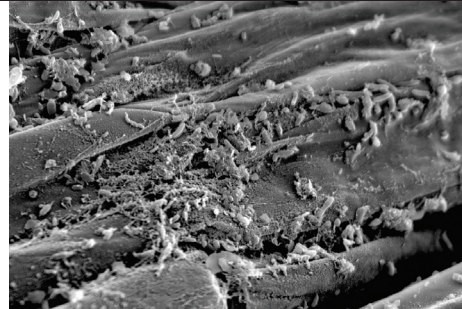


Piran Cargeeg, Technical Development Manager – North America

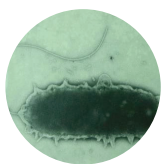


Bacillus subtilis

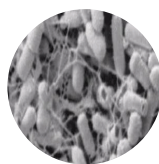


An Introduction to BioStacked[®] Inoculants

A new standard of performance offering consistency and improved nitrogen nutrition for soybean crops is now available. Becker Underwood's new BioStacked inoculants are stacked with more than one beneficial biological working together synergistically with the soybean root system to deliver enhanced performance. BioStacked inoculants contain *Bradyrhizobium japonicum* bacteria that colonize the soybean root system to enhance nitrogen fixation. In addition, the BioStacked inoculants also include a unique and patented micro-organism *Bacillus subtilis*, which acts as a Nodulating Trigger[®] – resulting in greater nodule biomass, faster canopy closure, and ultimately higher yields.



Bradyrhizobium japonicum



Bacillus subtilis

An Overview of *Bacillus subtilis*

Agricultural soils play host to a wide array of micro-organisms. Some of these organisms can inflict harm and disease while others can be beneficial and contribute to enhanced plant growth. One such naturally occurring beneficial organism is *Bacillus subtilis*, which can act both as a Plant Growth Promoting Rhizobacterium (PGPR) as well as exhibit unique biofungicidal activity.

Plant Growth Promoting Properties of *Bacillus subtilis*

The patented *Bacillus subtilis* strain (MBI600) that is formulated into Becker Underwood's BioStacked inoculants is well known in the scientific community for its ability to induce plant growth promoting responses. A complex dynamic is at work as the *Bacillus subtilis* bacteria colonizes the root zone of the host plant. This bacterium forms a "protective sheath" that completely covers the root system. As the *B. subtilis* grows, it produces phytohormones that can enhance plant growth and vigor as well as reduce time to canopy closure.

Nodulating Trigger Technology

Another exciting PGPR benefit that has been demonstrated by *Bacillus subtilis* is that it also enhances nitrogen fixation by rhizobia through the promotion of nodule formation. This leads to increased nodule biomass in soybeans and as such is referred to as the patented Nodulating Trigger technology within the BioStacked family of inoculants.

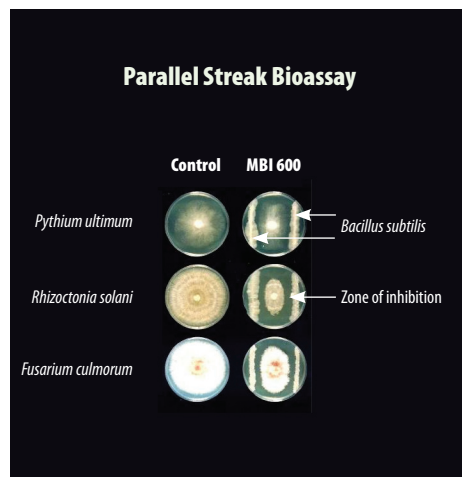
Biological Fungicide Activity of *Bacillus subtilis**

In the United States, the MBI600 strain of *Bacillus subtilis* is an EPA registered biological fungicide. Across a wide array of crops including soybeans, corn, wheat, barley, cotton and alfalfa; *Bacillus subtilis* has the unique ability to suppress the development of common disease organisms found in the soil.

One of the modes of this biofungicidal activity results from the formation of a physical barrier. This protective sheath of cells occupy "competitive space" on the root surface that inhibits harmful organisms from accessing points of infection that would otherwise lead to disease development or other harmful stress. This phenomenon is often referred to as "pathogen displacement".

The biofungicidal activity is further enhanced by direct activity on disease organisms from the secretion of novel antifungal metabolites. This activity has been demonstrated to inhibit soil borne diseases such as *Fusarium*, *Rhizoctonia*, *Alternaria*, and *Aspergillus*, to name but a few.

*Biological fungicide activity is a non-registered label claim in Canada.



Biocontrol Effects

| | |
|-------------------------------------|--|
| Tomato Spot | <i>Pseudomonas syringae</i> |
| <i>Phytophthora cactorium</i> | <i>Botrydiploidia theobromae</i> Pat |
| <i>Aspergillus niger</i> | <i>Fusarium moniliforme</i> |
| <i>Fusarium udum</i> | <i>Panecium sclerotigenum</i> |
| <i>Rhizoctonia solani</i> SX-6 | <i>Rhizoctonia</i> sp. |
| <i>Pythium aphanidermatum</i> ZJP-1 | <i>Botryis cinerea</i> |
| <i>Fusarium oxysporum</i> | few cases of nematocidal and bactericidal properties |

Reported Modes of Action – Biocontrol Properties

- Biofilm production on plant roots, which exhibits antimicrobial properties
 - Secretion of antibiotics (subtilin, subtilosin, bacilysin, surfactin etc.)
 - Pathogen displacement
- No reports of *B. subtilis* conferring disease or damage to the host plant

Source: CIA Safety Assessment of *Bacillus subtilis* (28 March 2007).

HiStick® N/T – The BioStacked Inoculant

Soybean inoculant technology has entered a new era with the availability of BioStacked products. The first of this new technology is now available as HiStick® N/T in both a liquid and a sterile peat formulation. BioStacked inoculants from Becker Underwood are stacked with more than one biological component that includes the patented Nodulating Trigger technology to increase nodule biomass and achieve higher yields.

HISTICK L N/T – THE BIOSTACKED LIQUID INOCULANT



HiStick L N/T is a highly potent liquid inoculant BioStacked with 3 biologicals, including the patented Nodulating Trigger® technology plus 2 rhizobium strains. HiStick L N/T is a convenient and cost effective way to achieve increased

nodule biomass, faster canopy closure, and higher yields. Whether applied on-farm, or custom applied as a pre-inoculant with Liquid Extender, this new liquid inoculant option sets a new standard.

Seed Treatment Compatibility of HiStick L N/T Liquid Inoculant

On-Seed shelf life and planting window after application*

| Seed Treatment | HiStick L N/T | HiStick L N/T with Liquid Extender |
|--------------------------|---------------|------------------------------------|
| None - Applied Alone | 10 days | 30 days |
| With Apron Maxx RTA® | 10 days | 30 days |
| With Cruiser Maxx® Beans | 10 days | 30 days |

* Wet or dry sequential application. These compatibility ratings are accurate as of the time of printing. Please contact your local dealer for the most up to date and current compatibility ratings.

HiStick L N/T Liquid Application and Use Rate

HiStick L N/T is packaged in a convenient 3.2 L twin pack comprised of a 3.1 L bladder of liquid inoculant @ 3 x 10⁹ nitrogen fixing rhizobia per gram, and a 100 mL container of the Nodulating Trigger – *Bacillus subtilis* @ 2.2 x 10¹⁰ per gram. The 100 mL of *Bacillus subtilis* are added to the inoculant bladder and disperses before application. One combined 3.2 L twin pack will treat 1136 Kg of seed (2500 lb. / 50 x 50 lb. units or 140,000 seeds per bag.)

HISTICK N/T – THE BIOSTACKED PEAT INOCULANT



HiStick N/T is a potent peat based BioStacked inoculant with patented Nodulating Trigger® technology. Soybean growers that favor peat formulations can now choose HiStick N/T for increased nodule biomass and higher yields.

Seed Treatment Compatibility of HiStick N/T Peat Inoculant

On-Seed shelf life and planting window after application*

| Seed Treatment | HiStick N/T peat |
|-------------------------|------------------|
| None – Applied Alone | 24 hours |
| With Apron Maxx RTA | 24 hours* |
| With Cruiser Maxx Beans | 24 hours* |

*Wet sequential application. These compatibility ratings are accurate as of the time of printing. Please contact your local dealer for the most up to date and current compatibility ratings.

HiStick N/T Peat Application and Use Rate

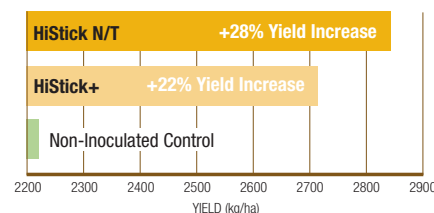
HiStick N/T is an all-in-one BioStacked peat inoculant formulation that contains both the nitrogen fixing rhizobia @ 2 x 10⁹ per gram along with the Nodulating Trigger component @ 1 x 10⁹ per gram. HiStick N/T peat is available in two pack size options: a 400 g or 1.6 Kg pouch and is applied according to the chart below.

Units of Seed Treated

| Application Rate | 400 g pouch | 1.6 Kg pouch |
|------------------|---|---|
| Full Rate | 125 Kg (5.5 x 50 lb./units or 140,000 seeds per bag.) | 500 Kg (22 x 50 lb./units or 140,000 seeds per bag.) |
| Reduced Rate | 250 Kg (11 x 50 lb./units or 140,000 seeds per bag.) | 1000 Kg (44 x 50 lb./units or 140,000 seeds per bag.) |

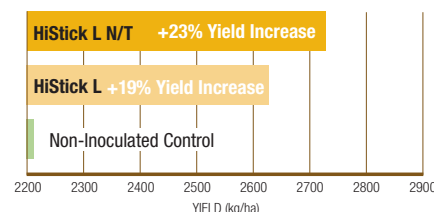
HiStick+ vs HiStick N/T Inoculants for Soybean – 85 Station Years

(Station Years = # of sites X # of Years)



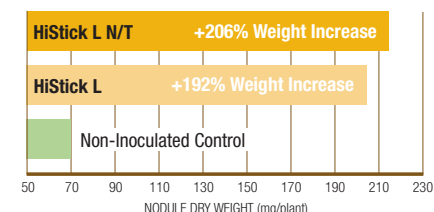
HiStick L vs HiStick N/T Inoculants for Soybean – 72 Station Years

(Station Years = # of sites X # of Years)



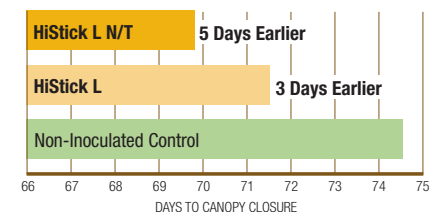
HiStick L vs HiStick L N/T Inoculants for Soybean – 56 Station Years

(Station Years = # of sites X # of Years)



HiStick L vs HiStick L N/T Inoculants for Soybean – 4 Station Years

(Station Years = # of sites X # of Years)



www.histicknt.com

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