FIRST And AFE Research Reports

FIRST and AFE fund a number of projects each year based on the well-being and health of plants. See what types of projects they are currently funding.

Compiled by Catherine Evans

Research projects keep our industry alive: They are how we learn about new plants, how to grow them and how to keep them healthy. Several floriculture organizations fund projects like this to help universities find the answers to problems growers are having.

Some of the main issues growers face relate to various pests and diseases. A number of research projects are currently being funded by organizations such as Floriculture Industry Research and Scholarship Trust (FIRST) and the American Floral Endowment (AFE). Though FIRST and AFE are not the sole funding agents of the projects below, they have contributed large amounts of money to ensure this research continues. For more information on the research FIRST and AFE are funding, visit www.firstinfloriculture.org and www.endowment.org.

The information below came from the researchers to make it as accurate as possible.

FIRST

Quantifying and enhancing the postharvest life of nonrooted cuttings during shipping and storage by Erik Runkle, Roberto Lopez and Arthur Cameron, Michigan State University.

In transit and storage, cuttings can be exposed to extreme temperatures that can consequently decrease cutting quality, rooting and subsequent performance. Michigan State is performing experiments to determine how nonrooted cuttings tolerate stress and is seeking ways to improve the tolerance of cuttings to stressful environments.

The objectives of this research are to quantify the thermal stress tolerance of nonrooted cuttings of petunia and New Guinea impatiens and determine recommended storage temperatures and maximum storage durations. Additional species will be investigated in the near future.

Another objective is to determine the effects of shipping/storage temperature and duration on rooting of cuttings, physiological processes, and subsequent growth and development of the finished plant. To quantify the effect of daily light integral (DLI) during propagation on rooting, cutting quality and subsequent performance of petunia and New Guinea impatiens.

The final objective is to determine if postharvest applications of exogenous sucrose, ethylene inhibitors or plant hormones can increase the shelf life and rooting of cuttings.

The preliminary results of this research indicated that New Guinea impatiens 'Harmony White' cuttings should not be stored at temperatures below 50° F for more than two days because of tissue damage that does not become apparent until several hours or more after removal from shipping/storage. The photosynthetic efficiency (a measurement of chlorophyll activity) of cuttings stored at 32° F decreased by 9, 12, 23, 32 and 65 percent as storage duration increased from 1 to 5 days, respectively, compared to non-stored cuttings. These damaged cuttings became horticulturally unacceptable and rooted poorly.

Rooting of New Guinea impatiens 'Harmony Magenta' after five days of storage at 32, 41, 50, 59, 68, 77 and 86° F. (Photo courtesy of Erik Runkle)

Evaluation of the potential role of chitosan films for enhanced bacterial disease and foliar nematode control in ornamental crops by Colleen Warfield and Samuel Hudson, North Carolina State University.

The objective of this research is to evaluate the anti-microbial activity of various derivatives and fabrications of chitosan to common bacterial foliar pathogens as well as foliar nematodes and to test the efficacy of these chitosan compounds as potential pesticides on ornamental crops.

While fungal diseases outnumber bacterial diseases on ornamentals, bacterial diseases can be equally as devastating when they occur. In addition, foliar nematodes are becoming increasingly common on a wide range of herbaceous and woody ornamentals. Foliar nematodes are a widespread problem in greenhouses and nurseries, but the importance of the problem has been largely disregarded. One of the primary reasons for this is the lack of effective management options.

Chitin, found in the shells of crabs, lobsters, shrimp and other crustaceans, is considered the second most abundant natural resource on earth next to cellulose. Each year in the United Sates, thousands of tons of chitin are produced as processing wastes of the crab and shrimp industries. When chitin is further deacetylated by about 50 percent it becomes soluble in dilute acids

Foliar nematode symptoms on tolmiea. (Photo courtesy of Colleen Warfield)

and is referred to as chitosan. Chitosan has been shown to have anti-microbial activity against bacteria, viruses and fungi and has been reported to induce the expression of a variety of genes involved in plant defense responses.

North Carolina State University has the unique opportunity for collaboration between the College of Textiles and the College of Agricultural and Life Sciences that will enable researchers to combine the expertise of a polymer chemist and leader in the field of chitosan fabrication, with an ornamental plant pathologist. The goal is the application of chitosan technology to the development of a class of natural pesticides that may provide new and promising options for plant disease management. The focus of the research will be to utilize chitosan as a structural polymer forming an anti-microbial barrier on the plant surface.

NC State has found a high degree of anti-microbial activity with one of its chitosan derivatives when tested in vitro. Aqueous chitosan does not have any direct anti-microbial effect on foliar nematodes. But when mobilized into films, the nematodes are unable to penetrate the films. NC State is currently experimenting with improved mobilization of the films on the leaf surface.

American Floral Endowment

Effective use of microbial inoculants for the suppression of soil-borne pathogens in greenhouse crops by George Elliott, University of Connecticut.

Disease-suppressive microbial inoculants (MI), sometimes called biofungicides, are an alternative to chemical fungicides for disease management in greenhouse production. However, research trials have shown highly variable results. In some cases, disease control with MI can be as good as conventional chemicals, but in other cases, MI fail to control disease or even seem to cause increased disease incidence.

When MI are added to potting mix, their subsequent fate is unclear. Do they persist or proliferate in the medium? Are they able to colonize roots? Are they biologically active? In order to answer these and related questions, we need methods to determine the number of beneficial microbes present.

Conventional methods for enumeration of MI in growing media rely on the ability to culture the organism in a selective medium and count the number of colonies formed. However, this technique is often subject to "false positive" results, and furthermore, the process is slow, tedious and not suitable for extensive studies of microbial populations and interactions. ➧

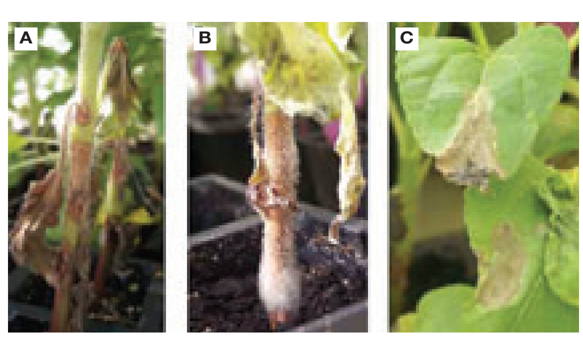
Culture methods for enumeration of microbes. Extracts from potting mixes were plated on selective media. ***Top left:*** *Non-inoculated potting mix in selective medium for Streptomyces.* ***Top right:*** *Potting mix in selective medium for Streptomyces inoculated with Actinovate.* ***Bottom left:*** *Non-inoculated selective medium for Bacillus.* ***Bottom right:*** *Potting mix in selective medium for Bacillus inoculated with Taegro. The Streptomyces medium shows a large number of colonies from uninoculated potting mix. The actual Streptomyces colonies from the inoculated mix are very small and could be overrun by other microbial colonies. The Bacillus medium shows no false positives, and the colonies are very uniform and discrete. (Photo courtesy of George Elliott)*

Molecular methods based on the amplication of microbial DNA using the polymerase chain reaction (PCR) are able to provide positive identification of specific microbes using DNA directly extracted from the organism, either in culture or in growing media. Using a technique called real-time PCR, the quantity of DNA can be estimated, providing a direct estimate of the number of active organisms in the medium. This work is aimed at developing molecular methods to identify and quantify MI in soilless potting mixes.

The University of Connecticut has had some success with molecular methods for detection of *Streptomyces lydicus* and *Trichoderma harzianum* as well as working on *Bacillus subtilis*.

Soluble silicon-based disease management of floricultural crops by Stephen Marek, Todd Cavins and Sophia Kamenidou, Oklahoma State University.

Silicon is not considered an essential element for most plants, with the exception of some members of the horsetail family. However, silicon supplementation is reported to enhance plant resistance to both abiotic and biotic stresses, such as water and chemical stresses and disease and pest problems,



Gray mold symptoms and signs on inoculated sunflowers. A. Decaying cotyledons and primary leaves with stem lesions occurring at the point of leaf attachment. B. Sporulation of Botrytis cinerea on a girdling stem lesion and senescent leaves. C. Blighted leaves infected from areas where free water collected. (Photo courtesy of Stephen Marek)

respectively. The greenhouse floriculture industry predominantly uses soilless substrates. These mostly peat-based substrates contain very limited amounts of available silicon and result in reduced plant tissue levels of silicon. Silicon supplementation of such "silicon deficient" crops could boost disease resistance and inexpensively augment standard disease management practices.

Oklahoma State is investigating whether supplemental silicon provides any protection against several common diseases in sunflower, zinnia and gerbera. One such disease, Botrytis blight affects a wide number of dicot plants and can cause significant losses during postharvest because the pathogen remains active at low temperatures. In cool, moist conditions, the causal fungus *Botrytis cinerea* can infect leaves, stems and flowers, reducing the ornamental value and shelf life of cut flowers. Powdery mildew, caused by *Golovinomyces* (Erysiphe) *cichoracearum*, affects the leaves and stems of numerous composite flowers. Many studies on greenhouse vegetables have shown silicon supplementation can reduce powdery mildew. Finally, Phytophthora root rots, caused by *Phytophthora cryptogea* and *P. parasitica*, can cause rapid and severe losses due to the movement of motile spores in greenhouse water supplies. The effects of silicon supplementation are unknown for these diseases in floricultural crops.

In these researchers' previous experiments, the concentrations and chemical forms (sodium silicate, potassium silicate and calcium silicate) of soluble silicon producing optimal horticultural traits were determined. Greenhouse-grown sunflowers, zinnias and gerberas supplemented with optimal rates of silicon, solely and in combination with reduced rates of fungicides, will be inoculated with fungal pathogens and any disease suppression will be assessed. The preliminary experiments have indicated silicon supplementation reduces stem lesion severity due to Botrytis blight.

Development of a PCR-based detection assay for foliar nematodes in ornamental host plant tissues for use as a diagnostic and research tool by Colleen Warfield and Eric Davis, North Carolina State University.

The goal of this project is to develop an efficient, highly sensitive, and reliable diagnostic assay to detect foliar nematodes (*Aphelenchoides sp.*) in plant tissues. There is a zero threshold level of tolerance for foliar nematodes in potted plants because of the ability of the nematodes to destroy the aesthetic value of the plant in a relatively short amount of time.

The development of a nucleic acid-based diagnostic assay using the polymerase chain reaction (PCR) to amplify and detect specific regions of foliar nematode DNA will serve as a diagnostic test. It will also serve as a research tool to study the life cycle of this pathogen in a greenhouse/nursery setting to determine when control measures are most likely to be effective based on the biology of the nematode, as well as to evaluate the effectiveness of potential cultural and chemical methods of control.

Because our assay detects genomic DNA, we have the ability to detect eggs as well as the juvenile and adult stages of the nematode. This is a

North Carolina State University graduate student Jamie McCuiston sampling a block of plants for foliar nematodes. (Photo courtesy of Colleen Warfield)

key point, as the traditional method of detection requires that the nematodes be motile in order to swim out of the plant tissue where they can be viewed microscopically (in which case, eggs or the first stage juveniles would not be detected by water extraction methods). Progress to date has focused on the optimization of the detection assay for specificity, sensitivity, reproducibility and the capacity to detect foliar nematodes within a range of plant species and plant tissues. Work is currently underway to determine which plant tissues are most likely to harbor the nematodes, as well as how much tissue must be sampled to reliably detect the nematodes if present. This will involve the development of a sampling scheme for screening large populations of plant materials for the presence of foliar nematodes. Early detection of this pest, through screening of incoming or onsite plant materials will help growers maintain nematode-free facilities; however, the identification and development of new control methods will be critical for situations where the nematodes have already become established in a facility and must be eradicated.

The development of more effective control options for managing foliar nematodes will promote higher standards and expectations for plant quality within the ornamentals industry.

Improving thrips control through better monitoring and timing of pesticide applications by Margaret Skinner, Michael Brownbridge, Tom Doubleday and Cheryl Frank, The University of Vermont.

Western flower thrips (WFT) are major pests of greenhouse ornamental crops. Substantial economic losses can result from foliar and flower feeding or virus vectoring, such as INSV and TSWV, from WFT. Few compounds are available for WFT management, therefore, increasing the need for the use of natural enemies and increased pesticide efficacy.

The ability to detect WFT early before they reach damaging levels allows for the greater use of biological controls. Knowledge of WFT's daily activity patterns will allow pesticides to be applied more efficiently, thus reducing the number of insecticide applications. This project will provide new information to assist growers in the timely detection and treatment of WFT, enhancing the use of biocontrols, preserving active compounds and reducing human and environmental health risks.

The objectives of this research are to test and refine the use of indicator (trap) plants for early detection of WFT in commercial greenhouses to allow for timely introduction of natural enemies and use of pesticides. As well as document the daily activity of WFT on spring bedding plants; so that the timing and efficacy of pesticide sprays will be optimized.

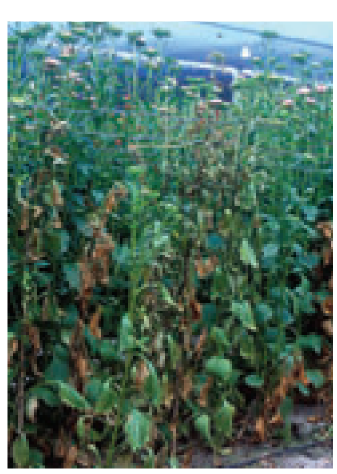
Growers from two commercial greenhouses where the trial was run were closely involved and extremely interested in the project. They were supplied with data sheets to fill out weekly, and indicated that they used the data they collected to schedule their pesticide applications.

Integrated management of Fusarium in florists' crops by Robert McGovern, Brent Harbaugh and Zhanao Dheng, University of Florida; Wade Elmer, Connecticut Agricultural Experiment Station; David Geiser, The Pennsylvania State University.

Species of the fungus Fusarium cause common, persistent and highly damaging diseases in most major potted and field-grown ornamentals; severe outbreaks of wilt, stem, corm, tuber and/or root rot caused by Fusarium annually result in extensive losses in the United States and worldwide. Florists' crops adversely affected by Fusarium include lisianthus (*F. avenaceum* and *F. oxysporum*), caladium (*F. solani*), China aster (*F. oxysporum*), cyclamen and gladiolus (*F. oxysporum*).

A multidisciplinary team of researchers, listed above, is investigating the biology, epidemiology, and genetics of Fusarium and to develop strategies for safe and effective integrated management of diseases caused by the fungus.

'Hero Yellow' marigold serving as an indicator plant. (Photo courtesy of Margaret Skinner)



Fusarium wilt in China aster. (Photo courtesy of Robert McGovern)

This group determined that infected propagative material (seed, corms, cuttings, tubers, transplants, etc.) and contaminated containers often play a critical role in the survival and spread of Fusarium and in the extensive production losses observed. Effective fungicides/disinfestants for treatment of propagative material and containers and protection of plants were determined including reduced risk fungicides, chemicals that trigger plant-based resistance and biological controls. Links to the dissemination of *F. avenaceum* and *F. oxysporum* by fungus gnats to lisianthus and cyclamen, respectively, were also established.

Resistance/tolerance to Fusarium in commercial cultivars of lisianthus and China aster was identified. Insensitivity to a widely used benzimidazole fungicide was documented in *F. solani* from caladium and *F. oxysporum* in lisianthus. Analysis of F. *avenaceum* isolates collected from around the world and from both ornamentals and non-ornamentals showed genetic homogeneity while isolates of *F. solani* from caladiums in Florida showed genetic divergence.

Creating a powdery mildew strategy that works by Margery Daughtrey, Cornell University, and Mary Hausbeck, Michigan State University.

Powdery mildew (PM) is one of the most alarming diseases that a grower faces. Two researchers, Mary Hausbeck at Michigan State and Margery Daughtrey at Cornell, have joined forces to learn how to improve our ability to curb PM diseases. Their project focuses on PM management via cultivar choices, environmental manipulations and skillful fungicide use.

Necrotic spots where powdery mildew colonies are growing on the petals of gerbera. (Photo courtesy of Margery Daughtrey)

Studies in N.Y. and Mich. comparing 52 cultivars of verbena have identified four consistently resistant to PM: 'Temari Patio Blue,' 'Superbena Dark Blue,' 'Superbena Large Lilac Blue' and 'Superbena Pink Shades'. Verbenas within a series are not necessarily similar in their susceptibility. 'Superbena Coral Red', for example, is highly susceptible under some conditions. The Babylon series also contains both highly resistant and high susceptible cultivars. Growers must choose the best individual cultivars in order to minimize fungicide use.

Hausbeck's data on gerbera PM shows how moderately warm greenhouse temperature and high humidity speed the course of an epidemic by stepping up spore production. Understanding environmental relationships can help growers fine-tune control.

Twenty-two products including reduced risk fungicides, biopesticides, industry standards and experimental products have been tested for control of PM of gerbera, verbena, balsam impatiens and hydrangea. Results contribute to the development of new products for the greenhouse industry. PM diseases on different crops behave differently. Strobilurins, for example, work well against PM on poinsettia but are not reliable against PM on verbena and gerbera. PM of verbena and gerbera, which are very difficult to control, have not been managed successfully using biological and biorational tools to date, although these materials have shown effectiveness against other PM diseases. Choosing less susceptible cultivars will help growers to utilize these tools effectively.

In the future, this team plans to continue studies of PM and to address downy mildew diseases as well. GPN

Catherine Evans is associate editor for GPN. She can be reached by phone at (847) 391-1050 or E-mail at cevans@sgcmail.com.

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