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GROWING Points

Buffalograss - A Promising Drought Resistant Turf For California

In California, water is becoming a limited resource. The question most commonly asked of a turfgrass specialist is: “What can I plant to save water, yet have an acceptable green, dense grass cover?” There is no panacea; in most cases, there is no way to have an acceptable turf stand without some irrigation.

FIGURE 1. Buffalograss (left) is more finely textured than bermudagrass (right).

Water shortages have caused some munici palities to consider (or actually place) restrictions on the amount of water that may be used on home, park, and cemetery lawns or golf course and sports turf. In some cities, a limit has been imposed on the allowable area-per-household of lawn composed of grasses with high water requirements. Water shortages and changes in philosophy by many turfgrass “consumers” have led to increased use of drought-tolerant grasses on sod farms, golf courses, industrial parks, parkways, and similar locations. Seed suppliers are also offering less luxurious, drought-tolerant grasses for turf purposes.

Generally, annual grasses escape drought as seed, while perennial grasses go dormant during extended dry periods. Some grasses stay green longer into drought periods than others, and this can be a valuable attribute. However, if such grass dies due to lack of water, one that turns brown earlier and lives through the long dry period is still preferable.

Several environmental factors contribute to the ability of a grass to withstand extended drought. A deep-rooted grass growing in deep soil with good subsoil moisture can remain green for extended periods. Once the subsoil moisture is depleted, however, heavy rainfall or irrigation is required to recharge the entire soil profile. Thus, in dry areas where rain or irrigation may wet the soil to a depth of only a few inches, deep-rooted plants such as tall fescue might not survive extended drought.

Researchers believe that the superior drought-resistance of buffalograss warrants its development for use in the landscape. Toward that end, projects at UC Davis and the UC Bay Area Research and Extension Center (UCBAR) in Santa Clara are aimed at identifying those turfgrass characteristics of buffalograss which are most amenable to improvement. As varietal selections are made, the goal is to make these species available to the public.

What is buffalograss?

Buffalograss (Buchloe dactyloides (Nutt.) Engelm.) is the oldest grass of the American great plains, growing on rangelands of the mid-western and western United States. Fossilized seed structures found in Kansas prairies reveals that buffalograss existed 5 to 7 million years ago. In the last 100 years, it has been used primarily for forage, but because of its drought tolerance, low nutritional requirements, and short growth stature, its potential for use as a low-maintenance turfgrass is drawing increasing attention.

Although it is grown for seed commercially, the seed supply is limited by various selection and breeding difficulties. Other drawbacks are its extended winter dormancy and relatively open turf stand which encourages weed invasion.

But what are the positive attributes of buffalograss? Are they sufficient to offset the drawbacks? Do they justify the development and use of buffalograss as a low-maintenance turfgrass? In order to replace high quality turf-type grasses such as tall fescue or Kentucky bluegrass with "pasture" grasses such as buffalograss, more research is needed to define the unique characteristics of these less familiar grasses and to discover how to manage drought-resistant grasses for turf.

Contents:

Development of New Buffalograss Cultivars

For the initial study, seed of 'Colorado Common' buffalograss was harvested from an established stand at the University of California Bay Area Research and Extension Center (BAREC). Plants established from these seeds were germinated, grown in the greenhouse and used to determine sex ratio and size classes of buffalograss. Later, stolons (runners) of some of these plants were transplanted into pots. The resulting vegetatively produced plants were grown both in the greenhouse and in the field and their performance was assessed. The sex ratio for these plants was examined as well.

The sex ratio determined from all plants indicated three distinct sex forms: male, female and monoecious (producing both male and female flowers). The ratio of male and female forms was about 1:1 and the monoecious form was found at low frequency (less than 5%). In some of the monoecious plants, perfect (bisexual) flowers were also found. Perfect flowers of two monoecious plants were pollinated with those of other monoecious plants and seeds were produced on flowers of male inflorescences.

The plants were isolated in three different greenhouses. Three weeks after pollination, 100 flowers from two plants were examined for seed set. The average seed set of the two plants was 48%. Initially, no seed was found in the self-pollinated flowers. In subsequent self-pollination tests, however, up to 30% seed set was found. Seeds developed from perfect flowers stayed on the flowers after ripening, possessing a non-shattering character--a favorable trait for seed harvest.

In general, the stalks of male flowers were found to be two or more times taller than the female stalks. But female and male flower stalk height distribution showed a considerable variation. In addition, flower stalks of greenhouse plants were much taller than the those of the field plants. These findings suggest that selection for flower stalk height is possible and may be conducted either in field or greenhouse conditions.

In addition to looking at sex ratio, the authors studied vegetatively propagated buffalograsses to determine differences in spreading rate and turf quality under reduced mowing, irrigation, and fertilization. Considerable differences were observed between collections in rate of turf establishment through vegetative propagation. Certain clones selected from the natural populations formed a solid turf within 5 weeks, starting from 1 inch plugs planted 12 inches apart. Turf established from selected female clones remained under 4 inches in height without mowing. Reasonable turf color and density were maintained with 1 lb. nitrogen per year and irrigation once a week during summer months.

For cultivar development, selection for female monoecious plants is emphasized, since female flowers remain below the turf canopy, resulting in better looking turf.

Recommended Cultivars. Seeds were collected from three locations in Mexico and plots established in the experimental field at UC Davis. Plants were mowed weekly at a 2 inch height during the growing season (from May to the end of October). Individual clones were selected for rapid vegetative growth, high turf density, and extended winter turf green color. About 80% of the plants were eliminated in the selection for the above characteristics. The remaining plants were subjected to drought stress during the following summer months by terminating the irrigation for a period of 8 weeks (from June 15 to August 15). Two male and two female plants from each of the three populations were selected for their superior performance under drought stress.

For the second selection cycle, the selected six male and six female clones were grown close together in the field, and seeds were harvested from the female plants. Six hundred plants were propagated from the seed progeny, planted in the field, and subjected to standard turfgrass management practices. Throughout the growing season, the plants were mowed weekly at a 2 inch height, irrigated every 10 days, and fertilized with 1 lb. N/1000 sq. ft., applied in August.

Female clones, named 'Hilite 15' and 'Hilite 25', were selected for their superior qualities. Asexual reproduction was accomplished from stolons, sprigs, plugs, and spreads of stolonization.

'Hilite 15' and 'Hilite 25' are distinguished by their fine texture, high turf density, rapid stolon spreading rate, competitive growth, short height, improved winter green color and short winter dormancy, spring turf quality, drought tolerance, low maintenance requirements, and improved turf performance (TABLE 1).

Subsequent to the development of vegetatively propagated 'Hilite 15' and 'Hilite 25', a seeded variety was also developed by crossing selected male and female clones (from previous trials) which exhibited superior performance in rate of vegetative growth, high turf density, retention of green color at low temperatures, and superior drought tolerance. This cultivar, named 'Hilite Seed (UCHL-1)', retains its green color to about freezing temperature and remains 6 to 8 inches high without mowing.

Relative Drought Tolerance of Commonly Used Grasses

Since development of a drought resistance scale for common turfgrass species , several new grasses have entered the market—most notably, buffalograss, which generally requires 50% less water than Kentucky bluegrass.

High	Buffalograss
	Hybrid bermudagrass
	Zoysiagrass
	Common bermudagrass
	Seashore paspalum
	St. Augustinegrass
	Kikuyugrass
	Tall fescue
	Red fescue
	Kentucky bluegrass
	Perennial ryegrass
	Highland bentgrass
	Creeping bentgrass
Low	Colonial bentgrass

Buffalo seed suppliers:

Frontier Hybrids
Abernathy, Texas, Ph. 800 872-0522

Bamert Seed Co.
Muleshoe, Texas, Ph. 806 272-5506

Character	Hilite 25	Hilite 15	Prairie	Texoka
Rate of spread	9a[1]	9a	7b	4c
Turf density	9a	8a	7b	3c
Drought tolerance	9a	9a	9a	7b
Injury regrowth potential	8a	8a	7b	4c
Shade tolerance	4a	4a	4a	3b
Color	7a	7a	4b	5c
Cold tolerance	9a	9a	9a	7b
Heat tolerance	9a	9a	9a	7b
Salinity tolerance	4b	6a	4b	3c

[1] Mean separated by Duncan's new multiple range test, P=1%. Scale: 1-9, where 9=best. Ratings with the same letter are not significantly different.

TABLE 1. Relative performance of 'Hilite 15' and 'Hilite 25' in comparison to other varieties.

"Hilite 15 and Hilite 25 buffalograss are vegetatively propagated, drought and heat resistant female buffalograss clones distinguished by their fine texture, good color, high density, rapid growth and short height."

Planting and Management

Buffalograss may be established by seed, sod, or plugs. For seeding, deburred seed is best because buffalograss seed burrs are hard and contain an oil which inhibits seed germination and seedling development. Deburred seed is more expensive than regular seed and not readily available. If deburred seed is not available, pretreated seed (treated with special chemicals and water to remove the germination-inhibiting oils and soften the seed coat) is recommended.

Buffalograss seeds germinate at soil temperatures above 60F. Therefore, seeding should be done in late spring or early summer. In most of California, May seeding is ideal. Since weed competition reduces the speed of stand establishment, weed abatement prior to seeding is essential. Although a seeding rate as low as 0.5 lb/1000 sq. ft. can eventually produce an acceptable stand, initial research indicates that buffalograss seeded at 1.5 to 2 lb/100 sq. ft. competes with weeds more effectively and produces an acceptable stand in a shorter time than stands seeded at lower rates.

Currently, only limited sod is produced and marketed in California; however, stand establishment will be faster with sodding than seeding. Sod should be planted from mid-spring to midsummer to enable the grass to root well before soil temperatures drop to below 60F. Soil preparation for both sodding and seeding is similar to what is recommended for other turfgrasses.

If the cost of sodding is prohibitive, then establishing buffalograss from plugs of established stands is a good alternative and will produce a turf stand faster than seeding. Vegetative plugs of about 2 to 3 inches in diameter and depth should be taken from a healthy stand and planted onto a new site, ideally at 1 foot spacings. Plugs may be planted as far apart as 24 inches, but the fastest rate of coverage will result from the closer planting. Under ideal conditions, a plugging with a spacing of 1 foot produces a fully covered turf stand within 1 1/2 to 2 months (in July and August). Several preemergent herbicides could be used effectively at the time of plugging to reduce weed competition. In California trials, oxadiazon has been effective in eliminating weed competition without injuring buffalograss plugs during establishment.

Fertilization. Buffalograss requires relatively little fertilizer for normal growth. Application of 1 lb. N/1000 sq. ft. in the first week of May stimulates new growth. A second 1 lb. application in mid-July is important for maintaining healthy growth throughout the growing season, and a third 1 lb. application of nitrogen at the end of August or the first week of September will stimulate a late-season flush of growth, thus prolonging winter turf color and enhancing early spring regrowth.

Mowing. This grass has a low growth stature and requires infrequent mowing. When grown in full sun, it should be mowed below 1 inch. In shade, however, buffalograss tends to grow more erect than in sunny areas and a higher mowing height (1.5 inches) is recommended to leave sufficient leaf area for photosynthesis and carbohydrate production. Through the growing season (from May to October) turf may be mowed once a week or once every two weeks. No mowing is needed from late October to April of the following year—the cool winter months when growth is slow or turf is dormant.

Irrigation. Buffalograss is drought resistant. It does, however, need irrigation to produce a quality turf stand, and due to a lack of summer rains in much of California, must be irrigated from late spring through fall to reproduce an acceptable stand. Its water requirement, however, is much less than cool season grasses such as Kentucky bluegrass and tall fescue. Although the actual amount of water needed by buffalograss is determined by the evapotranspiration (ET) demand at each site, in general, acceptable stands can be maintained with 50% less water than is required by Kentucky bluegrass. Buffalograss should be irrigated infrequently; once every 1 or 2 weeks is adequate for most of California. A non-mowed stand requires less water than a mowed one.

Pest Activity. Due to the limited buffalograss plantings in California, no specific insect or disease problems have been observed or reported. It is anticipated, however, that as the use of this grass increases in California landscapes, pest activities will develop, requiring research to find remedies.

Thatch Control. Thatch development has not been observed in California buffalograss stands and, considering the growth habit of this grass, is not anticipated.

For more information about buffalograss, contact Dr. Lin Wu (916) 752-7179 or Dr. Ali Harivandi (510) 670-5215.

(Buffalograss articles adapted from articles written by Lin Wu, Professor of Environmental Horticulture, UC Davis and Dr. Ali Harivandi, UC Cooperative Extension Area Environmental Horticulture Advisor, SF Bay Region, and published in "California Turfgrass Culture," *Volume 45, 1 and 2.)*

Practical Lawn Fertilization

Proper maintenance is the prerequisite to having an attractive lawn. One of its major requirements is adequate fertilization to ensure optimum growth and development of leaves, roots, and all other turfgrass parts. A well-planned and executed maintenance program - which includes mowing, irrigation, and thatch and compaction control as well as fertilization - will produce good-looking, pleasingly green turfgrass that will quickly recover from wear, pest damage or mechanical injury.

There are a series of factors to consider in designing a fertilization program for turfgrass. They are discussed below with the appropriate recommendation(s).

When to Fertilize. There are two methods to determine when to fertilize and which elements are needed. The most common is to visually evaluate the appearance of a turfgrass stand. A nitrogen deficient lawn will have poor color (yellow-green to yellow) , slow or restricted growth, poor density with possible weed invasion (especially clovers), and an obvious reduction in grass clippings after mowing. Iron deficiency also results in yellowing of young turfgrass leaves, although there is no initial stunting of the growth. Phosphorus is the third most common nutrient deficiency. A phosphorus-deficient turfgrass stand has a dull, blue-green color which progresses to individual leaf blades, giving them a purple color along their margins and then a reddish tint from leafblade tip to base.

Visual evaluation of the lawn for these deficiencies will often be adequate for determining when to apply more fertilizer. However, to learn the exact levels of soil nutrients, a representative soil sample should be submitted to a commercial soil-testing laboratory.

Kinds of Fertilizers to Use. The kinds of commercial fertilizers available to supply the commonly needed elements are shown in TABLE 2. The particular nutrient sources are listed on each fertilizer bag in an analysis statement which gives the percentage of each nutrient supplied by that particular product. An example might be 16-8-8, a turf fertilizer which contains 16% nitrogen (N), 8% phosphorus (P_20_5) and 8% potassium (K_20). A fertilizer containing nitrogen, phosphorus and potassium is referred to as a complete fertilizer. Nitrogen is the major element in a complete fertilizer.

Fast release or soluble fertilizers are usually the least expensive and provide a quick greening response for a relatively small amount of product applied. However, they can burn the lawn if improperly applied and are also rapidly depleted.

Natural organic materials, including sewage sludge, animal manures, compost, or other by-products, also contain plant nutrients. Although safer to use because they are less apt to burn turf, they generally are bulky and often more expensive than soluble fertilizers per pound of actual nitrogen content (although some municipalities and water districts may offer free supplies of sludge or compost). Some of these natural materials may contain weed seeds, salts or toxic materials, and some may have unpleasant odors. They do release nutrients over an extended period of time.

Slow-release chemical fertilizers allow nitrogen to become available over longer periods of time than do soluble fertilizers, and they will not burn turf even when applied at comparatively high rates (2 lbs actual nitrogen per 1000 ft^2 and higher). Such products contain much higher concentrations of required elements than do the natural organics, thereby eliminating the bulkiness associated with natural organic fertilizers. Slow release products can be applied less frequently than soluble fertilizers, but their release rate can vary depending on amount of water applied, temperature, or activity of soil microorganisms.

Frequency of Fertilizer Application. For a good turf fertilizer program, it is important to know the type of turfgrass being grown (TABLE 3). There are two main groups of turfgrasses in California: warm season and cool season. Warm season grasses make most of their growth in the warmest months and often are dormant (brown) in winter. Warm season species include hybrid and common bermudagrass, zoysiagrass, St. Augustine, buffalograss, and seashore paspalum. Cool season grasses grow well in spring, fall, and in winter when the climate is moderate to mild. In areas having summer temperature of 80F and higher these grasses often come under heat stress which results in reduced growth, increased disease, and/or poor appearance. Commonly used cool season species include tall fescue, Kentucky bluegrass, perennial ryegrass, and red fescue.

Developing A Fertilizer Timetable. Programming turfgrass fertilization involves many factors. Specifics can vary on each site depending on climate, soils, kind of turfgrass, type of fertilizer, desired quality level and budgetary considerations. Therefore, TABLE 3 should be considered only as a general guide for an "average" residential lawn. This program is a minimum fertilization schedule that will produce acceptable turf. More frequent fertilization is required for specialty turfs such as playing fields and putting greens and also in autumn to maintain green color of warm season grasses in mild winter regions, or just to have a greener, more lush lawn.

FIGURE 2. If a lawn has good color, density and unformity, and good appearance, the fertilizer program is probably adequate. Periodic soil testing can confirm the presence or absence of needed nutrients.

Application Rates. Soils should be fertilized before planting seed, sod, plugs, or stolons. At planting, apply 12 lbs of ammonium phosphate sulfate (16-0-0) per 1000ft², roto-tilled into the top 4 to 6 inches of soil. For existing lawns, a maximum of 1 lb of actual nitrogen per 1000ft² should be applied at one time when using a soluble chemical fertilizer. Slow release fertilizers can be safely applied at higher rates. See the fertilizer's label for specific information.

To find out how much of a particular fertilizer is needed to supply 1 pound of actual nitrogen, simply divide 100 by the first number of the analysis shown on the bag. This will give you the number of pounds of fertilizer needed to apply to 1000ft² of lawn area to supply 1 pound of actual nitrogen to the turf.

Method of Application. To achieve the most uniform distribution when using dry fertilizers, spread half the fertilizer in one direction and other half at right angles to the first. Liquid fertilizers can be applied with hose-end sprayer or other similar proportioning devices.

The fertilizer product should be watered in immediately after application. Watering-in removes the fertilizer from the leaves, thereby reducing the possibility of foliage burn. Also, it washes soluble nutrients, such as the nitrate form of nitrogen, into the soil where they will be absorbed by the root system. Over-irrigation after fertilizer application can result in runoff of water and dissolved nutrients or leaching of the nitrogen fertilizer (nitrate and urea) to below the turf-root system where it is unavailable to plants. *(Adapted from the recently published UCCE Leaflet #21250,* "Practical Lawn Fertilization," *by J. M. Henry, V. A. Gibeault, and V. F. Lazaneo)*

Fertilizer	Analysis1	Amount2	Remarks
Commercial Fertilizers. Fast Release Nitrogen (Soluble) Fertilizers			
Ammonium sulfate	21-0-0	5	Acidic reaction. Can burn turf if over-applied.
Ammonium nitrate	33-0-0	3	Can burn. Contains immediately available nitrate. Used for winter N fertilizer.
Calcium nitrate	15.5-0-0	6.5	Quickly available. Can burn. Used for winter fertilizer.
Urea	45-0-0	2	Converts quickly in soil to available ammonium nitrogen. High burn potential.
Ammonium phosphate sulfate	16-20-0	6	Used mainly as a pre-plant fertilizer for soil incorporation.
Natural Organic Materials and Fertilizers			
Activated sewage sludge	4 to 7	20	Acidic reaction. Can burn turf if over-applied.
Digested sewage sludge	1.5 to 3	40	Can burn. Contains immediately available nitrate. Used for winter N fertilizer.
Steer manure	2	50	Quickly available. Can burn. Used for winter fertilizer.
Poultry manure	3 to 4	30	Converts quickly in soil to available ammonium nitrogen. High burn potential.
Slow Release Fertilizers			
Urea -Form (U.F.)	38-0-0	3	Nitrogen released by soil micro-organisms. Poor winter release; faster summer release.
Methylene-Urea	20-30% N Varies	Varies[3]	Similar to U.F. but quicker nitrogen release.
I.B.D.U. (Isobutyl-enediurea)	Varies	Varies[3]	Nitrogen released by slowly dissolving in soil water. Long lasting response.
Coated/soluble fertilizer	Varies	Varies[3]	Foot traffic and mowing equipment may crush coated fertilizer and destroy slow-release properties, especially on putting greens.

[1] Percent of N-P-K.
[2] Amount needed to equal 1 lb actual N/1000 ft².
[3] Follow manufacturer's recommendations for application rates.

TABLE 2. Different types of fertilizers, from fast and slow release to natural organics materials.

Region	Southern California		Central Valley North and Central Coast		Mountain regions
Turfgrass	Warm Season	Cool Season	Warm Season	Cool Season	Cool Season
Month to apply N[1]		March		March	
	April				
	May	May	May	May	May[3]
			June		June
					August
	September		September	September	September[2]
	October	October	October	October[2]	
		November[2]			

[1] Apply 1 lb N/1000 ft², with slow release be sure an apply per manufacturer's suggested rates of application.
[2] This is the best time to apply a complete fertilizer containing N-P-K.
[3] After snow melts.

TABLE 3. A generalized turfgrass fertilization program by region and month.

Additional Information on Turgrass Selection and Maintenance

California Turfgrass Culture Newsletter
Contact Dr. Victor Gibeault
Anthony Hall, 2132 Batchelor
University of California
Riverside, CA 92521

Field Trials for Turfgrass Selection
UC Bay Area Research Station
Contact Dr. Ali Harivandi, 510-670-5215.
UC Riverside
Contact Dr. Victor Gibeault, 909-787-3575.

Additional UCCE publications may be obtained from your local cooperative extension office or by phone from ANR at the following address:

ANR Publications, University of California
6701 San Pablo Ave.
Oakland, CA 94608-1239
1-800-994-8849

- Turfgrass Evapotranspiration Map: Central Coast of California
  #21491 8 pp. + map $2.00
- Turfgrass Irrigation Scheduling
  #21492 16 pp. $2.50
- Evaluating Turfgrass Sprinkler Irrigation Systems.
  #21503 24 pp. $2.50
- Know Your Turfgrasses
  #2585 12 pp. $1.75
- Lawn Watering Requirements Along California's Central Coast
  #21432 8 pp. NP
- Managing Turfgrasses During Drought
  #21499 8 pp. $1.50
- Turfgrass Pests
  #4053 128 pp. $15.00
- Turfgrass Renovation
  #21132 12 pp. $1.75
- Turfgrass Water Conservation
  #21405 156 pp. $12.00

Research Update

New Anti-EthyleneTreatment for Ornamentals and Cut Flowers

One of the biggest problems encountered in the postharvest handling of ornamentals is damage (premature flower death, yellowing, leaf drop) due to ethylene, a gas found in engine exhaust and smoke and occurring naturally in ripening fruit and senescing (aging) flowers. Until recently, the only ways to avoid the negative effects of ethylene on ornamentals and other perishable products were to store products at low temperatures, provide continuous clean air ventilation of the storage space, or treat them with silver thiosulfate (STS). The use of STS to prolong the shelf-life of cut flowers and potted plants currently is widespread in the floral industry.

Because silver is a heavy metal and a suspected environmental pollutant, however, its uses are limited by restrictions on disposal. In other countries, regulations prohibit application of STS as a spray for potted plants. As a result, there is concern as to the long-term availability of STS as a commercial treatment for cut flowers.

Methylcyclopropene (MCP) is a naturally-occurring molecule which has been found, through studies at North Carolina State University, to block ethylene attachment to plant tissue. In projects funded by The Society of American Florists, California Cut Flower Commission and Floralife, Inc., the research group of Michael Reid of UC Davis, Dept. of Environmental Horticulture has conducted studies which show MCP to be at least as effective as STP in reducing ethylene damage to several flower species, including carnations and orchids. As part of ongoing studies to develop MCP for commercial use, the present study investigates practical methods for its application.

In order to advise growers and shippers on how to use this treatment most effectively, this study looks at the relationships among temperature, treatment time, and MCP concentration. Individual Kalanchoe florets ('Revelry' cultivar) were subjected to various combinations of the above conditions. They were then exposed to a test concentration of ethylene and their diameters were measured after 20 hours. Untreated florets would be completely closed (diameter 3 mm) after exposure to 1.5 parts per million (ppm) ethylene. Control florets (no ethylene), or florets given an effective MCP treatment would have a diameter averaging 14 mm. Measurements of floret diameter before MCP treatment and after exposure to ethylene were used to generate numerical data to determine the effectiveness of the various treatments.

The results indicate that MCP completely prevents the effects of ethylene exposure when Kalanchoe flowers are exposed to 128 ppb MCP for 30 minutes at room temperature, prior to being subjected to 1.7 ppm ethylene. Further indications from results: An operator desiring a one hour treatment regime would have to hold flowers at 24C (75F) and expose them to at least 16 ppb MCP. If the MCP exposure time is lengthened to six hours, the threshold concentration of 16 ppb is effective at 8C (47F). An extended treatment time of thirty-six hours allows MCP to protect against ethylene at 4C (39F) at a concentration of 8 ppb or higher. This same concentration is also effective at higher treatment temperatures.

At 2C (35F), the approximate temperature maintained by postharvest cooling operations, MCP in the concentration range of 1-128 ppb was not successful in protecting Kalanchoe florets from ethylene-induced senescence— even when the exposure time was increased to 36 hours. This is discouraging, since coolers have been considered potential MCP treatment sites. Current experiments attempt to identify the concentration of MCP that is effective at this temperature. Once this information is established, it is hoped that MCP's versatility as a gas will permit treatment during storage at the grower or shipper level and during truck transport of the packed product.

The data obtained in this study are but part of a large set relating the temperature, time, and concentration of MCP exposure to the inhibition of ethylene effects in Kalanchoe. Using these and other data, Reid's group is developing a mathematical model that will permit prediction of the proper exposure conditions for effective ethylene control for a range of desired treatment systems.

Ethylene-sensitive woody species used for cut foliage may also benefit from treatment with MCP. Dry cut stems of holly exposed to 200 ppb MCP for 42 hours at room temperature and subsequently subjected to 1 ppm ethylene for 6 days were protected almost completely from leaf and berry abscission.

For more information about these studies contact Dr. Michael Reid at: Telephone: (916)752-8473; Fax: (916)752-1819; e-mail: msreid@ucdavis.edu.

Profiles in Environmental Horticulture

Jim Harding, Professor of Environmental Horticulture

Research in the field of plant genetics provides insights that address a diversity of horticultural issues. The bulk of Dr. Harding's research focuses on two important areas: conservation of native species and flower breeding.

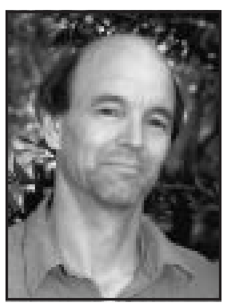
Successful conservation of native species relies, in part, on understanding how plant populations sustain themselves. Many kinds of human activity affect the ability of plant populations to survive. The importation of honey bees for crop pollination, for example, has resulted in a decrease in the number of native bumblebees on which some species of lupine (*Lupinus*) rely for pollination. One of Dr. Harding's studies uses lupine as a model to examine how genetic traits and the pollination system work together to determine a plant's evolution in response to its environment. Since some species of lupine (and many other plants) rely solely on pollination for reproduction, this information is an important piece of the sustainability puzzle.

Dr. Harding is one of many researchers who believe that loss of native plant populations has resulted from global warming. In collaboration with US Forest Service and Mexican forest scientists, he is monitoring three species of spruce (*Picea chihuahana*, *martinezii* and *mexicana*) in growth chambers to investigate the connection between heat sensitivity and survival for these species. These studies stem from the discovery of relic populations of spruce in the highlands of central Mexico that are survivors of a larger population believed to have thrived there during the most recent Ice Age.

Improving flowers for commercial production is complicated because genetic improvement must be predicted for multiple characteristics, including flower quality--color, shape, vase life, and stem length--and cut flower yield. "Some plants may be desirable for some traits and undesirable for others," he explains. By gathering information about these traits, he is able to develop methods by which commercial breeders can produce vigorous, well-branched plants with acceptable flowers. One such method, based on information gathered from long-term studies with Gerbera (*Gerbera hybrida*) uses a (pedigree-based) mathematical model that guides breeders in selecting the best plants to breed.

Dr. Harding received both his B.S. in Agronomy and Ph.D. in Genetics from the University of California at Davis, joining the Environmental Horticulture faculty in 1965. Currently, he teaches *Taxonomy and Ecology of Environmental Plants* and *Herbaceous Environmental Plants*. Between 1990 and 1995, he held the position of Department Chair. He also oversees the design and care of the teaching gardens here at the Department.

For information about his program, contact him as follows: Telephone: (916) 752-0349; Fax: (916) 752-1819; e-mail: jaharding@ucdavis.edu.



Michael Reid, Professor of Environmental Horticulture

Providing high quality cut flowers and ornamentals for nurseries and other retail businesses presents the floral industry with challenges currently addressed by Dr. Reid's research.

Keeping foliage and flowers fresh during transport and maximizing shelf-life requires protection from the effects of high temperatures and some chemicals in the environment. Ethylene (a gas produced by many environmental sources and plants themselves) induces costly damage to ornamentals and cut flowers. At the present time, most growers and nurseries treat sensitive ornamentals with silver thiosulfate (STS) to minimize ethylene-induced damage. But the use of STS is costly, in that its use necessitates safe disposal, requires additional handling for treatment, and does not always provide a good result.

In response to the need for a safer, more reliable treatment, Dr. Reid is investigating practical methods for using 1-methylcyclopropene (MCP), an ethylene analogue, to inhibit ethylene effects. (See Research Update.) He expects this treatment to become available to the floral industry soon.

In another study aimed at improving the viability of floral products, he is using molecular biology as a tool to understand flower senescence (the aging process) in bulb-type flowers. Using the daylily as a model system, he is isolating genes that play key roles in petal wilting of flowers such as iris, tulip and narcissus. These studies are expected to result in the potential to quadruple the life span of these and other bulb-type flowers.

Other projects on Dr. Reid's research agenda are: investigation of the mechanisms and biological systems by which flowers open (using time lapse video), and evaluation of rhododendron and azalea root stock for development of high pH (alkaline) tolerance.

In addition to his professorship with the Department, Dr. Reid holds an appointment as Associate Dean of Cooperative Extension in the College of Agriculture and Environmental Sciences. Among his current pursuits is a plan to "bring the College up-to-date" by making UC programs available to the public through online education. Through this program, anyone with access to a county cooperative extension office would be able to view talks and lectures and interact with instructors on subjects such as basic tree management in the landscape or plant disease diagnosis.

Formally educated at Auckland University, New Zealand, he received a B.S. in Botany, an M.S. in Microbiology and completed a Ph.D. in Cell Biology in 1968. He then worked as a research scientist with New Zealand Dept. of Scientific and Industrial Research, studying nutrient deficiency and postharvest physiology and technology of fruits and vegetables. In 1978, he joined the Environmental Horticulture faculty and teaches *Physiology and Handling of Horticultural Commodities* and *Postharvest Technology of Horticultural Crops.*

For more information about his program, contact him as follows: Telephone: (916) 752-8473; Fax: (916) 752-1819; e-mail: msreid@ucdavis.edu.

Compact Disc Review

Turfgrass Diseases: Diagnosis and Management

G.L Schumann and J.D. MacDonald

This turf disease CD-ROM is based upon the Compendium of Turfgrass Diseases by R.W. Smiley, P.H. Demoeden and B.B. Clark (2nd edition, 1992, by APS Press).

This is an interactive and comprehensive CD-ROM to aid in the identification, diagnosis and management of turfgrass diseases. A total of 39 turfgrass species are reviewed. Using a series of taxonomic images, the user can select from one of two choices in identifying features and come up with a specific turfgrass. Several dozen fungal diseases are covered, ranging from foliar diseases, snow molds, diseases of foliage, crown and/or roots, and patch diseases caused by ERI fungi. In addition, noninfectious diseases and other infectious disorders and agents including physical and chemical agents, nematodes, viruses, mycorrhizae and slime molds are covered. An exciting aspect of this program lies in the diagnostic guide, whereby the user, following a sequence of five steps, can either diagnose the problem by reading the descriptive text and clicking on various diseases to see detailed pictures or facilitate diagnosis by a laboratory.

Currently being developed at UC Davis, this CD-ROM will soon be available. Inquires may be directed to Dr. MacDonald (e-mail: jdmacdonald@ucdavis.edu; ph: 916-752-6897)

Departmental Notes

Composed of a series of gardens, the Environmental Horticulture outdoor teaching lab enhances learning in several courses offered by the Department. It contains a diverse collection of over 1,000 taxa which represent more than 100 families of ferns, conifers, monocots and dicots.

Some are common plants for Central Valley landscapes and others are rare new plants being evaluated for possible use. A shade shelter with acidic beds permits inclusion of families such as Ericaceae and a conifer area includes firs not typically seen in hot interior valleys. A drought tolerance garden and a Southern Hemisphere garden with taxa from Australia and New Zealand also contribute opportunities for students to identify and compare plants and their characteristics. Rare plants species include *Quillaja saponaria*, *Cormus coreana*, and a magnificent specimen of Montezuma Cypress *(Taxodium mucronatum)*.

Several of the specialty gardens, such as the rock garden and perennial border, were developed through student internship programs. Students gain valuable experience through these programs and can often be seen explaining their projects to visitors. The gardens are open to the public and tours can also be arranged by phoning the department at (916) 752-0130.

New Web Site

Recycled Water and Landscape Plant Compatibility

This new site addresses the lack of readily available information on the effective use of recycled irrigation water in the landscape. Created by Patricia Lindsey and Amanda Lewis at UC Davis, this site includes an overview of recycled water use in California, summaries of research on the effect of water quality on plants and soils, a description and ongoing results of the research program at UC Davis, plant lists for tolerance to recycled water, case studies, and the identification of additional resources.
http://envhort.ucdavis.edu/lindsey.

Subscription Information

Anyone wishing to receive Growing Points may be placed on our mailing list by writing to: Growing Points, Dept. of Environmental Horticulture, UC Davis, Davis, CA 95688. Email: growing@ucdavis.edu. Telephone: (916) 752-0130; Fax: (916) 752-1819. There is no subscription charge.

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