



Soybean Inoculant and Seed Treatment Interactions

Introduction

Soybean seed treatments provide protection against various seedling pests and diseases. Potential interactions of seed treatment formulations with seed applied *B. japonicum* bacterial inoculants are of interest. Fields that have not had soybeans present in several years or that have never had soybeans present may have little to no naturalized *B. japonicum* present in the soil. The survival of seed-applied bacterial inoculants is critical in these situations for achieving adequate nodulation and nitrogen fixation.

Objectives

- Investigate the interactions of seed treatment formulations with soybean bacterial inoculants.
- Improve consistency of soybean production on "new" soybean ground by addressing nodulation problems observed in recent years in Kansas.

Material and Methods

Seven field experiments were conducted at five locations in 2011 and 2012. Four of the experiments were on sites that had soybeans present in recent rotation (Table 1).

Locations:

- Belleville, no soybeans ~15 yrs in 2011, ~7 yrs in 2012
- Manhattan, soybeans in regular rotation
- Phillipsburg, no soybean history
- Scandia – irrigated, soybeans in regular rotation
- White City, no soybeans ~40 years

Seed Treatments:

- Untreated
- ApronMaxx[®] RFC[™]
- ApronMaxx[®] RFC[™] Cruiser[™]
- ApronMaxx[®] RFC[™] Cruiser[™] Avicta[®]
- ApronMaxx[®] RFC[™] Poncho[®] /VOTIVO[®]

Inoculant:

- Untreated
- Advanced Biological Marketing ExcalibreSA[™]
- Becker Underwood Vault[®] HP
- Novozymes Optimize[®]
- TerraMax Maximize

Experimental Set-up:

- Randomized complete block design, four replications
- Seed treatments and inoculants in factorial structure
- Individual plots 4 rows by 30 feet long

Table 1. Management Information.

Location:	Belleville		Manhattan		Phillipsburg	Scandia	White City
Year:	2011	2012	2011	2012	2012	2011	2011
Planting Date:	6/13	5/17	6/7	5/22	5/16	6/13	6/11
Variety:	KS3406RR		OHLDE 0-451		KS3406RR	KS3406RR	KS3406RR
Seeding Rate (sds/A):	140,000	150,000	140,000	150,000	150,000	140,000	140,000
Stand Count Date:	6/28	6/20	6/20	6/18	6/6	6/28	6/27
Nodule Sampling Date:	7/18	7/3	6/27	7/11	8/6	N/A	7/13
Harvest Date:	10/5	N/A	10/21	N/A	10/2	10/18	10/7

Material and Methods

Nodule development was analyzed at all locations with the exception of Scandia. Nodule analysis was limited to all seed treatment formulations in combination with Optimize.

Nodulation Analysis:

- 10 plants dug per plot
- Nodule count per plant
- Nodule dry mass
- Visual rating on a 0 to 5 scale (0 = no nodulation, 5 = several, large nodules at taproot)



Figure 1. Root Washer.

Plant Analysis:

- Plant top and root dry mass at V4
- Yield

Statistical Analysis:

- Analysis of variance conducted using PROC MIXED in SAS 9.2 ($\alpha = 0.05$)

Results and Discussion

Nodulation Performance:

- Seed treatments had no effect on nodule count (Figure 2), dry mass (Figure 3), or ratings (Figure 4) ($\alpha = 0.05$) at **Belleville, Manhattan, or White City**.
- At **Phillipsburg**, nodulation was improved (nodules per plant, Figure 2; nodule dry mass, Figure 3) with ApronMaxx[®] RFC[™] Cruiser[™] compared to the other seed treatments. Nodule ratings for the ApronMaxx[®] RFC[™] Cruiser[™] seed treatment were greater than the two treatments containing nematicides but not compared to the untreated check or fungicide only (Figure 4).
- Average number of nodules per plant at **Belleville** and **Manhattan** (Figure 2) was similar even though Belleville had no soybeans for more than 7 years and Manhattan had been rotated to soybeans every third year.
- All treatments had far fewer nodules per plant at **Phillipsburg** and **White City**, where soybeans had not been present for 40 years or more, compared to the other locations.

Plant Dry Mass:

- Seed treatments did not affect top or root dry mass at V4 in any experiment (data not shown).

Yield 2011 (data not shown):

- At **Belleville**, yield differed between some seed treatment – inoculant combinations, but none were different than the raw seed check with no inoculants or seed treatments ($\alpha = 0.05$).
- At **Manhattan** and **Scandia**, yield was not significantly impacted by seed treatment and inoculant combinations.

Discussion:

- Seed treatments used in this study had no significant negative effects on the survival and effectiveness of bacterial inoculant when in direct contact on the seed.
- Nodulation performance varied across sites only due to cropping history and location characteristics.

Results and Discussion

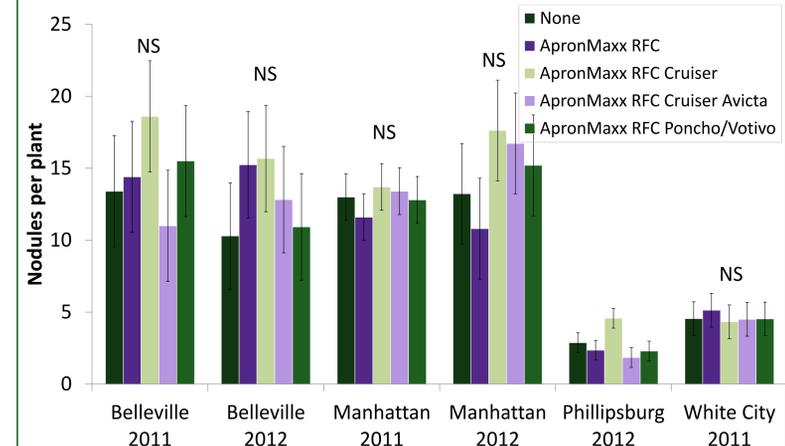


Figure 2. Average Number of Nodules Per Plant on Soybean with Differing Seed Treatments and Optimize[®] Inoculant.

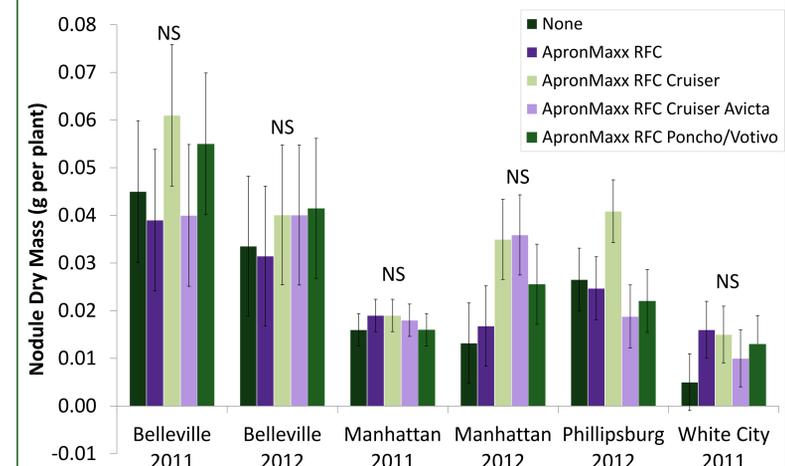


Figure 3. Average Nodule Dry Mass Per Plant on Soybean with Differing Seed Treatments and Optimize[®] Inoculant.

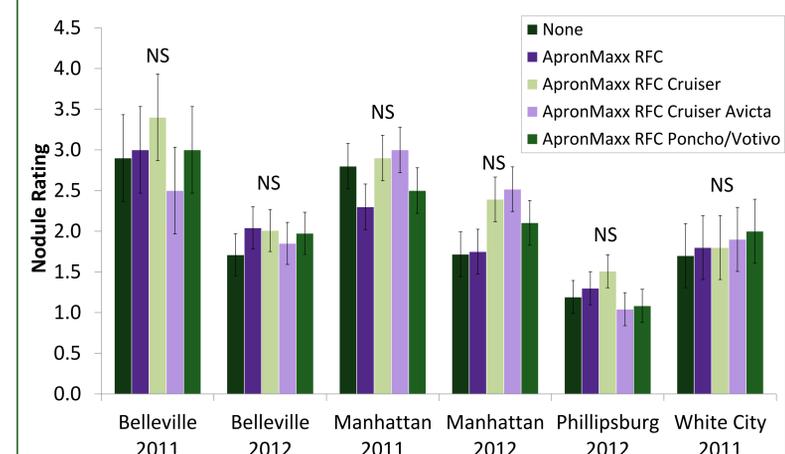


Figure 4. Average Nodule Rating on Soybean with Differing Seed Treatments and Optimize[®] Inoculant.

Conclusions

- Seed treatment formulations did not significantly affect soybean nodulation or yield.
- These results imply that seed treatments are not associated with problems that have been observed on "new" soybean ground with no naturalized *Bradyrhizobium japonicum* populations.

Acknowledgements

This work was supported by the Kansas Soybean Commission. Additional thanks goes to field cooperators - Doug Shoup, Randall Nelson, Phillip Goodyear, Matt Van Allen, and Tony Imm and fellow graduate students - Josh Jennings and Bryson Haverkamp.