PREMIER TECH

2021

AGTIV®

EFFICACY REPORT

CONTENTS

2021 EDITION

PREMIER TECH

PULSES

LENTILS & PEAS

2.7 bu/ac 178 kg/ha

LENTILS

AVERAGE YIELD INCREASE

62 sites over 11 years
Canada **10.1%**

Lentil split field with AGTIV® PULSES vs competitor 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

EFFICACY REPORT
SUMMARY – MYCORRHIZAL & RHIZOBIAL INOCULANT

LENTILS

► PLOT & STRIP TRIALS

Research partners: GMAC's Ag Team, Wheatland Conservation Area, Prairie Ag research, and Small Plot Inc.

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

Treatments: a) AGTIV® PULSES – Dual inoculant*;
b) Competitor inoculant A*;
c) Competitor inoculant B*;
d) Competitor inoculant C*;
e) Competitor inoculant D*.

Experimental design: 23 replicated plots per treatment (one trial with 6, one with 7, one with 8 and one strip trial with two replicated) in randomized complete block design

*Products applied according to manufacturers recommended rate.

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

Location	Year	AGTIV® PULSES Dual inoculant	Competitor inoculant A	Competitor inoculant B	Competitor inoculant C	Competitor inoculant D
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	
Vulcan (AB)	2019	32.6	28.8			28.4

Table 2. **Summary of Lentil yields (kg/ha) per trial.**

Location	Year	AGTIV® PULSES Dual inoculant	Competitor inoculant A	Competitor inoculant B	Competitor inoculant C	Competitor inoculant D
Brock (SK)	2015	1237	901	766		
Swift Current (SK)	2016	3367	2910	2762	2533	
Coalhurst (AB)	2017	1310	1284	1290	1243	
Vulcan (AB)	2019	2192	1937			1910

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EFFICACY REPORT

2020 – ON SEED RHIZOBIUM WITH INOCULANT EXTENDER

► LAB TEST

Test description: Nodulation tests on pea plants inoculated with ON SEED PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* with the AGTIV® Inoculant Extender for Pulses after different storage lengths & temperatures.

Research site: Premier Tech Campus (QC), Canada

Pea variety: CDC Meadowland treated with Cruiser Maxx

Experimental design: 12 plants per treatment.

Treatments:

AGTIV® ON SEED™ RHIZO ● Powder for Pulses **with** AGTIV® Inoculant Extender for Pulses:

b) stored for 7 days at 8-12°C;
c) stored for 20 days at 8-12°C;
d) stored for 30 days at 8-12°C;
e) stored for 60 days at 8-12°C;
f) stored for 7 days at 20-24°C;
g) stored for 20 days at 20-24 °C;
h) stored for 30 days at 20-24 °C;
i) stored for 60 days at 20-24 °C;

AGTIV® ON SEED™ RHIZO ● Powder for Pulses **without** AGTIV® Inoculant Extender for Pulses:

j) stored for 7 days at 8-12°C;
k) stored for 20 days at 8-12°C;
l) stored for 30 days at 8-12°C;
m) stored for 60 days at 8-12°C;
n) stored for 7 days at 20-24°C;
o) stored for 20 days at 20-24 °C;
p) stored for 30 days at 20-24 °C;
q) stored for 60 days at 20-24 °C;

Table 1. **Weighted nodule numbers with 8 to 12°C seed storage**

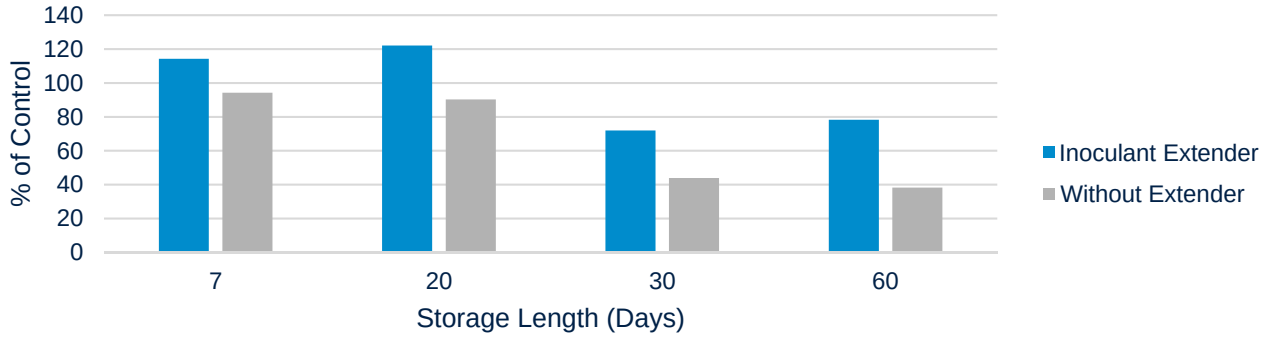
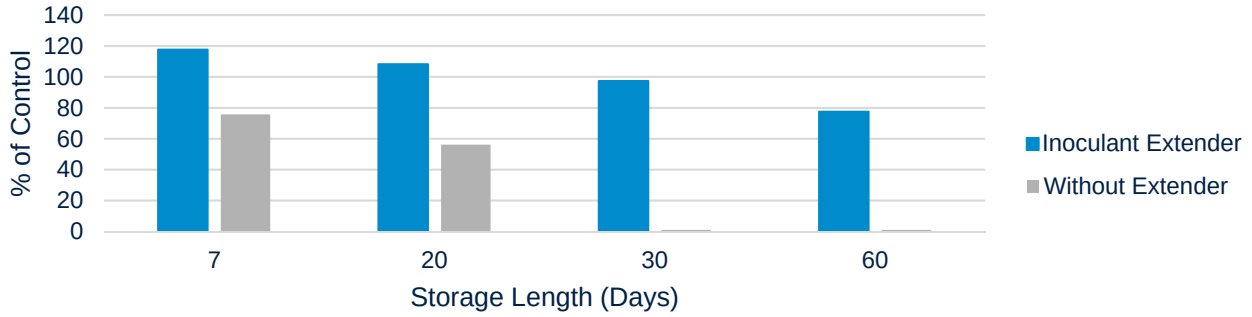


Table 2. **Weighted nodule numbers with 20 to 24°C seed storage**



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COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH ALPINE G22®

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Alpine G22® Liquid Fertilizer prior to seeding.

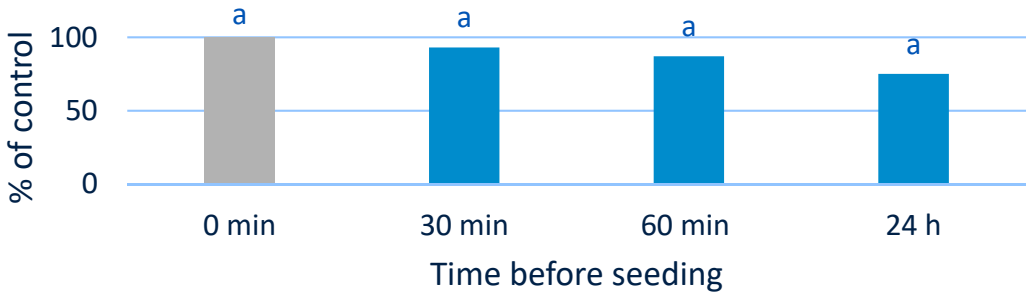
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Alpine G22® directly at seeding;
b) PTB160 / PTB162 in contact with Alpine G22® 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Alpine G22® 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Alpine G22® 24 hours before seeding.

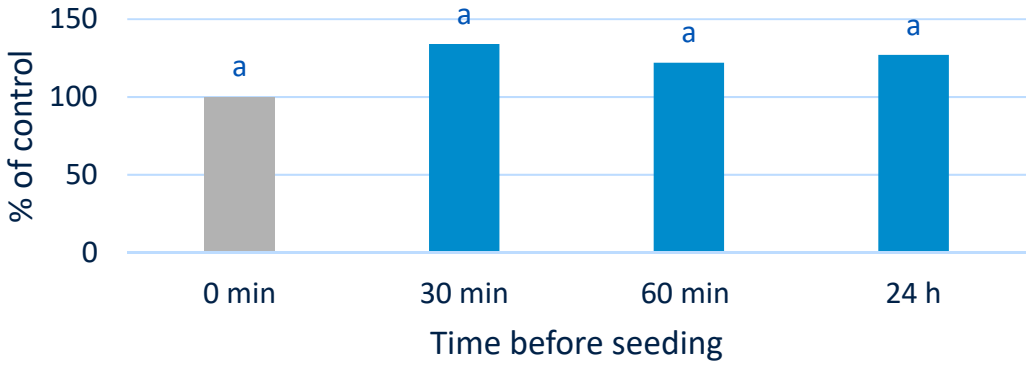
Experimental design: 6 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

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COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH AMMONIUM THIOSULFATE

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Ammonium Thiosulfate Liquid Fertilizer prior to seeding.

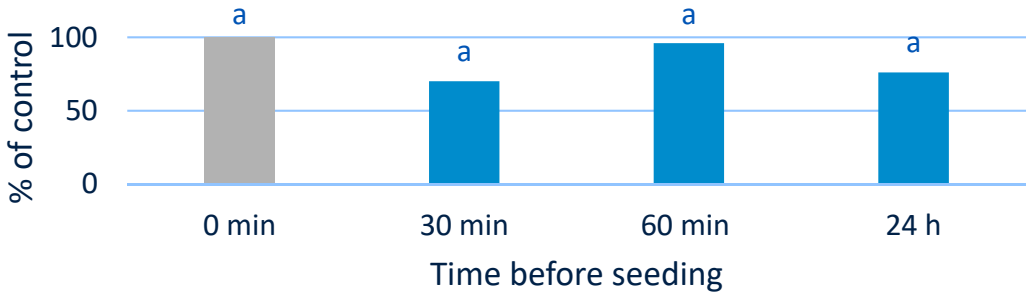
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Ammonium Thiosulfate directly at seeding;
b) PTB160 / PTB162 in contact with Ammonium Thiosulfate 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Ammonium Thiosulfate 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Ammonium Thiosulfate 24 hours before seeding.

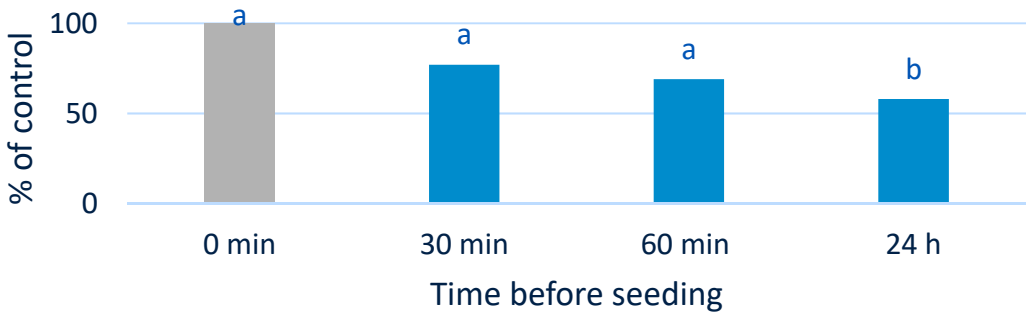
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH AMMONIUM POLYPHOSPHATE

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Ammonium Polyphosphate Liquid Fertilizer prior to seeding.

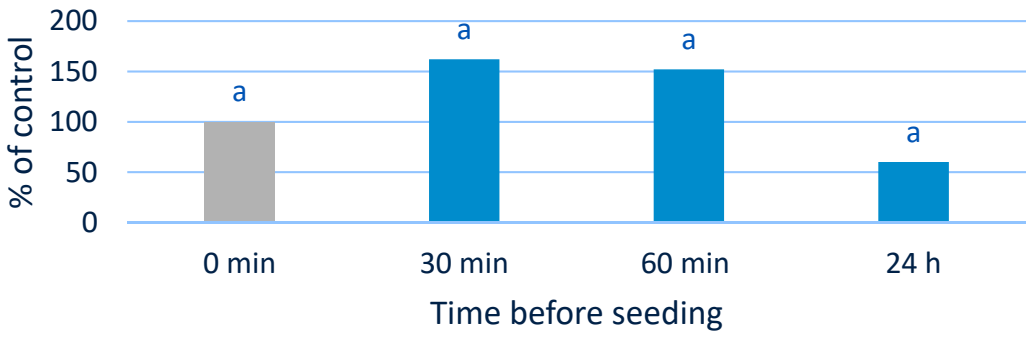
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Ammonium Polyphosphate directly at seeding;
b) PTB160 / PTB162 in contact with Ammonium Polyphosphate 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Ammonium Polyphosphate 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Ammonium Polyphosphate 24 hours before seeding.

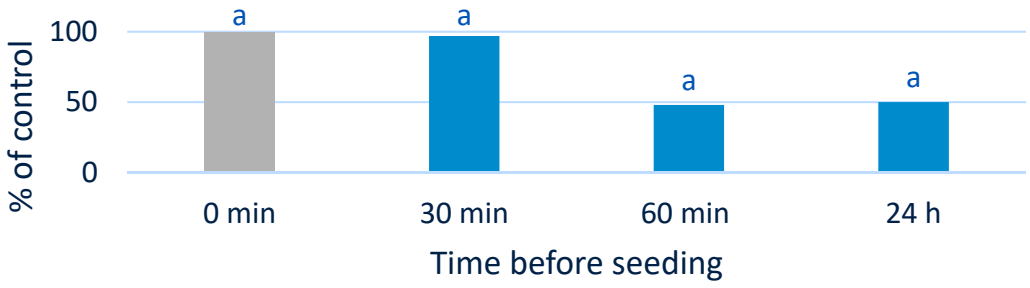
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH AGROCENTRE FERTILIZER

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Agrocentre fertilizer prior to seeding.

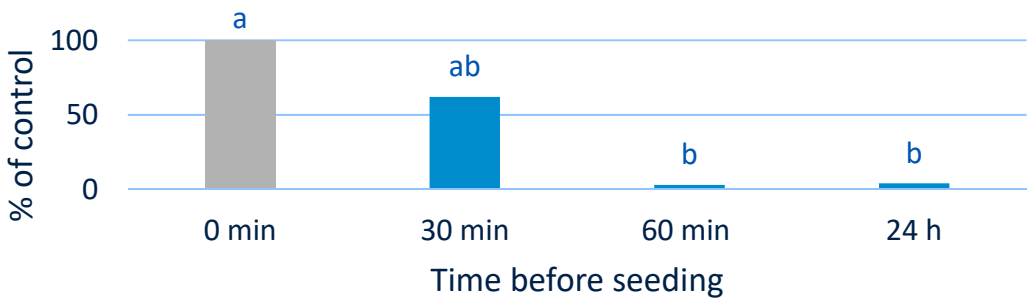
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Agrocentre fertilizer directly at seeding;
b) PTB160 / PTB162 in contact with Agrocentre fertilizer 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Agrocentre fertilizer 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Agrocentre fertilizer 24 hours before seeding.

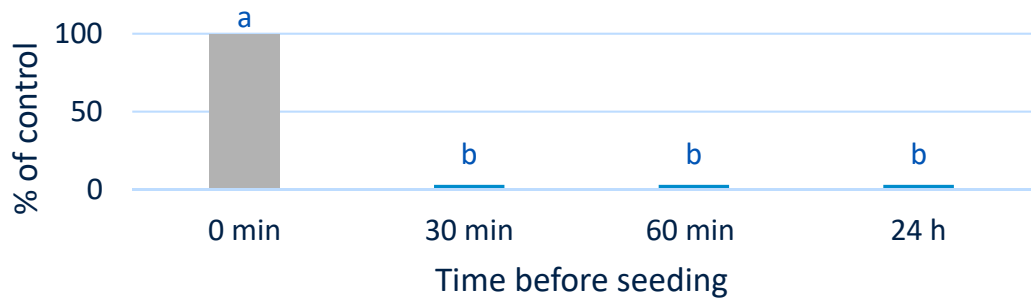
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

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COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH UREA AMMONIUM NITRATE

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Urea Ammonium Nitrate Liquid Fertilizer prior to seeding.

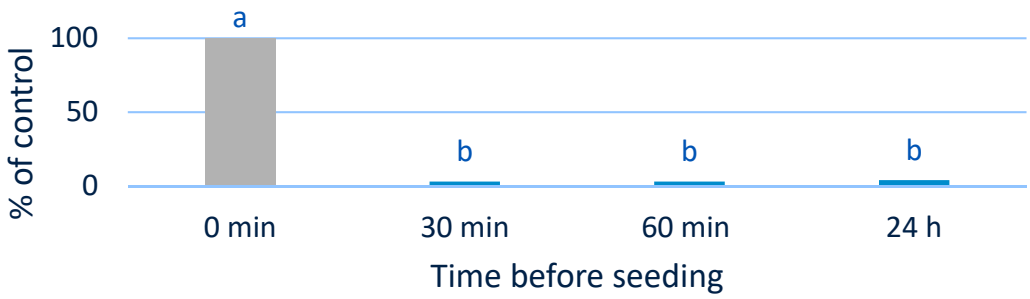
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Urea Ammonium Nitrate directly at seeding;
b) PTB160 / PTB162 in contact with Urea Ammonium Nitrate 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Urea Ammonium Nitrate 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Urea Ammonium Nitrate 24 hours before seeding.

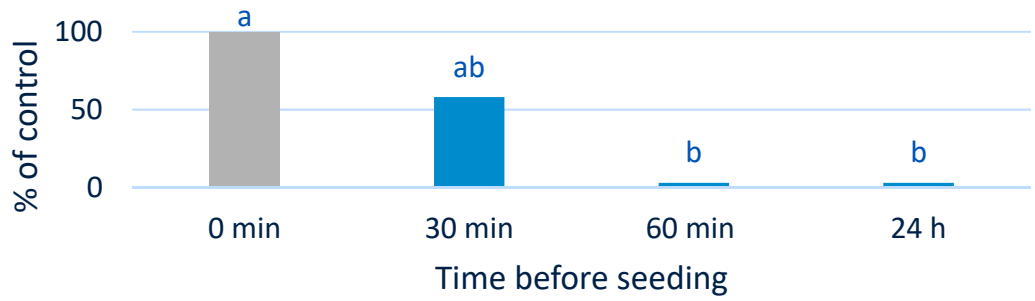
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

COMPATIBILITY REPORT
2019 – RHIZOBIUM ON SEED

► LAB TEST

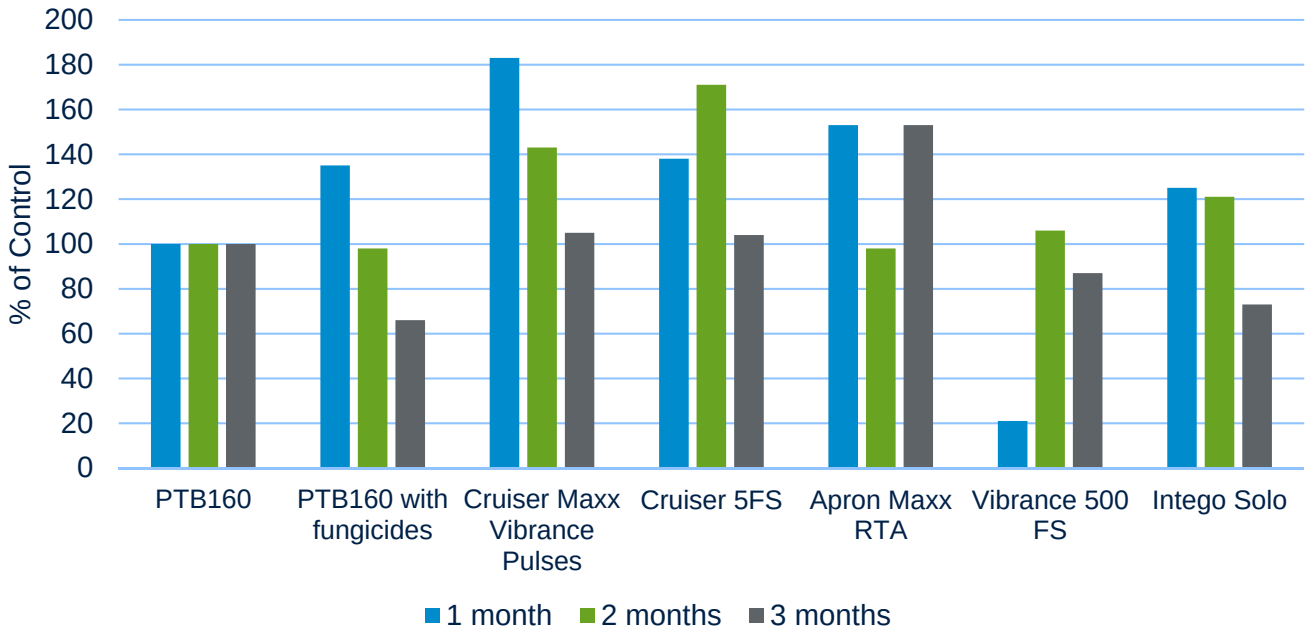
Test description: Nodulation tests on plants inoculated with PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) and fungicides applied on seeds for different periods of time prior to seeding. Treated seeds were stored in a cold room (temperature between 4ºC to 8ºC).

Research site: Premier Tech Campus (QC), Canada

Treatments:
a) PTB160 applied at seeding;
b) PTB160 & fungicide (Cruiser Maxx Vibrance Pulses) applied at seeding;
c) Seeds treated with PTB160, Cruiser Maxx Vibrance Pulses & water;
d) Seeds treated with PTB160, Cruiser 5FS & water;
e) Seeds treated with PTB160, Apron Maxx RTA & water;
f) Seeds treated with PTB160, Vibrance 500 FS & water;
g) Seeds treated with PTB160, Intego Solo & water.

Experimental design: 4 plants per treatment in randomized block design. Nodule count was done after 25 days.

Table 1. **Summary of weighted nodule numbers**



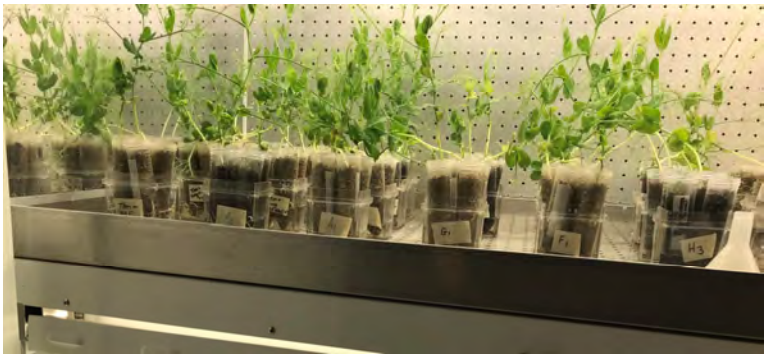


Figure 1. Plants during the test

EFFICACY REPORT
2019 – MYCORRHIZAL & RHIZOBIAL INOCULANT

LENTILS

► PLOT TRIAL

Research partner: Small Plot Inc.

Research site: Vulcan (AB), Canada

Treatments: a) ALPINE G22™ Liquid*;
b) ALPINE G22™ and AGTIV® COMBO • Liquid for PULSES*;
c) ALPINE G22™ and Competitor inoculant A*;
d) ALPINE G22™ and Competitor inoculant D*.

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

Lentil variety: Pedigree CDC Proclaim

Previous crop: Canola

Seeding details: Seeded May 14th, 2019 at 65 lb/ac with a 22.8 cm row spacing. Products were applied in-furrow.

*Products applied according to manufacturers' recommended rate

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

Treatment	Yield[1] (bu/ac)	Yield[1] (kg/ha)
ALPINE G22™ Liquid	25.0 [a]	1681 [a]
ALPINE G22™ and AGTIV® COMBO • Liquid for PULSES	32.6 [b]	2192 [b]
ALPINE G22™ and Competitor inoculant A	28.8 [ab]	1937 [ab]
ALPINE G22™ and Competitor inoculant D	28.4 [ab]	1910 [ab]

[1] Yields followed by different letters are significantly different (LSD Test at $p<0.05$). Data from bloc 1 were not analyzed due to a high presence of *Kochia scoparia*.

Plot operational notes and rain fall.

- No fertilization other than ALPINE G22™
- One herbicide application on June 6th, 2019
- Plants were dessicated September 22th and combined October 17th, 2019.

Month	Precipitation (mm)
May	16
June	50
July	16
August	25
TOTAL	**107**

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EFFICACY REPORT
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) AGTIV® RHIZO • Granular for PULSES in granular form applied at 5 lb/ac*;
c) Competitor inoculant A applied at 3.6 lb/ac*;
d) Competitor inoculant B applied at 3.6 lb/ac*;
e) Competitor inoculant 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/ft^2 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 competitor inoculant 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.**

Treatment	Yield (bu/ac)[1]	Yield (kg/ha)[1]
AGTIV® PULSES • Granular (dual inoculant)	50.1 [b]	3369 [b]
AGTIV® RHIZO • Granular for PULSES (single inoculant)	46.6 [b]	3134 [b]
Competitor inoculant A	43.3 [a,b]	2912 [a,b]
Competitor inoculant B	41.1 [a]	2764 [a]
Competitor inoculant C	37.7 [a2]	2535 [a2]

[1] Average yields followed by different letters are significantly different using Duncan's multiple range test at p≤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 at 0.67 L/ac
- Applied Edge pre-seed at 15 lb/ac
- Incrop with Odyssey at 17.3 g/ac
  + Poast Ultra at190 ml/ac
  + Merge at 0.5 L/100 L spray solution.
- Priaxor at 180 ml/ac at 10% flower
- Dessicated with Reglone @ 700 ml/ac + agsurf adjuvant at 0.1 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

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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 competitor inoculant brands with an emphasis on comparing granular formulations against the competitor inoculant D liquid formulation on lentil.

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

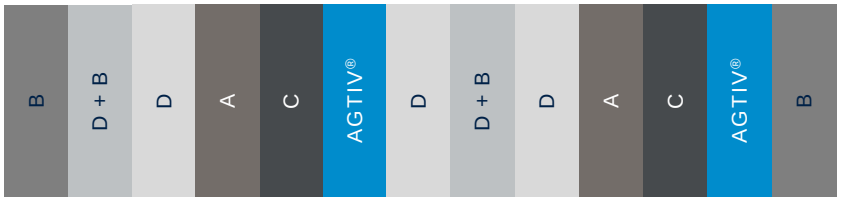
Table 1. **Summary of Lentil yields per treatment.**

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® PULSES • Granular (dual inoculant)	18.4	1237
Competitor inoculant A	13.4	901
Competitor inoculant B	11.4	767
Competitor inoculant C	11.8	794
Competitor inoculant D	11.3	760
Competitor inoculant D + B	11.1	747

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

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3.3 bu/ac 223 kg/ha

PEAS

AVERAGE YIELD INCREASE

21 sites over 9 years
Canada **6.2%**

Pea split field with AGTIV® PULSES vs competitor 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

EFFICACY REPORT
SUMMARY – MYCORRHIZAL & RHIZOBIAL INOCULANT

PEAS

▶ PLOT TRIALS

Research partners: ICMS, Wheatland Conservation Area

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

Treatments: a) AGTIV® PULSES – Dual inoculant*;
b) Competitor inoculant A*;
c) Competitor inoculant B*;
d) Competitor inoculant D*.

Experimental design: 17 replicated plots per treatment (two trials with 6 and one with 5) in randomized complete block design

*Products applied according to manufacturers recommended rate.

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

Location	Year	Seed variety	AGTIV® PULSES Dual inoculant	Competitor inoculant A	Competitor inoculant B	Competitor inoculant D
Fort Sakatchewan (AB)	2015	Meadow	88.6	86.2	79.5	
Swift Current (SK)	2017	Amarillo	14.0	12.7	12.4	
Saskatoon (SK)	2019	AAC Ardill	65.0	52		63.2

Table 2. **Summary of Pea yields (kg/ha) per trial.**

Location	Year	Seed variety	AGTIV® PULSES Dual inoculant	Competitor inoculant A	Competitor inoculant B	Competitor inoculant D
Fort Sakatchewan (AB)	2015	Meadow	5958	5793	5342	
Swift Current (SK)	2017	Amarillo	941	853	833	
Saskatoon (SK)	2019	AAC Ardill	4371	3497		4250

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EFFICACY REPORT

2020 – ON SEED RHIZOBIUM WITH INOCULANT EXTENDER

► LAB TEST

Test description: Nodulation tests on pea plants inoculated with ON SEED PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* with the AGTIV® Inoculant Extender for Pulses after different storage lengths & temperatures.

Research site: Premier Tech Campus (QC), Canada

Pea variety: CDC Meadowland treated with Cruiser Maxx

Experimental design: 12 plants per treatment.

Treatments:

AGTIV® ON SEED™ RHIZO ● Powder for Pulses **with** AGTIV® Inoculant Extender for Pulses:

b) stored for 7 days at 8-12°C;
c) stored for 20 days at 8-12°C;
d) stored for 30 days at 8-12°C;
e) stored for 60 days at 8-12°C;
f) stored for 7 days at 20-24°C;
g) stored for 20 days at 20-24 °C;
h) stored for 30 days at 20-24 °C;
i) stored for 60 days at 20-24 °C;

AGTIV® ON SEED™ RHIZO ● Powder for Pulses **without** AGTIV® Inoculant Extender for Pulses:

j) stored for 7 days at 8-12°C;
k) stored for 20 days at 8-12°C;
l) stored for 30 days at 8-12°C;
m) stored for 60 days at 8-12°C;
n) stored for 7 days at 20-24°C;
o) stored for 20 days at 20-24 °C;
p) stored for 30 days at 20-24 °C;
q) stored for 60 days at 20-24 °C;

Table 1. **Weighted nodule numbers with 8 to 12°C seed storage**

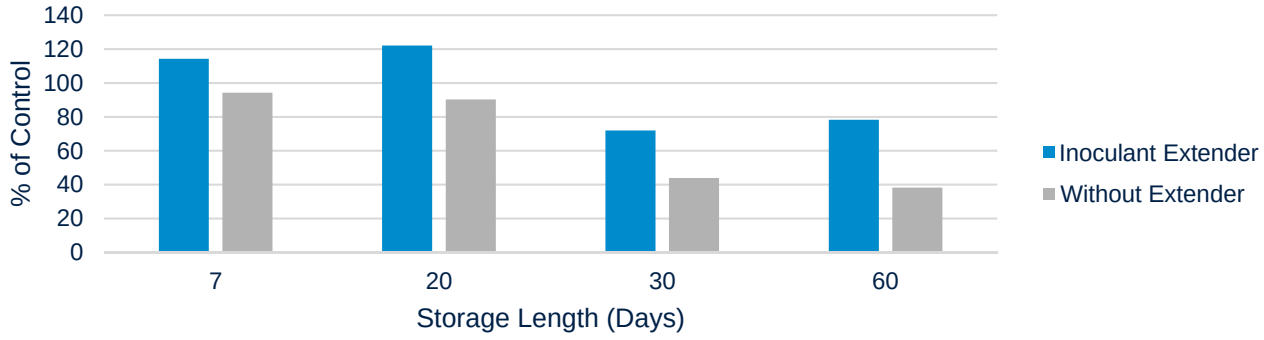
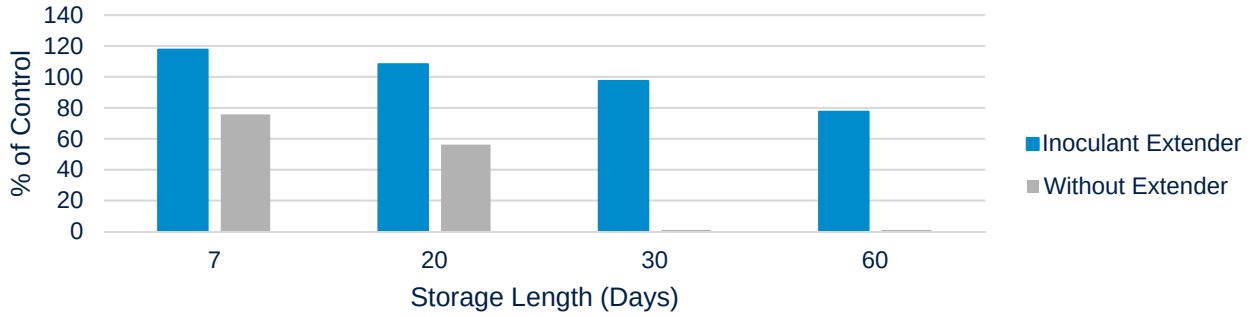


Table 2. **Weighted nodule numbers with 20 to 24°C seed storage**



PREMIER TECH

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH ALPINE G22®

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Alpine G22® Liquid Fertilizer prior to seeding.

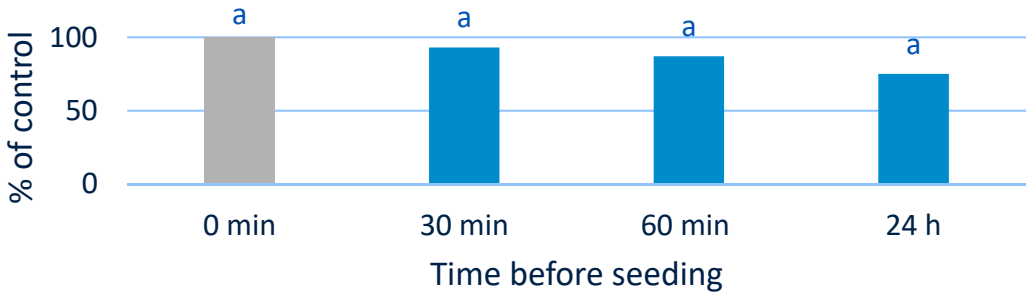
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Alpine G22® directly at seeding;
b) PTB160 / PTB162 in contact with Alpine G22® 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Alpine G22® 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Alpine G22® 24 hours before seeding.

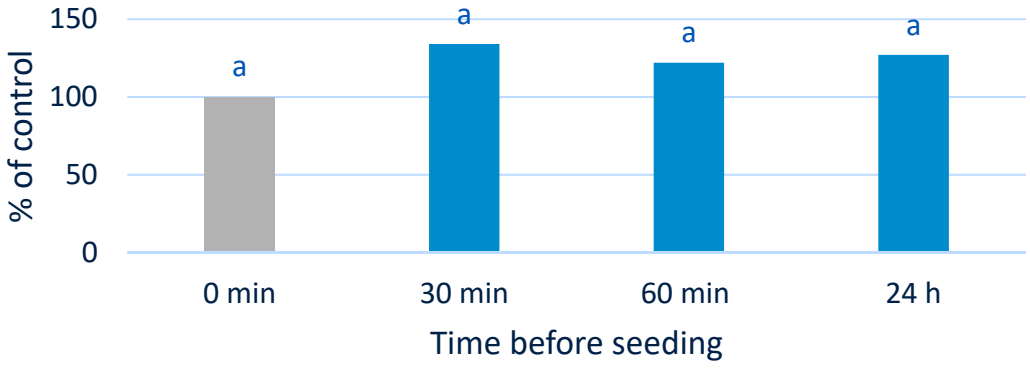
Experimental design: 6 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

PREMIER TECH

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH AMMONIUM THIOSULFATE

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Ammonium Thiosulfate Liquid Fertilizer prior to seeding.

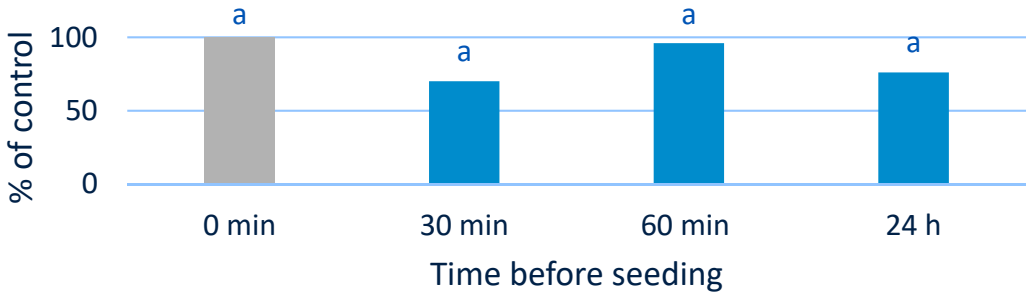
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Ammonium Thiosulfate directly at seeding;
b) PTB160 / PTB162 in contact with Ammonium Thiosulfate 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Ammonium Thiosulfate 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Ammonium Thiosulfate 24 hours before seeding.

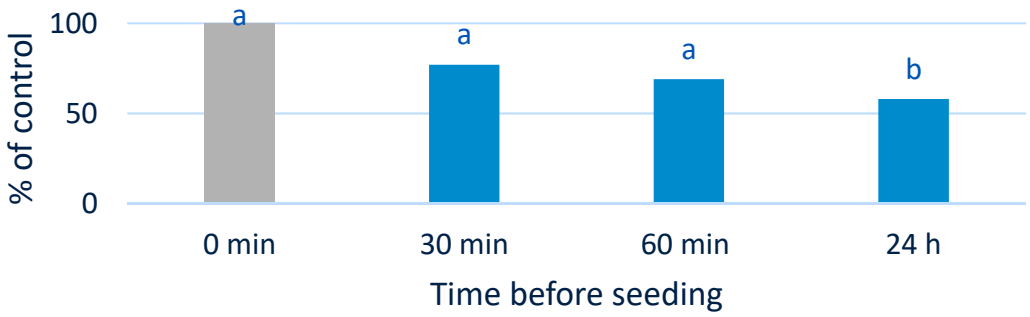
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH AMMONIUM POLYPHOSPHATE

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Ammonium Polyphosphate Liquid Fertilizer prior to seeding.

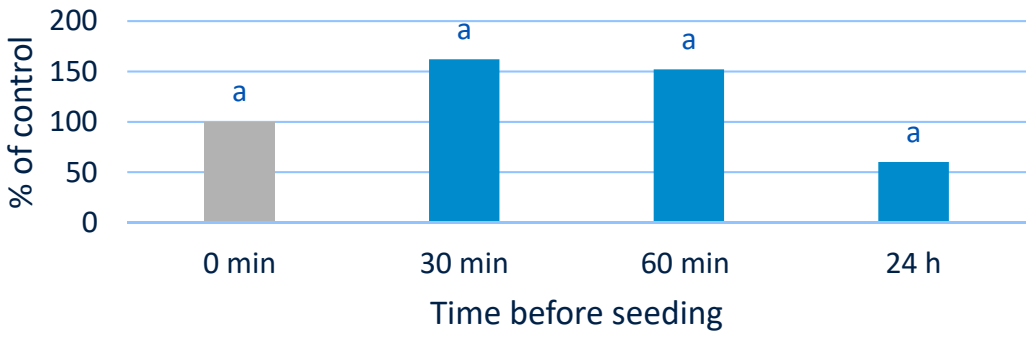
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Ammonium Polyphosphate directly at seeding;
b) PTB160 / PTB162 in contact with Ammonium Polyphosphate 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Ammonium Polyphosphate 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Ammonium Polyphosphate 24 hours before seeding.

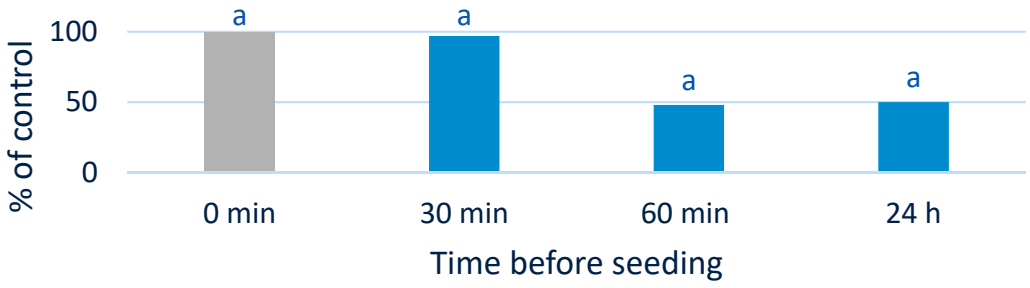
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH AGROCENTRE FERTILIZER

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Agrocentre fertilizer prior to seeding.

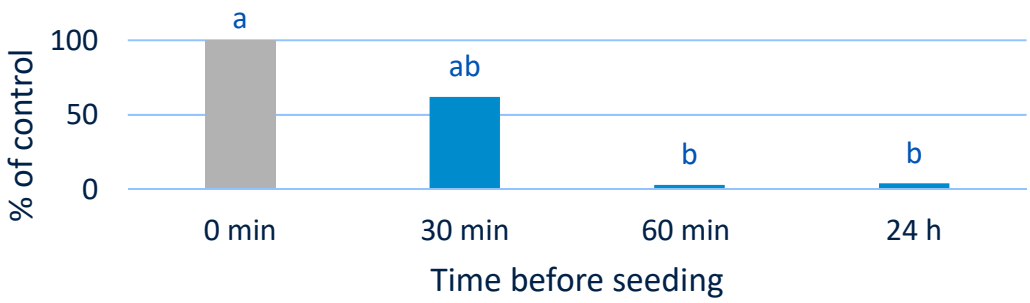
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Agrocentre fertilizer directly at seeding;
b) PTB160 / PTB162 in contact with Agrocentre fertilizer 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Agrocentre fertilizer 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Agrocentre fertilizer 24 hours before seeding.

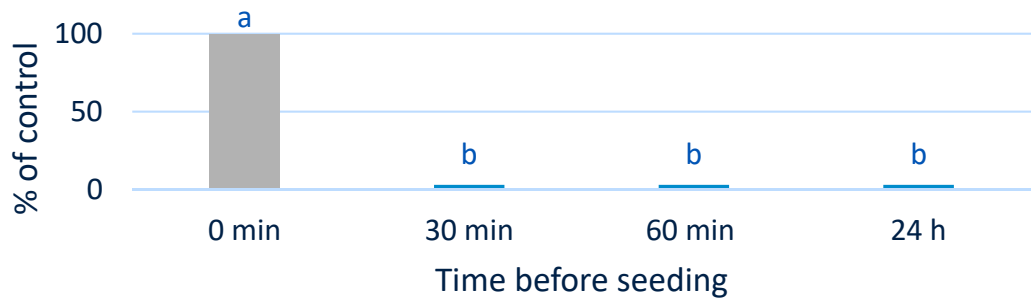
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

PREMIER TECH

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH UREA AMMONIUM NITRATE

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Urea Ammonium Nitrate Liquid Fertilizer prior to seeding.

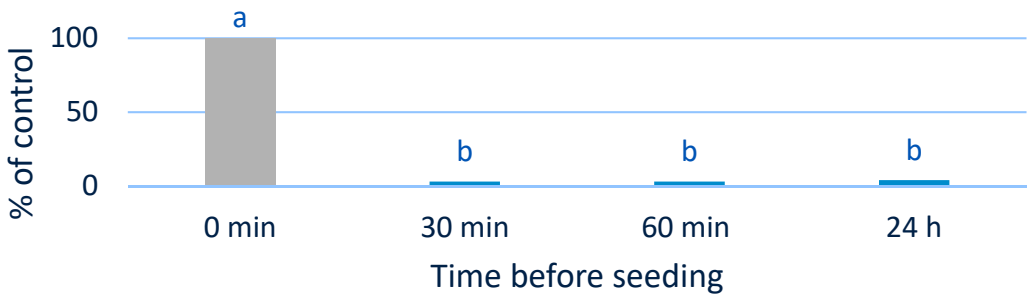
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Urea Ammonium Nitrate directly at seeding;
b) PTB160 / PTB162 in contact with Urea Ammonium Nitrate 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Urea Ammonium Nitrate 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Urea Ammonium Nitrate 24 hours before seeding.

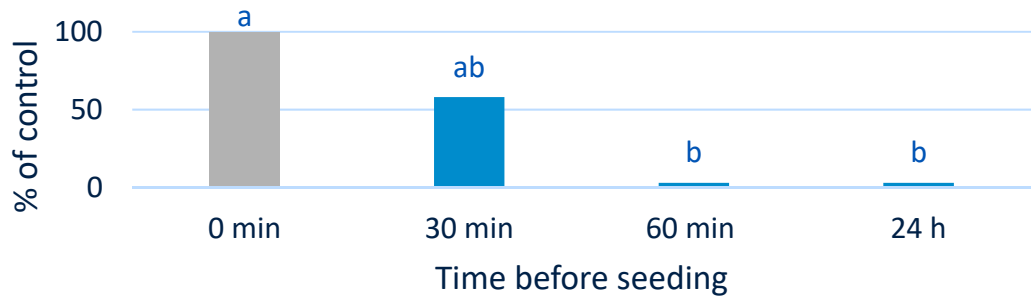
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

COMPATIBILITY REPORT
2019 – RHIZOBIUM ON SEED

► LAB TEST

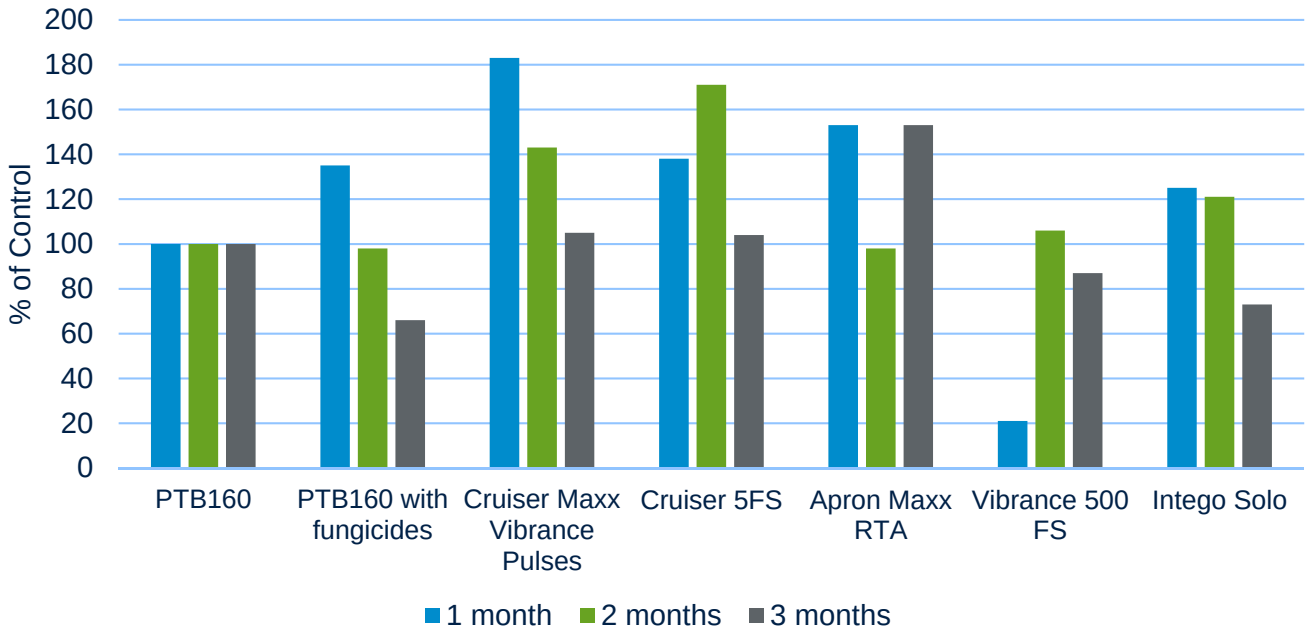
Test description: Nodulation tests on plants inoculated with PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) and fungicides applied on seeds for different periods of time prior to seeding. Treated seeds were stored in a cold room (temperature between 4ºC to 8ºC).

Research site: Premier Tech Campus (QC), Canada

Treatments:
a) PTB160 applied at seeding;
b) PTB160 & fungicide (Cruiser Maxx Vibrance Pulses) applied at seeding;
c) Seeds treated with PTB160, Cruiser Maxx Vibrance Pulses & water;
d) Seeds treated with PTB160, Cruiser 5FS & water;
e) Seeds treated with PTB160, Apron Maxx RTA & water;
f) Seeds treated with PTB160, Vibrance 500 FS & water;
g) Seeds treated with PTB160, Intego Solo & water.

Experimental design: 4 plants per treatment in randomized block design. Nodule count was done after 25 days.

Table 1. **Summary of weighted nodule numbers**



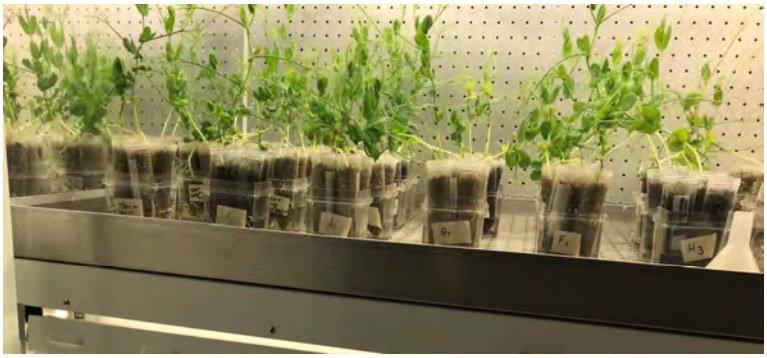


Figure 1. Plants during the test

EFFICACY REPORT
2019 – MYCORRHIZAL & RHIZOBIAL INOCULANT

PEAS

► PLOT TRIAL

Research partner: ICMS

Research site: Saskatoon (SK), Canada

Treatments: a) ALPINE G22™ Liquid*;
b) ALPINE G22™ and AGTIV® COMBO • Liquid for PULSES*;
c) ALPINE G22™ and Competitor inoculant A*;
d) ALPINE G22™ and Competitor inoculant D*.

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

Lentil variety: AAC Ardill

Previous crop: Wheat

Seeding details: Seeded with a cone seeder June 1st at 201 lb/ac with a 15.2 cm row spacing. Products were applied in-furrow.

*Products applied according to manufacturers' recommended rate

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

Treatment	Yield (bu/ac)	Yield (kg/ha)
ALPINE G22™ Liquid	56.0	3766
ALPINE G22™ and AGTIV® COMBO • Liquid for PULSES	65.0	4371
ALPINE G22™ and Competitor inoculant A	52.3	3517
ALPINE G22™ and Competitor inoculant D	63.2	4250

Plot operational notes and rain fall.

- Fertilizer (Urea 28%) applied at same moment as Viper herbicide at 0.8 lb/ac on July 12th 2019
- Two herbicide applications on July 12th 2019 (Viper) and 29th (Centurion), 2019
- Two insecticide applications (Matador) on July 8th and 13th, 2019
- Combined with a Small Plot Combine on October 11th, 2019.

Month	Precipitation (mm)
June	84.8
July	67.6
August	20.3
September	39.5
TOTAL	**212.2**

PREMIER TECH

EFFICACY REPORT
2017 – MYCORRHIZAL & RHIZOBIAL INOCULANT

PEAS

► 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) AGTIV® RHIZO • Granular for PULSES 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.**

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® PULSES • Granular (dual inoculant) + TAA + Fungicide	48.1	3235
AGTIV® RHIZO • Granular for PULSES (single inoculant) + designed fertility	35.8	2408

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.

PREMIER TECH

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) AGTIV® RHIZO • Granular for PULSES in granular form applied at 4 lb/ac*;
c) Competitor inoculant A applied at 3.6 lb/ac*;
d) Competitor inoculant B applied at 3.6 lb/ac*;
e) Competitor inoculant C applied at 4.0 lb/ac*;
f) Competitor inoculant 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.**

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® PULSES • Granular (dual inoculant)	14.0	942
AGTIV® RHIZO • Granular for PULSES (single inoculant)	13.1	881
Competitor inoculant A	12.7	854
Competitor inoculant B	12.4	834
Competitor inoculant C	13.2	888
Competitor inoculant E	12.3	827

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 at 1 L/ac and Aim at 30 ml/ac
- Application of 98 lb/ac of 11-52-0 sidebanded
- In crop with Viper ADV at 400 ml/ac + Poast Ultra at 190 ml/ac + UAN at 810 ml/ac spray solution.
- Combined on 17th August 2017 with Winterstieger plot combine.

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

PREMIER TECH

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) Competitor inoculant A applied at 3.3 lb/ac*;
c) Competitor inoculant 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.**

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® PULSES • Granular (dual inoculant)	88.6	5958
Competitor inoculant A	86.2	5797
Competitor inoculant B	79.5	5347

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

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

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® PULSES • Granular (dual inoculant)	88.6	5958
Competitor inoculant A	86.2	5797
Competitor inoculant B	85.8	5770

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

PREMIER TECH

BEANS

SOYBEANS & DRY BEANS

3.5 bu/ac 232 kg/ha

SOYBEANS

AVERAGE YIELD INCREASE

85 sites over 7 years
Canada and Europe 7.8%

Soybean split field with AGTIV® SOYBEAN vs competitor 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

EFFICACY REPORT
SUMMARY – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT & STRIP TRIALS

Research partners: ICMS, AgQuest, New Era Ag research, Stoney Ridge Ag Services, and South East Research Farm (SERF)

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

Treatments: a) AGTIV® SOYBEAN – Dual inoculant*;
b) Competitor inoculant A*;
c) Competitor inoculant B*;
d) Competitor inoculant C*;
e) Competitor inoculant D*.

Experimental design: Total of 86 replicated plots per treatment in randomized complete block design, and one strip trial with 2 replicated strips.

*Products applied according to manufacturers recommended rate.

Table 1. **Summary of Soybean yields (bu/ac)[1] per trial[2].**

Location	Year	Seed variety	AGTIV® SOYBEAN Dual Inoculant	Competitor inoculant A	Competitor inoculant B	Competitor inoculant C	Competitor inoculant D
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]	
Redvers (SK)	2018	Prograin, Dario	31.1	28.2	25.8		
Swan River (MB)	2018	Prograin, Dario	57.7	47.2	54.3	55.5	
Portage La Prairie (MB)	2018	Secan, Barker	49.4	47.2	47.8		
Elm Creek (MB)	2019	Gray R2	37.1	36.9			35.9
Redvers (SK)	2019	NSC Watson RR2Y	16.3	14.9		15.8	
Swan River (MB)	2019	Syngenta M2	35.7 [a]	29.9 [b]		35.7 [a]	

[1] Average yields followed by different letters are significantly different at p≤0.05.
[2] To obtain kg/ha results, multiply bushels per 60 and then by 1.12085 (n*60*1.12085).

PREMIER TECH

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH ALPINE G22®

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Alpine G22® Liquid Fertilizer prior to seeding.

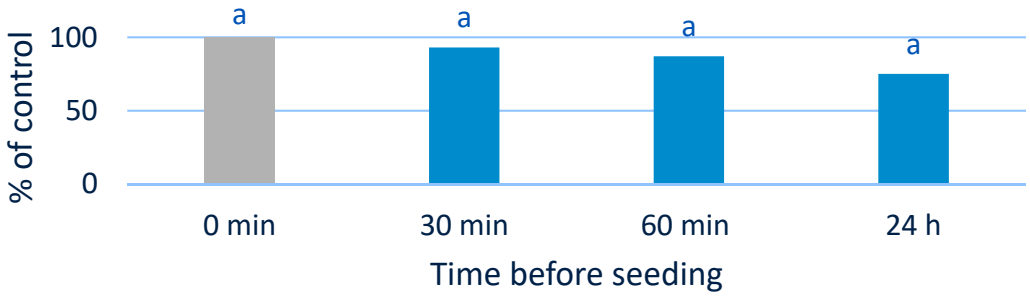
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Alpine G22® directly at seeding;
b) PTB160 / PTB162 in contact with Alpine G22® 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Alpine G22® 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Alpine G22® 24 hours before seeding.

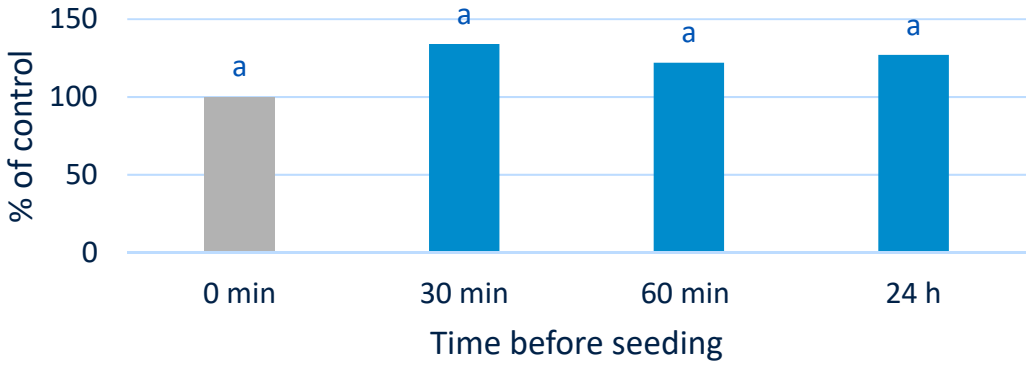
Experimental design: 6 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

PREMIER TECH

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH AMMONIUM THIOSULFATE

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Ammonium Thiosulfate Liquid Fertilizer prior to seeding.

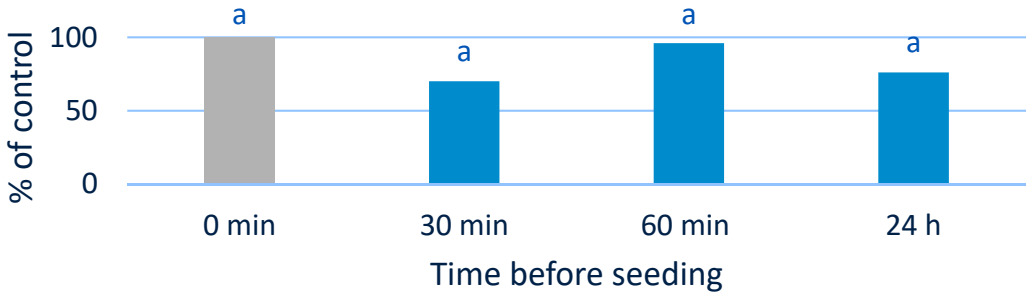
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Ammonium Thiosulfate directly at seeding;
b) PTB160 / PTB162 in contact with Ammonium Thiosulfate 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Ammonium Thiosulfate 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Ammonium Thiosulfate 24 hours before seeding.

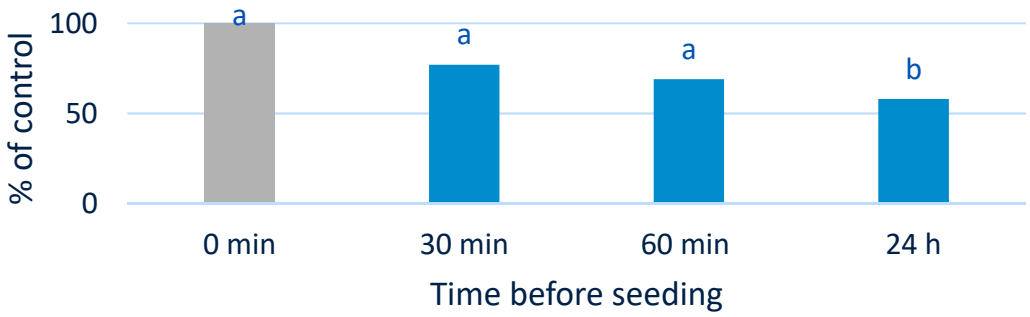
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH AMMONIUM POLYPHOSPHATE

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Ammonium Polyphosphate Liquid Fertilizer prior to seeding.

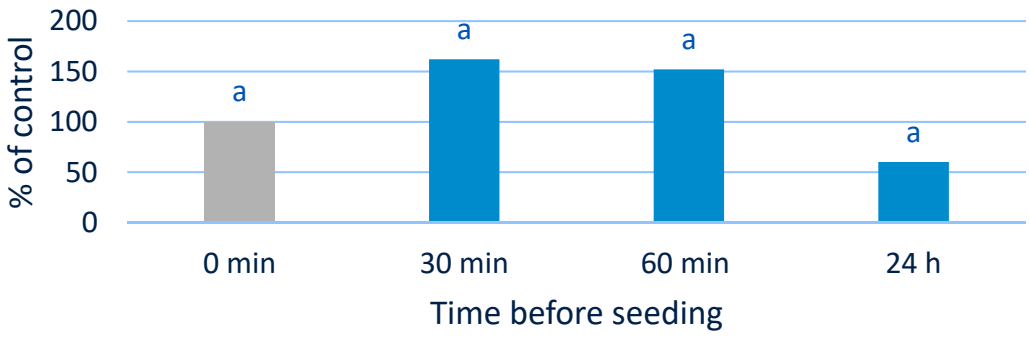
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Ammonium Polyphosphate directly at seeding;
b) PTB160 / PTB162 in contact with Ammonium Polyphosphate 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Ammonium Polyphosphate 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Ammonium Polyphosphate 24 hours before seeding.

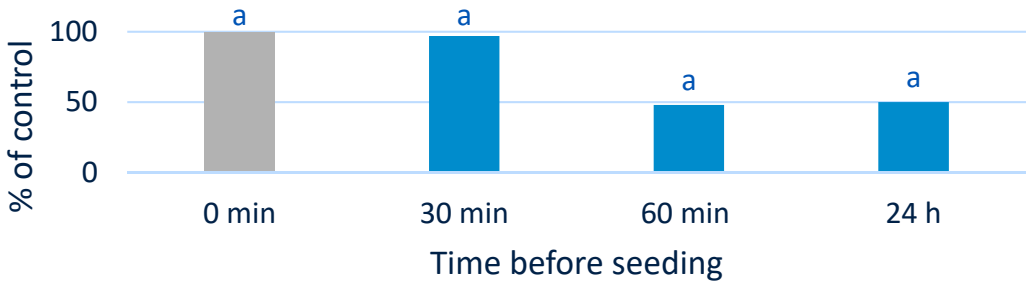
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH AGROCENTRE FERTILIZER

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Agrocentre fertilizer prior to seeding.

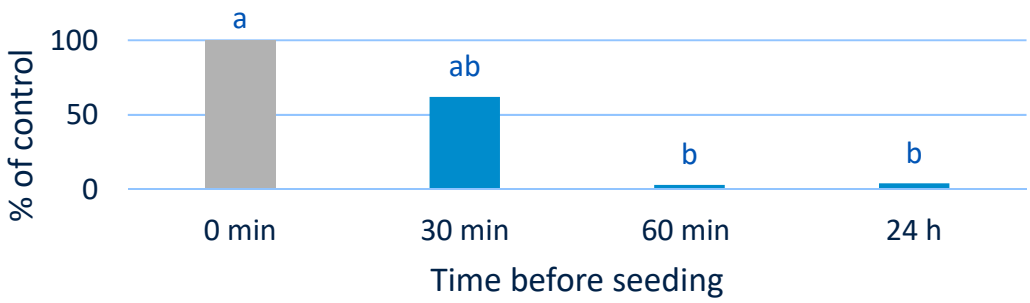
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Agrocentre fertilizer directly at seeding;
b) PTB160 / PTB162 in contact with Agrocentre fertilizer 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Agrocentre fertilizer 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Agrocentre fertilizer 24 hours before seeding.

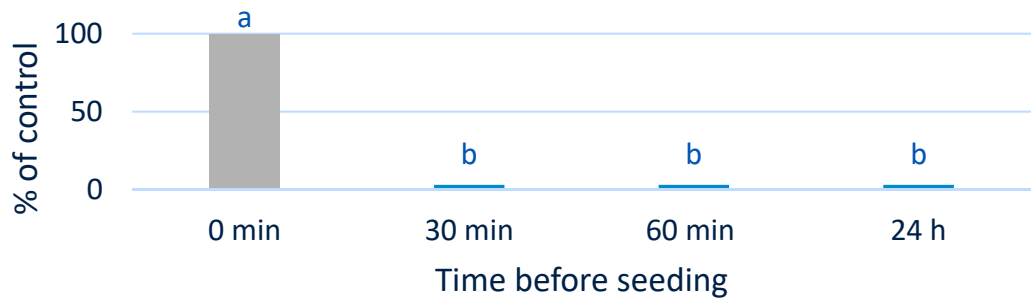
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

PREMIER TECH

COMPATIBILITY REPORT

2020 – RHIZOBIUM & BRADYRHIZOBIUM WITH UREA AMMONIUM NITRATE

► LAB TEST

Test description: Nodulation tests on plants inoculated with
PTB160 Technology - *Rhizobium leguminosarum* biovar *vicea* (peas) or
PTB162 Technology - *Bradyrhizobium japonicum* (soybean)
at different contact times with Urea Ammonium Nitrate Liquid Fertilizer prior to seeding.

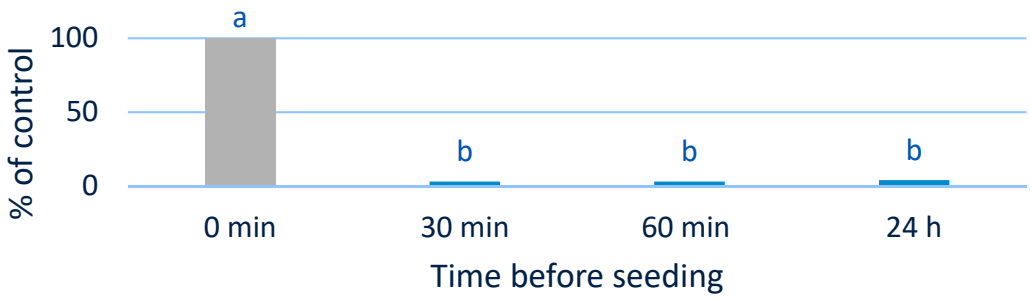
Research site: Premier Tech Campus (QC), Canada

Treatments for PTB160 and PTB162:

a) PTB160 / PTB162 in contact with Urea Ammonium Nitrate directly at seeding;
b) PTB160 / PTB162 in contact with Urea Ammonium Nitrate 30 minutes before seeding;
c) PTB160 / PTB162 in contact with Urea Ammonium Nitrate 60 minutes before seeding;
d) PTB160 / PTB162 in contact with Urea Ammonium Nitrate 24 hours before seeding.

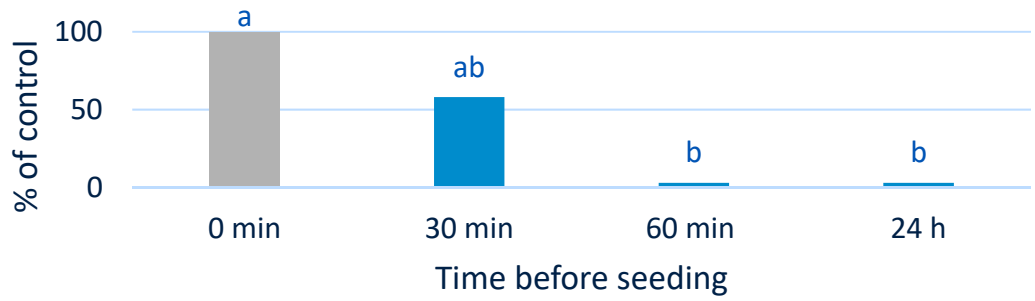
Experimental design: 8 plants per treatment. Nodulation was observed after 25 days. Fertilizer was applied at 37 l/ha (4 gal/ac).

Table 1. **Summary for the weighted nodule numbers for PTB160.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

Table 2. **Summary for the weighted nodule numbers for PTB162.**



Lowercase letters indicate Duncan ranking of averages at 5% confidence interval.

COMPATIBILITY REPORT
2019 – BRADYRHIZOBIUM ON SEED

► LAB TEST

Test description: Nodulation tests on plants inoculated with PTB162 Technology - *Bradyrhizobium japonicum* (soybean) and fungicides applied on seeds for different periods of time prior to seeding. Treated seeds were stored in a cold room (temperature between 4ºC to 8ºC).

Research site: Premier Tech Campus (QC), Canada

Treatments: a) PTB162 applied at seeding;
b) PTB162 & fungicide (Cruiser Maxx Vibrance Beans) applied at seeding;
c) Seeds treated with PTB162, Cruiser Maxx Vibrance Beans & water;
d) Seeds treated with PTB162, Cruiser Maxx Beans & water;
e) Seeds treated with PTB162, Vibrance 500 FS & water;
f) Seeds treated with PTB162, Intego Solo & water.

Experimental design: 4 plants per treatment in randomized block design. Nodule count was done after 25 days.

Table 1. **Summary of weighted nodule numbers**

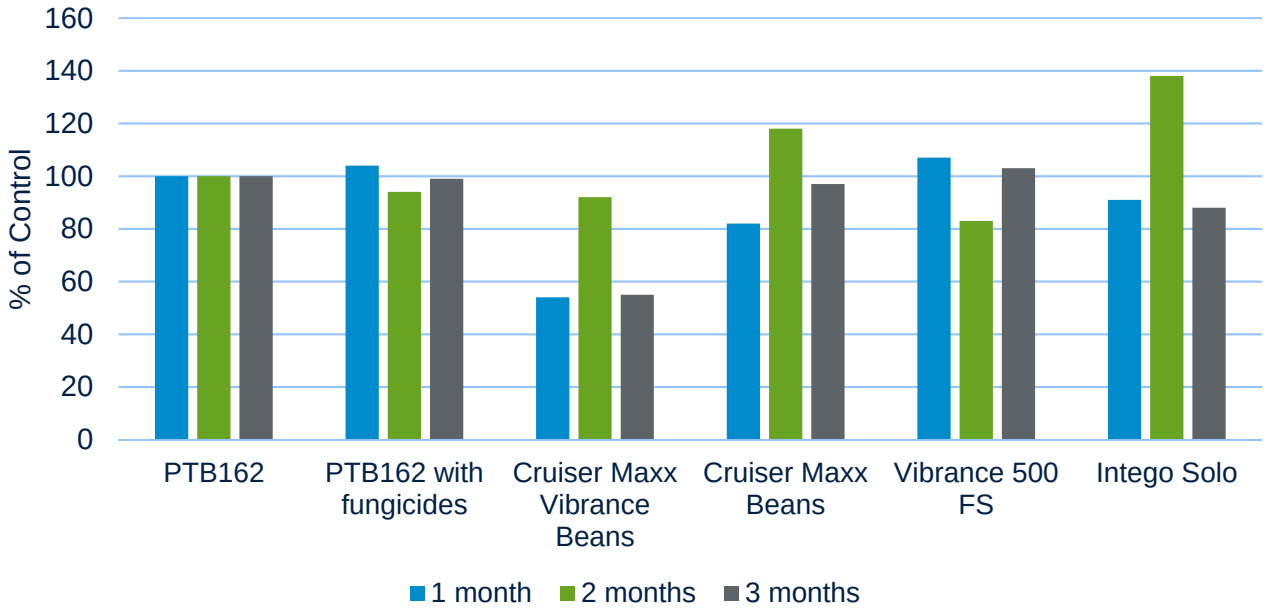


Figure 1. Plants during the test

EFFICACY REPORT
2019 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: AgQuest

Research site: Elm Creek (MB), Canada

Treatments: a) ALPINE G22™ Liquid*;
b) ALPINE G22™ and AGTIV® COMBO • Liquid for SOYBEAN*;
d) ALPINE G22™ and Competitor inoculant A*;
e) ALPINE G22™ and Competitor inoculant D*.

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

Soybean variety: Gray R2 with *Bradyrhizobium* pre-inoculated on the seed

Previous crop: Barley

Seeding details: Seeded May 28th 2019 with a 21 cm row spacing

*Products applied according to manufacturers' recommended rate

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

Treatment	Yield (bu/ac)	Yield (kg/ha)
ALPINE G22™ Liquid	34.6	2327
ALPINE G22™ and AGTIV® COMBO • Liquid for SOYBEAN	37.1	2495
ALPINE G22™ and Competitor inoculant A	36.9	2482
ALPINE G22™ and Competitor inoculant D	35.9	2414

Plot operational notes and rain fall.

- Three Roundup WeatherMax applications on June 14th, July 9th and 24th, 2019
- Insecticide (CORAGEN) August 14th 2019
- Combined on October 26th, 2019.

Month	Precipitation (mm)
May	42.2
June	59.5
July	91.7
August	40.9
September	196.7
TOTAL	**431**

PREMIER TECH

EFFICACY REPORT
2019 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: New Era Ag Research

Research site: Swan River (MB), Canada

Treatments: a) Untreated
b) AGTIV® SOYBEAN • Granular*;
c) Competitor inoculant A applied*;
d) Competitor inoculant C applied*.

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

Soybean variety: Syngenta M2 with *Bradyrhizobium* pre-inoculated on the seed

Previous crop: Canola stubble

Seeding details: Seeded May 24th, 2019 with a 22.4 cm row spacing and a rate of 190 000 seeds/acre.

*Products applied according to manufacturers' recommended rate

Table 1. **Summary of yields and protein content of Soybean per treatment**

Treatment	Yield[1] (bu/ac)	Yield[1] (kg/ha)	Protein content[1] (%)
Untreated	26.5 [a]	1782 [a]	32.87 [a]
AGTIV® SOYBEAN • Granular	35.7 [b]	2401 [b]	37.59 [c]
Competitor inoculant A	29.9 [a]	2011 [a]	35.27 [b]
Competitor inoculant C	35.7 [b]	2401 [b]	37.87 [c]

[1] Yields and protein contents followed by different letters are significantly different (Tukey's test HSD at p≤0.05).

Plot operational notes and rain fall.

- Fertilization :
  - 0-20-10-0 fertilizer applied at season start
- Herbicides applied June 12th and 25th, and July 12th (Glyphosate). Insecticide (POUNCE) applied August 12th, 2019
- Combined October 7th, 2019.

Month	Precipitation (mm)
May	25.7
June	26.1
July	59.4
August	51.8
September	48.8
TOTAL	**211.8**

PREMIER TECH

EFFICACY REPORT
2019 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: South East Research Farm (SERF)

Research site: Redvers (SK), Canada

Treatments: a) Untreated
b) AGTIV® SOYBEAN • Granular*;
c) Competitor inoculant A*;
d) Competitor inoculant C*.

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

Soybean variety: NSC Watson RR2Y with *Bradyrhizobium* pre-inoculated on the seed

Previous crop: Canola

Seeding details: Seeded May 27th 2019 at a rate of 210 000 seeds/acre.

*Products applied according to manufacturers' recommended rate

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

Treatment	Yield (bu/ac)	Yield (kg/ha)
Untreated	13.4	901
AGTIV® SOYBEAN • Granular	16.3	1096
Competitor inoculant A	14.9	1002
Competitor inoculant C	15.8	1063

Plot operational notes and rain fall.

- Herbicides applied June 18th (Glyphosate) and July 1st (Viper and UAN)
- Combined October 6th, 2019.

Month	Precipitation (mm)
May	18
June	79
July	54
August	88
September	99
TOTAL	**338**

PREMIER TECH

EFFICACY REPORT
2018 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: South East Research Farm (SERF)

Research site: Redvers (SK), Canada

Treatments: a) AGTIV® SOYBEAN • Granular applied at 5 lb/ac*;
b) AGTIV® FIELD CROPS • Liquid applied at 48 ml/ac and AGTIV® BRADY • Liquid for SOYBEAN applied at 279 ml/ac;
c) Competitor inoculant A applied at 5 lb/ac*;
d) Competitor inoculant B applied at 4.5 lb/ac*.

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

Soybean variety: Dario

Previous crop: Canola stubble

Seeding details: Seeded May 28th 2018 at 210 000 seeds/ac with 15 cm row spacing

*Granular products applied according to manufacturers' recommended rate.

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

Treatment	Yield (bu/ac)	Yield (kg/ha)	Protein (%)
AGTIV® SOYBEAN • Granular	31.1	2092	32.5
AGTIV® FIELD CROPS • Liquid and AGTIV® BRADY • Liquid for SOYBEAN	28.2	1896	29.0
Competitor inoculant A	25.8	1735	28.5
Competitor inoculant B	29.7	1997	30.8

Plot operational notes and rain fall.

- No tillage
- Fertilization: 58 lb/ac of P
- Glyphosate applied twice during growth
- Combined on September 27th, 2018.

Month	Precipitation (mm)
May	13.8
June	44.3
July	19.5
August	17.4
September	27.6
TOTAL	**122.6**

PREMIER TECH

EFFICACY REPORT
2018 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: Integrated Crop Management Services (ICMS)

Research site: Portage La Prairie (MB), Canada

Treatments: a) AGTIV® SOYBEAN • Granular applied at 5 lb/ac*;
b) AGTIV® FIELD CROPS • Liquid applied at 48 ml/ac and AGTIV® BRADY • Liquid for SOYBEAN applied at 279 ml/ac;
c) Competitor inoculant A applied at 5 lb/ac*;
d) Competitor inoculant B applied at 4.7 lb/ac*.

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

Soybean variety: Barker

Previous crop: Fallow

Seeding details: Seeded June 6th 2018 with 24 m² per plot.

*Granular products applied according to manufacturers' recommended rate.

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

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® SOYBEAN • Granular	49.4	3322
AGTIV® FIELD CROPS • Liquid and AGTIV® BRADY • Liquid for SOYBEAN	47.4	3188
Competitor inoculant A	47.2	3174
Competitor inoculant B	47.8	3215

Plot operational notes and rain fall.

- No fertilization
- Pesticides:
  - Round up on July 5th
  - Thiram on July 10th, 17th and 27th
- Combined on October 19th, 2018.

Month	Precipitation (mm)
June	65.1
July	41.1
August	31.8
September	115.3
TOTAL	**253.3**

PREMIER TECH

EFFICACY REPORT
2018 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: New Era Ag Research

Research site: Swan River (MB), Canada

Treatments: a) AGTIV® SOYBEAN • Granular applied at 5.1 lb/ac*;
b) Competitor inoculant A applied at 5 lb/ac*;
c) Competitor inoculant B applied at 4.45 lb/ac*;
d) Competitor inoculant C applied at 7.14 lb/ac*.

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

Soybean variety: Dario

Previous crop: Canola stubble

Seeding details: Seeded May 21st 2018 at 200 000 seeds/ac with 25 cm row spacing

*Granular products applied according to manufacturers' recommended rate.

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

Treatment	Yield (bu/ac)	Yield (kg/ha)	Protein (%)
AGTIV® SOYBEAN • Granular	57.7	3880	34.2
Competitor inoculant A	47.2	3174	31.5
Competitor inoculant B	54.3	3651	33.1
Competitor inoculant C	55.5	3732	33.6

Plot operational notes and rain fall.

- No tillage
- Fertilization:
  - 30 lb/ac of P
  - 40 lb/ac of K
- Pesticides:
  - Glyphosate on June 6th, 25th and July 5th
  - Proline on July 10th
  - Round up + Heat on September 12th
- Combined on October 6th 2018.

Month	Precipitation (mm)
May	38.4
June	127.6
July	59.3
August	35.4
September	51.1
TOTAL	**311.8**

PREMIER TECH

EFFICACY REPORT
2017 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► 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) Competitor inoculant A applied at 5.0 lb/ac;
c) Competitor inoculant B applied at 5.0 lb/ac;
d) Competitor inoculant 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.**

Treatment	Yield (bu/ac)[1]	Yield (kg/ha)[1]
AGTIV® SOYBEAN • Granular	30.11 [a]	2025 [a]
Competitor inoculant A	27.71 [b]	1864 [b]
Competitor inoculant B	28.99 [a,b]	1950 [a,b]
Competitor inoculant C	28.46 [b]	1914 [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, 2017 and weighed using J&M Speed Tender.

PREMIER TECH

EFFICACY REPORT
2017 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► 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) AGTIV® BRADY • Granular for SOYBEAN 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.**

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® SOYBEAN • Granular + TAA + Fungicide	39.1	2630
AGTIV® SOYBEAN • Granular + TAA & No Fungicide	41.1	2764
AGTIV® BRADY • Granular for SOYBEAN + designed fertility	34.9	2347

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.

PREMIER TECH

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) AGTIV® BRADY • Granular for SOYBEAN applied at 4 lb/ac*;
c) Competitor inoculant A applied at 5.0 lb/ac*;
d) Competitor inoculant B applied at 4.5 lb/ac*;
e) Competitor inoculant C applied at 7 lb/ac*;
f) Competitor inoculant 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.**

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® SOYBEAN • Granular	58.3	3921
AGTIV® BRADY • Granular for SOYBEAN	54.6	3672
Competitor inoculant A	54.5	3665
Competitor inoculant B	54.5	3665
Competitor inoculant C	54.7	3679
Competitor inoculant D	54.9	3692

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, 2017 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**

PREMIER TECH

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) Competitor inoculant A applied at 5.0 lb/ac*;
c) Competitor inoculant A applied at 10 .0 lb/ac;
d) Competitor inoculant C applied at 7.1 lb/ac*;
e) Competitor inoculant 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.**

Treatment	Yield (bu/ac)[1]	Yield (kg/ha)[1]
AGTIV® SOYBEAN • Granular	40.7 [a]	2737 [a]
Competitor inoculant A low rate	35.0 [b,c]	2354 [b,c]
Competitor inoculant A high rate	36.5 [b]	2455 [b]
Competitor inoculant C low rate	32.5 [c]	2186 [c]
Competitor inoculant C high rate	35.3 [b,c]	2374 [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.

PREMIER TECH

EFFICACY REPORT
2017 – MYCORRHIZAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: Blackcreek Research

Research site: Bright (ON), Canada

Treatments: a) Untreated;
b) AGTIV® ON SEED™ 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]	Yield (kg/ha)[1]
Untreated	41.4 [a]	2782 [a]
AGTIV® ON SEED™ mycorrhizal inoculant	44.0 [b]	2957 [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 at 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, 2017 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

EFFICACY REPORT
2017 – MYCORRHIZAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: Independent consultant

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

Treatments: a) Untreated;
b) AGTIV® ON SEED™ 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 (bu/ac)	Yield (kg/ha)
Untreated	46.4	3119
AGTIV® ON SEED™ mycorrhizal inoculant	48.8	3280

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 25th
- Combined on September 27th, 2017 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**

PREMIER TECH

EFFICACY REPORT
2017 – MYCORRHIZAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: Independent consultant

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

Treatments: a) Untreated;
b) AGTIV® ON SEED™ 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 (bu/ac)	Yield (kg/ha)
Untreated	44.3	2953
AGTIV® ON SEED™ mycorrhizal inoculant	45.9	3058

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 25th
- Combined on September 27th, 2017 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**

PREMIER TECH

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) Competitor inoculant A applied at 5 lb/ac*;
c) Competitor inoculant B applied at 4.5 lb/ac*;
d) Competitor inoculant 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.**

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® SOYBEAN • Granular	79.7	5360
Competitor inoculant A	77.8	5232
Competitor inoculant B	77.7	5225
Competitor inoculant C	75.7	5091

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	378.3

PREMIER TECH

EFFICACY REPORT
2015 – MYCORRHIZAL & RHIZOBIAL INOCULANT

SOYBEAN

► PLOT TRIAL

Research partner: AgQuest

Research site: Morden (MB), Canada

Treatments: a) AGTIV® SOYBEAN • Granular applied at 5 lb/ac*;
b) Competitor inoculant A applied at 5 lb/ac*;
c) Competitor inoculant 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.**

Treatment	Yield (bu/ac)[1]	Yield (kg/ha)[1]
AGTIV® SOYBEAN • Granular	31.8 [a]	2139 [a]
Competitor inoculant A	27.8 [b]	1870 [b]
Competitor inoculant B	30.5 [a, b]	2051 [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

EFFICACY REPORT
2015 – 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) Competitor inoculant A applied at 5 lb/ac*;
c) Competitor inoculant 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.**

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® SOYBEAN • Granular	57.3	3853
Competitor inoculant A	55.4	3725
Competitor inoculant B	58.2	3913

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

PREMIER TECH

235 lb/ac 263 kg/ha

DRY BEANS

AVERAGE YIELD INCREASE

11 sites over 4 years
Canada 8.9%

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).

PREMIER TECH

EFFICACY REPORT
SUMMARY – MYCORRHIZAL INOCULANT

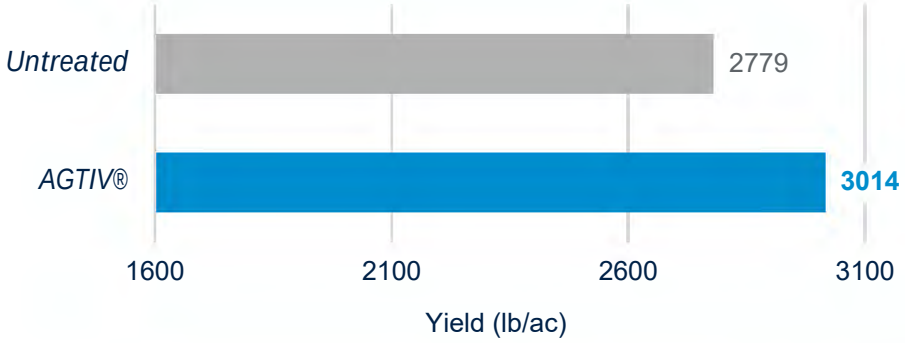
DRY BEANS

► 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 (kg/ha)	Average increase (%)
2014	2	337	378	13
2015	2	423	474	17.3
2016	5	130	146	5.5
2017	2	146	164	5.1
Total	**11 sites**	**235 lb/ac**	**263 kg/ha**	**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

CHICKPEA

1.5 bu/ac 101 kg/ha

CHICKPEA

AVERAGE YIELD INCREASE

2 sites over 1 year
Canada

4%

EFFICACY REPORT
2018 – MYCORRHIZAL & RHIZOBIAL INOCULANT

CHICKPEA

► PLOT TRIAL

Research partner: Wheatland Conservation Area

Research site: Swift Current (SK), Canada

Treatments: a) AGTIV® CHICKPEA • Granular applied at 5 lb/ac*;
b) AGTIV® FIELD CROPS • Granular applied at 5 lb/ac*;
c) Competitor inoculant A applied at 5 lb/ac*;
d) Competitor inoculant B applied at 3.6 lb/ac*.

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

Chickpea variety: Leader

Previous crop: Canola stubble

Seeding details: Seeded with cone seeder May 14th 2018 at 40 plants/m² with 22.8 cm row spacing.

*Granular products applied according to manufacturers recommended rate.

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

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® CHICKPEA • Granular	28.0	1882
AGTIV® FIELD CROPS • Granular	26.0	1747
Competitor inoculant A	28.8	1935
Competitor inoculant B	26.1	1754

Plot operational notes and rain fall.

- Fertilized with 96 lb/ac of 11-52-0
- Pre-seeding burn off : Authority at 118 ml/ac on May 14th
- Combined on August 16th 2018.

Month	Precipitation (mm)
May	13
June	28
July	48
August	19
TOTAL	**108**

PREMIER TECH

EFFICACY REPORT
2018 – MYCORRHIZAL & RHIZOBIAL INOCULANT

CHICKPEA

► PLOT TRIAL

Research partner: Prairie Ag Research

Research site: Lethbridge (AB), Canada

Treatments: a) AGTIV® CHICKPEA • Granular applied at 5 lb/ac*;
b) AGTIV® FIELD CROPS • Granular applied at 5 lb/ac*;
c) Competitor inoculant A applied at 5 lb/ac*;
d) Competitor inoculant B applied at 3.6 lb/ac*.

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

Chickpea variety: Alma

Previous crop: Canola stubble

Seeding details: Seeded with cone seeder May 22nd 2018 in 2 X 8 m plots

*Granular products applied according to manufacturers recommended rate.

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

Treatment	Yield (bu/ac)	Yield (kg/ha)
AGTIV® CHICKPEA • Granular	73.0	4906
AGTIV® FIELD CROPS • Granular	71.5	4805
Competitor inoculant A	71.3	4791
Competitor inoculant B	71.0	4771

Plot operational notes and rain fall.

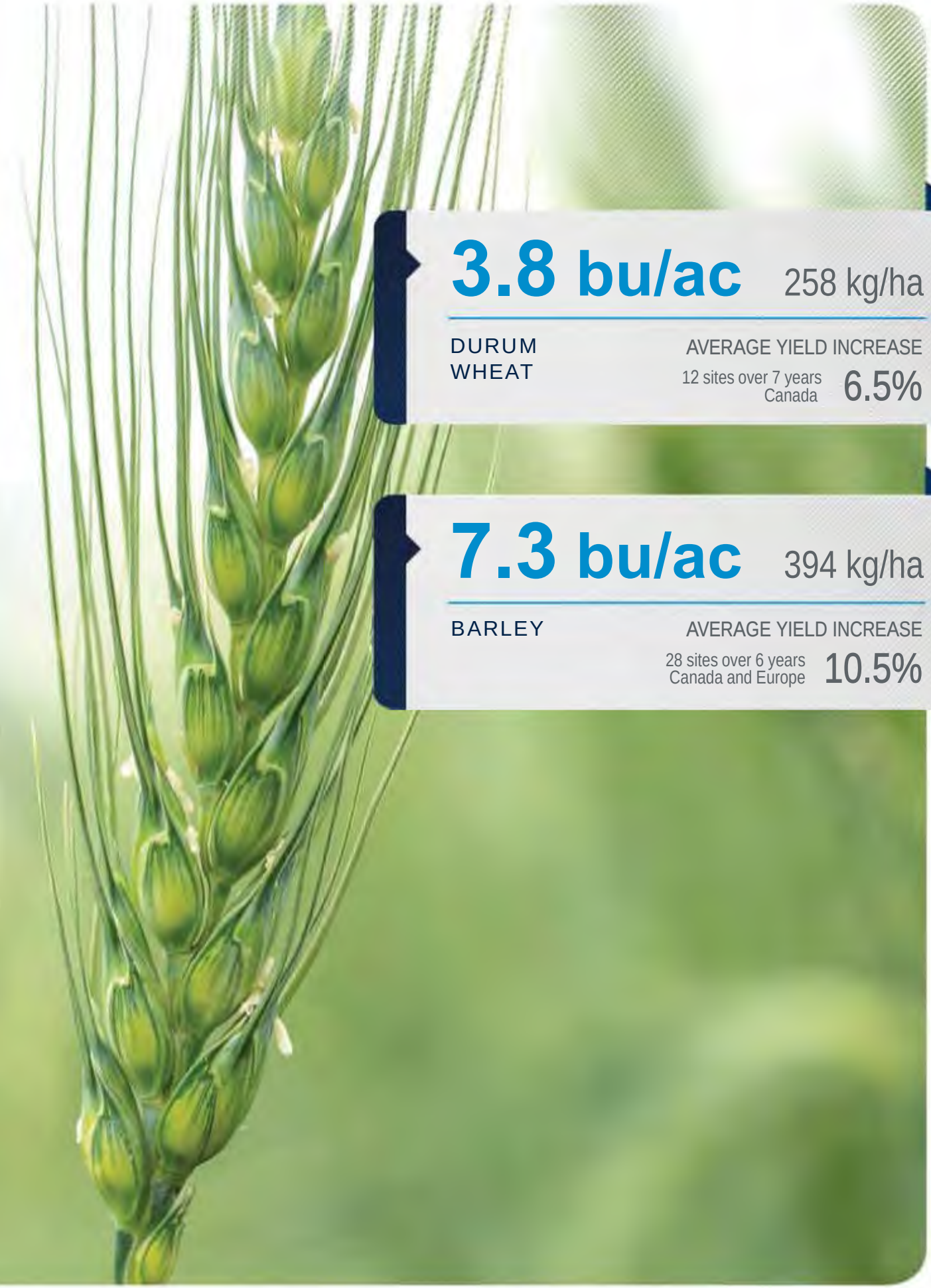
- No fertilization
- Pre-seeding burnoff with Aim, Agral 90, and Glyphosate applied on May 15th. Odyssey and Merge were applied June 5th to control weeds during the trial
- Combined on September 17th 2018.

Month	Precipitation (mm)
May	25.1
June	45.8
July	13.6
August	21.5
September	19.1
TOTAL	**125.1**

PREMIER TECH

CEREALS

DURUM WHEAT & BARLEY



3.8 bu/ac 258 kg/ha

DURUM WHEAT

AVERAGE YIELD INCREASE

12 sites over 7 years Canada **6.5%**

7.3 bu/ac 394 kg/ha

BARLEY

AVERAGE YIELD INCREASE

28 sites over 6 years Canada and Europe **10.5%**

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

SUMMARY – MYCORRHIZAL INOCULANT

► GROWER SPLIT FIELDS

Table 1. **Average yield increase with AGTIV® mycorrhizal inoculant in Canada and Europe (39 sites, 2012 to 2020).**

Number of sites	Average increase (%)
39	8.0%

Table 2. **Average yield increase with AGTIV® mycorrhizal inoculant in Western Canada (2012 to 2018).**

Number of sites	Average increase (bu/ac)	Average increase (%)
12	3.8 bu/ac	6.5%

Table 3. **Average yield increase with AGTIV® mycorrhizal inoculant in FRANCE, Europe (2014 to 2020).**

Number of sites	Average increase (bu/ac)	Average increase (%)
27	8.7 bu/ac	8.5%

EFFICACY REPORT
2019 – MYCORRHIZAL INOCULANT

DURUM WHEAT

► PLOT TRIAL

Research partner: Eurofins Agroscience Services

Research site: Beauce, France

Treatments : a) Untreated;
b) AGTIV® FIELD CROPS • Powder*.

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

Wheat variety: Anvergur

Previous crop: Sugar beet

Seeding details: Seeded on November 15th at 300 seeds/m^2 with 15 cm row spacing.

*Products applied according to manufacturer's recommended rate.

Table 1. **Summary of wheat yield per treatment.**

Treatment	Yield[1] (bu/ac)	Yield[1] (t/ha)
Untreated	142.8 [a]	9.6 [a]
AGTIV® FIELD CROPS • Powder	155.2 [b]	10.4 [b]

[1] Yields with same letter are not statistically different following a Tukey HSD test at p≤0.05

Plot operational notes and rain fall.

- Fertilization:
  - N:P+S at 450 kg/ha (19-02-18)
  - Ammonitrate at 290 kg/ha (19-03-18)
- Pesticides:
  - Atlantis Pro (19-03-21)
  - Priori Xtra (19-04-21)
  - Bofix and Chardol (19-04-23)
  - Rubric 125 SC (19-05-15)
  - Prosaro (19-05-29)
- Harvested on July 25th 2019.

Year	Month	Precipitation (mm)
2018	November	96.7
	December	57.9
2019	January	41.2
	February	34.3
	March	77.5
	April	30.8
	May	79.2
	June	70.7
	TOTAL	**488.3**

PREMIER TECH

EFFICACY REPORT
2018 – MYCORRHIZAL INOCULANT

DURUM WHEAT

► PLOT TRIAL

Research partner: Wheatland Conservation Area

Research site: Swift Current (SK), Canada

Treatments: a) Untreated;
b) AGTIV® FIELD CROPS • Granular*.

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

Wheat variety: Precision durum

Previous crop: Canola stubble

Seeding details: Seeded with fabro plot drill & Atomjet knife openers on May 13th 2018 at 115 lb/ac on 20 m² plots with 9 in row spacing

*Granular product applied according to manufacturer's recommended rate.

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

Treatment	Yield (bu/ac)	Yield (kg/ha)
Untreated	12.0	806
AGTIV® FIELD CROPS • Granular	13.3	894

Plot operational notes and rain fall.

- Fertilized with
  - 58 lb/ac 21-0-0-24
  - 67 lb/ac 11-52-0
  - 111 lb/ac 46-0-0
- Pre-seeding burn off with Clean Start
- Combined on August 9th 2018.

Month	Precipitation (mm)
May	8.8
June	23.6
July	15.1
August	28.3
TOTAL	**75.8**

PREMIER TECH

EFFICACY REPORT
SUMMARY – MYCORRHIZAL INOCULANT

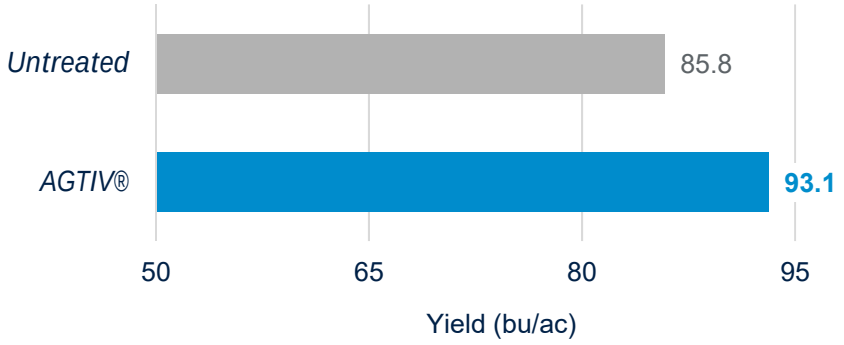
BARLEY

► 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 (kg/ha)	Average increase (%)
26	7.0	377	10.6%

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



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

PREMIER TECH

EFFICACY REPORT
2019 – MYCORRHIZAL INOCULANT

FIBER FLAX

► PLOT TRIAL

Research partner: Antédis

Research site: Bourbourg, North department, France

Treatments : a) Untreated;
b) AGTIV® FIELD CROPS • Powder*.

Experimental design: 9 replicated plots per treatment in randomized complete block design

Seeding details: Seeded April 26th at 2 000 seeds/m^2 16.5 cm row spacing.

*Product applied according to manufacturer's recommended rate.

Table 1. **Summary of flax marketable yield (whole and fiber) per treatment**

Treatment	Yield [1]		Fiber yield	
	(kg/ha)	(lb/ac)	(kg/ha)	(lb/ac)
Untreated	5490 [a]	4898 [a]	730 [a]	651 [a]
AGTIV® FIELD CROPS • Powder	6390 [b]	5701 [b]	856 [b]	764 [b]

[1] Yields followed by different letters are significantly different (Tukey's test HSD at p≤0.05).

Plot operational notes and rain fall

- Pesticides:
  - Patton M (19-04-26)
  - Lontrel + Oil (19-05-22)
  - Nissodium (19-05-31)
- Harvested October 15th, 2019.

Month	Precipitations (mm)
April	3.8
May	47
June	66.6
July	33.2
August	25.4
September	69.6
October	60.6
TOTAL	**306.2**

PREMIER TECH

FORAGES

577 kg/ha

FORAGES

AVERAGE YIELD INCREASE

47 results over 2 years
Canada

16.1%

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

EFFICACY REPORT
SUMMARY – MYCORRHIZAL INOCULANT

FORAGES

► 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).

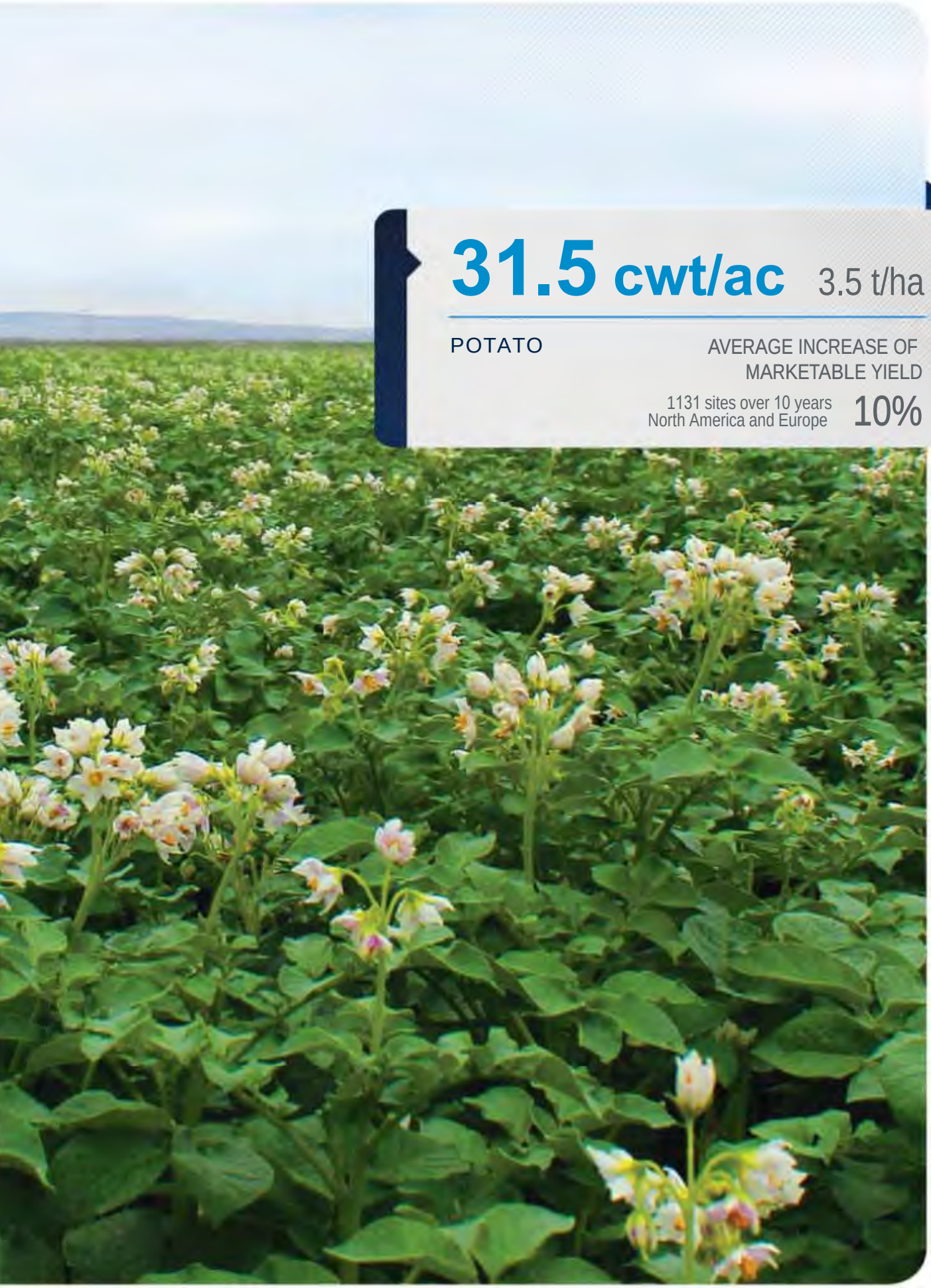
Table 3. **Two-year summary of Alfalfa dry weight yield average**[2]

	AGTIV®		Untreated		Difference	
	(kg/ha)	(bu/ac)	(kg/ha)	(bu/ac)	(kg/ha)	(bu/ac)
2016	3910 [b]	58.1 [b]	3295 [a]	49.0 [a]	615	9.1
2017	4190 [b]	62.3 [b]	3691 [a]	54.9 [a]	499	7.4
2016 + 2017					**1 114**	**16.6**

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

PREMIER TECH

POTATO



31.5 cwt/ac 3.5 t/ha

POTATO

AVERAGE INCREASE OF MARKETABLE YIELD

1131 sites over 10 years
North America and Europe

10%

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

SUMMARY – MYCORRHIZAL INOCULANT

► GROWER SPLIT FIELDS

Table 1. **Average increase of marketable yields** with AGTIV® POTATO • Liquid for different territories (2011 to 2020).**

Territory	Number of sites	Yield increase (t/ha)	Yield increase (cwt/ac)	Yield increase (%)
Canada	565	3.1	27.7	9.9
United States	67	3.3	29.8	10.8
Mexico	4	2.3	20.0	8.6
France & Switzerland	471	4.0	36.0	9.9
Germany	24	4.2	37.5	10.3
Total	**1131 sites**	**3.5 t/ha**	**31.5 cwt/ac***	**10 %**

Table 2. **Average increase of marketable yields** with AGTIV® POTATO • Liquid for different years (2011 to 2020).**

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
2018	113	3.4	30.2	11.2
2019	117	3.5	30.7	8.5
2020	49	2.9	25.6	9.8
Total	**1131 sites**	**3.5 t/ha**	**31.5 cwt/ac***	**10 %**

* cwt/ac = 100 lb/ac

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

EFFICACY REPORT
2019 – MYCORRHIZAL INOCULANT

POTATO

► STRIP TRIAL

Research partner: Willard Waugh & Sons LTD.

Research site: Bedeque (PEI), Canada

Treatments: a) Untreated;
b) AGTIV® POTATO • Liquid*.

Experimental design: 20 acres strip

Potato variety: Prospect

Previous crop: Alfalfa

Seeding details: Seeded May June 7th 2019 at 6 tubers/m with 33 cm row spacing

*Liquid products applied according to manufacturers' recommended rate.

Table 1. **Summary of potato marketable yields per treatment.**

Treatment	Yield (cwt/ac*)	Yield (t/ha)
Untreated	359.1	40.2
AGTIV® POTATO • Liquid	405.2	45.4

Plot operational notes and rain fall.

- Conventional tillage
- Pesticides: Titan & Emesto
- Fertilization: 17-16-10 at 392.4 kg/ac
- Harvested on October 10th, 2019.

Month	Precipitation (mm)
June	113.0
July	26.6
August	115.1
September	204.9
October	100.0
TOTAL	**559.6**

PREMIER TECH

*cwt/ac = 100 lb/ac

POTATO

► GROWER SPLIT FIELDS

Research partner: EUROCELP

Research site: 75 farms (fields) in France, Europe

Treatments: a) Untreated;
b) AGTIV® mycorrhizal inoculant.

Experimental design: Every data point per field consists in an average of 3 samples each (untreated and AGTIV®).

Table 1. **Marketable potato yields per treatment (all markets)**

Treatment	Yield (cwt/ac)	Yield (t/ha)	Difference (%) AGTIV® vs untreated
Untreated	412.7	45.7	
AGTIV® mycorrhizal inoculant	455.1	50.4	+9.3%*

*Statistically significant at p≤0,05 using T Test analysis for paired samples.

Figure 1. **Marketable potato yields (t/ha) per treatment (all markets)**

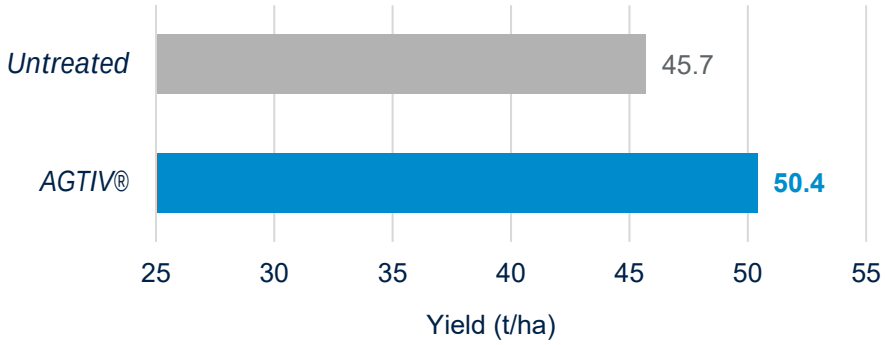
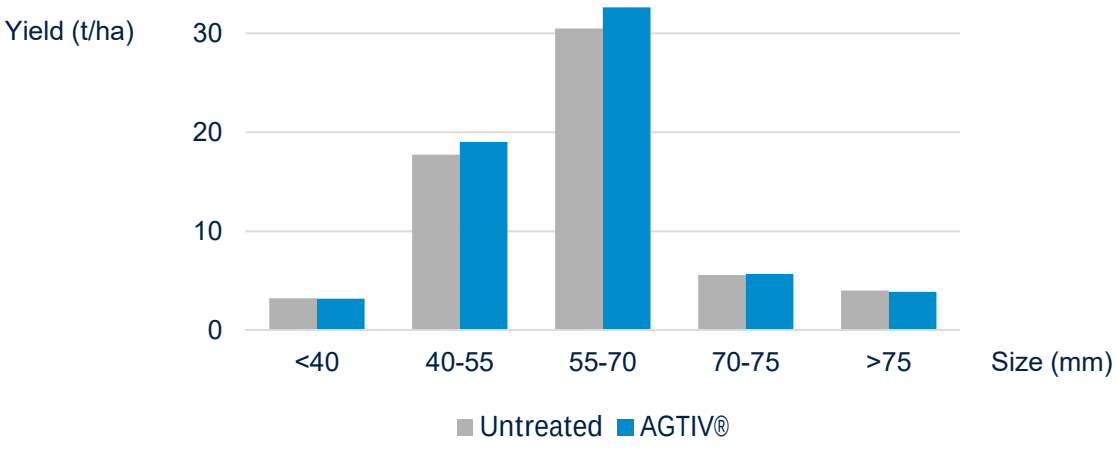


Figure 2. **Potato yield (t/ha) for the tablestock market (32 plots) by marketable size (40/75 mm)**



PREMIER TECH

► PLOT TRIAL

Research partner: Agréco

Research site: Rawdon (Lanaudière, QC), Canada

Treatments: a) Untreated;
b) AGTIV® POTATO • Liquid.

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

Potato variety: Goldrush

Previous crop: Potato in 2010, Wheat in 2009

Seeding details: Each plot comprised four rows of 20 seed pieces (35.6 cm apart). Inoculant in liquid suspension applied in furrow. Planted May 21st 2011.

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

Treatment	Marketable Yield (lb/plot)	Marketable Yield (kg/plot)	Average marketable potato weight (g/potato tuber)
Untreated	23.8 [a]	10.8 [a]	123 [a]
AGTIV® POTATO • Liquid	27.3 [b]	12.4 [b]	136.5 [b]

Results followed by different letters are statistically different according to Duncan
(Marketable yield at p≤0.1; Marketable potato weight at p≤0.05)

Plot operational notes.

- Fertilization:
  - 206 kg/ha N;
  - 170 kg/ha P_2O_5 and 270 kg/ha K_2O.
- Pesticides:
  - Titan, Quadris and Actara at planting time;
  - Sencor (June 13th), Polyram (June 15th), Bravo (once a week from end of June until August 12th), Reason (August 12th).
- Planted manually in sandy soil.
- Harvested September 18th 2011.

EFFICACY REPORT
2010 – MYCORRHIZAL INOCULANT

POTATO

► PLOT TRIAL

Research partner: Agréco

Research site: Lyster (Centre-du-Québec, QC), Canada

Treatments: a) Untreated;
b) AGTIV® POTATO • Liquid.

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

Potato variety: Goldrush

Seeding details: Each plot of 6 m (20 feet) long with 15 seed pieces per treatment. Inoculant in liquid suspension applied in furrow. Planted May 26th.

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

Treatment	Yield (lb/plot)	Yield (kg/plot)	Marketable tuber number per plot
Untreated	15.4 [a]	7.0 [a]	34 [a]
AGTIV® POTATO • Liquid	20.5 [b]	9.3 [b]	48 [b]

Results followed by different letters are statistically different according to Duncan *(p≤0.1)*

Plot operational notes and rain fall.

- Fertilized according to recommendations by the host growers.
- Pesticides:
  - Quadris and Actara at planting time.

Month	Precipitation (mm)
May	39.8
June	104.4
July	48.8
August	112.0
September	184.8
TOTAL	**489.8**

Meteorological data from Québec

PREMIER TECH

EFFICACY REPORT
1999 – MYCORRHIZAL INOCULANT

POTATO

► PLOT TRIAL

Research partner: Laval University (Qc), Canada

Research site: Lavaltrie (QC), Canada

Treatments: a) Untreated;
b) AGTIV® mycorrhizal inoculant.

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

Potato variety: Goldrush

Seeding details: The trial plot consisted of 32 60-meter rows spaced at 0.9 meter.

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

Treatment	Total Yield		Marketable yield	
	(cwt/ac)	(t/ha)	(cwt/ac)	(t/ha)
Untreated	446.1 [a]	49.4 [a]	417.2 [a]	46.2 [a]
AGTIV® mycorrhizal inoculant	466.9 [b]	51.7 [b]	442.5 [b]	49.0 [b]

Results followed by different letters are statistically different according to Duncan *(p≤0.05)*

Plot operational notes and rain fall.

- Fertilization:
  - 1800 kg/ha of 10-12-12 (3% Mg, 0.22% B) at planting time;
  - 336 kg/ha of 10-0-15 during the summer.
- Pesticides:
  - Fumigation: Vapam (Previous fall)
  - Insecticides: Cymbush, Admire, Furadan (during growth season)
  - Herbicides: Gramoxone, Lexone, Laroxe (during growth season)
- Irrigated twice: June & July.

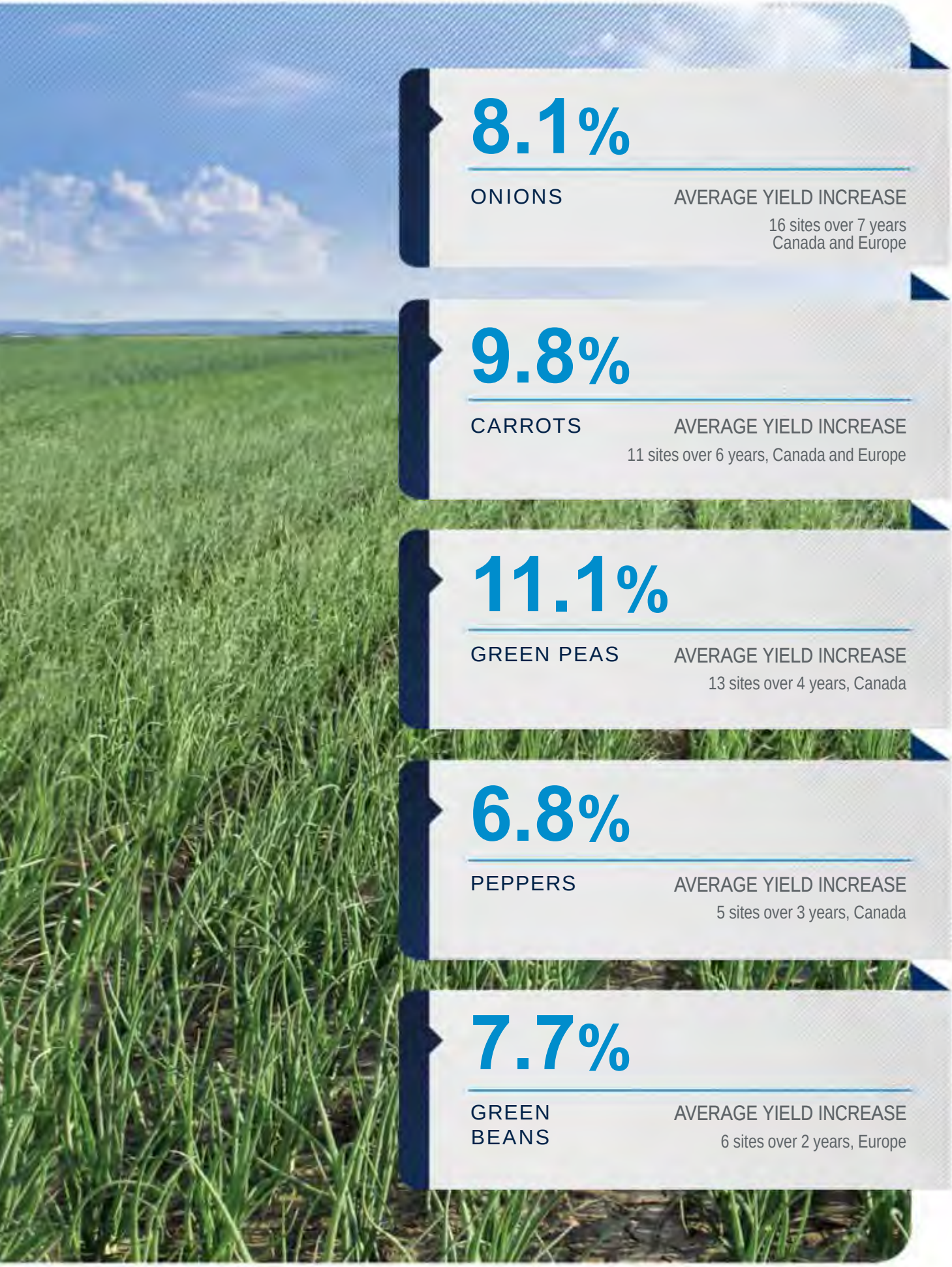
Month	Precipitation (mm)
May	33.1
June	103.6
July	58.9
August	73.1
Septembre	123.6
TOTAL	**392.3**

Meteorological data from Trois-Rivières

PREMIER TECH

SPECIALTY CROPS

FRUITS & VEGETABLES



8.1%

ONIONS

AVERAGE YIELD INCREASE

16 sites over 7 years
Canada and Europe

9.8%

CARROTS

AVERAGE YIELD INCREASE

11 sites over 6 years, Canada and Europe

11.1%

GREEN PEAS

AVERAGE YIELD INCREASE

13 sites over 4 years, Canada

6.8%

PEPPERS

AVERAGE YIELD INCREASE

5 sites over 3 years, Canada

7.7%

GREEN BEANS

AVERAGE YIELD INCREASE

6 sites over 2 years, Europe

ONIONS

▶ GROWER SPLIT FIELDS AND PLOT TRIALS[1]

Table 1. **Average increase of marketable yields[2] (t/ha) with AGTIV® SPECIALTY CROPS for different years (2014-2019)**

Year	Number of sites	Yield Untreated	Yield AGTIV®	Yield increase	Yield increase (%)
2014	2	67.7	73.2	5.4	8.0
2015	4	44.3	47.6	3.3	8.7
2016	1	60.7	64.1	3.4	5.6
2017	1	18.2	20.4	2.2	12.2
2018	2	40.0	46.1	6.2	20.3
2019	6	50.3	52,6	2.2	3.3
Total	**16 sites**	**48.3[a]**	**51.8[b]**	**3.5 t/ha**	**8.1%**

[1] Split fields and trials conducted in North America and Europe

[2] Yields without the same letter are statisticly different based on a Tukey HSD test (p≤0.05).

Table 2. **Average increase of marketable yields[2] (lb/ac) with AGTIV® SPECIALTY CROPS for different years (2014-2019)**

Year	Number of sites	Yield Untreated	Yield AGTIV®	Yield increase	Yield increase (%)
2014	2	60 400	65 307	4 817	8.0
2015	4	39 523	42 467	2 944	8.7
2016	1	54 155	57 188	3 033	5.6
2017	1	16 237	18 200	1 962	12.2
2018	2	35 687	41 129	5 531	20.3
2019	6	44 876	46 928	1 962	3.3
Total	**16 sites**	**41 813[a]**	**45 203[b]**	**3 375 lb/ac**	**8.1%**

[1] Split fields and trials conducted in North America and Europe

[2] Yields without the same letter are statisticly different based on a Tukey HSD test (p≤0.05).

EFFICACY REPORT
2019 – MYCORRHIZAL INOCULANT

ONIONS

► PLOT TRIAL

Research department: Antédis

Research site: Issé, Loire-Atlantique department, France

Treatments : a) Untreated;
b) AGTIV® SPECIALTY CROPS • Powder*.

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

Carrot variety: Santero F1

Previous crop: Spring barley

Seeding details: Seeded April 1st at 80 seeds/m^2 with 32 cm row spacing.

*Products applied according to manufacturer's recommended rate.

Table 1. **Summary of onions marketable yields per treatment.**

Treatment	Marketable yield (lb/ac)	Marketable yield (t/ha)
Untreated	55 315	62.0
AGTIV® SPECIALTY CROPS • Powder	56 474	63.3

Plot operational notes and rain fall

- Fertilization:
  - Liquid Solution N 39 (19-03-19)
  - AVF K4 (from 20/08 to 25/08 2019)
- Pesticides:
  - In April – Baroud SC and Lentagran
  - In May – Challenge 600, Lentagran 200 and Satarne 200
  - In June - Challenge 600, Satarne 200, Hacrobat M DG, DEFI, Bordeaux mixture and Caiman WP
  - In July – Bordeaux mixture, Dithane M 45, Scala, Acrobat M DG,
  - In August – Bordeaux mixture, Acrobat M DG, Dithane M45
  - In September – ITCAN SL 270
- Harvested September 24th, 2019.

Month	Precipitations (mm)
April	36.4
May	90.6
June	34.4
July	10.6
August	42.9
September	4.6
TOTAL	**219.5**

Better growth on the right with AGTIV®.

PREMIER TECH

EFFICACY REPORT
2018 – MYCORRHIZAL INOCULANT

ONIONS

► PLOT TRIAL

Research partner: Black Creek Research

Research site: Bright (ON), Canada

Treatments: a) Untreated;
b) AGTIV® ON SEED™ mycorrhizal inoculant.

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

Onion variety: Catskill

Previous crop: Soybean

Seeding details: Seeded June 7th with Clean seeder at 40 seeds/m of row with 30 cm row spacing.

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

Treatment	Yield		Marketable Yield	
	(lb/ac)	(t/ha)	(lb/ac)	(t/ha)
Untreated	20 434	22.9	18 467	21.0
AGTIV® ON SEED™ mycorrhizal inoculant	29 179	32.7	26 644	29.8

Plot operational notes and rain fall.

- Fertilization:
  - MAP - 70 kg/ha
  - Potash - 98 kg/ha
  - KMag - 125 kg/ha
  - Urea - 112 kg/ha
- Conventional till
- Pesticides:
  - Venture L (18-06-20)
  - Pardner (18-06-25)
  - Prowl H_2O (18-06-29)
  - Pardner (18-07-05)
  - Prowl H_2O (18-07-15).
- Harvested on October 18th 2018.

Month	Precipitation (mm)
June	91
July	63.1
August	116.6
September	57.8
TOTAL	**328.5**

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

PREMIER TECH

ONIONS

► GROWER SPLIT FIELDS

Research site: France, Europe

Treatments: a) Untreated;
b) AGTIV® mycorrhizal inoculant.

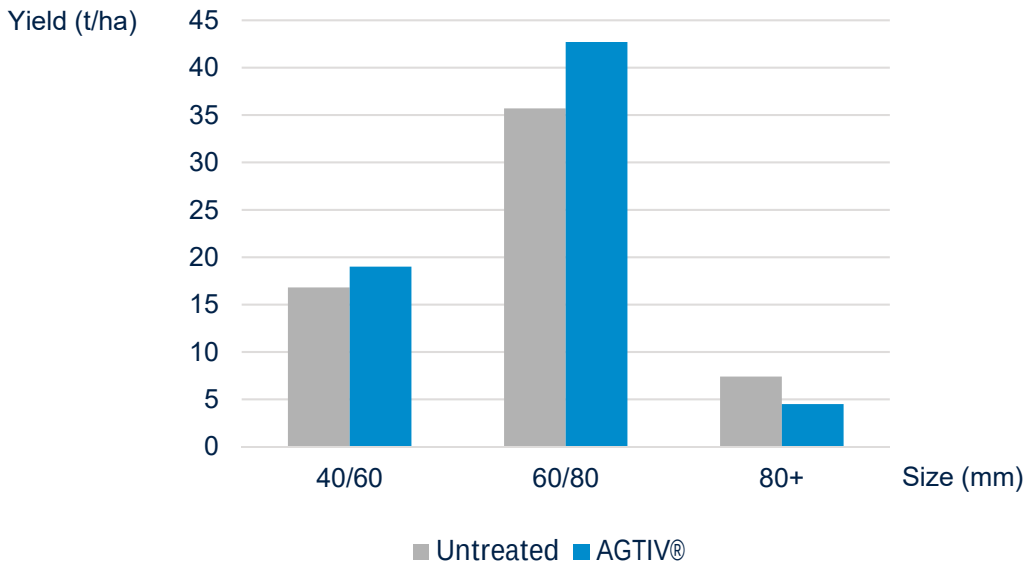
Experimental design: Every data point per field consists in an average of 3 samples each (untreated and AGTIV®).

Variety: Hytunes

Table 1. **Marketable onion yields per treatment.**

Treatment	Yield (lb/ac)	Yield (t/ha)	Bulb number / ha	Difference (%) AGTIV® vs untreated
Untreated	53 441	59.9	531 667	
AGTIV® ON SEED™ mycorrhizal inoculant	59 062	66.2	616 667	+10.5%

Figure 1. **Onion yield (t/ha) by marketable size (mm)**



EFFICACY REPORT
2017 – MYCORRHIZAL INOCULANT

ONIONS

▶ 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® ON SEED™ mycorrhizal inoculant.

Experimental design: Randomized complete block design, 8 replicates.

Table 1. **2017 summary of onion yields and % difference.**

Location	Year	Variety	Untreated		AGTIV® mycorrhizal inoculant		% Yield difference
			(lb/plot)	(kg/plot)	(lb/plot)	(kg/plot)	
Ontario	2017	Frontier	32.2	14.6	34.0	15.4	+5.5%
Quebec	2017	Trailblazer	23.8	10.8	25.4	11.5	+6.3%
Average	**2017**		**28.0**	**12.7**	**29.8**	**13.5**	**+6.2%**

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

PREMIER TECH

ONIONS

► GROWER SPLIT FIELDS

Research site: France, Europe

Treatments: a) Untreated;
b) AGTIV® mycorrhizal inoculant.

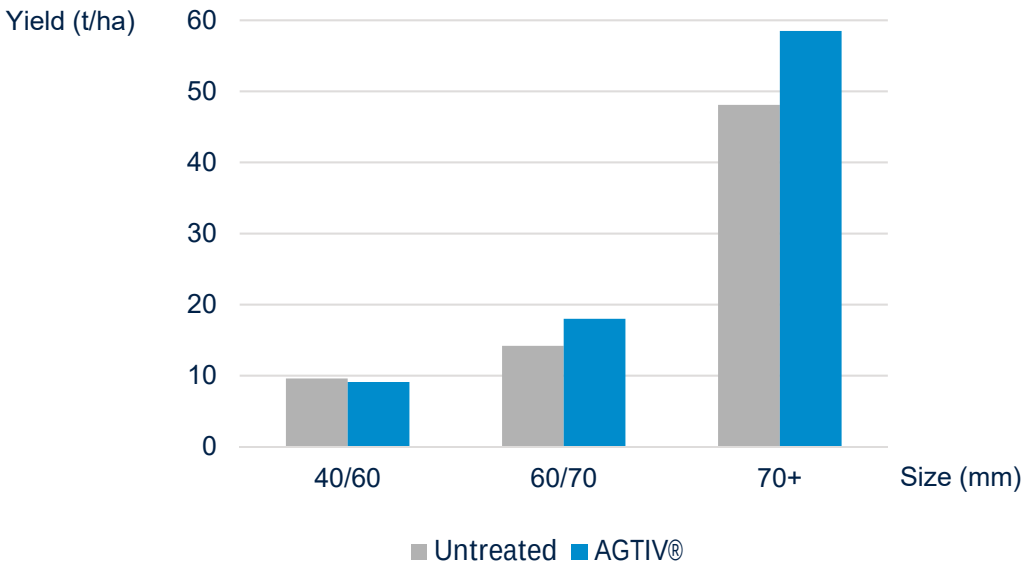
Experimental design: Every data point per field consists in an average of 3 samples each (untreated and AGTIV®).

Variety: SPIRIT

Table 1. **Marketable onion yields per treatment.**

	Untreated	AGTIV® mycorrhizal inoculant	Difference (%) AGTIV® vs untreated
Yield (t/ha)	71.9	85.7	+19.2%
Bulb number / ha	409 877	459 259	+12.0%

Figure 1. **Onion yields (t/ha) by marketable size (mm).**



EFFICACY REPORT
2019 – MYCORRHIZAL INOCULANT

CARROTS

► PLOT TRIAL

Research partner: Antédis

Research site: Ploërmel, Morbihan department, France

Treatments : a) Untreated;
b) AGTIV® SPECIALTY CROPS • Powder*.

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

Carros variety: Bolero F1

Previous crop: Ray-grass

Seeding details: Seeded May 24th at 850,000 seeds/ha.

*Products applied according to manufacturer's recommended rate.

Table 1. **Summary of carrot marketable yields per treatment.**

Treatment	Marketable yield (lb/ac)	Marketable yield (t/ha)	Increase
Untreated	87 433 [a]	98.0 [a]	
AGTIV® SPECIALTY CROPS • Powder	96 266 [b]	107.9 [b]	+10.1%

[1] Yields with same letter are not statistically different following a Tukey HSD test at p≤0.05.

Plot operational notes and rain fall

- Fertilization:
  - 30 m^3 of cattle manure (19-05-21)
- Pesticides
  - Racer ME, Baroud SC and Centium 36 CS (19-06-02)
  - Challenge 600 and DEFI (19-06-26 et 19-08-01)
  - Switch and Heliosoufre (19-08-13)
- Harvested October 28th, 2019.

Month	Precipitations (mm)
May	3.0
June	144.4
July	18.4
August	57.4
September	67.8
October	172.5
TOTAL	**463.5**

PREMIER TECH

EFFICACY REPORT
2019 – MYCORRHIZAL INOCULANT

CARROTS

► PLOT TRIAL

Research partner: Eurofins Agroscience services

Research site: Meneac, Morbihan department, France

Treatments : a) Untreated;
b) AGTIV® SPECIALTY CROPS • Powder*.

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

Carrot variety: Bolero F1

Previous crop: Barley

Seeding details: Seeded May 24th at 600,000 seeds/ha with 60 cm row spacing.

*Products applied according to manufacturer's recommended rate.

Table 1. **Summary of carrot marketable yields per treatment.**

Treatment	Marketable yield[1] (lb/ac)	Marketable yield[1] (t/ha)	Increase
Untreated	79 047 [a]	88.6 [a]	
AGTIV® SPECIALTY CROPS • Powder	84 757 [b]	95.0 [b]	+7.2%

[1] Yields with same letter are not statistically different following a Tukey test at p≤0.05

Plot operational notes and rainfall

- Fertilization:
  - Chicken manure 2200 kg/ha (19-04-15)
  - Ammonitrate (19-02-23; 180 kg/ha and 19-03-15; 150 kg/ha)
- Pesticides:
  - Cherokee (19-04-19)
  - Keynote (19-05-08)
  - Baroud, Racer Centium (19-05-25)
  - Signum, Heliosoufre and Bordeaux mixture (19-06-25)
- Harvested October 1st, 2019.

Month	Precipitations (mm)
June	181.1
July	23.3
August	53.6
September	45.7
TOTAL	**303.7**

PREMIER TECH

EFFICACY REPORT
2018 – MYCORRHIZAL INOCULANT

CARROTS

► PLOT TRIAL

Research partner: Agricultural Development Group Inc.

Research site: Eltopia (WA), USA

Treatments: a) Untreated;
b) AGTIV® ON SEED™ mycorrhizal inoculant.

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

Carrot variety: Envy

Previous crop: Squash

Seeding details: Direct seeded May 24th at 20 seeds/m of row;
1.3 million seeds per hectare.

Table 1. **Summary of carrot marketable yields per treatment.**

Treatment	Marketable Yield (lb/ac)	Marketable Yield (t/ha)	Marketable Yield (%)
Untreated	12 499	14.0	92
AGTIV® ON SEED™ mycorrhizal inoculant	16 941	19.0	92

Plot operational notes and rain fall.

- Conventional till
- Herbicide:
  - Two maintenance herbicide applications were made on July 13th with Lorox and August 23rd with Nortron
- Harvested on October 8th 2018.

Month	Precipitation (mm)
May	9.9
June	15.25
July	0
August	0
September	0.5
October	20.8
TOTAL	**46.45**

PREMIER TECH

EFFICACY REPORT
2018 – MYCORRHIZAL INOCULANT

CARROTS

► PLOT TRIAL

Research partner: Black Creek Research

Research site: Bright (ON), Canada

Treatments: a) Untreated;
b) AGTIV® ON SEED™ mycorrhizal inoculant.

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

Carrot variety: Envy

Previous crop: Soybean

Seeding details: Seeded June 11th with Clean seeder at 50 seeds/m of row;
3.3 million seeds per hectare.

Table 1. **Summary of carrot marketable yields per treatment.**

Treatment	Marketable Yield (lb/ac)	Marketable Yield (t/ha)	Marketable Yield (%)	Reject (%)
Untreated	20 488	23.0	64%	4.75%
AGTIV® ON SEED™ mycorrhizal inoculant	23 244	26.0	69%	3.13%

Plot operational notes and rain fall.

- Conventional till
- Fertilization:
  - MAP - 70 kg/ha
  - Potash - 98 kg/ha
  - KMag - 125 kg/ha
  - Urea - 112 kg/ha
- Herbicide :
  - Lorox FL (480 g/L, 3.25 L/ha, June 12th)
  - Venture L (125g/L, 2L/ha, July 10th)
- Harvested on September 24th 2018.

Month	Precipitation (mm)
June	91
July	63.1
August	116.6
September	57.8
TOTAL	**328.5**

PREMIER TECH

EFFICACY REPORT
2017 – 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® ON SEED™ mycorrhizal inoculant.

Experimental design: Randomized complete block design, 8 replicates.

Table 1. **Summary of carrot marketable yields and % difference.**

Location	Year	Variety	Untreated		AGTIV® mycorrhizal inoculant		% Yield difference
			(lb/ac)	(t/ha)	(lb/ac)	(t/ha)	
Ontario	2017	Bolero	36 579	41	38 542	43.2	+5.3%
Quebec	2017	Olympus	28 817	32.3	34 438	38.6	+19.5%
Average	**2017**		**32 653**	**36.6**	**36 490**	**40.9**	**+11.7%**

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

PREMIER TECH

EFFICACY REPORT
2019 – MYCORRHIZAL & *BACILLUS* INOCULANT

SWEET CORN

► PLOT TRIAL

Research partner: Schreiber & Sons

Research site : Eltopia, Washington, USA

Treatments : a) Untreated;
b) AGTIV® ON SEED™ – SPECIALTY CROPS • Film coating + AGTIV® ON SEED™ BACILLUS • Liquid *.

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

Sweet corn variety: Nirvana

Previous crop : Fallow (2017) and wheat (2018)

Seeding details: Seeded June 4th, 2019 at 30 000 seeds/ac with 75 cm row spacing.

*Products applied according to manufacturer's recommended rate.

Table 1. **Summary of sweet corn yields per treatment.**

Treatment	Yield (lb/ac)	Yield (t/ha)	Increase
Untreated	17 854.0 [a]	20.0 [a]	
AGTIV® ON SEED™ – SPECIALTY CROPS • Film coating + AGTIV® ON SEED™ BACILLUS • Liquid	21 067.7 [b]	23.6 [b]	+18%

[1] Yields with same letter are not statistically different following a LSD test at p≤0.05.

Plot operational notes and rain fall

- Herbicides application on June 22th (Atrazine) and July 22nd (Atrazine + Impact)
- Plots were irrigated and fertilized
- Harvested on September 16th, 2019.

Month	Precipitation (mm)
June	1.95
July	2.44
August	25.62
September	11.94
TOTAL	**41.95**

PREMIER TECH

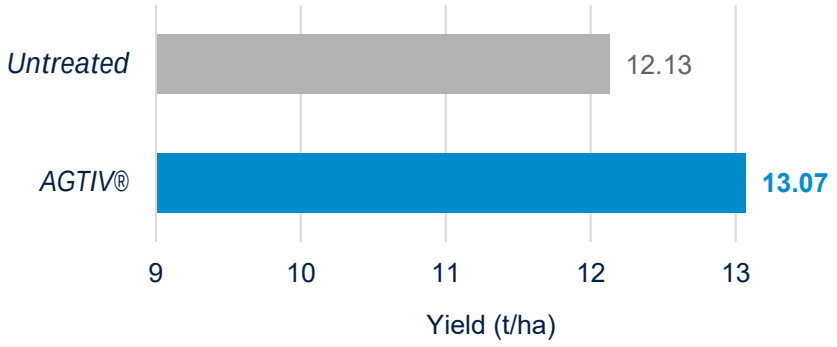
SUMMARY – MYCORRHIZAL INOCULANT

► GROWER SPLIT FIELDS

Table 1. **Average yield increase with AGTIV® mycorrhizal inoculant for different years (2017 and 2018) in France, Europe.**

Variety	Untreated		AGTIV® mycorrhizal inoculant		Difference (%) AGTIV® vs untreated
	(lb/ac)	(t/ha)	(lb/ac)	(t/ha)	
Stanley	13 561	15.16	14 810	16.56	+9.2
Costal	11 865	13.31	12 668	14.24	+6.9
Bamaco	15 167	16.98	16 594	18.57	+9.4
Compass	8 297	9.27	9 635	10.8	+16.5
Paloma	9 546	10.73	9 367	10.47	-2.5
Linex	6 512	7.33	6 959	7.83	+6.8
Average	**10 795 lb/ac**	**12.13 t/ha**	**11 687 lb/ac**	**13.07 t/ha**	**+7.7%**

Figure 1. **Yield increase with AGTIV® mycorrhizal inoculant.**



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EFFICACY REPORT

SUMMARY – MYCORRHIZAL & RHIZOBIAL INOCULANT

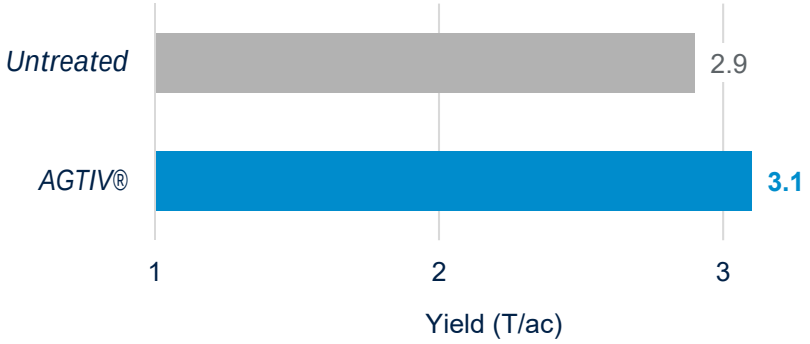
GREEN PEAS

► GROWER SPLIT FIELDS

Table 1. **Average yield increase with AGTIV® SPECIALTY CROPS – PEA • Powder for different years (2015 to 2019) in Ontario and Quebec, Canada.**

Year	Number of sites	Average increase (t/ac)	Average increase (t/ha)	Average increase (%)
2015	4	0.31	0.77	23.3
2016	7	0.08	0.20	3.5
2017	1	0.12	0.30	3.7
2019	1	0.32	0.80	22.6
Total	**13 sites**	**0.17 t/ac**	**0.42 t/ha**	**11.1%**

Figure 1. **Average yield increase with AGTIV® SPECIALTY CROPS – PEA • Powder in Ontario and Quebec, Canada (2015 to 2019).**



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

PREMIER TECH

EFFICACY REPORT
SUMMARY – MYCORRHIZAL INOCULANT

PEPPERS

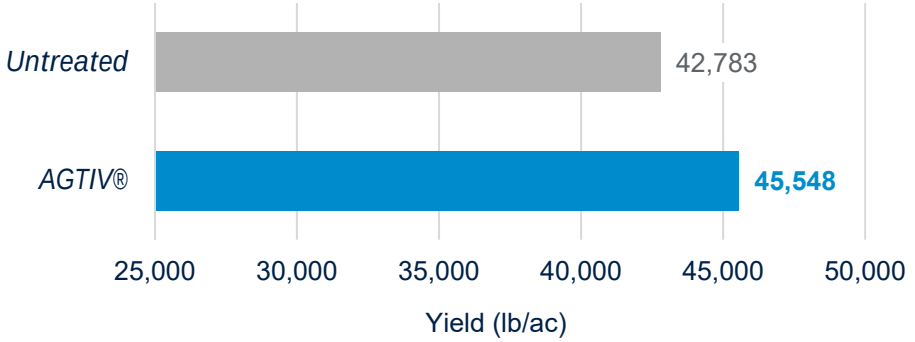
► GROWER SPLIT FIELDS

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 (t/ha)	Average increase (%)
2002	2	*	*	5.1
2015	2	2840	3.18	10.0
2016	1	2617	2.93	3.7
Total	**5 sites**	**2766 lb/ac ****	**3.10 t/ha ****	**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

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

EFFICACY REPORT
2016 – 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/plot) per treatment.**

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

Larger and bigger plants with AGTIV® on the right.

PREMIER TECH

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PREMIER TECH

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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.

Creativity is a mix of knowledge, expertise and passion for unprecedented efficient solutions. Innovation, Research & Development and biological active ingredients have combined forces to put commercial offers to the agricultural market.

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.

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. Through the current innovation program IPSO: Innovation in Products-Processes, Services and commercial Offers, 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 make a difference for our clients' profitability**, and ultimately ensure our continued relevance as a strategic partner.

CELEBRATING DECADES OF

35 years OF EXPERTISE IN ACTIVE INGREDIENTS

Established manufacturer and marketer, Premier Tech builds on innovation and collaboration with local partners and growers to offer reliable high-quality inoculants. Every day, in our labs, facilities, and in the field, highly experienced scientists, engineers, and specialists from various domains collaborate to maximize the outcomes of research and turn them into effective products making a difference on your bottom line.

PRODUCTION

In 2000, Premier Tech set up a world-first endomycorrhizal inoculum plant, developing a new mycoreactor process for industrial scale production. Backed by more than 35 years of expertise in active ingredients, Premier Tech constantly develops and innovates in terms of production of mycorrhizae, rhizobium and other active ingredients:

- ☑ No contamination through a strictly controlled and aseptic environment
- ☑ Large-scale manufacturing production
- ☑ Adapted quality control for each step of the production processes, ensuring consistent high-quality inoculum

PTAGTIV.COM/en/expertise

INNOVATION AND VALUE

FORMULATION

Premier Tech's know-how makes it possible to adapt formulations with multiple active ingredients, concentrations and carriers tailored to different crops and application methods. Because a quality inoculant makes all the difference, our proven formulations are based on these important elements:

- Carrier compatible with the active ingredients
- Formulations that guarantee active ingredient viability until use
- Quality control at several key points ensuring the performance of active ingredients
- Various formulations also tailored for organic production

APPLICATION

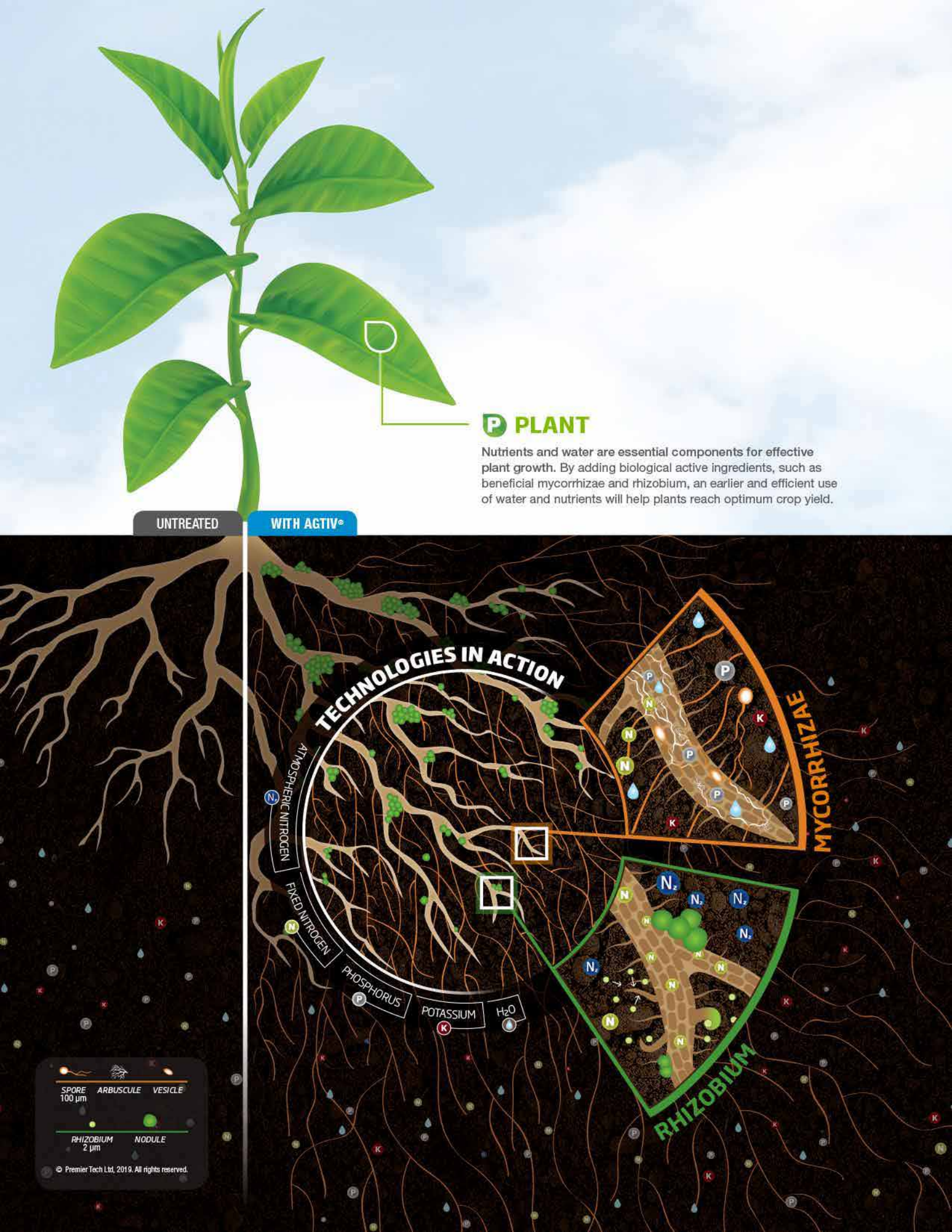
Caring about our clients' performance, each recommendation for product use takes into consideration validation by our field experts and by farmers themselves, which ensures:

- Effective application rates, at the right time and place, with the right inoculant
- Products adapted to growers' equipment
- Easy integration into farming practices
- Validation of compatibility with other agricultural inputs

SERVICE

The AGTIV® experience combines highly effective value-added products and the access to a team of field experts dedicated to supporting your growth. From our management team and research project managers to our field specialists, our multidisciplinary team is listening to growers' needs to continuously improve our products and level of service:

- Technical support for product application, equipment compatibility and field demonstration
- Proud promoter of science education and knowledge sharing
- Partnership with agriculture retailers throughout Canada, the United States and Europe


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.
UNTREATED
WITH AGTIV®
TECHNOLOGIES IN ACTION
ATMOSPHERIC NITROGEN
FIXED NITROGEN
PHOSPHORUS
POTASSIUM
H2O
MYCORRHIZAE
RHIZOBIUM
SPORE
100 µm
ARBUSCULE
VESICLE
RHIZOBIUM
2 µm
NODULE
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BIOLOGICAL ACTIVE INGREDIENTS

Backed by more than 35 years of expertise in biological active ingredients, Premier Tech masters a unique large-scale manufacturing process that meets the highest quality control standards, allowing you to fully benefit from the highly effective inoculants of our AGTIV® agricultural product line. For stronger growth through better plant resistance to stresses, **higher yields** and superior **crop quality**, you can count on AGTIV®.

M MYCORRHIZAE

PTB297 Technology, *Glomus intraradices*

Mycorrhizae are beneficial associations between a mycorrhizal fungus and roots. The mycorrhizal spores germinate in the soil and produce filaments (hyphae) which will enter into root cells. This association will allow the formation of an intra and extra-radical network of filaments that will explore the soil and access more nutrients and water, and transfer them to the plant.

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

+ R RHIZOBIUM

PTB160 Technology (pulses), *Rhizobium leguminosarum* biovar *viciae*

PTB162 Technology (soybean), *Bradyrhizobium japonicum*

Mesorhizobium ciceri (chickpea)

Rhizobium bacteria live and thrive in symbiosis in root nodules produced by the plant. They are responsible for fixing the atmospheric nitrogen and making it available for the plant.

- FIX NITROGEN & MAKE IT AVAILABLE TO THE PLANT

= TRIPARTITE SYMBIOSIS

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.

- INCREASE PROPAGATION OF RHIZOBIUM TO OTHER ROOTS
- HELP FEED THE PLANT
- ENHANCE PHOTOSYNTHESIS

To learn more about the tripartite symbiosis

PTAGTIV.COM/**en/tripartite**

MYCORRHIZAE

EFFICACY – VERSATILITY – COLLABORATION

Why use Premier Tech's mycorrhizae?

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." [A]

How does the technology work? Mycorrhizae develop a network that explores the soil and accesses more nutrients and water to transfer to the plant. The beneficial alliance between mycorrhizal fungi and roots accelerates root development and stimulates plant growth.

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 grain filling.

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." [B]

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

"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." [D]

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Efficient P uptake and transfer

Thonar et al. (2010)[E] 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."

Cavagnaro et al. (2005)[F] 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."

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. (2011)[G], 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'." [G]

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 35 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." [H]

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)[I] 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**
  at seeding time to trigger the symbiosis quickly after seed germination

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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." [K]

Duan et al. (2011)[L] 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; […]." [M]

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.[N]

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C. Jones, C. E. 2014. Nitrogen: the double-edge sword. Amazing Carbon. pp. 8.
D. Jones, C. E. 2009. *loc. cit.*
E. Thonar, C. et al. 2011. Traits related to differences in function among three arbuscular mycorrhizal fungi. Plant Soil. 339: 231 – 245.
F. Cavagnaro, T et al. 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.
G. Kiers et al. 2011. Reciprocal Rewards Stabilize Cooperation in the Mycorrhizal Symbiosis. Science 333:80-882.
H. Trivedi et al. 2007. Organic farming and mycorrhizae in agriculture.I.K. International Publishing House Ltd. New Delhi, pp.290.
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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. Gisjbert et al. 2014. Order of arrival structures arbuscular mycorrhizal colonization of plants. New Phytologist. pp. 10.
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M. 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.
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RHIZOBIUM

FERTILITY – PRODUCTIVITY – COLLABORATION

Why is rhizobium important?

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]

How does the technology work? Rhizobium are a bacteria that live and thrive in symbiosis in root nodules produced by the plant. These nodules house the bacteria responsible for fixing the atmospheric nitrogen and makes it available for the plant.

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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 free oxygen can stop nitrogen fixation, preventing ammonium (NH_3) synthesis and transfer to the plant. 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.

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 et al. 2010. Key Molecules Involved in Beneficial Infection Process in Rhizobia–Legume Symbiosis. In: Microbes for Legume Improvement, Chapter 3:55-80.
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PREMIER TECH

THE TRIPARTITE SYMBIOSIS
HELPS YOU GET BIGGER YIELD

How can the tripartite symbiosis improve crop productivity?

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."* [A]

How do the technologies work? 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."* [A] 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%[B]. *"The rate of photosynthesis increased substantially more than the C* [Carbon] *costs of the rhizobial and AM* [Arbuscular Mycorrhizal] *symbioses."* [B] 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* […]*"*.[C]

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

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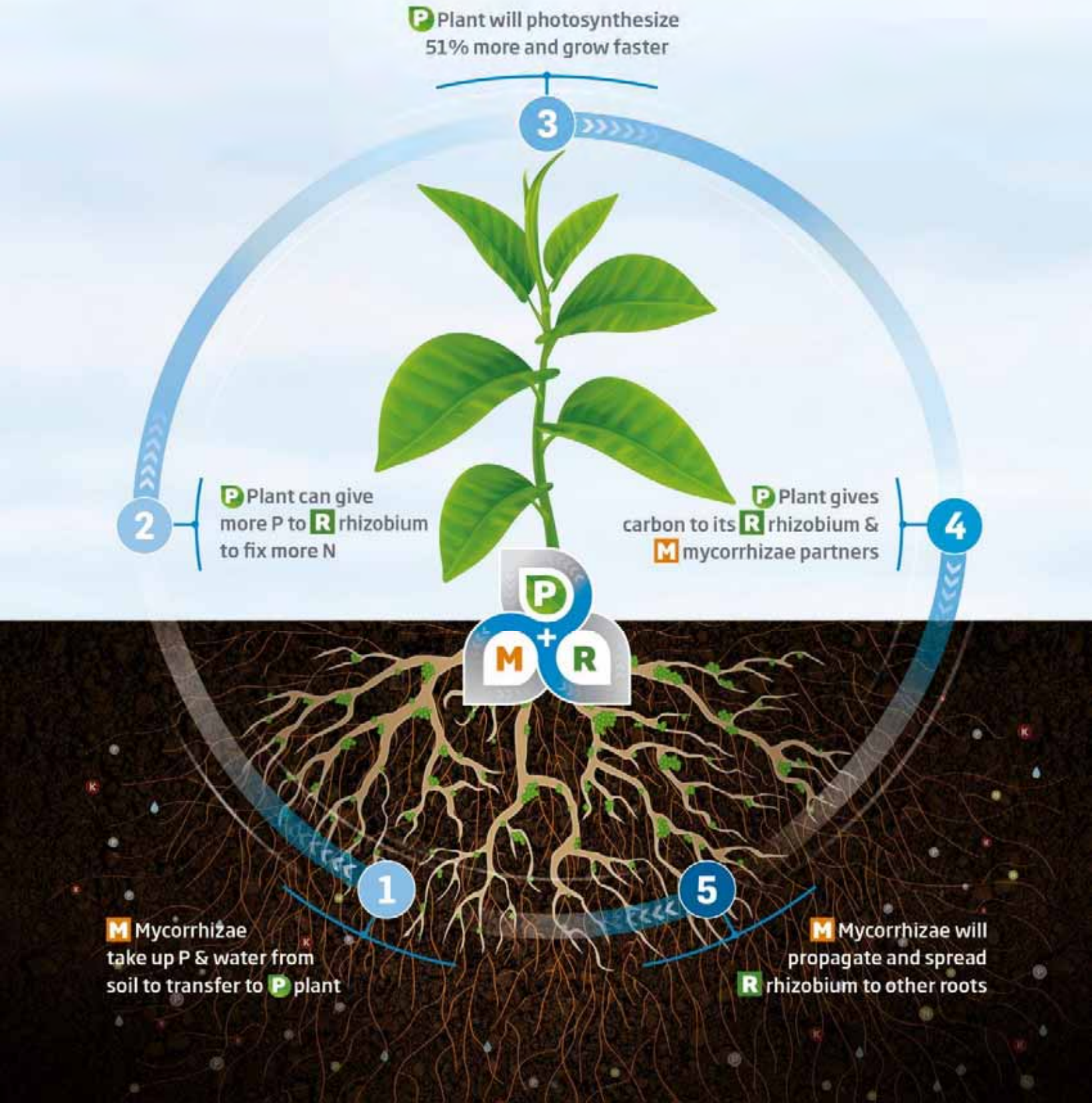
PTAGTIV.COM/en/tripartite

TRIPARTITE SYMBIOSIS

BIOLOGICAL INTERACTIONS BETWEEN MYCORRHIZAE, RHIZOBIUM AND PLANTS

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.



THE CANOLA ROTATION INOCULANT

HELPS YOU COUNTER REDUCED YIELD AFTER CANOLA

What affects your soil biology?

Many crop practices (tillage, fallow land, flooding and crop rotation) contribute to decreasing the beneficial biology, such as mycorrhizal fungi population, in your agricultural soils. For example, it is well known that crops following *Brassicaceae* plants (canola and mustard), in a rotation generally tend to demonstrate reduced yield, compared to results when seeded after another crop. It can largely be explained by the relationship (or lack of relationship) between *Brassicaceae* and beneficial microorganisms, such as mycorrhizae[A]. Canola roots exude a toxic compound that reduces populations of those beneficial microorganisms in the soil. Furthermore, the "absence of a mycorrhizal host plant during the fallow period decreases mycorrhizal colonization potential for the succeeding crop and results in P deficiency symptoms in plants that are mycorrhizal dependent, such as corn, soybean, sunflower, and cotton." [B]

A. Gavito, M. E., Miller M. H., 1998. Changes in mycorrhizal development in maize induced by crop management practices. Plant Soil. 198: 185-192.

B. Ellis, J. R., 1998. Plant Nutrition. Post Flood Syndrome and Vesicular-Arbuscular Mycorrhizal Fungi. J. Prod. Agric., Vol. 11, no.2: 200-204.

C. Bagyaraj, D. J. et al. 2015. Phosphorus nutrition of crops through arbuscular mycorrhizal fungi. Current Science, Vol. 108, no. 7: 1288-1293.

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

E. Grant, C. A. et al. 2001. The importance of early season phosphorus nutrition. Canadian Journal of Plant Science. 211-224.

Reach more nutrients and water

Sufficient nutrient and water uptake is critical for effective plant growth and ultimately to maximize your yield potential, especially for low mobility nutrients such as P and Zn.[C] By adding a mycorrhizal inoculant, the plant develops a secondary root system (mycorrhizal hyphae) allowing it a larger soil contact surface and thus better to access to nutrients and water. "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." [D]

Ensure early P uptake

"Phosphorus plays a critical role in energy reactions in the plant [such as photosynthesis. Phosphorus is also a key component in building blocs for plant.] Deficits can influence essentially all energy requiring processes in plant metabolism. Phosphorus stress early in the growing season can restrict crop growth, which can carry through to reduce final crop yield." [E] Mycorrhizae make soil phosphorus (P) more available to the plant, and actively absorb and transfer it via the mycorrhizal filament network (hyphae) directly to the root.

Increase your yield potential

By introducing mycorrhizal inoculant close to the seed at seeding, you get the association working early with the full benefits of increased nutrient and water uptake when plants need them. Therefore, get more out of the fertilizer you have already invested into the crop.

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PTAGTIV.COM/en/canola

AGTIV® highly effective inoculants make a difference in the field by pushing crops' yield potential and increasing growers' net returns. Lead the way with Premier Tech's expertise for AGTIVated acres.

MYCORRHIZAE & RHIZOBIUM INOCULANTS

► Visit our website for product availability according to the territory and their eligibility for organic use : PTAGTIV.COM/**en/products**.

	ACTIVE INGREDIENT		ORGANIC	APPLICATION MODE				FORMULATION
				GRANULAR IN-FURROW	MIXING WITH SEEDS	LIQUID IN-FURROW	LIQUID ON SEED	
PULSES (peas, lentils & faba beans)								
AGTIV® PULSES • Powder **F:** Powder (peat) **S:** 4.7 kg (10.3 lb) pail **C:** Peas & faba beans: **16 ha (40 acres)** – Lentils: **24 ha (60 acres)**	M	R	✓		●			
AGTIV® PULSES • Granular **F:** Granules (peat) **S:** 18.2 kg (40 lb) bag – 364 kg (800 lb) tote bag **C:** Peas, lentils & faba beans: Bag: **4 ha (10 acres)** – Tote bag: **80 ha (200 acres)**	M	R	✓	●				
AGTIV® RHIZO • Granular for PULSES **F:** Granules (peat) **S:** 18.2 kg (40 lb) bag – 364 kg (800 lb) tote bag **C:** Peas, lentils & faba beans: Bag: **4 ha (10 acres)** – Tote bag: **80 ha (200 acres)**		R	*	●				
AGTIV® RHIZO • Liquid for PULSES **F:** Liquid **S:** 8 L (8 kg) bag-in-box **C:** Peas, lentils & faba beans: **32 ha (80 acres)** or **6530 kg of seeds (240 bu)**	C	R	✓			●	●	
AGTIV® ON SEED™ – RHIZO • Powder for PULSES N F: Powder (peat) **S:** 4.7 kg (10.3 lb) pail **C:** Peas & faba beans: **16 ha (40 acres)** – Lentils: **24 ha (60 acres)**		R	*		●			
SOYBEAN								
AGTIV® SOYBEAN • Powder **F:** Powder (peat) **S:** 4.7 kg (10.3 lb) pail **C:** Soybean: **16 ha (40 acres)**	M	R	✓		●			
AGTIV® SOYBEAN • Granular **F:** Granules (peat) **S:** 18.2 kg (40 lb) bag – 364 kg (800 lb) tote bag **C:** Soybean: Bag: **4 ha (10 acres)** – Tote bag: **80 ha (200 acres)**	M	R	*	●				
AGTIV® BRADY • Granular for SOYBEAN **F:** Granules (peat) **S:** 18.2 kg (40 lb) bag – 364 kg (800 lb) tote bag **C:** Soybean: Bag: **4 ha (10 acres)** – Tote bag: **80 ha (200 acres)**		R	*	●				
AGTIV® BRADY • Liquid for SOYBEAN **F:** Liquid **S:** 11 L (11 kg) bag-in-box **C:** Soybean: **16 ha (40 acres)** or **4600 kg of seeds (200 units)**	C	R	✓			●	●	
CHICKPEA								
AGTIV® CHICKPEA • Powder N **F:** Powder (peat) **S:** 4.7 kg (10.3 lb) pail **C:** Chickpea: **16 ha (40 acres)**	M	R	✓		●			
AGTIV® CHICKPEA • Granular **F:** Granules (peat) **S:** 18.2 kg (40 lb) bag – 364 kg (800 lb) tote bag **C:** Chickpea: Bag: **3.2 ha (8 acres)** – Tote bag: **64 ha (160 acres)**	M	R	✓	●				
FORAGES								
AGTIV® FORAGES • Powder **F:** Powder (diatomaceous earth) **S:** 1.6 kg (3.5 lb) pail **C:** Alfalfa, mix forages & grass: **8 ha (20 acres)**	M		*		●			

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	ACTIVE INGREDIENT		ORGANIC	APPLICATION MODE							FORMULATION
				IN-FURROW	SEED-PIECE TREATMENT AT THE WAREHOUSE	MIXING WITH SEEDS	INCORPORATION INTO GROWING MEDIA	TRANSPLANTING	SEED TREATMENT		
FIELD CROPS (cereals, flax & dry beans)											
AGTIV® FIELD CROPS – ○ • Powder **F:** Powder (peat) **S:** Case of 4 x 800 g (4 x 1.75 lb) pails **C:** Cereals, flax & dry beans: **32 ha (80 acres)** per case Alfalfa, mix forages & grass: **16 ha (40 acres)** per case	M		✓			●					
AGTIV® FIELD CROPS • Powder **F:** Powder (diatomaceous earth) **S:** 2 kg (4.4 lb) pail **C:** Cereals, flax & dry beans: **16 ha (40 acres)**	M		*			●					
AGTIV® FIELD CROPS • Granular **F:** Granules (zeolite) **S:** 18.2 kg (40 lb) bag – 364 kg (800 lb) tote bag **C:** Cereals, flax & dry beans: Bag: **3.2 ha (8 acres)** – Tote bag: **64 ha (160 acres)**	M		✓	●							
AGTIV® FIELD CROPS • Liquid **F:** Liquid (spores in suspension) **S:** Case of 2 x 950 ml (2 x 32 fl. oz) bottles **C:** Cereals, flax, beans & pulses: **16 ha (40 acres)** per case	M	C	✓	●							
POTATO											
AGTIV® POTATO • Liquid **F:** Liquid (spores in suspension) **S:** Case of 2 x 950 ml (2 x 32 fl. oz) bottles **C:** Potato: **8 ha (20 acres)** per case	M		✓	●	●						
GREEN PEAS											
AGTIV® SPECIALTY CROPS – PEA • Powder **F:** Powder (peat) **S:** 2.4 kg (5.3 lb) pail **C:** Green peas: **8 ha (20 acres)**	M	R	✓			●					
SPECIALTY CROPS											
AGTIV® SPECIALTY CROPS • Powder **F:** Powder (diatomaceous earth) **S:** Case of 4 x 500 g (4 x 1.1 lb) pails **C:** Vegetables, berries & garlic	M		*			●	●	●			
AGTIV® SPECIALTY CROPS • Granular **F:** Granules (peat) **S:** 10 kg (22 lb) pail **C:** Vegetables, herbs, berries & fruit trees	M		✓	●			●	●			
AGTIV® ON SEED™ **F:** Treated seeds **C:** Vegetables and fruits Ask your representative for more details.	M	B	*						●		

F: Formulation
S: Size
C: Crop/ Coverage

ACTIVE INGREDIENTS:

M MYCORRHIZAE
PTB297 Technology

B BACILLUS
PTB180 Technology

R RHIZOBIUM
PTB160 Technology (pulses)
PTB162 Technology (soybean)
Mesorhizobium ciceri (chickpea)

N New product

C Combo available

ORGANIC:

✓ For organic use

* Eligibility may vary depending on the territory. Contact us for more details.

TOOLS

Dedicated to offer technical support for product application, field demonstration, equipment and input compatibility, and to promote educational agronomic knowledge, Premier Tech provides various tools on PT**AGTIV**.COM.

EASY TO USE

For an easy integration in your farming practices, access:

- Labels, SDS, organic certificates
- Application videos, charts and rate calculators

PTAGTIV.COM**/en/toolbox**

In addition, to ensure performance through efficient and precise application of its inoculants, Premier Tech recommends the use of approved equipment, such as the AGTIV® Liquid Injection Kit, endorsed by pay-back programs on selected AGTIV® products.

PTAGTIV.COM**/en/equipment**

EFFECTIVE

For the compatibility lists of our active ingredients with various agricultural inputs, such as:

- Pesticides
- Liquid fertilizers

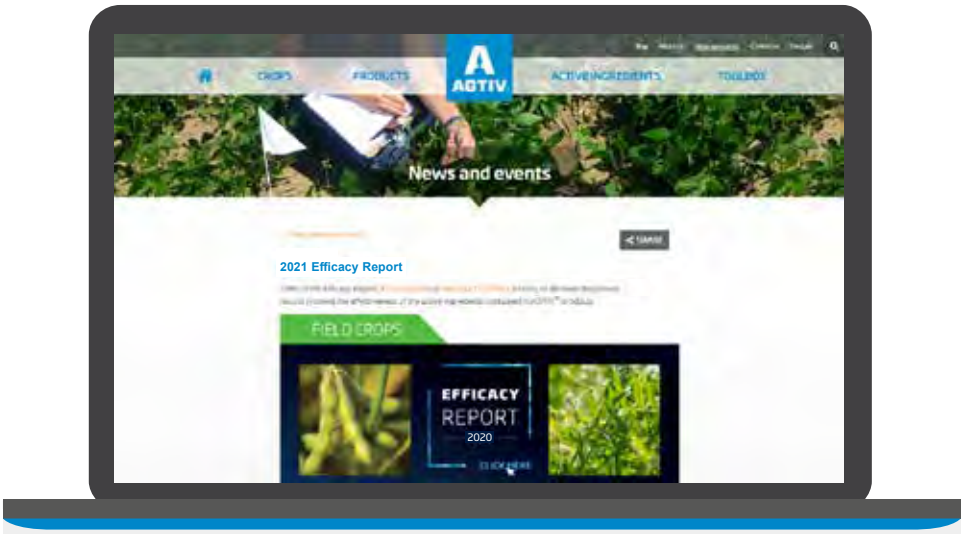
PTAGTIV.COM**/en/compatibility**

AGRONOMIC KNOWLEDGE

Access blog articles on various agronomic topics:

- Soil biology
- Plant health
- Active ingredients, etc.

PTAGTIV.COM**/en/blog**



PROVEN RESULTS

Discover the third-party results proving the effectiveness of the active ingredients contained in AGTIV® products:

- Efficacy report
- Field observations

PTAGTIV.COM**/en/results**

CONTACT OUR DEDICATED TEAM TODAY.
WE CARE ABOUT YOUR SUCCESS!

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