Success of Commercial Arbuscular Mycorrhizal Fungi Inoculum In Colonizing Cotton Roots

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ABSTRACT

Agricultural producers are increasingly interested in commercial application of plant growth promoting microorganisms to increase water savings and plant productivity. Successful use of these products could be especially beneficial in semi-arid environments that are subjected to extreme temperatures drought, often in nutrient-depleted soils. Application of commercial inoculum products in field settings has had mixed results on plant productivity, potentially due to harsh environmental conditions or other barriers to successful colonization of added microbes in crop plants. The objective of this study was to evaluate the colonization success of inoculated arbuscular mycorrhizal fungi (AMF) from commercial products added to cotton seeds in a semi-arid field production system. We quantified colonization rates of arbuscular mycorrhizal fungi via staining and microscopy in cotton roots excavated from field plots. We tested three commercial seed treatments from different companies that contained either a mix of beneficial bacteria, AMF, or bacteria and AMF, as compared to fertilized or unfertilized cotton plots with no inoculum treatment. Results from this study will help determine whether inoculums containing AMF are able to successfully colonize field cotton roots. This reveals whether colonization success is a factor that potentially limits the efficacy of these products in the field, and how this may be regulated by the combinations of applied bacteria and fungi and fertility management.

INTRODUCTION

- Beneficial soil microorganisms may be used as inoculums to promote plant growth and quality while improving soil health (Souza et al., 2015).
- Commercial products (biofertilizers) developed and marketed to producers to enhance soil microbial communities, plant yield.
- Low nutrient availability, harsh environmental conditions can challenge inoculum success in the field (Pereg and McMillan, 2015).
- Do inoculated plant root symbionts such as arbuscular mycorrhizal fungi (AMF) in semi-arid cotton field systems colonize plant roots and persist?

Objective: Quantify how seed-application of arbuscular mycorrhizal fungi (AMF) and bacteria influence cotton root AMF colonization.

METHODS & RESULTS

METHODS:

- Field plots at TTU New Deal Research Farm, Lubbock, TX.

Commercial treatments applied to cotton seeds:
1. **Bacteria** (blend of *Bacillus* spp.)
2. **Fungi** (arbuscular mycorrhizal fungi - AMF)
3. **Bacteria + Fungi** (blend of bacteria & AMF)

- Control plots with no inoculum and either:

1. 60 lb N applied at planting (Control, fertilized), or
2. No fertilizer (Control, unfertilized)

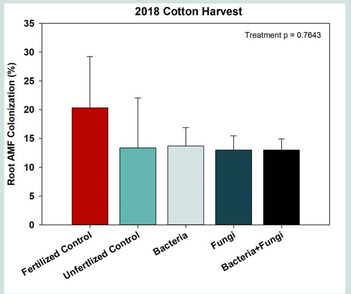


Figure 1: Cotton lint yield (lb/ac) harvested in 2018. Bar values are means (± 1 standard error).

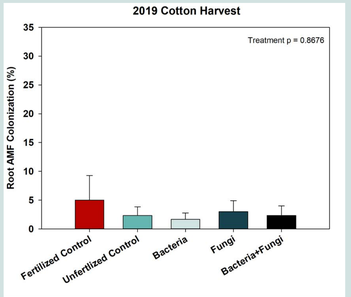
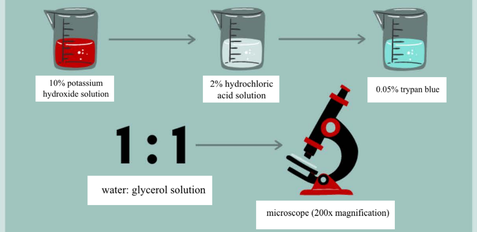


Figure 2: Cotton lint yield (lb/ac) harvested in 2019. Bar values are means (± 1 standard error).

METHODS:

Root samples collected from field
1. After cotton emergence (~15 days after planting)
2. At cotton harvest

- Root samples placed in tissue biopsy cassettes cleared with KOH, acidified with HCl, stained with trypan blue.



Root AMF colonization (%) estimated via microscopy, gridline-intersect method. (McGonigle et al., 1990)

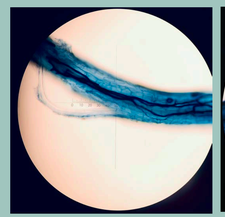


Figure 3: Slide with AMF hyphae.

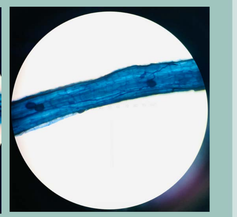


Figure 4: Slide with AMF hyphae and vesicles.

Scored the root segments with intersections a total of 50 times.

DISCUSSION

No effect of inoculated AMF and/or bacteria on root AMF colonization at cotton harvest.

- Much lower AMF colonization after plant senescence, defoliation.
- Unknown whether AMF present in roots was applied or indigenous.
- AMF not inhibited by fertilization.

CONCLUSION

Commercial inoculants tested do not increase colonization or presence of beneficial AMF in semi-arid cotton systems

Future work
- Measure AMF colonization in early-season roots during cotton establishment.
- Assess root colonization during third year of study.

LITERATURE CITED:

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ACKNOWLEDGEMENTS:

Funding for this project was provided by a grant from the Texas State Support Committee, Cotton Incorporated to L. Slaughter (#18-085TX). We greatly appreciate Irish Pabuayon for help with seed preparation, planting, and cotton harvest. We also thank Billi Jean Petermann and Hannah Decker for help with field plot maintenance and sample collection.

Cotton Incorporated
Texas State Support Committee

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