Special Research Report #535 Production Technology: Identifying Beneficial Bacteria from the Rhizosphere of Floriculture Plants That Can Enhance Production and Post-Production Quality

Part 1: Creation of the Greenhouse Rhizospheric Bacteria Collection

Nathan P. Nordstedt[1], Kaylee A. South[1], and Michelle L. Jones[1]
[1] Department of Horticulture and Crop Science, Ohio Agricultural Research and Development Center, The Ohio State University, Wooster, OH

BACKGROUND

Greenhouse ornamental crops can be subjected to extreme environmental conditions throughout their production chain, which can result in exposure to unwanted stresses. Low-nutrient stress can occur throughout the production chain as a result of insufficient fertilizer rates or lack of nutrient availability to crops even when adequate fertilizer rates are applied. Low-nutrient stress can result in stunted plant growth, increased production time, or low-quality plant appearance. In addition, water deficit stress can occur post-harvest and can increase the production of stress ethylene and permanently affect overall plant health and quality. The negative effects of water and low-nutrient stress can impact ornamental crop quality, increasing shrink for producers and retailers, while decreasing consumer success in the landscape.

The use of microbe-containing biostimulant products has gained popularity in the horticulture industry as a sustainable solution to increase the tolerance and resiliency of plants subjected to stresses. However, many biostimulants currently labeled for use on greenhouse ornamentals are formulated with bacteria originating from agronomic crops, field soils, and other environments. The lack of efficacy of biostimulant products in greenhouse production may be due to the source of inoculum not being able to colonize and grow in soilless media production with high chemical inputs. In addition, there is still a lack of third-party trials that validate these commercial products for their use in ornamentals.

The goals of this study were to create a collection of bacteria isolated from the rhizosphere of greenhouse-produced plants (part one) and identify strains with the ability to increase the health and quality of ornamental crops subjected to water deficit stress or grown under low-nutrient conditions (part two).

Rhizosphere: Dynamic environment surrounding the plant root system that is directly influenced by compounds secreted from the plant and plays host to diverse microbial communities.

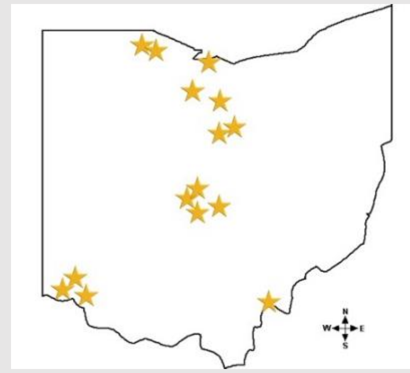

Fig. 1: Greenhouse locations where plants were collected for the greenhouse rhizospheric bacteria collection.

MATERIALS & METHODS

We were interested in isolating bacteria from cultural conditions that were representative of various greenhouse production systems. To capture the diversity of cultural inputs in greenhouse production systems, plants at the final marketable stage were collected from 15 different greenhouse facilities across Ohio and West Virginia **(Fig. 1)**. Coleus, geranium, petunia, vinca, and zinnia plants were brought to our research greenhouses **(Fig. 2)** and subjected to three cycles of controlled water stress by withholding irrigation until plants were completely wilted and then rewatered for recovery **(Fig. 3)**. The objective of the controlled water stress was to alter the media environment, selecting for microorganisms in the plant rhizosphere that can survive the onset of severe water stress.

Fig. 2: Plants collected from 15 greenhouse facilities were brought to our research greenhouses for collection of rhizosphere bacteria.

Following the third cycle of water stress, bacteria were collected by rinsing root samples in sterile water **(Fig. 4).** Water samples were then inoculated onto plates with bacteria growing media and incubated to allow for diverse microbial growth **(Fig 5)**. From these plates, bacteria with unique color, morphology, or growth rate were isolated into pure cultures and catalogued for the collection **(Fig. 5)**.

After the greenhouse rhizospheric bacteria collection was established, the entire collection was screened through two in-lab experiments. These experiments selected bacteria that were able to withstand osmotic stress and produce an enzyme, ACC deaminase, known to reduce levels of stress ethylene in plants.

Fig. 3: Plants were subjected to three cycles of severe water stress prior to isolation of rhizosphere bacteria.

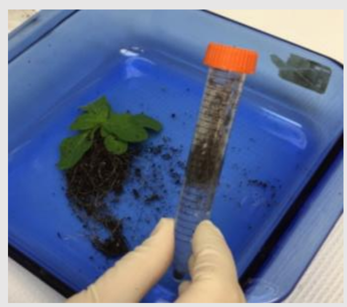

Fig. 4: Root samples were collected from the different greenhouse crops and rinsed in sterile water to collect rhizosphere bacteria.

RESULTS

- In total, 314 plants were collected from 15 different greenhouse facilities across Ohio and West Virginia.
- A total of 1,056 individual cultures were isolated from the rhizosphere of these plants, which are now referred to as the greenhouse rhizospheric bacteria collection.
- The in-lab experiments identified 35 bacteria with the ability to withstand osmotic stress and 59 bacteria able to produce the enzyme ACC deaminase.

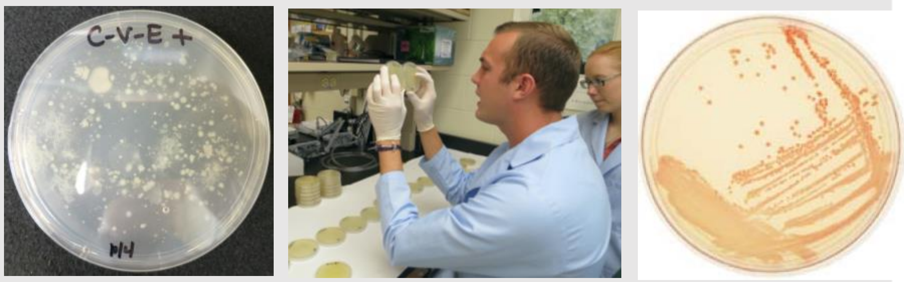

Fig. 5: Plates with microbial growth from the root washes (left) were observed after incubation (center) and microbial colonies that appeared unique were transferred to a new plate and isolated into a pure culture for future experiments (right).

CONCLUSIONS

This study has isolated a diverse collection of bacteria from the rhizosphere of greenhouse-produced ornamental crops. These bacteria were then evaluated in two in-lab experiments to select potentially beneficial bacteria that can be evaluated in greenhouse production systems to evaluate their ability to increase plant growth and stress tolerance. Bacteria selected from these in-lab experiments were then evaluated in water stress and low-nutrient greenhouse trials (see Special Report #535, Part 2).

INDUSTRY IMPACT

This research begins to identify bacteria that can be utilized by industry partners to formulate biostimulant products specifically for the greenhouse ornamental industry. Implementation of effective biostimulant products in greenhouse production can lead to increased sustainability while decreasing crop loss due to abiotic factors that reduce marketability. For additional information, contact jones.1968@osu.edu