Research Update: Plant growth promoting bacteria used to control gray mold

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Plant growth promoting bacteria as biocontrol agents

Microorganisms, including bacteria and fungi, play an important role in plant growth and overall health. These microorganisms can be pathogens that cause disease, they can have no effect on the plant, or some can even be beneficial. Plant growth promoting bacteria (PGPB) can benefit plants by improving nutrient availability and plant uptake or increasing tolerance to diseases and environmental stresses. Some PGPB can be used as biocontrol agents for the control of plant diseases such as gray mold, which is caused by the pathogenic fungus *Botrytis cinerea*. We have previously identified several PGPB that can reduce disease symptoms caused by *Botrytis* in petunias (South et al., 2020a). *Botrytis* infects many different crops and can result in large postharvest losses of cut flowers. PGPB are a promising control method for *Botrytis* in cut flowers (Figure 1).

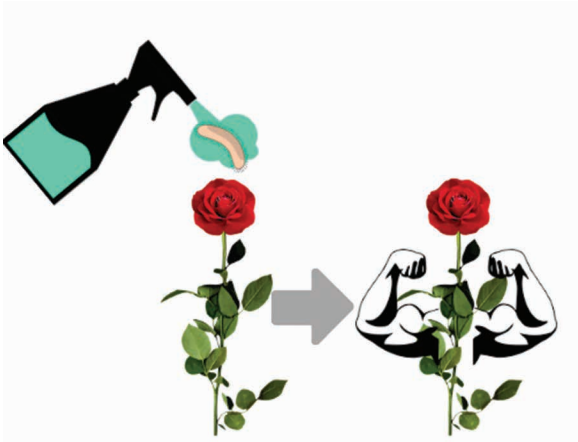

Figure 1. Plant growth promoting bacteria (PGPB) are being evaluated for the biocontrol of fungal pathogens in cut flowers.

Background and Objective

Previously, four beneficial strains of *Pseudomonas* were evaluated for the biocontrol of *Botrytis* in lisianthus (*Eustoma grandiflorum*) cut flowers. Application of *Pseudomonas chlororaphis* 14B11 resulted in reduced disease severity compared to the untreated flowers (South et al., 2020b). The objective of the current study was to evaluate additional PGPB and calcium chloride ($CaCl_2$) treatment for the biocontrol of *Botrytis* in various species of cut flowers.

Treating the flowers with bacteria or $CaCl_2$ (Figure 2)

1. Ranunculus (*Ranunculus asiaticus* 'Elegance Salmon') were obtained from Sunny Meadows Flower Farm (Columbus, OH). The flowers were separated into treatment groups to apply the bacterial and $CaCl_2$ treatments.
2. Each flower was treated with either an individual strain of bacteria (6 total strains) or a 600 ppm solution of $CaCl_2$ using trigger spray bottles. Control flowers were untreated (no bacteria or $CaCl_2$). All bacteria were applied at the same final concentration (10^8 cell/mL).
3. Flowers sat for one day after being treated.
4. Flowers were then inoculated with *Botrytis cinerea* (10^4 spore/mL) using a hand pressure sprayer.
5. The flower stems were cut to 30 cm, placed in vases with deionized water, and covered with plastic bags to create optimal conditions for *Botrytis*. This experiment was set up as a randomized complete block design in an interior room with fluorescent lighting. The average temperature during the experiment was 21.8°C (71.3°F).

6. The flowers were removed from the bags 2 days after the *Botrytis* inoculation and disease severity evaluations began. A rating scale was developed specifically for ranunculus (Figure 3) on a scale from zero (no disease symptoms) to 9 (bent stem and symptoms and signs of *Botrytis* are present OR all petals fell off). Rating for the flowers continued until 6 days after *Botrytis* inoculation.

Table 1. Treatment information

Treatment	Treatment Description
Control	LB growing media only (no bacteria or $CaCl_2$)
$CaCl_2$	600 ppm $CaCl_2$
14B11	*Pseudomonas chlororaphis*
94G2	*Pseudomonas frederiksbergensis*
89F1	*Pseudomonas fluorescens*
MBSA-3BB1	*Pantoea agglomerans*
15H3	*Pseudomonas protegens*
AP54	*Pseudomonas protegens*

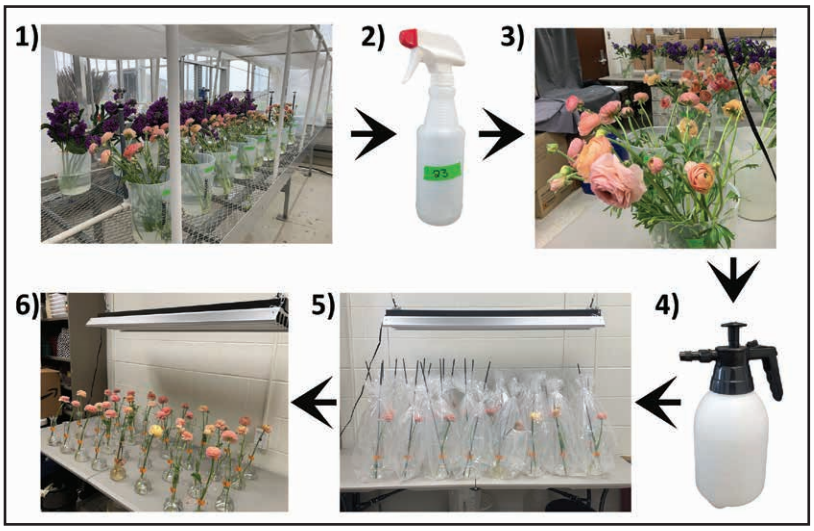

Figure 2. Method used for the evaluation of PGPB for the biocontrol of *Botrytis* in ranunculus.

Figure 3. Flowers were rated daily on a scale of 0 to 9 based on symptoms and signs of *Botrytis*.

PGPB found to reduce disease severity

The daily disease severity ratings were used to determine if disease was reduced in ranunculus flowers treated with one of the PGPB or the $CaCl_2$ treatments compared to the control (untreated) flowers. On day 4, all six bacterial treatments and the $CaCl_2$ treatment reduced disease severity compared to untreated control flowers (Figure 4). The greatest reduction in disease was seen with *Pseudomonas protegens* AP54. $CaCl_2$ and *Pantoea agglomerans* MBSA-3BB1 were the next most effective treatment for reducing *Botrytis* severity. Five days after *Botrytis* inoculation, flowers treated with PGPB strain MBSA-3BB1 had less gray mold and associated damage than the control flowers (Figure 5).

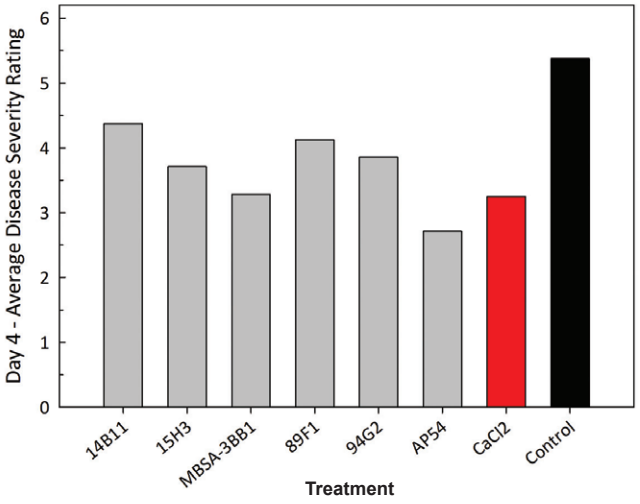

Figure 4. The average disease severity ratings 4 days after *Botrytis* inoculation of ranunculus treated with PGPB or CaCl2. Control flowers were untreated (sprayed with only the LB liquid growing media with no bacteria or CaCl2).

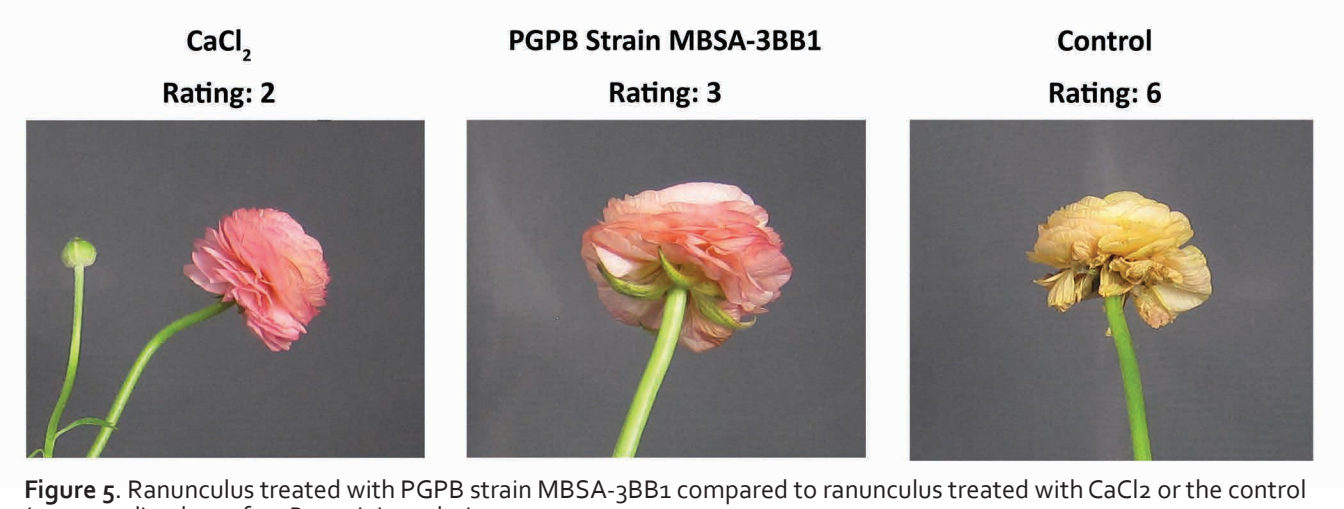

Figure 5. Ranunculus treated with PGPB strain MBSA-3BB1 compared to ranunculus treated with $CaCl_2$ or the control (untreated) 5 days after *Botrytis* inoculation.

Conclusion

The bacterial and $CaCl_2$ applications in this study resulted in a decrease in gray mold caused by *Botrytis* in ranunculus cut flowers. These treatments were also evaluated in stock (*Matthiola incana* 'Katz Purple'). *Pantoea agglomerans* MBSA-3BB1 treatment resulted in the greatest decrease in disease severity compared to the untreated control flowers in the study with stock. Future experiments are evaluating additional application methods to improve the efficacy of the bacterial treatments. PGPB as biocontrol agents provide growers with promising tools for the control of *Botrytis.*

References

South, K. A., Peduto Hand, F., and Jones, M. L. (2020a). Beneficial bacteria identified for the control of *Botrytis cinerea* in petunia greenhouse production. *Plant Dis.* 104(6), 1801-1810. doi:10.1094/pdis-10-19-2276-re.

South, K.A. Chapin, L.J., Jones, M. L. J. (2020b). Biocontrol of *Botrytis* in cut flowers. *The Cut Flower Quarterly*. 32, 28–30.