CORF News

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Hydroponic Cut Flower Production

By Dr. Richard Evans, Horticulture Specialist, UC Davis Department of Environmental Horticulture

Hydroponic cut flower production is in vogue. My local florist charges a premium for "hydro-roses." Many growers have decided to switch to hydroponic production, and many others are thinking about it. Unfortunately, misinformation and extravagant claims made by some proponents of hydroponics may hinder growers who want to make an informed decision. Here, I provide a brief description of the development of hydroponics, compare hydroponics to soil culture, and offer guidelines for choosing the method best suited for flower crop production.

About 300 years ago, a British medical professor, John Woodward, grew plants in water collected either from rain or from a river. He added "garden mold" to some of the containers of water, found that the greatest plant growth occurred in water containing soil, and concluded "that a great part of the terrestrial matter, mixed with the water passes up into the plant along with it." Woodward's experiment got little notice from peers or plant science historians, but it represents the first recorded experiment with hydroponics.

Solution culture remains important for studies of plant nutrition. The physical system has not changed much over the years (except for the advent of rockwool, expanded shale, and coir), but early in the 20th century important improvements were made in the chemical composition of the solution bathing the plant roots. By the 1930s, solution culture had become such a reliable means of producing plants for research that a University of California scientist, W.F. Gericke, adapted the system to a commercial scale. Gericke called his system "hydroponic," from the Greek words *hydro* (water) and *ponos* (labor).

The advent of commercial hydroponic systems drew widespread publicity. Creative salesmen claimed that a brief training course was all that was needed to prepare someone for the new profession, "soilless farming." Claims were made that all the food needed by city dwellers could be grown on the roofs of buildings because hydroponics would increase yields and allow for closer plant spacing. Further impetus for hydroponic production came from public awareness of environmental problems, especially erosion and soil depletion.

Despite early promise, hydroponics never reached the mainstream. The reasons are clear, once you wash away the hype. Compare soil culture with solution culture. Soil provides plants with water, nutrients, anchorage, and root aeration. If the soil is irrigated, and the hydroponic system has provisions for anchoring plants and aerating the solution, the only important difference between them is the composition of the nutrient solution. Soil solutions typically have lower concentrations of nitrogen, potassium,

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Fresh Flower Foods

By Dr. Michael S. Reid, UC Davis Department of Environmental Horticulture

Careful selection and proper use of fresh flower foods (floral preservative solutions) are crucial steps in the postharvest care and handling of cut flowers. Cut flowers placed in solutions of fresh flower foods can remain decorative for at least twice as long as those in water alone. Several manufacturers offer fresh flower foods in the form of powders, tablets or liquid concentrates. Although the specific formulations of these products are known only to the manufacturers, all satisfactory fresh flower foods are based on ingredients known to have effects on the postharvest life of flowers. They extend flower longevity by providing three essential ingredients- a biocide, sugar and an acidifier.

The biocide component of fresh flower foods acts to kill bacteria, yeast and fungi present in water and on cut stems. When cut flower stems are placed in water, the microbes that are present grow rapidly, feeding on the sap that bleeds from the cut stem. It has been shown that within a day of placing a freshly-cut rose stem in a clean vase containing tap water, nearly 30 million bacteria may be present in each

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and phosphorus than do hydroponic solutions. This difference reflects a requirement of the hydroponic system, not a deficiency of the soil solution. Plants can grow normally in very dilute nutrient solutions, and higher concentrations do not increase nutrient uptake. Commercial hydroponic solutions usually have nutrient concentrations that are 100-10,000 times higher than plants require for optimum growth. Nutrient solutions have high concentrations because it is difficult to maintain low (but adequate) concentrations against the constant uptake of nutrients by plants. Soil solutions are constantly replenished as nutrients are dissolved from minerals in the soil solid phase. A similar process in hydroponics would require constant vigil by the grower. (Some hydroponic systems in use today are touted because growers can make fine adjustments in the composition of the nutrient solution, but these systems operate at concentrations that greatly exceed the range at which plants are affected.)

Fifty years ago, the University of California published "The Water-Culture Method for Growing Plants without Soil," by D.R. Hoagland and D.I. Arnon, which describes procedures for establishing a hydroponic system. The nutrient solution recipe in it, commonly called Hoagland's solution, is still widely used in research and commerce. What is most remarkable about the publication, however, is its set of conclusions. The authors state that "commercial application is justifiable under very limited conditions and only under expert supervision." They compare solution culture to soil culture and conclude that the former is "rarely superior." In fact, yields are similar under comparable conditions, plant spacing cannot be decreased, and water use, nutritional quality, and insect and disease problems are all similar.

TABLE 1: Cut flower yields from 'Royalty' roses grown in either a soil or hydroponic system. Yields are averages from harvests between April-August over a two year period (1992-1993).

	Soil culture	Solution culture
Stems harvested	9.1	9.2
Stem length (cm)	52.6	51.7
Dry weight harvested	56.5	57.0

Those conclusions remain valid today. Several years ago, Raul Cabrera and I compared the growth of roses in soil and hydroponic culture. There were no differences between them in flower number, stem length, water uptake, or mineral nutrition. Neither method had an inherent advantage over the other, except that hydroponic culture required more attention. In Australia, researchers came to the same conclusion after comparing hydroponic and soil culture of carnations. The key to success with either system is management to maintain proper levels of air, water, and nutrients.

If the choice between soil culture and hydroponics is to be made strictly on economics and convenience, then soil

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culture wins hands down. Hydroponic systems are more expensive, require staff trained in principles of nutrition, and demand constant attention to maintenance. On the other hand, hydroponics may be preferred where soil is poor or nonexistent. Furthermore, soil-borne plant diseases may be eradicated more easily in hydroponic systems, and chemical runoff is more readily controlled.

Growers who are adamant about getting their crops out of soil should consider growing plants in containers or raised beds, using a standard nursery mix with chemical amendments. A good nursery mix is more forgiving than soil about irrigation management problems, yet more forgiving than hydroponics about nutrition problems. Many research trials have demonstrated the utility of nursery mixes for cut flower crops, and there are several successful enterprises using them. You might say it's a happy medium. ❖

Flower Foods

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ounce of vase water. These bacteria quickly clog up the tiny tubes that conduct water in the flower stem and the result is premature wilting of the flower and leaves.

There are several kinds of biocides used in commercial fresh flower foods. The most widely-used compounds are 8-hydroxyquinoline citrate (8-HQC) and 8-hydroxyquinoline sulfate (8-HQS). Other materials with the ability to kill microbes in vase solutions include Physan-20 (a quartenary ammonium compound), silver nitrate, household bleach (diluted one part bleach to one thousand parts water) and slow-release chlorine compounds similar to those used in swimming pools. It is important to note that biocides in fresh flower foods are used in concentrations that are marginally effective, when they are strong enough to kill microbes the chemicals are nearly strong enough to injure the flowers themselves. It is, therefore, critical to follow the manufacturer's instructions for mixing up solutions so that just the right amount of biocide is present.

The second main ingredient of all fresh flower foods is a food supply in the form of sugar. This is necessary to replace the nutrient source lost when the flower is cut from the plant. Sugar is used by the cut flower to provide energy for opening buds, completing flower development and maintaining color. Most fresh flower foods are formulated to provide 0.5% to 1.5% sugar in the vase solution. This range is optimum for many flower species; higher amounts of sugar in the vase solution may cause leaf burn.

The third main fresh flower food ingredient is an acidifying agent. This ingredient is necessary to enable water to move more easily up the stem of a cut flower. Getting water to move up a stem can be difficult, particularly if the flower has been dehydrated (as during shipment) or if the water is very hard (contains high amounts of calcium). Lowering the acidity of the water to a pH reading of 3.5 to 4.5 allows maximum

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uptake of water by the cut stem. Citric acid and aluminum sulfate are the compounds most commonly used as acidifying agents.

Commercial fresh flower foods may contain other ingredients in addition to those already mentioned. Growth regulators or hormones may be incorporated to reduce leaf yellowing in such species as alstroemeria and chrysanthemum. Wetting agents or detergents may be added to reduce the surface tension of water thereby promoting water uptake in cut stems. Products containing such wetting agents may produce a soapy foam in solution.

Most commercial fresh flower foods contain similar ingredients and display similar properties under controlled laboratory conditions (Table 1). The question then becomes which is the best product? The answer is by no means absolute- it depends on a range of aspects of the handling system used by an individual grower or shipper. One factor that contributes to the performance of a fresh flower food is water quality. Most people in the industry are aware of the characteristics of their particular water source, and that these characteristics can vary greatly with locality and with time. Each commercial fresh flower food reacts uniquely with the natural salts (calcium, magnesium), added chemicals (chlorine, fluorine) and acidity of different water sources, thereby affecting its ability to prolong cut flower life.

Another obvious factor to consider when comparing fresh flower foods is product mix. Many species in the sunflower family (chrysanthemum, gerbera, aster) do not benefit from the sugar in vase solutions and may respond with leaf yellowing or reduced vase life. Spike-type flowers and those that are traditionally harvested in the bud stage will, on the other hand, benefit from vase solutions with the higher sugar content needed to provide energy for bud opening. The photograph shows the effects of different fresh flower foods on a range of specialty flower crops. Under our vase-life conditions, one commercial preservative was damaging to all the flowers we tested, perhaps because of a high salt content. Foods with high sugar content (b, d) worked well with flowers whose display life depends on satisfactory continued opening of buds (lysimachia, gypsophila, solidaster). The photograph shows how dramatic the differences can be between plain water (a) and fresh flower foods (b-f), and even between flower foods. It also shows that some flower foods work better for particular flowers. This points out the importance of testing preservatives under your conditions and with your flowers before choosing which to use.

In the process of finding the appropriate fresh flower food for your particular water and crops, experimentation is critical. Set up a typical mix of several flowers in a series of identical vases in an office or well-lighted room. Use several different available flower foods and be sure to set up "control" flowers in plain water. Keep a record of when each flower dies along with other observations such as opening and flower color. These preliminary steps will ensure that you find the right "fresh flower food" to enhance your product's quality. The chart on page 5 shows the effects of some common flower preservatives on the life of some specialty cut flowers. When the preservatives were prepared in deionized water, all the flowers did best in one of the commercial fresh flower foods. The performance in the other preservatives depended on the species, but usually the flowers did better in any preservative than in plain water.

The correct fresh flower food selection may also differ depending on which part of the marketing chain you are involved with. The experiments that we do with preservatives are mostly considering the needs of the retail florist and consumer - our question is how long the flowers will last under normal display conditions with the different flower foods that we try. For a producer or wholesaler, these preservatives may not be appropriate. Directly after harvest, many flowers are best treated with a solution containing only a biocide, or perhaps a biocide and a wetting agent. Some flowers, like carnations, larkspur, gypsophila, and sweet peas require pre-treatment with STS to prevent the effects of ethylene. Others, like gladiolus, watsonia, and tuberose, are greatly improved by a "pulse" pre-treatment with high concentrations (20%) of sugar. Producers and shippers also should determine the optimum treatment for the crops that they produce. ❖

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chart and photo

Table 1. Properties of selected commercial fresh flower foods.

Product	Form	Sugar Content (%)	Acidity (pH)	Salt Content (EC)
Deionized Water	———	———	7.29	0.00
Tap Water (Davis, CA)	———	———	8.67	0.55
Chrysalä	powder	1.0	4.14	1.50
Crystal Clearä (Floralife)	liquid	1.0	3.03	0.55
Floralifeä	powder	0.75	3.51	0.45
Floralife Hard Waterä	powder	0.75	5.25	0.55
Floralife Pure Waterä	powder	0.50	3.13	0.65
Oasisä	powder	0.50	3.12	0.31
Rogardä	liquid	0.50	5.67	0.11
Schultz Instantä	liquid	1.0	3.30	0.19

Field Observations

Mystery Sunflower Disease

An unusual leaf disease occurred this spring on greenhouse-grown cut sunflower. White blotches, mostly angular, sometimes not angular, occurred on the upper leaf surfaces of the upper leaves. Yet, on some leaves, these blotches occurred only on their tips. Under a dissecting microscope, at 40X magnification, the leaf damage seemed superficial. Only plant cells on the upper surface seemed to be effected. There was no surface mycelium present or anything that looked like it might be caused by a fungus. Samples were sent to a North Dakota plant pathologist who specializes in sunflower diseases, but he found no pathogens. Chemical phytotoxicity, therefore, seemed like a good possibility. However, there were no chemical applications during the period, and the angular nature of most of the blotches is not a typical symptom for phytotoxicity. Chock this one up for the "unknown" list! I can email a digital image of this problem for anyone interested.

What a difference a year makes

The central California coast was basking in sunshine this spring. All will remember the cold and wet conditions last year that resulted in a tremendous increase in foliar and flower diseases and delayed crops. This year, there is a marked reduction in foliar leaf diseases and root rots for field flower growers. Yes, field flower growers had product to sell for Mother's Day too.

Creeping fieldcress (*Rorripa sylvestris*) spreads with cultivation equipment

A local greenhouse cut flower nursery has found this weed can spread widely throughout the nursery, hitch-hiking on cultivation equipment. Remember that *Rorripa* has to be killed before any equipment works the soil, as pieces of the root, as small as 1 inch, can be moved and grow in new areas. It is always a good idea to clean cultivation equipment after every use in the field. For more information, see my observations in the winter issue 2000, CORF News.

Regional Report

Santa Cruz & Monterey Counties

Minimum Re-entry Fungicide Trials

Growers are under increasing pressure to use pesticides that have minimum re-entry intervals following their application. The experiment reported here evaluated the efficacy of several reduced risk and biorational powdery mildew fungicides that have short reentry interval periods. In addition these fungicides are relatively safe to the environment and have low mammalian toxicity. The fungicides were tested on potted miniature roses ('Fiesta Parade') to control powdery mildew. (These fungicides were from several diverse fungicidal classes: the strobilurins (Cygnus, Heritage, Compass), bicarbonate salts (Kaligreen and Armicarb), jojoba oil (E-Rase), biocontrol agents (AQ-10, QRD713, and Topshield), contact chemicals (Zerotol and Cinnamite), and activated resistance compounds (SP5001, BAS 4UBF and Elexa).Fungicides were applied at manufacturers' recommended rates and frequencies to potted miniature roses (4 inch pots).

The strobilurins, as a group, performed well without causing loss in plant vigor. Many other fungicide treatments were moderately effective in controlling powdery mildew but caused mild to severe loss in vigor due to phytotoxicity.

For this abbreviated report, I'll discuss only the strobilurin fungicides. For a complete report that includes the evaluation of the other compounds, please contact me.

The strobilurins are synthetically derived compounds, chemically similar to a naturally occurring fungicidal compound that was discovered in a mushroom in the genus *Strobolurus*. Strobilurins have an unusually wide spectrum of fungicidal activity with each of the commercial compounds offering a unique spectrum of fungicidal activity. The three strobolurins tested were Compass (Novartis, Greensboro, NC) Heritage (Zeneca Professional Products, Wilmington, DE), and Cygnus (Toppro Specialties, Research Triangle Park, NC). Heritage and Compass are registered for greenhouse and nursery use in California.

Compass at 2 oz. / 100 gal. provided very good control when applied every 14 days. The longer interval treatment (28 days) failed to control mildew adequately after 21 days. There was unacceptable leaf yellowing on large areas (sometimes greater than 50% leaf surface) after the first application. After two weeks these areas became necrotic. This treatment was subsequently repeated in a commercial greenhouse on the same cultivar, at the same rate, and no phytotoxicity was observed. Of course, with any new fungicide, growers will need to be especially careful to look for subtle and not-so-subtle effects on vigor or phytotoxic reactions. Heritage at 1 oz. / 100 gal. had very good control with weekly intervals and moderate control at 2 oz. /100 gal. with 14 day intervals. Heritage without an adjuvant beaded up on foliage. The first Heritage treatments were made with 6 fl.oz. / 100 gal. No-foam B (CMR, Fresno CA) a non-ionic surfactant. This still did not adequately wet foliage, so subsequent Heritage treatments contained 12 fl. oz. / 100 gal. No-foam B. There was no phytotoxicity and vigor ratings reflected the fact that treated plants were very healthy. Cygnus had good control at 1.6 oz. / 100 gal. at weekly intervals and slightly less control at 3.2 oz. / 100 gal. with 14 day intervals. There was no phytotoxicity and vigor ratings reflected the fact that treated plants were very healthy. Apparently preventative application is important, necessitating a weekly spray interval with Heritage and Cygnus for best results.

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Regional Report

San Diego County

Tospoviruses and Western Flower Thrips - Thoughts on Control

The weather has warmed and thrips are increasingly abundant. I have received numerous requests for information on control of thrips and tospoviruses recently, so it's time to dust off the notes and review the strategies available to growers for thrips control.

Monitoring for thrips and tospoviruses is key to any IPM program for thrips. The use of petunia plants to monitor for tospoviruses was featured in the 1999 Spring Issue of CORF News. If you would like more information on this, please send me a request. The use of petunia indicator plants can be a powerful tool for early identification of virus transmission by thrips. But then what does a grower do to control the insect/disease problem?

There are many strategies that growers can employ to reduce the impact of thrips on their crops. The first strategy is exclusion. Greenhouse growers do currently have the option of exclusion screening to prevent movement of thrips into greenhouses, although some manipulation is required to overcome problems associated reduced air flow into our (mostly) passive-air-flow-cooled greenhouses. When this strategy is used, it is essential that the plants and greenhouse start out clean, so that thrips and other insects aren't confined in the screened area. Heather Costa, Cheryl Wilen, Julie Newman and I are currently evaluating the effects of UV absorbing plastics on reducing insect movement into greenhouses as well. For growers of field flowers, Julie Newman, Steve Tjosvold and I are evaluating the ability of reflective mulches to reduce insect populations in flower crops. We will report more on those results in future issues of CORF News.

Cultural control strategies such as weed control can have an important impact both in reducing thrips numbers and by reducing potential sources of tospovirus. Rapid removal of non-marketed flowers or plants can also dramatically reduce breeding populations in some floriculture crops. In roses, for example, buds of most of the cultivars are harvested before thrips have had time to develop from egg to adult. Thus, most thrips are either entering the greenhouse from outside or they are developing in those full-blown roses that were left on the plant. Regular removal of these roses eliminates most of the breeding within the greenhouse. Unmarketable potted plants or cut flowers should be viewed as weeds and promptly removed.

Chemicals are very important in controlling thrips populations. Some of the materials available for thrips control are listed in the field observations on this page. The potential for insecticide resistance must always be a consideration when developing control strategies for thrips.

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Michael A. Mellano Receives Outstanding Person of the Year Award

Michael A. Mellano, of Mellano and Company in San Luis Rey, has been selected by the San Diego County Flower and Plant Association to receive their Outstanding Person of the Year Award. This honor is given each year to a person who has made substantial contributions to the horticulture industry as a whole. Congratulations, Mike, on this prestigious award.

Field Observations

Chemical Control Options for Thrips

Chemicals are important tools in the control of thrips. However, since thrips have a propensity to develop insecticide resistance, treat only when monitoring indicates that there is a need and use resistance management strategies. Please remember that the label is the law and newly registered materials often have restrictions regarding number of applications allowed, rotations, etc. A general rule of thumb for materials without these restrictions for OPs, carbamates, etc. is to make two applications 5-7 days apart, depending on temperature, when populations are on the increase. Efficacy will be maximized when applications are directed where the thrips are commonly found, i.e. in the flowers or in the protection of terminal foliage.

Some of the materials registered* for use on thrips include:

- Botanical – cinnamaldehyde (Cinnamite); azadirachten (Azatin, Ornazin); nicotine (Fulex Nicotine)
- Carbamate – methiocarb (Mesurol)
- Macrocyclic Lactone – abamectin (Avid)
- Microbial – *Beauveria bassiana* (Botanigard)
- Organochlorine – endosulfan (Thiodan)
- Organophosphate – acephate (Orthene, PT1300); chlorpyrifos (Dursban); diazinon (KnoxOut);
- Spinosyn – spinosad (Conserve)
- Pyrethroid(+) – pyrethrin +PBO (Pyrenone Crop Spray, PT1100); rotenone + pyrethrin (Pyrellin)

**Please note that not all chemicals are labeled for use on all crops. Mention of a product does not imply endorsement or imply efficacy. Omission of products is unintentional. Read and follow the instructions on the label. Before using a pesticide for the first time or on a new crop or cultivar, treat a few plants and check for phytotoxicity.*

Field Observations

Erwinia Soft Rot: Bacterial Disease

With humid, warm summer temperatures and increased watering, growers are seeing more outbreaks of Erwinia soft rot (*Erwinia carotovora* pv. *carotovora*), particularly in propagation areas and where potted plants and bedding plants are grown directly on the ground. Propagation areas are notorious for Erwinia, because so much of the plant tissue is "soft," and all of the cuttings have wounds, which are ideal entry points for the bacteria.

Symptoms of Erwinia soft rot include water-soaked lesions, followed by a massive rotting of plant tissue, accompanied by a foul smell. Plant tissue becomes soft and watery, and entire plants can quickly collapse.

Splashing water is a primary spread of Erwinia, so be aware of this when watering overhead or by hand. Also, plants on the ground can pick up Erwinia by subirrigation – the bacteria exits the bottom of an infected pot, and moves up into adjacent pots with the irrigation water. This is why it is so important to remove **all** infected plants and get them out of the area – they serve as a bacterial source for adjacent plants. The bacteria is also spread by tools, hands, and insects. Propagation knives and clippers should be kept very clean.

The real key is **prevention** and **sanitation**. Inspect all incoming plant material for Erwinia, and keep it out of growing areas by having good sanitation and watering practices, and roguing out plants *immediately* when they become infected. Disinfest the area when plants are removed. Avoid excessive splashing of water on plants.

Regional Report

San Mateo & San Francisco Counties

Postharvest Trials During Sabbatic Leave

I am currently on sabbatic leave from San Mateo County, working with Dr. Michael Reid in the Environmental Horticulture Department at UC Davis until early next year.

I just finished teaching the graduate class, *Analysis of Horticultural Problems*, during spring quarter. It was an exciting opportunity to teach graduate students about the floriculture and landscape industry, because many of them are interested in pursuing jobs in floriculture production and pest management. The students are always interested in jobs/careers when they finish school, and are also looking for summer jobs in the floriculture industry. If you have positions that are suitable for graduating and ongoing students, contact your local and state universities/colleges with horticulture and botany departments (such as UC Davis, UC Riverside, Cal Poly, and the many community colleges in California).

For the remainder of my leave I will be conducting applied postharvest trials that will benefit the floriculture industry. Some of the areas to be covered include:

- Temperature management of potted plants during shipping
- The use of MCP (EthylBloc) for potted and cut flowers, especially new species of plants
- Alternatives to MCP that can be sprayed onto potted plants to prevent ethylene problems during shipping

As most growers in California know, MCP (1-Methylcyclopropene) is a great substitute for STS (silver thiosulfate). STS is no longer permitted in the floriculture industry, and growers have anxiously been awaiting the California registration of EthylBloc (MCP). Final registration should occur very soon (of course, most other states already have EthylBloc).

MCP is a gas which binds to ethylene binding sites in plant tissue, making the plants "safe" from the damaging effects of ethylene. It works on both potted plants and cut flowers, and is generally considered non-phytotoxic on most ornamental species. Application is difficult for some growers, however, so we will be examining how best to apply it in commercial situations.

In addition, potted plant growers would like to find a material to spray onto the plants prior to shipping that will also counteract ethylene. Michael Reid and his research group are examining a new trial material that shows great promise, so I will be working with Dr. Reid on trying the material on a range of potted plant species.

Stay tuned for results of these trials in future editions of *CORF News*.

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Regional Report

Ventura & Santa Barbara Counties

CORF Tour Visits Rose PMA Site

One of the nursery stops at this year's CORF Grower Tour held on June 22 was Sunshine Floral, Oxnard where participants had a chance to see one of eight statewide Pest Management Alliance (PMA) demonstration sites implementing reduced risk pest management strategies in fresh cut roses. Other nursery sites involved in this project include Dramm and Echter, Kocher Flowers, Roseflor (San Diego County); Koch California, Myriad Nursery, Westerlay Roses (Ventura, Santa Barbara, San Luis Obispo Counties); and Aspen Nursery, Kitayama Brothers (Santa Cruz/Monterey Counties).

California growers produce 70% of U.S. greenhouse cut roses, generating $64 million dollars in 1998. Western flower thrips, twospotted spider mite, and powdery mildew are key rose pests. They are difficult to control and, coupled with high aesthetic standards, result in as many as 50-60 pesticide applications annually. Pesticide resistance and regulatory pressure are causing growers to decrease pesticide use and switch to reduced risk methods. However, there are no widely accepted sampling plans or thresholds for rose pests. Fixed precision sampling plans for thrips and mites have recently been developed by Michael Parrella's lab, but need to be validated.

The bent cane production system recently adopted by most California rose growers has important implications for pest management. The bent cane system separates the flowers from the lower canopy, creating an opportunity for the integration of mite predators with chemical control. The lower canopy serves as a refuge for predators where they can be protected from pesticides directed at the flowers for thrips control. Additionally, when sprays are directed at the flower buds instead of the whole canopy, it reduces spray volume without affecting efficacy.

Our objective is to develop IPM programs for roses based on the latest monitoring methods and economic threshold data. We hope to reduce overall pesticide use and substitute newer reduced-risk pesticides and biological control for conventional materials.

Scouting at the demonstration sites began in early March under the supervision of cooperating farm advisors. Monitoring occurs weekly; the information is summarized and recommendations are discussed with the grower. The sampling plan for thrips uses yellow sticky traps and a threshold of 25-50 thrips/trap/week. The exact threshold is tailored to reflect regional differences in growing conditions. The sampling plan for mites is based on inspecting 44 plants per 10,000 ft^2, focusing in the crown areas where mites primarily occur. A sampling plan and threshold for powdery mildew are being developed by PMA investigators using a predictive model based on environmental conditions and scouting data. We are comparing pesticide use, pest management costs, and crop yield and quality under conventional and IPM programs.

This project is coordinated at UC Davis by Michael Parrella and Chris Casey, a graduate student, in the Department of Entomology, and by Jim MacDonald and SRA Linda Bolkan in the Department of Plant Pathology. Karen Robb, Steve Tjosvold, and I are the cooperating farm advisors. Others involved in the project include representatives from chemical companies, an insectory, and a weather station consultant. The project is funded by The American Floral Endowment, the California Association of Nurserymen, the California Cut Flower Commission, the California Department of Pesticide Regulation, Roses Inc., the UC Davis Center for Pest Management Research and Extension, and USDA-ARS.

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Field Observations

Twospotted Spider Mites (TSSM). Now is the time to monitor carefully for TSSM, as warm summer days can result in population explosions. TSSM attack a wide range of floriculture crops. They pierce plant cells and remove sap, typically from lower leaf surfaces, causing stippling and chlorosis. Cast skins and webbing on foliage is also unaesthetic. Reduced-risk pesticides for TSSM control that we are evaluating in our rose PMA demonstration sites are Avid, Sanmite, Triact, M-Pede and Floramite. Floramite is not yet registered in California but is fairly compatible with mite predators. Resistance to some pesticides, e.g. Avid have been reported. Use of *Phytoseiulus persimilis* has been very effective at Myriad Nursery in Carpinteria, where we compared two poly houses, each 6,048 ft^2, containing 'Kardinal' rose plants. Mites in the IPM house were over the 5-10% threshold level when scouting began in March. We made two Persimilis releases uniformly in the rows, with additional mites targeted at hot spots. Five weeks after the second release TSSM was within the threshold level. Since then, TSSM remained close to zero. In contrast, in the control house, despite an application of Sanmite, TSSM remained high. At Sunshine Floral, Oxnard, where we compared a 4,082 ft^2 area of 'Kardinal' roses inside a plastic greenhouse with a similar sized area outside the structure, preliminary results of Persimilis releases have not been as dramatic. Although we have not been able to control TSSM below the 5-10% threshold level, co-occurrence of predator mites has increased. However, TSSM suppression is not as effective as in the control area, where two applications of Pentac were made.

Campus News & Updates

Submitted by Julie Newman, Farm Advisor UCCE

News

UC DAVIS. ***Dr. David Burger***, Environmental Horticulture Professor, was among 12 individuals awarded for outstanding contributions to the teaching, research and public service mission of UC Agriculture and Natural Resources. He received the 1999 Distinguished Service Award in the "Outstanding Faculty" category. The award recognized Dave's leadership activities in the Environmental Horticulture program, his efforts in improving communication among CE advisors, and his contribution to the development of the Ornamental Horticulture Research and Information Center (http://ohric.ucdavis.edu). OHRIC is a state-wide Cooperative Extension resource providing research, outreach, news, and information for the California horticulture industry.

Antonio Ferrante, a new postharvest researcher from Italy, is spending a year with Michael Reid and Don Hunter in the Department of Environmental Horticulture. He is investigating the control of senescence in the leaves of short-lived foliage.

Clyde Elmore, in the Weed Science Program, has started an interdisciplinary project to further evaluate chemical alternatives to methyl bromide. ***John Roncoroni***, Weed Science; ***James MacDonald*** and ***Linda Bolkan,*** Plant Pathology; and ***Howard Ferris*** and ***Inga Zasada***, Nematology are other researchers participating in the project. Microplots will be set up in three studies at Davis and at two sites in Watsonville. The project will evaluate methyl iodide, methyl bromide, propargyl bromide and metham. Three plant pathogens, 1 nematode, and 5 weed species will be evaluated at each site on calla lilies and gladioli bulbs. All of these pest species are common to field grown cut flowers. After these microplot studies, additional field tests will be conducted.

The following Elvenia J. Slosson Research Endowment awards of interest to the floriculture and nursery industry were recently made to UC Davis faculty: ***Dave Burger*** (Department of Environmental Horticulture) for "Selection and propagation of deep-rooted ornamental trees for urban environments," ***Michael Reid, Ellen Zagory*** *and* ***Wes Hackett*** (Department of Environmental Horticulture) for "Grafting for production of environmentally tolerant rhododendrons, azaleas and grevilleas" ***Harry Kaya*** (Department of Nematology) for "Molluscicidal nematodes for biological control of pest slugs" and ***Giles Waines*** *and* ***Stephen Morgan*** (Department of Botany and Plant Sciences) for "Ornamental selections of South African origin with educational interpretive displays."

UC RIVERSIDE. The Second California Conference on Biological Control will be held on July 11-12, 2000 at the Historic Mission Inn, Riverside, California. The purpose of the conference is to promote biological control and facilitate contact between biological control practitioners and researchers in California. The conference features a lineup of impressive speakers addressing biological control issues of importance to California. Organizations involved in planning this event include the Agricultural Research Service, USDA; Animal Plant and Health Inspection Service, USDA; California County Agricultural Commissioners; California Department of Food and Agriculture; California Department of Pesticide Regulation; California State University; and the University of California. Registration after June 23, 2000 is $150. Please visit: http://www.biocontrol.ucr.edu/ for more details on the conference and for registration information.

The California Department of Pesticide Regulation (DPR) recently awarded a Pest Management Alliance grant to the "California Containerized Nursery Industry Pest Management Alliance." UC principal investigators are ***Mike Rust, Bob Krieger, Heather Costa*** and ***Les Greenberg*** in the Department of Entomology, Riverside Campus; ***Cheryl Wilen,*** UCIPM Area Advisor in San Diego County and ***John Kabashima,*** UCCE Advisor in Orange County. In addition to University of California researchers, this industry alliance is composed of representatives from various containerized nurseries, allied agricultural industries, the California Association of Nurserymen, and DPR. The Alliance will demonstrate alternative strategies that allow growers to reduce the use of organophosphate pesticides and/or increase protection of surface water and ground water from runoff. A Pest Management Evaluation was developed to provide background information on the most important pests and pest management concerns of the containerized nursery industry in California, and to identify the materials presently used to manage those pests. From this evaluation, issues with the greatest potential for impact on DPR priority areas were identified. During the first year of funding, the Alliance will focus on the demonstration of improved monitoring techniques for red imported fire ant, to ultimately reduce the amount of organophosphates and other insecticides in quarantined areas. Another objective during the first year is demonstration of runoff mitigation techniques that can be achieved through an integration of industry practices currently being utilized by various agricultural commodities.

Antoon Ploeg, Department of Nematology, and ***Steve Tjosvold,*** UCCE Farm Advisor, Santa Cruz County, recently received a grant from the Elvenia J. Slosson Research Endowment for "Bio-fumigation/solarization for the control of nematodes and weeds."

Research Updates

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Bio-fumigation and soil heating for root-knot nematode control. Non-chemical methods for nematode control include bio-fumigation and soil solarization. Bio-fumigation occurs when biological materials release volatiles with pesticide-like properties. Brassica-type crops

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(broccoli, cabbage, collard etc.) release cyanide-like compounds after incorporation into the soil during decomposition. Both methods can provide nematode control, but root-knot nematodes appear among the most difficult. Stapleton & Duncan showed that combining both methods greatly improved control of the root-knot nematode *M. incognita*. We recently completed greenhouse experiments on the effects of soil temperature, treatment period, and amending soil with broccoli leaves on control of *M. incognita* and *M. javanica*. Closed containers with nematode-infested soil were placed in waterbaths at different temperatures. Melon seedlings, highly susceptible to root-knot nematodes, were used as bio-assay plants. The results showed that both nematode species reacted similarly to the treatments. When no broccoli was added and the soil was not heated, almost all melon seedlings died as a result of the nematode infestation. At soil temperatures below 86° F, adding broccoli to the soil did not affect the infestation of the melon seedlings. However, at temperatures above 86° F, adding broccoli significantly reduced the nematode infestation. The higher the soil temperature, the sooner the effect of adding broccoli was apparent. The results of these greenhouse experiments are being evaluated under field conditions at two different locations.

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Estimate of crop losses to plant parasitic nematodes. Annual U.S. crop losses to plant parasitic nematodes have been estimated to be about $8 billion. Information on pest related crop losses are crucial to government agencies, crop production and protection corporations, universities, extension agencies, commodity boards, and growers. Regulatory policy actions, pesticide impact assessments, resource allocation, program prioritization, and pest management decisions are frequently contingent upon such data. However, despite the obvious benefits, crop-loss assessment data are increasingly difficult to obtain. Therefore, the Society of Nematologists Extension Committee used survey and inquiry techniques to poll the expert opinions of university crop production and pest management specialists for information on estimated crop losses caused by plant-parasitic nematodes in major crops. Included in this recently published paper* are survey results from 35 states on various crops. The data are reported systematically by state and include the estimated loss, area of production, source of information, nematode species and crop value.

* Koenning, S.R., C. Overstreet, J.W. Noling, P.A. Donald, J.O. Becker, and B.A. Fortnum 1999. Survey of crop losses in response to phytoparasitic nematodes in the United States for 1994. J. Nematology 31:587-618.

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Special Thanks to these Sustaining Sponsors of the 2000 CORF Grower Education Programs...

CORF
Floriculture education from the Kee Kitayama Research Foundation

CORF News is the quarterly publication of CORF, the California Ornamental Research Federation, a statewide partnership of growers, floriculture associations, allied industry and research/educators whose mission is to identify and meet the research and educational needs of the California floriculture industry.

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Calendar of Industry Events

July
14-16.....Texas State Florists Assn Convention, Houston, 512/834-0361
August
11-13....CSFA Floriculture Retreat, San Luis Obispo, 916/448-5266
September
10-15....CCFC, Trade Mission, TBD, 831/728-7333
20-23....SAF Annual Convention, 703/836-8700
26.....CORF Frost Control Seminar, San Diego, 707/462-2425
26.....CORF Grower School: Asters & Lisianthus, Salinas, 707/462-2425
October
3.....CORF Bugs 2000 Seminar, Ventura, 707/462-2425
13-15 .. CSFA *Calif Flora 2000*, Newport Beach, 916/448-5266
18.....CORF Frost Control Seminar, Watsonville, 707/462-2425
26.....CORF Soil Steaming Seminar, Salinas, 707/462-2425
November
30.....CORF CA Ornamental Plant Disease Control Symposium, Watsonville, 707/462-2425
December
7.....CORF Container Media Seminar, Half Moon Bay, 707/462-2425

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