M+R
800 lb (364 kg) – tote bag	160 acres (64 ha)	

AGTIV® FIELD CROPS • Granular

D: Mycorrhizal inoculant
F: Granules (zeolite)
C: Cereals and flax

SIZE	COVERS	AI
40 lb (18.2 kg) – bag	8 acres (3.2 ha)	M
800 lb (364 kg) – tote bag	160 acres (64 ha)	

AGTIV® PULSES • Granular

D: Mycorrhizal inoculant & rhizobium
F: Granules (peat)
C: Peas, lentils and faba beans

SIZE	COVERS	AI
40 lb (18.2 kg) – bag	8 acres (3.2 ha)	M+R
800 lb (364 kg) – tote bag	160 acres (64 ha)	

LIQUID IN-FURROW APPLICATION

AGTIV® FIELD CROPS • Liquid

D: Mycorrhizal inoculant
F: Spores in liquid suspension
C: Soybean

SIZE (Case)	COVERS (1 case)	AI
2 x 32 fl. oz – bottles (2 x 950 ml)	40 acres (16 ha)	M

AGTIV® FIELD CROPS • Liquid

D: Mycorrhizal inoculant
F: Spores in liquid suspension
C: Cereals, flax and edible beans

SIZE (Case)	COVERS (1 case)	AI
2 x 32 fl. oz – bottles (2 x 950 ml)	40 acres (16 ha)	M

PREMIER TECH AGRICULTURE

LEGEND: ACTIVE INGREDIENTS (AI)

M **MYCORRHIZAE** – PTB297 Technology
R **RHIZOBIUM** – PTB160 Technology (pulses)
PTB162 Technology (soybean)

D: Description
F: Formulation
C: Crop(s)

LEAD THE WAY

BIOLOGICAL ACTIVE INGREDIENTS

Product	IN-FURROW APPLICATION	SEED-PIECE TREATMENT AT THE WAREHOUSE	MIXING WITH SEEDS	INCORPORATION INTO GROWING MEDIA	TRANSPLANTING	SEED TREATMENT
AGTIV® POTATO • Liquid	✓	✓				
AGTIV® SPECIALTY CROPS – PEAS • Powder			✓			
AGTIV® SPECIALTY CROPS • Powder			✓	✓	✓	
AGTIV® SPECIALTY CROPS • Granular	✓			✓	✓	
SEED TREATMENT						✓

POTATO

AGTIV® POTATO • Liquid

D: Mycorrhizal inoculant
F: Spores in liquid suspension
C: Potato

SIZE (Case)	COVERS (1 case)	AI
2 x 32 fl. oz (2 x 950 ml) – bottles	20 acres (8 ha)	M

PEAS

AGTIV® SPECIALTY CROPS – PEAS • Powder

D: Mycorrhizal inoculant & rhizobium
F: Powder (peat)
C: Peas and faba beans

SIZE	COVERS	AI
5.3 lb (2.4 kg) – pail	20 acres (8 ha)	M+R

SPECIALTY CROPS

AGTIV® SPECIALTY CROPS • Powder

D: Mycorrhizal inoculant
F: Powder (diatomaceous earth)
C: Vegetables, berries and garlic

SIZE	COVERS	AI
4 x 1.1 lb (500 g) – pails	See catalogue or PTAGTIV.COM	M

AGTIV® SPECIALTY CROPS • Granular

D: Mycorrhizal inoculant
F: Granules (peat)
C: Vegetables, herbs, berries and fruit trees

SIZE	COVERS	AI
22 lb (10 kg) – pail	See catalogue or PTAGTIV.COM	M

SEED TREATMENT

D: Mycorrhizal inoculant
F: Treated seeds
C: Vegetables and fruits

	AI
ASK YOUR REPRESENTATIVE FOR MYCORRHIZAE ON-SEED APPLIED	M

LEGEND: ACTIVE INGREDIENTS (AI)

M MYCORRHIZAE – PTB297 Technology
R RHIZOBIUM – PTB160 Technology (peas)
PTB162 Technology (soybean)

D: Description
F: Formulation
C: Crop(s)

PREMIER TECH AGRICULTURE

AGTIV

PTAGTIV.COM

2017 EFFICACY REPORT

FOR AGRICULTURE

PREMIER TECH AGRICULTURE

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