

Soybean Biological / Microbial Seed Treatments

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Beginning ten to twelve years ago, inoculant manufacturers initiated several changes that have greatly improved current inoculant products. These include:

- **Improved inoculant carriers.** In place of unsterilized peat carriers, many of today's inoculants use sterile liquid or sterile peat carriers.
- **Increased counts of live bacteria.** Today's high quality inoculants contain over two billion live bacteria per gram of product. This is 10 to 100 times the live bacteria in many former products.
- **Improved rhizobia strains.** Newer strains of rhizobia have been developed that colonize the root more extensively and fix more nitrogen than traditional indigenous strains. Newer inoculants often contain multiple strains of rhizobia.
- **Use of "extenders".** This recent addition has significantly expanded the planting window for on-seed inoculants. Extenders allow the inoculant to be applied to the seed one to four months before planting with minimal loss of rhizobia viability. Extenders/conditioners can also allow the inoculant to be combined with a seed treatment fungicide or insecticide. These improvements have allowed the shift to custom application of inoculants by seed suppliers.

University research has shown a positive yield response to inoculants in a corn-soybean rotation. Some of the most extensive research has been conducted by the Ohio State University. In 64 field trials over the last 11 years, researchers reported an average yield increase of 1.9 bu/acre. North Dakota State University trials from 1999-2005 averaged 2.7 bu/acre more with inoculation. Purdue University and Michigan State University have shown a 1.0 bu/acre increase over a similar time frame. Pioneer researchers wanted to know if any of the newest soybean biological/microbial seed treatments produced similar results.

Research Objectives

The primary objective of this study was to evaluate several new inoculant products that included growth promoters and/or other biological fungicides, alone and in combination with a seed treatment fungicide. A second objective was to evaluate the effect of extending the planting window beyond 30 days after seed application for the Optimize® treatment when combined with a fungicide.



Study Description

Research plots were planted at seven sites in 2008 (Table 1). Plots were planted in 30-inch rows at 160,000 seeds/acre, in a split-plot arrangement of a randomized complete block design. Variety was the main plot and seed treatment was the split plot, and treatments were replicated four times. Four commercial Pioneer® brand varieties were included at each location. Varieties* included Pioneer 92M21, 92Y30, 92M32, and 92M40 at the Group II locations, and Pioneer 93M11, 93M42, 93M43, and 93M61 at the Group III locations. The cropping system was a corn-soybean rotation with conventional tillage at each location.

Table 1. Locations and planting dates in 2008.

Location	Planting Date	Maturity Group
Mankato, MN	April 30	Group II
Dysart, IA	May 15	Group II
Princeton, IL	April 24	Group II
York, NE	May 1	Group III
Alleman, IA	May 7	Group III
Champaign, IL	May 1	Group III
Windfall, IN	May 5	Group III

Seven seed treatments and an untreated check were evaluated (Table 2).

Table 2. Seed treatments, rates, and treatment codes for the eight treatments in 2008.

Treatment Code*	Treatment Name	Product Rates/cwt
FSTCHK	ApronMaxx®	ApronMaxx RFC @ 1.5 oz
AMEXQR	ApronMaxx + ExcalibreQR™	ApronMaxx RFC @ 1.5 oz + ExcalibreQR @ 0.40oz + extender @ 1.0 oz
EXCAQR	ExcalibreQR	ExcalibreQR @ 0.40 oz + extender @ 1.0 oz
VAULT	Vault® LVL	Vault LVL @ 2.6 oz + Integral® @ 0.14 oz + conditioner @ 0.40 oz
OPTM30	ApronMaxx + Optimize®	ApronMaxx RFC @ 1.5 oz Optimize @ 4.25 oz within 30 days planting
OPT120	ApronMaxx + Optimize	ApronMaxx RFC @ 1.5 oz Optimize @ 4.25 oz within 120 days planting
TMAXZ	TerraMax™ Z	TerraMax Z @ 4.25 oz
CHECK	Check	Untreated Check

* Treatment codes used in graphs.

ApronMaxx RFC (Syngenta) is a seed treatment fungicide containing fludioxonil and mefenoxam that was developed for lower rhizobia toxicity. This treatment was included as a fungicide check.

ExcalibreQR (Advanced Biological Marketing) is an encapsulated inoculant that contains three strains of *Bradyrhizobium japonicum*, an extender that increases the on-seed planting window to 120 days, and QuickRoots™ soil inoculant. QuickRoots is a biological seed treatment containing two common bacterium, *Bacillus subtilis* and *Trichoderma virens* to promote root growth. Seed for the AMEXQR and the EXCAQR treatments were treated on April 11.

Vault LVL (Becker Underwood) is a multi-strain liquid inoculant combined with Integral™ biological fungicide and an extender to extend the life of rhizobia on the seed up to 35 days. Integral is a registered biological fungicide containing a common bacterium, *Bacillus subtilis*, to suppress fusarium and rhizoctonia infections. VAULT seed was treated on April 15.

Optimize (EMD Crop Bioscience) is lipo-oligosaccharide (LCO) in a Cell-Tech® liquid inoculant carrier. Cell-Tech inoculant contains dual strains of rhizobia. Optimize is commonly referred to as a growth promoter or an LCO technology treatment. Nitrogen fixation occurring in soybean

nodules is a temperature dependent process. According to the manufacturer, this promoter technology accelerates and enhances nodulation and early season growth and vigor, making these processes less temperature dependent. The OPTM30 treatment represented seed that was planted within 30 days of treatment. The OPTM30 seed was treated on April 15th. OPT120 seed was treated on March 5th. In 2007, EMD extended the planting window for Optimize to 120 days. The purpose of these two treatments was to determine if extending the planting window beyond 30 days impacted yield compared to a 30-day treatment.

TerraMAX Z (TerraMax) is a liquid inoculant containing two strains of rhizobia and two strains of *azospirillum* bacteria. *Azospirillum* has been reported to fix atmospheric nitrogen, but does not form nodules. It has also been reported to increase amylase activity during germination, thus enhancing seedling vigor. TMAXZ seed was treated on April 15.

Applied Questions

Do these new inoculant products increase soybean yield?

All treatments except TerraMax Z showed a small, but statistically significant increase in yield (Figure 1). These yield increases ranged from 1.0 to 1.9 bu/acre when the yield data were combined over all seven locations. However, only the EXCAQR, VAULT, and TMAXZ treatments did not include a fungicide. The other biological products contained ApronMaxx; therefore, some of the yield increase may have been due to the fungicide. Three of the seven individual locations showed a significant yield response to one or more of the treatments and an additional three locations showed trends to higher yields with one or more of the inoculant products. Only the Mankato location showed no yield responses.

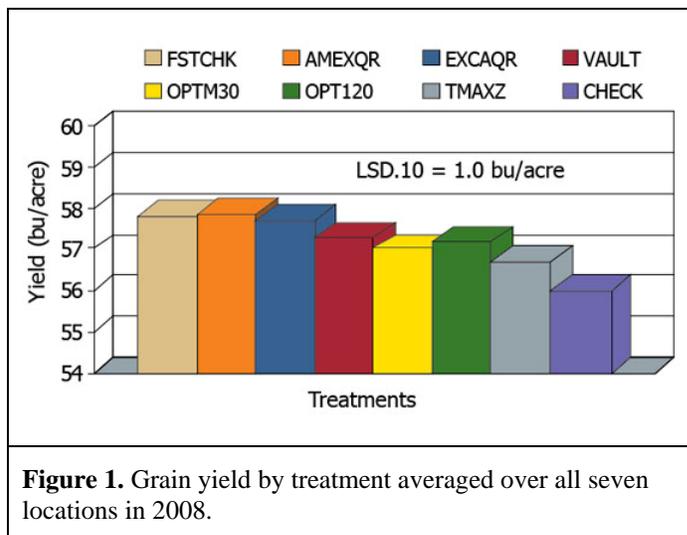


Figure 1. Grain yield by treatment averaged over all seven locations in 2008.

Was there a difference in yield between the two Optimize® treatments?

There was not a significant yield difference between the two treatments, which averaged 57.0 and 57.2 bu/acre for OPTM30 and OPT120, respectively (Figure 1). The planting window in this study varied from 50-70 days after treatment for OPT120 and 9-30 days for OPTM30. According to EMD, Optimize can be applied with most seed treatments (such as ApronMaxx®) up to 120 days before planting with no negative impact on the viability of the rhizobia.

* All soybean varieties used in the study were Pioneer varieties with the Roundup Ready® trait.

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® Cell-Tech and Optimize are registered trademarks of EMD Crop BioScience, Inc.

® Integral and Vault are registered trademarks of Becker Underwood Limited. *Bacillus subtilis*, MBI 600 strain is a product of Becker Underwood, Inc.

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™ QuickRoots is a trademark of TJ Technologies, Inc.

™ TerraMax Liquid is a trademark of TerraMax, Inc.

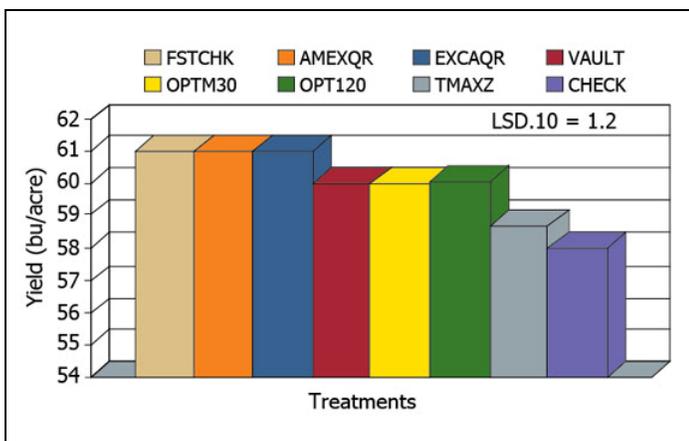


Figure 2. Grain yield by treatment averaged over the four Group III locations in 2008.

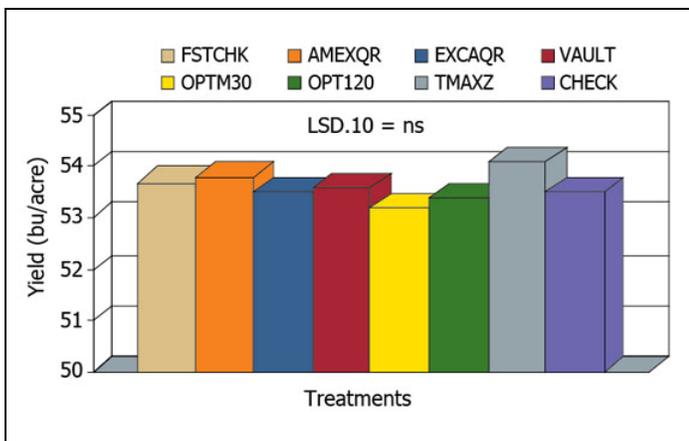


Figure 3. Grain yield by treatment averaged over the three Group II locations in 2008.