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CO-HORT

A NEWSLETTER FOR TURFGRASS, LANDSCAPE, AND NURSERY ISSUES.

LANDSCAPE LINKS

by Dennis R. Pittenger

INTERNET RESOURCES FOR HORTICULTURAL SCIENCE INFORMATION

There is an excellent Internet resource, called INFOMINE, developed by a Project Team at the University of California Riverside Library. It is a unique hyper-text database Internet management tool, annotated and indexed, which provides over 7,000 links to Internet resources. INFOMINE can be accessed through Netscape Navigator or Microsoft Internet Explorer by entering 'INFOMINE' or its URL: http://lib-www.ucr.edu. It offers access to eight broad databases, electronic journals, online library card catalogues, directories of researchers and many other types of information. Horticultural science resources can be searched for and accessed through INFOMINE's Biological, Agricultural, and Medical Database. Specific features of the INFOMINE system are:

* INFOMINE provides a sophisticated search engine, allowing access by direct links to thousands of Internet resources. Searches can be done using titles, subjects, or keywords, which are assigned by INFOMINE contributors. In contrast to robotic search engines (e.g., Lycos) which utilize minimal human input, the indexing terms assigned by librarians allow INFOMINE searches to result in more focused and relevant retrievals.

* INFOMINE's database manager functions have the capacity to generate on-the-fly virtual tables of contents of linkable Internet resources arranged by broad subject categories. This feature allows users to browse and access up-to-date Internet resources without the need for librarians to maintain and update Web pages manually.

* INFOMINE provides direct links to related resources by clicking on indexing terms assigned to resources contained in INFOMINE databases. This capacity allows users to expand their searches in a speedy manner.

* INFOMINE provides a "What's New" current awareness feature, giving users links to new resources added during the past 20 days.

* For INFOMINE contributors, INFOMINE provides a forms-based resource adder/editor,

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allowing them to add new resources or to edit/delete existing INFOMINE records as appropriate. Adding new resources to INFOMINE databases is a simple four-step process: 1) selecting Internet sites; 2) assigning subjects; 3) assigning keywords; and 4) writing annotations.

* INFOMINE features a built-in automatic Hyper Text Markup Language conversion function, eliminating the need for contributors to acquire HTML skills.

* To overcome the problem of "disappearing" Internet sites, INFOMINE contains an automatic, customized URL checker. This function periodically checks the linkability of Internet resources indexed in INFOMINE databases. Resources that can no longer be accessed are flagged for further verification.

* INFOMINE presently contains eight broad subject/discipline oriented databases: Biological, Agricultural & Medical; Government Information; Maps and GIS; Physical Sciences, Engineering, Computing & Math; Visual & Performing Arts; Social Sciences & Humanities; Instructional Resources; and Internet Enabling Tools. Other links provide the access to the UCR campus resources, other UC Web servers, local and regional resources, K-12 resources, and the Library's InfoKiosk. Each database is coordinated by a librarian to ensure the quality and the integrity of the database. The Biological, Agricultural & Medical collection and the Government Information collection are especially strong in meeting the research and instructional needs of the broader academic community.

The following are some of the best Internet sites for horticultural sciences-related information. Browsing these can be very rewarding. With INFOMINE, simply type in the identification listed, or without INFOMINE, use the URL address.

AgDB: Agriculture-Related Information Systems, Databases and Datasets **(http://www.agric.nal.usda.gov/agdb/)**. *A large database through USDA, including a calendar of conferences and meetings, directories of agriculture-related Internet resources, directories of experts in agriculture, and an online reference project.*

FAIRS: Florida Agricultural Information Retrieval System, **(http://hammock.ifas.ufl.edu/)**. *Listings of the University of Florida Extension publications and information.*

AgriGator: (http://www.ifas.ufl.edu/www/agator/htm/society/htm/). *A directory of agricultural related societies and their services plus other site indexes.*

EXTOXNET: (http://ace.ace.orst.edu/info/extoxnet/). *Good "desk reference" for agriculture-related chemicals information.*

Agricultural-genome: (http://probe.nalusda.gov:8000/index.html/). *Good databases on genetics and breeding of agricultural organisms.*

Flowerbase: (http://www.flowerbase.com). *A database of over 7,000 pictures of flowers and garden plants.*

National Plant Germplasm System (or NPGS): (http://www.ars-grin.gov/npgs).
Germplasm Repository Program: (gopher://gopher.ars-grin.gov).
These two URL's provide information and databases on germplasm of plants and animals inventoried by USDA including detailed horticultural descriptions of selected species.

UC_IPM: *Offers Degree-days Phenology Models and access to the UC IPM Project's pest management guidelines and other items.*

Anyone finding or knowing of other good agricultural or horticultural sciences sites are urged to inform Steve Mitchell at the UCR Bio-Ag Library. He is a key member of the INFOMINE Project Team and can be contacted by e-mail at smitch@ucrac1.ucr.edu or by telephone at (909) 787-6454.

SCHEDULING DRIP IRRIGATION FOR TREES AND SHRUBS

The following article has been adapted from: "Scheduling Drip Irrigation for Trees and Shrubs," 1997, by Jimmy Tipton, Extension Specialist for Arid Ornamental Plants, University of Arizona.

When properly designed, installed, and operated, a drip system is the most efficient and accurate method of applying water to trees and shrubs. Poorly designed, installed, or operated systems can lead to many problems including plant death.

Soils and Roots

The texture of landscape soils can range from coarse sand to fine clay. Sands hold less water than clays, but permit deeper, narrower penetration of water from emitters. Shallow soils, less

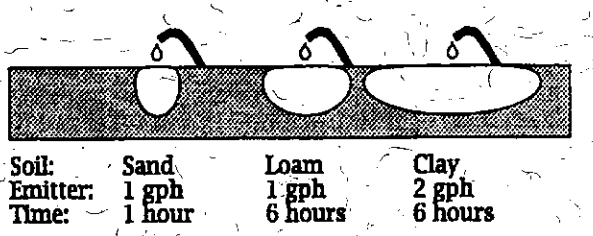

Figure 1. Wetting patterns by a single drip emitter on sand, loam, and clay soils.

than a foot deep, of any texture, hold very lilltle water and are easy to flood. You will have to apply less water more frequently on a shallow soil than a deep soil.

In a natural setting, most woody plant roots spread one and a half to three times the width of the canopy and are within the top two feet of soil. Most of the water used by a plant comes from soil outside the canopy drip line. Shallow or compacted soils can affect the spread and depth of the root zone, as can improper watering. Often it is not feasible to irrigate the entire root zone, but each irrigation should cover at least half the root zone surface and wet the soil to the depth of the primary rooting zone, usually eighteen inches to

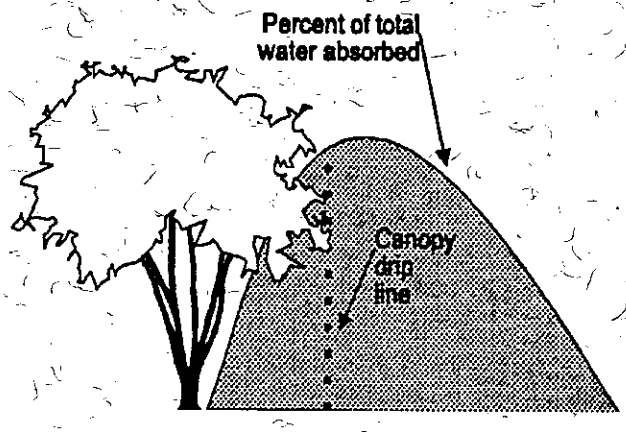

Figure 2. Most water used by trees and shrubs is absorbed outside the canopy drip line.

two feet. It is important to wet the same area of soil to the same depth every time you irrigate to maintain a healthy, well-distributed root system. Occassional deeper irrigation may be needed to leach salts out of the primary root zone.

The number and placement of emitters required depends upon the width and depth of the wetting pattern from a single emitter. Irrigate from an isolated drip emitter for a set length of time, one hour on sand up to three or six hours on loam or clay. The following day, push a thin metal rod into the wet soil at several places. The rod should easily push through the wet soil and stop when it reaches dry soil. Use this technique to determine the width and depth of the wetting pattern. Dig a hole to measure the wetting pattern on rocky soil. You may need to repeat the test for different times to wet the soil as deep as eighteen inches.

You now know the run time required to wet the soil to a depth of eighteen inches. Use the same run time every time you water. Frequent, shallow waterings encourage a shallow root system and an unstable plant. Also most plants will use water that is available, although it may not be needed, so frequent waterings can waste water. The soil should be allowed to dry some between waterings.

Emitter number and placement

When designing a drip system, plan for the size of the root system at plant maturity and allow for adding emitters. Roots can grow more than three

feet a year so it is important to install enough emitters early in a plant's life. Table 1 shows the minimum number of emitters recommended based on canopy width at maturity and wetting at least half of the root zone.

The large number of emitters recommended, especially on sandy soils with a narrow wetting pattern, may be impractical. However, plants in a landscape share root zones and can share emitters. Consider a tree with a fifteen-foot wide canopy and five large shrubs planted within its root zone, each with a four-foot wide canopy.

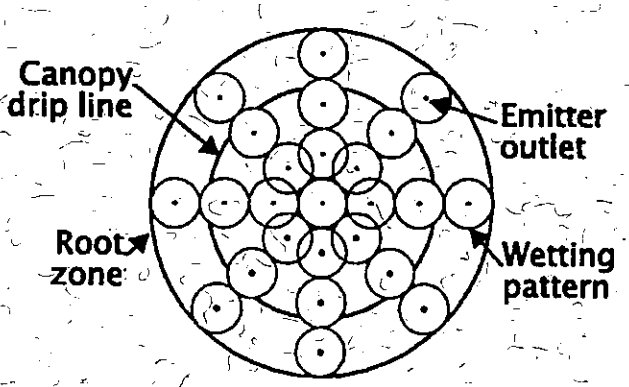

Figure 3. Suggested emitter placement for a young tree.

The plants are in a loam soil where the wetting pattern for each emitter is thirty inches wide. According to the table, each shrub requires three emitters and the tree requires forty-one, a total of fifty-six. However, if the shrubs are planted within the tree root zone, all the emitters could be shared so only forty-one would be required.

Arrange drip emitters radiating outward from the trunk. Space them so the wetting patterns meet or overlap slightly. Be sure that emitters are placed beyond the canopy drip line. Emitters can be placed under a surface mulch or underground with distribution tubing sticking aboveground.

An alternative to a large number of individual emitters is tubing with incorporated emitters. Several brands of these 'in-line emitters' are available with spacing typically ranging from twelve to twenty-four inches.

Table 1. Number of drip emitters required to wet half the root zone. (J. Tipton, Univ. of Arizona)

Canopy Width (ft.)	Diameter of Wetting Pattern for Individual Emitter on Undisturbed Soil (in.)						
	12	18	24	30	36	42	48
	Inches of Water Applied per Gallon						
	2.04	0.91	0.51	0.33	0.23	0.17	0.13
	Number of Emitters Required to Wet Half the Minimum Root Zone						
2	5	2	1	1	1	1	1
4	18	8	5	3	2	1	1
6	41	18	10	6	5	3	3
8	72	32	18	12	8	6	5
10	113	50	28	18	13	9	7
15	253	113	63	41	28	21	16
20	450	200	113	72	50	37	28
25	703	313	176	113	78	57	44
30	1013	450	253	162	113	83	63

Irrigation frequency

Many factors determine how much water a tree or shrub needs and how often you should water. Among these are the type, size, and density of plants in the landscape. A dense landscape, with many plants in a small area, will require more water than a sparse landscape. Exposure is also important (i.e., north side versus south side of a building).

Another major factor is weather. Plants use more water during the hot summer than in the winter. They will also use more water during an exceptionally hot summer than in an average summer. A common method of scheduling irrigations is by reference evapotranspiration (ET_0). Reference ET is the water used by a well-irrigated turfgrass.

The approximate number of days between irrigations can be calculated using the following equation:

$$Days = \frac{WHC \times Depth \times AD}{ET_0 \times PF}$$

where:

WHC = soil water holding capacity (inches/foot)
Depth = desired wetting depth (inches)
AD = acceptable soil moisture depletion (percent)
ET_0 = daily ET_0 (inches)
PF = plant factors, or percent of ET_0 a given plant needs (percent)

The conversion from gallons to inches of water, based on wetting pattern width, is given in Table 1.

Most established trees and shrubs require less water than we typically provide. Research suggests that many species can probably be irrigated at 50 to 25 percent of ET_o. Start with the 50 percent plant factor and observe the plant. Look for signs of drought: leaves curl, wilt, or turn yellow and drop off. Most plants recover easily from a slight wilt. If signs of drought are observed, increase the plant factor by 10 percent. If you do not see these symptoms, then reduce the plant factor to 40 percent. Continue looking for signs of drought stress and adjust to the next higher or lower increment of 10 for the plant factor as needed to obtain acceptable plant performance with minimum water. If you have several plants on a single drip line then one maybe more sensitive to drought than the others are. This plant will determine how often you must water. Continue to monitor your plants and adjust the schedule as conditions change. A more precise, site-specific schedule can be developed by modifying equation inputs to fit local conditions and accessing daily ET_o information.

NURSERY NOTIONS

by Ursula K. Schuch

Following are excerpts of research reports that were presented at the WRCC-58 meeting in March 1997 in Kona, Hawaii.

Michigan State University published a series of articles in "Greenhouse Grower" in 1996 that cover forcing of potted perennials in the greenhouse. Plants featured in the articles are:

Lavander (*Lavandula angustifolia*)
Tickseed (*Coreopsis grandiflora*)
Threadleaf (*Coreopsis verticillata*) 'Moonbeam'
Carpathian Harebell (*Campanula carpatica*) 'Blue Clips'
Balloon Flower (*Platycodon grandiflorus*) 'Sentimental Blue'
Speedwell (*Veronica longifolia*) 'Sunny Border Blue'
Obedient Plant (*Physostegia virginiana*)
Black-Eyed Susan (*Rudbeckia fulgida*) 'Goldsturm'
Blanket Flower (*Gaillardia x grandiflora*) 'Goblin'

Influence of Stock Plant Photoperiod on Cutting Production and Rooting

Paul Koreman, Art Cameron, Royal Heins, and William Carlson
Department of Horticulture
Michigan State University
East Lansing, MI 48824-1325

We have studied the effects of photoperiod treatment, vernalization and juvenility on flowering of herbaceous perennials for the past several years. The responses of many perennials have been dramatic. Since many of these herbaceous perennials are vegetatively propagated, we have become interested in how the induction of growth and flowering is related to propagation success. Several growers are already manipulating photoperiod to encourage growth. The objective of this research has been to determine how these treatments affect rooting potential and subsequent performance of herbaceous perennials.

Five vegetatively propagated perennial species that received 0 or 15 weeks of cold treatment were placed under seven photoperiods (10-, 12-, 13-, 14-, 16-, 24-, and 4-hour night interruption). Cuttings were harvested every 3 weeks, and their number and total fresh weight were recorded. Cutting bases were dipped in a 1200 ppm IBA solution for 5 seconds, stuck in perlite, and placed under mist for 3 weeks. Results varied by species. Stock plants of *Achillea* 'Moonshine' produced the most cuttings under a 12-hour photoperiod. Noncold treated *Coreopsis verticillata* 'Moonbeam' only produced cuttings under pho-

toperiods longer than or equal to 14 hours. Cold treated 'Moonbeam' produced cuttings under all photoperiods in the first flush. Eighty percent of cuttings from the first flush of *Phlox paniculata* 'Eva Cullum' rooted when taken from plants growing under the 10-hour photoperiod, but only 1.2 cuttings per plant were harvested; 2.5 cuttings per plant were taken from *Phlox* grown under the 24-h photoperiod, but only 20% rooted. Only stock plants of *Sedum* 'Autumn Joy' receiving a 14-hour photoperiod produced significant numbers of vegetative shoots. Cutting production and rooting of *Veronica* 'Sunny Border Blue' was not affected by photoperiod.

Ongoing research at Colorado State University:

Evaluation of Herbaceous Perennial Groundcovers Under Varying Levels of Water Stress

Dr. James Klett and Scott W. Dunn
Colorado State University
Horticulture Research Center

This experiment is being conducted to evaluate the ornamental quality of four herbaceous perennial groundcovers at increasing levels of drought stress utilizing a relative standard reference for irrigation needs. This research will be beneficial to both homeowners and the commercial industry. We will get better knowledge of how certain perennial groundcovers will survive with less water throughout the United States. The plants examined in this study are often recommended for xeriscape gardening and placed under different watering zones based on observations only. No real data exists.

Drought stress is imposed by irrigation treatments based on percent evapotranspiration (ET) at 100%, 75%, 50%, 25% and 0%. Data collection consists of a visual rating to determine landscape performance, plant growth measurements of density, height, and width, and relative water content. Percent soil moisture is monitored with the use of the Time Domain Reflectometry System (TDR).

We hope to answer several questions from this experiment: 1. How much water do these plants actually need to survive and maintain an acceptable level of ornamental quality for the landscape?; 2. What will be the impact of the drought avoidance mechanisms of each plant species in the survival process?; 3. What is the ability of each plant species to tolerate water deficits under increasing levels of water stress as determined by plant growth?; 4. Even though the plant may have the ability to survive a drought, will it be acceptable for use in the landscape by retaining its ornamental qualities?; 5. Is there a relationship between soil moisture calculated with the TDR system, plant tissue water, plant growth, and appearance; 6. Will mechanical root pruning prior to planting cause an increase in root mass resulting in increased drought resistance, vigor and survival?

The plant species being examined in this study include:

Yellow Hardy Ice Plant	(*Delosperma congestum*)
Purple Hardy Ice Plant	(*Delosperma cooperii*)
Himalayan Border Jewel	(*Polygonum affine*)
Turkish Veronica	(*Veronica liwanensis*)

Plant materials were planted June 12 and 13, 1996. One half of the plants received mechanical root pruning (butterflying) prior to planting. Stress treatments began on August 1, 1996 and continued until September 30, 1996. Data collection will resume May 1, 1997 and will continue throughout the Summer of 1997. Plants will be hand dug at the end of the growing season and shoot and root dry weights will be taken.

Plant Select® and Woody Plant Evaluation

Dr. James E. Klett
Colorado State University
Horticulture Research Center

Colorado State University and the Denver Botanic Gardens have joined together to organize and conduct a research program to evaluate and introduce new plant materials suited to the Rocky Mountains and Plains States. This program is known as Plant Select®.

Over the last decade, staff from both institutions, along with nursery workers, landscape architects and growers have been evaluating plants at Denver Botanic Gardens, Colorado State University and elsewhere in the region. We have determined that there are many plants of merit that are rarely seen in commerce.

Plant Select® will include both a testing and introduction along with an endorsement program to promote existing plants fitting our criteria. During the past three to five years, more emphasis has been placed on the introduction phase. Now, and continuing into the future, promotion of some existing but underused plants will be a strong part of Plant Select®.

One plant that we are evaluating is *Chrysothamnus* species (Rabbitbrush). Plant Select® is looking for a selection with blue foliage and a more dense, compact growth habit with a long season of bloom. Certain selections have been made from seedling's population (seven), have been grown and are lined out in this field. They were field planted last fall and you can see the foliage color and height variations today. The Plant Select® committee would appreciate any feedback on a potential selection.

In 1995, a memorandum of agreement was signed with the Upper Colorado Environmental Plant Center in Meeker that Plant Select® would evaluate several native plant species which have been tested mainly for shelterbelt and grazing purposes for possible landscape use. Certain taxa which Plant Select® is currently evaluating from this center include: *Rhamnus smithii*, Smith's Buckthorn; *Holodiscus dumosus*, Rock Spirea; *Artemisia frigida*, Fringed Sagebrush; *Artemisia ludovicana*, Louisiana Sage; and *Philadelphus microphyllus*, Littleleaf Mockorange.

Other species planted in our nursery from the Meeker Station include: *Amelanchier alnifolia* 'Long Ridge' (Long Ridge Serviceberry); *Amelanchier alnifolia* (Serviceberry); *Berberis haematocarpa* (Red Barberry); *Physocarpus monogynus* (Mountain Ninebark), *Ribes aureum* (Golden Currant); *Ribes cereum* (White Flowered Currant); and *Shepherdia argentia* (Silver Buffaloberry).

In 1996 and 1997, Plant Select® will be promoting three endorsed plants and two introduced plants so the industry and general gardening public will become familiar with the Plant Select® name and logo: *Salvia argentea*, Silver Sage; *Daphne* x *burkwoodii* 'Carol Mackie', Carol Mackie Daphne; *Viburnum* x *rhytidophylloides* 'Alleghany', Alleghany Viburnum; *Veronica liwanensis*, Turkish Veronica; and *Agastache rupestris*, Sunset Hyssop.

Ongoing research at Iowa State University:

Subirrigation to Replace Mist During Propagation via Stem Cuttings

Anthony Aiello

We have reported a technique for rooting leafy softwood cuttings by using continuous subirrigation instead of mist or other means of humidification. The method results in higher rooting percentages and enhanced root development than the use of intermittent mist for various maple (*Acer* L.) cultivars. Recent studies have compared the subirrigation method (with and without simultaneous fertilization) to intermittent mist for woody plants in the genera *Amelanchier* Medic., *Maackia* Rupr. & Maxim., *Rhododendron* L., *Spiraea* L., *Syringa* L., and *Ulmus* L. Cuttings of plants in three of the six genera (*Spiraea*, *Syringa*, *Ulmus*) had similar rooting percentages when provided mist and subirrigation. For the other taxa, mist resulted in higher rooting percentages than subirrigation. In contrast to results for *Acer*, the subirrigation method was generally more successful when fertilizer was not added to solution cuttings of the other genera.

Ongoing research at Arizona State University:

Micropropagation of *Aloe*, *Gasteria*, and *Haworthia* Species

Arthur M. Richwine, Jimmy L. Tipton, and Gary A. Thompson, University of Arizona

Abstract

Shoot culture of *Aloe*, *Gasteria*, and *Haworthia* species were initiated directly from immature inflorescences. Explants placed on a modified MS medium containing 5.4 μM zeatin riboside initiated shoots within 8 to 12 weeks. Long-term shoot cultures were established and maintained on media containing either 5.4 μM zeatin riboside or 4 μM BA. Shoots easily rooted in vitro and plantlets were established in soil.

Micropropagation of Mexican Redbud

Wayne A. Mackay
Texas A&M University
Research and Extension Center at El Paso
Jimmy L. Tipton and Gary A. Thompson
University of Arizona

Abstract

Mature Mexican redbud were successfully micropropagated. Optimum shoot proliferation was on WPM salts supplemented with 11.1 μM BA. Microshoots rooted readily when pulsed with 6.15 μM IBA or 6.71 μM NAA.

Micropropagation of Red Yucca

Arthur M. Richwine, Jimmy L. Tipton, and Gary A. Thompson
University of Arizona

Abstract

We successfully micropropagated species of red yucca from mature plants. Shoot cultures were directly initiated from mature plants using immature inflorescences. Pedicel bud explants initiated shoots on a modified Murashige and Skoog medium containing Nitsch and Nitsch vitamins and zeatin riboside. Axillary shoot multiplication from established cultures was most responsive to changing concentrations of BA. Shoots rooted easily in vitro or ex vitro and rooted shoots were easily acclimatized. The methods described in this paper are being used to commercially micropropagate red yucca.

The Leaf Cuticle of Eastern and Mexican Redbuds

Jimmy L. Tipton and Marcia White
University of Arizona

Abstract

The objective of this study was to compare the structure and efficacy in terms of retarding cuticular transpiration of leaf cuticles from eastern redbud and dull-leaf and glossy-leaf Mexican redbuds. Leaves of Mexican exhibited several xeromorphic characteristics compared to eastern redbud: a smaller, thicker leaf with thicker cuticles, more cuticular wax, a higher specific leaf mass, and greater hydrated water content on a leaf area basis. Mexican redbuds with a glossy leaf differed from those with a dull leaf only in a thicker adaxial cuticle lacking wax crystallites on the surface. Epicuticular wax crystallites were present on the abaxial surface of all leaves examined. Detached leaves of eastern redbud had a higher water loss rate than those of Mexican redbud only on a dry mass basis, not on a leaf area basis. There was no difference in the rate of water loss by detached leaves of glossy-leaf and dull-leaf Mexican redubds after 4 hours.

Evaluation of Arizona Yard Waste Compost as Container Growing Medium

Jimmy Tipton and Libby Davison
University of Arizona

Abstract

Bioassays were conducted to assess the phytotoxicity of compost derived from eucalyptus and oleander when used as a component of container medium using marigold as an indicator species. There was no apparent phytotoxic effect of either eucalyptus or oleander compost. In fact, favorable plant characteristics generally increased with increasing portion of either in the medium. Plants grown in a medium containing either compost were not significantly different from, or were superior to, plants grown in the control medium. Additional bioassays were conducted to assess the uniformity of yard waste compost. Compost

was collected at different times and from different production sites. Based on initial results, the compost was blended 50:50 by volume with perlite and used as germination medium for garden bean, calendula, and salvia. Results confirm a lack of uniformity, but with mixed impact on germination or early growth of the test species.

Effect of Planting Practices on Tree Performance

Jimmy L. Tipton, Elizabeth Davison
University of Arizona
Juan Barba
Arizona Forest Products

Abstract

The effect of transplanting practices on root and shoot growth of South American mesquite and southern live oak trees planted in a typical southwestern caliche soil was investigated. Results from these studies agree with previous work done in other locations with different soil types and plant materials. Organic amendments in the backfill do not improve and may reduce shoot and root growth. A shallow, wide hole with unamended backfill and a surface mulch is an acceptable, if not superior, planting standard for trees and shrubs.

The Root Systems of Planted Southwestern Trees

Jimmy L. Tipton
University of Arizona
Juan Barba
Arizona Forest Products

Abstract

Root systems of mature, container-grown, drip-irrigated trees were investigated as part of a project to predict the success of salvaging trees from an interstate median. Three blue palo verde (*Cercidium floridum*), and two each white thorn acacia (*Acacia constricta*), South American mesquites (*Prosopis spp.*) and aleppo pines (*Pinus halapensis*) that had been planted in the late 1970s were examined. The results supports the general view that tree roots are predominately shallow, within 60 cm (2 feet) of the surface, and lateral. Only one tree had sinker roots where tap roots would be expected. This also supports the assumption that container-produced plants do not develop tap roots.

Water Use of Two Landscape Trees in Containers

Dan G. Levitt, James R. Simpson, and Jimmy L. Tipton
University of Arizona

Abstract

Although water conservation programs in the arid southwestern United States have prompted prudent landscaping practices such as planting 'low water use' trees, there is little data on the actual water use of most species. The purpose of this study was to determine the actual water use of two common landscape trees in containers and the water use coefficients for these trees based on the crop coefficient concept. Water use of Southern live oak and South American mesquite in containers was measured from July to October 1991 using a precision balance. Water-use coefficients for each tree species were calculated as the ratio of measure water use per total leaf area or per projected canopy area to reference evapotranspiration. After accounting for tree growth, water-use coefficients on a total leaf area basis were 0.5 and 1.0 for oak and mesquite, respectively, and on a projected canopy area basis were 1.4 and 1.6 for oaks and mesquites, respectively. These coefficients indicate that mesquites, normally considered a more 'low water use' species, use more water than oaks under nonlimiting conditions.

TURFGRASS TABLOID

by Victor A. Gibeault

The following releases are from the latest issue of "Better Turf Thru Agronomics," which is an activity of the University of California Riverside Turfgrass Research Advisory Committee. The newsletter is edited by Vic Gibeault and Deborah Silva.

UCR's New Putting Green Traffic Simulator Facilitates Fine-Tuning Research Results and Recommendations

The new apparatus provides uniform, reliable data on putting green wear and tear caused by metal cleats or alternate-spiked shoes under high, moderate, or low traffic conditions.

UCR's new putting green traffic simulator, affectionately known as the "blue beast," has its first off-station job at the Desert Horizons Country Club in Indian Wells.

The metal-cleated simulator, which mimics the punishment that golf shoes deliver to turf, yields uniform data for quantifying wear traffic patterns. The apparatus was unveiled at the UCR Turfgrass Research Advisory Committee semi-annual meeting in December 1996.

Since cleat traffic can affect the competitive relationship among turf species, the simulator is being employed to provide uniform, representative wear over the entire test plot for evaluating the effect of fall renovation practices on the spring transition back to bermudagrass from an overseeded perennial rye-*Poa trivialis* mixture at the Desert Horizons Country Club.

"The new putting green traffic simulator facilitates fine-tuning our cultural practice recommendations. Since the amount of play influences how much punishment cleats deliver to turf, accounting for the traffic variable is critical to making recommendations that fit real golf course needs," said **Robert Green**, UCR Turfgrass Research Agronomist.

Depending on the number of passes per week, the simulator can deliver low, moderate, or high traffic to mimic the playing conditions on any golf course. Most university putting green research does not have traffic on it, unless a practice putting green doubles as a research plot, Green said.

At Desert Horizons Country Club, **Lane Stave**, Superintendent, and his staff are applying the traffic treatments and determining the number of passes per week that resemble the metal-cleated golf traffic on their course. Stave and his staff recently named the simulator the "blue beast."

The simulator was designed by **Steve Cockerham**, Superintendent, UCR Agricultural Operations, and commissioned by Green. It was built using the frame of a walk-behind mower.

The Hi-Lo Desert Golf Course Superintendents Association is sponsoring Green's research at Desert Horizons Country Club.

New Simulator Mimics Metal Spikes or Alternate Spikes

The new putting green traffic simulator can yield uniform turf wear data for metal-spiked or alternate-spiked shoes, depending on the apparatus' configuration, said **Steve Cockerham**, UCR Superin-tendent of Agricultural Operations.

Alternate-spiked shoes, which have small plastic cleats for traction, rather than steel spikes, are gaining in popularity among golfers and golf courses.

"We designed the apparatus initially to mimic the destruction caused by metal-spiked shoes, but it can be modified easily to mimic alternate-spiked shoes," Cockerham said.

Larry Gilhuly, Western Region Director of the

USGA's Green Section, recently computed the number of spike marks left behind in the turf after one month of 200 rounds of golf/day -- 61,776,000! Gilhuly calls golf spikes the "metallic mashers of monocots" in his recent article in the *USGA Green Section Record* (Sept./Oct. 1996 issue).

Seminal research a decade ago on golf shoes and their relative destructiveness to putting green turf by the UCR Turfgrass Research Program determined that spikeless shoes caused low turf damage in comparison to metal-spiked shoes. (See "Golf Shoe Study II" by UCR's Vic Gibeault and Vic Youngner, and the National Director of the USGA's Green Section, William Bengeyfield in the Sept./Oct. 1983 *USGA Green Section Record*.)

Nitrogen Transport and Fate: Key Factors in Fertilization Program

Understanding nitrogen fate is essential to developing an environment-friendly fertilization program that nourishes turf appearance and recuperative ability. Fate studies show that turf acts like a "sponge," soaking up applied nitrogen, said **Vic Gibeault**, Extension Environmental Horticulturist. Nitrogen (N) is the nutrient supplied most often and in the largest amount by turf managers.

Most N applied to turf usually stays in the 'turf system.' Fertilizer N applied to a dense, mature, and well-maintained turf sward is normally used rapidly by turf and its associated soil microbes. Analysis of N in turf clippings, verdure, thatch, and soil show that the 'system' is dynamic due to the high level of surface organic matter and microbes involved in N cycling associated with turf, he said.

Nitrate (NO_3^-)

- Many fertilizers deliver N as NO_3^-. Mineralization/nitrification of organic N yields NO_3^-.
- NO_3^- is not bound to soil or organic colloids. It moves with soil water to plant roots where absorption occurs. NO_3^- can be taken up by turf and other plant roots. NO_3^- causes concern because it can move off-site via runoff and leaching into surface or ground waters. However, in mature turf systems, which act like sponges, little risk of downward NO_3^- movement below the root zone (leaching) occurs. When immature turf grows on pure sand, leaching can occur.
- Low N rates or slow-release sources should be used on sand or very leachable soils.
- After fertilization, avoid runoff to protect surface water from contamination.
- Apply fertilizer when NO_3^- levels are expected to be low, when turf roots can use the nutrient.
- **Avoid overirrigation after fertilization.** In saturated soils, soil microbes reduce NO_3^- to nitrous oxide (N_2O) gas and elemental N (N_2) gas, which are both subject to volatilization losses.

Ammonium (NH_4^+)

- Turf and other plant roots can also absorb NH_4^+, but it is often bound to soil particle surfaces and cannot move as easily to roots as NO_3^-. Soil microbes can convert NH_4^+ to NO_3^-.
- "Water-in" fertilizer immediately after application. NH_4^+ is mineralized rapidly to gaseous ammonia (NH_3) and lost via volatilization, unless it dissolves quickly in water. Gaseous loss of N can be minimized to about 1% if fertilizer is watered-in.

Tall Fescue Is More Effective Than Perennial Ryegrass in Resisting Kikuyugrass Invasion

New tall fescue cultivars can slow or eliminate the penetration of kikuyugrass into established turf. They are more effective than perennial ryegrass in resisting kikuyugrass, as measured by cover, stolon spread, length, and biomass.

Growing the new tall fescue cultivars next to stands of kikuyugrass should slow or eliminate the

penetration of kikuyugrass into established turf swards, say UC Cooperative Extension Weed Specialists **Clyde Elmore** and **Dave Cudney** and UC Cooperative Extension Environmental Horticulturist **Vic Gibeault** in an upcoming issue of *Weed Technology*.

Parks, school grounds, and home landscapes, where fine turf is not needed and kikuyugrass is viewed as a weed, can take advantage of the results of the three recent UC studies, which document that tall fescue (*Festuca arundinacea*) is more effective than perennial ryegrass (*Lolium perenne*) in resisting kikuyugrass (*Pennisetum clandestinum*) invasion.

- **Study 1: Kikuyugrass Suppression After Overseeding With Cool-Season Turf**

Overseeding established kikuyugrass swards with tall fescue or perennial ryegrass reduced kikuyugrass cover. Doubling the overseeding rate from 10 to 20 lb/1000 ft^2 improved ryegrass establishment, but not that of tall fescue; however, one year after overseeding with tall fescue at a rate of 10 lb/1000 ft^2, it reduced kikuyugrass more effectively than perennial ryegrass when ryegrass was overseeded at (a) the same rate (10 lb/1000 ft^2) and (b) double the rate (20 lb/1000 ft^2).

- **Study 2: Evaluation of Kikuyugrass Plug Establishment in Cool-Season Turf**

Kikuyugrass plugs (10-cm) were planted into experimental plots of established perennial ryegrass ('Derby', 'Manhattan II,' 'Gator,' 'Reppel') and established tall fescue ('Fawn,' 'Olympic,' and 'Falcon'). Irrigation was supplied with sprinklers at 75% ET_o for perennial ryegrass. Fertilizer was applied monthly using a commercial 15-15-15 formulation for a total annual nitrogen (N) application of 6 lb N/1000 ft^2.

Fifteen months after the study was established, kikuyugrass growth and invasion were evaluated by counting stolons outside the 10-cm plug, measuring the length of each stolon (stolon spread), and drying and weighing shoot and root biomass. "When all ryegrasses were compared to all tall fescue cultivars, the tall fescue cultivars were more effective in reducing the percentage of kikuyugrass cover, stolon spread, and biomass," Elmore, Gibeault, and Cudney wrote.

- **Study 3: Resistance to Kikuyugrass Plug Establishment in Cool-Season Turf**

Results in Study 3 were similar to Study 2. When kikuyugrass plugs were introduced into established tall fescue ('Fawn,' 'Olympic,' or 'Bonsai') or perennial ryegrass turf ('Linn,' 'Manhattan II,' or 'Reppel'), tall fescue reduced the invasion of kikuyugrass stolons more effectively than perennial ryegrass. Tall fescue significantly reduced the number and length of kikuyugrass stolons and their biomass compared to perennial ryegrass.

"Stolons of kikuyugrass were able to penetrate the perennial ryegrass stand and were found under the perennial ryegrass and at greater lengths from the original plug than the stolons within the tall fescue cultivars. This may be due to the dense turf formed from the tall fescue; whereas, the perennial ryegrass cultivars produced a more open turf allowing stolon penetration," concluded Elmore, Gibeault, and Cudney.

The newer turf-type tall fescue cultivars, 'Bonsai,' 'Falcon,' and 'Olympic' produced a dense, vigorous turf that suppressed kikuyugrass and were more effective than the older 'Fawn' cultivar. Irrigation and fertilization treatments in Study 3 were identical to Study 2.

Buffalograss -- A Promising Drought-Resistant Turf for California

UC scientists are vegetatively propagating buffalograss, developing new cultivars, and testing their performance for use as low-input, low-maintenance, drought-resistant turf.

Buffalograss (*Buchloe dactyloides*), the oldest, warm-season native grass of the North American Great Plains, holds promise as a drought-resistant, low-input, low-maintenance turf for California, but several obstacles need to be overcome.

Extended winter dormancy causes loss of color, and a relatively open growth habit encourages weed invasion. Such inferior traits require improvement. But due to buffalograss' drought

tolerance, low nutritional requirements, and short growth stature, its potential for use as a low-maintenance turf is drawing increasing attention.

UC researchers are participating in the National Turfgrass Evaluation Program (NTEP) studies to assess the performance of commercial and experimental buffalograsses. During the past century, buffalograss has been used primarily as forage, and, thus, is at the beginning stages of improvement for turf.

Sex expression is inconsistent in buffalograss, which makes breeding and selection challenging. Buffalograss is primarily dioecious, with separate male and female plants; however, monoecious plants (separate male and female flowers on one plant) do occur. On some monoecious plants, certain flowers are hermaphroditic (both male and female organs in one flower). Sex expression of individual plants often varies between years and locations, complicating the breeding process.

Breeding projects throughout the country are focusing on developing turf-type cultivars suitable for a range of climatic and use conditions. UC breeders are selecting vegetatively propagated varieties so that uniform cultivars can be made available to the public. Mowing encourages increased vegetative reproduction by male plants, in contrast to female plants, said **Lin Wu**, Professor, Department of Environmental Horticulture, UC Davis.

At UC, scientists found that cool temperatures, low light, and high nitrogen favors male sex expression in monoecious forms. Conversely, warm temperatures, high light, and low nitrogen favored female sex expression. Among natural buffalograss populations, the frequency of monoecious plants was negatively correlated with stand density.

Harvesting seeds from female plants or female flowers of monoecious plants is difficult because seedheads are borne near the ground and shatter. Burrs on seeds produced by female plants contain an oil that inhibits germination. Seeds produced by hermaphroditic flowers lack burr structures and dormancy and do not shatter.

UC Scientists Release Two Buffalograss Cultivars; Continue Performance Tests

'Highlight 25' and 'Highlight 15' released by UC rank among the best.

Scientists at UC Davis and the Bay Area Research and Extension Center (BAREC) have vegetatively propagated buffalograsses and recently released two cultivars, 'Highlight 15' and 'Highlight 25'. Both are drought- and heat-resistant female clones mass selected for rapid growth, high density, and extended winter green color.

Stolons, sprigs, and plugs were used for asexual reproduction. Cultivars were field-tested at UC Davis and at BAREC in Santa Clara.

Both UC releases are distinguished by their fine texture, high turf density, rapid stolon spreading rate, competitive growth, short height, improved winter green color, short winter dormancy, spring turf quality, drought tolerance, low maintenance requirements, and improved turf performance, said **Ali Harivandi**, Extension Environmental Horticulture Advisor, San Francisco Bay Region.

The UC releases and 20 other buffalograss cultivars supplied by the National Turfgrass Evaluation Program are currently undergoing performance testing.

None have produced the deep green color of most turf-type tall fescues and Kentucky bluegrasses. All cultivars lost color during the winter and went dormant.

"If long winter dormancy is not an issue in a given situation, then several top performers, including the UC releases, could provide a low-input, low-maintenance, and moderate visual quality alternative to high maintenance, manicured lawns," Harivandi said.

CALENDAR

MONTH	EVENT AND LOCATION	CONTACT
July 23-26	94th ASHS Annual Conference, Salt Palace Convention Center, Salt Lake City, UT	ASHS Headquarters (703) 836-4606, FAX (703) 836-2024, e-mail: meetings@ashs.org
August 2-5	73rd International Society of Arboriculture Annual Conference and Trade Show, Salt Lake City, UT	Jerry Moorman, ISA Headquarters, (217) 355-9411, FAX (217) 355-9516, e-mail: isa@isa-arbor.com

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