Paul C. And Edna H. Warner Endowment Fund for Sustainable Agriculture
2015 Progress Report Form

Project: Farmer-centered Evaluation of OMRI-approved Microbe-containing Products

Investigators: Julie Laudick, Zheng Wang, Matt Kleinhenz

Summary:

We set out to: 1) evaluate specific microbe-containing biofertilizers (MCBFs) advertised to enhance crop growth, at the OARDC and in cooperation with Ohio organic vegetable growers, and 2) to help prepare growers to complete reliable evaluations in the future. So far, our experimental results suggest: a) that the concentration but not necessarily the purity of MCBFs is as advertised, and b) that these MCBFs can have measurable effects on crops. However, these effects are influenced by application rate, timing, soil amendments, and other factors. We also observe that farmers demonstrate high levels of interest in MCBFs and in evaluating them effectively.

What was done?

We selected six commercially available, OMRI-/OEFFA-listed MCBFs based on their compositions, mode of application, and popularities among Ohio growers. The products were tested in the lab for their purity and concentration (CFU; colony-forming unit) prior to their use in five experiments (see table below). Data collection for Experiments 4 and 5 is still in progress.

Experiment	Timeline; Location; Setting	Crop(s)	What we want(ed) to Learn
1	spring-fall; 4 MCBFs, 4 OH organic farms; open field and high tunnel	pepper; tomato	Do single and multi-organism inoculants have similar effects?
2	spring-fall; 4 MCBFs, 1 conventional NPK fertilizer, OARDC; open field	tomato	Using the same MCBFs as in Expt. 1, we asked how their effects compared to those of a NPK fertilizer.
3	summer-fall; 4 MCBFs, 1 OH organic farm; open field	broccoli	Using MCBFs used in Expts. 1 and 2 and others, we asked if their effects hinged on whether organic NPK fertilizers were also used.
4	fall-early winter; 2 MCBFs, OARDC; high tunnel	spinach	Using two MCBFs from Expt. 3, we asked if their survival and efficacy of MCBFs are influenced by organic N fertilizers.
5	winter; 1 MCBF, OARDC; mid tunnel	lettuce	The effects of application frequency on survival and efficacy of MCBFs.

Plant growth and development, including the transition from vegetative to fruiting stage, where applicable, were tracked with destructive and non-destructive measures. Total and marketable yield and specific aspects of crop quality, including Brix, were also recorded. When possible and essential (especially in Experiments 4 and 5), rhizospheric soil microbial populations were also quantified.

What were the results?

The CFU of each product was at or above the advertised level. However, two of the three products advertised as single-species inoculants were not pure cultures.

Experiments 1 and 2 revealed that several products can increase plant size and stimulate early fruiting and flowering; however, none of the MCBFs consistently increased yield.

In Experiment 3, broccoli yield was lowest in control plots (no MCBF or fertilizer) and similar in plots receiving a MCBF and/or a fertilizer. Inoculation and fertilization did not have additive effects.

In Experiment 4, inoculation significantly increased microbial abundance on the surface of roots in unfertilized plots, but not in fertilized plots. Both fertilizers and inoculants showed a small (5-6%), but not significant, increase in yield 1 month after planting, but no differences were observed 2 months after planting. Crop quality data will be collected in January-2016.

In Experiment 5, each MCBF was applied at three-times the manufacturer-recommended rate (for reasons that will be described later). Plots received one, two, or four applications. Soil microbial abundance was greater in inoculated plots and seedling leaf biomass was greater in plots receiving a least two MCBF inoculations.

Overall, our preliminary results suggest: 1) that certain MCBFs may stimulate plant growth and accelerate the development of reproductive structures (flowering and fruiting), but not necessarily enhance yield, 2) that MCBFs may be less effective when used at the same times as other fertilizers, and 3) higher than recommended rates applied more than once may be required to increase marketable yield, especially in winter.

How have the results contributed or will they contribute sustainable agriculture?

Early in 2015, we noted that 160 MCBFs offered by sixty-nine companies were available to organic growers. While this diversity could be an asset, it is currently a liability since there are no research-based, publicly available data describing the efficacy of MCBFs or and returns on investment from their use. That has not stopped organic growers from using MCBFs. One examination of certification records revealed that approximately 51% of Ohio organic vegetable farmers used biofertilizers between 2009 and 2014. While some MCBFs are inexpensive, many are very expensive. We set out to develop baseline estimates of the efficacy of six popular MCBFs under a range of production conditions common in Ohio and elsewhere. Our process involved growers, their farms, research stations, and the collection of numerous types of data (microbial, crop, and soil). Through the many ways we engage growers in evaluating products and sharing experimental outcomes, we are beginning to establish important farmer-farmer, farmer-researcher, and farmer-researcher-industry dialogue regarding MBCFs. Continuing this effort may facilitate positive changes in, e.g., MCBF labeling, systematic testing, and grower selection and use. Ultimately, growers would be more likely to experience significant returns on their investments in MCBFs. More effective use of MCBF may lower the need for or enhance the effectiveness of other inputs.