



CORF News

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Nitrogen Fertilizer Management for Ornamental Crops

By Richard Evans and Linda Dodge, Dept. of Environmental Horticulture, UC Davis

In the typical nursery, fertilizer and irrigation water are applied to crops frequently and in large amounts, so the potential for introduction of pollutants from runoff and leaching losses is great. Although there is a wide range of both ornamental crops and production systems, many characteristics of fertilizer and water use by these crops can be generalized and used to develop management goals. Growers can reduce the introduction of nutrients into surface and groundwater by attending to three important aspects of plant management.

1. Apply the correct amount of nitrogen.

Nitrogen usually is applied to ornamental crops in amounts that exceed plant needs. Where fertilizers are injected into the irrigation water, nitrogen fertilizer overuse can also result from application of excessive amounts of water and from overspray that misses containers or beds. Nitrogen application rates vary widely among nurseries, but typical annual

values range from 2,500-7,000 lb/acre. Nitrogen uptake by crops is also variable, but for most ornamental crops nitrogen uptake projected over a year is between 400-1,000 lb N/acre, which means the typical amount applied is more than six times what is needed for plant growth.

How much nitrogen do ornamental crops need? We lack this information for many crops, but Table 1 presents values for a few crops (see pg. 2)

Plant requirements for nitrogen vary according to growth rate and stage of development. For example, the rate of nitrogen uptake by potted chrysanthemums increases during vegetative growth, then decreases sharply after flower buds form (Figure 1, see pg. 2). Poinsettias behave in a similar fashion. Roses and some other woody species exhibit a cyclical pattern of nitrogen uptake that is related to episodes

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Central Coast Greenhouses to be Regulated as Point Pollution Sources

By Julie P. Newman, UCCE, Ventura and Santa Barbara Counties

As a part of the agriculture industry, the California Regional Water Quality Control Board (RWQCB) usually regulates greenhouses less stringently than factories and other industrial pollution sources. Recently, however, the Central Coast Region publicly departed from other RWQCBs (such those regulating Orange, Los Angeles, Ventura, and San Mateo Counties) in examining greenhouses as point pollution, rather than non-point pollution sources. They also exclude greenhouses in their definition of agriculture, in which they include "outdoor nurseries, field flowers, row crops, and orchards."

According to statewide RWQCB terminology, point pollution sources distribute water through a pipe. However, this is not the major reason that the Central Coast Regional Board considers greenhouses as point pollution sources. They contend that greenhouses not only distribute water through pipes, but also typically discharge **processed wastewater** produced from **within** the greenhouse (eg from RO systems, boilers, and hydroponic-type systems). In contrast, "agriculture" manages **rainwater**, although the Central Coast Board concedes that agriculture may also distribute water through pipes. This regional interpretation of the RWQCB regulation policy is important because non-point sources of wastewater are regulated through best management practices to reduce pollution, and

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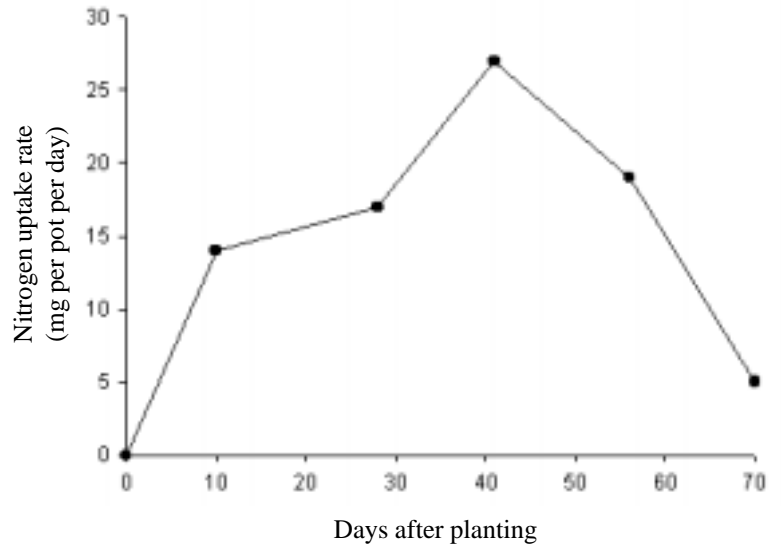
Nitrogen for Ornamentals

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Table 1. Nitrogen content, in grams, for certain ornamental crops at commercial maturity.

<u>Crop</u>	<u>Tissue N, g</u>
Poinsettia (6-inch)	0.5-0.7
Chrysanthemum (6-inch)	1.2-1.7
Hydrangea (1-gallon)	1.75
Azalea (6-inch)	0.5-0.7
Holly (1-gallon)	0.5-0.7
Rose (per harvested stem)	0.2
<i>Euonymus japonica</i> (3 months)	0.9-1.6
<i>Quercus agrifolia</i> (1 season)	0.6
<i>Pistacia chinensis</i> (1 season)	2.6
<i>Platanus acerifolia</i> (1 season)	4.7

Figure 1. Nitrogen uptake rate of a 6 - inch potted chrysanthemum



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Nitrogen for Ornamentals

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of shoot growth and either pruning or dormancy. Depending on the method of applying nitrogen, it may be possible for growers to adapt the fertilizer program to match changes in plant nitrogen demand.

Liquid feeding is less expensive than controlled-release fertilizers, after initial capital costs for injectors, and it is well suited to nurseries that produce large areas of uniform crops because fertilizer concentrations can be varied according to crop needs - for example, decreasing the nitrogen supply late in a chrysanthemum crop. The major disadvantages of liquid feeding are its inefficiency in putting nitrogen into the root zone and its susceptibility to leaching losses of nitrogen from excessive irrigation.

Controlled-release fertilizers can greatly reduce nitrogen losses if they are applied correctly. Nutrient release rates are controlled by the properties of the capsule walls and by temperature and moisture, not by plant needs. Therefore an amount of controlled-release fertilizer that releases enough nitrogen to feed a rapidly-growing plant (for example, a 40-day-old chrysanthemum that takes up 30 mg N per day) would be far more than the amount needed for a young plant or one that is no longer taking up much nitrogen (for example, a 70-day-old chrysanthemum). The excess nitrogen that is released can be lost to leaching if plants are over-irrigated. Controlled-release fertilizer formulations are improving, so the range of ornamental crops for which they are suitable is expanding.

2. Apply the correct amount of water.

Most nurseries over-irrigate. Growers need to know how much water their crops use and irrigate accordingly. Water use can be measured directly in nurseries that produce plants in containers. Using a scale that expresses weights to the nearest gram, growers can record the weights of a representative number of pots an hour after irrigation and again the next day just before irrigation. The difference in weight, expressed in grams, represents the water use in milliliters (mL). By taking measurements periodically, the grower can anticipate average seasonal crop water needs. The average daily water use of some

mature ornamental crops grown in Davis, California, is presented in Table 2.

Water needs can be estimated by using local values for reference evapotranspiration (ET_0). Evapotranspiration refers to water lost by plant uptake and by evaporation from the soil surface. More details about ET can be found in UC Leaflet 21199, 'Basic Irrigation Scheduling.' Briefly, the idea is to relate the water use of a crop to the water use of a standardized planting (usually grass) or surface (usually a pan of free water). Crop water use is related to the standard water use by a number called the crop coefficient. Values for ET_0 are available through the California Irrigation Management Information System (<http://www.dpla.water.ca.gov/cgi-bin/cimis/cimis/hq/main.pl>). Table 3 presents estimated water use of greenhouse and outdoor crops based on ET_0 . Measured values for a few summer flower crops grown near the coast in San Mateo County are about 20% lower than the calculated values, so this method for estimating water needs is good but not perfect. Growers interested in estimating water requirements are welcome to contact us.

3. Apply the water and fertilizer accurately.

The steps above are of limited value unless irrigation water is delivered uniformly. Nurseries should install well-designed irrigation systems that employ reliable nozzles or emitters. Efficiency can be further improved if plants are grouped by expected water use and runoff water is either captured and recycled or channeled through vegetative filters that remove nitrogen before it leaves the nursery. ❖

Table 2. Average daily water use of some ornamental crops grown in Davis, California.

Crop	Water use (mL per day)
Hydrangea (1 gallon, outdoor)	450
Holly (1 gallon, outdoor)	170
Rhododendron (1 gallon, outdoor)	200
Privet (1-gallon, outdoor)	225
Greenhouse rose (for cut flowers)	400
Chrysanthemum (6-inch)	240

Table 3. Calculated average daily water use of ornamental crops in Half Moon Bay, based on historic ET_0 values.

	Outdoor crop		Greenhouse crop	
	(mL/ft ²)	(gal/1000 ft ²)	(mL/ft ²)	(gal/1000 ft ²)
Jan	118	31	177	47
Feb	126	33	189	50
Mar	189	50	189	50
Apr	228	60	171	45
May	307	81	230	61
Jun	330	87	248	65
Jul	338	89	254	67
Aug	323	85	242	64
Sep	275	73	206	55
Oct	220	58	220	58
Nov	102	27	179	47
Dec	79	21	157	42

California Growers Share Their Views and Experiences on Water Regulations

By Steven A. Tjosvold, Julie P. Newman, Ann King and Karen L. Robb

California growers are facing increasingly stringent water and water runoff regulations. We have asked growers throughout the state to comment on their views and experiences in dealing with water regulations. We found that many growers are taking a proactive approach to dealing with these increasing water regulations.

Santa Cruz County

Managers at Suncrest Nursery in Watsonville are not waiting for the inevitable regulations limiting water runoff to push them into making their operation more water efficient and reducing runoff. They have taken an active role for many years in limiting water runoff at this 25 acre containerized-ornamentals nursery. Their investments in water studies, improvements in irrigation distribution, irrigation automation, and runoff recycling have saved thousands of gallons of water per year and paid off financially as well. Production plants seem to be responding very well with the improved irrigation system and management tools too.

General manager Jim Marshall stated, "We knew we could improve our irrigation efficiency, even in the late 70's." In 1989, with new owners supporting his work, and Jim fresh from 2 years of training in hydrology, the nursery undertook a series of evaluations of water use and irrigation designs. "Initially the priorities were to improve irrigation distribution and automate irrigation timing," Jim said. Production plants were organized into groups by their appropriate water needs. Recently, a local engineer has helped design a drainage system and water collection basin. Most plants in the nursery receive recycled water blended with 50% fresh well water. Some plants such as ferns and plants in the propagation greenhouses were deemed too sensitive and do not receive any recycled water, which is higher in soluble salts.

The recent purchase of a nearby nursery in Watsonville, now known as Sunspot Nursery, gave the managers a great opportunity to start to implement even bigger plans for water recycling. At this new operation, a 6-mil tarp underlies all production areas and is capable of collecting all water runoff. Irrigation drainage and a collection pond are designed and awaiting permit approval for construction.

Santa Barbara & Ventura Counties

As a result of the RWQCB's recent decision

to hold growers accountable to point source pollution regulations, many of the greenhouse growers in Carpinteria are planning to recycle their water. Some are installing collection systems for overdrain or using existing ponds where they will filtrate, treat, blend and recycle. Many are examining the use of RO systems to use with recycling because the Carpinteria city water is high in bicarbonates. Some hydroponic-style growers are already recycling, using RO water and computer-controlled injection of fertilizers. The runoff water is recaptured and treated to reduce pathogens. A number of the Dutch style operations are using heat treatment for reducing pathogens, but UV-ozonation and sand sedimentation is also being examined. In some cases, poor-quality water that is collected from the nursery is being used for irrigating landscapes and avocado trees not used for production.

In Ventura County, recycling that is currently underway is limited to a couple of outdoor nursery stock operations. Many growers are starting to think about recycling but are not yet prepared to do so. As a result of the situation in Carpinteria, one nursery contacted the RWQCB with jurisdiction in Ventura County and was assured that greenhouses in Ventura County would continue to be treated as non-point sources of pollution. Based on this information, the nursery decided to install a pond with sediment filter for \$10,000 rather than going with a complete recycling system with a quoted cost of \$150,000. They plan to use this collected water to control dust on the roads instead of using fresh water, thereby conserving over-all water use.

In addition to recycling, growers in Ventura and Santa Barbara Counties are examining other ways of reducing runoff and conserving water. These include use of pulse irrigation, switching timed irrigation schedules to those controlled by environmental sensors, increasing the number of solenoids to improve the operating efficiency of automated systems, installing pressure regulators and check valves, increasing the use of slow release fertilizers over soluble fertilizer applications, switching from overhead and hand

irrigation to use of booms, micro sprinklers, drip and subirrigation, and collecting rain water from greenhouse roofs.

Orange County

Growers in Orange County have been facing water regulations since the mid 1980s, so being regulated is not new to them. George Gutman, of Bordier's Nursery and previously with Hine's Nursery has some excellent advice for growers who are just now facing these regulations. The bottom line, according to George, is that if there is no runoff leaving the property, you have no problems. So the closer your system is to reducing 100% of water runoff, whether it be through water recycling systems, pulse irrigation practices, etc., then the easier it is to deal with whatever runoff does occur.

"Be proactive and work to the common good," recommends George. In the long run, any grower or any business who challenges these environmental regulations will face an uphill battle. "Get involved and work with the local boards. You don't have to be an activist, but you do need to let them know your concerns." George has been working with the water board in Orange County since the mid 1980s. During this time, he has observed that a sense of trust and cooperation has developed on all sides. View this as an opportunity to educate and change opinions. For example, the water board seemed to be of the opinion that all of the nitrogen in the Newport Back Bay was the result of nursery runoff. However, it became clear in the 1990 report that only 12-13% of the nitrogen going to the bay was due to nurseries.

It turns out that the systems growers have implemented in Orange County make good economic sense, irrespective of water regulations. "Where water recovery systems were installed, they have paid for themselves at least three times over in water and fertilizer savings. Compliance with environmental issues is gravy," states George.

Working through the regulations can be intimidating at first, but the process becomes routine, according to George. "Plan to add staff. Environmental compliance has become a full time job for most big businesses here in Orange County. While

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Central Coast Regulations

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growers are often self-regulated. More stringent regulation, however, is mandated for point pollution sources.

As point pollution sources, RWQCB recommends that greenhouse water is recycled. This is because if there is no waste discharge, no regulation is required other than submission and acceptance of a technical report.

However, if growers elect to discharge into ponds without recycling, then more reports and monitoring will be required. In addition to a technical report, these growers must submit a Report of Waste Discharge (ROWD). Based on the ROWD, the RWQCB may conditionally waive or adopt Waste Discharge Requirements (WDRS). Minimal monitoring and reporting would be necessary for ponds that are unlined, although wastewater treatment could be required. If wastewater concentrations exceed groundwater quality standards, then growers must line the pond. Lined ponds require substantial monitoring of wastewater discharge and pond contents due to concern that the water might escape the pond. They also require groundwater monitoring, frequent reporting and inspections by RWQCB staff, and typically require wastewater treatment.

If growers elect to discharge into a creek or other surface water and have wastewater concentrations substantially less than drinking water quality with low flow rates, then in addition to the technical report they must obtain a Notice of Intent to Comply with Low-Threat Discharge General Permit. Moderate monitoring and reporting are required with this permit and wastewater treatment may be required. If, however, growers elect to discharge into a creek or other surface water, and have wastewater concentrations that exceed surface drinking water quality standards, then they must obtain a Federal National Pollutant Discharge Elimination System Permit by the RWQCB upon public meetings. This permit requires substantial monitoring, reporting, and inspections, and typically requires wastewater treatment.

Since the Central Coast RWQCB regulates San Luis Obispo, Monterey, and Santa

IPM Update - Temperature Plays a Part in Biocontrol Efficacy

Do you recall the 2-3 week heat wave that went through California in August? I do and am still feeling the effects of it in emails from homeowners. Not that I had anything to do with the heat, but I happen to be the contact person on a website that contains information about the landscape pest, giant whitefly (GWF). People have been emailing me with questions about what to do to control it. GWF had not been too bad most of the summer but now it is really out of control. These emails started about 3 weeks after the heat wave and I think the GWF population exploded because the biocontrols were affected by the heat and could not keep up with the GWF population. This served as an important reminder to me that we have to be vigilant in monitoring not only pest numbers but also those of the parasitoids or predators, particularly when an unusual event occurs. What is an unusual event? Temperature spikes or dips, use of a pesticide that is not normally in your rotation, and removing or putting in a new crop near the one you are monitoring are all examples. The problem is, the effects of these "unusual events" are not usually noted until a period of time following the event. Therefore, it is very important to keep good records of weather, application dates, and cropping dates, and use that information to work backwards to determine the cause if a problem occurs. One of the best ways to overcome such situations is to have a good, regular, monitoring and record-keeping program in place. That way these unwelcome surprises are kept to a minimum.

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Cruz Counties, there is a strong likelihood that point source regulations will apply to greenhouses in these areas as well in the future, as the RWQCB intends to use these policy interpretations throughout the region. In addition, other RWQCBs may modify their definition of agriculture and point vs. non-point source pollution, based on the outcome in central coast counties. There are also other signs that this new interpretation may eventually become statewide. San Diego County, for example, is interpreting the state RWQCB definition of point pollution sources to include not only greenhouses, but also nurseries and botanic gardens, as well as landscapes, golf courses and cemeteries. Although nothing has been formally presented yet in writing, it is likely that as the holders of RWQCB permits, San Diego County will be requiring nursery grower participants in the non-point source pollution program to obtain the required point pollution permits in the future if they are discharging wastewater.

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Regional Report

San Mateo & San Francisco Counties

98th International Conference of the American Society for Horticultural Science



The 98th International Conference of the American Society for Horticultural Science was held in Sacramento in July.

This is one of the annual conferences at which University researchers present research data on horticultural production and related topics. The conference features oral sessions, poster sessions, and special workshops and symposia.

There were so many interesting papers and topics that I cannot present them all here, but I will give you some of the highlights relating to floriculture production and postharvest. It should be encouraging to growers to note that much of the floriculture research was applicable to current production practices.

Shoot-Bending on Roses: Heiner Lieth's lab at the University of California Davis found that shoot-bending does increase stem length and dry matter, but that the number of harvestable shoots is reduced, as has been previously shown. What is interesting is the economic analysis that was conducted in this study, and which is missing in many past studies. His student, Soo-Hyung Kim, found that the improvement of stem length in 'Fire 'N Ice' rose cultivar did not offset the economic loss due to the reduced number of shoots, as a result of shoot-bending. Only under market conditions where extra-long stems are of substantially high value could shoot-bending in roses result in greater economic gain.

Gibberellin on Postharvest Life of Cut Lilies: Anil Ranwala and Bill Miller at Cornell University showed that pulse treatments or sprays of different gibberellic acid formulations on cut Oriental, Asiatic, and LA-hybrid lily cultivars not only delayed leaf chlorosis, but also prolonged the life of the flowers by several days. The leaf chlorosis that often appears following low temperature storage was also delayed by gibberellic acid treatment.

Gibberellin on Calla Lily Bulbs: D. Zhang (University of Maine) and W. Brown (Golden State Bulb Growers) treated *Zantedeschia rehmannii* tubers with different gibberellic acid concentrations prior to planting the tubers into 6" pots. The total number of flowers per plant increased five-fold, and the total number of shoots per plants increased significantly. Treated plants were taller than untreated plants, and the plants emerged a little earlier following gibberellin treatment. Plants had a much better appearance with 200 ppm or higher concentrations of gibberellin applied to the tubers prior to planting, as compared with plants not treated with gibberellin.

Thidiazuron to Prevent Leaf Yellowing: Michael Reid's group at the University of California Davis is working to develop thidiazuron (TDZ), a material with cytokinin-like activity, as a treatment to prevent leaf yellowing and leaf drop in cut flower stems and on potted plants. Antonio Ferrante, Don Hunter, et al showed that TDZ has a substantial effect on reducing leaf yellowing on cut *Alstroemeria* stems. Ann King, Mingfong Yi, et al showed that TDZ markedly delays leaf yellowing in potted poinsettias, lilies, and other species (this was work that I conducted during my sabbatic last year at UC Davis, and am continuing with Michael Reid and several California growers).

Paclobutrazol for Poinsettia Height Control: Niu, Heins, and Carlson (Michigan State University) examined late-season height control of 'Freedom' poinsettia with Bonzi drenches. While Bonzi controls late stretch, it can also reduce bract size if not used properly. They found that Bonzi's effect on plant height and bract size reduction decreased as application of Bonzi was delayed until later in the growing cycle. Their conclusion was that drench applications should be delayed as long as possible to avoid significant reduction in bract size.

Aluminum-Charged Zeolite for Blue

Hydrangea: Opena and Williams (Kansas State University) experimented with developing an aluminum-charged zeolite which could be incorporated into the growing medium to avoid the traditional labor-intensive aluminum treatments, which are made several times during the growing season. They formulated an aluminum-charged zeolite, which was then oven-dried and incorporated into a peat-perlite growing mix prior to planting. The zeolite released a lot of aluminum during the first 2 weeks of greenhouse forcing, followed by a lower steady aluminum concentration during the remainder of production. Final aluminum content of the foliage in the zeolite treatment was not significantly different from the commercial control (multiple manual applications). They suggest the pre-charged zeolite can be used for blue hydrangea production.

"Iron-Out" Program for Iron and Manganese Toxicity: Paul Fisher's group at the University of New Hampshire presented information on an interesting extension program, called "Iron-Out," which shows how to manage the pH of soilless growing media and avoid Iron (Fe) and Manganese (Mn) toxicity symptoms on sensitive crops such as geranium and marigold. The program stresses the need for regular monitoring of pH and EC. Watch for more about this grower-friendly program in trade journals.

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Regional Report

Santa Cruz & Monterey Counties

National Greenhouse & Nursery Plant Management Workshop Demonstrates Similarity of Grower Problems



A workshop sponsored by Valent USA Corporation held in Virginia this June brought together 20 researchers from around the country who work on ornamental plant diseases, insects, weeds and plant growth regulators. As a participant of this two day event, it was very interesting for me to hear from my colleagues in these diverse parts of the United States about the industries and disciplines they represented. What was clear to me in the free-flowing discussions is that our issues and problems in California are very similar to those in other regions of the United States.

Take for example the issue of water quality and water conservation. John Erwin, Associate Professor in Floriculture at the University of Minnesota talked of the public outcry in eastern Minnesota related to the findings of poor water quality traceable to the nursery industry. As a result, the Minnesota nursery industry is changing. There are more impermeable production surfaces and more recycling of water. More planning is necessary too; the so-called 'Nutrient Management Plans' are being implemented by Minnesota nurseries. Larry Barnes, Extension Plant Pathologist at Texas A&M, confirmed that Texas nurseries are also developing more water recycling systems. Larry sees an increased need to solve the problems associated with plant pathogens in recycled water. Joe Neal and Brian Whipker from North Carolina State University reiterated the increased use of recycled irrigation water but it was not primarily for water quality issues. North Carolina and much of the South were hit hard by a serious drought. Growers needed to conserve water otherwise they couldn't grow crops!

Growers around the nation still are fighting new insects and diseases and resistance to chemical pesticides.

Mealybugs seem to be the pest of most concern now. Ron Oetting, Entomologist at the University of Georgia, related problems in the South in controlling what has been called the citrus mealybug. Pesticides such as Orthene, Talstar, and Dursban that formerly worked just don't have the punch they once had. The Mexican mealybug might actually be the culprit he says; it tends to be harder to control. Oriental beetle and Asian ambrosia beetle are new pests introduced in the South and they are tough to control. Margery Daughtrey, plant pathologist from Cornell University Cooperative Extension said she is seeing some copper resistance to some bacterial diseases. Copper, however, still works better than some new systemic activated resistance compounds (Actigard and Messenger). After a lengthy and lively discussion on resistance management, the bottom line still is: *Delay resistance with chemical rotation.*

Although there are general guidelines on chemical labels for use of plant growth retardants, the fine-tuning of these chemical applications has to be left to the grower. Jim Barrett, Professor at the University of Florida, outlined the factors that a grower needs to consider when making these applications. These include, knowledge of the cultivar, stage of growth, geographical differences, application techniques, and influence of environmental control through 'DIF', the manipulation of day and night temperatures.

Although the California ornamental industry may think that it is very unique in many ways, what I heard in two days of discussion on industry issues, is that we are, in many aspects, facing similar challenges and needs as the rest of the country.

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Field Observations

Virus in Greenhouse-grown Cut Snapdragons

An extensive virus infection has been discovered in a large planting of cut snapdragons in a Monterey Bay area greenhouse. It is significant in that two years ago this problem was first found on winter cultivars, primarily 'Marilyn White'. At this time the summer plantings of snapdragons in the Potomac series ('Potomac Rose' and 'Potomac Ivory') are showing substantial virus symptoms.

The virus or viruses causing the symptoms remained unidentified in 1999. Virologist Dennis Mayhew, CDFA in Sacramento, confirmed 2 double-stranded RNA species, with crystal present, which is suggestive of a virus. However, ELISA testing for 8 common viruses proved negative. The most common viruses found in snapdragons are Impatiens necrotic spot, Tomato spotted wilt, and Cucumber mosaic.

Symptoms in the present plantings are identical to the symptoms in the past. The symptoms start to show up when the flower buds start to fully swell, but before they open. In the present planting the plants are about 3 feet tall when symptoms appear (a harvestable planting would be around 5 feet tall). The first symptoms show up on the older foliage, as the plants reach maturity the symptoms appear to move up onto younger foliage. So far, the symptoms do not move up significantly at the top third of the plant in a way that precludes the sale of the crop. Leaves have "bleached" irregular areas and circular patterns only visible on the top surface of the leaf. Affected leaves are not distorted.

These symptoms are not caused by downy mildew. Downy mildew can be seen in some of these same plantings but it usually occurs on the youngest foliage, often causes leaf distortion, and in the right conditions will express itself with fluffy gray spores on the underside of the leaf.

New samples are being sent for virus testing. I would be very interested in hearing from anyone who has seen similar symptoms. We might be able to link a particular source or cultivar series to this problem. I can email digital images of the symptoms to anyone that requests them.

Field Observations

Downy Mildew

Recently, an Oxnard chrysanthemum sample was confirmed by Dr. Albert Paulus, UC Riverside, to be infected with a downy mildew, *Peronospora leptosperma*. Although this downy mildew fungus has been found in Florida, it has never been reported in California. However, it is found in California on native *Artemisia* sagebrush, where the fungus infection possibly originated.

Downy mildew is a disease favored by cool temperatures, high humidity, and leaf wetness. Fog and dew increase disease incidence because the fungal spores require moisture to germinate. Primarily found in the spring, due to the unusually foggy, cool weather this summer, it is not an uncommon problem.

The name downy mildew refers to the fuzzy white to purplish-brown fungal growth. This growth, unlike powdery mildew, is typically on leaf undersides. Discolored areas are sometimes visible on upper surfaces, and plant growth may be distorted in systemic infections. Snapdragons, roses, pansies, alyssum, and salvia are particularly susceptible. The fungi that cause the disease are host specific; i.e. the downy mildew that occurs on roses cannot infect snapdragons, etc. To manage downy mildew, know the susceptible crops and their disease symptoms. Scout frequently to ensure timely treatment. Rogue diseased plants immediately and carefully because spores are airborne. Treatment is warranted before you see signs of infestation if you grow a susceptible crop with a disease history and conditions are wet. Symptoms can be prevented in the greenhouse by heating and reducing humidity. Chemical options include Dithane T/O, Protect T/O, Alliette, Phyton 27, Subdue MAXX, Heritage, and COMPASS. Check the label for registration and use information.

Regional Report

Ventura & Santa Barbara Counties

New Regulations Force Carpinteria Greenhouse Growers to Recycle



In response to high nitrate levels found in the Santa Monica and Franklin Creeks, the Central Coast Regional Water Quality Control Board (RWQCB) sent 66 nurseries in Carpinteria a 'Cease and Desist Order' on July 2, 2001. The RWQCB assumed that elevated nitrate levels may be partly due to Carpinteria greenhouses because random inspections found that greenhouses were discharging wastewater into the creeks. However, according to the Santa Barbara County Water Agency, only a minority of the acreage for greenhouse operations exists in these watersheds, and only brine from water softeners was found in the random inspections, not high nitrate levels.

Nevertheless, greenhouse owners were ordered to cease discharging water into any surface water. Owners were also ordered to submit a technical report describing how they currently dispose of greenhouse, groundwater, and rainstorm runoff. For greenhouse water, estimated flow rates and water chemical analysis for General Minerals, including nitrate and TTDS were to be described. Growers were also ordered to prepare a plan for proper disposal of wastewater in the future with a timetable for implementation by March 1, 2002. The deadline for the technical report was August 17, but was later extended to October 17, 2001.

All this came at a time when growers were still reeling from countless meetings to oppose county rezoning that would severely curtail future Carpinteria greenhouse development. In addition, recent emergency intervention strategies demanded growers' time concerning new County and City plans to use private land currently occupied by greenhouses for other purposes. Growers were weary, not only from all the confrontations with regulatory agencies, but also from the constant media portrayal of the industry as blatant despoilers of the environment.

A public workshop was held by the RWQCB on August 20 to explain the meaning of the order and address questions. It became apparent at the meeting that if growers do not recycle their water, they most likely will have to apply for special permits, be regulated by RWQCB, and provide regular monitoring information.

Growers at the workshop mentioned several obstacles to compliance with RWQCB demands. This included starting with water that is below drinking water standards and a lengthy permit process for installing recycling facilities. These problems will be taken into account in RWQCB decisions. The RWQB is of the opinion that growers who recycle would contribute primarily to high salts and not necessarily to high nitrates, and are looking to the industry to demonstrate that they are not the source of high nitrates. High salts end up in the Carpinteria salt marsh where they are not a problem, although it can be an issue in ground water. RWQB also stated that compliance would put growers in good shape when TMDLs for identified impaired Carpinteria water bodies are developed in approximately 5 years.

New UCCE Water Coordinator Available to Assist Growers

We recently hired a Water Coordinator to work with flower and nursery growers in Ventura and Santa Barbara Counties on an individual and anonymous basis. **Christie Rea** (phone: 805/645-1463; e-mail: cearea@ucdavis.edu) is available to assist in the development of nursery water quality plans and self-assessments, technical reports, development of best management practices, or any other water/nutrient run-off related problem.

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Regional Report

San Diego County

Redgum Lerp Psyllid Biological Control Established in San Diego County



The redgum lerp psyllid, an insect native to Australia, has defoliated thousands of eucalyptus trees planted throughout California since the pest was discovered in Los Angeles County in 1998. Last year, it was not uncommon to see stark, bare branches of normally evergreen eucalyptus. Most of the defoliated trees are *Eucalyptus camaldulensis*, river red gum, the preferred host of the red gum lerp psyllid, *Glycaspis brimblecombei*. Other eucalyptus species include *E. rudis* (flooded gum), *E. globulus* (blue gum), *E. diversicolor* (Karri), *E. sideroxylon* (red ironbark), *E. nicholii* (narrow-leaved peppermint), and *E. lehmanii* (bush yate).

Infested trees are damaged by the psyllid nymphs. Their feeding causes damaged leaves to drop and dense populations can completely defoliate even large trees. The bare branches produce new leaves to replace lost foliage, but repeated defoliation progressively weakens trees and can eventually kill them.

Biological Control Program: The best long-term solution to this problem is to control the psyllid with its own natural enemies. A team of UC researchers, headed by Dr. Donald Dahlsten, UC Berkeley entomologist, has been working statewide on this program. In August 1999, Dr. Dahlsten traveled to Australia, collected tiny parasitic wasps, *Psyllaephagus bliteus*, that feed on the psyllid and brought them back to a quarantine facility near Berkeley. The beneficial wasps were reared at the facility and extensively tested to determine if they could be safely released without harm to any native species. With approval from federal and state regulatory agencies, the first field release was made in Los Angeles County on June 7, 2000.

Difficulties in rearing the psyllid in enclosed environments limited the numbers of parasites available for mass releases. Only one hundred of the parasitic wasps were initially released in San Diego on September 15, 2000, at a test site in Scripps Ranch. A second release was made on October 18 at Mission Bay and Rancho Santa Fe. Additional wasps were released this year on April 11 at Mission Bay and May 9 at Rancho Santa Fe.

THE PARASITES ARE ESTABLISHED!! Despite the low numbers initially released, the parasites are working and they are spreading. At the original release site in Scripps Ranch, for example, there has been a dramatic reduction in the numbers of lerp psyllids on new foliage. Most of the second and third instar psyllid nymphs present on these leaves are parasitized at the original site of release. Not only have the parasites established, they are expanding their range. And we are seeing foliage reappear on trees which have been repeatedly defoliated. Will the parasites eliminate the psyllids? No, but we are anticipating that the population will be held in check, similar to the situation with the blue gum psyllid and its *Psyllaephagus* parasite.

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Field Observations

Spotted Gum Lerp Psyllid Spreading in Southern California

The spotted gum lerp psyllid (*Eucalyptolyma maideni*) is another lerp psyllid which has recently found its way into California and is making its presence known on *Eucalyptus citriodora* and *E. maculata*. To date, this psyllid is found in Los Angeles, Orange, Riverside and San Diego Counties.

This lerp psyllid is also native to Australia. Unlike red gum lerp psyllids, spotted gum lerp psyllid nymphs produce a funnel-like lerp structure of crystallized honeydew as a protective cover. Young nymphs build a flat funnel-like lerp by secreting gelatinous honeydew. The lerp looks as if it has skeletal ribs on its sides. More than one nymph can live under these lerps. The nymphs are quite mobile and move easily in and out of the lerps.

These psyllids are copious producers of honeydew. Expect complaints regarding the nuisance nature of these psyllids.

Eucalyptus Tortoise Beetle Attacks *E. nicholii*

Growers of *E. nicholii* for cut foliage have reported extensive foliar damage as a result of eucalyptus tortoise beetle feeding. This damage is characterized by notched edges. The damage is more frequently observed than the beetle larvae or adults. There is a biological control program underway at UCR under the direction of Dr. Tim Paine, evaluating the efficacy of the parasite, *Enoggera reticulata*, for control of this pest.

Lemongum Eucalyptus Gall Wasp Found in Southern California

A small gall-forming wasp is attacking lemongum eucalyptus in Los Angeles, Orange and San Diego Counties. Lemongum eucalyptus gall wasp, *Epichrysocharis burwelli*, belongs to the parasitic wasp family Eulophidae. It is only known to attack lemon gum and the damage is only cosmetic. Larval wasps inject a toxin in the leaves which results in the formation of a gall. Upon completion of larval and pupal development, the adult wasp hatches out of the gall, leaving a characteristic hole in the top of the gall.

Growers' Views

Continued from page 4

compliance with environmental regulations may not always make money, it certainly keeps a company from losing money.”

San Mateo County

In San Mateo County, growers are recycling water to reduce overall consumption, but they are also implementing measures to reduce runoff of fertilizers, pesticides, and soil particles. The growers in the county have formed several watershed working groups to develop practices to proactively protect adjacent watersheds.

John Muller, owner of Daylight Nurseries in Half Moon Bay, is Chairman of the San Francisco Water Quality Control Board, so he is serious about getting local growers to take measures to protect water quality. As a field flower grower, one of his current efforts is to reduce soil erosion from his fields. He plants bell beans as a strip cover crop between his fields and an adjacent watershed habitat to prevent soil movement from his fields into the creek. He uses cover crops on bare soils whenever possible throughout the year. Not only does this reduce soil erosion (and possible movement

of fertilizers off-site), but it also reduces his need to add commercial nitrogen fertilizers to the soils. John also uses hay bales as a low-cost innovative way to slow water flow out of the fields — this effectively reduces the amount of soil carried from the fields into adjacent creeks.

The large greenhouses that produce potted plants in San Mateo County have been proactive for years and do a great job of recycling their runoff water. With bench-produced plants, the growers have installed concrete floors in the greenhouses. It is relatively easy to recirculate this water (although there are costs involved), thereby eliminating runoff of fertilizers, pesticides, and excess water. Growers regularly monitor the recycled water for salinity (EC) and pH, and when necessary, they blend the recycled water with “fresh” water. They also watch for pathogens in the recycled water. The concrete floors also reduce pesticide use, in that fungus gnats, which are notorious in potted plant greenhouses, can no longer use the algae-covered wet ground as breeding areas.

New Publications

Submitted by Ann King, UCCE Farm Advisor, San Mateo & San Francisco Cos.

'Simple Solutions – Ergonomics for Farm Workers' is an excellent publication that shows how to make simple equipment or changes in processes encountered by farm workers. Many of the sections deal with greenhouse or nursery situations. It can be found at: <http://www.cdc.gov/niosh/01-111pd.html>

You can download the latest version of **'Labor Management in Agriculture: Cultivating Personnel Productivity'** from <http://www.cnr.berkeley.edu/ucce50/ag-labor/>

Go to “BOOK,” then follow the link to **DOWNLOAD FREE VERSION**. Follow the instructions there.

'Selected Rare Plants of Northern California' is a new ANR publication from the University of California. It is a field guide to 149 rare plants, with many photos and line illustrations. The publication (#3395) is 370 pp, costs \$36, and is available from ANR at (800) 994-8849, or online at <http://anrcatalog.ucdavis.edu>



Internet Sites - Regulations Regarding Nursery Water Runoff

Compiled by Dr. Donald Merhaut, Extension Specialist, Nursery and Floriculture, UC Riverside

New regulations regarding runoff water from nurseries appear to come out about every other week. As a grower, it is your responsibility to keep up-to-date with the water quality regulations that impact your area. This may seem difficult, but thanks to the web, it is quite easy. There are two primary sites to bookmark: (1) the California Environmental Protection Agency's Statewide Water Resources Control Board (SWRCB) <http://www.swrcb.ca.gov/nps/protecting.html> and (2) the United States Environmental Protection Agency's Office of Wetlands, Oceans, and Watersheds <http://www.epa.gov/owow/TMDL/states/ca.html>.

Site 1: The State Water Resources Control Board has the state divided up into nine regions. Just click on the region where you are located. This will take you the water quality control programs for your region. This site contains information on beach closures, TMDLs, meetings, storm water runoff policies, etc. Since each region is operated independently, the websites will vary with the region. This site will keep you updated on the regulations and programs going on in your area. If you have any additional questions, there are phone numbers and email addresses to help you. This site is highly recommended for the 'nuts and bolts' information that is needed and the sites appear to be updated regularly.

Site 2: The second site hosted by the United States Environmental Protection Agency also has a map. This site will give you the national perspective on water quality, but information is somewhat general regarding the state of California. ❖

Thanks to these Sustaining Sponsors of CORF Educational Programs



Campus News & Research Updates

Submitted by Julie Newman, Farm Advisor UCCE

Campus News

UC DAVIS. *Dr. Heiner Lieth*, the new Environmental Horticulture (EH) Department Chair, is planning to focus on the development of horticultural methods to solve environmental problems and the development of sustainable horticultural methods that are environmentally sound. Dean van Alfen has voiced recognition of the value of this approach and is committed to the department's growth. Thus, in the years to come, Lieth expects that the EH department will be seeing significant growth, in contrast to the drastic downsizing that occurred in the 1990s during poor economic times. This will include growth in the area of ornamental crop production, where Lieth's goal is to achieve an international reputation, working with growers to develop best-management practices (BMPs). The future for the EH Department is very exciting.

Born in Germany, Lieth immigrated with his parents when he was a child, growing up in North Carolina. Lieth went to college at UNC-Chapel Hill and received a PhD in Biomathematics from North Carolina State University, working on development of mathematical models for plant growth. In 1984, after a postdoctoral research position in Texas, he was hired by the EH department at UC Davis to apply his mathematical modeling skills to horticultural situations. He has been conducting research, teaching and extension for 17 years, focusing on greenhouse and nursery production of ornamental plants.

Lieth is also Chair of the Floriculture & Nursery Workgroup, and he recently announced that the Workgroup received a total budget of \$24,460 for the next fiscal year. Of this total amount, \$8450 is earmarked for a TMDL project to be expended this fiscal year (2001-2002).

After six years of guidance and advocacy for Environmental Horticulture, *Dr. Dave Burger*, the previous Chair of the EH Department, plans to be in Riverside later this year. He will be on a sabbatical leave, focusing his attention on turf research.

The **Small Farm Center** has created an online database, www.calagtour.org, to connect tourists with more than 300 farm experiences. The site lists real working farms that are welcoming visitors to enjoy the rural setting, farm-fresh produce, open space and more simple way of life. The database is an out-growth of the Small Farm Center's agri-tourism program, launched three years ago. The goal is to help operators of small farms and ranches market their commodities, as well as the farm experience and ambience, to urban visitors.

UC RIVERSIDE. On May 4, the UC Riverside campus opened its \$15 million, high-security Insectary and Quarantine Facility, the only three-stage quarantine facility in the state. The 28,000-square-foot insectary will advance the study of exotic pests, the evaluation of potential natural enemies and the development of genetically engineered plants and insects. The primary beneficiaries of the insectary will be the growers, ranchers and resource managers who will have access to new, economically viable pest management tools developed and field tested at the University of California. These new tools will help clientele stay one step ahead of insects, rodents, bacteria and other pests while significantly reducing use of pesticides and other chemicals. A new exotic pest is introduced into the state every 60 days, on average. These insects or the pathogens they carry cause an estimated \$3 billion in agricultural damage each year in this state alone. The insectary will expand UC's role in the fight against pests such as the glassy-winged sharpshooter, ash whitefly and eucalyptus longhorned borer.

Research Updates

Australian Rust on Groundsel, English Daisy

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The weed 'common groundsel' is found in disturbed and cultivated habitats, including field and container nurseries, and landscapes. In November 2000, groundsel growing next to lettuce fields and in landscapes of Monterey County were infected with a rust disease. Rust is recognized by the clustered, yellow orange, tiny cup-shaped fruiting bodies (aecia) on leaves and stems. Diseased stems were deformed and leaves that were severely infected dried out and died. The pathogen, *Puccinia lagenophorae*, is native to Australia and New Zealand and infects plants in the Asteraceae. This finding in California is significant because this is the first report of *P. lagenophorae* in North America. In December 2000, English daisy (*Bellis perennis*) growing in Salinas nurseries were found to be infected with the same rust; this likewise was a first record. Inoculations showed that English daisy, cineraria (*Senecio cruentus*), and groundsel are susceptible to this fungus, but not dusty miller (*Senecio cineraria*) or pot marigold (*Calendula officinalis*). In other continents the disease can cause reduced growth and seed production in groundsel. However, because the rust infects commercially grown ornamentals, the deliberate use of this fungus for biocontrol seems unlikely. We intend to study this rust further. Contact Steven Koike if this rust occurs in your area. Reference: Plant Disease 85:335.

Lisianthus (*Eustoma grandiflorum*) is a Host for Root-knot Nematodes.

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Lisianthus is a greenhouse grown cut-flower that has been increasing in popularity. Recently, some growers noticed patches with stunted plants. The root systems of these plants exhibited galling, typical of infestation by root-knot nematodes (*Meloidogyne* spp.). As there appeared to be no data in the literature on

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Campus News

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the host status of *Lisianthus* for root-knot nematodes, we initiated a greenhouse study to test this. Three species of root-knot nematodes (*M. hapla*, *M. javanica*, *M. incognita*) were added to pots with young transplants of *Lisianthus* var. Mariachi - Lime Green (100, 1,000, or 10,000 second stage juveniles per pot). Tomato plants inoculated with the same nematode species and numbers were set-up as a comparison. After 10 weeks the tops of all plants were weighed, the roots examined for galling and the eggs were extracted from the roots and counted. All three nematode species caused galling and produced eggs on *Lisianthus* roots. Fewer eggs were recovered from total root systems of *Lisianthus* than from tomato root systems. The number of eggs produced per gram root, however, was very similar for *Lisianthus* and tomato. *Meloidogyne incognita* and *M. javanica* were more damaging to *Lisianthus* than *M. hapla*.

Weeds That May Compromise Nematode Control

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Strategies aimed at nematode control include crop rotation, fallowing, or the use of nematode resistant crop varieties. These strategies all rely on not providing the nematodes with a suitable food source (host plant roots) for a certain period of time. Some nematodes die fairly quickly without food; others, for example cyst nematodes, can survive without food for several years. The presence of weeds that are hosts to the nematodes may seriously compromise or even nullify the effectiveness of these strategies. We tested the host status of 11 common weeds for

the root-knot nematode *Meloidogyne incognita*. Under Velvetleaf, Lambsquarters, Black Nightshade, London Rocket, and Wild Mustard the nematode numbers more than doubled over an 8 week period, and these weeds can be considered excellent to good hosts for *M. incognita*. Under Common Purslane the nematode numbers remained the same, and very few or no nematodes were recovered from Yellow Sweetclover, Annual Bluegrass, Crabgrass, Yellow Nutsedge, and Italian Ryegrass. ❖

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Floriculture education from the
Kee Kitayama Research Foundation

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Calendar of Industry Events

November

8 CORF Frost Control Workshop,
Ventura, 707/462-2425
15 CORF CA Ornamental Plant
Disease Symposium, San Diego,
707/264-2425
28-29 .. CCFC Committee & Board
Meetings, Shell Beach
831/728-7333

December

17 CORF California Insect & Mite
Symposium, Watsonville
707/462-2425

January

February

20-22 .. Southern California Plant Tour Days,
various sites, 760/431-2572
24-26 .. SAF Pest Management Conference,
San Diego, 800/336-4743

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