they set up during the previous sessions. Additional compost materials are also examined so participants can make comparisons among several different compost products.

Section 4. This session highlights safety precautions necessary in setting up and running large scale composting operations. Governmental rules regulating composting and compost use are described, and the role of indictor organisms in compost quality control programs is delineated. In the workshop period the participants use manufactured premixed test kits to measure total aerobic bacteria and total coliform bacteria in the compost piles they set up in the second session.

Section 5. The consequences of using immature composts, including biological blockage of nitrogen and ephemeral phytotoxicity, are described in the lecture portion of this section. The major criteria for determining compost maturity are highlighted. In the workshop session, participants conduct simple seed bioassays to evaluate compost stability.

Section 6. The discussion period focuses on the uses of compost products as components in horticultural growing media, and as soil additives in landscapes and gardens, and in commercial horticulture. Published case studies are highlighted, and reasons for success or failure are examined. During the workshop session the plant growth test is evaluated. Fresh plant biomass measurements are made and yield of the edible portions is determined. Results are compared with results achieved in the control medium.

Using the Curriculum

The 6 part curriculum can be used in its entirety as an introductory or survey course on making and using compost. Some extension educators have done this, and have augmented the course materials with field trips to local composting facilities and to botanical gardens, plant nurseries and farms where compost products are used.

In situations where the complete course is not required, extension leaders can select certain sessions, or parts of them to present. A minimal arrangement might include the sessions on basic principles of composting and compost use in horticulture. Although the workshop sessions were designed to require simple, inexpensive and readily accessible equipment, some agents might elect to not offer the workshop components, but to design a program that uses only lecture and discussion sections. The flexibility of the Master Composter Curriculum allows it to be used in a variety of ways in extension educational programs, depending upon local needs and resources.

Copies of the course outline and workshop materials list and directions are available by contacting any one of the authors.

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THE CENTRAL FLORIDA RESEARCH AND EDUCATION CENTER'S "MASTER RESEARCHER" PROGRAM

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Abstract. **A new program has been developed at the Central Florida Research and Education Center to achieve several goals:**

1) **to provide a mechanism to educate people about agricultural research so they can better understand why it is needed in our society;**
2) **to give interested people an opportunity to conduct consumer-oriented research that is scientifically correct, i.e. use the scientific method; and**
3) **to encourage publication of the resulting research observations in journals, magazines, extension newsletters, and in other ways to better inform the public of our mission.**

Faculty conduct sixteen hours of classroom teaching which give an introduction to the University of Florida and its Research Centers, science, statistics and specific areas of research in ornamentals, fruits and vegetables. Instruction focuses on

concepts in horticulture in the areas of disease diagnosis, integrated pest management and biological controls, marketing, media, plant breeding and biotechnology, physiology and weed science. Graduates then choose a research area in which to establish and conduct experiments with faculty guidance.

Since the inception of each location of the Central Florida Research and Education Center (CFREC), faculty have performed research that was of most immediate benefit to commercial growers. Recently, faculty have discussed methods for broadening their approach in order to more directly include final consumer concerns. Awareness of the Master Gardener Program and its nationwide success led to the idea of a similar approach aimed toward research that would benefit urban clientele. To that end, faculty at each of the three CFREC locations discussed the possibility of a program to introduce citizens to agricultural research in such a way that they could assist in conducting research which would answer commonly encountered questions.

Objectives of the program were three-fold: 1) to provide a mechanism to educate people about agricultural research so they better understand why it is needed in our society; 2) to give volunteers an opportunity to conduct research that is scientifically correct; and 3) to encourage and assist those involved in the program to publish their research observations in order to better inform the general public of beneficial findings. Once the goals were defined, one faculty member assumed the role of program coordinator and contacted local county extension agents and Master Gardener leaders to determine the level of interest that might be expected in such a program. Finding that the interest was sufficient to warrant further planning, faculty proceeded to develop the program. To accomplish the defined goals, the program was designed with two parts: 1) an intensive classroom teaching portion providing sufficient background for understanding the hows, whys and wherefores of research and 2) follow-up research projects. Because of space limitations, an outline and a schedule, with a deadline for enrollment, were sent to those who had been previously contacted. After the class capacity was reached, additional callers were notified that a second class would be held in about a year.

In October 1992, four 4-hour classroom sessions (Tuesday and Wednesday afternoons, for two successive weeks) were conducted by faculty members. Audio-visual equipment was used as deemed appropriate and each participant was provided with a loose-leaf notebook containing a class syllabus of general information on each topic covered in the course. The notebook also had room for any supplemental printed material (hand-outs) that faculty wished to provide during their sessions. To begin the instruction, the volunteers were presented with a 20-minute preliminary overview which included the purpose of the Master Researcher Program. The overview also encompassed an introduction to the University of Florida as a land-grant institution charged with doing agricultural research—and the organization of the university in order to accomplish that mission. The introductory portion of the program was concluded with a discussion of the Institute of Food and Agricultural Sciences and the 28 on-campus departments and 21 satellite research centers that fall under its purview and whose faculty have the responsibility to define goals and perform research to fulfill the needs of agriculture and the environment.

To establish a basic understanding of agricultural research, the group was then provided a 10-minute introduction to science—what it is, how it is used to make predictions, and how it developed through everyday observations and usages—and the scientific method as an integral part of science.

This portion was followed by a 10-minute discussion of the methods and tools used for transfer of information (data and conclusions) collected from research. Traditional means such as professional societies, scientific publications and trade magazines, trade association meetings and extension seminars, etc., are now being supplemented by technology such as CD ROM publications. Finally, a brief explanation of what environmental horticulture is and how it interacts with other areas of research concluded the introductory portion of the program and led into several one-hr sessions on various specific areas of concern in environmental horticulture.

The plant nutrition segment of the program discussed such things as sources, functions, required amounts, leachability, and deficiency and toxicity symptoms of essential elements; sources and application methods of fertilizers; and the development of fertilizer programs, by utilizing information on growth rates, fertilizer ratios and cultural factors to determine frequency, rate and source of fertilizer.

After a short recess, a session on marketing was held. The discussion focused on the why, what and how of marketing. A key marketing concept presented consisted of determining the needs/wants of consumers and then making certain those desires were fulfilled more completely, quickly, and less expensively than competitors could do so.

The first day's classroom activities concluded with a case study of the sweetpotato whitefly. The case study progressed from economic problems associated with this pest, i.e. yield loss and expense of attempting to control the pest; to problems arising from these attempts at control, such as development of resistance, environmental contamination, disruption of beneficial and non-target organisms; and finished with the concept of IPM (integrated pest management) programs. Examples of natural enemies (biological control) and how they could be used with IPM scouting, cultural controls and selective chemicals for an effective program against this whitefly and needs for further research in the area ended the day's discussion.

The second afternoon of classes began with a session on soils and potting media. An introduction on the functions of soils, the soil profile, and categorization of soils by organic content was followed by a discussion on the physical and chemical properties of soil (pore space, water-holding capacity, pH, etc.) that allow the soil to perform its functions, and what can be done to improve existing soil conditions to allow more efficient functioning for better plant growth. Differences between in-ground (landscapes, gardens) and container-grown plants was discussed with a focus on selection of potting media ingredients to provide effective physical and chemical conditions in an economically feasible way.

The next topic, the relationship between plants and water, included a brief introduction to the roles that water plays in plant cells, how a plant gets water from its environment and transfers it through its entirety, and some of the problems faced by growers such as when to water, how much to water and how often to water. Water quality as it relates to plant growth and appearance, the quantity of

water required and factors that influence these needs, water/soil relationships, and the problems of water stress from under- or over-watering were also discussed.

Following the day's recess, a presentation on the concepts of inductive and deductive reasoning was introduced to lead the group into a discussion of statistics. The importance of designing an unbiased experiment, being objective and accurate in data collecting, and the necessity for replication of experimental units receiving the same treatment(s) was stressed. It was explained that by following simple rules of experimental design, researchers can then use the results of statistical analysis to draw conclusions about cause/effect relationships of the experiment. Finally the distinction about a difference that is statistically significant, but not economically or biologically significant was discussed.

Completing the first week's classroom activities was a discussion on three environmental factors which influence plant growth—light, temperature and gases. Properties of light, such as intensity, duration and quality, and their effects on plants in such processes as photosynthesis, flowering, and acclimatization were discussed in the context of how growers and researchers manipulate these properties to achieve desired effects. The presentation on temperature and its effects on plants included topics such as the principle of heat exchange, transpiration and the manipulation of the environment (greenhouse, shadehouse or open area) to optimize (or, at extreme temperatures, to minimize) the effects of temperature on a crop. Finally the essential gases, oxygen and carbon dioxide, and their roles in respiration and photosynthesis were discussed, as were some aerial pollutants (e.g. ethylene and mercury) and minimization of their effects on plants.

The third day's activities began with presentations on how to improve plants through selective breeding. The first segment included a basic presentation of genetics, asexual propagation, discussion of some hybridization techniques and barriers, and some consequences of hybridization. It concluded with a discussion of the breeding goals and theory involving a specific ornamental plant genus being studied and related each of the previous points of the session to the overall program and some specific examples of flower structure and methods of pollination.

Completing the discussion on plant improvement was a presentation on plant biotechnology, how it relates to plant improvement, and its laboratory, equipment and personnel requirements. Two major subdivisions of biotechnology, tissue/cell culture and the prospects of genetic engineering, were examined. The discussion proceeded into the development of the commercial tissue culture industry, techniques used, benefits to horticulture and the more recent expansion of genetic engineering into the actual transformation of DNA.

Following the discussion of genetically improving plants was a session on improving crop yield, quality and profit by controlling weeds. The discussion included how weeds interfere with yield, quality and profit, the importance of correct identification of the weed to its control, how knowledge of the types of weeds and their life cycles can be important in weed control, and methods of weed control by prevention, eradication or suppression. Types of mulches, inorganic and organic, and types of herbicides—selective vs. nonselective, contact vs. systemic, and preemergence vs. postemergence—were discussed as means of weed control.

The formal classroom portion of the program ended with a discussion of plant pathology. Conditions under which diseases arise, the biotic causal agents (fungi, bacteria, viruses, nematodes) and their modes of action, as well as the abiotic or environmental factors which contribute to plant disease were described. Steps in diagnosing diseases by determining the symptoms, isolating and culturing the pathogen, and perhaps identifying a previously unknown disease were covered. Finally, control of diseases through protection by slowing growth of the pathogen, exclusion, eradication, therapy, and host resistance completed this session.

After the classroom instruction portion was complete, possible projects for research were discussed. Potential projects were suggested by both instructors and participants and the feasibility (space, cost, availability of required items, etc.) of each project was discussed and alternatives examined. Each participant was asked to think about the different projects and the time commitments involved and then select his/her first three preferences for research topics. Appropriate faculty members were notified of the choices and they contacted participants to schedule meetings to finalize experiment parameters, plans of action and set up schedules.

To ensure the efficient functioning and assure success of the program, someone familiar with the facilities at the research center acted as research facilitator. Since neither faculty nor master researcher volunteers were always available to provide the day-to-day requirements of some of the experiments, a support staff (USPS) employee was assigned this function as part of daily routine. We believe this is essential for the success of the program and must not be overlooked when contemplating the initiation of such a program.

Examples of Research Projects Conducted

Postproduction irrigation schedule effects on quality of bedding plants. This experiment was designed to see if some guidelines could be established which, when disseminated by extension agents, could help consumers maintain healthy patio plants while conserving water. Designed to yield information which could be readily applied by consumers, the findings would be of environmental as well as economic value since water restrictions are becoming a way of life in central Florida.

Pots of pansies (*Viola* × *Wittrockiana*) were placed on a postproduction watering schedule of watering every day, every two days, every three days or every four days. After one month, plant grades were assigned and number of flowers per pot was recorded and the experiment was terminated. Two other plants, *Petunia hybrida* and *Zinnia elegans*, have also been used in the same experimental design.

Evaluation of groundcovers for use in sunny and shade locations. This project was set up to provide information to consumers which they could then use in choosing groundcovers for use as replacement for turf in heavily shaded locations where turfgrasses do not do well or simply as a matter of preference. Eight low-growing groundcovers were selected by the volunteer group and the faculty supervisor to test for their potential for replacing turf in the landscape. Volunteers then helped locate, acquire and plant the groundcovers under full sun, or 30, 50 or 80%

shade. Plots were fertilized with controlled-release fertilizer at time of planting, oak-leaf mulch was applied and is reapplied as needed, soil moisture is monitored by in-ground tensiometers so each plot can be watered as needed and weeding is done at least once a month. Plant growth is rated, recorded and entered into the computer by the volunteers monthly. The experiment will be continued for a year to allow for plant growth and coverage of an area and to determine seasonal effects on the plants.

Plant survey and evaluation research. This long-term project is oriented toward finding somewhat elusive, preferably low-maintenance, crops which have the potential to be desirable ornamentals. The research team is collecting information about 'old-time' plants included on a preliminary list made during the first meeting of the group. Each team member is trying to locate specimen plants in area landscapes and identify the growing conditions. They are also checking on availability and quality of those plants in local garden centers during the prime planting seasons of spring and fall, searching the literature for information about the listed plants, identifying persons with knowledge about the plants, and collecting photographs and propagules, whenever possible, of the plants. Plans are to follow up with some growth experiments of candidate plants and finally summarize findings into fact sheets that can be made available for public use.

Conclusions

The first Master Researcher class has proven to be rewarding to both the faculty involved and the "master researchers". A second set of participants received training in October 1993, and a waiting list has been started for the 1994-95 term. Refinements were made to both the concepts taught in the classroom and research projects, as is typical of any teaching/field experience, and time will tell just how beneficial the program is as a research-extension tool.

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EVALUATION OF SEED GERANIUM CULTIVARS FOR THE LANDSCAPE

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Abstract. **Seed geranium (*Pelargonium* × *hortorum* L. H. Bailey) cultivars were evaluated based on days to flower, flower and umbel diameter, flower color, plant dimensions, uniformity, appearance, longevity and floriferousness during the spring and fall of 1992 and spring 1993. *Spring 1992:* Days from sowing to flower for 60 cultivars ranged from 96 to 115 days. 'Tetra Scarlet' was significantly later to flower than all other cultivars except 'Orange Appeal', which flowered at 112 days. Plant height ranged from 9.6 to 15.1 inches at the beginning of flowering. 'Pinto White' was taller than all other cultivars except 'Tetra Scarlet', 'Pinto Quicksilver' and 'Pinto Bicolor'. Umbel diameter ranged from 3.7 to 5.6 inches. 'Freckles' had the largest umbel diameter. At 111 days after sowing, umbel number ranged from 1.0 to 11.5, with 'Multibloom Salmon' and 'Multibloom Pink' producing the greatest number of umbels. *Fall 1992:* Days from sowing to flower for 62 cultivars ranged from 85 to 136 days. 'Orange Appeal' flowered later than any other cultivar, and 'Tetra Scarlet', which flowered at 119 days, was also later than any other cultivar, except 'Orange Appeal'. Mature plant height ranged from 10.0 to 16.6 inches. 'Pinto White' was significantly taller than 38 other cultivars. Umbel diameter ranged from 3.3 to 5.2 inches. *Spring 1993:* The earliest cultivar to flower was 'Avanti White' at 85 days, while the latest was 'Tetra Scarlet' at 118 days. Mature plant height ranged from 10.6 to 14.8 inches with the 'Pinto' series being among the tallest. Umbel diameter ranged from 3.9 to 5.0 inches among the 60 cultivars. During the week 117 days after sowing seed, umbel number ranged from less than 1.0 to 19.3 per plant. All multiflora types had at least 5 umbels at this time.**

Florida ranked eighth nationally in the quantity of potted seed geraniums (a.k.a. hybrid geranium) sold in 1992 (USDA, 1993). Since Florida-grown potted seed geraniums were sold at very low wholesale prices ($0.60 for pots less than five inches and $1.65 for pots at five inches or larger), Florida ranked only twelfth in wholesale value nationally. Potted seed geranium sales in Florida during 1992 were valued at $1.22 million. Figures for flats of geranium produced in Florida are not reported separately.

Potted seed geraniums in Florida were produced in 1.3 million sq ft of space in 1992, up dramatically from 0.5 million sq ft in 1991 (USDA, 1993). The most pronounced increase occurred in a specific production niche. During 1992, the number of seed geraniums produced in Florida in pots under 5 inches more than tripled from production

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The information contained in this report is a summary of experimental results and does not contain recommendations for crop production. Where trade names are used, no discrimination is intended or endorsement implied.

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