Department of Environmental Horticulture • University of California, Davis

GROWING Points

Reorganization of the Plant Science Departments at UC Davis

by Heiner Lieth

The leadership of the College of Agricultural and Environmental Sciences has worked with faculty to strategically plan the future of the various departments that work primarily in the plant sciences. Last fall Dean Neal van Alfen charged a faculty committee with identifying issues and ideas related to merging these into one department and to identify the ideal structure for a department, recognizing that this would be a very difficult activity. The result of that strategic planning process was the identification of a new one-department model for the plant science faculty. In addition to this, the resulting department was to have several sections which would group faculty into interest groups.

Implementation committee given charge in Fall 2003

At the start of the fall quarter, Dean van Alfen assembled a committee with the charge of implementing this plan. The vision is that this change will allow exciting opportunities for collaboration and investment in the plant sciences and will thus sustain UC Davis' leadership in the field far into the future. The projected date for implementation is July 1, 2004.

Environmental Horticulture is one of four departments involved in this effort. The other current departments are Agronomy and Range Science, Vegetable Crops, and Pomology.

While a decision has been made regarding the organization of the plant sciences at a broad level, we are now in the process of addressing the many issues required for success. The implementation committee is currently developing a detailed proposal that ultimately will go to Chancellor Vanderhoef for approval.

The implementation committee consists of faculty from each of the current departments and includes the current department chairs. The latter are Professors Vito Polito, (committee chair and currently Chair of the Department of Pomology), John Yoder (current Chair of the Department of Vegetable Crops), Chris van Kessel (current Chair of the Department of Agronomy and Range Science) and Heiner Lieth (current Chair of the Department of Environmental Horticulture). Professors Steffen Abel, Joe DiTomaso, Dave Burger, Beth Mitcham, Dan Potter, Emilio Laca and Ken Tate are also on the committee. Ms. Dee Maddera is a staff representative on the committee. To address the many complex issues, a number of subcommittees were set up so as to bring the wide range of special expertise of our faculty to bear on the project.

Faculty are united in effort

While it is as yet too early to report specific results from this effort, it is already clear that the faculty are taking this effort very seriously and are united in the effort to create a situation that will optimize our ability to respond to the needs of Californians, as well as the nation, in the various plant sciences in which we have expertise. Our current structure has us focused very tightly on specific commodities, but we have been working for many years at collaborations that transcend these traditional boundaries. The current planning process is moving in the direction where we will be able to respond to specific problems with greater focus and broader expertise. For example, instead of working separately in each of our departments to deal with similar environmental issues facing agriculture, we will now be able to approach the broader issue in a more concerted effort. In the case of Environmental Horticulture, there will be much greater freedom to involve other faculty colleagues in research efforts. Thus we see this to be a winning situation for the clientele which we currently serve. Our various clientele groups can count on greater access to faculty with wider interests and skills when they are looking for scientists to work on specific, important issues.

Another advantage is that, in the future, newsletters such as this one will bring you information relevant to your interests that draws from a broader scientific base. Hopefully the proposed cutting of outreach programs at the University of California will not include cutting of outreach efforts of this type, at a time when they are becoming more and more valuable to Californians.

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http://envhort.ucdavis.edu

If You're Going to San Francisco... by Robby Flannery

Ah…San Francisco! The first time I ever visited San Francisco was in 1983, when I was five years old. I can hardly recall the details of this stopover, but I do remember the clam chowder served in sourdough bowls on the pier being really, really yummy. Although this particular trip to SF did not leave a lasting impression of the vast culture of the city on me, I have since frequented the place throughout my college career at UC Davis. Fortunately, these trips will often involve more than eating clam chowder on the pier. Sometimes I'll eat pizza on the pier, or there are times that I will eat clam chowder elsewhere in the city. Then there are times that I will go to the city and actually accomplish something other than eating on the pier. One Sunday morning in the beginning of November, the Environmental Horticulture Club at UC Davis traveled to the Conservatory of Flowers at Golden Gate Park and I just so happened to tag along. Although no food or drink were allowed inside the conservatory, this trip was rather stimulating and is something that I would like to share.

The EH Club at the SF Conservatory of Flowers

First off, some history of the Conservatory is in order. It's doors opened to the public in 1879. Only four years later, the boiler exploded and caused the main dome to catch fire resulting in its utter destruction. Twenty-five relatively uneventful years went by. Sure many visitors enjoyed the exhibits during this quarter century, but it wasn't until 1918 that the main dome burned down again. Eventually the building's structural instability caused the Park Commission to close it down in 1933. A mere thirteen years passed before the Conservatory's doors were opened again. The dome was deteriorating and in 1964 it was refurbished to prevent its collapse. The refurbishments from 1964's refurbishing were then refurbished to once again prevent the dome's collapse in 1978. Then another seventeen years went by before anything exciting happened because in 1995 the Conservatory had to be closed due to extensive wind damage. And then finally, the Conservatory of Flowers was reopened again this past September. I would strongly suggest visiting this virtual phoenix of a San Francisco monument because no one really knows the next time it will burn down or fall apart and close down for a decade or two. Granted, the dome did not collapse nor did any heating boilers explode during my visit, but the exposition of exotic plants and flowers more than makes up for any calamities that could befall the building.

www.conservatoryofflowers.org

The Conservatory itself is full of plants, most of which are tropical in origin. There were many orchids growing epiphytically, in pots, in the ground…you name it. There were even some potted-orchids in cages. Someone in the group tried to convince me that they were behind bars to prevent the pilfering of the plants from the premises, but I think I know the real reason they were imprisoned. The orchids that were behind bars were the ones that had nasty dispositions. These ill-tempered plants had to be maintained in seclusion because they don't play well with others; be it their allelopathic properties or their tendencies to selfishly hog all the sun.

Part of the reason why someone would build a conservatory for flowers is because they want to be able to grow and show off plants that you normally wouldn't see growing outside, and therefore are deemed exotic. Hence, we did not see many petunias, impatiens or violas. Plants such as tropical palms, *Hibiscus*, *Nepenthes*, *Philodendrons*, chocolate trees and several tropical cycads were found throughout the greenhouse. Some of these plants require augmented humidity to survive, which made taking pictures in this environment somewhat difficult. Some of the photos looked as though I had taken them in a sauna. In this same room of the Conservatory, vines and lianas were twisting up palm trees and stretching their aerial roots towards the soil underneath our feet. Tarzan himself couldn't have designed the hanging vines any better. Finding yourself in such a room right after walking through Golden Gate Park on a brisk November morning is quite a contrast.

The Conservatory of Flowers had a display discussing the different pollinators that plants have. It was here that I began

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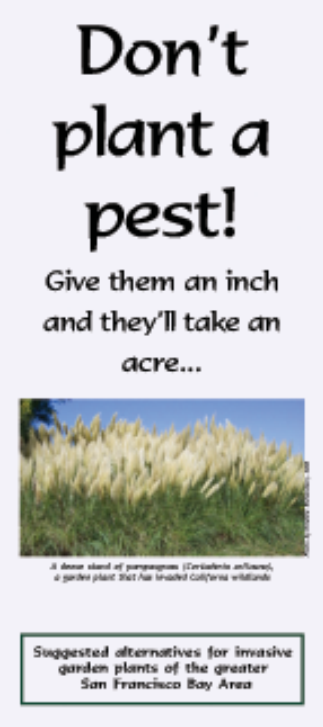
New Brochure Featuring Alternatives to Invasive Plants Now Available From Cal-IPC (formerly Cal-EPPC)

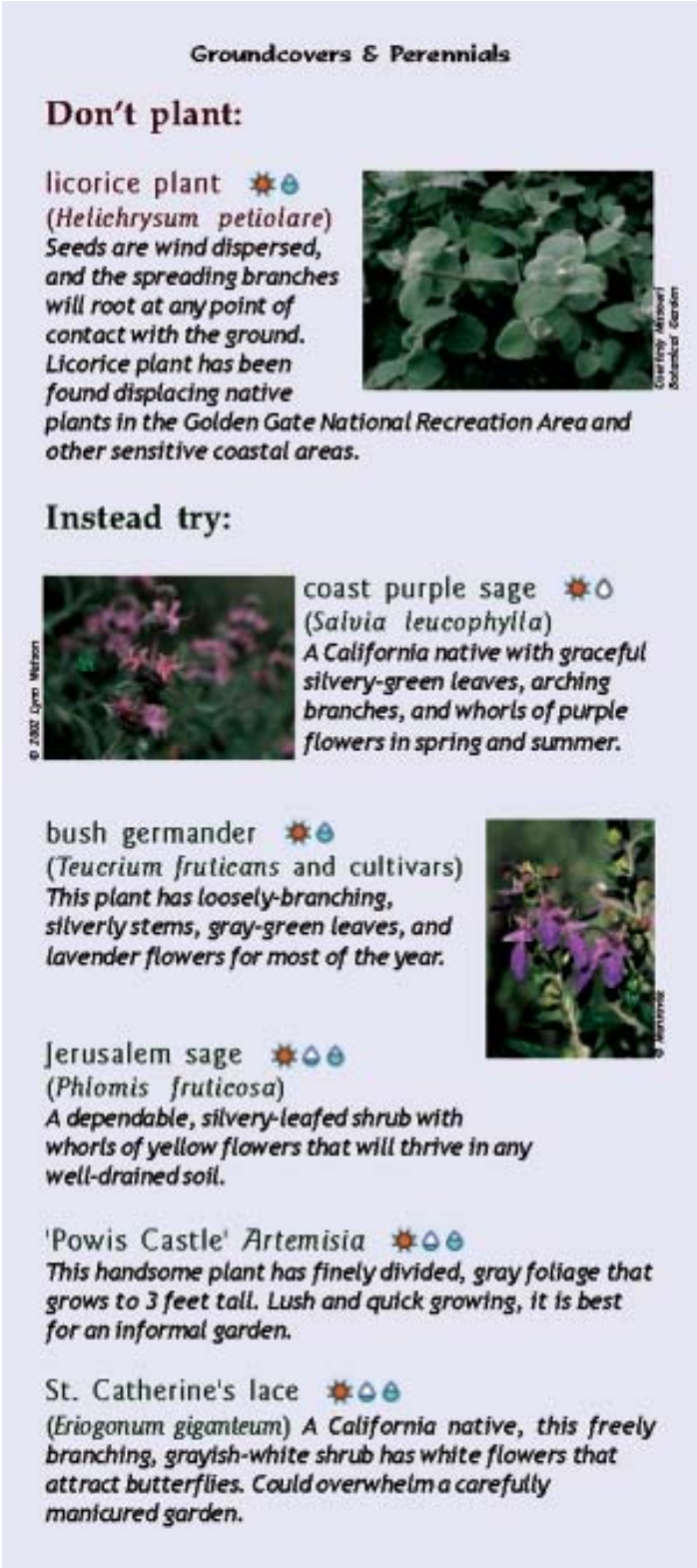


In September, 2003 the California Exotic Pest Plant Council (Cal-EPPC) changed its name to the California Invasive Plant Council **(Cal-IPC)** in order to make the organization's mission more instantly recognizable to legislators, corporate contacts, agency representatives, and the public. Cal-IPC proposes and facilitates solutions to problems caused by non-native pest plant invasions in California wildlands. The group's membership includes public and private land managers, ecological consultants and researchers, planners, volunteer stewards, and concerned citizens. Cal-IPC is recognized as the authoritative source of new information on all aspects of wildland weed management.

Among the organization's activities is the Cal-IPC Nursery Sustainability Program. Because the horticulture industry is a significant source of invasive plant introductions, this program is designed to bring nurseries, growers, retailers, landscape architects, gardeners, consumers, and weed workers together to work toward a solution. For several months, participants in the Nursery Sustainability Program have been developing educational materials promoting non-invasive ornamental plants as alternatives to invasive exotics for landscaping.

The first Landscaping Alternatives brochure is now available. The brochure suggests alternatives for garden plants known to be invasive in the greater San Francisco Bay area. (A second brochure, which will suggest alternatives for invasive trees in Central California, is currently in production.) It is the product of a collaborative effort that involved all the stakeholders affected by this complicated issue, including: weed experts, UC Cooperative Extension programs, commercial and retail nurseries, growers, botanical gardens, gardeners, state and local agencies, non-profit organizations, and land managers. The brochure is designed to be a tool for Cal-IPC members and others to use in approaching their local nurseries, an educational tool for gardeners and consumers, and a template for other organizations that wish to produce similar or related materials.

The brochure entitled "Don't Plant a Pest" is being distributed initially through county Weed Management Areas, CNPS chapters and Master Gardener groups. If you can put some brochures to good use, please contact the Cal-IPC office at (510) 525-1502 or email **Doug Johnson** at dwjohnson@cal-ipc.org. A donation of $30 per pack of 100 brochures is suggested to help cover production costs. Cal-IPC's website: www.cal-ipc.org GP



Example page from Cal-IPC landscaping alternatives brochure showing invasive garden species and suitable non-invasive alternative plants.

Hands-On Irrigation Training for Nursery Growers

Dr. Richard Evans, UCCE Horticulture Specialist
Department of Environmental Horticulture, University of California, Davis

During the past year, Dr. Richard Evans has conducted several workshops for nursery growers throughout California that have focused on improving irrigation efficiency for plants in containers. California nurseries are trying to comply with strict regulations regarding runoff and pollution from their properties. Re-examining and optimizing their irrigation practices are actions growers can readily take to fulfill regulatory obligations while maintaining plant quality. This series of workshops was funded by the Kee Kitayama Research Foundation. Following are excerpts from the educational materials used by Dr. Evans at his workshops.

Why is Irrigation Efficiency Important?

Achieving high irrigation efficiency can be time-consuming, but its importance is increasing throughout California. The most direct reason is the increasing cost of water as consumers fight for this limited resource. Another reason is concern about water pollution. Federal, state, and regional government entities may demand that nurseries reduce or eliminate the introduction of pollutants into water leaving the property. The most important pollutants from nurseries are pesticides, sediments, nitrogen, and phosphorus. Nurseries that irrigate efficiently will have less runoff, and therefore less of a potential problem to manage.

What Factors Affect Irrigation Efficiency?

Irrigation efficiency is affected by how much water is applied relative to crop needs, how uniformly water is applied among the crop plants, and how much leaching is needed to manage water quality problems.

How Much Water Do Plants Need?

Growers can control some aspects of irrigation efficiency. For example, growers determine the amount of water applied at each irrigation. Clearly, this amount should be enough to replace what the plant has transpired since the previous irrigation. However, most growers do not know how much water their crops use. Table 1 presents average daily water use values for some ornamental crops. Note that none of them uses more than a pint of water per day under normal conditions.

A grower can estimate plant water use by measuring the change in weight of a pot containing the crop plant between irrigations. For our purposes, it is most convenient to use a scale that records in grams (one gram of water is the same as one milliliter). For pot plant growers, this is easy to do. For crops in the ground, an estimate of water use can be made by growing some plants in pots. It is best to use a potting mix rather than the field soil—water use will not be affected. For accurate results, sink an empty pot into the ground next to the field-grown crop, and nest the potted plants inside those pots. To measure water use, irrigate the plants, wait an hour or more until drainage stops, then weigh the pot. Weigh the pot again the next day before irrigating. The difference in weight represents the amount of water used. It is best to weigh several pots distributed throughout the growing area, if possible.

How is Irrigation Uniformity Measured?

Most irrigation systems are imperfect. Some sprinklers or emitters put out more water than average, and others apply less than average. Some plants will receive more water than others at each irrigation. To meet the needs of plants that receive less than average amounts of water, growers must supply excessive amounts to other plants. Measuring irrigation uniformity gives growers two important pieces of information. First, it provides a measure of how good the system is. In many cases, there are simple steps that can be taken to increase uniformity (for instance, using better nozzles, repairing leaks, and eliminating sources of large pressure drops). Second, the measured irrigation uniformity gives growers a way to decide exactly how much water to apply.

There are several methods for evaluating irrigation uniformity. The simplest method is the low-quarter distribution uniformity. To measure it, follow these steps:

1. Place catch cans in a grid throughout an irrigation block.

2. Irrigate for a known amount of time that results in partial filling of the cans.

3. Measure the amount of water in the cans. The volume of water can be measured with a scale similar to the one used to measure plant water use. Another method is to measure the height of water, if all of

Dr. Richard Evans presents a hands-on irrigation training workshop to growers gathered at Weidners' Gardens in Encinitas, CA.

Table 1. Average Daily Water Use for Selected Ornamental Crops

Crop	Water use (mL per day)	oz. per day
Hydrangea (1 gallon, outdoor)	340	11
Holly (1 gallon, outdoor)	140	5
Rhododendron (1 gallon, outdoor)	200	7
Greenhouse rose (for cut flowers)	400	14
Chrysanthemum (6-inch)	240	8

the cans have the same dimensions and vertical walls.

4. Make a table listing the cans and the amount of water in them.

5. Calculate the average amount of water in the cans by adding up the total amount, then dividing by the number of cans.

6. Calculate the average amount of water in the lowest quarter of the cans (for example, the lowest 5 cans if the total number of cans is 20).

7. Divide the average for the low quarter by the overall average to get the value of distribution uniformity.

If you know the volume applied in a known amount of time, then you can calculate the rate of application. For example, if you catch 60 mL in 30 seconds, the application rate is 120 mL/minute.

What Determines Water Quality?

For agriculture, the salts in water are the main determinants of water quality. Water picks up salts from the geologic materials it comes in contact with. There are several common constituents of water in California, depending on the geologic materials through which the water passes (Table 2). In reports from laboratories, these constituents are usually reported in either milligrams per liter (mg/L) or milliequivalents per liter (meq/L). An older unit, parts per million (ppm), is nearly equivalent to mg/L.

Why is Water Quality Important?

1. Salt accumulation in soil or container media can decrease yield and crop quality.

Most irrigation water, especially from wells, contains dissolved salts. Plants take up some of these salts when they take up water, but most accumulate in the root zone. Over time, the accumulated salts reduce the amount of water available to plants. A high amount of dissolved salts reduces yield and crop quality.

The salinity of a water is usually measured by its electrical conductivity (EC). It used to be reported as millimhos per centimeter (mmho/cm), but now the common unit is decisiemens per meter (dS/m). The values are the same for both units. The EC is related to total dissolved solids (TDS):

EC X 640 = TDS (in mg/L)

Irrigation water with an EC greater than 1.5 dS/m is regarded as having a high salinity hazard.

2. Soil pH is affected by water quality.

Bicarbonate in irrigation water results in a gradual increase in soil pH to undesirable levels. This is a greater problem on permanent or long-cycle crops than it is on bedding plants and most potted flowering crops. If the bicarbonate concentration is between 2-4 meq/L, the soil pH can be managed by increasing the use of ammoniacal fertilizers. If the bicarbonate concentration exceeds 4 meq/L, it may be necessary to acidify the water. This should be done through consultation with a laboratory familiar with acid injection.

3. Some constituents of water are toxic to plants if present at high concentrations.

Boron, chloride, and sodium are the most important problems for California ornamental crop producers.

Boron. Boron is toxic to plants at low concentrations. Some crops are sensitive to water boron concentrations as low as 0.5 mg/L. It is absorbed by roots and transported to the leaves, where it accumulates along the leaf margins. Sensitive crops develop marginal leaf burn.

Chloride. After being taken up by plant roots, chloride ions move through the plant and accumulate in the leaves. Some crops tolerate chloride, but others (especially roses, camellias, azaleas, and rhododendrons) develop marginal burning or leaf drop. Overhead irrigation with water high in chloride (greater than 3 meq/L) results in foliar uptake, which can also cause leaf scorch or leaf drop.

Sodium. Plants irrigated with water high in sodium may develop symptoms similar to those from chloride.

4. Some constituents of water are major plant nutrients.

Irrigation water can be a significant source of three elements that plants require in large amounts: calcium, magnesium, and sulfur. Some well waters contain enough nitrogen to be a significant fertilizer source. The contribution of irrigation water to crop nutrition should be considered when deciding on fertilizers and rates of addition.

How is Water Quality Managed?

Water treatment (e.g., reverse osmosis or deionization) is expensive, but effective leaching can reduce the hazard from marginal water quality by preventing excessive accumulation of salts in the root zone. Leaching is best achieved on ornamental crops by applying the proper *leaching frac-*

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Table 2. Common Constituents of California Waters

Cations			Anions		
Element	**Symbol**		**Element**	**Ion**	**Symbol**
		major			
Calcium	Ca^{2+}		Chlorine	Chloride	Cl^-
Magnesium	Mg^{2+}		Sulfur	Sulfate	SO_4^{2-}
Sodium	Na^+		Carbon	Bicarbonate	HCO_3^-
			Carbon	Carbonate	CO_3^{2-}
		minor			
Potassium	K^+		Phosphorus	Phosphate	HPO_4^{2-}
			Nitrogen	Nitrate	NO_3^-
			Fluorine	Fluoride	F^-
			Boron	Borate	$B(OH)_3$
			Silicon	Silicate	$Si(OH)_4$

Table 3. Recommended leaching fractions.

EC Applied	EC Leached (dS/m)			
(dS/m)	**3**	**6**	**9**	**12**
0.50	0.17	0.08	0.06	0.04
0.75	0.26	0.12	0.09	0.06
1.00	0.33	0.17	0.11	0.08
1.25	0.43	0.20	0.15	0.10
1.50	0.50	0.25	0.17	0.12
1.75	0.60	0.28	0.21	0.14
2.00	0.67	0.33	0.22	0.17
2.25	0.77	0.36	0.27	0.18
2.50	0.83	0.42	0.28	0.21
3.00	1.00	0.50	0.33	0.25
5.00		0.83	0.56	0.42

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Since many of the Environmental Horticulture alumni are also *Growing Points* readers, I would like to also assure you that we are looking at improving our teaching curricula as part of this reorganization effort. We have already determined that we can find new synergies among our teaching programs that can result in improvements in our various undergraduate majors.

All in all, this reorganization is a good thing for us and for you, our clients. While the current four departments are all excellent in their separate ways, and continuing in our traditional ways would not be a bad thing, it is clear that as an integrated unit we will be even stronger and able to be of far greater benefit to you in all the things we do for you (teaching, research and extension). We already know that this approach will allow us to be considered for investment on campus, as well as from off-campus sources, as we expect to be the very best. GP

Notes From the Chair... by Heiner Lieth

In the midst of all the campus activity regarding reorganization of the plant sciences, the Environmental Horticulture department continues to deliver programs:

Recent Outreach Activities

The International Cut Flower Growers Association held their annual meeting at Lake Tahoe from September 9-13. I organized a three-day educational program that included sessions for growers on water quality, irrigation and fertilization for greenhouse cut flower production. A tour of EH, Entomology and the new Plant Sciences Teaching Facility on the UCD campus was also part of the program. Assisting me with delivery of the program were Drs **Richard Evans, Raul Cabrera** (EH alumnus) currently at Texas A & M University and EH alumnus **Cliff Low** of Perry Laboratory in Watsonville. My graduate students **Neil Mattson** and **Robby Flannery** also gave presentations of research results that were pertinent to the subject matter. Participants came from many US states as well as other countries (Canada, Colombia and Ecuador).

UCCE Landscape Specialist **Loren Oki** organized a Horticulture Research and Education Conference at UCD's Mondavi Center on September 23. The event was sponsored by the **California Association of Nurseries and Garden Centers** as well as ANR, CAES and EH. The day was divided into several informative sessions addressing current issues affecting the nursery industry including pathogens in recycled water systems, pesticide runoff, new propagation systems and updates on disease and pest control. Of particular interest to participants were presentations on complying with the conditional agricultural waiver for runoff, given by state officials and water quality control board representatives.

During the first weekend in November, **Richard Evans** attended the **International Farmers' Aid Association** annual meeting in Yosemite. Among the attendees were students from Japan, Brazil and Korea participating in farm internships here. Richard spoke about current economic and production trends for ornamental horticulture.

Faculty Pursuits

From October 20-23 **Linda Dodge** and I attended an IR4 Ornamentals Workshop in Connecticut. This was the first time we participated in this annual national meeting of researchers and chemical industry representatives. We learned a great deal over four days about how the IR4 process works and hope to incorporate this new knowledge in our fledgling IR4 program here in California.

Don Durzan received a 2003 NASA Innovation Award for his work on the recovery of taxanes and drugs by cell and biosynthetic surface enrichment with anti-drug magnetic antibodies. Don also served as a member of NASA's Scientific Working Group for the biotechnology facility on the International Space Station.

Alison Berry was named director of the UC Davis Road Ecology Center (http://johnmuir.ucdavis.edu/road_ecology/). This center brings together researchers from the John Muir Institute of the Environment (JMIE) and the Institute of Transportation Studies (ITS-Davis) to assess the impacts of roads and transportation systems on natural landscapes and human communities. They plan to create analytical methods, professional practices, and institutional processes to support sustainable transportation systems and to disseminate this information broadly to professional communities, to students and environmental scientists, to agencies, and to public interest groups.

USDA Recruitment of Research Horticulturist

The **Agricultural Research Service** is currently recruiting for a research horticulturist to be housed on the UCD campus. This position will focus on greenhouse-based floriculture crop production research. Our EH faculty are looking forward to working with this scientist on collaborative projects that will benefit the floral industry in the state and nation-wide.

Future Events

January and February are the months for local green industry trade shows and there are several coming up in 2004 in which EH faculty may be participating. January 14 is the **Sacramento Valley Landscape and Nursery Expo** (www.sacvalexpo.com). Dr **Loren Oki** and I will be making presentations and the **EH Club** will be manning a booth. The **NorCal Show** in San Mateo is on January 22 and its sister event, the **Southern California Spring Nursery and Landscape Show**, is on February 4 in Pomona.

As featured in the previous issue of *Growing Points*, the **27th Annual Society of Ethnobiology Conference** will take place on the UCD campus March 24-27, 2004. NRCS ethnobiologist and EH affiliate, **Kat Anderson**, is organizing the event entitled "Living Landscapes: Linking Ethnobiology and Restoration Ecology in the Revival of Native Systems". Registrations are currently being accepted; if you wish to attend one of the tours, register soon as these are almost certainly going to fill up. GP

Workshop participants check irrigation uniformity using the can test.

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tion. This is the ratio of the volume of water leached (for example, the water that runs out of the bottom of a pot) to the volume of water applied (for example, the total amount of water applied to a pot). The proper leaching fraction depends on the salinity of the irrigation water (including fertilizer, in a liquid feed program) and the salinity sensitivity of the crop. In Table 3, EC Applied is the salinity of the irrigation water and EC Leached is the desired value in the water that has passed through the root zone. For most ornamental crops, EC Leached should be between 6-9 dS/m.

Applying the selected leaching fraction requires application of the information known about crop water use and irrigation distribution uniformity. Table 4 gives the volume of irrigation water needed for several amounts of plant water use and several leaching fractions. The values for leaching fraction and water use can be rounded off to conform to the table values. For example, a pot mum that used 240 mL of water should be irrigated with about 313 mL of water if the EC Applied is 2 dS/m and the desired leachate EC is 9 dS/m (the leaching fraction is about 0.22).

The values in Table 4 do not take into consideration the distribution uniformity. To correct for that, the values in the table must be divided by the distribution uniformity value. For example, if the distribution uniformity is 0.8, the mum in the example above would require 390 mL.

Using the average application rate of the irrigation system (calculated during the test of distribution uniformity), the duration of each irrigation cycle can be calculated. Again using the pot mum example, the 390 mL needed could be applied in just over 3 minutes if the system applies water at 120 mL per minute.

Pot plant growers can monitor leaching fraction and leachate EC by catching leachate from a few pots periodically. Measure the volume of leachate and either measure or calculate the volume of irrigation water applied. The ratio of leachate volume to total volume applied is the actual leaching fraction.

How Often Should Plants Be Irrigated?

The maximum amount of time between irrigations is determined by the amount of easily available water. This amount can be determined easily for potted crops. Irrigate some plants thoroughly and wait for drainage to stop. Weigh the pots, and withhold irrigation until the plants show the first signs of wilting. Weigh the pots again. Subtract this weight from the weight just after irrigation. The difference (in grams) is equal to the volume of water (in milliliters) that is available to plants. This is sort of like the "gas tank" of water the plants can use. The normal recommendation is to irrigate when about half of this volume has been used by the plant. For example, if a pot holds 500 mL of easily available water, then irrigation should be scheduled when about half of that, or 250 mL, has been used by the plant. The pot mums we discussed above used 240 mL per day, so a daily irrigation would be just right. GP

Table 4. Volume of water (in mL) to apply to achieve desired leaching fraction.

Leaching fraction	Plant water use (mL)										
	50	**75**	**100**	**125**	**150**	**175**	**200**	**250**	**300**	**350**	**400**
0.075	54	81	108	135	162	189	216	270	324	378	432
0.100	56	83	111	139	167	194	222	278	333	389	444
0.125	57	86	114	143	171	200	229	286	343	400	457
0.150	59	88	118	147	176	206	235	294	353	412	471
0.175	61	91	121	152	182	212	242	303	364	424	485
0.200	63	94	125	156	188	219	250	313	375	438	500
0.225	65	97	129	161	194	226	258	323	387	452	516
0.250	67	100	133	167	200	233	267	333	400	467	533
0.275	69	103	138	172	207	241	276	345	414	483	552
0.300	71	107	143	179	214	250	286	357	429	500	571
0.400	83	125	167	208	250	292	333	417	500	583	667
0.500	100	150	200	250	300	350	400	500	600	700	800

Continued from page 2

to formulate this idea about plants: "Plants use animals to do their bidding." Now hear me out on this one. Here we have this display about all the different kinds of pollinators ranging from bees and butterflies to birds and bats. Plants, being sessile organisms, use these motile creatures to accurately deliver pollen to flowers on other plants. And what do these poor animals get in return…maybe a bit of nectar? Sometimes these animals are even fooled. Some orchids will form petals that emulate the body of a caterpillar in order to fool a wasp into laying its eggs in the "caterpillar" for nutrition for the next generation of wasps. In the meantime, the mother wasp is spreading pollinia sacs from one orchid flower to the next. How conniving can you get? However, it doesn't stop there. Plants have also come to the realization that they can abuse the benevolent nature of humans as well. I'm sure a couple of orchids a long time ago were talking about how to get out of actually competing and struggling to live in nature. They probably said, "Hey, if we develop pretty flowers that these human beings will like to look at, they'll take care of us. They'll weed for us, provide us with sufficient nutrients and keep us comfy-cozy in little greenhouses that they will build in the middle of Golden Gate Park for us one day."

Water garden at the SF Conservatory of Flowers

I will get off my soapbox and conclude by saying that although I have come to the horrific realization that plants have a master plan that involves the subjugation of the human race and the fulfillment of their every whim, I had a good time. The Conservatory itself is quite beautiful. The city of San Francisco should be applauded for its contributions to restoring and maintaining this historical, living landmark. The diverse collection of plants in the Conservatory is astonishing, and the facilities are organized in a way as to promote learning and provoke interest in the botanical world. My trip to the Conservatory of Flowers at Golden Gate Park helped me discover that although the hippie generation has come and gone, it seems that "flower power" is still alive and well in the heart of San Francisco.

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