Fall 2005 - Vol. 9, Issue 3

CORF news

Floriculture Education from the Kee Kitayama Research Foundation

Reducing Greenhouse Energy Bills

by James F. Thompson, Department of Biological and Agricultural Engineering, UC Davis

Increased natural gas prices will hit the greenhouse industry hard this winter. The best way to handle this is to own your own natural gas well, but short of this there are some economical ways to reduce natural gas use. A calibrated, fast response thermometer for measuring air temperature and the following options will guide you to cost-effective ways to reduce energy use.

Best Use of Existing Equipment

Timely maintenance of existing equipment is the fastest and least expensive way to cut energy costs. Identify potential problems by surveying the air temperature when the heating system is operating. Temperature variation will be most easily observed in the early morning hours when outside air temperature is lowest and the sun has not begun to influence heating needs. If everything is working correctly, air temperature at crop height should be consistent and at the desired level. If the average temperature is higher than needed, reduce the thermostat setting accordingly. Keeping a greenhouse one-degree warmer than needed increases gas bills by 10% to 15% under typical California conditions. One note of caution – if you have been operating the facility with this error for several seasons your production scheduling may be inadvertently based on this higher temperature. Reducing growing temperatures may slow the next crop.

Differences between average air temperature and thermostat set point temperature are caused by an error in thermostat calibration or locating

Reducing Energy Bills cont. on page 2

Inexpensive Improvements for Short Term Energy Savings

by James A. Bethke, Department of Entomology, UC Riverside

When pest control failures occur, researchers will suggest that you review all methods available in the Integrated Pest Management system beginning with cultural control methods, and they'll suggest that you make improvements in areas that you have been neglecting. Likewise, when energy becomes as issue as it has this year, it pays to review any helpful bullet points from the NGMA, the National Greenhouse Manufacturers Association (**http://www.ngma.com/**), and ditto, look for

Inexpensive Improvements for Energy cont. on page 4

A Software Tool for Scheduling Cut Flower Roses Based on Temperature

by Neil Mattson and Heiner Lieth, Department of Plant Sciences, UC Davis

With the dramatic rise in fuel prices predicted for this winter many growers are looking for ways to save on heating costs. Lowering greenhouse temperatures reduces heating costs but increases crop production times. The trick is determining how the production timing is likely to change. We have developed a software tool that growers can use for scheduling cut flower roses and in making temperature decisions.

How the Software Works

The basis for the software is that

Software for Cut Roses cont. on page 4

Editor's Note:

In this issue we focus on energy conservation issues. Our feature articles offer helpful discussions and suggestions to use energy efficiently. Farm Advisor regional reports discuss energy-conservation rebates, energy curtains and increasing irrigation efficiency (and therefore energy-use efficiency). We have a special regional report from Del Norte and Humboldt counties. Farm Advisor Deborah Giraud provides an informative discussion on Easter lily production and industry challenges. Web sites are given that provide additional information on energy conservation in "Hooking Up". Don't forget to read the continuing discussions in "Science to Grower" and "Get Cultured".

- Steve Tjosvold, Editor, CORF News

IN THIS ISSUE

the unit in a relatively cold or warm location in the greenhouse. Aspirated enclosures allow thermostats to accurately sample air temperature and reduce error caused by thermostat location. Put a tag on the thermostat indicating the date of calibration and temperature correction factor.

Air temperatures at crop height should be consistent around the facility. Cold areas are often caused by air leaks. Check weather stripping on doors, lubricate fan louvers and ensure they close tightly, patch holes in covering, check lap seals in glass covered houses, and install seals on ridge vents. Seals cost a few cents per square foot of floor area and are a good investment. Make sure that thermal blanket systems close completely. Poor heating system maintenance can also cause cold areas in the greenhouse. Inspect steam and hot water pipes to be sure they are not accidentally buried in trash and debris. Poor hot air distribution from convection heaters can also cause poor air temperature uniformity. Clean fan blades to get original air output and check jet tubes for leaks.

Air temperature should also be fairly uniform from crop to roof. Higher air temperature near the roof indicates inadequate air movement in the greenhouse. Poor air circulation allows cold air to settle to the floor and warm air to rise to the roof. Most of the heat in a greenhouse escapes through the roof so high air temperature near the roof acts just like an improperly calibrated thermostat to increase energy use. Reducing air temperature near the roof by one degree Fahrenheit may lower fuel use by 10%. Air can be mixed with a horizontal fan system or a jet tube unit.

Heating systems may still effectively heat a greenhouse but suffer from poor efficiency if they are not regularly maintained. Over time, boiler tubes become fouled, soot builds up in furnace heat exchangers, and burners lose proper adjustment. Flush boilers to remove scale and deposits. Check the burner combustion efficiency of unit heaters and boilers with a flue gas analysis kit. Clean heat exchangers with a wire brush and vacuum or with a special cleaning compound. A 1/8 inch layer of soot can increase fuel use by 10%. Repair or replace malfunctioning steam traps. Check insulation on steam and hot water pipes located outside the greenhouse. If you do not have a regular heating system maintenance program in place, work with your equipment supplier to design a program for your specific system.

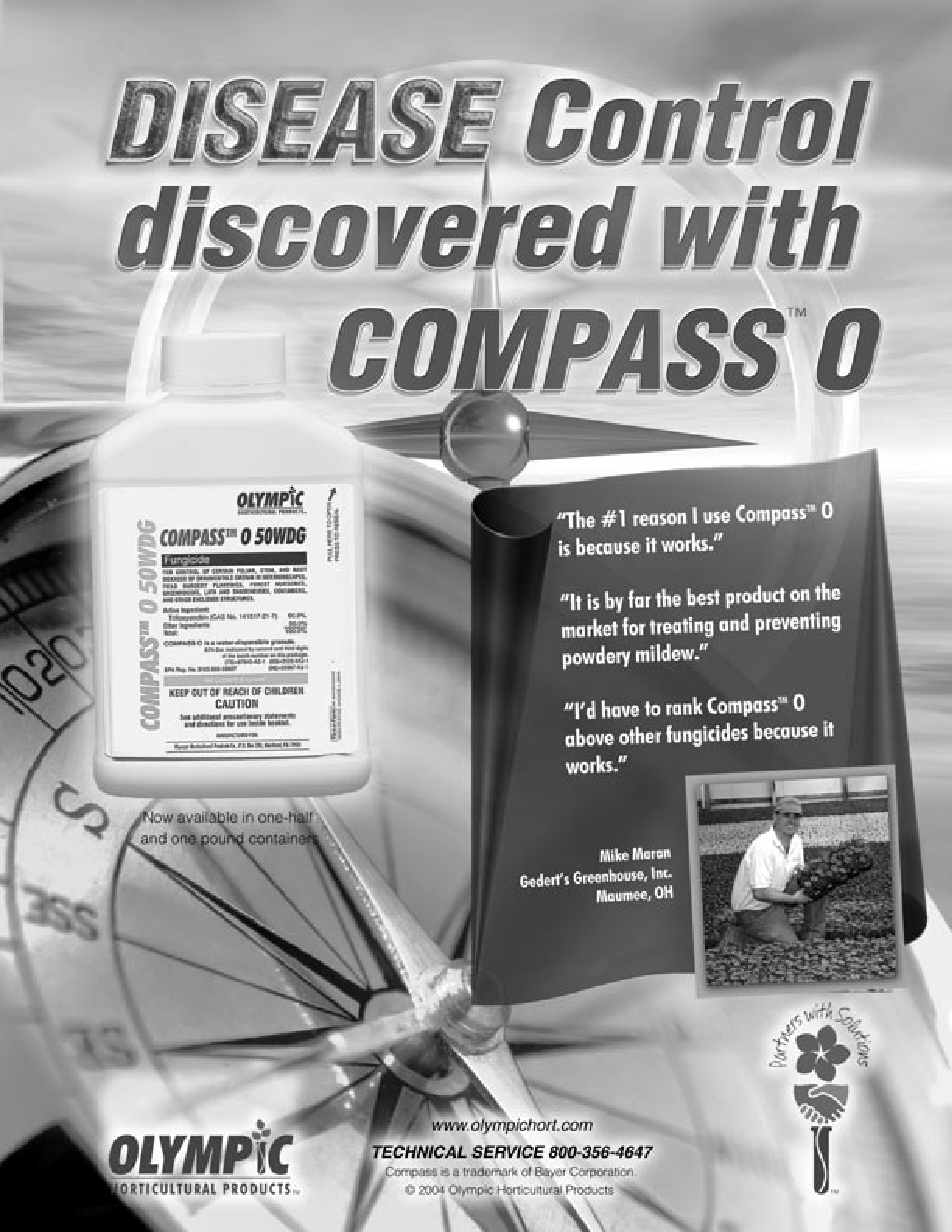
Purchase Energy Saving Equipment

After maintaining equipment, the next step to reduce energy costs is considering capital investment in new equipment. Most of the options increase the insulating effect of the greenhouse by adding a second or third layer of covering. For example, a polyethylene subroof installed under the roof trusses will reduce fuel use by 20% to 30%. All heating and ventilating systems must operate below the added subroof. Energy savings will repay installation costs in one or two seasons. Thermal blankets that are extended inside the walls and roof at night and can reduce energy use by 35% to 50%. Insulated thermal blankets have even greater potential for savings. All of these systems are expensive and some greenhouses may not be strong enough to support them. Work with commercial greenhouse equipment companies to determine costs and estimated savings. Rigid board insulation applied to the inside of north walls and below bench height on other walls reduces energy use by 5% to 10%.

Installing moveable benches reduces energy costs per plant produced by increasing the number of plants that can be grown in a greenhouse. Bench space often occupies about 65% of total greenhouse area, the rest of the area is devoted to aisles. Moveable benches allow access to plants but increase usable bench space to about 85% of the greenhouse area, cutting energy use by 30% per plant sold.

The heating season will begin soon for most growers. Crews should be busy maintaining the greenhouse and heating equipment. Work with commercial equipment companies to plan installation of energy conservation equipment. Remember many utilities have programs to help finance capital improvements.

James F. Thompson
Biological & Agricultural Engineering
University of California
One Shields Ave.
3034 Bainer Hall
Davis, CA 95616-5294
Phone: (530) 752-6167
Fax: (530) 752-2640
e-mail: jfthompson@ucdavis.edu


DISEASE Control discovered with COMPASS™ O
OLYMPIC
COMPASS™ O 50WDG
Fungicide
KEEP OUT OF REACH OF CHILDREN
CAUTION
Now available in one-half and one pound containers
"The #1 reason I use Compass™ O is because it works."
"It is by far the best product on the market for treating and preventing powdery mildew."
"I'd have to rank Compass™ O above other fungicides because it works."
Mike Maran
Gedert's Greenhouse, Inc.
Maumee, OH
Partners with Solutions
OLYMPIC HORTICULTURAL PRODUCTS
www.olympichort.com
TECHNICAL SERVICE 800-356-4647
Compass is a trademark of Bayer Corporation.
© 2004 Olympic Horticultural Products

areas that you have been neglecting.

One thing that the NGMA suggests is that most greenhouse operations have the ability to economize on fuel use. A major retrofit to a more energy efficient system is usually engineered for optimum conversion of fuel, heat distribution and retention. They can often produce better, more uniform crops. Even if it takes additional capital to achieve the highest level of energy saving, the long life of many energy saving greenhouse system components make them sound investments.

Obviously, a major retrofit would be helpful, but it's not always practical. Therefore, here are a number of system checks you may want to make that will provide you with some inexpensive improvements with a short term payback.

- Insulate pipes, foundation walls and north walls
- Use light reflective materials on inner greenhouse surfaces such as ground covers, north walls, posts and benches
- Close up fan housings with insulated covers
- Caulk and seal all air leaks
- Clean, service, adjust all louvers and vent systems and check to ensure they seal properly when closed.
- Make sure exhaust fans, pad and fan systems are in good working order
- Use poly liners to reduce heat loss and increase the relative humidity factor in cold winter months
- Concentrate crops and shut unused greenhouses
- Plant later and grow warmer or plant earlier and grow cooler
- Check control settings for accuracy and proper temperature sensor placement (usually at the top of the crop canopy)
- Service and adjust boilers and unit heaters
- Make sure thermal curtain systems are working properly and are in good repair
- Isolate propagation areas from growing zones - only heat the areas you currently need
- Maintain clean glazing surfaces
- Reduce boiler water temperature in warmer weather
- In colder months, use the lowest heating set points and the highest cooling set points possible
- Use split day/night temperatures where possible
- Allow climate temperatures to rise naturally late in afternoon to reduce energy demands at night
- Thermal curtain installation or retrofit
- If you capture carbon dioxide from your boilers, consider heat storage options

Lastly, you might want to consider contacting an experienced greenhouse manufacturer or consultant to assist you. They may make recommendations that may help you for decades to come.❁

James A. Bethke
College of Natural & Agricultural Sciences
University of California
Entomology, 15 Entomology Annex 1
Riverside CA, 92521
Phone: (951) 827-4733
Fax: (951) 827-3086
e-mail: james.bethke@ucr.edu

the rate of rose flower stem development depends on temperature. That is, the higher the greenhouse temperature, the faster rose stems will grow and be ready for harvest. This software uses the concept of "heat units" (also known as "degree days") to calculate how quickly rose flower stems develop.

How the Software Can be Used

The software can be used in several ways for scheduling your crop or exploring how changing greenhouse temperature could change the length of the crop cycle. Here are a couple ways the software can be used:

- **Decide when to initiate a new growth cycle:** Let's say you would like a crop of a particular variety to be ready for Valentine's Day by harvesting them on February 6th. Enter this as the target harvest date. If based on previous years, you know your average greenhouse temperature is likely to be 64°F, then you can use this for projected temperature (or set it to what you anticipate). For the variety "Fire and Ice" the program calculates that this cycle should be initiated on December 6th to be ready as desired.
- **Determine the greenhouse temperature to produce a crop for a target date:** Let's say you would rather be able to harvest the above crop on December 19th (for Christmas sales) and you would the next growth cycle ready for Valentine's Day. In this case you enter December 19th as the cycle initiation date, now adjust the temperature panels until you find a temperature that gives you an appropriate harvest date. In our 'Fire and Ice' example, the program calculates a temperature of 69°F will give us flower stems ready for February 8th.

Using the Software with Your Own Varieties

At UC Davis, we have determined the number of heat units for growth cycles of a few rose varieties. We have found that the heat units required changes depending on variety. Thus, for the software to be effective you will need to determine heat units for your own varieties. The software contains a tool to allow a rose grower to calibrate for own varieties using past records of crop observations coinciding with known average greenhouse temperature data.

This software should not substitute for a grower's own common sense. The grower must be aware of reasonable growing temperatures for the crop. Also, the program does not take into account the effect that temperature has on crop quality.

Where to Download the Software

You can download the software and more detailed information of how to use the software at: **http://lieth.ucdavis.edu/Research/HU/RoseTime/**❁

Heiner Lieth
College of Agricultural & Environmental Sciences
University of California
One Shields Ave.
1001A Dept. of Plant Sciences Building
Davis CA, 95616-8587
Phone: (530) 752-7198
Fax: (530) 752-1819
Heiner Lieth: e-mail: jhlieth@ucdavis.edu

Easter Lily Bulb Production

by Deborah D. Giraud, UC Cooperative Extension, Del Norte & Humboldt

Coastal Easter lily bulbs overseen by Lee Riddle.

On the foggy coastal marine terraces of Del Norte County, California, and Curry County, Oregon, a fascinating and challenging industry exists that supplies the entire United States with beautiful Easter lilies. Bulbs, the final product of these farmers' hard work are sent to greenhouse ranges around the world to force a potted Easter lily which is sold to customers.

About 600 acres of fertile coastal land in the two counties is planted each year. This is a $6.5 million to $7 million industry employing hundreds of people, and obviously an important asset to these rural communities hard-strapped by declining forest revenues. More than 65,000 boxes of bulbs are shipped worldwide by the 10 companies who make up the Pacific Bulb Growers Association.

Lily bulb propagation is a cloning process. Named varieties such as Nellie White, Ace and Snowwhite are the product of years of selection. (The breeding of lilies is another whole story in itself!)

The cycle begins with planting in fall. Both small-stem bulblets and scales are planted. Scales are the specialized leaves designed for food storage that are attached to the basal plate which together make up a bulb. When separated and planted, a small bulb will grow at its base.

Stem bulblets grow on the underground portion of the stem and can be planted to grow into larger bulbs. It takes two to three years for a salable bulb to be produced. Each year after planting, everything is dug up and sorted, the commercials are packed and sold, and everything else is replanted for another year of growth. Salable bulbs are packed and shipped to greenhouse growers around the nation who force the bulbs to produce flowers for Easter time. The natural cycle of the plant is to bloom in July.

Major Production Challenges

Putting small pieces of fleshy bulbs into the soil in late summer and hoping you have something a year later after 80 inches of rain, soil and airborne fungi, bacteria, nematodes, freezes, gophers, etc. is truly an act of faith and a highly refined agricultural production methodology. It is easy to understand why the Pacific Bulb Growers Association own their own research station and hire a full time researcher, Lee Riddle, to run it.

The A.N. Roberts Easter Lily Research Station is located in Harbor, Oregon. This industry has an interesting history, and many scientific articles have been written about Easter lilies as researchers from Oregon State University, University of California, Washington State, University of Minnesota and many other institutions have conducted experiments to try to help solve the numerous production challenges. Nematodes, basal rot and botrytis, are still the biggest concerns. Aphids attack the plants throughout the spring and summer.

Nematodes: The Biggest Challenge

Protecting the young bulbs from *Pratylenchus penetrans,* the lesion nematode, is far from easy. This nematode has a very wide host range and there are no commercial crops that are not a host to rotate to. Pasture for dairy and beef cattle is the main rotational use of the land. The number of nematicides available has shrunk to just a few: Telone II®, Thimet®, Nemacur®, Basamid®, metam sodium. Methyl bromide is not used anymore. For California growers the list is shorter as Nemacur® is not registered. Soil fumigation continues to be an important tool for pre-plant crop protection, but an in-furrow application of a granular nematicide is also used to protect this crop, which is in the ground for a year at a time.

There is a complex interaction between the damage the nematodes do to the roots and the invasion of *Fusarium* and other fungal basal plate rotters. Fungicides are used as pre-plant dips to protect the bulbs. Cultural practices, such as clipping the roots off and many other techniques, are constantly being evaluated for economic practicality and disease control success.

Protecting the crop from nematodes and fungus are the primary emphasis of researchers today. Lee Riddle sets up many test plots at the experiment station trialing pesticides and cultural practices and reporting to the growers meeting monthly. Dr. Becky Westerdahl, UC Cooperative Extension

Easter Lily Bulb Production cont. on page 15

Deborah D. Giraud
UC Cooperative Extension
5630 South Broadway
Agricultural Center Building
Eureka, CA 95503-6998
Phone: (707) 445-7351
Fax: (707) 444-9334
e-mail: ddgiraud@ucdavis.edu

Rebates Offered from Pacific Gas and Electric

by Steve Tjosvold, UC Cooperative Extension, Santa Cruz and Monterey

Lesser-seeded bittercress in ornamental crops (See Field Observations on weed control).

Ok, energy prices are rising and there is little you can do except conserve the precious energy that you use. In that regard, the Pacific Gas and Electric Co. (PG&E), serving many of the agricultural operations in northern and central California, is offering a variety of rebates for business customers who purchase and install energy-efficient commercial equipment. New rebate incentives have just been added that might be useful for greenhouse operations too. Thinking of changing from sprinklers to drip, think energy rebate too. Read on. I'll describe aspects of these programs that might interest you, the ornamental producer.

The Express Efficiency rebate incentives for 2005 are for small and medium agricultural operations and composed of four programs—gas, refrigeration, lighting, and other technologies. Small and medium agricultural accounts with monthly demand of less than 500 kW or average monthly natural gas use of less than 20,800 therms can apply for this rebate. Larger energy consumers are encouraged to apply for the Standard Performance Contract (SPC). The later program, except for natural gas incentives, is open to other utility customers in southern California too. I'll describe the SPC program last.

The most notable incentives for the Express Efficiency Gas incentives are for installing insulation on tanks and pipe in the heating distribution system of gas-fired boiler, greenhouse heat curtains, and infrared polyethylene film covers for existing greenhouses. For heat curtains, only installation of interior curtains for heat retention in existing gas-heated greenhouses qualifies. The rebate applies to new and retrofit curtain system installations in existing greenhouses used for floriculture, nursery products and food crops grown under cover and landscape and horticultural services which store agricultural products under cover. Infrared film installations must be single sheet infrared anti-condensate polyethylene plastic with a minimum 6 mil. thickness for heat retention on existing heated greenhouses. Greenhouses must be for agriculture, floriculture, landscape and horticultural-services uses.

Express Efficiency Refrigeration incentives provide rebates for replacing or retrofitting existing medium and low temperature refrigeration equipment. Replacing equipment with energy efficient condensers and compressors, installing strip curtains for walk-in coolers are just some examples of improvements covered by this program.

Express Efficiency Lighting incentives provide rebates for replacement and installation of energy efficient light-

Rebates from PG&E cont. on page 13

FIELD OBSERVATIONS

Although I can think of several notable disease, insect, and nematode problems to discuss here, right now, weeds are a big problem for several ornamental growers. In particular, controlling weeds in greenhouses have become an important and expensive problem. Why is this and what can be done?

There are several good pre-emergent herbicides registered for nursery stock and cut flowers grown in the field. These herbicides can be used preventatively to keep most weeds from germinating and establishing in containers or field-bed. But there are no pre-emergent herbicides registered for use in greenhouses. Some post-emergent herbicides such as pelargonic acid (Scythe®), diquat (Reward®), glufosinate (Finale®) or glyphosate (Roundup®) are registered for greenhouse use but are non-selective, unless used as a directed spray that only contacts the targeted weeds.

The most common weeds in and around greenhouses include annual bluegrass, lesser-seeded bittercress, creeping woodsorrel, pearlwort, common chickweed, moss, and liverwort. Others that may be present include cudweed, fireweed, cheeseweed, and prostrate spurge. Controlling these weeds inside the greenhouse will also help reduce the reservoir of insects and diseases that are often associated with weeds.

Sanitation is the best method for good control. Weeds may be brought into the greenhouse in potting-soil, cuttings, bulbs, dirty pots, and tools. Cover potting-soil piles outside with tarps to prevent wind-blown seed from contaminating the soil. If weeds do get into the greenhouse, they should never be allowed to flower and seed. This might require frequent hand-weeding. If the floors are concrete, regularly wash or sweep away soil that drops to the floor so that weeds will not establish. When crops are removed from the greenhouse, control weed infestations and the seed reservoir in the soil. Post-emergent herbicide treatments can be used to reduce weed populations and to keep the weeds from flowering and seeding. Plastic weed barriers can be used on soil surfaces. Plastic disks or mulches can be placed in containers to prevent weed growth in new plantings.

Steve Tjosvold
UC Cooperative Extension
1432 Freedom Blvd.
Watsonville, CA 95076-2796
Phone: (831) 763-8040
Fax: (831) 763-8006
e-mail: satjosvold@ucdavis.edu

Thermal Curtains and Screens Save Energy

by Julie P. Newman, UC Cooperative Extension, Ventura and Santa Barbara

Many growers are taking advantage of loans and rebate programs offered through the Southern California Gas Company to install thermal curtains.

With gas prices skyrocketing growers are reexamining ways to save energy. This is the time to make sure you keep greenhouse doors closed, seal leaks in the greenhouse, and maintain heaters. In addition, many greenhouse growers are using thermal curtains and screens. Some have reported 30% reduction in natural gas costs.

Many types of materials can be used for thermal control. Plastic-film products that alter the far red spectrum were specifically designed for this use. Another type includes shading and photo period control materials that have found wider use as thermal insulation in recent years. These types of materials are often the most cost effective because they have multiple purposes, both outside and within the greenhouse.

Thermal insulation provided by screens trap warm air nearer the crop by preventing the loss of radiative heat to the cold night sky during the evening. In addition, thermal screens maintain better heat distribution under the screen resulting in substantial energy savings.

Selecting and managing thermal screens appropriately can be an important component of an integrated disease control strategy for pathogens that thrive under conditions of high humidity such as those caused by *botrytis* and powdery mildew. Screens can help reduce foliar diseases such as those caused by *botrytis* by preventing condensation on the leaf surface—keeping the temperature above the dew point of the air surrounding it.

Conversely, care must be taken to avoid excessive humidity and condensation on and under the thermal material itself. This is primarily a problem in the winter months when humidity can build up under the screen during the night because of plant transpiration in a heated environment.

To manage humidity, establish a moisture gap between the curtain and the greenhouse covering, allowing movement of air between the cold space above the curtain and warm humid space below it. Perforate plastic film screens to produce air movement through them, in the manner of fan-jet poly tubes.

Thermal curtains and screens have been reported to reduce natural gas costs as much as 30%.

A large temperature difference between the space above and under a thermal screen can cause condensation to deposit on the material, which can shower onto the plant canopy when the screen is moved. "Cold shock" is another threat that occurs when blankets are opened after a cold night causing cold air trapped in the space above the screen to drop onto the plant canopy. Open blankets incrementally to prevent plant damage, condensation on leaf surfaces, and to prevent development of foliar diseases that require free water to proliferate.

When using screens, periodically vent and reheat to avoid high relative humidity in a closed greenhouse at night. Use of horizontal air flow fans can reduce the buildup of high humidity

Thermal Curtains cont. on page 15

FIELD OBSERVATIONS

Light Reflecting Coverings Cool Greenhouses, Save Energy and Reduce Insects

Plastic films and fabric materials that alter light wave transmission are commercially available for greenhouse use as covers, for shading, and for screening. Although these products are typically more expensive than comparable products without light altering properties, they have value added characteristics. Light reflecting covering products can be used to keep the greenhouse cooler, thereby saving energy.

I am currently evaluating a UV-light blocking shade cloth product, coated with a metallic reflective surface (Aluminet®, Polysack Plastic Industries Ltd., Israel). This is a high-density polyethylene that can be installed over the outside of a poly or glass greenhouse to reflect away radiation from the sun and reduce temperatures within the house. It is also a light weight alternative to standard black shade cloth that doesn't absorb heat.

When used as a shadehouse covering, we found that in addition to reducing temperatures, this product can reduce thrips found in the crop. This is comparable to results we demonstrated in earlier trials using a metallic, light-reflecting bird net as a covering over outdoor container nursery crops and flower crops. A limitation of the bird net was lack of durability, and pest control was short-lived, especially in windy situations. However, thrips were reduced in all studies as compared to the control.

The light-reflecting plastic cloth covers we are currently evaluating are much more durable than bird netting. They provide a physical barrier to the entry of insect pests, in addition to potentially repelling insects by affecting flight and orientation patterns.

Julie P. Newman
UC Cooperative Extension
669 County Square Drive, Suite 100
Ventura, CA 93003-5401
Phone: (805) 645-1459
Fax: (805) 645-1474
e-mail: jpnewman@ucdavis.edu

Improving Irrigation Uniformity

by Karen L. Robb, UC Cooperative Extension, Mariposa and David A. Shaw, UC Cooperative Extension , San Diego

The last issue of *CORF News* described methods for determining Irrigation Distribution Uniformity (DU). This is one of the first steps in the San Diego County Ag Water Quality Research and Education Program. Since irrigation systems are run long enough to meet the needs of the driest plant, improving DU helps to reduce runoff by minimizing the number of plants receiving excessive water when all plants are adequately irrigated. Good uniformity is a result of proper system design, installation, and maintenance. We have found the following maintenance practices useful in improving uniformity and reducing runoff from nurseries.

Irrigation System Improvement/Maintenance Practices

Major system maintenance or improvements should be performed before the crop in place and the system should be checked periodically during the crop cycle.

Leaks. We frequently observe leaks in the connections in irrigation systems during site assessments. Another common site for leaks is at the ends of drip tape or feeder lines. Fixing these leaks removes a constant source of water runoff and reduces flow within the system, thus reducing friction loss and pressure differentials in lines.

Disconnects. Geysers erupt at each irrigation event from unplugged holes in the feeder line. Disconnects result when spaghetti tubing is removed from the line or the installer has difficulty inserting the tubing or relocating the hole. These water displays also arise when there is no emitter at the end of the spaghetti tubing. The remedy for this is proper installation of components, and regular inspection of the lines to plug the geysers.

Clogged lines/emitters. Algae and calcification both can clog lines and filters and have a dramatic affect on DU. Filters are important in preventing clogging. Follow the manufacturer's directions for cleaning and maintenance of the drip system. For algae problems, the system can be cleaned with approved algaecides. Removal of calcification requires an acid treatment and should only be undertaken when there are no plants present.

Misplaced or mismatched emitters. Mismatched emitters have different flow rates, so some plants receive more water than others do during the same irrigation cycle. Incorrect placement of some emitters can also affect how much water is wasted, versus reaches the plant; if the fan spray is directed partially out of the pot, for example.

Incorrect insertion of spaghetti tubing in the feeder line. Spaghetti tubing can be inserted too far into the poly laterals, thus filling the supply tube with spaghetti, which increases friction loss and reduces the flow capability.

Drainage of the system through 'low' emitters after each irrigation. Ideally, unused emitters should be shut off. If unused emitters are left to dangle below the feeder line, the line will drain after each irrigation event. Not only is water wasted through this drainage, but the system also must be recharged with water before all emitters are operational. As a result, plants closer to the water source receive more water than plants at the ends of the irrigation system. This is especially important when growers are utilizing short, frequent runtimes ('pulsing' irrigation).

Incorrect or lacking elevation compensation on slopes. Without pressure compensation for slopes, plants at the bottom of the slope receive more water than plants at the top of the slope, due to increased water pressure in the system at the lower points.❁

Karen L. Robb
UC Cooperative Extension
5009 Fairgrounds Road
Mariposa, CA 95338-9435
Phone: (209) 966-2417
Fax: (209) 966-5321
e-mail: klrobb@ucdavis.edu

FIELD OBSERVATIONS

New Invasive Species

by James A. Bethke

Diaprepes citrus root weevil.

There are two very important new invasive pests in California that you should be aware of, the Q-Biotype of the sweetpotato whitefly, *Bemisia tabaci Gennadius,* and the citrus root weevil, *Diaprepes abbreviatus (L.).*

Diaprepes is a large weevil with a host range of 270 plants in 59 plant families including numerous ornamental host as well as citrus and other agronomic crops. Females can live as long as about 150 days and can lay as many as 5000 eggs in its lifetime. Like the black vine weevil, the grubs burrow into the soil and feed on the root system of host plants and adults feed on foliage. Control options for soil borne grubs are lacking and difficult.

A three square mile area of Orange County is now under quarantine by the CDFA, and they estimate that it may take from 3-5 years to eradicate the weevil. For more information and links see **http://www.cdfa.ca.gov/** In addition, the UC Exotic/Invasive Pest and Disease Program published publication #8131, *Diaprepes* Root Weevil. An electronic version of this publication is available on the ANR Communications Services web site at **http://anrcatalog.ucdavis.edu**

Back in April of this year, researchers at UC Riverside identified the sweetpotato whitefly Q-Biotype from a find in Arizona. The initial find was traced back to growers in California, and subsequent CDFA inspections confirmed that the Q-Biotype was indeed present in San Diego and San Luis Obispo Counties. The CDFA initially quarantined the two facilities until they eradicated the pest, but both facilities were cleared soon afterward.

The difference between the B-Biotype, the silverleaf whitefly *Bemisia argentifolii Bellows and Perring,* and the Q-Biotype is that the Q-Biotype has demonstrated resistance to pesticides currently effective against the B-Biotype, and the Q-Biotype is an efficient vector of serious phytopathogens in vegetables in Europe. Until recently efficacy trials against the Q-Biotype could only be conducted under quarantine conditions. However, we have identified California as one of many states presently infested with the Q-Biotype and have therefore been given permission to study this insect outside of quarantine at UC Riverside and now have numerous trials ongoing in an effort to identify pest management solutions.

Science to the Grower

Growers can use Temperature and Light Interactions to Control Crop Quality

by Richard Y. Evans, UC Cooperative Extension, Department of Plant Sciences, UC Davis

Crop production has always been a battle against the elements, and putting plants in a greenhouse only changes the battlefield. In fact, a greenhouse grower recently asked: Can I produce high-quality crops without becoming a slave to the power company? The answer is simple: A grower who faithfully applies scientific principles can produce a high-value crop.

In truth, there is no escape from the fact that temperature affects the rate of plant development. Between the extremes that kill plants outright, plants grow slowly if temperatures are low and rapidly if they are high. In fact, accumulated heat is a good predictor of the developmental rate of many plants and animals. This is commonly done by monitoring degree-days. A degree-day is a unit that approximates the accumulation of heat over time, and one degree-day is one day (or 24 hours) with the temperature one degree above some minimum value at which growth stops. Of course, things aren't so simple. Light interacts with temperature to affect plant quality: A plant will grow rapidly at high temperatures, but if light is low the stems will be weak.

Some researchers argue that the ratio of light to temperature is a better predictor of crop growth than either light or temperature alone. This ratio is called the photothermal ratio, or PTR, with light expressed as the number of photosynthetically active photons that fall on a given plant or production area, and temperature expressed as degree-days. Early workers focused on field crops, such as corn and rice, but greenhouse ornamental crops have not been ignored. For example, Royal Heins's group at Michigan State University has done some interesting studies of PTR effects on poinsettia growth before and after the onset of flowering.[1] They established many different combinations of plant spacing, temperature, and light on greenhouse-grown poinsettia plants and evaluated effects of PTR on yield and quality. They found that plant growth increases linearly as PTR increases, meaning that similar yields can be obtained at high or low temperatures (the range was 66-80°F) if light is adjusted appropriately. PTR also affects plant quality. High PTR values early in crop development result in finished plants with strong lateral shoots that are resistant to stem breakage. High PTR values after flower initiation increase bract and cyathia size, resulting in higher flower quality in the finished plant.❁

[1] Liu, B. and R.D. Heins. 2002. Photothermal ratio affects plant quality in 'Freedom' poinsettia. J. Amer. Soc. Hort. Sci. 127:20-26.

Richard Y. Evans
Extension Specialist
Department of Plant Sciences
University of California
Davis, CA 95616
Phone: (530) 752-6617
Fax: (530) 752-1819
e-mail: ryevans@ucdavis.edu

The Following New ANR Publications are Now Available:

compiled by Steve Tjosvold, UCCE Santa Cruz and Monterey

Planner's Guide for Oak Woodlands, 2nd Edition

G. Giusti, D. McCreary, R. Standiford

First published in 1992, A Planner's Guide to Oak Woodlands was the first such manual of its kind. Designed for professional planners, consultants, and landscape architects, this new edition provides science-based information that can guide decision-making.

Chapters cover a range of planning and conservation topics including:

- Biology of Oak Resources
- Wildlife Habitat
- Watershed Management
- Regional Planning
- Mapping Resources and Modeling Risk for Improved Land Use Planning
- Ordinances

The 116-page second edition also features a sturdier binding and more photographs. The encroachment into oak woodlands addressed at the time of the first edition has not stopped, and in some cases it has continued at an alarming rate. As more development occurs in the oak woodlands, this guide can provide a framework for preserving this icon of the California landscape.

3491
$15.00
http://anrcatalog.ucdavis.edu/InOrder/Shop/ItemDetails.asp?ItemNo=3491

Back in Stock:

Scheduling Irrigations
3396
$25.00
http://anrcatalog.ucdavis.edu/InOrder/Shop/ItemDetails.asp?ItemNo=3396

Updated Pest Notes Recently Posted to the Online Catalog

Cliff Swallows
7482
http://anrcatalog.ucdavis.edu/InOrder/Shop/ItemDetails.asp?ItemNo=7482

Hackberry Woolly Aphid
741111 http://anrcatalog.ucdavis.edu/InOrder/Shop/ItemDetails.asp?ItemNo=74111

New Free Publications Recently Posted to the Online Catalog

Managing Mosquitoes on the Farm
8158 http://anrcatalog.ucdavis.edu/InOrder/Shop/ItemDetails.asp?ItemNo=8158

Compiled by
Steve Tjosvold
UC Cooperative Extension
1432 Freedom Blvd.
Watsonville, CA 95076-2796
Phone: (831) 763-8040
Fax: (831) 763-8006
e-mail: satjosvold@ucdavis.edu

Hooking Up!

Greenhouse Energy Use Efficiency Websites

compiled by Don J. Merhaut, Department of Botany and Plant Sciences, UC Riverside

There is a plethora of internet sites related to energy use in greenhouse production. When searching on the internet for ways of reducing energy costs in greenhouses, you need to customize your search so that topics related to global warming and global greenhouse gases are not also included in your results. Advance search options will allow you to select the option of 'without the words' and type in 'global warming'. Below is a brief list of sites related to energy use efficiency (EUE). There are many more specific sites related to fuel sources, greenhouse construction, greenhouse coverings, etc. However, the sites listed below will provide a general overview of greenhouse construction and cultural practices that will directly or indirectly increase EUE.

http://www.nraes.org/publications/nraes3.html

This site is provided by the Natural Resource, Agriculture, and Engineering Service (NRAES) and gives access to book publications. There is one book called *"Energy Conservation for Commercial Greenhouses"*. This book will provide a general overview related to greenhouse production, design and operation.

http://www.horticulture.wisc.edu/freshveg/Educational Resources.htm

This site is sponsored by the University of Wisconsin. There is a slide presentation titled "Greenhouse Energy Efficiency" by Scott Sanford. This presentation provides a great overview on greenhouse structure, design, space utilization, heating alternatives, and greenhouse coverings.

http://attra.ncat.org/energy.html

This site is managed by the National Center for Appropriate Technology (NCAT), which is funded by the USDA Rural Business – Cooperative Service. There are links to three articles related to greenhouse heating: (1.) Solar Greenhouse Resource List; (2.) Compost Heated Greenhouses; (3.) Rootzone Heating For Greenhouse Crops.

http://ohioline.osu.edu/aex-fact/0802.html

Maintained by Ohio State University, this link is to an article titled 'Greenhouse Condensation Control' and talks about the use of thermal screens to conserve heat and prevent condensation in greenhouses.❁

Compiled by
Donald J. Merhaut
Department of Botany & Plant Sciences
University of California
4118 Batchelor Hall
Riverside, CA 92521
Phone: (951) 827-7003
Fax: (951) 827-5717
e-mail: donald.merhaut@ucr.edu

Get Cultured

Heat Disinfection of Recycled Irrigation Water

by Donald J. Merhaut, Department of Botany and Plant Sciences, UC Riverside

History

Heat to sanitize materials is commonly used to sterilize substrates in the nursery industry. However, heat has also been used to sterilize water, especially for nurseries in European countries. Since no chemicals are added in this process, there is no concern regarding chemical storage or chemical residues. This article will briefly describe disinfection of irrigation water through heating for the specific use in nursery production facilities.

How does heat treatment work?

All living organisms have a certain heat tolerance, the ability to withstand a certain maximum temperature for a specified period of time. Once this time or temperature is exceeded, the organism dies. Viruses are killed at temperatures as low as 130°F (55°C), if that temperature is maintained for a period of 1.5 hours. At higher temperatures, the required heat duration for organism death decreases.

Procedures for heat treatment of irrigation water

Metal heat exchangers are situated at one point along the water treatment system. The number and size of exchangers will depend on the volume of water that needs to be treated during a given time period. Prior to passing over the heat exchangers, the water pH may be acidified to 4.5 to prevent calcium accumulation on the exchangers. If the water is particularly dirty, filtration may be recommended prior to heat treatment. After heating, the water must be cooled before using on plants.

ADVANTAGES

+ **No chemical residues –** since no chemicals used.
+ **No additional chemicals –** proper heating procedures will require no chemical treatment.
+ **Maintenance –** no maintenance, unless calcium builds up on exchangers.
+ **Pathogen control –** all pathogens will be killed.
+ **Algae control –** the system will kill algae.
+ **Plant safe –** if cooled sufficiently after heat treatment, there are no potential toxicities from heating.

DISADVANTAGES

– **Difficult monitoring –** water must be checked through laboratory procedures to ensure that that all pathogens are killed.
– **Water cooling –** water must be cooled prior to usage.
– **Lengthy treatment period –** depending on the maximum temperature utilized, heating duration may take up to 1.5 hours to achieve 100% mortality of pathogens.
– **Space allocation –** since the efficacy of heat treatment is related to exposure time at a certain temperature, tanks will be needed to hold treatment water and cooling water.
– **High operation cost –** for electricity source, natural gas, or oil.
– **Water pH –** water will require acidification to approximately 4.0-4.5 prior to heating (to prevent calcium buildup on heat exchangers), and then will have to be neutralized (to crop requirements) after heat treatment.
– **Floating debris removal –** does not break down or remove floating debris.
– **Clay and silt removal –** clays and other soil particles are not removed or broken down.
– **Chelates destroyed –** if chelates for iron or other nutrients are used, temperatures up to 150°F should not be a problem. However, accidental temperatures near boiling (212°F) will denature chelates.
– **Pesticide breakdown –** please check pesticide labels for temperature stabilities in solutions.

Conclusions

When used properly, heat treatment can be an effective method to disinfect irrigation water in some nursery systems. Some of the primary limitations to heat treatment systems are space for holding tanks for heating and cooling water and the high cost of heating water.

When disinfecting recycled irrigation water, always check for effective control of pathogens, regardless of the treatment process being used.

Donald J. Merhaut
Department of Botany & Plant Sciences
University of California
4118 Batchelor Hall
Riverside, CA 92521
Phone: (951) 827-7003
Fax: (951) 827-5717
e-mail: donald.merhaut@ucr.edu

Rebates from PG&E cont. from page 7

ing fixtures, lamps and their components. For example, rebates are provided for replacing magnetic ballasts with energy-efficient electrical ballasts.

Express Efficiency HVAC/Food Service/Other Technologies incentives at first look might not seem like it fits with agricultural operations, but look closer. Besides rebates for insulated hot food holding cabinets, there are rebates for converting sprinkler to drip irrigation and for low pressure sprinkler nozzles. Drip conversions must be from a high-pressure, impact-type, sprinkler irrigation system (50 psi operating pressure or more at the sprinkler head) to a micro-irrigation system. Drip tape systems are not eligible. For low-pressure sprinkler conversions, the rebate application must have a pumping efficiency analysis to ensure the new system has a 45% pumping efficiency.

The Standard Performance Contract (SPC) offers cash incentive payments for projects involving replacement of existing equipment or systems with new, high-efficiency equipment or systems. The program is open to projects involving all commercial, industrial and agricultural customers, including those small and medium energy consumers that qualify for the incentives in the Express Efficiency incentives, described above. Payment amounts are determined by the quantity of savings resulting from installation of the new equipment or system.

There is electric and gas funding available for the 2005 SPC program. PG&E has received approval to immediately spend 2006 funding in 2005 for 2005 program continuity, including funding existing 2005 gas applications that were previously wait listed. More information on the Express Efficiency rebates can be obtained at **www.pge.com/express** and for the SPC rebates at **http://www.pge.com/biz/rebates/spc_contracts/** or at 1-800-468-4743.

Campus News & Research Updates

Compiled by Julie Newman, Farm Advisor, UCCE

UC Davis Campus News

A reception to present Ray Hasek with an emeritus status from UC Davis was held on October 14th at UC Davis. Ray made many significant contributions to the floral industry during his career. It was only due to an unfortunate paperwork glitch that he wasn't granted emeritus status earlier.

Ray Hasek received his Ph.D from Ohio State and worked in the flower industry for 15 years prior to joining UC. One of his earliest contributions was work on vacuum cooling cut flowers, reporting its first use in the US.

Serving as Cooperative Extension Specialist for Environmental Horticulture from 1967-1985, he worked statewide with farm advisors to solve problems in the county and to extend research information. He taught courses at UC Davis and wrote numerous articles.

Upon his retirement from UC he served as Executive Director of the California Floral Council (CFC) for 7 years, administrating, representing the Council on various issues, and writing a monthly newsletter to keep 250 flower grower members informed on legislation, labor issues, and imported flower duty problems. He worked with the Floral Trade Council, handled their finances, and wrote newsletters sent to over 500 flower growers nationally, pro bono. He also contributed and was a catalyst to the formation of the California Cut Flower Commission.

During Ray's career he received many industry awards, including a Roses Inc. Fellowship and a Research Award. He also received the "Man of the Year" award for the California State Florists Assoc., which included $5000 and a month tour of Holland and Germany to study energy saving procedures in commercial flower growers' greenhouses.

Ray worked internationally, extending horticulture information to growers world-wide.❁

Research Updates

UC Davis is Testing 14 Elm Varieties

by Jim Harding[1], Greg McPherson[2], Skip Mezger[3], Mary Louise Flint[4,5] and Steve Dreistadt[5]

Elm trees were dominant features along the streets of many American cities during the early 20th century. But beginning in the 1930s, Dutch elm disease began taking its toll, and by the 1970s the disease had swept across the country killing most of the elms. For many years, it was as if the elm was extinct. Now, an elm revival is underway. New disease resistant trees have been propagated and are being planted once again.

As part of this national renaissance, researchers, teachers, students, and grounds crews planted 70 elms at the Bowley Plant Science Teaching Center on the campus of UC Davis during May 2005. The trees, provided by Schmidt Bros. Nursery in Oregon, consist of 14 different varieties selected because of their potential to be good performers in Northern California. They include the disease tolerant American elm cultivar 'Valley Forge' and hybrids such as 'Accolade,' mostly of Asian heritage, whose vase-shape duplicates the American elm. Other promising cultivars have the added advantage of elm leaf beetle resistance, ornamental bark, and a wide range of environmental tolerances.

The trees, planted every 20-ft in four rows at the Bowley Center plot, will be measured and evaluated annually for five years, then transplanted to various sites on campus and monitored for another five years. Students are assisting with annual evaluations.

UC Davis, USDA Forest Service, and other researchers will compare the trees' performance in terms of growth, health, fall color, and resistance to elm leaf beetle and Dutch elm disease. Their root architecture will be examined using air-spades that expose roots with minimal disturbance. This technology makes it possible to identify cultivars with deep and shallow rooting patterns, thereby reducing future conflicts between tree roots and sidewalks.

This project partnership between UC Davis Plant Science Department, Grounds Division, and USDA Forest Service, Center for Urban Forest Research is providing new information that will spur reintroduction of what was the crown jewel of many California cities—the elm tree.❁

American elm cultivar Valley Forge. (Photograph by Gilbert Carley, 1996)

[1]Department of Plant Sciences, University of California Davis; [2]USDA Forest Service Center for Urban Forest Research, University of California Davis; [3]Facilities, University of California Davis; [4]Department of Entomology, University of California Davis; [5]IPM Education & Publications, Statewide IPM Program, University of California Davis.

Compiled by
Julie P. Newman
UC Cooperative Extension
669 County Square Drive, Suite 100
Ventura, CA 93003-5401
Phone: (805) 645-1459
Fax: (805) 645-1474
e-mail: jpnewman@ucdavis.edu

Easter Lily Bulb Production cont. from page 6

Nematology Specialist, has been project leader on many trials conducted at the station in Curry County and in Humboldt County on nematode control. The research teams consist of Farm Advisor Deborah Giraud, Cindy Anderson (UC Davis), Lee Riddle and several graduate students. Trials are performed in an effort to control these diseases; nematicides, alternatives to chemicals, application techniques and hot water dips are some of the treatments. Ditera, trichoderma, treating the bulbs with ozone gas, Quillaja, meadowfoam seed meal, BrotAct, and Muscador Albans are in trials now. Some have shown limited success last year.

Nematodes are a very challenging pest, and an integrated approach while constantly looking for new techniques is needed to keep the Easter lily bulb industry healthy and thriving.

www.easterlily.net

Thermal Curtains cont. from page 8

pockets and can help reduce airborne pathogens such as *botrytis* and powdery mildew.

Thermal blankets are costly to install, especially when retrofitting. Some growers in this region received low-interest loans to install thermal curtains from the California Energy Commission's Energy in Agriculture program in 2001. Today, many nursery growers are taking advantage of loans and rebate programs offered through the Southern California Gas Company to install thermal curtains.❁

CORF
FLORICULTURE EDUCATION FROM THE
KEE KITAYAMA RESEARCH FOUNDATION

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

Reproducing and distributing material from this newsletter is encouraged, provided credit is given to the author and *CORF News*.

California Ornamental Research Federation
P.O. Box 318
Freedom, CA 95019-0318
Phone: (831) 724-1130
Fax: (831) 728-7337
www.corf.org

Address Service Requested

THANKS to these Sponsors of CORF Educational Programs

ANR University of California

California Association of Flower Growers • Shippers

California Cut Flower Commission

BioWorks

ohp Partners with solutions

Western Farm Service

Sustaining Sponsors

Gowan Company
Phyton (Source Tech Biologicals)
Romeo Packing
SePRO
Target Specialty Products