FMC An Agricultural Sciences Company

BIOLOGICALS
by
FMC

Innovative Plant Health Solutions

2025 Product Guide

Table of Contents

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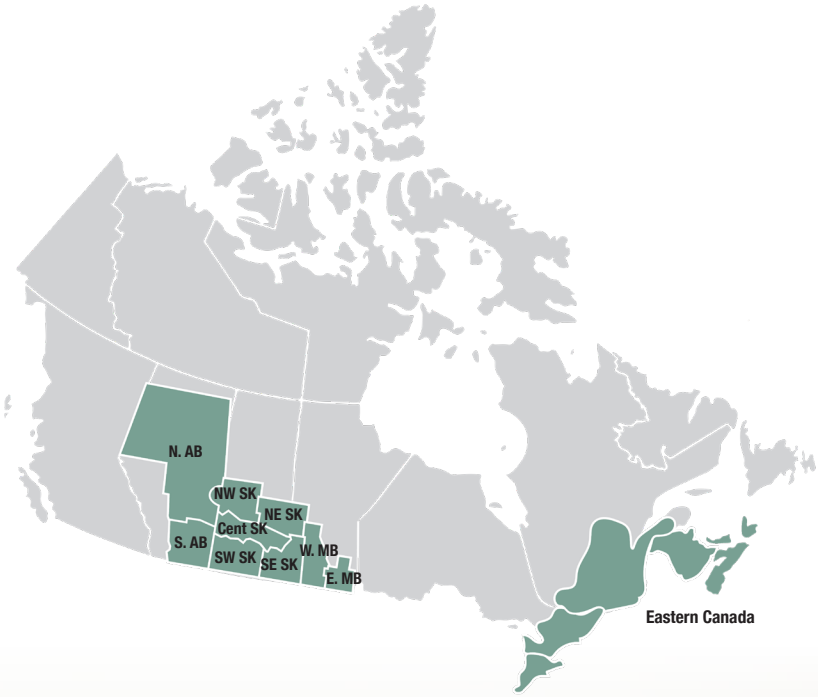
The Benefits of Biologicals

Investing in key nutrients like nitrogen, phosphate, and potassium is essential to unlocking your crop's yield potential. Maximizing the effectiveness of these nutrients is crucial to your bottom line, as they are fundamental to your crop's health, affecting leaf, stalk, stem, and root development.

In order to achieve maximum yields with your crops, soils often need to be supplemented – whether through traditional fertilizers or biological products. Biologicals play a unique role by enhancing nutrient availability, allowing you to make the most of your fertilizer investment.

These beneficial microbes not only fix atmospheric nitrogen for your pulse crops but also improve nutrient efficiency to promote early, vigorous crop growth. By fostering strong root systems, biologicals help your crops reach their full yield potential by season's end.



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TagTeam® BioniQ®

CROPS: CHICKPEA I FABA BEAN I LENTIL I PEA

Product Overview

Supercharge Root Growth and Fortify Crops

TagTeam® BioniQ® combines five biological actives to energize your pulse crops. It helps maximize the effectiveness of inputs and improve yield potential all while fixing nitrogen for the plant. That's multiple ways to help you succeed, all in one inoculant.

A specially selected Rhizobium strain and the proven performance of LCO (lipochitooligosaccharide) technology are utilized to provide improved nodule formation and increased nitrogen fixation. TagTeam® BioniQ® contains the phosphate-solubilizing benefits of the *Penicillium bilaiae* fungi as well as the addition of the biologicals, *Bacillus amyloliquefaciens* and *Trichoderma virens* for increased availability and uptake of nitrogen, phosphate and potassium. The ability to release nutrients from the soil and solubilize inorganic phosphorus fertilizer helps maximize the effectiveness of inputs and improve yield potential.

TagTeam® BioniQ®'s 5 Biological Actives:

- *Rhizobium leguminosarum*
- LCO (lipochitooligosaccharide) technology
- *Penicillium bilaiae*
- *Bacillus amyloliquefaciens*
- *Trichoderma virens*

Note: TagTeam® BioniQ® chickpea and TagTeam® BioniQ® faba bean contain a *rhizobia*, *Penicillium bilaiae*, *Bacillus amyloliquefaciens* and *Trichoderma* virens only.

NEW

Improved Granular Formulation

The improved granular formulation of TagTeam® BioniQ® features granules with 10% better flow, 9% greater hardness than crumble granules, and a significant reduction in dust.

Hardness

Peat particles bond together within the granule through APT's proprietary polymerization process, resulting in high crush strength

Resistance to attrition test

- Simulates movement and vibration
- Measures particle size change before and after

Results:
Improved granule product has a **9% increase** in granular hardness

Flowability

Results:
Flowability improved by **greater than 10%**

Benefit: A lower angle of repose can lead to easier and more complete filling of tanks

Dust Level

Results:
Improved granular product shows little to no dust in the Dustiness Assay test.

BioAdvantage Trials

Producers, retailers, and agronomists all want the same thing - increased yield and performance for a greater return on investment. While many products on the market make these claims, TagTeam® BioniQ® has the large-scale field trials and data to back them.

Pea

Competitors	51.8 (bu/ac)
TagTeam® BioniQ®	54.5 (bu/ac)

65% Win Rate

+2.7 Yield Advantage

Source: Results were collected from 43 farmer-conducted, large-scale, side-by-side BioAdvantage Trials conducted in Western Canada from 2017-2022.

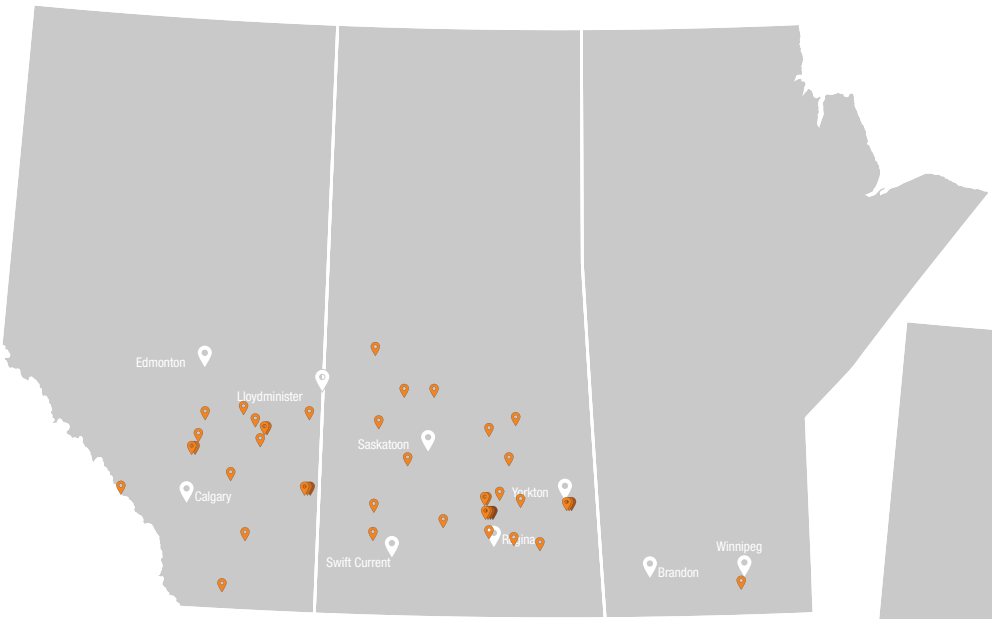
Lentil

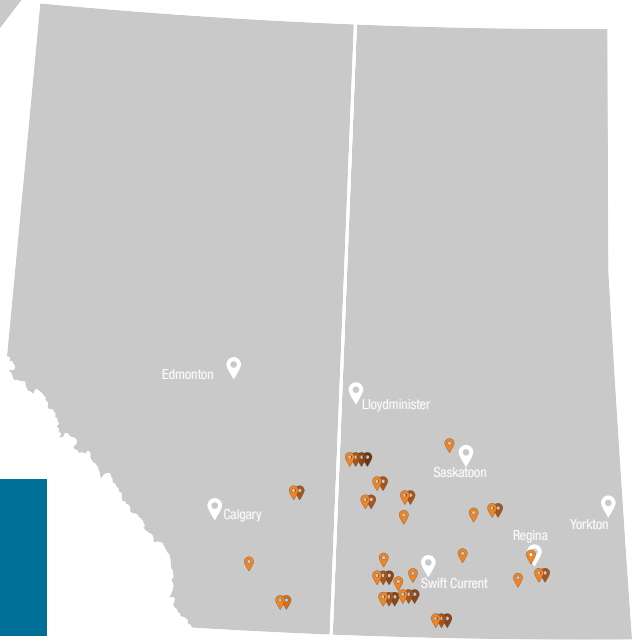
Competitors	24.2 (bu/ac)
TagTeam® BioniQ®	25.1 (bu/ac)

76% Win Rate

+0.9 Yield Advantage

Source: Results were collected from 41 farmer-conducted, large-scale, side-by-side BioAdvantage Trials conducted in Western Canada from 2017-2022.





TagTeam® BioniQ® increases yield and performance over a wide range of geographic locations and field conditions.

Multiple Modes of Action

The *Bacillus amyloliquefaciens* and *Trichoderma virens* based treatments have the ability to solubilize organic nutrients and release phosphate in the soil not readily available to the plant. With two strains of *Penicillium bilaiae* fungi, the biological is active in varying soil temperatures allowing for the promotion of phosphate availability all season long. TagTeam® BioniQ® deploys multiple modes of action to solubilize all forms of phosphorus and increase nutrient availability in pulse crops.

Earlier Nodulation Development

LCO is a molecule involved in the rhizobia–legume nodulation system. LCO is an important component in nodulation as a key driver in the communication between plants and rhizobia. When the LCO molecule is present at the time of planting, it allows for the nodulation process to begin, independent of variety, soil and environmental conditions. The benefit of earlier nodulation formation is greater nitrogen fixation for the plant, which supports plant growth such as root and shoot development.

Root and Shoot Development

Penicillium bilaiae helps the plant harness the energy required to build root mass, by making phosphate available to the plant to support root and shoot growth.

Better Phosphate Uptake With TagTeam® BioniQ®

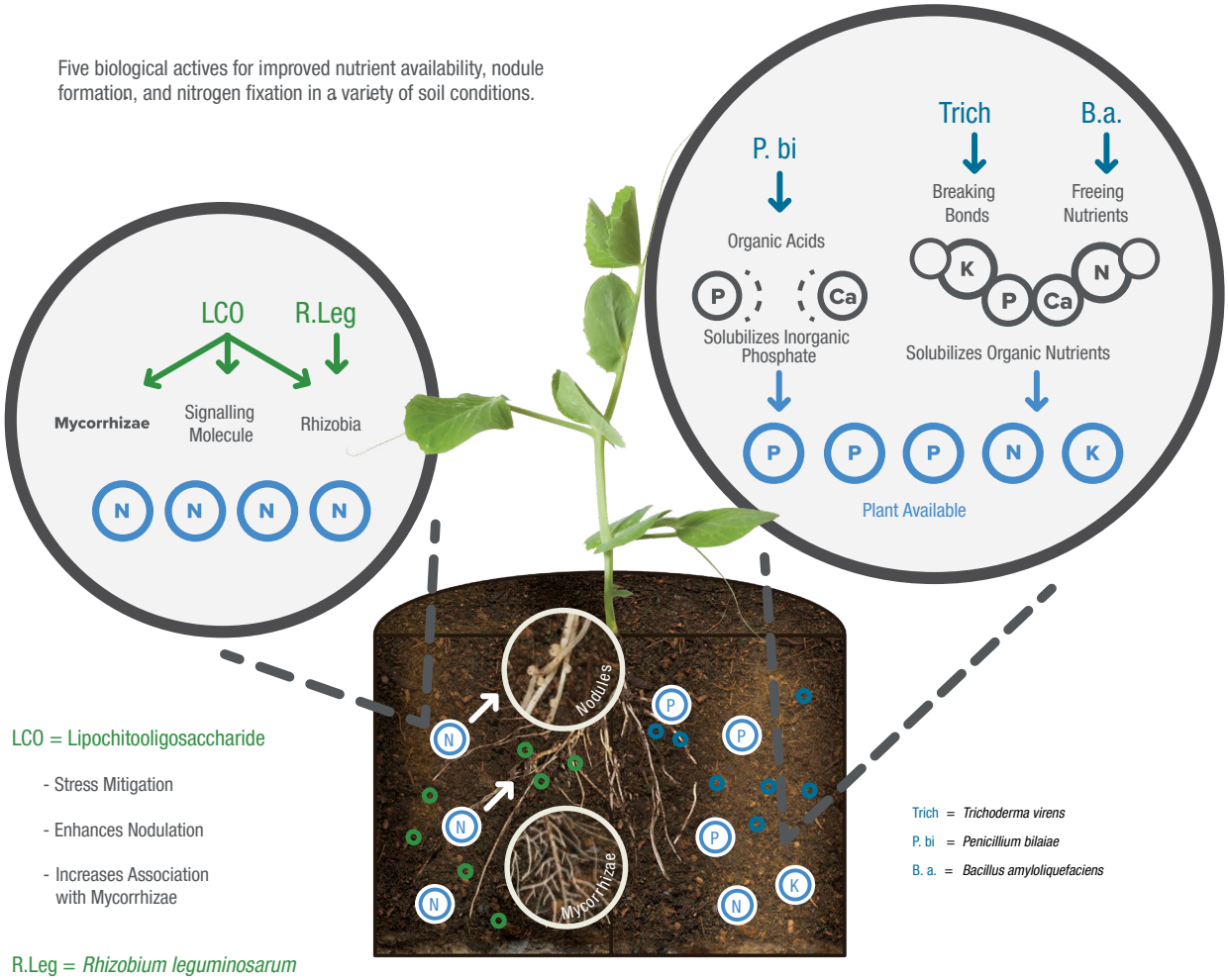
Tested for performance - Over 250 strains of fungus and bacteria were tested to find the best combination of strains for TagTeam® BioniQ®.

Early vigour - Early spring conditions, including cool soils, are difficult on plants and can limit early-season phosphate availability. This can lead to reduced plant growth and, ultimately, crop yield. Because TagTeam® BioniQ® is active under varying soil conditions and temperatures, phosphate availability is improved and present when your plant needs it most.

Greater stress tolerance - Plants with larger healthy root systems have the ability to better withstand a variety of stresses, such as drought and disease pressure. Healthy root systems help plants access moisture and nutrients more efficiently. TagTeam® BioniQ® increases phosphate availability in all areas of the soil that the root explores, which helps promote more root growth and ultimately result in higher yields.

How It Works

Five biological actives for improved nutrient availability, nodule formation, and nitrogen fixation in a variety of soil conditions.



LCO = Lipochitooligosaccharide

- Stress Mitigation
- Enhances Nodulation
- Increases Association with Mycorrhizae

R.Leg = *Rhizobium leguminosarum*

- Fixes Nitrogen

Trich = *Trichoderma virens*
P. bi = *Penicillium bilaiae*
B. a. = *Bacillus amyloliquefaciens*

TagTeam® BioniQ® Is Available In The Following Formulations

CROP	INOCULANT ACTIVES	TAGTEAM® BIONIQ® FORMULATIONS AVAILABLE
Pea, Lentil	*Penicillium bilaiae* + *Rhizobium leguminosarum* + *Bacillus amyloliquefaciens* + *Trichoderma virens* + lipochitooligosaccharide	Improved granule
Chickpea	*Penicillium bilaiae* + *Mesorhizobium ciceri* + *Bacillus amyloliquefaciens* + *Trichoderma virens*	Improved granule
Faba bean	*Penicillium bilaiae* + *Rhizobium leguminosarum* + *Bacillus amyloliquefaciens* + *Trichoderma virens*	Improved granule

Application

TagTeam® BioniQ® granular should be applied directly with the seed in the seed row using a granular tank for application. Application rates vary according to row spacing (refer to table). Please read the label before application for complete use instructions.

- Pour into tank through a screen.
- Fill the tank to match or slightly exceed seed requirements. Do not overfill the tank to avoid compaction.
- If augering TagTeam® BioniQ® granular, do so at low speeds to avoid damage to the granules.
- Do not mix TagTeam® BioniQ® granular in the same tank with seed or fertilizer.
- Do not leave TagTeam® BioniQ® granular in the tank overnight as condensation can cause lumps to form.

TagTeam® BioniQ® Improved Granular Application Rates

PACKAGE SIZE	16.5 kg (36.31 lb) bag		Super Sack (454 kg)
Row spacing	lb/ac	ac/bag	ac/bag
6 in	5.5	6.6	182.0
7 in	4.7	7.7	213.0
8 in	4.1	8.9	244.1
9 in	3.6	10.1	278.0
10 in	3.3	11	303.3
12 in	2.7	13.4	370.7
15 in	2.2	16.5	455.0

TagTeam® BioniQ® Improved Granular Product Packaging

Chickpea	Improved Granular	1	x	16.5 kg	=	
	Improved Granular	1	x	454 kg	=	
Faba bean	Improved Granular	1	x	16.5 kg	=	
Pea/lentil	Improved Granular	1	x	16.5 kg		
	Improved Granular	1	x	454 kg		

TagTeam®

CROPS: CHICKPEA | LENTIL | PEA | SOYBEAN

Product Overview

Balanced Nutrition

Balanced nutrition of phosphate and nitrogen is necessary to maximize your crop's yield potential. TagTeam® inoculant provides this balanced nutrition by combining the active ingredient from JumpStart® inoculant with a nitrogen-fixing bacteria to produce a dual-action inoculant.

The active ingredient in JumpStart® is the soil fungus, *Penicillium bilaiae*. This fungus and the rhizobia in TagTeam® work together to create a unique value equation.

The soil fungus is the key to the equation. It grows along the plant roots and makes less-available forms of phosphate available to the plant. Phosphate is an important component that drives the needed energy for the nitrogen fixation process.

Penicillium bilaiae helps the plant harness the energy required early in the season to build root mass, by making phosphate available to the plant to support root and shoot growth.

TagTeam® Inoculant Solves Starter Fertilizer Problems

TagTeam® improves the availability of phosphorus even when a starter P fertilizer is used. TagTeam® helps the developing primary roots access phosphate early in the growth stages before the root reaches the starter fertilizer band.

As the primary root develops, TagTeam® provides greater availability of soil and fertilizer phosphate, allowing the root to better access phosphate nutrition throughout the rooting zone.

Phosphate Is Crucial To Nitrogen Fixation

Research shows that phosphate nutrition has a significant, positive impact on nitrogen fixation.[1] Good phosphate nutrition results in more nodules being formed and more active nitrogen fixation.

- Phosphate helps move the energy from photosynthesis to the roots, where it is needed to fuel nitrogen fixation.
- More extensive root growth provides greater opportunity for the development of nitrogen-fixing nodules.
- Faster development of active nodules results in greater nitrogen fixation.
- Phosphate nutrition increases the number and size of nodules and the resulting a mount of nitrogen fixed by the plant.

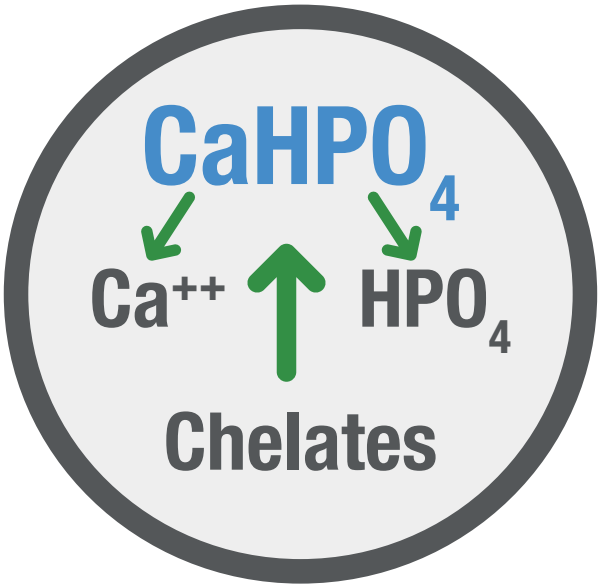
Most phosphate fertilizer is banded during pea and lentil seeding, resulting in limited early-season availability to the plant. *Penicillium bilaiae* helps overcome this limitation by providing early-season access to soil and starter fertilizer phosphate.

Source: Phosphorus for Agriculture. Potash and Phosphate Institute. 1988. Reprinted from Fall 1988 issue of Better Crops with Plant Food magazine.

Features & Benefits

- Improved nodule formation
- Improved phosphate availability
- Enhanced nutrient availability, which supports root and shoot growth
- Increased nitrogen fixation

How *Penicillium bilaiae* works…..



***P. bilaie* Breaks Phosphate Bonds**

- Phosphate commonly forms bonds with calcium, magnesium, aluminum and iron with the type of bond varying according to soil type.
- *P. bilaiae* breaks the bonds that form between the elements within the root zone, releasing the phosphate so it can be taken up by the plant and chelates cation so it can not reattach

TagTeam® Is Available In The Following Formulations

CROP	INOCULANT ACTIVES	TAGTEAM FORMULATIONS AVAILABLE
Chickpea	*Penicillium bilaiae* + *Mesorhizobium ciceri*	Peat
Pea, Lentil	*Penicillium bilaiae* + *Rhizobium leguminosarum*	Liquid, peat
Soybean	*Penicillium bilaiae* + *Bradyrhizobium japonicum*	Improved Granular

TagTeam® for Soybeans - with improved granules

TagTeam® for soybeans with an improved granular formulation combines the phosphate-solubilizing organism *Penicillium bilaiae* and *Bradyrhizobium japonicum* in one inoculant to help address your soybean crop's phosphate and nitrogen fertility needs.

Soybean Fertility

Phosphate fertility programs in soybeans must deal with several challenges that may limit phosphate availability and uptake.

- Soybean seed is very sensitive to fertilizer injury from applied phosphate fertilizer. If you are unable to seed-place phosphate effectively, or if you broadcast phosphate before seeding, TagTeam® will help make phosphate available to your soybean crop at the critical early-season stage.
- Calcareous soils readily tie up phosphate. The phosphate-solubilizing component of TagTeam® will help increase phosphate availability of both residual soil phosphate and incorporated phosphate in these types of soils.

Application

TagTeam® is available in improved granular, peat and liquid formulations to meet your different crop and equipment needs. Please read the label before application for complete use instructions.

TagTeam® Improved Granular

TagTeam® improved granular should be applied directly with the seed in the seed row using a granular tank for application. Application rates vary according to row spacing (refer to Table 1 below for details).

- Pour into tank through a screen.
- Fill tank to match or slightly exceed seed requirements. Do not overfill tank to avoid compaction.
- If auguring TagTeam® granular, do so at low speeds to avoid damage to the granules.
- Do not mix TagTeam® in the same tank with seed or fertilizer.
- Do not leave TagTeam® granular in the tank overnight as condensation can cause lumps to form.

Table 1. TagTeam® Improved Granular Application Rates

CROP	SOYBEAN	
Package size	16.5 kg (36.37 lb) bag	
Row spacing	lb/ac	ac/bag
7 in	6.2	5.9
8 in	5.4	6.7
9 in	4.7	7.7
10 in	4.3	8.4
12 in	3.6	10.1
15 in	2.9	12.6
24 in	1.8	20.2
30 in	1.4	25.9

Note: The bulk density of TagTeam® granular is approximately 0.6 g/cm^3 (37 lb/ft^3).

TagTeam® Liquid

TagTeam® liquid should be applied directly to the seed at a rate of (75 ml/27 kg) of seed. Once applied to bare seed, plant within 48 hours.

Table 2. TagTeam® Liquid Application

TAGTEAM® LIQUID		AMOUNT OF SEED TREATED	
Crop	Size	bu	lb
Pea, lentil	3.0 litre + 57 g WP	40	2,400

TagTeam® Peat

TagTeam® peat has its own sticker in the formulation. A separate sticker is not needed.

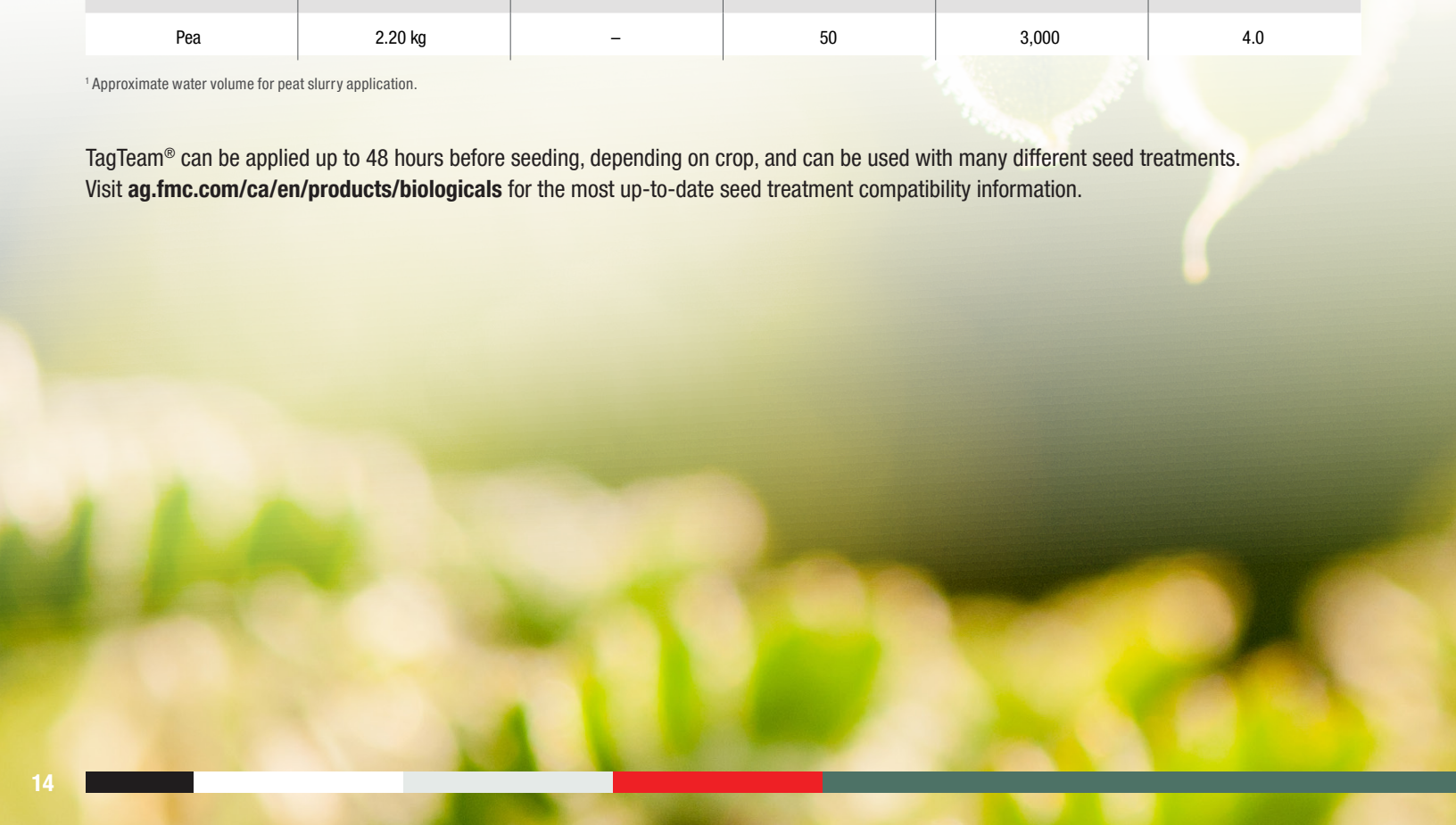
Apply TagTeam® to pre-moistened seed, or add water while applying TagTeam®, or mix TagTeam® with cool, clean water and apply to seed as a slurry. Please refer to Table 3 for approximate water rates. Once TagTeam® is mixed into water, apply to seed within six hours.

Table 3. TagTeam® Peat Application

TAGTEAM® PEAT		AMOUNT OF SEED TREATED/BAG			WATER RATE [1]
Crop	Bag size	Units	bu	lb	Litres
Chickpea	2.20 kg	–	50	3,000	4.0
Lentil	2.20 kg	–	30	1,800	2.5
Pea	2.20 kg	–	50	3,000	4.0

[1] Approximate water volume for peat slurry application.

TagTeam® can be applied up to 48 hours before seeding, depending on crop, and can be used with many different seed treatments. Visit **ag.fmc.com/ca/en/products/biologicals** for the most up-to-date seed treatment compatibility information.



Product Packaging

Chickpea		Peat	7	x	2.2 kg bag	=	
Pea/Lentil		Peat	7	x	2.2 kg bag	=	
		Liquid	4	x	3 L + 57 g wettable powder	=	
Soybean		Improved Granular	1	x	16.5 kg	=	

BioniQ®

CROPS: BARLEY | CANOLA | WHEAT

Product Overview

Tap Into the True Potential of Your Farm

BioniQ® combines three biological actives to trigger powerful growth in your cereal and canola crops. Now, there's no need to miss out on better performance.

The *Penicillium bilaia*e fungus helps release bound mineral forms of soil and fertilizer phosphate, making it more readily available for the plant to use. The biologicals *Bacillus amyloliquefaciens* and *Trichoderma virens* help increase availability and uptake of nitrogen, phosphate and potassium, which supports root and shoot growth in cereal and canola crops.

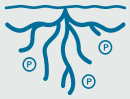
BioniQ®'s 3 Biological Actives:

- *Penicillium bilaiae*
- *Bacillus amyloliquefaciens*
- *Trichoderma virens*

Features & Benefits

Increased yield and return on investment

Performance in a variety of soil conditions and types; active in cool soils for enhanced early-season vigour



Improved availability of phosphate for enhanced root growth

Earlier, more uniform maturity

Enhanced nutrient availability, which supports root and shoot growth

Get The Most From BioniQ®

- **Seeding into cold soils:** BioniQ® is active in cool soil temperatures making soil phosphate available to the plant, helping to enhance early-season vigour.
- **Seed-placed phosphate is applied more than 1/5 inches from the seed:** Phosphate fertilizer is not close enough to the seed for early-stage growth. BioniQ® makes the phosphate in the soil around the seed more available resulting in better, uniform emergence.
- **Maturity concerns:** An adequate early-season supply of phosphate shows up at harvest time in the form of more even maturity, and a more uniform seed set. BioniQ® helps ensure phosphate is available to meet early-season needs.

Multiple Modes of Action

The *Bacillus amyloliquefaciens* and *Trichoderma virens* based treatments have the ability to solubilize organic nutrients and release phosphate in the soil that is not readily available to the plant.

With two strains of *Penicillium bilaiae* fungi, the biological is active in both warm and cool soil conditions allowing for the promotion of phosphate availability all season long.

BioniQ® deploys multiple modes of action to solubilize all forms of phosphorus and increase nutrient availability for cereal and canola crops.

BioAdvantage Trials

In every program, there will be wins, losses and ties. With our BioAdvantage Trials program we are transparent with our data and show every trial result, as we want to show the proof behind our products and not just promise that they will work.

Canola

Untreated	44.9 (bu/ac)
BioniQ®	46.9 (bu/ac)

72% Win Rate

+2.0 Yield Advantage

Source: Results were collected from 87 farmer-conducted, large-scale, side-by-side BioAdvantage Trials conducted in Western and Eastern Canada from 2017-2022.

Wheat

Untreated	63.5 (bu/ac)
BioniQ®	66.6 (bu/ac)

78% Win Rate

+3.1 Yield Advantage

Source: Results were collected from 46 farmer-conducted, large-scale, side-by-side BioAdvantage Trials conducted in Western Canada from 2017-2022.

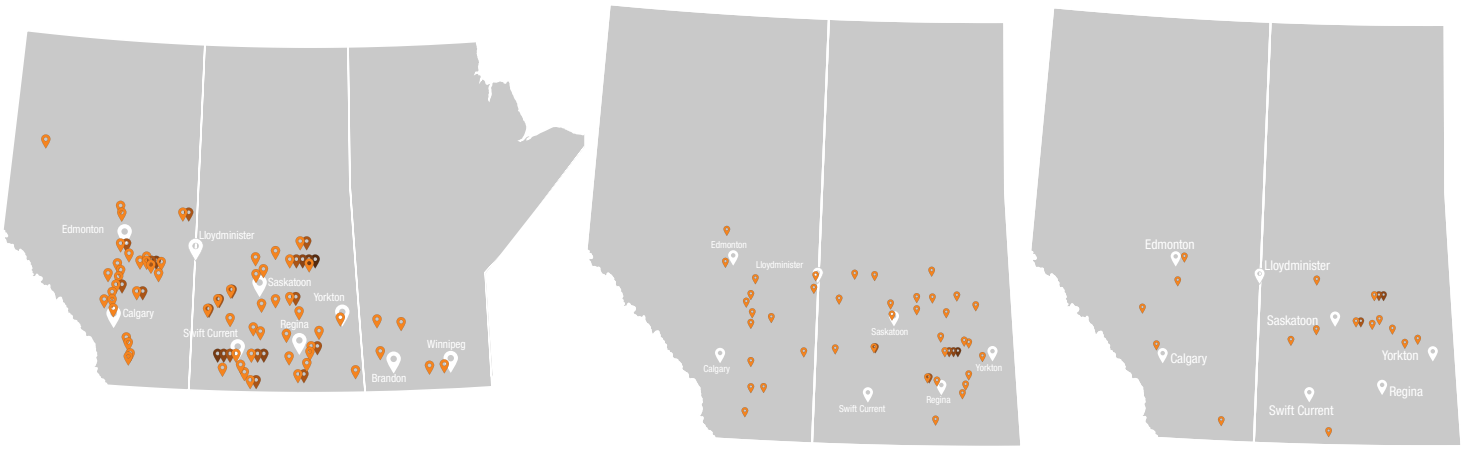
Barley

Untreated	77.0 (bu/ac)
BioniQ®	81.0 (bu/ac)

74% Win Rate

+3.9 Yield Advantage

Source: Results were collected from 19 farmer-conducted, large-scale, side-by-side BioAdvantage Trials conducted in Western Canada from 2017-2022.



BioniQ® increases yield and performance over a wide range of geographic locations and field conditions.

Better Phosphate Uptake With BioniQ®

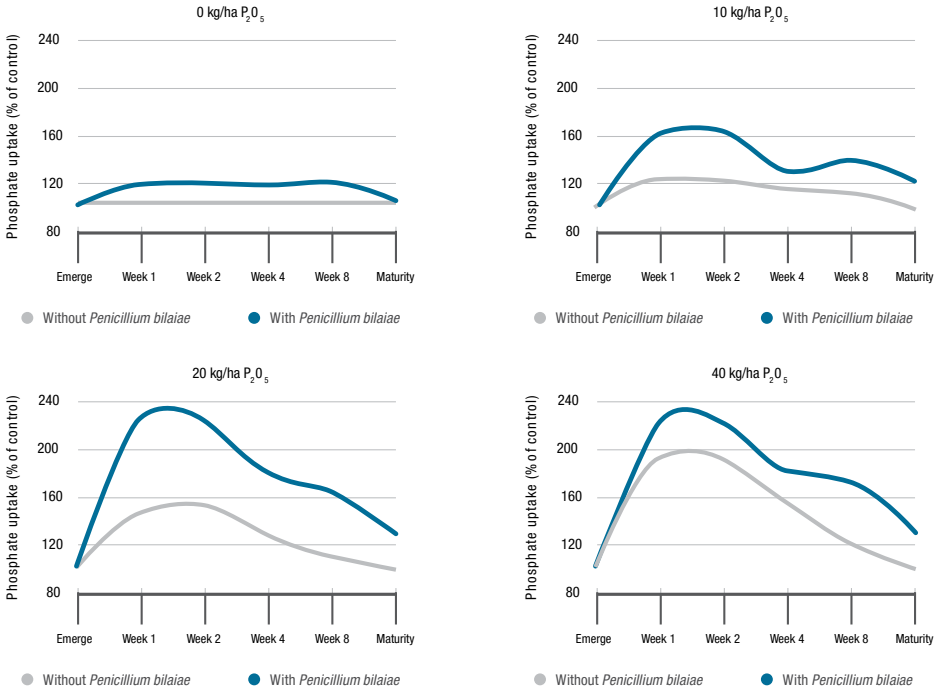
Tested for performance - Over 250 strains of fungus and bacteria were tested to find the best combination of strains for BioniQ®.

Early vigour - Early spring conditions, including cool soils, are difficult on plants and can limit early-season phosphate availability. This can lead to reduced plant growth and, ultimately, crop yield. Because BioniQ® is active under varying soil temperatures, or varying soil conditions, phosphate availability is improved and there when your plant needs it most.

Greater stress tolerance - Plants with larger healthy root systems have the ability to better withstand a variety of stresses, such as drought and weed pressure. Healthy root systems help cereal and canola plants access moisture and nutrients more efficiently. BioniQ® increases phosphate availability in all areas of the soil that the root explores, not just around the fertilizer band, which helps promote more root growth.

Penicillium bilaiae increases the availability of phosphate, resulting in increased uptake by the plant

Research data from the University of Manitoba shows the increase in uptake of phosphate throughout the growing season when using *Penicillium bilaiae* on wheat.



Source: J. Chambers and J. Yeoman, MB Soc. of Soil Sci. mfg on wheat. Six field trails on wheat, 1989-1990, University of Manitoba.

Benefits of BioniQ® on Canola

Increased Availability of Soil And Fertilizer Phosphate
Enhanced phosphate availability results in increased root growth and increased leaf surface area. As a result, canola inoculated with BioniQ® may flower earlier, have an increased number of pods and pod-bearing branches, and have earlier, more uniform maturity. Ultimately, you can help your canola crop reach its full potential.

A More Even Supply of Phosphate to Improve Crop Uniformity
A healthy uniform canola crop has more potential to withstand weed, insect and disease pressures. Timing of pesticide applications, swathing and crop dry-down are easier to assess with a uniformly developed canola crop.

Earlier Access to More Phosphate with Sensitive Seed
Top-yielding canola varieties require significant amounts of nitrogen and phosphate fertilizer to achieve their yield potential. Inoculating canola with BioniQ® will help address phosphate needs with sensitive seed.

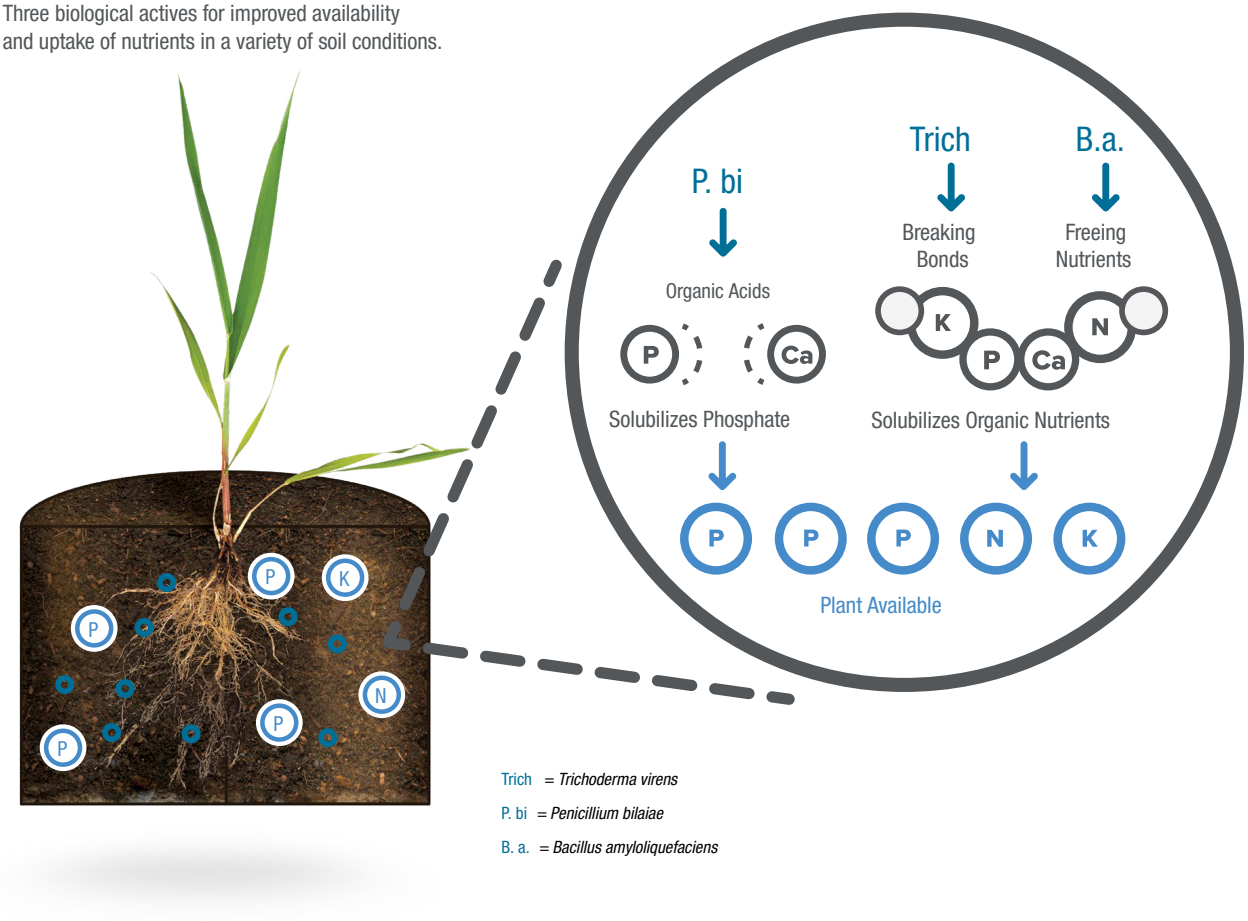
Phosphate Fertility In Canola
Ensuring phosphate is available to the plant throughout the growing season is important for high-yielding canola crops. Canola seedlings require phosphate to advance from germination through to the three and four leaf stage, as a consequence of their small seed size phosphate content in the seed can only support seedling growth for approximately one week.

Factors Limiting Phosphate Availability In Canola
- Phosphate is relatively immobile in the soil. This means phosphate must be placed within or near the seed row to be available for emerging seedlings.
- Canola is sensitive to seed-placed fertilizer. With good to excellent soil moisture, no more than 20 to 25 pound of P_2O_5 per acre should be seed-placed.[1]

[1] Source: Guidelines for Safe Rates of Fertilizer Placed with Seed, Saskatchewan Ministry of Agriculture.

How It Works

Three biological actives for improved availability and uptake of nutrients in a variety of soil conditions.



Trich = *Trichoderma virens*

P. bi = *Penicillium bilaiae*

B. a. = *Bacillus amyloliquefaciens*

BioniQ® On Winter Wheat

When it comes to a successful winter cereal crop, the beginning determines the end. Without good stand establishment in the fall, winter survival suffers and yields decline. Phosphate fertility and other key factors, including seeding date and planting depth, require careful attention to ensure a good start.

For the best winter survival, cereals must germinate uniformly in the fall and develop at least two to three leaves and crown tissue. Then, in the spring, the winter cereal plant re-grows from the crown tissue.

Development Of Root And Shoot Growth

Proper phosphate fertility helps winter cereals establish quickly and uniformly. Phosphate, which is an essential component of the energy-building process, enhances early plant development and vigorous root and shoot growth.

Better Stand Establishment

Achieving high winter wheat yields requires two critical factors: winter hardiness and rapid spring re-growth. Both factors are directly influenced by the phosphate status in the plant. Adequate phosphate nutrition promotes rapid emergence and establishment in the fall, allowing the plants to achieve optimal root and shoot growth and nutrient uptake prior to dormancy. This promotes winter hardiness and a greater probability of the crop withstanding adverse environmental conditions. A healthy, well-established stand is better able to survive over winter and is better able to exhibit rapid re-growth in the spring to set up yield potential.

Application

BioniQ® comes in a wettable powder co-pack that is optimally formulated for canola and cereal crops. The product is conveniently packaged for ease of use and can be applied similar to other wettable powder inoculants in the Biologicals by FMC portfolio. Please read the label before application for complete use instructions.

Open package only when ready to use. Use before expiration date. Apply this product only as specified on the label. Reference the specified application rate to determine the proper amount needed for seed.

Inoculate seed on-farm by adding and thoroughly mixing the entire contents of both Active Powder A (333 g) and Active Powder B (450 g) in the appropriate amount of water (refer to Table 1) prior to or during seeding.

- BioniQ® can be applied utilizing commercial on-seed application equipment.
- Applicators used previously for pesticides should be triple rinsed before being used for BioniQ® application.
- BioniQ® can be applied up to 60 days prior to seeding (depending on seed type) and can be used with many different seed treatments. Visit **ag.fmc.com/ca/en/products/biologicals** for the most up-to-date information on seed treatment compatibility.

Table 1. BioniQ® Wettable Powder Application

783 g co-pack			
Crop	Seed treated/one 783 g co-pack		Water (litres)
Barley	250 bu	12,000 lb	34
Canola/mustard	10 bu	500 lb	5
Oats	250 bu	8,500 lb	24
Rye	250 bu	14,000 lb	39
Wheat	250 bu	15,000 lb	42

Product Packaging

JumpStart®

ALL CROPS

Product Overview

Phosphate Fertilizer Use Efficiency

Up to 90% of applied phosphate fertilizer goes unused in the year of application as it gets tied (bound) to soil particles and other elements, making it unavailable to the crop. Some of this is used over subsequent years, but at least 25% never becomes available.[1] It is crucial to make the most efficient use of fertilizer phosphate to maximize yield potential.

JumpStart® inoculant contains the naturally occurring soil fungus *Penicillium bilaiae*, discovered by Agriculture and Agri-Food Canada, which grows along plant roots, releasing phosphate bound in the soil, making it more readily available for the crop to use.

Factors Affecting Phosphate Availability

Phosphate Is Less Available:

- In soils containing high levels of cations, such as calcium, magnesium, iron or aluminum.
- In soils with high clay content.
- At colder soil temperatures.
- To crops with a tap root system.
- In dry soils.

Source: Phosphorous for Agriculture, International Plant Nutrition Institute (formerly: Potash and Phosphate Institute)

Features & Benefits

Benefits To Better Phosphate Uptake With JumpStart®

JumpStart® inoculant promotes greater phosphate availability, which results in early vigour, greater stress tolerance and earlier, more even maturity. JumpStart® improves phosphate availability to plants at the most vulnerable stages and reduces the need to seed-place high rates of phosphate fertilizer with sensitive seeds like canola, pea, lentil and soybeans.

Penicillium bilaiae, the active ingredient in JumpStart®, does not eliminate the need for phosphate fertilizer, but in fact enhances the uptake of phosphorous fertilizer in the year of application which provides crops access to more phosphate for higher yield potential.

- JumpStart® results are greatest in soils with lower levels of available phosphate and high to medium levels of bound/unavailable phosphate.
- JumpStart® works at low soil temperatures when phosphate availability is normally limited.
- In independent research, JumpStart® resulted in a 22% increase in the proportion of root that contained root hairs and a 33% increase in the mean root-hair length in field pea.[2]
- JumpStart® can work in soils within a wide pH range. It is the level of available phosphate, not the pH, that determines the benefit of JumpStart®.

[1] Source: Better Crops Vol. 86 (2002, No. 4), International Plant Nutrition Institute (formerly: Potash and Phosphate Institute).

[2] Source: Penicillium bilaiae inoculation increases root-hair production in field pea. Robert H. Gulden and J. Kevin Vessey. May 17, 2000.

Early Vigour

Cool soils, common under direct seeding or early seeding conditions, mean phosphate is less available to plants. Cool soils are difficult on plants and can limit early-season phosphate availability. This can lead to reduced plant growth and, ultimately, crop yield. Because JumpStart® is active under varying soil temperatures or varying soil conditions, phosphate availability is improved and there when your plant needs it most.

Greater Stress Tolerance

Plants with larger healthy root systems have the ability to better withstand a variety of stresses such as drought and weed pressure. Healthy root systems help plants access moisture and nutrients more efficiently. JumpStart® increases phosphate availability in all areas of the soil that the root explores, not just around the fertilizer band, which helps promote more root growth.

Features & Benefits

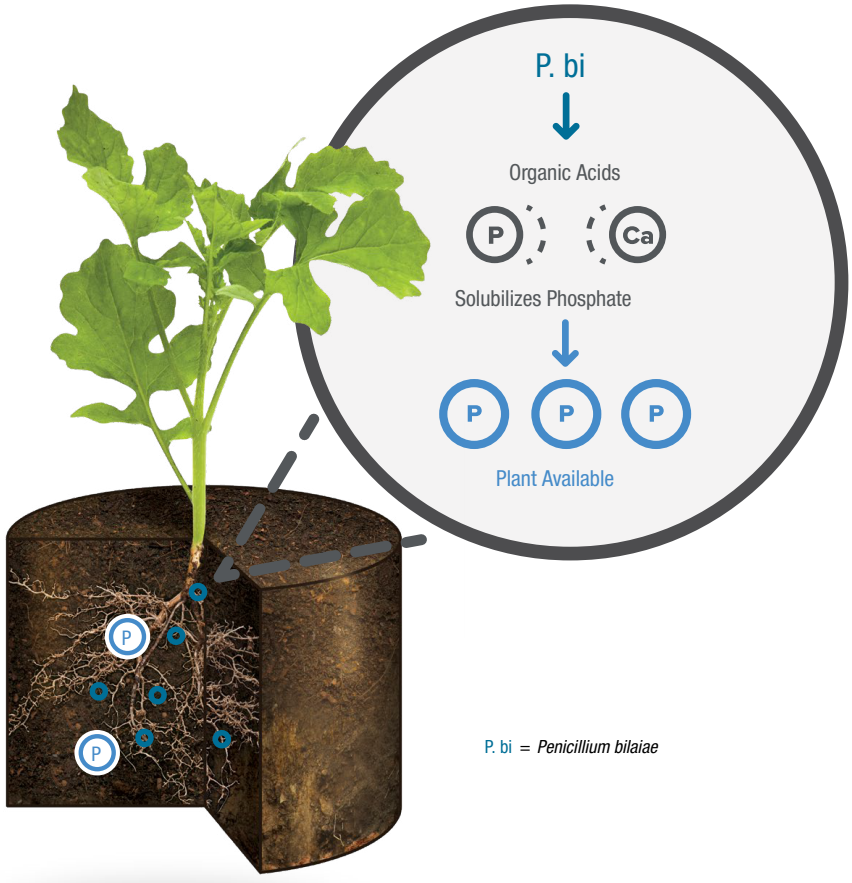
- Improved phosphate availability
- Active in cool soil temps helping to enhance early-season vigour
- Earlier, more uniform maturity

How It Works

Naturally occurring soil fungus to release bound mineral forms of soil and fertilizer phosphate.

Freeing Phosphate

Penicillium bilaiae releases bound mineral forms of soil and fertilizer phosphate, making it more available to the plant to use.



P. bi = *Penicillium bilaiae*

Benefits of JumpStart® on Canola

Phosphate Fertility In Canola

Ensuring phosphate is available to the plant throughout the growing season is important for high-yielding canola crops. Canola seedlings require phosphate to advance from germination through to the three and four leaf stage, as a consequence of their small seed size phosphate content in the seed can only support seedling growth for approximately one week.

Factors Limiting Phosphate Availability In Canola

- Phosphate is relatively immobile in the soil. This means phosphate must be placed within or near the seed row to be available for emerging seedlings.
- Canola is sensitive to seed-placed fertilizer. With good to excellent soil moisture, no more than 20 to 25 pounds of P_2O_5 per acre should be seed-placed.[1]

Increased Availability Of Soil And Fertilizer Phosphate

Enhanced phosphate availability results in increased root growth and increased leaf surface area. As a result, canola inoculated with JumpStart® may flower earlier, have an increased number of pods and pod-bearing branches, and have earlier, more uniform maturity. Ultimately, you can help your canola crop reach its full potential.

More Even Supply Of Phosphate To Improve Crop Uniformity

A healthy uniform canola crop has more potential to withstand weed, insect and disease pressures. Timing of pesticide applications, swathing and crop dry-down are easier to assess with a uniformly developed canola crop.

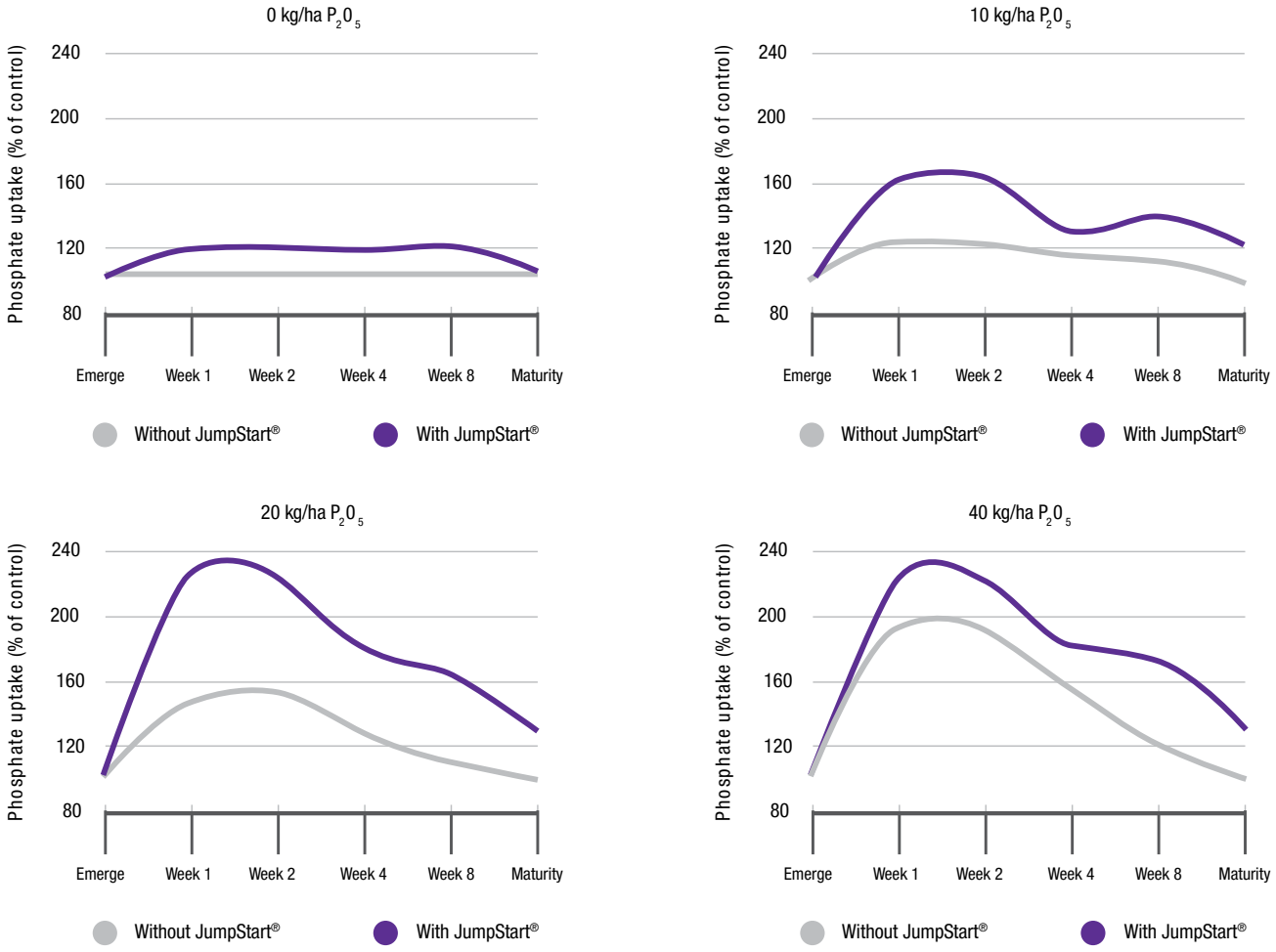
Earlier Access To More Phosphate With Sensitive Seed

Top-yielding canola varieties require significant amounts of nitrogen and phosphate fertilizer to achieve their yield potential. Inoculating canola with JumpStart® will help address phosphate needs with sensitive seed.

1 Source: Guidelines for Safe Rates of Fertilizer Placed with Seed, Saskatchewan Ministry of Agriculture.

JumpStart® increases the availability of phosphate, resulting in increased uptake by the plant

Research data from the University of Manitoba, show the increase in uptake of phosphate throughout the growing season when using JumpStart® on wheat.



Source: J. Chambers and J. Yeoman, MB Soc. of Soil Sci. Mfg on wheat. Six field trials on wheat, 1989-1990, University of Manitoba.

Get The Most From JumpStart®

- **Seeding into cold soils:** JumpStart® is active in cool soil temperatures making soil phosphate available to the plant, helping to enhance early-season vigour.
- **Seed-placed phosphate is applied more than 1.5 inches from the seed:** Phosphate fertilizer is not close enough to the seed for early-stage growth. JumpStart® makes the phosphate in the soil around the seed more available resulting in better, uniform emergence.
- **Maturity concerns:** An adequate early-season supply of phosphate shows up at harvest time as even maturity, and a more uniform seed set. JumpStart® helps ensure phosphate is available to meet early-season needs.

Application

JumpStart® is not crop specific. JumpStart® colonizes (grows along) the root system rather than infecting the root, so you do not have to purchase a specific type of JumpStart® for a specific crop. Please see Table 2 for a list of registered crops and their application rates. Please read the label before application for complete use instructions.

JumpStart® Granular

JumpStart® is available in a granular formulation for canola, barley, flax, mustard, oat, pea, lentil, soybeans, wheat and canary seed. Application rates will vary according to row spacing; please refer to Table 1 for details.

Table 1. JumpStart® Granular Application Rates

PACKAGE SIZE	18 KG (39.64 LB) BAG	
Row spacing	lb/ac	ac/bag
6 in	5.5	7.2
8 in	4.1	9.7
9 in	3.6	11.0
10 in	3.3	12.0
12 in	2.7	14.7

Note: The bulk density of JumpStart® granular is approximately 0.6 g/cm^3 (37 lb/ft^3).

JumpStart® Wettable Powder

JumpStart® is available as a wettable powder that is mixed into water and applied to the seed as a liquid. Once JumpStart® is mixed into the water, apply to the seed within 24 hours.

Water volume rates vary according to the type of seed treated. These water volumes can be adjusted according to your application methods, as long as the correct amount of JumpStart® is applied to the seed. Please see Table 2 for approximate water volume rates.

When tank mixing a seed treatment with JumpStart®, the total liquid volume should equal the water volume listed in the table. Example: if you are using JumpStart® on wheat, the total water volume required is 50 litres. If you are tank mixing with a seed treatment with an application rate of 25 litres per 300 bushels of wheat, then you only need to add another 25 litres of water for a total liquid volume of 50 litres per every 300 bushels of wheat treated.

Apply the JumpStart® suspension to seed when transferring seed from the bin or bag to the truck, or from the truck to the tank or seed cart. Applicators used previously for pesticides should be triple rinsed before being used for JumpStart® application. To improve coverage on small-seeded crops like canola, mustard, alfalfa and sweetclover, we recommend using a batch-treating system or purchasing pre-treated seed where available.

JumpStart® can be applied to bare seed up to 60 days prior to seeding (depending on seed type) and can be used with many different seed treatments. Visit **ag.fmc.com/ca/en/products/biologicals** for the most up-to-date information on seed treatment compatibility.

Table 2. JumpStart® Wettable Powder Application

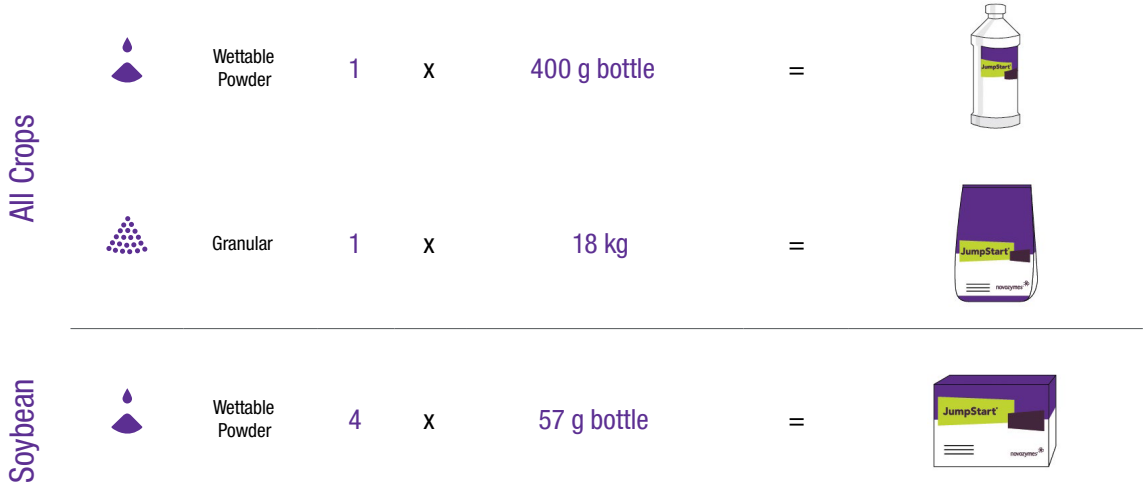
CONTAINER SIZE	400 G CONTAINER		
Crop	Seed treated/container		Water (litres)
	bu	lb	
Alfalfa/sweetclover	–	1,100	10
Canola/mustard	–	1,000	10
Chickpea	400	24,000	30
Corn	70 bags* (5,600,000 kernels)		19.6
Dry bean	300	18,000	25
Lentil	300	18,000	25
Pea	500	30,000	40
Soybean	300	18,000	25
Wheat	300	18,000	50

*80,000 kernels per bag.

Table 3. JumpStart® Wettable Powder Application

57 G (2.0 OZ) CONTAINER		
Crop	Seed treated/container	Approximate water volume
Soybean	50 units (1,135 kg, 2,500 lb, 42 bu)	3.5 litres (3.9 US quarts)

Product Packaging



Optimize® LV

CROPS: SOYBEAN

Product Overview

Expand Your Ability to Grow

Optimize® LV is a concentrated formulation soybean inoculant, with a low application rate of 98 ml/100 kg (1.5 fl oz/100 lb).

Optimize® LV is a retailer-applied dual-action product that delivers the benefits of a specially selected Bradyrhizobium japonicum inoculant along with LCO (lipochitooligosaccharide) technology – helping to improve your crop's potential by enhancing nutrient availability.

With Optimize® LV, the plant does not need to wait for the LCO signal as it is delivered on the seed, potentially reducing the time required for this process to occur naturally and therefore, accelerating nodulation and nitrogen fixation to the young crop.

What Is LCO Technology?

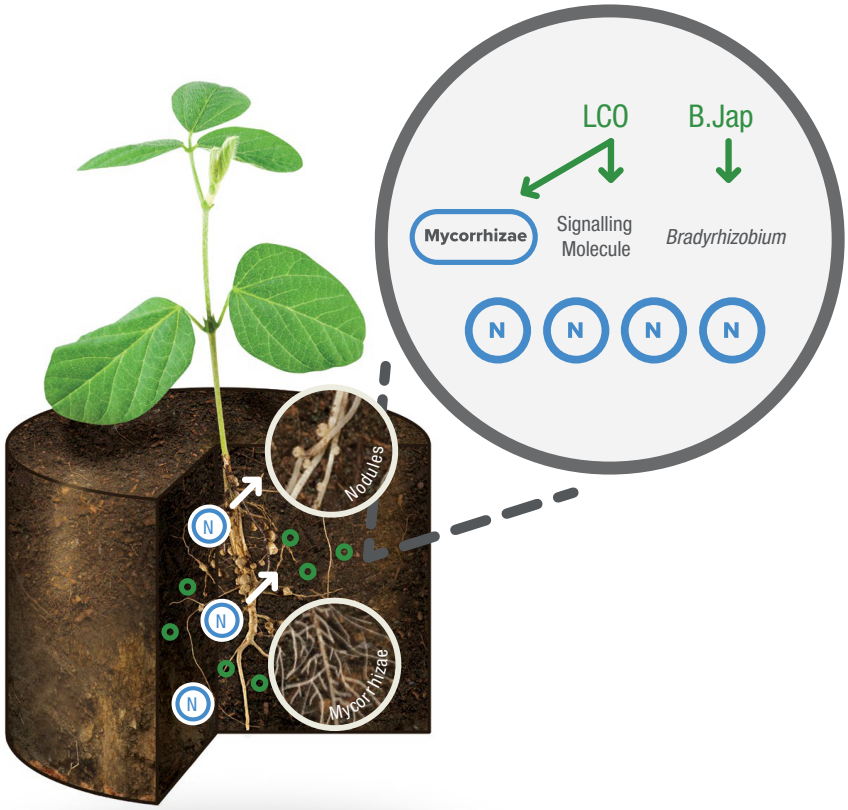
LCO is a signalling molecule involved in the rhizobia legume nodulation process. When the LCO molecule is present at the time of planting, it allows for the nodulation process to begin, independent of variety, soil and environmental conditions. The benefit of earlier nodulation initiation is earlier nitrogen availability to the plant, which supports plant growth such as root and shoot development.

The result of this early-season activity is better plant performance. LCO is an important component in nodulation as a key driver in the communication between plants and rhizobia.

How It Works

Dual-action inoculant to enhance nutrient availability and development of nitrogen-fixing nodules.

1. Needing nitrogen, the plant releases flavonoids to signal rhizobia.
2. Sensing the flavonoids, the rhizobia signal LCO back to the plant.
3. The plant can respond to the LCO, allowing the rhizobia to infect its roots.
4. This symbiotic relationship creates nodules, which can help fix atmospheric nitrogen.



LCO = Lipochitooligosaccharide

- Stress Mitigation
- Enhances Nodulation
- Increases Association with Mycorrhizae

B.Jap = *Bradyrhizobium japonicum*

- Fixes Nitrogen

Double Inoculate Your Soil To Help Maximize Yield Potential

Land that has been through less than ideal growing conditions, or has not had soybeans for a few years, requires special attention when it comes to inoculation. Double inoculation can help quickly establish high populations of rhizobia bacteria to help ensure the best possible nodulation and soybean performance. Land with a history of longer soybean rotations, or land with a history of flooding or drought, is not conducive to rhizobia survival. It is in these soils that farmers will benefit greatly from the application of two formulations of inoculant.

Seed-applied inoculants tend to form nodules closer to where the seed is located (closer to the primary root); in-furrow applied granular inoculants tend to form nodules on the secondary or lateral roots. Combining the two formulations allows for wider distribution of nodules along the whole root system.

For best results, you may apply Optimize® LV with Cell-Tech® or TagTeam®. Consult your local Biologicals by FMC representative or local retailer for a customized inoculant approach.

Application

Optimize® LV is applied to soybean seed by retailers. Please contact your seed retailer to order. Please read the label before application for complete use instructions.

Table 1. Optimize® LV Liquid Application

PACKAGE SIZE AND CONTENTS	AMOUNT OF SEED TREATED /INDIVIDUAL CASE	
2 x 0.686 Optimize® LV liquid, plus 2 x 0.2 L liquid additive	80 units	4,000 lb
6.9 L Optimize® LV liquid, plus 2 L liquid additive	400 units	20,000 lb

Product Packaging

Soybean		Liquid	1	x	6.9 L bag + 2 L jug (liquid additive)	=	
		Liquid	5	x	2 x 0.686 L bags + 2 x 0.2 L jugs (liquid additive)	=	

Cell-Tech®

CROPS: LENTIL | PEA | SOYBEAN

Product Overview

Nitrogen-Fixing Inoculant

Cell-Tech® is a single-action inoculant that contains specially selected rhizobia that can provide effective nodulation to enhance nitrogen-fixation, even in cooler soils – increasing yield potential as planting conditions change.

If phosphate is limited, Cell-Tech® can be applied at the same time as JumpStart®, for improved phosphate uptake.

Cell-Tech® Is Available In The Following Formulations

CROP	INOCULANT SPECIES	CELL-TECH® FORMULATIONS AVAILABLE
Pea, Lentil	*Rhizobium leguminosarum*	Liquid, peat, and granular
Soybean	*Bradyrhizobium japonicum*	Liquid, peat, and granular

Application

Please read the label before application for complete use instructions.

Cell-Tech® Pea/Lentil Liquid

Cell-Tech® liquid should be applied directly to pea or lentil seed at a rate of 2.5 fluid ounces per bushel (60 lb) of seed (75 ml/27 kg) or 2.1 fluid ounces per 50 pounds (63 ml/23 kg). The planting window for Cell-Tech® liquid on bare pea or lentil seed is 48 hours.

Cell-Tech® Soybean Liquid

Cell-Tech® liquid should be applied directly to soybean seed at a rate of 2.5 fluid ounces per bushel (60 lb) of seed (75 ml/27 kg) or 2.1 fluid ounces per 50 pounds (63 ml/23 kg) of seed. The planting window for Cell-Tech® liquid on bare soybean seed is four days.

Cell-Tech® liquid can be applied with other seed treatments, but the planting window may be reduced. Visit **ag.fmc.com/ca/en/products/biologicals** for more details.

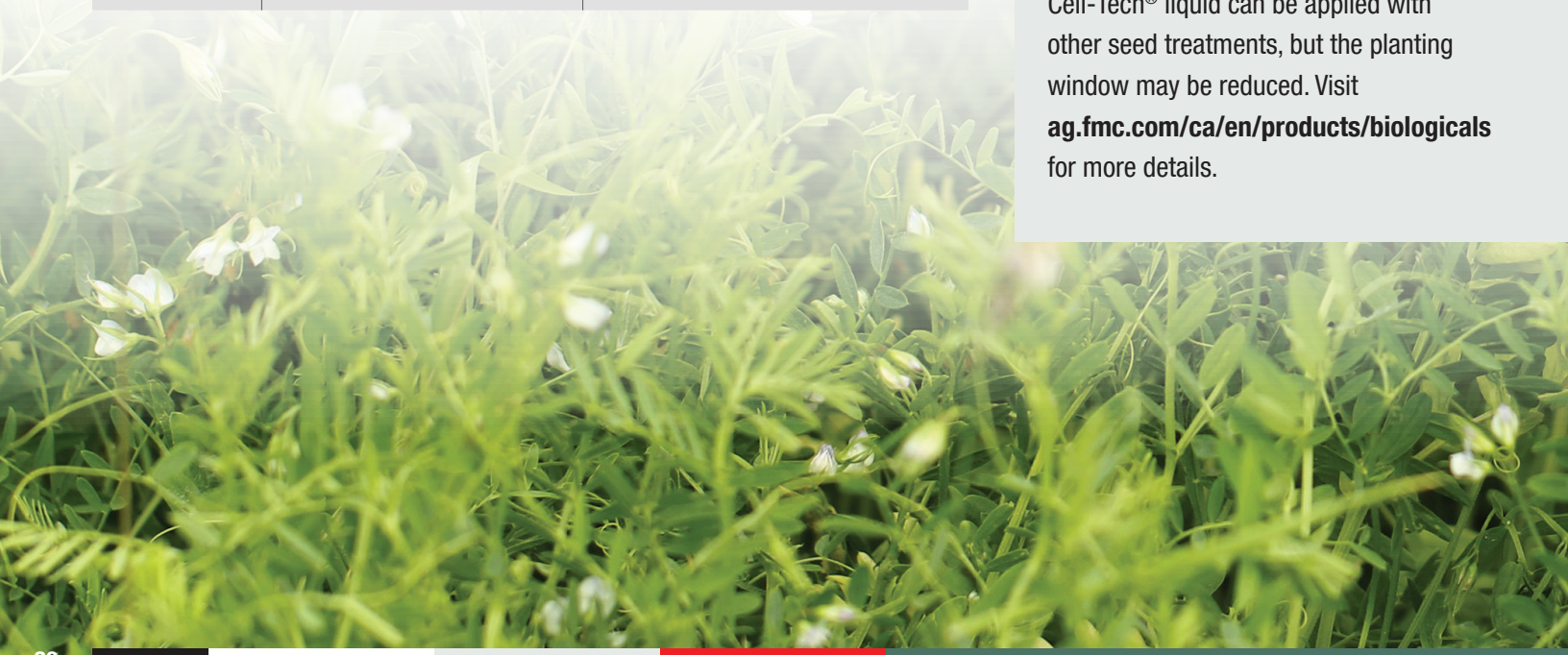


Table 1. Cell-Tech® Liquid Application

CELL-TECH® LIQUID	PACKAGE SIZE	ONE PACKAGE INOCULATES		
Crop	Litres	Units	bu	lb
Pea, lentil	3.0	–	40.0	2,400
	9.8	–	130.0	7,840
Soybean	3.1	50	41.7	2,502
	12.5	200	167.0	10,000

Cell-Tech® Peat

Cell-Tech® peat has its own sticker in the formulation, so no additional stickers are required. Apply Cell-Tech® dry to pre-moistened seed, or add water while applying Cell-Tech®, or mix with cool, clean water and apply to seed as a slurry (refer to Table 2). Make sure that inoculated seed is evenly coated. Inoculate bare seed with Cell-Tech® peat up to 48 hours before seeding.

Table 2. Cell-Tech® Peat Application

CELL-TECH® PEAT	ONE 2.2 KG (4.8 LB) BAG INOCULATES			WATER
Crop	Unit	bu	lb	litres
Pea	–	50	3,000	4.0
Lentil	–	30	1,800	2.5
CELL-TECH® PEAT	**ONE 2.32 KG (5.1 LB) BAG INOCULATES**			**WATER**
Crop	Unit	bu	lb	litres
Soybean	30	25	1,500	N/A

Cell-Tech® and Cell-Tech® NS peat can be used with different seed treatments, but planting windows vary according to type of seed treated and seed treatment used. Visit **ag.fmc.com/ca/en/products/biologicals** for the most up-to-date seed treatment compatibility information.

Cell-Tech® Granular

Cell-Tech® granular should be applied directly with the seed in the seed row using a granular tank for application. Application rates vary according to row spacing (refer to Table 4 below).

- Fill tank to match or slightly exceed seed requirements.
- Do not overfill tank to avoid compaction.
- Pour into tank through a screen.
- If augering, please do so at low speeds to avoid damage to Cell-Tech® granular.
- Do not mix Cell-Tech® granular in the same tank with seed or fertilizer.
- Do not leave Cell-Tech® granular in the tank overnight as condensation can cause lumps to form.

Table 4. Cell-Tech® Granular Application Rates

	CELL-TECH® PEA/LENTIL			CELL-TECH® SOYBEAN		
Package size	Application rate	18.0 kg bag	454 kg bag	Application rate	18.0 kg bag	454 kg bag
Row spacing	lb/ac	ac/bag	ac/bag	lb/ac	ac/bag	ac/bag
7 in	6.6	6.1	151.7	6.2	6.5	161.5
8 in	5.8	6.9	172.6	5.4	7.3	185.4
9 in	5.1	7.8	196.3	4.7	8.4	213.0
10 in	4.6	8.7	217.6	4.3	9.3	232.8
12 in	3.8	10.5	263.4	3.6	11.0	278.1
15 in	3.1	13.3	333.7	2.9	13.8	345.2
24 in	–	–	–	1.8	22.2	556.1
30 in	–	–	–	1.4	28.6	715.0

Note: The bulk density of Cell-Tech® granular is approximately 0.6 g/cm³ (37 lb/ft ³).

Product Packaging

Pea/Lentil	Peat	7	x	2.2 kg bag	=	
	Granular	1	x	18 kg	=	
	Granular	1	x	454 kg	=	
	Liquid	4	x	3 L	=	
	Liquid	1	x	9.8 L	=	
Soybean	Peat	7	x	2.32 kg bag	=	
	Granular	1	x	18 kg	=	
	Granular	1	x	454 kg	=	
	Liquid (East only)	4	x	3.1 L	=	
	Liquid	1	x	12.5 L	=	

Nitragin® Gold

CROPS: ALFALFA | CLOVER | SWEETCLOVER

Product Overview

Nitragin® Gold inoculant was developed for bulk treatment by the seed processor. It is a one-step system that provides a convenient and economical inoculant for your customers.

Nitragin® Gold alfalfa/sweetclover is OMRI Listed for organic use. It does not contain any genetically modified organisms, sludge or waste-derived products.

Note: Nitragin® Gold clover is not OMRI Listed.

Order your alfalfa, sweetclover or clover seed pre-treated with Nitragin® Gold.

OMRI LISTED
For Organic Use

Benefits Of Nitragin® Gold Inoculant

- **Yield:** Specially selected natural rhizobia strains result in high levels of nitrogen fixation for maximum yield potential.
- **Super seed adhesion:** Micron-sized particles provide optimal seed adhesion and minimal "dusting off".
- **Quality assurance:** Drying system assures customers of high rhizobia levels on the seed.
- **Apron® XL /Allegiance® FL compatible:** Compatibility with Nitragin® Gold alfalfa/sweetclover and Apron XL and Allegiance FL seed treatments will allow the combined benefits of an inoculant and a fungicide where required.

Note: Nitragin® Gold clover is not compatible.

Time on seed for alfalfa and sweetclover is 24 months and 6 months on clover. If you need more information or have questions about Nitragin® Gold, visit **ag.fmc.com/ca/en/products/biologicals**.

Product Packaging

Alfalfa/ Sweetcover		Clay Powder	1	x	19 kg	=	
Clover		Clay Powder	1	x	19 kg	=	

BIOLOGICALS
by
FMC

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