

Final Report
Saratoga Horticultural Research Endowment
2009-2011

Expanding evaluations of the water use and climate zone tolerance of landscape ornamentals for sustainable California gardens

Principal Investigator:

Karrie Reid, UCCE Environmental Horticulture Advisor, San Joaquin County
2101 E. Earhart Ave., Ste 200
Stockton, CA 95206-3949
(209) 953-6109 office
(209) 953-6128 fax
skreid@ucdavis.edu

Co-Investigators:

Lorence (Loren) R. Oki, Ph.D., CE Specialist, Dept. of Plant Sciences, UC Davis
David W. Fujino, Ph.D., Director, California Center for Urban Horticulture, UC Davis
Ellen Zagory, Director of Horticulture, UC Davis Arboretum

Introduction

These irrigation and climate zone trials are the fourth round in a series of 2-year trials to evaluate the water use of plants thought to be drought-tolerant, and to assess the performance of these plants in a broad range of California's varied climates. The majority of these plants have been from the "UC Davis Arboretum All-Stars" list, but we have now expanded to include selections from the plant introduction departments of several growers.

The Water Conservation Act of 2009 requires all water suppliers to reduce urban water use 20% by 2020 to maintain eligibility for state water grants and loans (OWUE, 2009). Part of the regulation creates a Model Water Efficient Landscape Ordinance (MWELo), which states that new and renovation landscape plans that fall under the requirement for a permit must provide a water budget calculated using the Landscape Coefficient Method delineated in *The Water Use Classification of Landscape Species* (WUCOLS) (Costello, L.R. et al., 2000). This method requires knowledge of plant water use. WUCOLS makes recommendations on plant water use based on the collected experience of a knowledgeable panel, rather than actual research data, since this has been unavailable for most landscape species. The plant list for this publication is currently being revised and updated and is incorporating the data obtained from these and previous trials.

Additional aspects of the MWELo require the installation of irrigation controllers that can be adjusted for weather and the water use of each hydrozone. To remain below the maximum applied water allowance, landscapes must incorporate a percentage of low and moderate- water -use plants. Real data on water use will be useful for the required landscape water budgets, and for urban landscape managers creating irrigation schedules using ET-based controllers. An important component of mitigating wasteful urban water use is for the ornamental industry to provide and promote appealing, hardy plants with low water requirements. These data provide a research-based promotion point for growers of these materials.

Goals

The primary goal of these evaluations was to find the optimal rate of irrigation for each trial species, i.e., the lowest rate of irrigation that would still yield a healthy plant with an aesthetically

acceptable appearance in the landscape, and where appropriate, uncompromised flowering. This report covers the 18 species (nine in full sun, and nine in 50% shade) that finished their deficit irrigation treatments October, 2011, listed below in Table 1, and includes both “UC Davis Arboretum All-Stars” (UC Davis Arboretum, 2009) and Ball Ornamentals (Ball Ornamentals, 2013) selections. California natives are marked with an asterisk.

During 2010, we became aware of a more accurate method of calculating ET₀ for our shade field than had been used during the summer of 2010, which data was previously reported. To evaluate these species with the treatments more accurately calculated, we kept those plants in the field through the 2011 growing season, and that data is reported here as well.

The secondary goal of this work was to evaluate how well these species performed during their first two years in a variety of soils and climate types found in UC Master Gardener-managed demonstration gardens across the state, and to report all these data to our stakeholders.

Table 1. Species evaluated in irrigation trials October, 2009-October, 2011

Scientific name	Common name
SUN	
Arboretum All-Stars	
<i>Aster</i> ‘Purple dome’	‘Purple dome’ Michaelmas daisy
<i>Bulbine frutescens</i> ‘Tiny tangerine’	‘Tiny tangerine’ cape balsam
<i>Rosa</i> ‘Korbin’	Iceberg® rose
<i>Salvia clevelandii</i> ‘Winnifred Gilman’ *	‘Winnifred Gilman’ Cleveland sage
Ball Ornamentals	
<i>Buddleia</i> ‘Podaras #8’ pp. 22,069 ‘Blue Heaven’	Dwarf butterfly bush
<i>Cordyline</i> ‘Purple Sensation’ ppaf	
<i>Escallonia</i> × <i>exoniensis</i> ‘Fradesii’ ‘Jamie’ ppaf	‘Pink Whisper’ escallonia
<i>Lomandra confertifolia</i> sp. <i>rubiginosa</i> ‘Seascape’ pp. 20,010	Seascape mat rush
<i>Mimulus</i> ‘Curious Georgie Boy’	Georgie Boy monkey flower
SHADE	
Arboretum All-Stars	
<i>Helleborus</i> × <i>hybridus</i> ‘Red lady’	‘Red lady’ Lenten rose
<i>Heuchera maxima</i> *	Island alumroot
<i>Osmanthus heterophyllus</i> ‘Purpureus’	Purple leaf tea olive
<i>Ribes viburnifolium</i> *	Evergreen currant
<i>Woodwardia fimbriata</i> *	Giant chain fern
Ball Ornamentals	
<i>Abelia</i> × <i>grandiflora</i> ‘Sunshine Daydream’ ppaf	Same
<i>Hypericum androsaemum</i> ‘Ignite Red’ pp. 19,468	‘Ignite red’ St. Johnswort
<i>Trachelospermum jasminoides</i> ‘Sebra’ ppaf	‘Star of Toscane’ star jasmine
<i>Ligustrum sinense</i> ‘Sunshine’ pp. 20,379	‘Sunshine’ privet

*Denotes California native

Research Methods

Irrigation Trials

Twenty-four plants of each cultivar were planted in the ground on the University of California campus in Davis, CA. Two fields were used, one in full sun, and one under 50% shade cloth. The soil in these adjacent fields is characterized as Yolo clay loam, a fairly heavy soil.

Plants were placed 2 meters apart in 1-meter wide planting rows, with 1 meter between rows. Beds were covered with 3 inches of chipped wood mulch. Each row was supplied with 4 water lines corresponding to one of the 4 irrigation treatments. Two 2-gallon/hour drip emitters attached to one of the four lines were installed under the mulch in the root zone of each plant. The plants and treatments were randomized throughout the fields in two complete blocks with a total of 6 repetitions of each water treatment for each species. The field was manually weeded between rows and glyphosate herbicide was applied around the perimeter of the field as needed. Throughout the trial, no pesticide or fertilizer treatments were applied to the plants, with the exception of carbaryl/metaldehyde granules to control slugs under the Lenten roses in the winter of 2010-2011. The plants were established on regular irrigation as well as rainfall during fall 2009 through spring 2011.

Deficit irrigation treatments began in April 2011 and continued through October. Irrigation was based on reference evapotranspiration (ET_0) as reported online by the local California Irrigation Management Information System (CIMIS) weather station (CA DWR, 2009). ET_0 is defined as the total amount of water loss from a reference plant (in this case, a well-maintained tall fescue) through evaporation and transpiration. There were four treatment levels: 80%, 60%, 40%, and 20% ET_0 , corresponding to high, moderate, moderate-low, and low irrigation levels as described in WUCOLS. An equal volume of water was applied at each irrigation equivalent to 50% of the soil's water holding capacity in the root zone (about 16.5 gallons) to a depth of 18 inches. The frequency of the irrigation was determined using a water budget for each treatment percentage of ET_0 , and modified for the shade treatments using an executable tool provided online by the UC Davis Biometeorology Program (Snyder, R.L., 2007).

Measurements of length (l), width (w), and height (h) were taken monthly. These measurements were used to calculate a plant growth index ($PGI = [(l + w)/2 + h]/2$) (Irmak, S. et.al. 2004). A relative plant growth index was also calculated ($PGI / \text{initial PGI}$) and tracked to account for original plant size differences, and to evaluate the percentage of new growth along with final average plant size for each treatment.

Qualitative ratings were also taken on a monthly basis. The plants were rated on a scale of 1-5 for foliage appearance, flowering, pest tolerance, disease resistance, vigor, and overall appearance, with 5 being highest and 1 lowest. In all categories, these rating can be characterized as 5=exceptional, 4=very good, 3=average, 2=below average, 1=very poor. Examples of these guidelines for ratings are as follows:

- A "5" rating for **Foliage** means the plant is in full leaf with no signs of leaf burn, disease or insect damage, and has an appealing appearance. A "1" would mean the plant was in very poor health and close to dead.
- A "5" for **Flowering** means full, glorious bloom for the species. A "1" means a plant is either just beginning to bloom with very few blooms open, or just finishing its bloom cycle. A "3" would indicate that about 50% of the plant was blooming. The rating is more a quantitative measure than a qualitative one.
- A "5" for **Insect tolerance** or **Disease resistance** means no visible damage. A "1" means badly damaged and probably dying.
- A "5" for **Vigor** means the plant is thriving and pushing out new growth, a "3" means it is surviving but not actively growing, and "1" means it is on its way out.

- A “5” for **Overall Appearance** means that everything is working together: flowers (if present), leaves, the shape and condition of the plant are all very appealing. It has the WOW factor that makes it an attractive garden plant, even if each individual factor isn’t perfect.

During the deficit irrigation treatments of 2011, the plants in full sun on 80%, 60%, and 40% ET₀ were irrigated approximately every 2, 3, and 4 weeks, respectively. All the plants received the benefits of almost *an inch of rain on June 28*. The full sun 20% treatment was then irrigated only once more on August 8. In the shade, the frequency was far lower: due to the significant rainfall late in June, the 80% treatment was irrigated only twice, the 60% and 40% treatments were irrigated once, in August and September respectively, and the 20% treatment not at all.

Table 2. 2011 Irrigation Deficit Irrigation Frequency Details – April to October

Irrigation % of ET₀	# of Irrigations	Dates of Irrigation (6/28: 0.8” rain)
SUN		
80	9	4/25, 5/7, 6/8, 6/23, 7/13, 8/1, 8/15, 9/2, 9/23
60	6	5/3, 5/27, 7/3, 7/22, 8/15, 9/9
40	4	5/7, 7/13, 8/12, 9/21
20	1	8/8
SHADE		
80	2	6/22, 8/24
60	1	8/8
40	1	9/27
20	0	

Climate Zone Evaluations

The nine UC Davis Arboretum All-Stars species were delivered to a total of 12 demonstration gardens in 11 counties with UC Master Gardener programs and access to a public garden area for the trials plants. Not all gardens could accommodate all the plants; Table 3 shows the distribution of each species. It is noted in the table when a species was already successfully growing in a county, and the master gardeners would recommend it for their area.

Master gardeners collected quarterly growth data and rated the quality of the plants monthly using the same criteria as the irrigation trials. Their data was uploaded through an on-line survey to a UC-hosted website where it can be accessed by the PI for evaluation at the end of each trial period. The location of the trials gardens and a map are included in the Appendix.

Table 3. Distribution of trial species to county demonstration gardens,

	Alameda	Fresno	Los Angeles	Mariposa	Nevada	Orange	Riverside	SD- inland	SD- coastal	San Joaquin	Santa Clara	Shasta
SUN												
<i>Aster</i> 'Purple Dome'	X				X	X	X		X	X	X	X
<i>Bulbine</i> 'Tiny Tangerine'	X				X	X	X	X	X	Already growing	X	X
<i>Rosa</i> 'Korbin'	X					X	X			Already growing	X	X
<i>Salvia clevelandii</i> 'Winnifred Gilman'*	X		Already growing	X	X	X	X	X	X	X	X	X
SHADE												
<i>Helleborus</i> 'Red Lady'					X	X	X		X		X	X
<i>Heuchera maxima</i> *	X	X	X	X	X	X	X		X		X	X
<i>Osmanthus heterophyllus</i> 'Purpureus'					X	X	X	X			X	
<i>Ribes viburnifolium</i> *	X	X	X	X		X	X		X	X	X	X
<i>Woodwardia fimbriata</i> *		X	X	X	X	X	X		X			X

Results and Discussion

It must be noted that during the course of the first year it became evident that our source for the *Salvia* 'Winnifred Gilman' had unknowingly provided us with two different cultivars or species, which became obvious in both the irrigation trials field and the demonstration gardens as it pushed out new growth and bloomed. There was also a high level of mortality in the field and the gardens. Consequently, no data from this plant is reported.

The tea olive in the trials was intended to be the Arboretum All-Stars selection *Osmanthus x fortunei*. Our grower for this plant was provided with cuttings from their source which were incorrectly identified, and were, in fact, *Osmanthus heterophyllus* 'Purpureus', which again became evident with the new growth. Since the plants had already been established, and were a similar appearing plant, we kept them in the trials for evaluation, and results are reported here.

Irrigation Trials

The following table summarizes the quality ratings at each irrigation level for each species. Unless flowering is compromised, the combination of highest ratings and lowest irrigation level is the recommended rate of irrigation for that species. Where there were no statistically significant differences between treatments, the range of irrigation levels that produced the highest ratings is shown. Rather than just recommended the lowest rate, this range was included since it is helpful to know if a plant may be useful in more than one hydrozone. Discussion of individual species follows in the order shown in Table 4; more detailed plant growth index charts and monthly average quality ratings in each category for each species are included in the appendix.

Table 4. Summary of average overall quality ratings on 4 irrigation treatments for 2011

PLANT NAME	Overall Rating on each ET ₀ % (1-5)				Recommended rate
	80	60	40	20	
SUN					
Arboretum All-Stars					
<i>Aster</i> 'Purple Dome'	4.1	4.2	4.2	3.9	40-60%
<i>Bulbine</i> 'Tiny Tangerine'	4.5	4.2	4.5	4.6	20%
<i>Rosa</i> 'Korbin'	3.9	4.2	4.1	3.9	60%
<i>Salvia clevelandii</i> 'Winnifred Gilman'	<i>Not reported</i>				
Ball Ornamentals					
<i>Buddleia</i> 'Blue Heaven'	3.9	4.0	3.8	3.6	60%
<i>Cordyline</i> 'Purple Sensation'	2.3	1.8	2.0	2.6	20%
<i>Escallonia</i> 'Pink Whisper'	2.3	2.5	2.7	2.4	40%
<i>Lomandra</i> 'Seascape'	3.5	2.9	3.2	2.6	40-80%
<i>Mimulus</i> 'Curious Georgie Boy'	2.5	3.0	3.0	3.2	20%
SHADE					
Arboretum All-Stars					
<i>Helleborus</i> 'Red Lady'	3.4	3.4	3.3	3.3	40-60%
<i>Heuchera maxima</i>	4.0	4.1	3.7	4.0	20-60%
<i>Osmanthus heterophyllus</i> 'Purpureus'	4.4	4.4	4.4	4.2	40%
<i>Ribes viburnifolium</i>	4.9	4.9	4.9	4.9	20-80%
<i>Woodwardia fimbriata</i>	3.9	3.3	3.1	3.0	80%+
Ball Ornamentals					
<i>Abelia</i> 'Sunshine Daydream'	4.5	4.4	4.5	4.4	20-80%
<i>Hypericum</i> 'Red Ignite'	4.1	4.0	4.0	4.2	20%
<i>Ligustrum sinense</i> 'Sunshine'	4.9	4.9	4.8	4.8	20-80%
<i>Trachelospermum</i> 'Sebra'	3.7	3.6	3.6	3.5	40%

Climate Zone Trials

Table 5 below shows a summary of the average annual ratings given each species by the individual counties who evaluated them, along with the Sunset climate zone. Detailed tables of individual quality category ratings by county are in the appendix. Master Gardener comments are included with the individual species discussions.

Table 5. Summary of MG Average Quality Ratings in 11 Counties

	Alameda	Fresno	Los Angeles	Mariposa	Nevada	Orange	Riverside	SD- inland	SD- coastal	San Joaquin	Santa Clara	Shasta
Sunset Climate Zone	14	8	21	7	7	23	18/19	22	24	14	15	9
SUN												
<i>Aster</i> ‘Purple Dome’	4.0				4.3	4.1	3.4		3.8	3.7	3.8	4.0
<i>Bulbine</i> ‘Tiny Tangerine’	4.7				4.5	4.4	4.7	4.5	4.2	4.5	4.4	3.6
<i>Rosa</i> ‘Korbin’	4.0					4.5	4.0			4.5	4.5	4.0
SHADE												
<i>Helleborus</i> ‘Red Lady’					4.2	3.7	3.2		3.9		3.5	3.8
<i>Heuchera maxima</i> *	4.1	4.6	4.2	4.5	4.4	4.4	3.0		3.4		3.9	3.9
<i>Osmanthus heterophyllus</i> ‘Purpureus’					4.0	4.3	4.4	4.9			4.1	
<i>Ribes viburnifolium</i> *	4.5	4.5	4.8	4.4		4.8	4.1		4.5	4.6	4.3	4.1
<i>Woodwardia fimbriata</i> *		4.4	4.8	3.8	4.4	4.6	2.3		3.8		4.2	4.1

Red numbers indicate the ratings given by the MGs for plants already growing in their county.

DISCUSSION:

UC Davis Arboretum All-Stars

SUN

Aster ‘Purple Dome’

Like other Michaelmas daisies, ‘Purple Dome’ is an herbaceous perennial that dies to the ground in late fall/early winter and the only maintenance required is an annual cutting to the ground at this time. In the irrigation trials, the plant performed adequately on all irrigation levels, but best at 40% ET₀ and above. The relative growth for all treatments was similar with the only significant difference between the lowest and highest rates of irrigation (20% and 80%). Though the differences in quality ratings were small, the 20% ET₀ treatments scored consistently lower than the other three treatments, and would not be recommended.

Although the leaves tend to be bothered by spider mites late into the hot summer, the flowering of the plant is so profuse that the leaves cannot even be seen when in full bloom. They also have a tendency to have chlorotic leaves at the base of the stems, which can be unattractive until the plant blooms. This is sometimes reflected in a poor leaf quality rating, but a high overall appearance rating. This plant was devoured by rabbits that worked their way under the field fence the first spring after planting; each plant was subsequently caged for the duration of the trials.

Master Gardener leaf quality ratings were sometimes taken at the end of the season as the leaves began to turn yellow, and annual average ratings for leaf quality as well as overall averages, are sometimes lower than they might otherwise be. The three counties that did not recommend this plant for their area, Alameda, coastal San Diego, and Riverside, all cited rabbit damage as their main issue. Of course, this is a site specific objection, rather than regional. The largest size achieved at the end of two years in the demonstration gardens was 21” high by 24” wide, making it a good choice for small gardens.

***Bulbine* ‘Tiny Tangerine’**

This cultivar of cape balsam is an exceptional garden plant with superior pest tolerance and disease resistance. It blooms for an extremely long period of time, slowing only during the coldest months from December to early February, and then pausing again in July. The most remarkable feature of this plant turned out to be its attraction for lady bugs during the winter months. They rested by the dozens down between the bases of the succulent leaves. When the weather warmed up in spring, they awoke and took care of all the aphids on the neighboring Iceberg roses in the field within a month. This suggests a possible beneficial companion planting scheme. There were no significant differences in plant growth between treatments, but with marginally better overall quality, the lowest rate of 20% would be recommended, especially in a heavier soil.

The Master Gardeners consistently gave high marks to ‘Tiny Tangerine’, except in the coldest areas, Shasta and Nevada Counties, where it did not survive the extreme cold and snow during the first and second winters, respectively. They all praised its long bloom period, consistently good looking leaves, and tidy habit. The plant was especially appreciated in Riverside County, where it was irrigated only twice a month in a very freely-draining granitic soil.

***Rosa* ‘Korbin’**

Iceberg rose is not new to the ornamental industry, but it is gaining popularity with landscape designers as a tough, drought and heat-tolerant landscape rose. We observed superior performance of Iceberg at 60% ET₀ (about once every three weeks), significantly less water than is given in most landscape situations. Though plants on the highest water rate put on relatively more growth than only the lowest rate, the quality ratings were consistently highest on the 40% and 60% ET₀ treatments. Only minor damage from black spot was found during the wet, cold early months of spring, but it was quickly outgrown. It was very floriferous and fragrant, and attracted a wide range of beneficial insects.

This rose generally performed well in all counties and soil types. It was recommended for its clean foliage and flowers, almost non-stop bloom, resistance to typical rose pests and diseases, and relatively low maintenance requirements. Only Alameda felt it did not thrive as it should. This garden is in a very hot, windy site outside of Livermore, and a close look at the irrigation schedule revealed it was receiving only 1-2 gallons of water per week, which probably only moistened the top 1-2 inches of the root zone in their rocky clay soil. This was probably the cause of its low flowering score there as well.

SHADE

***Helleborus* ‘Red Lady’**

This Lenten rose was favored because of the attractive deep ruby color of the flower bracts in late winter. The flowers held for months on the plant, and were still attractive when dry. The leaf appearance was affected by slugs, which were controlled in spring 2011, but the damage remained throughout the summer. These plants improve with age, and would have undoubtedly raised their overall appearance scores with more time in the garden, as new leaves were attractive and free of damage.

There were no significant differences in growth between the treatments, but during the peak flowering season, the best bloom was on the 40% and 60% treatments. Since this was also the rainy season, and irrigation was not taking place during the flowering time, the differences in flowering can only be attributable to the differences in the previous year's irrigation treatments (every 2 weeks, 3 weeks, 4 weeks, and twice a summer for 80%, 60%, 40%, and 20%, respectively).

The counties were mixed in their evaluation of this plant's performance, though some of the poor performance is related to a failure to meet this plant's cultural needs: shade and adequate water during establishment. One garden transplanted it during the trial period to a shadier spot, which slowed growth and affected ratings. Where it was not recommended, Riverside, it was exposed to hot mid-day sun, despite our recommendations, and was only watered twice monthly during establishment in a fast draining soil. Some plants were also rated poorly before it was understood that, although hellebores are evergreen, older leaves often need to be clipped off at the end of the season. The garden with the most snow, Nevada County, was impressed with its cold hardiness and early bloom for them. They also understood its management, and not surprisingly, rated it the highest. It is safe to say this Lenten rose would perform in a wide variety of climate zones as long as its cultural needs were met.

Heuchera maxima

Island alumroot is an attractive herbaceous perennial California native, even when not flowering. Like many plants in this category, its overall appearance improves with age and its bloom in the trials field during the spring of 2011 was impressive. The flowers hold for a long period of time and are an attractive rosy color for many weeks after they dry. There were no significant differences in growth indexes between treatments, making this plant a desirable choice for dry shade.

Master Gardener recommendations were mixed with this plant. It was a target for deer and rabbit browsing in some areas. Santa Clara found it unexciting, and an uneven performer throughout the year, and would not recommend it for their area close to the coast. Riverside did not provide adequate shade or water to establish it. It was recommended, however by gardens as diversely situated as Nevada and Orange Counties, given proper cultural care.

***Osmanthus heterophyllus* 'Purpureus'**

This variety of tea olive, also called purple-leaf false holly and holly olive, is a slow-growing evergreen shrub. It had maximum height of 35" and an average height of 28" after two years in the ground in the trials field.

It is pest and disease free, and its new foliage is an attractive burgundy color which contrasts beautifully with its dark green, glossy foliage. There were no statistically significant differences in growth indexes or quality ratings between treatments making this a truly versatile landscape plant. It did not bloom during the course of these trials, so we cannot speak to the effect of irrigation level on flowering. This species may require a certain level of maturity before flowering.

The few demonstration gardens that could accommodate this plant found its foliage clean and attractive. All commented that it was slow to establish and begin to grow. The only failures or low ratings came from poor site conditions, not the plants themselves. The quality of this evaluation would have been improved with a longer trial period. This is something to consider in the future when evaluating large shrubs.

Ribes viburnifolium

Evergreen currant is a California native with a wide-spreading, low-mounding habit that can be used as a low shrub or tall groundcover. Although it was slow to put on new growth the first year, it grew quickly in its second year to an average of 8.5' wide. There were no differences in growth indexes or quality ratings between treatments, making it another versatile plant for shade where a large shrub is needed.

Although the MG quality ratings overall are fairly high, the comments indicated that a few found it uninteresting, while others felt it was too sprawling for all but the most informal woodland gardens. The best performance overall was found in gardens with fairly well-drained soil and weekly summer water.

Woodwardia fimbriata

The giant chain fern struggled in establishment in the trials field. Having deficit irrigation treatments its first summer (2010) may have played a role in its struggling performance during the more severe deficit treatments of 2011. It showed a definite preference for the 80% ET₀ irrigation treatment, and we suspect it would have gladly taken more. The plants began 2011 with staggered growth indexes that exactly paralleled their irrigation treatments the previous summer. Although all treatments put on a similar percentage of new growth, the other treatments were unable to overcome the advantage the 80% plants had going into the second year. Foliage appearance, disease resistance, vigor, and the overall appearance were all significantly higher at 80% ET₀. We recommend establishing these plants in shade on a regular irrigation schedule for at least a year and using them in a high water-use hydrozone.

Because most of the demonstration gardens are devoted to low water-use landscaping, it was difficult for them to provide adequate water, and in some cases, shade, for this species. Those with ratings below "4" were unable to provide adequate water. Not surprisingly, plants performed best in loam soils with full shade and weekly watering.

Ball Ornamentals Selections

(These results have already been provided to Ball along with the graphical data in the appendix.)

SUN

***Buddleia* 'Blue Heaven'**

Buddleia 'Blue Heaven' was a real favorite in this round of trials. Except for the middle of the winter, as is typical of this genus, this plant was consistently handsome in the trials field. The plants were cut back during the winter, so ratings for December and January were not taken. Though the winter of 2010 was wet, we had an unusually dry March and April in 2011, which accounts for the low spring ratings. This was the first year we have had to apply irrigation in April or May. This butterfly bush cultivar was bothered very little by pests or diseases, and bloomed for five months beginning in June. In fact, there were still blooms into November, though we had finished taking ratings by then.

The only significantly different plant growth numbers were between the relative growth of the 60% and the 80 and 40% treatments. Though all plants topped out between 3 and 4 feet high, the relative amount of growth put on at the 60% rate was highest through the summer. Consistently higher

ratings in most categories including relative plant growth index lead us to recommend this plant be irrigated at 60% ET₀ once established. However, it should be noted that by the middle of the summer, the plant was performing in most categories at a 4 or better on all irrigation levels, making it a very adaptable plant. Although we would not recommend the very low level, the chances of the plant surviving such drought conditions are fairly good, as the mortality for this plant occurred during the winter months. One specimen was also left in the field to fend for itself while the field lay fallow for a year. The plant appeared unscathed and bloomed quite beautifully until the field was re-planted in November 2012.

***Cordyline* ‘Purple Sensation’**

This *Cordyline* cultivar suffered high mortality the first summer. The remaining plants sulked through fall, and disappeared from winter through spring. The surviving plants were evaluated from May through August. Only two plants remained by the beginning of September. Because of the high mortality rate, it is difficult to assess any real differences of the plant’s performance on the varying irrigation levels. The main factor in this failure was most likely the full sun exposure. The grower sheet published by Ball Horticultural states, “Light: Partial shade of 25 to 50%. Will tolerate full sun close to coasts.” Other sources make similar recommendations. When we questioned the placement of this plant in full sun at the beginning of the trial, we were assured it was intentional. In retrospect, this decision may have been reached without a full understanding of the trial field conditions and/or the plant’s limitations.

The plants that survived and were measured and rated showed no real trend in preference for one water level over another. In fact, the two remaining plants in September were on each of the lowest two water levels. We suspect that if this plant were grown in light shade, it would indeed be able to perform well on low water, but we cannot confirm that without another trial in the shade.

***Escallonia* ‘Pink Whisper’**

The plugs we originally received did not survive transplant, and we replanted completely in October 2011. We allowed the plants to settle in before beginning to take ratings in February. Sadly, the second transplants were also very small, and were not vigorous enough to really take hold.

Pest pressure was not an issue with this plant. Irrigation also did not seem to be limiting; the 40% irrigation level produced the highest survival rate, and the best overall appearance. Given this, we would recommend a moderately low irrigation rate once established. However, in our field trial, it was just not vigorous enough to recommend itself, as the ratings clearly show. It should also be noted that after transplant, the plants died back, and never regained their original size, which can be seen in the relative plant growth chart where all plants are below the blue “starting line”. Because of its very dwarf proportions, it should probably not be sold in less than a #1 container.

***Lomandra confertifolia* ‘Seascape’**

Following is a quote from a botanical website in Australia, where this plant is native. “All the *Lomandra confertifolia* species described grow in dry sclerophyll forest with some shade, except for one type which grows in rocky sandstone type soils. This is probably the reason why most fail in humid type climates, as well as dry climates where it is full sun and heavy soil types (sic)” (which

describes our exact conditions). This same source recommended planting out no smaller than 6” pots; the plants we had were 4” pots. Given these characteristics, it is not surprising that this plant did not thrive in the full sun in our clay loam soil. Establishment on regular water was just not sufficient to overcome this plant’s probable preference for partial shade in our hot location.

The only significant differences in growth parameters were between the highest and lowest irrigation levels. Very low water is clearly not recommended for *Lomandra*. The flowering was probably triggered by a stress survival response. We felt that given the ideal growing conditions, this did have the potential to be an attractive landscape plant for dry shade, though another trial in shade would be needed to confirm that.

***Mimulus* ‘Curious Georgie Boy’**

This plant began with great promise with dark green leaves and attractive golden yellow blooms beginning in May, but quickly showed a fickleness that was difficult to understand. Though the plants on the highest water level seemed to outpace the other treatments initially, when summer hit, they went from 3 plants in July to 1 plant in August that died by September. Until the 80% treatment suddenly died, its quality ratings were fairly good; it seems to have grown and bloomed itself to death on the high water level. From one week to the next, plants would have entire branches die back; from one month to the next, whole plants would just die, with no obvious cause. If the mortality numbers in Table 11 are combined with common growing recommendations for the *Mimulus* cultivars with California native parentage, it becomes obvious that this plant does not tolerate much irrigation at all, especially in heavy soil. Because of the progressive mortality rates, serious statistical analysis of the growth indexes was problematic late in the season when irrigation differences would be most telling.

Abundant flowering over a long period was the best feature of this plant. It was not self-cleaning, though, and might need some deadheading to reduce the unattractive persistent dead blooms.

SHADE

***Abelia* ‘Sunshine Dream’**

The data reveal no significant difference in plant growth based on irrigation for either the plant size or the percentage growth (relative growth index). Clearly this plant can be used in a variety of landscape situations, including very low-water plantings in the shade.

This *Abelia* was virtually pest and disease free for its entire stay in our field which can be seen in the consistently high ratings in those categories. The foliage maintained an almost flawless appearance year round, and the plants on all irrigation levels grew vigorously throughout the year. The flowering was attractive and pleasantly, if mildly fragrant, though not the key feature in this plant’s overall good looks. Variegation was not as strongly pronounced the second year on older foliage though the new foliage displayed the expected color range of this cultivar. Some direct early morning light, or a lighter level of shade may produce a stronger contrast.

As the second growing season got going in spring, there was a tendency for this plant to send up from its center very long shoots with leaves spaced far apart. We were uncertain if this was a desirable trait for the long-term growth of this cultivar, or if these should be pruned down to promote a denser, bushier habit. Since we were measuring overall growth, we did not prune these out during the trial, leading to a gangly appearance on some individual plants.

***Hypericum* ‘Red Ignite’**

There were no statistically significant differences in either overall or relative growth between irrigation treatments for *Hypericum* ‘Red Ignite’, making it suitable to a variety of landscape irrigation situations, including very low water use. After the establishment year, there was no mortality for any irrigation level.

Early into the second growing season, the plants began to show variability we couldn’t attribute to position in the field or irrigation treatment. Plants seemed to have one of two forms: very dark green leaves, denser habit, and showier display of berries, or paler green leaves, and floppier, more open habit. Both colors bloomed satisfactorily, but the darker leaved plants bloomed earlier, and held their berries later. The previous season’s growth for both forms became yellow and died on the interior of the plant, and often became floppy, so to get a fair assessment of this cultivar’s potential, we pruned plants back evenly in late April to encourage new growth and a more appealing habit. We would make this an annual cultivation recommendation for this plant, perhaps even earlier in the season.

Though some aphids appeared on the new growth following pruning, they did not inflict serious enough damage to affect leaf or flower quality ratings. The only statistical difference between treatments in quality ratings was for disease resistance between 20% and 80%. Though the incidence of leaf necrosis was not high during the growing season, it was most likely to occur on the highest irrigation level. Since overly tall growth tends toward a more floppy appearance, we would recommend irrigation at the 20% to 40% ET₀ level. Overall this plant was attractive in leaf, flower and berry. With pinching, it might make a denser shrub, but we would recommend it for informal gardens where its loose blousy habit would naturally look appropriate and require minimal maintenance.

***Ligustrum sinense* ‘Sunshine’**

There was no significant difference between the four irrigation treatments in overall growth or percent new growth during the second growing season of *Ligustrum* ‘Sunshine’ in our field conditions under 50% shade. Any irrigation could be used for this plant down to the very low 20% ET₀ level without compromising quality. A very low water level as the plant aged might eventually lead to more conservative growth that would reduce pruning needs.

Plants had consistently even growth, good form, high leaf quality, and were completely unbothered by pests or disease. They had a slightly conical habit in their early life in our field which resembled little lime-colored Christmas trees. The leaves colored a brighter yellow on the south side of plants where early season sun hit the plants more directly. These were a real staff and visitor favorite.

***Trachelospermum* ‘Sebra’**

The slow start and late performance of this star jasmine was undoubtedly due to the small size of the transplants. However, by early summer this plant’s growth and quality began to show marked improvement as it attained a reasonable field size. Although quality ratings were not strongly affected by irrigation level, vigor and growth were directly proportional to the amount of water the plants received. Plants on the highest irrigation level were significantly larger than those on the three lower levels once deficit irrigation treatments began. Interestingly, the *percentage* of new growth put on was significantly higher on the lowest level of irrigation compared to the two highest levels by the end of

the summer. It would seem that once plants have established they can continue to put on new growth, even on very low water. If it is remembered that the lowest water treatment in the shade received no supplemental irrigation after the late rain on June 28, this is indeed remarkable.

Some minor chlorosis was observed on the 80% irrigation treatment, but overall leaf quality remained fairly high throughout the growing season. Plants that seemed susceptible to pests or disease during the cold months bounced back with new growth that was mostly unbothered by May. Flowering was most pronounced in July and highest on the 40% irrigation level. If quality ratings were isolated to the August through October period, the average overall appearance ratings would have been higher (Table 28. blue highlights). We would recommend irrigation at the 40% level once transplants were well established.

Literature Cited:

Ball Ornamentals, <http://www.ballornamentals.com/>

Costello, L.R., N.P. Matheney, and J.R. Clark. 2000. *A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California. The Landscape Coefficient Method and Water Use Classification of Landscape Species*. University of California Cooperative Extension. California Department of Water Resources. <http://www.water.ca.gov/wateruseefficiency/docs/wucols00.pdf>

Irmak, Suat, D.Z. Haman, A. Irmak, J.W. Jones, K.L. Campbell, T.L. Crisman. 2004. Measurement and Analyses of Growth and Stress Parameters of *Viburnum odoratissimum* Grown in a Multi-pot Box System. *HortScience* 39(6):1445-1455.

Office of Water Use Efficiency. 2009. Water Conservation Act of 2009. Department of Water Resources, <http://www.dwr.water.ca.gov/wateruseefficiency/sb7/>

Snyder, R.L. and S. Eching. 2007. *PMday, Penman-Montieth Daily Reference Evapotranspiration*. University of California, Davis, <http://biomet.ucdavis.edu/evapotranspiration.html>

State of California, Department of Water Resources, Office of Water Use Efficiency. 2009. California Irrigation Management Information System. <http://www.cimis.water.ca.gov/cimis/welcome.jsp>

UCD Arboretum. 2009. UC Davis Arboretum All-Stars. http://arboretum.ucdavis.edu/arboretum_all_stars.aspx. Accessed Aug. 28, 2009.

Appendix

PHOTOS

SUN- Arboretum All-Stars



Fig. 1. *Aster* 'Purple Dome' in September 2011, caged for rabbit protection; 40% ET₀



Fig. 2. *Bulbine* 'Tiny Tangerine' in April 2011; 20% ET₀



Fig. 3. *Rosa* 'Korbin' in September 2011 on 40% ET_0

SUN- Ball Ornamentals



Fig. 4. *Buddleia* 'Blue Heaven' in September 2011 on 60% ET_0 (60" high; 2x the expected height)



Fig. 5. *Cordyline* 'Purple Sensation' on 60% ET_0 in July showing signs of sunburn



Fig. 6. *Escallonia* 'Pink Whisper' September, 2011, on 40% ET_0 with drip head for size comparison



Fig. 7. *Lomandra* 'Seascape' on 40% ET₀ in September 2011



Fig. 8. *Mimulus* 'Curious Georgie Boy' on 20% ET₀ in September 2011

SHADE- Arboretum All-Stars



Fig. 9. *Helleborus* 'Red Lady' in full bloom, March 2011, showing slug damage on leaves



Fig. 10. *Heuchera maxima* in full bloom April 2011



Fig. 11. *Osmanthus heterophyllus* 'Purpureus' in April 2011 showing reddish new growth



Fig. 12. *Ribes viburnifolium* on 40% ET_0 in April 2011



Fig. 13. *Woodwardia fimbriata* in April 2011 on 80% ET₀

SHADE - Ball Ornamentals



Fig. 14. *Abelia* 'Sunshine Daydream' on 40% ET₀ in June 2011



Fig. 15. *Hypericum* 'Red Ignite' on 20%ET₀ in September 2011



Fig. 16. A view of *Ligustrum* 'Sunshine' on a variety of irrigation levels in September 2011



Fig. 17. *Trachelospermum* 'Star of Toscane' on 40% ET₀ in September 2011

Addresses for Master Gardener Demonstration Gardens Participating at time of trials

Alameda County

Martinelli Center
3585 Greenville Road
Livermore, CA 94550

Los Angeles County

Theodore Payne Foundation
10459 Tuxford Street
Sun Valley, CA 91352-2116

Nevada/Placer Counties

The Demonstration Garden
Nevada Irrigation District Business Center
1036 W. Main St.
Grass Valley, CA 95945

Riverside County (no longer participating)

Jurupa Mountain Cultural Center
7621 Granite Hill Dr.
Riverside, Ca

Santa Clara County

Eleanor Pardee Community Garden
1201 Channing Avenue
Palo Alto, CA 94309

San Diego County-coastal

San Diego Botanical Garden
230 Quail Gardens Drive
Encinitas, CA 92024

Fresno County

Garden of the Sun
1944 N. Winery Ave.
Fresno, CA 93703

Mariposa County

Mariposa Creek Parkway
700 block Stroming Rd.
Mariposa, CA 95338

Orange County

South Coast Research and Extension Center
7601 Irvine Boulevard
Irvine, CA 92618

San Joaquin County

Robert J. Cabral Ag Center
2101 E. Earhart Avenue
Stockton, CA 95206

Shasta County

Shasta College Teaching Gardens
11555 Old Oregon Trail
Redding, CA 96003

San Diego County- inland

The Water Conservation Garden
12122 Cuyamaca College Dr. W.
El Cajon, California, 92019

Participating UC Master Gardener Demonstration Gardens 2010-2012

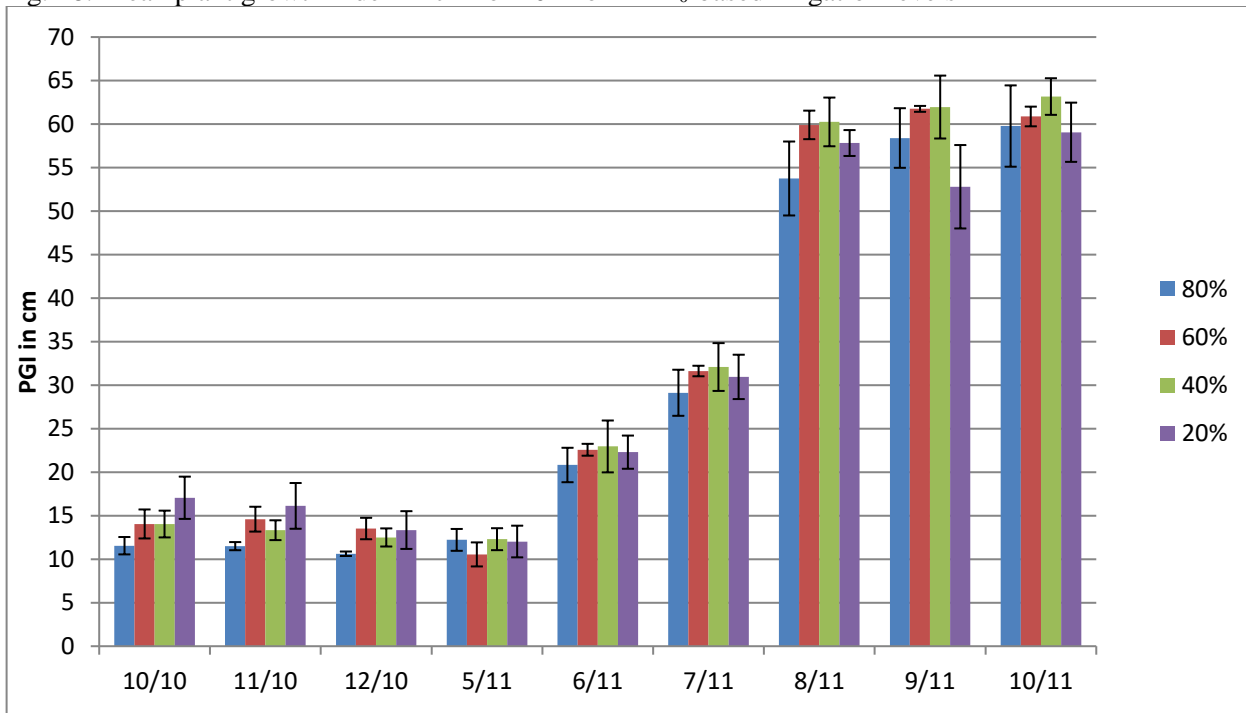


PLANT GROWTH INDEXES AND QUALITY RATINGS

SUN- Arboretum All Stars

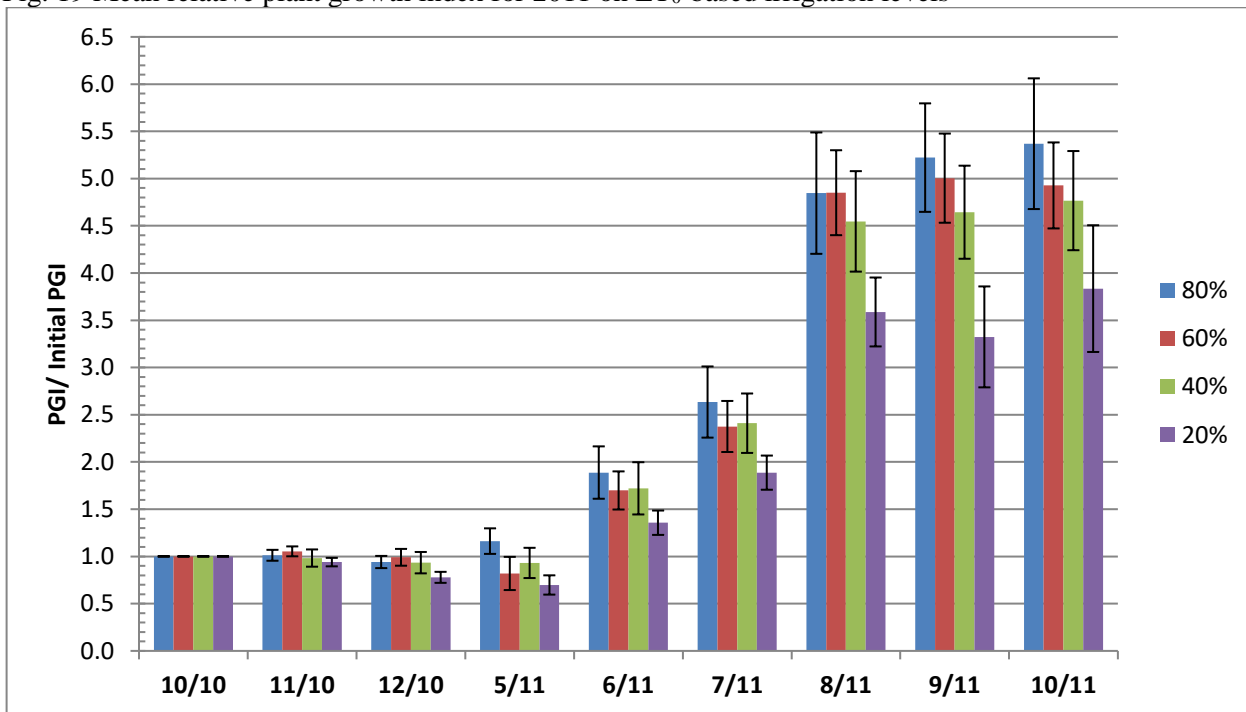
Aster 'Purple Dome'

Fig. 18. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE.

Fig. 19 Mean relative plant growth index for 2011 on ET₀-based irrigation levels



Error bars represent ± 1 SE.

Table 6. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels in 2011

Aster 'Purple Dome'								
foliage	MAY	JUN	JULY	AUG	SEPT	OCT	AVG	
80%	4.6	4.3	4.2	4.4	4.4	3.1	4.2	
60%	4.5	4.7	4.1	4.8	4.8	3.0	4.3	
40%	4.6	4.3	4.3	4.5	4.3	3.2	4.2	
20%	4.0	4.7	4.4	4.3	3.2	2.5	3.8	
flowering								
80%				1.0	4.3	1.8	2.3	
60%				1.0	4.9	1.3	2.4	
40%				1.0	4.8	1.8	2.5	
20%				1.0	3.2	1.8	2.0	
pest tolerance								
80%	4.6	4.3	5.0	5.0	4.4	3.1	4.4	
60%	4.5	4.8	5.0	5.0	4.8	3.0	4.5	
40%	4.6	4.2	5.0	5.0	4.2	3.1	4.3	
20%	3.6	4.7	4.7	5.0	4.6	2.5	4.2	
disease resistance								
80%	5.0	5.0	5.0	4.1	5.0	3.5	4.6	
60%	5.0	5.0	5.0	5.0	5.0	3.3	4.7	
40%	5.0	5.0	5.0	4.5	5.0	3.4	4.7	
20%	5.0	5.0	5.0	4.3	3.6	3.0	4.3	
vigor								
80%	3.5	4.4	4.1	4.8	4.5	4.0	4.2	
60%	2.9	4.8	4.1	4.8	5.0	5.0	4.4	
40%	3.5	4.5	4.0	4.8	4.8	4.6	4.4	
20%	3.4	4.8	4.4	5.0	3.3	3.8	4.1	
overall appearance								
80%	3.5	4.6	4.1	4.5	4.6	3.5	4.1	
60%	3.0	4.8	4.2	4.9	5.0	3.4	4.2	
40%	3.6	4.5	4.2	4.7	4.8	3.4	4.2	
20%	3.6	4.9	4.4	4.5	3.2	2.8	3.9	

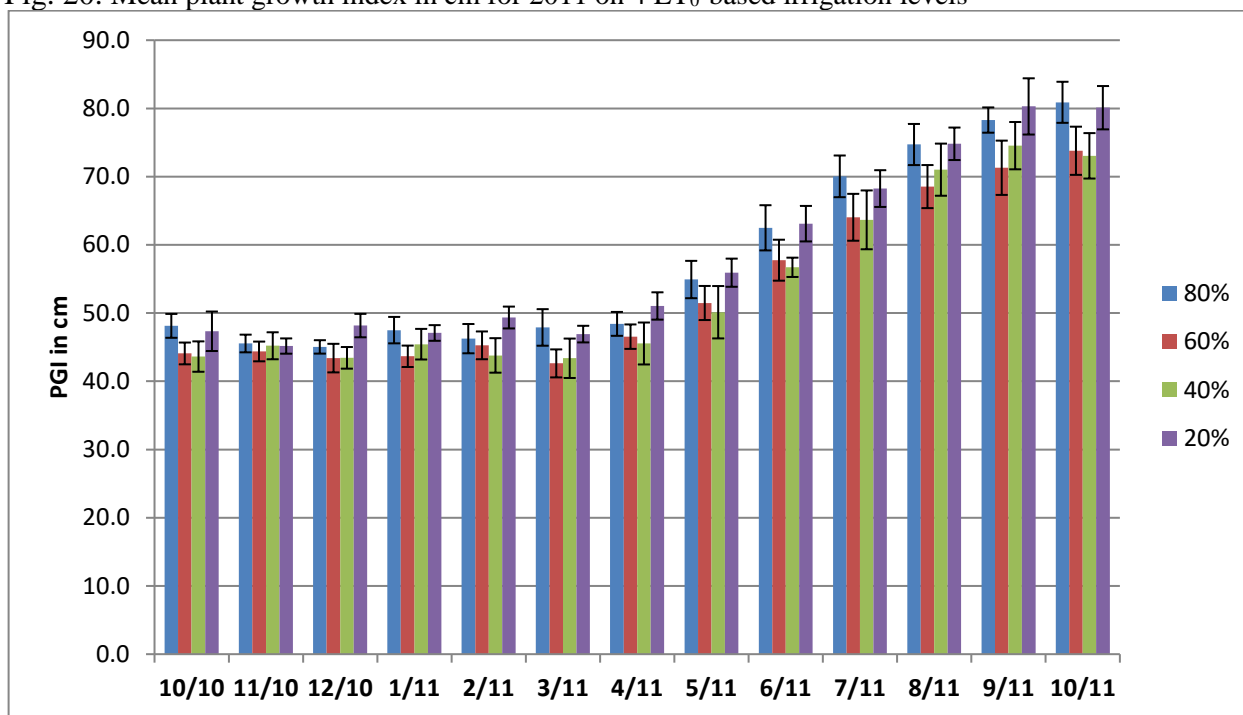
Table 7. Master Gardener quality average annual quality ratings for Aster 'Purple Dome'

Aster 'Purple Dome' average quality ratings over 2 years in 8 Counties								
COUNTY	Alameda	Nevada	Orange	Riverside	San Joaquin	Santa Clara	SD-coastal	Shasta
Sunset Zone	14	7	23	18/19	14	15	24	9
Foliage	3.8	3.8	3.8	2.5	3.4	3.4	3.5	3.9
Flowering	2.8	4.0	3.1	2.0	2.5	3.3	2.8	2.7
Insect Tol	4.7	4.6	4.7	4.9	4.8	4.0	4.4	4.6
Disease Res.	5.0	5.0	5.0	5.0	4.7	5.0	5.0	4.9
Vigor	3.6	3.9	3.9	2.4	3.3	3.3	3.5	3.9
Overall avg.	4.0	4.3	4.1	3.4	3.7	3.8	3.8	4.0
Flowering period/ highest rating	Aug- Sep/ 5.0	Aug- Oct/ 5.0	May- Oct/ 5.0	Aug - Oct/ 3.0	Oct - Dec*/ 4.0	Aug- Oct/ 4.7	May- Sept/ 4.5	July- Sept/ 4.0

*rabbit browsing delayed bloom

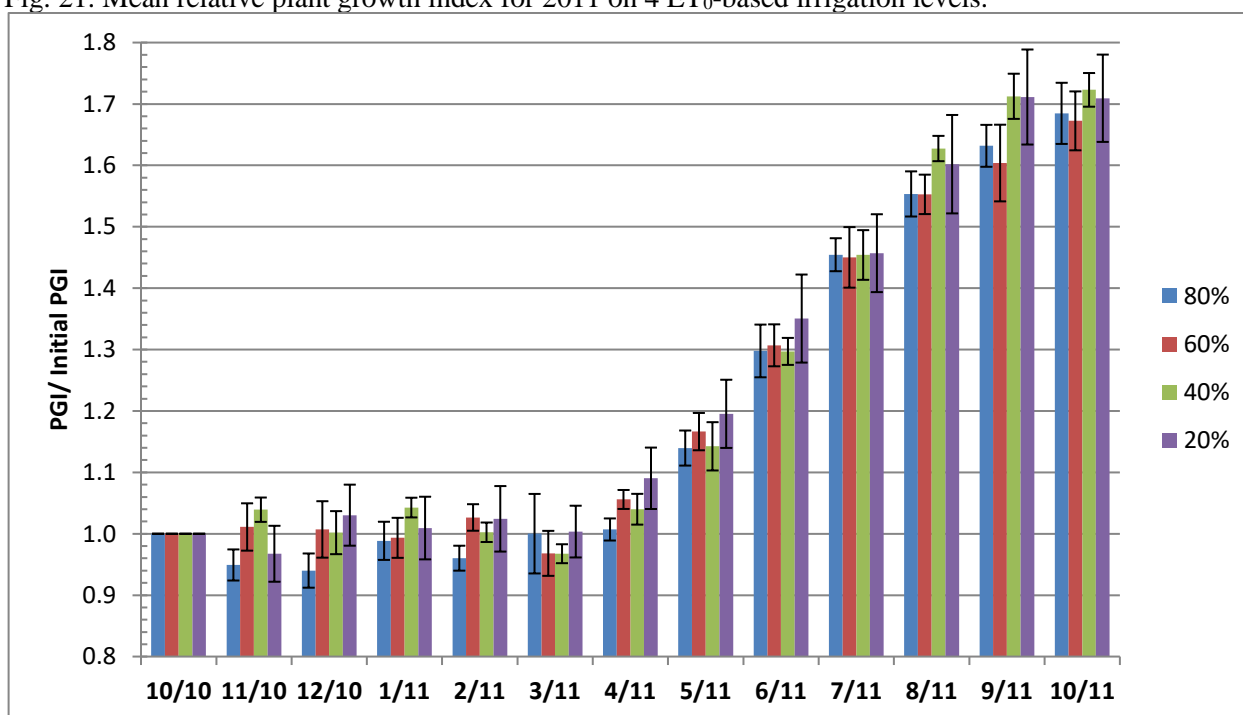
Bulbine ‘Tiny Tangerine’

Fig. 20. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE.

Fig. 21. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels.



Error bars represent ± 1 SE.

Table 8. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels Oct. 2010- Oct. 2011

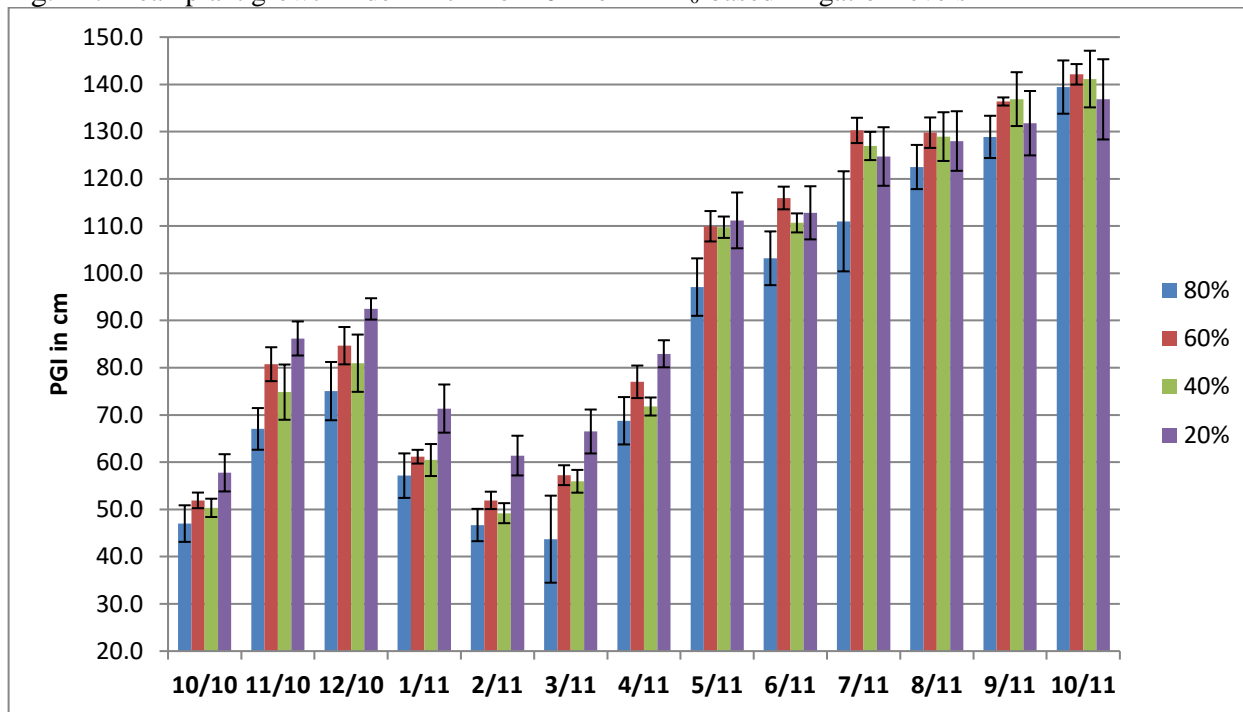
Bulbine 'Tiny Tangerine'												
foliage	OCT	NOV	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	AVG
80%	4.4	4.4	3.9	4.0	4.3	4.4	4.0	4.0	4.2	4.2	4.0	4.2
60%	4.3	4.3	3.9	4.0	4.3	4.1	3.8	3.8	3.7	3.7	3.7	4.0
40%	4.3	4.4	3.9	3.9	4.3	4.4	4.1	3.9	4.3	4.1	4.0	4.2
20%	4.6	4.6	3.9	4.0	4.3	4.5	4.0	4.0	4.1	4.0	3.9	4.2
flowering												
80%	4.5	5.0	1.0	1.3	3.3	4.8	3.9		3.7	4.8	3.6	3.6
60%	4.0	4.8	1.0	1.0	2.2	4.6	4.0		3.0	3.8	3.0	3.1
40%	4.8	4.8		1.0	2.5	5.0	3.8		3.7	4.4	3.6	3.7
20%	4.8	5.0		1.0	2.3	5.0	4.6		3.5	4.9	3.3	3.8
pest res.												
80%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
60%	5.0	5.0	4.8	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
40%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
20%	5.0	5.0	4.8	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.8	5.0
disease res.												
80%	5.0	5.0	4.1	4.2	4.1	4.6	4.1	5.0	4.1	4.3	4.0	4.4
60%	5.0	5.0	3.8	4.0	4.4	4.1	3.9	5.0	3.7	3.8	3.7	4.2
40%	5.0	5.0	3.8	4.0	4.3	4.6	4.1	5.0	4.5	4.1	4.0	4.4
20%	5.0	5.0	4.2	4.0	4.3	4.5	4.0	5.0	4.1	4.2	3.9	4.4
vigor												
80%	4.7	4.8	4.5	4.8	4.7	4.7	4.7	4.2	4.7	4.7	5.0	4.7
60%	4.4	4.8	4.5	4.7	4.5	4.5	4.3	4.1	4.3	4.3	4.2	4.4
40%	4.7	4.7	4.3	5.0	4.5	4.8	4.5	3.8	4.5	4.3	4.7	4.5
20%	4.7	4.8	4.8	5.0	4.8	4.8	5.0	4.4	4.8	5.0	5.0	4.8
overall app.												
80%	4.7	5.0	4.2	4.2	4.3	4.8	4.5	4.2	4.4	5.0	4.5	4.5
60%	4.3	4.9	4.0	4.2	4.4	4.3	4.3	4.0	3.8	4.1	3.9	4.2
40%	4.8	4.8	4.0	4.3	4.4	4.9	4.5	4.0	4.6	4.6	4.8	4.5
20%	4.8	4.9	4.1	4.3	4.4	4.9	4.9	4.3	4.3	5.0	4.5	4.6

Table 9. Master Gardener quality average annual quality ratings for *Bulbine* 'Tiny Tangerine'

Bulbine 'Tiny Tangerine' average quality ratings over 2 years in 8 counties								
COUNTY	Alameda	Nevada	Orange	Riverside	Santa Clara	SD-inland	SD-coastal	Shasta
Sunset Zone	14	7	23	18/19	15	22	24	9
Foliage	4.8	4.3	4.3	4.6	3.9	4.7	4.1	3.0
Flowering	3.9	3.6	3.5	4.2	3.5	2.9	2.6	2.0
Insect Tol.	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Disease Res.	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Vigor	4.9	4.7	4.4	4.6	4.3	5.0	4.4	3.0
AVERAGE	4.7	4.5	4.4	4.7	4.4	4.5	4.2	3.6
Flowering period/highest rating	all but July/ 5.0	May-Nov/ 5.0	Feb-Nov/ 5.0	all year/ 5.0	all year/ 5.0	all but Feb./ 5.0	all year/ 4.3	Apr - Nov/ 3.0

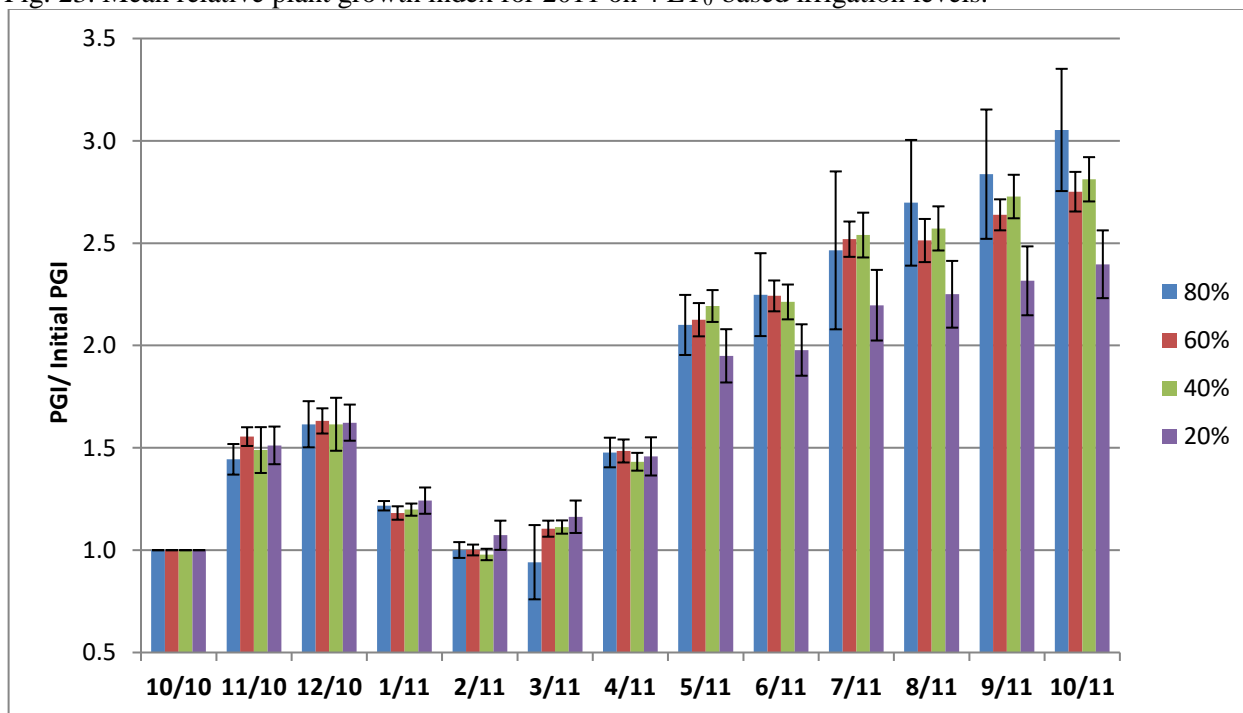
Rosa 'Korbin'

Fig. 22. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE.

Fig. 23. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels.



Error bars represent ± 1 SE.

Table 10. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels Oct. 2010- Oct. 2011

Rosa 'Korbin'													
foliage	OCT	NOV		FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	AVG
80%	2.9	3.8		3.2	4.8	4.9	4.3	4.0	3.5	3.5	4.3	4.1	3.9
60%	3.9	4.8		3.8	4.4	5.0	4.6	3.9	3.4	4.3	4.3	4.0	4.2
40%	4.0	4.3		3.5	4.3	5.0	4.4	4.0	3.8	4.1	4.4	4.1	4.2
20%	3.4	4.3		3.4	4.3	5.0	4.2	3.8	3.7	3.8	3.9	3.8	4.0
flowering													
80%	2.9	3.0					3.8	2.7	3.8	2.2	3.5	2.8	3.1
60%	3.2	2.9					3.7	3.4	3.3	2.8	3.8	3.0	3.3
40%	2.2	3.0					4.1	3.6	3.9	3.0	3.8	3.2	3.3
20%	3.7	3.6					4.0	3.3	3.8	2.0	2.3	2.4	3.1
pest tolerance													
80%	4.2	4.6		3.5	5.0	4.8	4.0	4.0	4.8	3.5	4.6	4.6	4.3
60%	3.8	5.0		4.1	5.0	5.0	3.4	3.9	4.8	4.8	4.9	4.8	4.5
40%	3.8	4.8		4.4	5.0	5.0	3.4	4.0	5.0	4.6	4.8	4.3	4.5
20%	3.2	5.0		3.8	4.8	5.0	3.7	4.2	4.8	4.6	4.3	4.4	4.3
disease res.													
80%	3.6	4.0		3.1	4.8	5.0	4.7	4.2	4.5	3.3	4.3	4.1	4.1
60%	3.7	4.7		3.6	4.3	5.0	4.8	3.9	4.3	4.2	4.1	4.0	4.2
40%	3.8	4.3		3.4	4.1	5.0	4.6	4.0	4.4	4.0	4.5	4.1	4.2
20%	3.2	4.8		3.6	4.6	5.0	4.2	3.7	4.3	3.6	3.8	3.6	4.0
vigor													
80%	3.8	3.8		3.0	4.0	4.3	4.2	4.2	4.1	4.2	4.6	4.6	4.1
60%	4.1	4.7		3.7	4.7	4.9	5.0	4.8	4.2	4.8	4.8	4.9	4.6
40%	3.8	4.5		3.4	4.2	4.8	4.8	4.5	3.9	4.9	4.5	4.5	4.4
20%	4.0	4.8		4.0	4.2	4.7	5.0	4.5	4.2	3.8	4.0	3.6	4.2
overall app.													
80%	3.0	4.0		3.1	4.3	4.8	4.3	4.0	4.1	3.5	4.0	4.1	3.9
60%	3.9	4.7		3.7	4.3	5.0	4.3	3.9	3.9	4.0	4.3	4.4	4.2
40%	3.8	4.3		3.3	4.2	5.0	4.2	4.1	3.9	4.1	4.3	4.3	4.1
20%	3.6	4.1		3.4	3.9	4.8	4.3	4.0	3.8	3.7	3.9	3.9	3.9

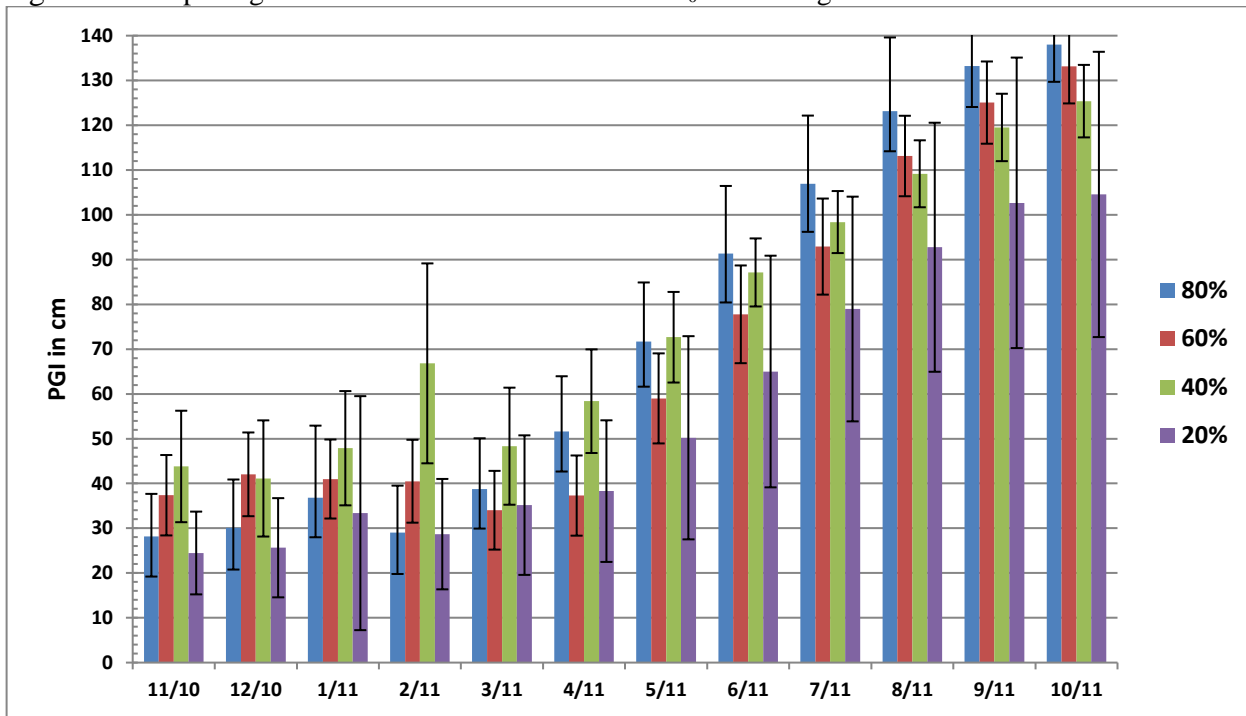
Table 11. Master Gardener quality average annual quality ratings for *Rosa* 'Korbin'

Rosa 'Korbin' (Iceberg) Average Quality Ratings in 5 Counties 2010-2011					
COUNTY	Alameda	Orange	Riverside	Santa Clara	Shasta
Sunset Zone					
Foliage	3.3	4.3	3.5	4.3	3.8
Flowering	2.3	3.4	2.9	3.4	3.1
Insect Tol.	4.9	4.7	4.4	4.8	4.5
Disease Res.	5.0	4.9	4.9	4.5	3.8
Vigor	2.8	4.1	3.3	4.6	3.8
Overall avg.	4.0	4.5	4.0	4.5	4.0
Bloom period/ highest rating	May-Jun; Oct- Nov/4.0	Mar-Dec/ 5.0	all year/ 5.0	Apr- Dec/ 5.0	Apr-Nov/ 5.0

SUN- Ball Ornamentals

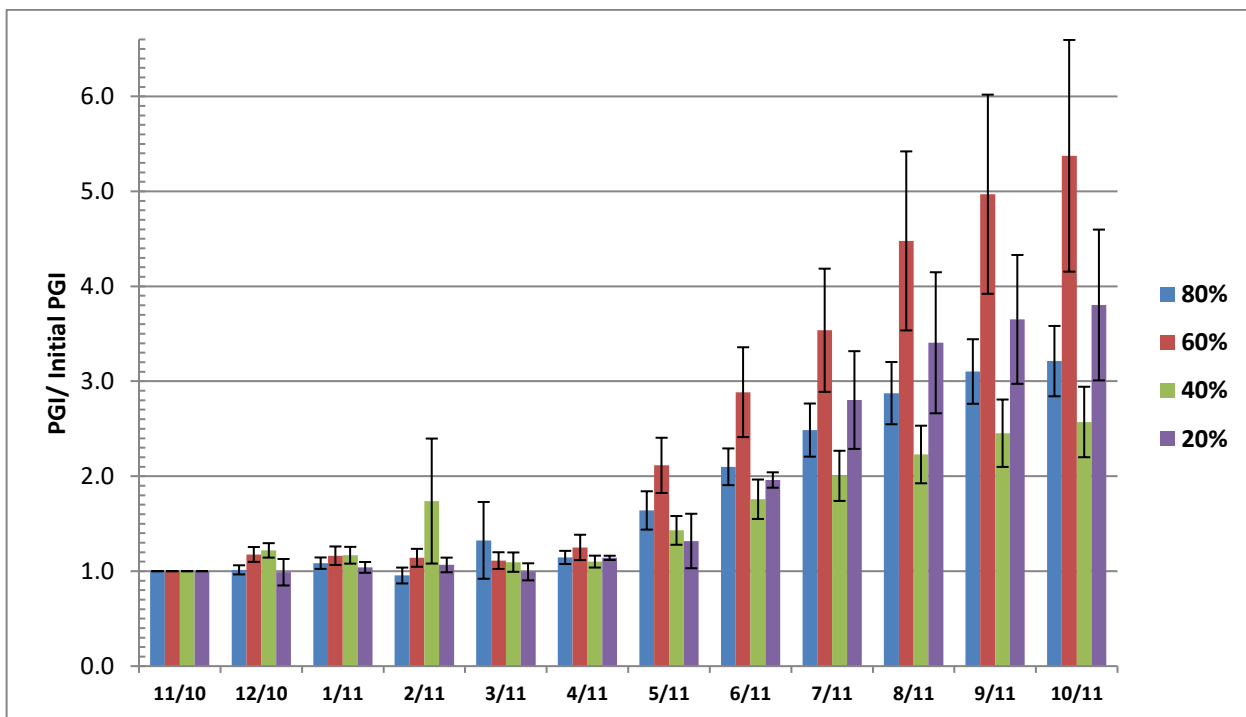
***Buddleia* ‘Blue Heaven’**

Fig. 24. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE.

Fig. 25 Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



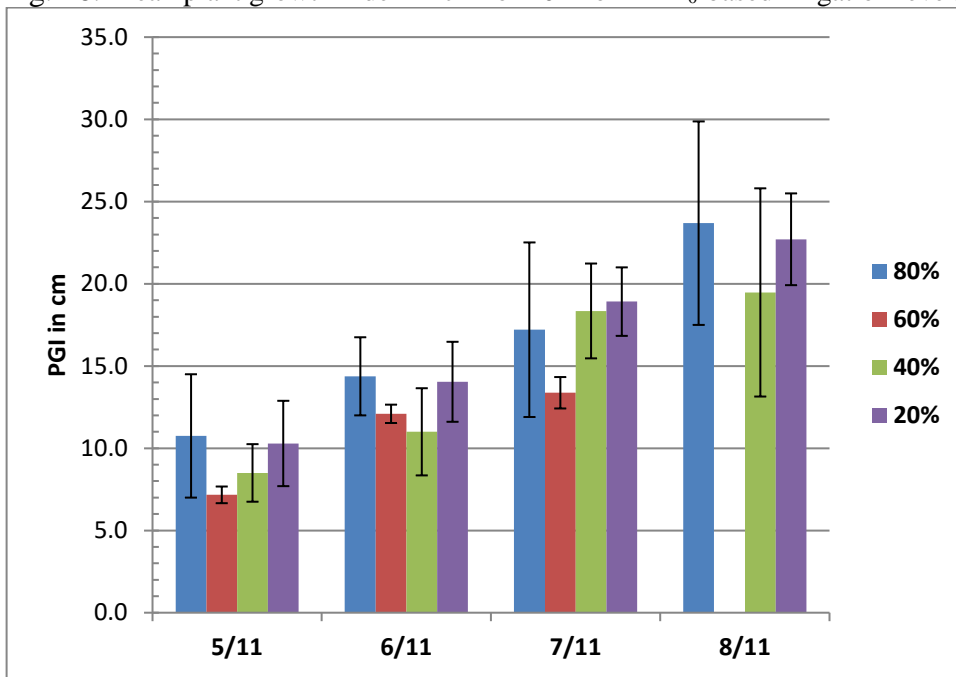
Error bars represent ± 1 SE.

Table 12. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels Nov. 2010- Oct. 2011

<i>Buddleia</i> 'Blue Heaven'											
foliage	NOV	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	AVG
80%	4.4	3.2	2.9	3.6	4.0	4.0	3.5	4.8	4.8	4.3	3.9
60%	4.0	3.5	3.7	4.8	3.8	3.5	3.6	4.5	4.9	4.6	4.1
40%	3.7	3.4	3.1	3.3	3.8	3.9	3.3	4.0	4.3	4.1	3.7
20%	3.5	2.9	2.6	4.5	3.1	3.8	3.8	4.3	4.3	4.3	3.7
flowering											
80%	3.0					1.4	3.5	4.0	4.3	3.3	3.3
60%	2.4					1.8	3.8	3.6	4.2	3.2	3.2
40%	2.6					2.0	3.5	3.9	4.1	3.8	3.3
20%	4.0					1.0	3.4	4.0	4.2	2.8	3.2
pest tolerance											
80%	4.8	3.6	3.7	4.3	4.7	3.5	5.0	3.4	5.0	5.0	4.3
60%	4.7	4.3	4.2	5.0	3.8	3.7	4.6	5.0	4.9	5.0	4.5
40%	5.0	3.6	3.6	3.8	4.3	3.8	4.3	4.8	5.0	4.6	4.3
20%	5.0	3.4	3.2	4.5	3.5	3.7	4.5	4.7	5.0	5.0	4.2
disease resistance											
80%	4.8	3.1	2.8	3.5	3.7	4.3	5.0	4.8	4.8	4.3	4.1
60%	4.7	3.4	3.8	4.6	3.8	4.1	5.0	4.4	4.9	4.6	4.3
40%	4.4	3.4	2.9	3.6	3.8	3.8	4.6	4.1	4.3	4.0	3.9
20%	4.3	3.1	2.8	4.0	2.8	4.7	5.0	4.3	4.0	4.2	3.9
vigor											
80%	3.3	3.2	3.0	3.5	4.7	4.7	4.2	4.5	4.7	4.3	4.0
60%	3.3	3.3	3.6	3.6	3.8	3.8	4.0	4.3	4.6	4.4	3.9
40%	3.4	3.8	3.6	3.6	4.3	4.5	4.0	4.4	4.0	4.0	4.0
20%	3.1	3.0	2.8	4.5	3.0	3.7	3.6	3.3	3.7	3.7	3.4
overall appearance											
80%	3.5	3.1	2.8	3.5	4.3	4.0	3.8	4.9	4.8	4.7	3.9
60%	3.4	3.3	3.6	3.9	3.8	3.6	3.8	4.5	4.8	5.0	4.0
40%	3.3	3.4	3.1	3.3	3.9	4.0	3.6	4.1	4.6	4.1	3.8
20%	2.8	2.9	2.6	4.0	2.8	3.7	3.8	4.3	4.5	4.2	3.6

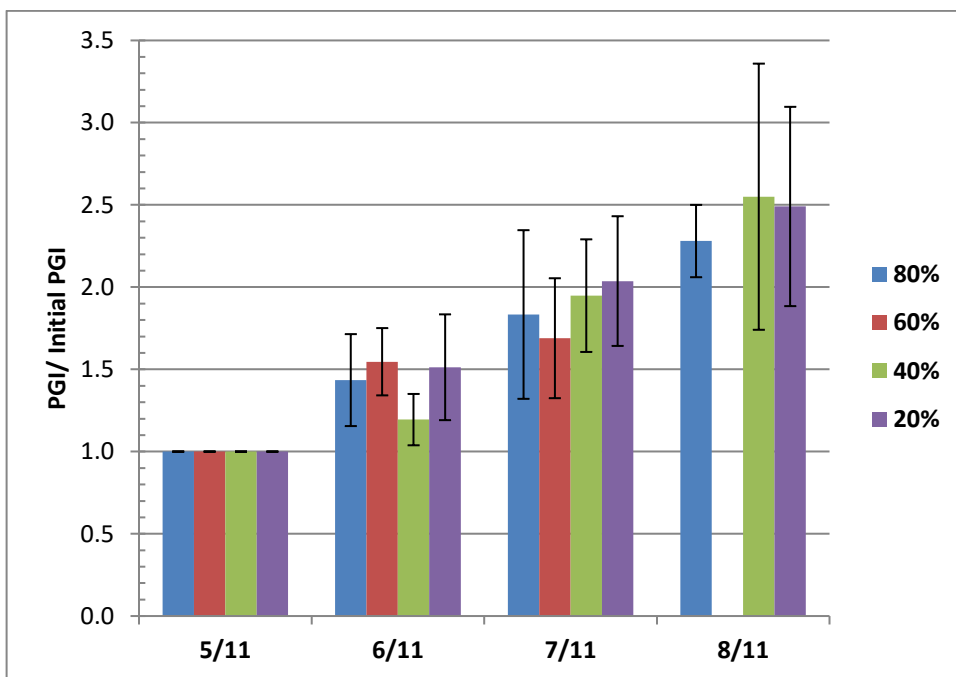
Cordyline 'Purple Sensation'

Fig. 26. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE.

Fig. 27 Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



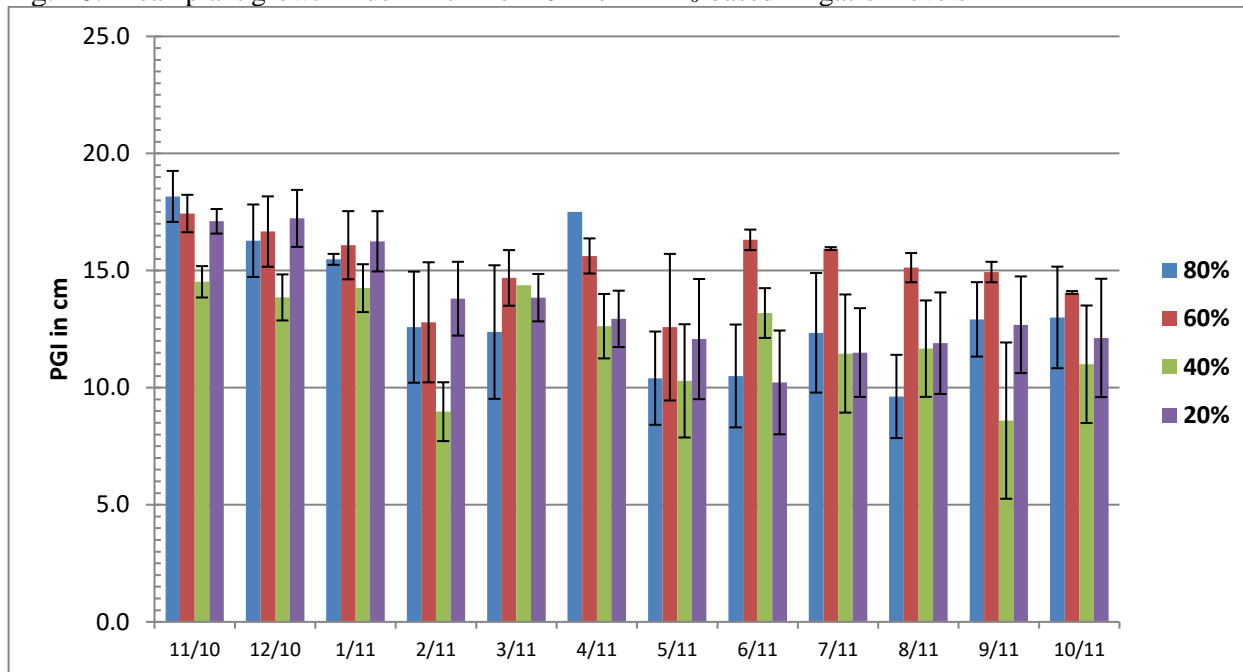
Error bars represent ± 1 SE.

Table 13. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels Summer 2011

<i>Cordyline</i> 'Purple Sensation'					
foliage	MAY	JUN	JUL	AUG	AVG
80%	4.0	3.2	2.5	2.2	3.0
60%	1.5	1.8	3.0	3.5	2.4
40%	2.7	2.8	2.5	2.3	2.6
20%	3.2	3.3	3.2	2.5	3.0
pest resistance					
80%	4.0	3.2	5.0	4.7	4.2
60%	1.7	1.8	5.0	4.5	3.2
40%	2.7	2.7	4.0	3.2	3.1
20%	3.7	3.3	5.0	2.5	3.6
disease resistance					
80%	5.0	4.7	5.0	2.0	4.2
60%	1.7	1.8	5.0	3.3	2.9
40%	3.7	3.2	4.0	2.2	3.3
20%	3.8	3.3	5.0	2.5	3.7
vigor					
80%	1.5	2.0	3.0	2.0	2.1
60%	1.0	1.0	1.7	3.5	1.8
40%	1.3	1.5	2.5	2.6	2.0
20%	1.8	1.7	3.2	2.5	2.3
overall appearance					
80%	2.0	2.3	2.8	2.0	2.3
60%	1.2	1.4	1.5	3.3	1.8
40%	1.8	1.9	2.1	2.2	2.0
20%	2.3	2.5	3.0	2.5	2.6

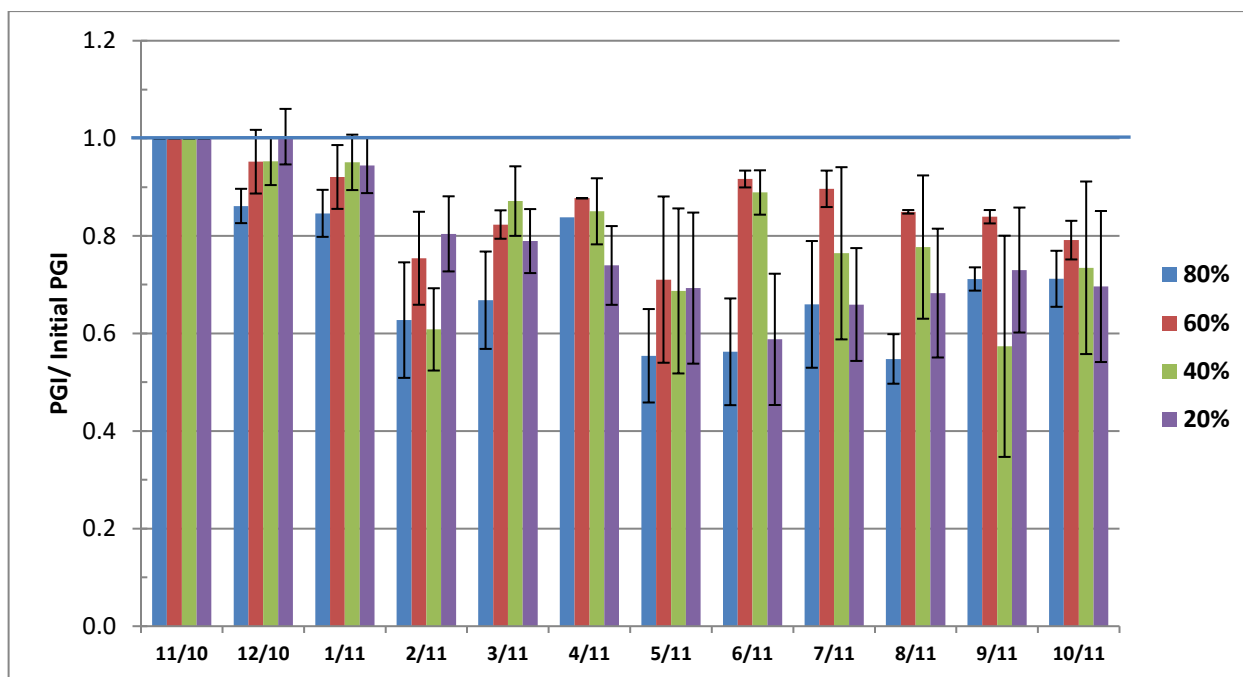
Escallonia ‘Pink Whipper’

Fig. 28. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE.

Fig. 29 Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



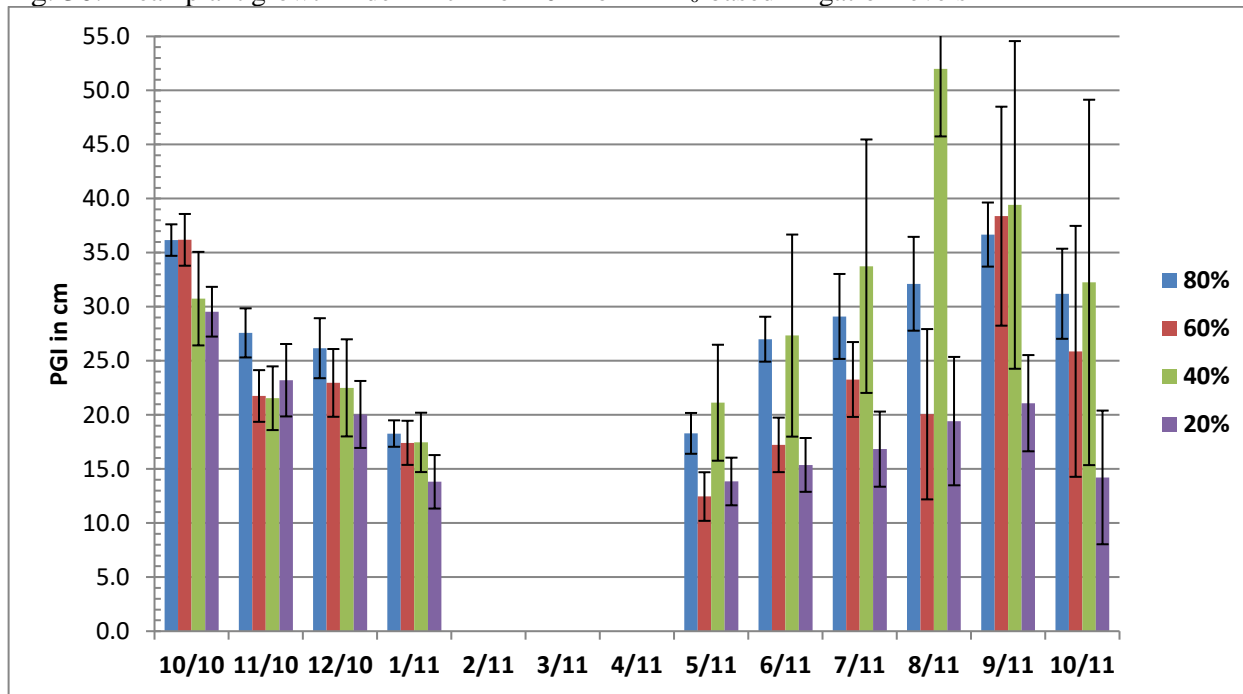
Error bars represent ± 1 SE.

Table 14. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels during 2011

<i>Escallonia</i> 'Pink Whisper'										
foliage	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	AVG
80%	1.5	1.6	2.0	2.4	3.4	3.6	3.3	3.7	4.0	2.8
60%	2.3	2.3	2.5	2.3	3.0	4.0	2.7	3.0	2.8	2.8
40%	1.6	1.8	3.5	3.0	2.5	3.5	3.7	3.8	3.5	3.0
20%	2.0	1.9	2.0	2.9	3.3	4.0	3.9	3.6	3.0	3.0
flowering										
80%						4.3				4.3
60%									2.0	2.0
40%										
20%									4.0	4.0
pest tolerance										
80%	1.6	5.0	2.0	4.4	3.8	5.0	5.0	4.3	5.0	4.0
60%	2.7	5.0	2.5	3.0	4.0	5.0	3.7	5.0	4.3	3.9
40%	2.0	5.0	3.5	4.0	2.7	5.0	4.3	5.0	5.0	4.1
20%	2.0	5.0	2.5	3.4	3.6	5.0	5.0	5.0	5.0	4.1
disease resistance										
80%	1.4	2.0	2.0	2.4	3.5	5.0	3.0	3.0	3.5	2.9
60%	2.0	2.0	2.5	2.3	3.0	5.0	2.7	3.0	2.8	2.8
40%	1.5	1.8	3.5	3.0	2.3	5.0	3.3	3.8	3.5	3.1
20%	2.0	2.0	2.0	2.6	3.2	5.0	4.1	3.2	3.0	3.0
vigor										
80%	1.2	1.4	2.0	1.4	1.4	3.1	2.5	2.0	2.7	2.0
60%	2.0	2.0	2.5	2.0	2.5	2.7	2.7	2.5	3.7	2.5
40%	1.5	1.8	3.5	2.5	1.7	2.7	3.3	3.5	2.5	2.5
20%	1.8	1.6	1.8	1.9	1.8	2.5	2.8	2.4	2.6	2.1
overall appearance										
80%	1.4	1.5	2.0	1.9	2.0	3.1	2.5	2.7	3.3	2.3
60%	2.0	2.0	2.5	2.2	2.8	2.8	2.7	2.8	2.8	2.5
40%	1.5	1.8	3.5	2.8	2.0	2.8	3.3	3.8	3.0	2.7
20%	1.9	1.9	1.9	2.2	2.3	2.8	3.0	3.0	2.8	2.4

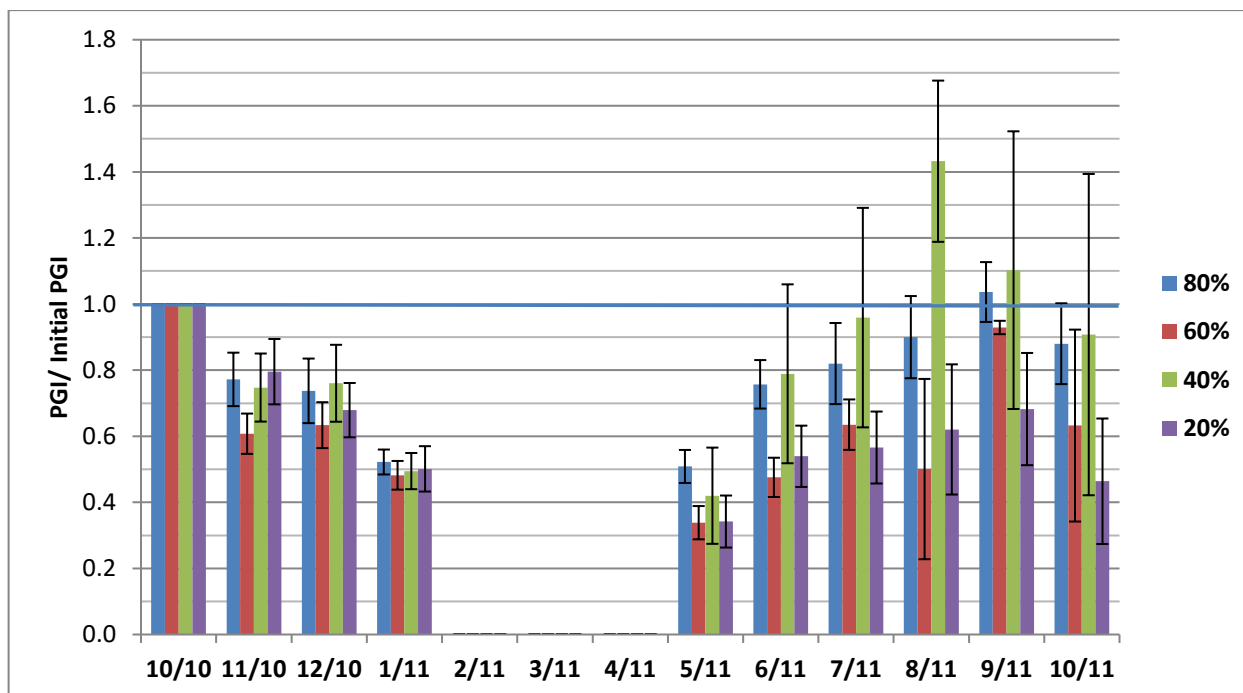
***Lomandra* 'Seascape'**

Fig. 30. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE.

Fig. 31. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



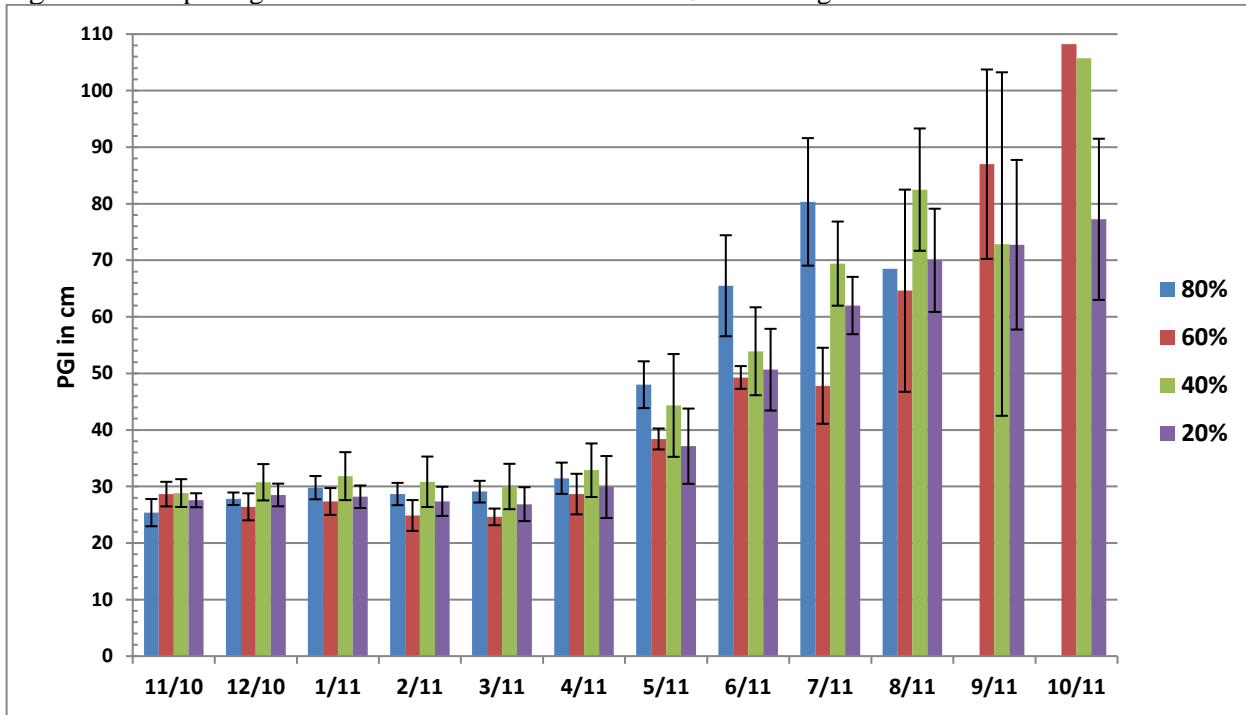
Error bars represent ± 1 SE.

Table 15. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels during 2011

Lomandra 'Seascape'										
foliage	SEPT	OCT	APR	MAY	JUN	JUL	AUG	SEP	OCT	AVG
80%	3.6	4.0	2.4	3.6	3.7	3.6	3.7	4.2	4.3	3.7
60%	3.2	3.9	2.0	2.3	3.2	3.3	2.5	3.0	4.0	3.0
40%	3.2	3.0	2.0	2.2	3.7	4.0	4.0	4.3	4.0	3.4
20%	2.9	3.1	2.3	3.0	3.4	3.5	2.4	3.0	3.0	2.9
flowering										
80%										
60%							1.0	4.0		2.5
40%							1.0		1.0	1.0
20%	3.7				5.0					4.4
pest tolerance										
80%	5.0	4.7	5.0	4.5	5.0	5.0	4.5	5.0	5.0	4.9
60%	4.5	4.8	5.0	5.0	5.0	4.8	2.8	4.5	5.0	4.6
40%	5.0	4.0	5.0	4.4	5.0	5.0	5.0	5.0	5.0	4.8
20%	5.0	4.5	5.0	5.0	4.9	5.0	2.6	5.0	5.0	4.7
disease resistance										
80%	5.0	5.0	5.0	3.6	3.6	5.0	3.7	5.0	4.3	4.5
60%	4.7	5.0	5.0	2.3	3.2	5.0	2.8	4.5	4.0	4.1
40%	5.0	5.0	5.0	2.2	3.7	5.0	4.0	5.0	4.0	4.3
20%	4.6	5.0	5.0	3.3	3.6	5.0	2.4	5.0	4.3	4.2
vigor										
80%	3.3	3.8	2.4	2.8	2.8	3.3	3.7	4.2	3.9	3.4
60%	3.1	3.7	2.0	2.0	2.1	2.9	2.3	3.0	4.0	2.8
40%	2.9	3.2	2.0	2.0	3.3	3.2	4.5	4.0	4.0	3.2
20%	2.6	2.8	2.3	2.3	3.0	3.0	2.0	2.3	2.0	2.5
overall appearance										
80%	3.5	3.8	2.4	3.0	3.1	3.6	3.7	4.2	3.9	3.5
60%	3.2	3.8	2.0	2.2	2.5	3.2	2.4	3.2	4.0	2.9
40%	3.0	2.9	2.0	2.1	3.2	3.3	4.3	4.3	4.0	3.2
20%	2.7	2.8	2.3	2.5	3.3	3.0	2.2	2.5	2.2	2.6

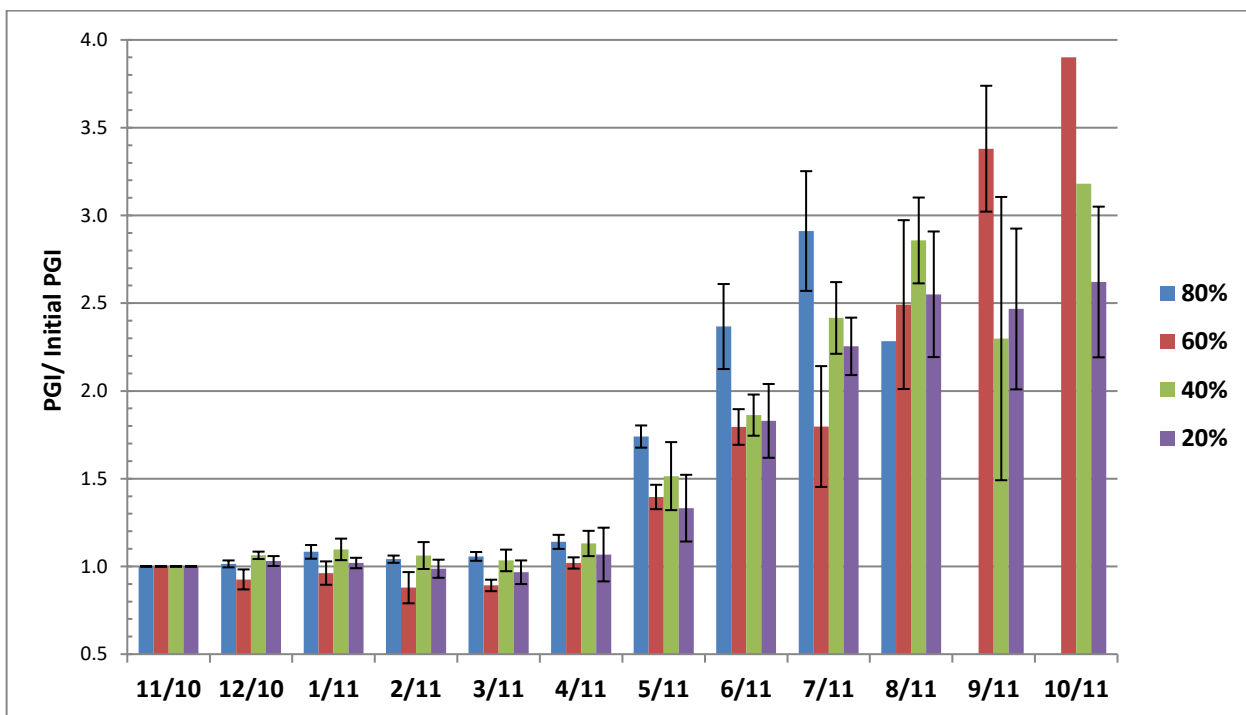
Mimulus ‘Curious Georgie Boy’

Fig. 32. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Fig. 33. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

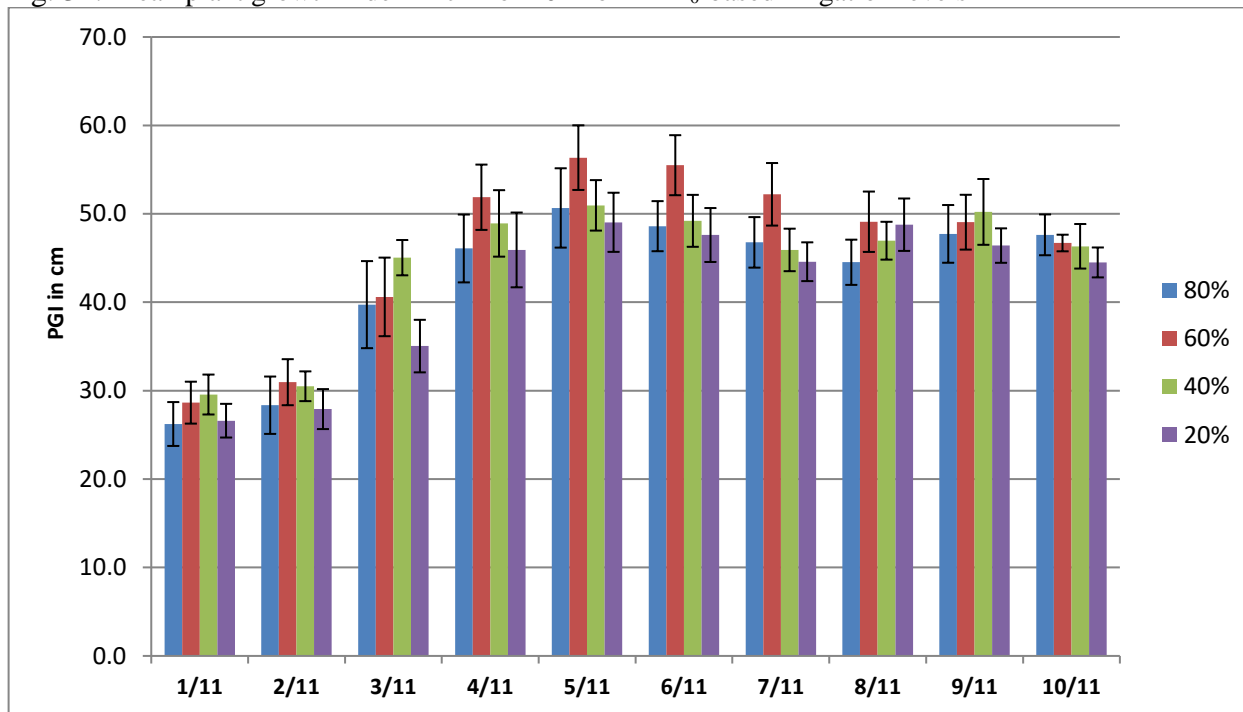
Table 16. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels during 2011

Mimulus 'Curious Georgie Boy'										
foliage	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	AVG
80%	3.3	3.3	3.3	4.0	3.8	3.8				3.6
60%	2.3	2.5	2.6	3.3	3.4	3.0	4.0	2.5	5.0	3.2
40%	3.2	3.2	3.3	3.7	3.2	3.3	2.8	2.0	2.0	3.0
20%	3.0	2.9	3.0	3.5	3.5	3.1	2.7	2.3	3.5	3.0
flowering										
80%				2.0	4.3	4.8				3.7
60%				3.2	3.8	4.0	4.0	5.0	5.0	4.2
40%				3.5	4.2	4.2	3.3	4.0	2.0	3.5
20%				2.3	3.8	4.3	4.5	3.8	3.3	3.7
pest tolerance										
80%	5.0	5.0	4.7	4.7	5.0	5.0				4.9
60%	3.8	5.0	3.8	4.5	4.8	5.0	5.0	3.0	5.0	4.4
40%	4.7	5.0	4.0	5.0	4.3	5.0	5.0	5.0	5.0	4.8
20%	5.0	5.0	3.8	4.8	4.8	5.0	3.7	5.0	5.0	4.7
disease resistance										
80%	3.0	3.0	2.7	3.7	3.8	5.0				3.5
60%	2.0	2.3	2.3	2.9	3.4	5.0	3.7	2.0	4.0	3.1
40%	2.8	2.5	3.0	3.0	3.0	5.0	2.7	2.0	2.0	2.9
20%	2.8	2.5	2.8	3.0	3.3	5.0	2.7	2.0	3.3	3.0
vigor										
80%	3.7	3.0	3.3	4.5	4.3	4.5				3.9
60%	2.5	2.7	2.8	3.6	3.9	3.3	3.7	3.0	5.0	3.4
40%	3.8	3.7	3.3	4.0	4.3	4.0	3.3	3.0	3.0	3.6
20%	2.8	3.0	3.1	3.3	3.8	3.6	3.3	4.0	4.0	3.4
overall appearance										
80%	3.3	3.2	3.2	4.0	4.2	4.3	0.0	0.0	0.0	2.5
60%	2.3	2.5	2.6	3.3	3.4	3.0	3.7	2.3	4.0	3.0
40%	3.2	3.0	3.2	3.3	3.5	3.7	2.8	2.0	2.0	3.0
20%	3.0	2.6	3.0	3.3	3.6	3.8	2.7	2.8	3.8	3.2

Red numbers represent the ratings from a single surviving plant.

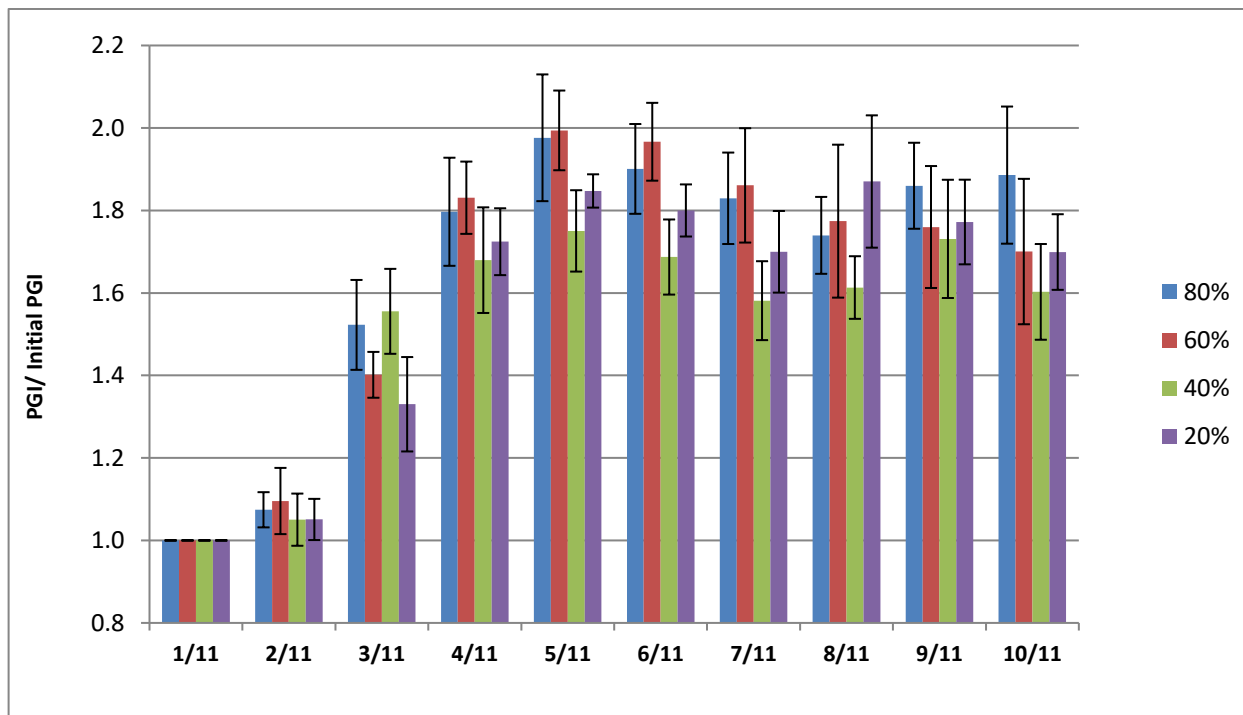
SHADE- Arboretum All Stars
***Helleborus* 'Red Lady'**

Fig. 34. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Fig. 35. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Table 17. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels during 2011

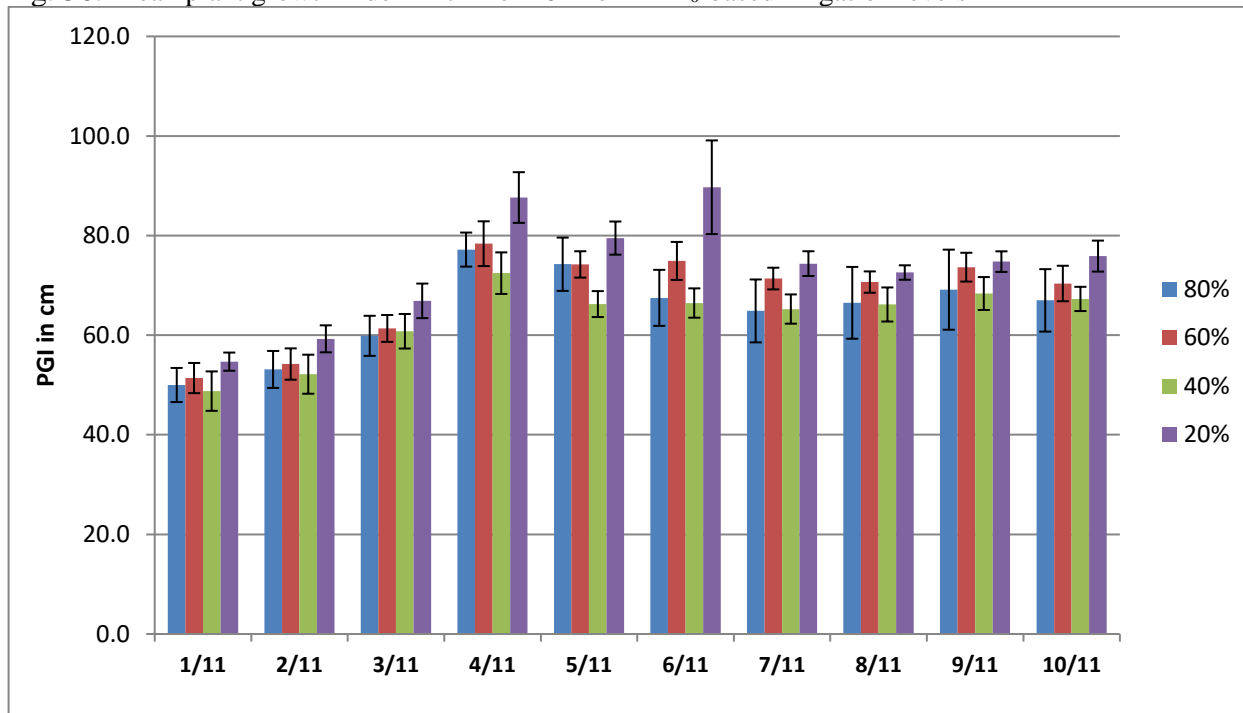
Hellebore 'Red Lady'											
foliage	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	AVG
80%	3.3	2.7	2.9	3.2	3.7	3.5	3.2	3.7	3.7	3.3	3.3
60%	2.4	2.5	2.9	3.3	3.7	3.6	3.2	3.7	3.4	3.6	3.2
40%	2.5	2.2	2.3	3.0	3.5	3.7	3.1	3.8	3.7	3.4	3.1
20%	2.6	2.4	2.6	3.3	3.5	3.5	3.1	3.9	3.6	3.5	3.2
flowering											
80%		2.0	2.7	3.5	1.0						2.3
60%		2.0	3.8	3.7	1.3						2.7
40%		1.8	4.3	3.0	1.0						2.5
20%		2.0	2.8	2.3	1.0						2.0
pest tolerance											
80%	3.0	2.5	2.7	3.2	3.8	4.2		3.7	4.0	3.7	3.4
60%	3.0	2.3	2.7	2.8	4.0	3.9		3.6	3.7	4.0	3.3
40%	2.4	2.2	2.2	2.9	3.4	3.8		3.8	3.9	4.0	3.2
20%	2.7	2.5	3.0	3.0	3.6	3.7		3.8	4.2	3.8	3.4
disease resistance											
80%	3.2	3.0	3.0	3.3	4.0	3.4		4.1	3.7	3.3	3.4
60%	2.5	3.2	3.0	3.8	3.5	3.3		3.8	3.5	3.6	3.4
40%	2.3	2.7	3.1	3.2	3.4	4.1		3.7	3.7	3.3	3.3
20%	2.8	2.3	3.0	3.3	3.6	4.0		4.2	3.5	3.9	3.4
vigor											
80%	3.2	3.1	3.1	3.2	4.6	4.3	3.6	4.0	4.2	3.9	3.7
60%	2.8	2.9	3.2	4.0	4.5	4.6	3.6	4.5	3.8	4.2	3.8
40%	2.8	2.8	3.5	3.5	3.9	4.3	3.8	4.5	3.8	4.2	3.7
20%	2.9	2.8	2.9	3.3	4.4	4.1	3.4	3.8	3.8	4.0	3.5
overall appearance											
80%	2.9	2.8	3.0	3.3	3.8	3.7	3.2	3.9	3.7	3.3	3.4
60%	2.6	2.7	3.2	3.8	3.8	3.8	3.3	3.8	3.3	3.8	3.4
40%	2.4	2.5	3.3	3.4	3.5	3.9	3.3	3.9	3.6	3.6	3.3
20%	2.8	2.6	2.7	3.1	3.6	3.7	3.2	3.8	3.8	3.7	3.3

Table 18. Master Gardener quality average annual quality ratings for *Helleborus* 'Red Lady'

Hellebore 'Red Lady' Average Quality Ratings over 2 years in 6 Counties						
COUNTY	Nevada	Orange	Riverside	Santa Clara	SD- coastal	Shasta
Sunset Zone	7	23	18/19	15	24	9
Foliage	3.8	3.2	2.5	3.3	3.7	3.5
Flowers	4.0	2.5	1.2	2.6	2.5	3.3
Ins. Tol.	4.3	4.5	4.2	3.3	4.5	3.7
Disease Res.	4.9	4.8	4.7	4.9	4.9	4.9
Vigor	4.0	3.3	2.5	3.7	3.8	3.5
Overall avg.	4.2	3.7	3.2	3.5	3.9	3.8
Flowering period/ highest rating	Mar- July/ 4.8	Jan- June/ 4.5	Feb- may/ 2.0	Dec- Aug/ 4.7	Jan- June/ 4.6	Jan- May/ 4.6

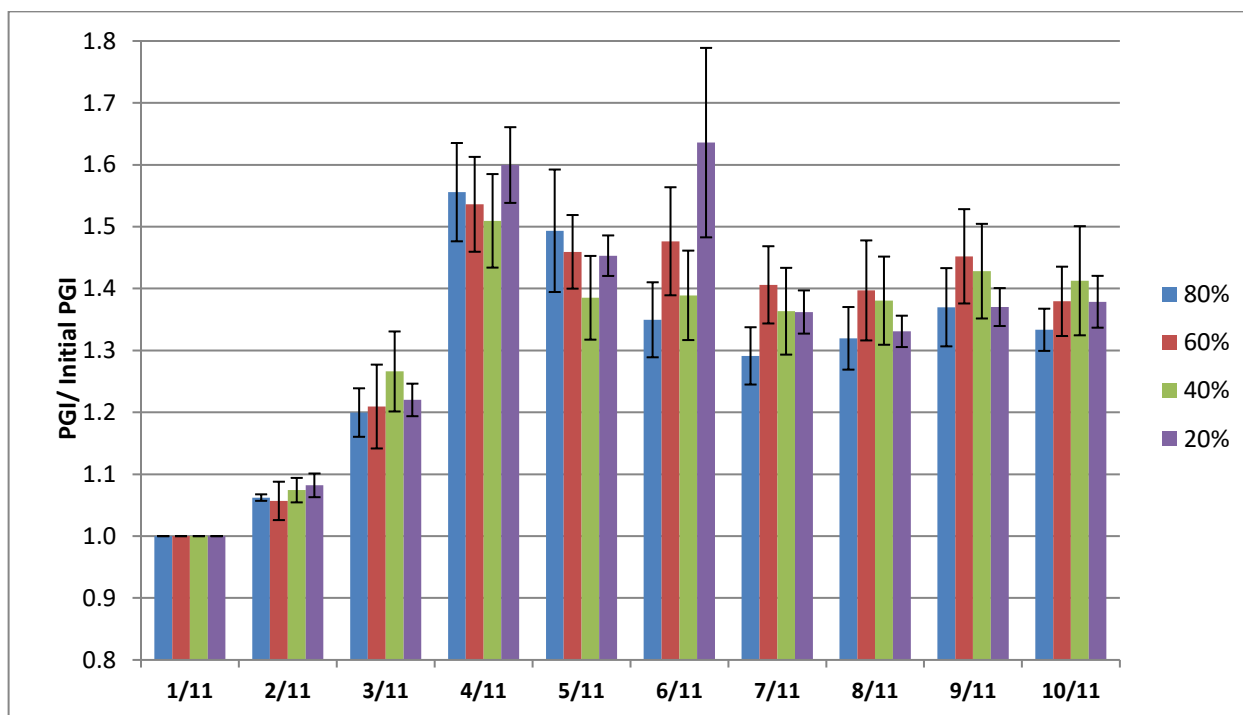
Heuchera maxima

Fig. 36. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Fig. 37. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Table 19. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels during 2011

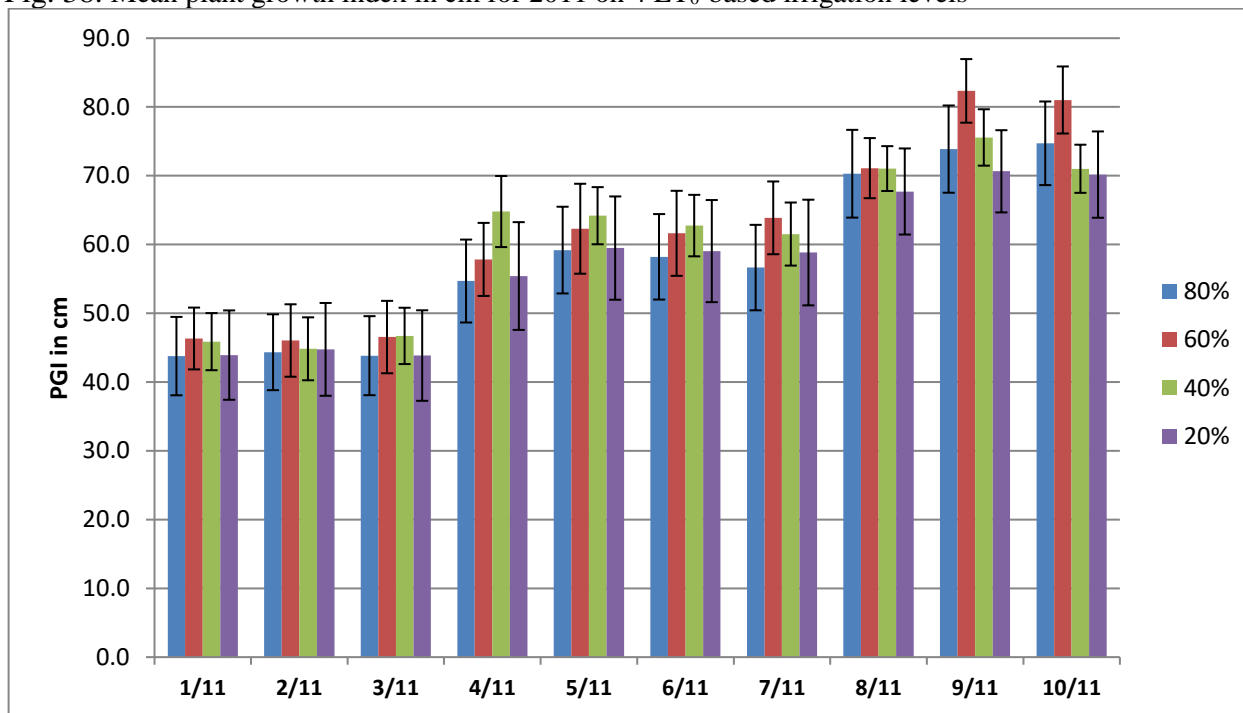
<i>Heuchera maxima</i>											
foliage	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	AVG
80%	3.9	4.1	3.8	5.0	3.5	3.5	3.2	3.8	3.9	3.8	3.8
60%	4.0	4.3	3.9	4.7	4.0	3.9	3.3	4.2	3.6	3.5	3.9
40%	4.0	4.0	3.5	4.5	3.3	3.3	2.9	3.7	3.7	3.6	3.6
20%	4.0	4.4	3.8	4.8	3.9	3.9	3.3	3.8	3.5	3.3	3.9
flowering											
80%				1.0	3.0						2.0
60%				1.0	3.8	2.0					2.3
40%				1.0	3.0	1.5					1.8
20%				1.0	3.9	1.0					2.0
pest tolerance											
80%	4.8	5.0	5.0	5.0	5.0	5.0		4.6	5.0	5.0	4.9
60%	5.0	4.8	5.0	5.0	4.8	5.0		4.8	4.7	5.0	4.9
40%	4.6	4.8	5.0	5.0	5.0	4.8		4.8	4.5	5.0	4.8
20%	5.0	4.9	5.0	5.0	5.0	5.0		5.0	4.8	4.8	5.0
disease resistance											
80%	3.8	4.3	3.6	5.0	3.1	3.5		3.8	3.8	3.8	3.8
60%	4.0	4.3	3.7	4.7	3.8	3.8		4.2	3.7	3.5	3.9
40%	3.9	4.0	3.2	4.2	2.9	3.2		3.7	3.6	3.6	3.6
20%	4.1	4.4	3.7	4.7	3.3	3.8		3.6	3.6	3.3	3.8
vigor											
80%	5.0	5.0	4.0	4.4	4.3	4.4	3.6	4.4	4.5	4.5	4.4
60%	4.8	4.7	4.5	4.5	4.8	5.0	3.8	5.0	5.0	4.8	4.7
40%	4.3	4.3	4.0	4.3	4.3	4.7	3.6	4.5	4.5	4.7	4.3
20%	5.0	5.0	4.7	5.0	5.0	4.8	3.9	4.5	4.8	5.0	4.8
overall appearance											
80%	4.4	4.3	3.8	4.9	3.6	3.8	3.5	4.1	4.0	3.8	4.0
60%	4.3	4.4	3.9	4.7	4.0	4.1	3.8	4.4	3.8	3.8	4.1
40%	4.1	4.0	3.5	4.3	3.4	3.5	3.0	3.9	3.8	3.8	3.7
20%	4.3	4.4	3.9	4.8	3.9	4.0	3.7	3.8	3.6	3.6	4.0

Table 20. Master Gardener quality average annual quality ratings for *Heuchera maxima*

<i>Helleborus</i> 'Red Lady' Average Quality Ratings over 2 years in 6 Counties										
COUNTY	Alameda	Fresno	LA	Mariposa	Nevada	Orange	Riverside	Santa Clara	SD-coastal	Shasta
Sunset Zone	14	8	20/21	7	7	23	18/19	15	24	9
Foliage	3.7	4.8	4.2	3.7	4.1	4.5	2.4	3.9	3.4	3.2
Flowers	3.3	3.3	2.7	5.0	3.7	2.3	1.3	1.8	1.3	4.0
Insect Tol.	5.0	5.0	4.8	4.9	4.9	4.9	4.2	4.9	4.3	4.7
Dis. Res.	5.0	5.0	4.9	4.8	5.0	5.0	4.9	5.0	4.5	4.7
Vigor	3.7	4.9	4.4	3.8	4.4	4.5	2.4	3.9	3.7	3.2
Overall avg	4.1	4.6	4.2	4.5	4.4	4.2	3.0	3.9	3.4	3.9
Flowering period/highest rating	April/ 4.3	April/ 5.0	April/ 4.7	May-Jun/ 5.0	June/ 5.0	April/ 5.0	April/ 1.7*	May/ 4.5	April/ 1.3*	April/ 5.0

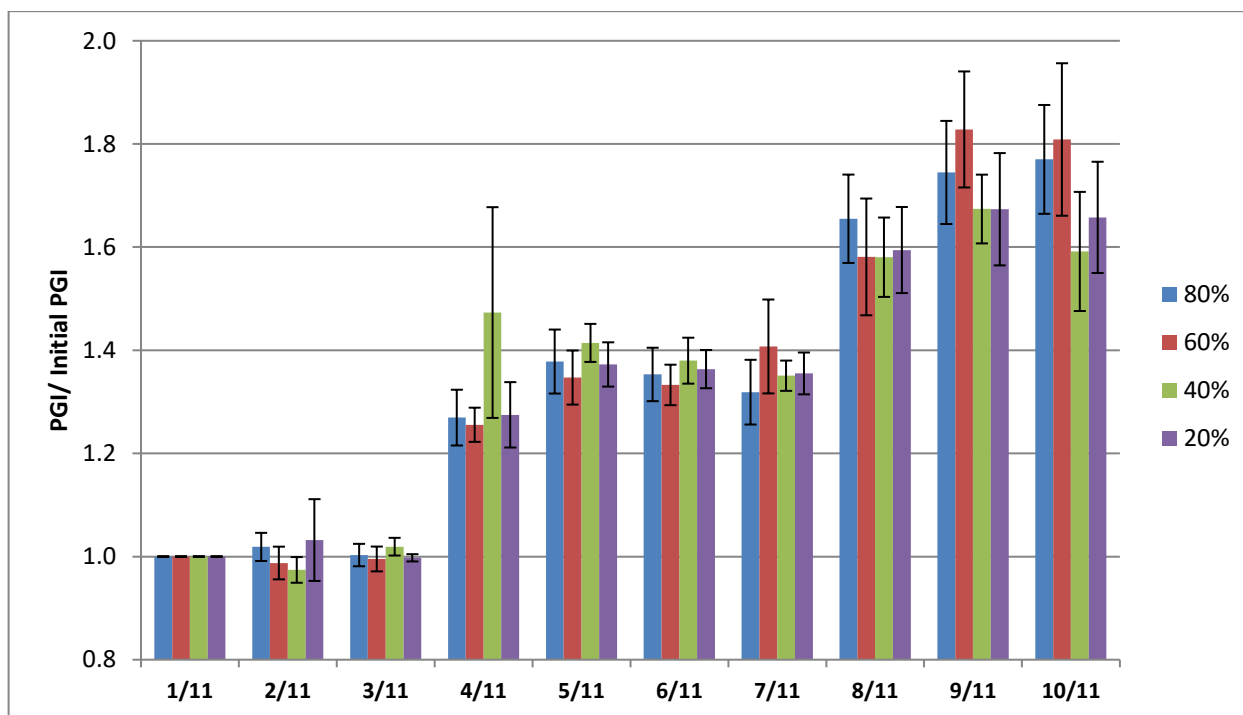
Osmanthus heterophyllus 'Purpureus'

Fig. 38. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Fig. 39. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Table 21. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels during 2011

<i>Osmanthus heterophyllus</i> 'Purpureus'											
foliage	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	AVG
80%	5.0	5.0	4.8	5.0	4.8	5.0	4.0	5.0	5.0	5.0	4.9
60%	4.3	5.0	5.0	5.0	5.0	5.0	3.8	5.0	5.0	5.0	4.8
40%	4.8	4.7	5.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0	4.9
20%	5.0	4.7	5.0	5.0	4.9	4.9	4.1	5.0	5.0	5.0	4.9
pest tolerance											
80%	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
60%	4.8	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
40%	4.8	4.8	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
20%	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
disease resistance											
80%	5.0	5.0	4.8	5.0	4.8	5.0		5.0	5.0	5.0	5.0
60%	4.6	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
40%	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
20%	5.0	5.0	5.0	5.0	4.9	5.0		5.0	5.0	5.0	5.0
vigor											
80%	4.0	4.5	3.8	4.0	4.4	4.3	3.8	4.3	3.8	4.3	4.1
60%	4.2	4.5	4.0	4.2	4.7	4.3	3.5	4.2	4.4	4.5	4.2
40%	4.5	4.5	4.0	4.8	4.6	4.7	3.8	4.2	4.2	4.2	4.3
20%	3.8	4.1	3.6	3.7	4.2	4.2	3.7	4.0	3.7	3.8	3.9
overall appearance											
80%	4.5	4.8	3.9	4.7	4.7	4.8	3.8	4.3	4.1	4.0	4.4
60%	4.3	4.7	4.3	4.5	4.9	4.8	3.8	4.6	4.1	4.0	4.4
40%	4.5	4.6	4.2	4.9	4.8	4.8	3.7	4.5	4.0	4.1	4.4
20%	4.3	4.3	4.0	4.2	4.7	4.6	3.5	4.3	4.1	4.0	4.2

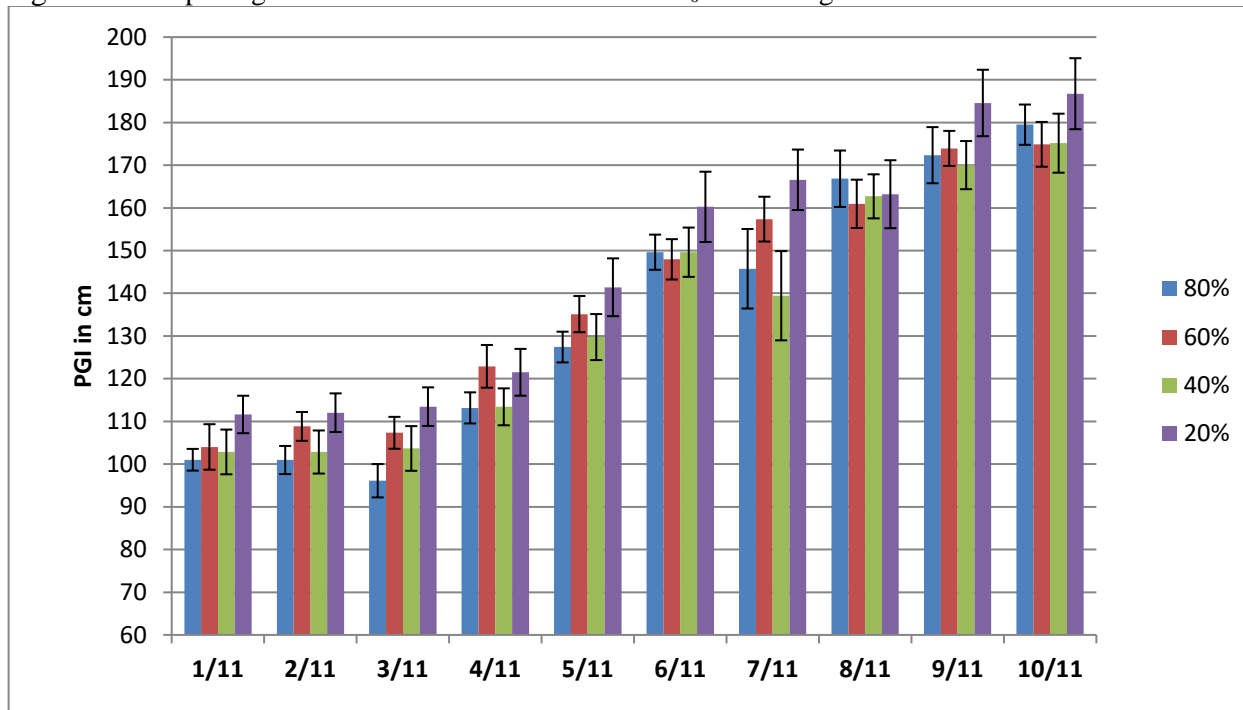
Table 22. Master Gardener quality average annual quality ratings for *Osmanthus heterophyllus* 'Purpureus'

<i>Osmanthus heterophyllus</i> 'Purpureus' Average Quality Ratings over 2 years in 5 Counties					
COUNTY	Nevada	Orange	Riverside	Santa Clara	SD- inland
Sunset Zone	7	23	18/19	15	22
Foliage	3.1	3.7	3.8	3.6	4.9
Insect Tolerance	5.0	5.0	5.0	4.4	5.0
Disease Resistance	4.8	4.8	5.0	4.8	5.0
Vigor	3.0	3.6	3.8	3.6	4.8
Overall Average	4.0	4.3	4.4	4.1	4.9

This species did not bloom during the 2-year trials period.

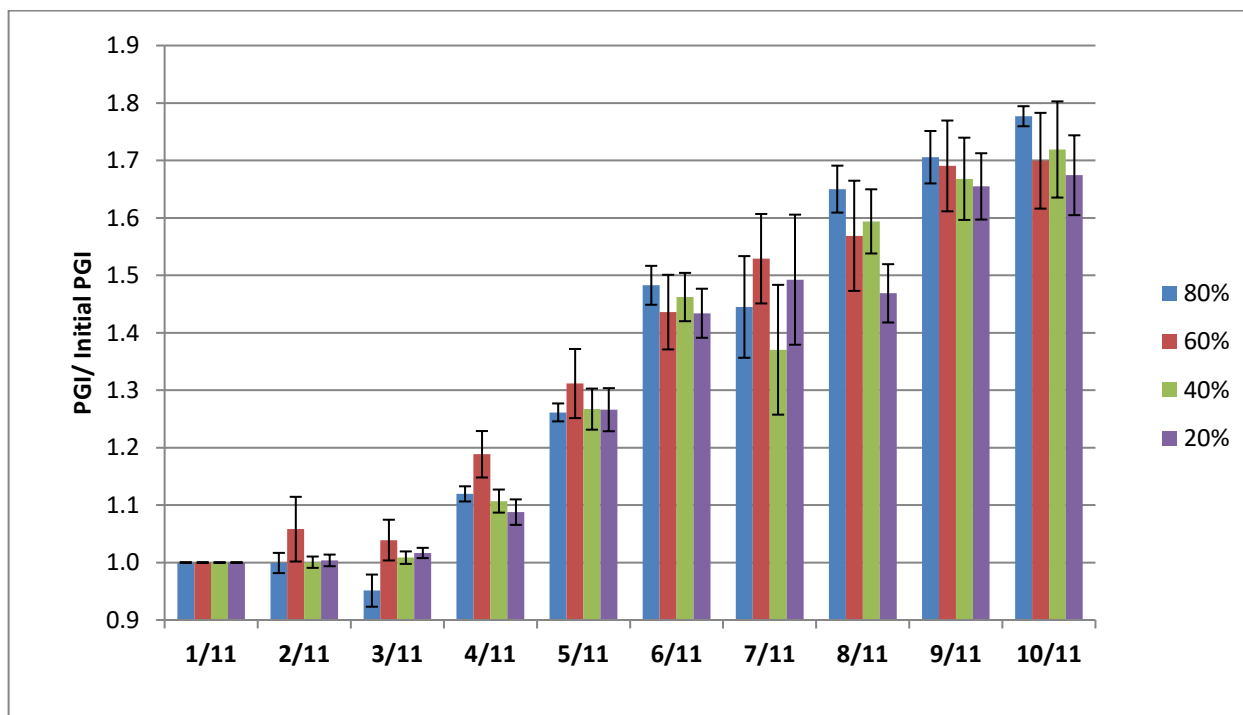
Ribes viburnifolium

Fig. 40. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Fig. 41. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Table 23. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels during 2011

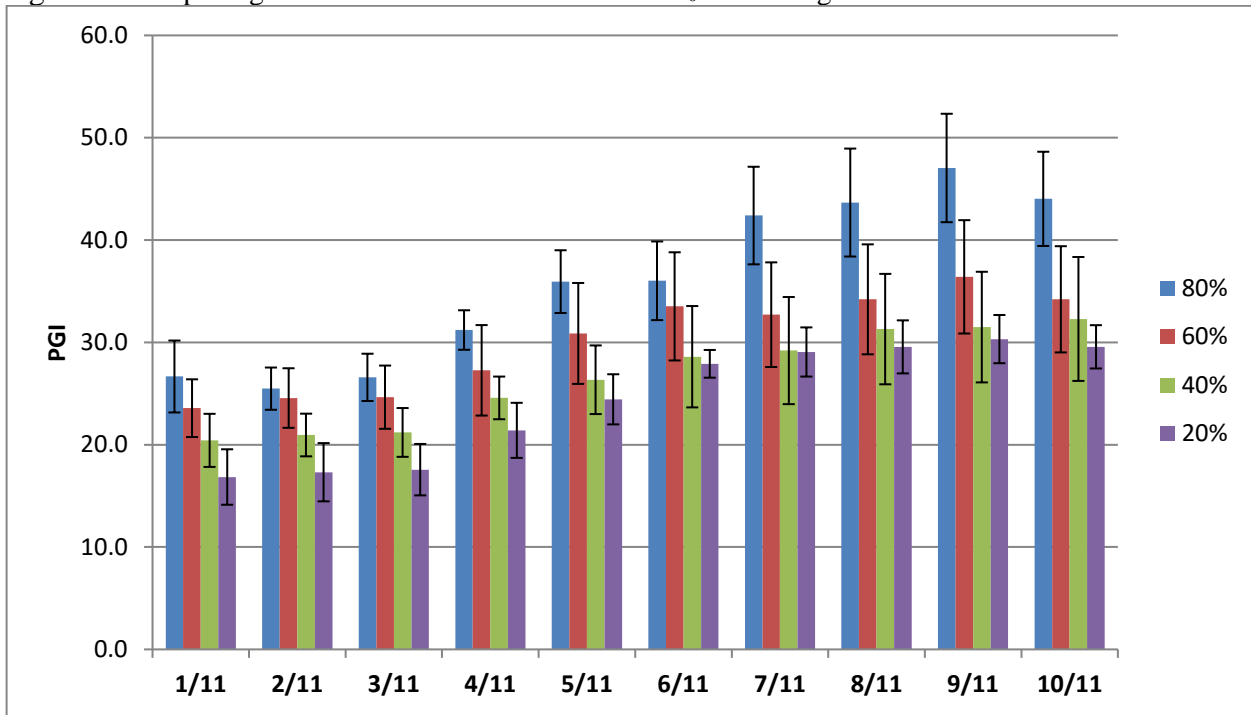
Ribes viburnifolium											
foliage	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	AVG
80%	5.0	5.0	5.0	5.0	4.5	4.4	3.8	4.6	4.8	4.9	4.7
60%	4.7	5.0	5.0	5.0	4.8	4.8	4.2	5.0	4.8	4.8	4.8
40%	4.6	5.0	5.0	5.0	4.8	4.9	4.1	4.7	4.8	4.9	4.8
20%	4.8	5.0	5.0	5.0	4.7	4.9	4.3	4.5	4.8	4.8	4.8
pest tolerance											
80%	5.0	5.0	5.0	5.0	4.8	4.8		5.0	5.0	5.0	5.0
60%	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
40%	4.8	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
20%	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
disease resistance											
80%	5.0	5.0	5.0	5.0	4.5	4.4		4.5	4.7	4.9	4.8
60%	4.8	5.0	5.0	5.0	4.8	4.8		5.0	4.8	4.8	4.9
40%	4.8	5.0	5.0	5.0	4.8	4.9		4.7	4.8	4.9	4.9
20%	4.8	5.0	5.0	5.0	4.7	4.9		4.5	4.8	4.8	4.8
vigor											
80%	4.7	4.7	4.8	4.8	5.0	5.0	4.2	5.0	5.0	5.0	4.8
60%	5.0	5.0	4.8	5.0	5.0	5.0	4.3	5.0	5.0	5.0	4.9
40%	4.9	4.3	4.7	4.8	5.0	4.9	4.2	5.0	5.0	5.0	4.8
20%	4.8	4.8	4.7	5.0	4.8	5.0	4.6	5.0	4.8	5.0	4.9
overall appearance											
80%	5.0	5.0	5.0	5.0	4.8	4.8	4.3	4.8	4.9	5.0	4.9
60%	4.7	5.0	4.9	5.0	4.8	4.9	4.4	5.0	4.9	4.8	4.9
40%	4.8	5.0	5.0	5.0	5.0	4.9	4.2	5.0	5.0	5.0	4.9
20%	4.8	4.9	4.9	5.0	4.9	5.0	4.3	4.9	4.9	5.0	4.9

Table 24. Master Gardener average annual ratings for *Ribes viburnifolium*

Ribes viburnifolium Quality Ratings in 10 Counties 2010 - 2011											
COUNTY	Alameda	Fresno	LA	Mariposa	Orange	Riverside	San Joaquin	Santa Clara	SD-coastal	Shasta	
Sunset Zone	9	8	20/21	7	23	18/19	14	15	24	9	
Foliage	4.3	4.3	4.6	3.8	4.6	3.4	4.3	4.0	4.4	3.3	
Flowering	2.0	2.5	3.1		3.5		1.0	1.0	3.0	2.0	
Insect Tol.	5.0	4.5	4.7	5.0	5.0	4.8	5.0	4.1	4.3	4.9	
Disease Res.	5.0	5.0	4.9	5.0	5.0	5.0	5.0	4.9	4.7	4.9	
Vibor	3.8	4.3	4.8	3.9	4.5	3.4	4.1	4.0	4.5	3.3	
Overall avg.	4.5	4.5	4.8	4.4	4.8	4.1	4.6	4.3	4.5	4.1	
Bloom period/highest rating	Feb/ 2.0	Feb-Mar/ 4.0	Jan-Mar/ 4.0	did not bloom	Dec-Mar/ 5.0	did not bloom	April/ 1.0	Mar-Apr/ 1.0	Jan/ 3.0	Feb-Apr/ 2.0	

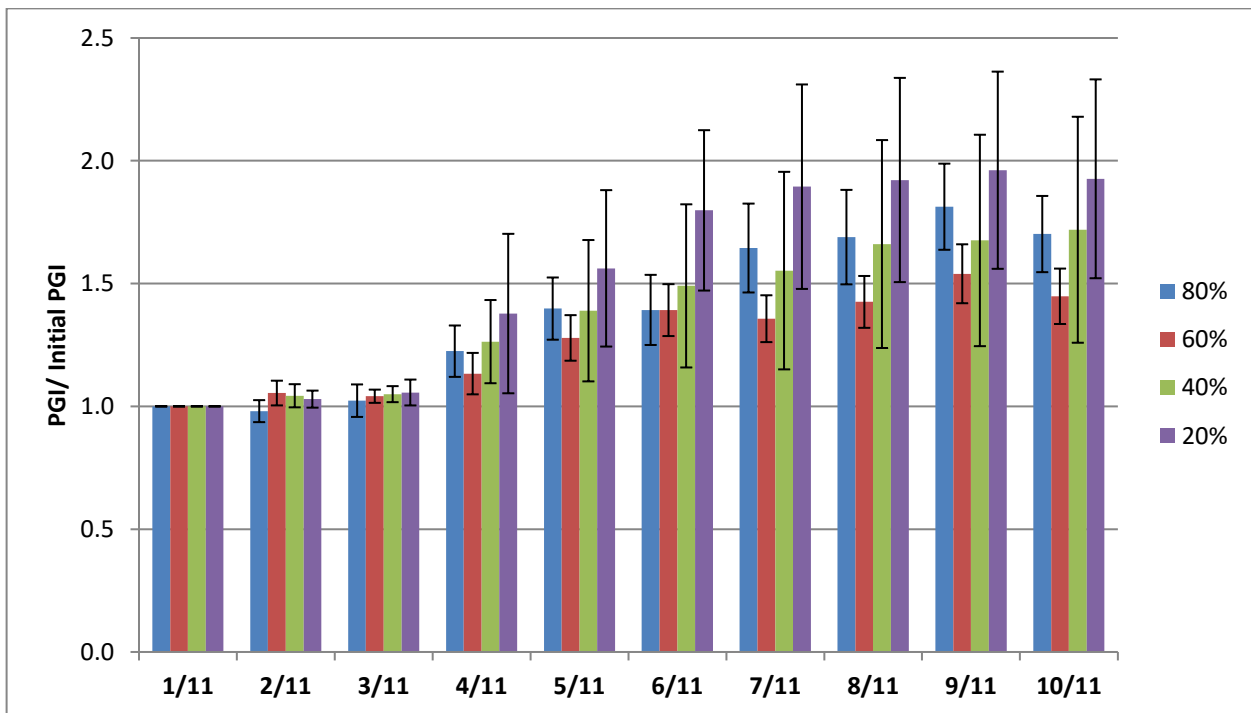
Woodwardia fimbriata

Fig. 42. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Fig. 43. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Table 25. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels during 2011

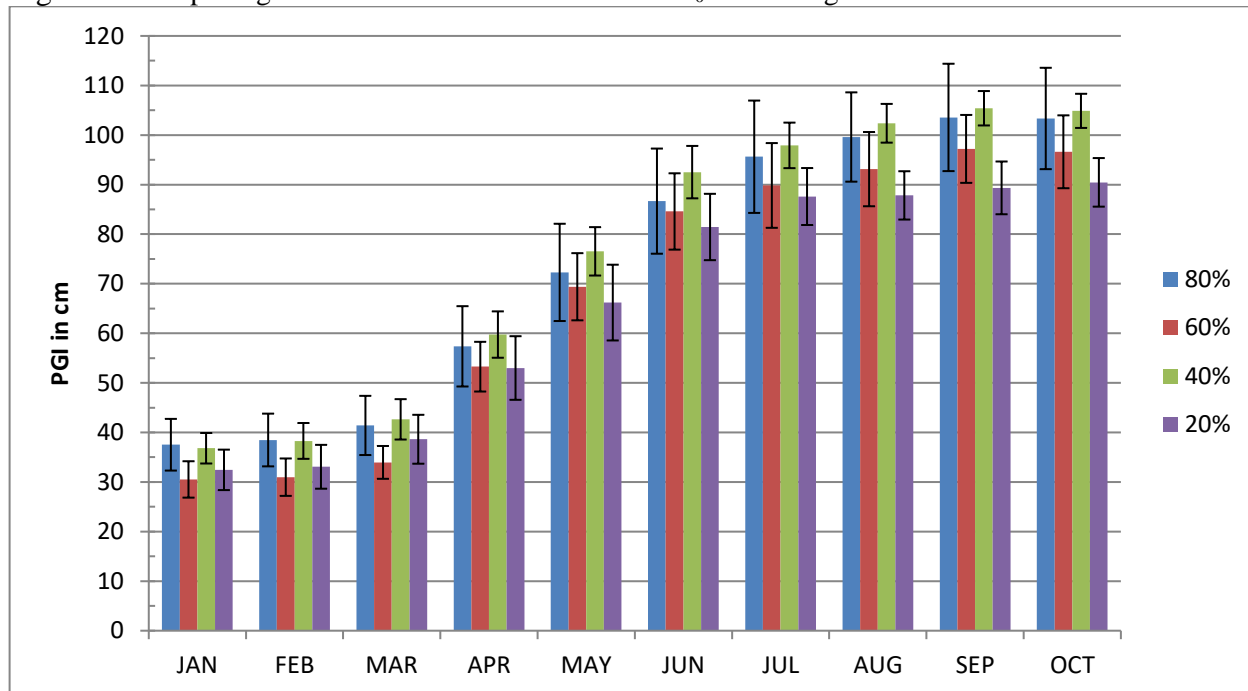
Woodwardia fimbriata											
foliage	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	AVG
80%	3.8	3.8	3.9	3.8	3.9	4.1	3.9	4.3	4.3	4.2	4.0
60%	3.6	3.1	3.0	2.9	3.3	4.0	3.6	3.8	3.8	3.7	3.5
40%	2.8	3.6	3.1	3.2	3.3	3.8	3.9	4.2	3.9	4.3	3.6
20%	3.0	2.8	2.8	2.6	3.6	4.2	3.6	4.0	3.6	3.6	3.4
pest tolerance											
80%	4.7	4.8	5.0	5.0	5.0	5.0		5.0	5.0	5.0	4.9
60%	4.8	4.3	5.0	3.8	5.0	5.0		5.0	5.0	5.0	4.8
40%	5.0	4.8	4.0	3.6	5.0	5.0		5.0	5.0	5.0	4.7
20%	5.0	4.0	4.3	4.3	5.0	5.0		5.0	5.0	5.0	4.7
disease resistance											
80%	3.8	3.8	3.7	3.8	3.7	4.1		4.3	4.1	4.2	3.9
60%	3.7	3.0	2.9	2.7	2.8	3.9		3.6	3.8	3.7	3.3
40%	2.6	3.0	3.0	3.2	3.2	3.7		4.2	3.9	4.3	3.5
20%	2.8	3.0	2.8	2.4	3.9	4.2		3.5	3.5	3.6	3.3
vigor											
80%	3.7	3.8	4.2	3.8	4.2	4.2	3.8	4.5	4.3	4.5	4.1
60%	3.7	2.9	3.2	3.3	3.2	3.5	3.3	4.2	3.4	3.3	3.4
40%	2.5	2.4	3.0	2.6	2.6	2.9	2.8	3.5	3.1	3.2	2.9
20%	1.8	2.0	2.4	2.4	3.0	3.8	3.6	2.9	2.8	3.0	2.8
overall appearance											
80%	3.7	3.8	3.8	3.8	3.9	4.0	3.7	4.3	4.2	4.3	3.9
60%	3.5	2.9	3.1	2.8	3.0	3.8	3.2	3.8	3.6	3.3	3.3
40%	2.7	3.0	2.8	2.9	2.9	3.3	2.8	4.0	3.2	3.8	3.1
20%	2.5	2.5	2.5	2.4	3.4	3.9	3.1	3.3	3.3	3.5	3.0

Table 26. Master Gardener average annual ratings for *Woodwardia fimbriata*

Woodwardia fimbriata Quality Ratings over 2 years in 9 Counties									
COUNTY	Fresno	LA	Mariposa	Nevada	Orange	Riverside	Santa Clara	SD-coastal	Shasta
Sunset Zone	8	20/21	7	7	23	18/19	15	24	9
Foliage	4.0	4.6	2.6	3.8	4.1	1.5	3.5	3.3	3.1
Insect Tol.	4.9	5.0	5.0	5.0	5.0	3.0	5.0	4.1	4.9
Disease Res.	4.9	5.0	5.0	5.0	5.0	3.0	4.9	4.3	4.9
Vigor	4.1	4.5	2.6	3.9	4.1	1.5	3.4	3.3	3.2
Overall avg	4.4	4.8	3.8	4.4	4.6	2.3	4.2	3.8	4.1

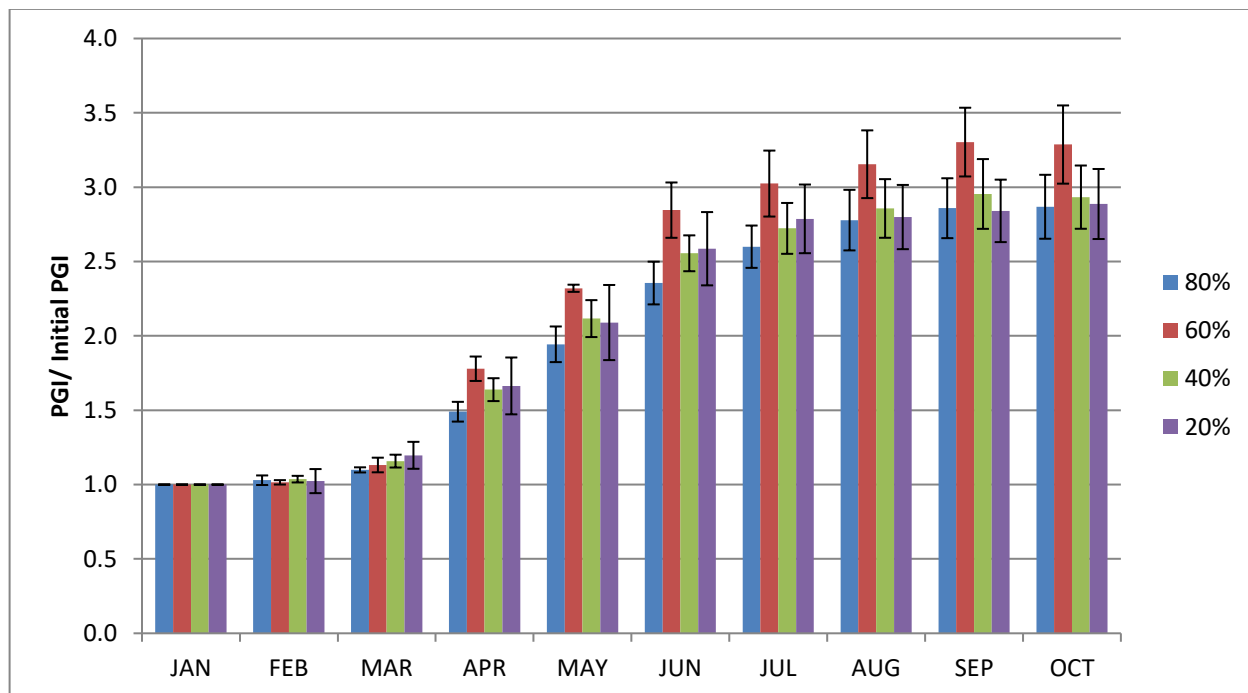
SHADE- Ball Ornamentals
***Abelia* ‘Sunshine Daydream’**

Fig. 44. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE

Fig. 45. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



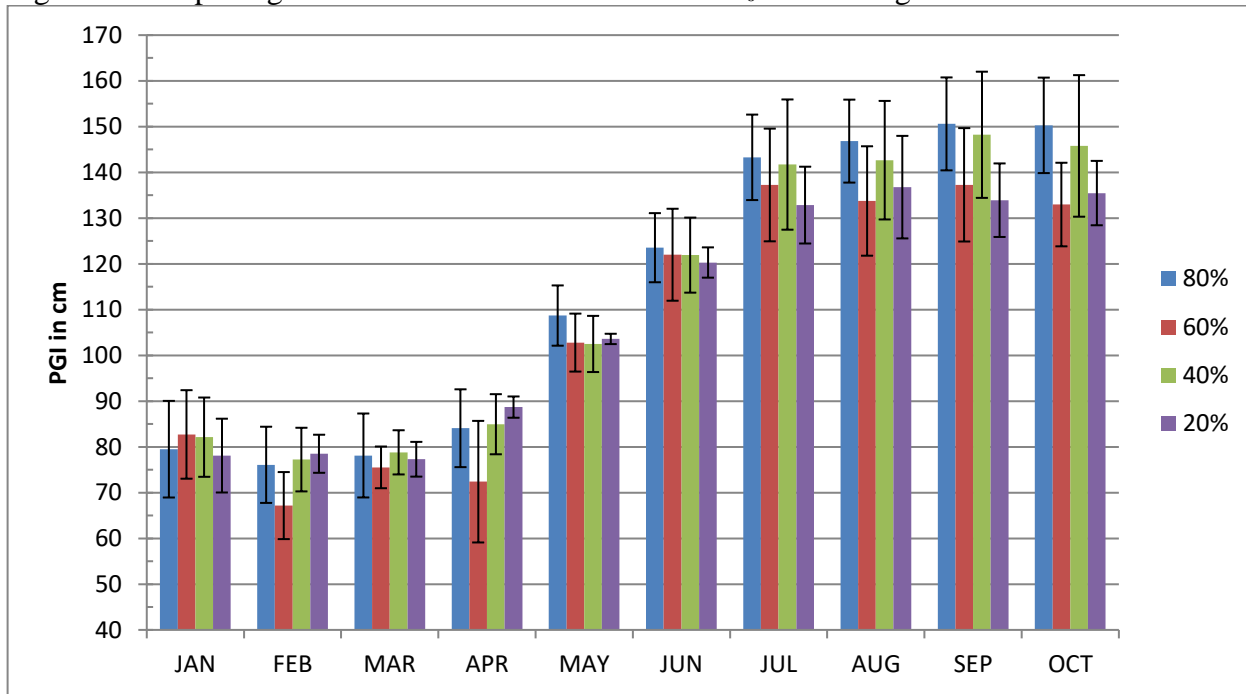
Error bars represent ± 1 SE

Table 27. Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels during 2011

Abelia 'Sunshine Daydream'											
foliage	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	AVG
80%	5.0	4.8	5.0	5.0	5.0	5.0	4.0	4.0	4.3	5.0	4.7
60%	5.0	5.0	5.0	5.0	5.0	5.0	4.1	4.2	4.3	5.0	4.8
40%	4.8	4.9	5.0	5.0	5.0	5.0	4.0	4.0	4.0	5.0	4.7
20%	4.7	4.8	5.0	5.0	5.0	5.0	4.0	4.2	4.1	4.8	4.7
flowering											
80%							2.5	3.2	3.1	1.3	2.5
60%							2.0	2.8	2.8	2.1	2.4
40%							2.9	2.8	2.0	1.0	2.2
20%							2.0	2.8	2.0	1.5	2.1
pest resistance											
80%	4.8	4.8	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
60%	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
40%	4.8	4.8	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
20%	4.8	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
disease resistance											
80%	5.0	5.0	5.0	5.0	5.0	5.0		4.0	4.3	5.0	4.8
60%	5.0	5.0	5.0	5.0	5.0	5.0		4.0	4.3	5.0	4.8
40%	5.0	5.0	5.0	5.0	5.0	5.0		4.0	3.8	5.0	4.8
20%	5.0	5.0	5.0	5.0	5.0	5.0		4.2	4.1	4.8	4.8
Vigor											
80%	4.3	4.6	4.3	4.2	4.7	4.7	3.7	4.8	4.8	4.8	4.5
60%	4.2	4.2	4.0	4.2	4.6	4.5	3.8	4.7	4.7	4.5	4.3
40%	4.7	4.7	4.3	4.3	4.8	4.8	4.0	5.0	4.7	4.8	4.6
20%	4.2	4.3	4.0	4.3	4.5	4.7	3.8	4.8	4.2	4.2	4.3
overall appearance											
80%	4.8	4.8	4.6	4.6	4.9	5.0	3.3	4.5	4.3	4.1	4.5
60%	4.6	4.5	4.5	4.5	4.9	5.0	3.5	4.4	4.2	3.9	4.4
40%	4.8	4.8	4.6	4.8	4.9	5.0	3.7	4.3	3.9	4.0	4.5
20%	4.5	4.8	4.3	4.7	4.8	4.8	3.6	4.3	4.0	4.0	4.4

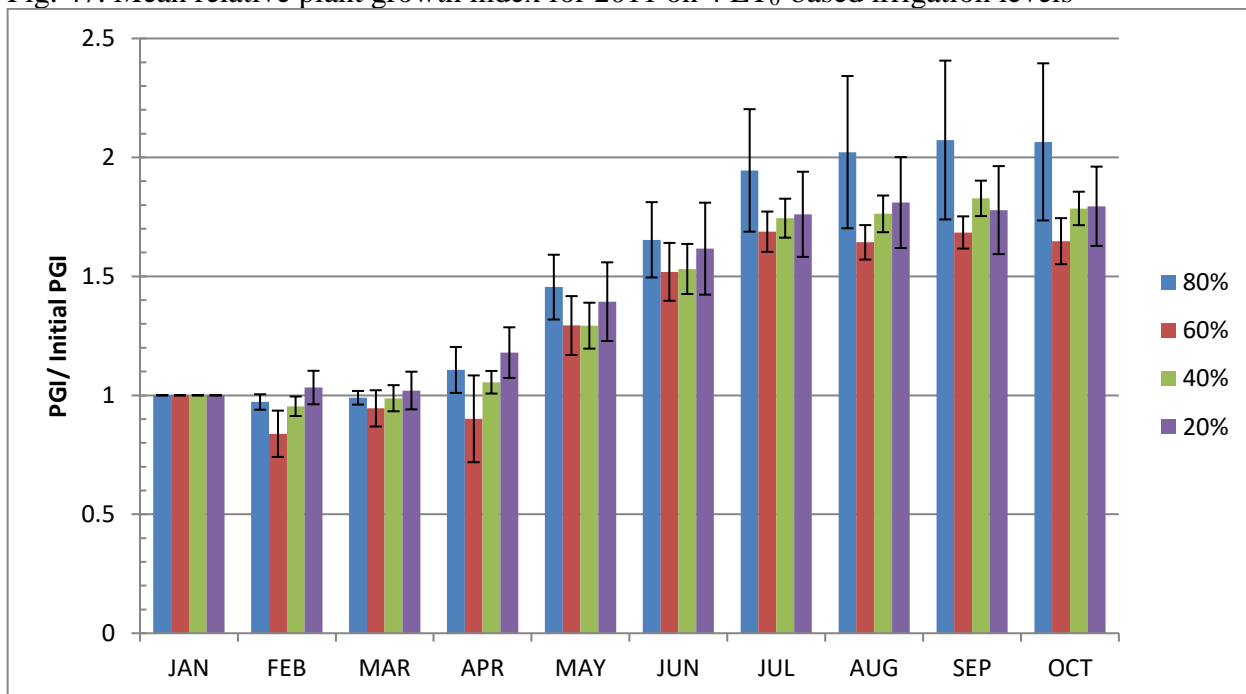
***Hypericum* 'Red Ignite'**

Fig. 46. Mean plant growth index in cm for 2011 on 4 ET₀- based irrigation levels



Error bars represent ± 1 SE.

Fig. 47. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



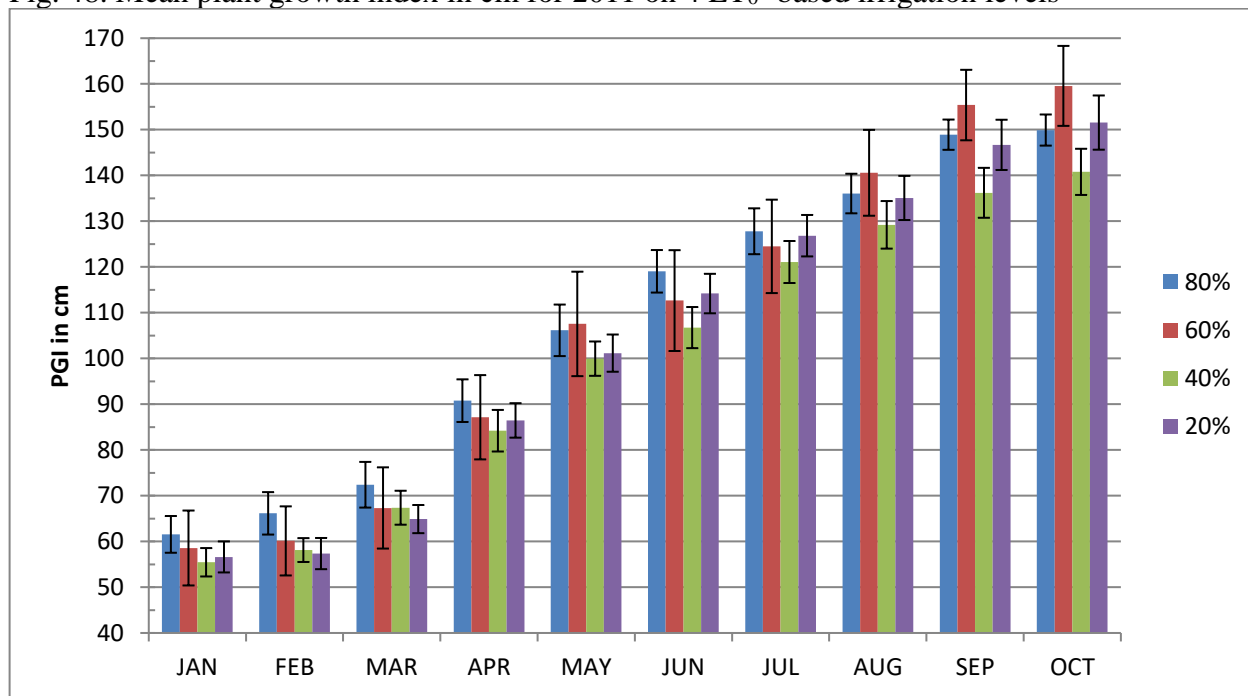
Error bars represent ± 1 SE.

Table 28. 2010-2011 Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels

<i>Hypericum 'Ignite Red'</i>											
foliage	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	AVG
80%	4.0	3.7	4.0	4.0	4.2	4.3	3.8	4.3	4.2	4.1	4.1
60%	4.0	3.9	3.6	3.9	4.2	4.5	4.0	4.0	4.8	4.4	4.1
40%	3.8	3.7	3.4	4.0	4.2	4.4	3.9	4.6	4.3	4.2	4.1
20%	4.4	3.8	3.8	4.0	4.4	4.7	3.9	4.8	4.3	4.5	4.3
flowering											
80%	2.5				2.8	2.4	2.9	2.0	2.5	1.5	2.4
60%	2.0				2.9	1.9	2.7	1.6	1.5	1.0	1.9
40%	2.0				2.2	2.6	3.3	2.0	2.0	1.0	2.1
20%	1.3				3.3	2.4	2.9	2.0	1.0	1.0	2.0
pest resistance											
80%	4.7	4.5	3.8	4.8	4.5	4.9		4.5	4.8	4.8	4.6
60%	4.8	4.6	4.2	4.5	4.8	5.0		4.8	5.0	4.8	4.7
40%	4.9	4.5	3.7	4.8	5.0	4.9		5.0	5.0	5.0	4.8
20%	4.7	4.4	4.2	5.0	4.8	4.7		4.8	4.8	5.0	4.7
disease resistance											
80%	3.9	3.7	3.5	4.0	4.0	4.6		4.3	4.2	4.1	4.0
60%	4.2	3.7	3.6	3.6	4.4	4.5		4.0	4.8	4.4	4.1
40%	3.8	3.3	3.3	4.0	3.8	4.4		4.6	4.3	4.2	4.0
20%	4.5	4.0	3.8	3.6	4.4	4.8		4.8	4.3	4.5	4.3
vigor											
80%	4.5	4.5	4.5	4.7	4.7	4.8	4.3	5.0	4.6	4.5	4.6
60%	4.8	4.7	4.6	4.6	4.8	5.0	4.4	4.5	4.6	4.6	4.7
40%	4.6	4.7	4.7	4.7	4.5	4.7	4.7	4.7	4.5	4.6	4.6
20%	4.4	4.7	4.8	4.8	4.9	4.9	4.5	5.0	4.4	4.4	4.7
overall appearance											
80%	4.1	3.8	3.7	4.0	4.3	4.5	3.9	4.5	4.1	3.8	4.1
60%	4.0	4.0	3.8	3.8	4.3	4.5	4.0	4.0	4.1	3.9	4.0
40%	3.9	3.7	3.7	3.6	4.1	4.4	3.9	4.3	4.3	3.8	4.0
20%	4.3	4.0	3.8	3.9	4.4	4.9	4.0	4.7	4.3	3.9	4.2

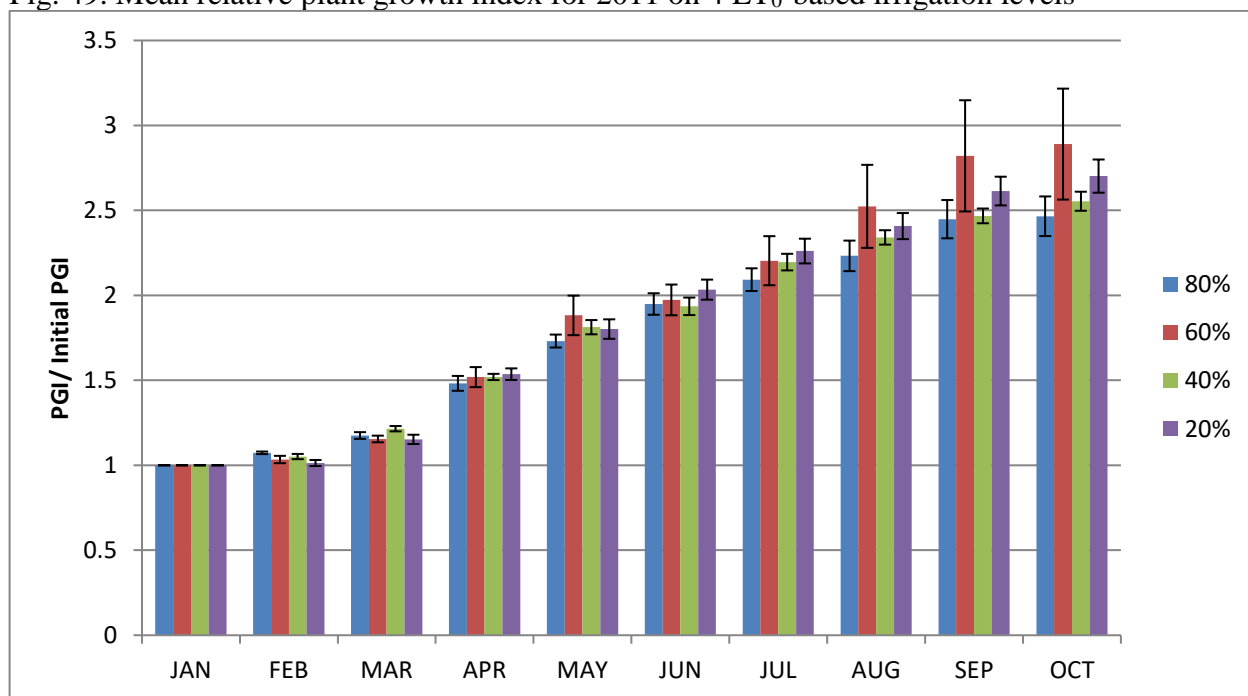
Ligustrum 'Sunshine'

Fig. 48. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE.

Fig. 49. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



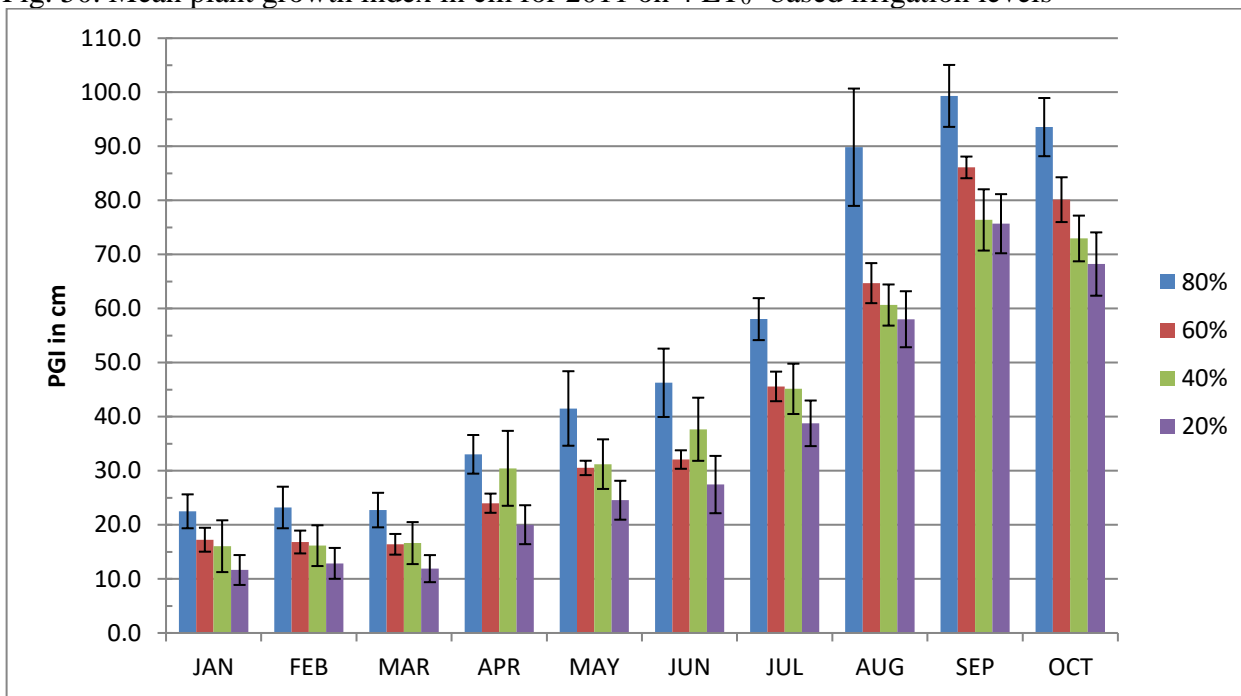
Error bars represent ± 1 SE.

Table 29. 2010-2011 Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels

<i>Ligustrum sinense</i> 'Sunshine'											
foliage	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	AVG
80%	5.0	5.0	5.0	5.0	5.0	5.0	4.0	4.9	5.0	5.0	4.9
60%	5.0	5.0	5.0	5.0	4.8	5.0	4.0	5.0	4.9	5.0	4.9
40%	4.7	5.0	5.0	5.0	4.9	5.0	4.1	5.0	4.9	5.0	4.9
20%	4.7	4.8	5.0	5.0	5.0	5.0	4.3	5.0	5.0	5.0	4.9
pest resistance											
80%	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
60%	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
40%	4.7	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
20%	5.0	4.8	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
disease resistance											
80%	5.0	5.0	5.0	5.0	5.0	5.0		4.9	5.0	5.0	5.0
60%	5.0	5.0	5.0	5.0	4.8	5.0		5.0	4.9	5.0	5.0
40%	4.7	5.0	5.0	5.0	5.0	5.0		5.0	4.9	5.0	5.0
20%	4.8	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0
vigor											
80%	4.6	4.6	4.6	4.8	4.8	4.5	4.1	4.8	4.8	4.4	4.6
60%	4.3	4.7	4.6	4.8	4.7	4.8	4.3	4.8	4.8	4.9	4.7
40%	4.3	4.2	4.5	4.7	4.5	4.5	4.0	4.3	4.5	3.8	4.3
20%	3.8	4.3	4.3	4.8	4.8	4.3	4.0	4.3	4.7	4.3	4.4
overall appearance											
80%	4.8	5.0	5.0	5.0	5.0	5.0	4.1	5.0	5.0	5.0	4.9
60%	4.7	4.9	4.9	5.0	4.8	5.0	4.2	5.0	5.0	5.0	4.9
40%	4.5	4.7	4.8	5.0	4.9	5.0	3.8	5.0	5.0	5.0	4.8
20%	4.3	4.8	4.8	5.0	5.0	5.0	4.2	5.0	5.0	5.0	4.8

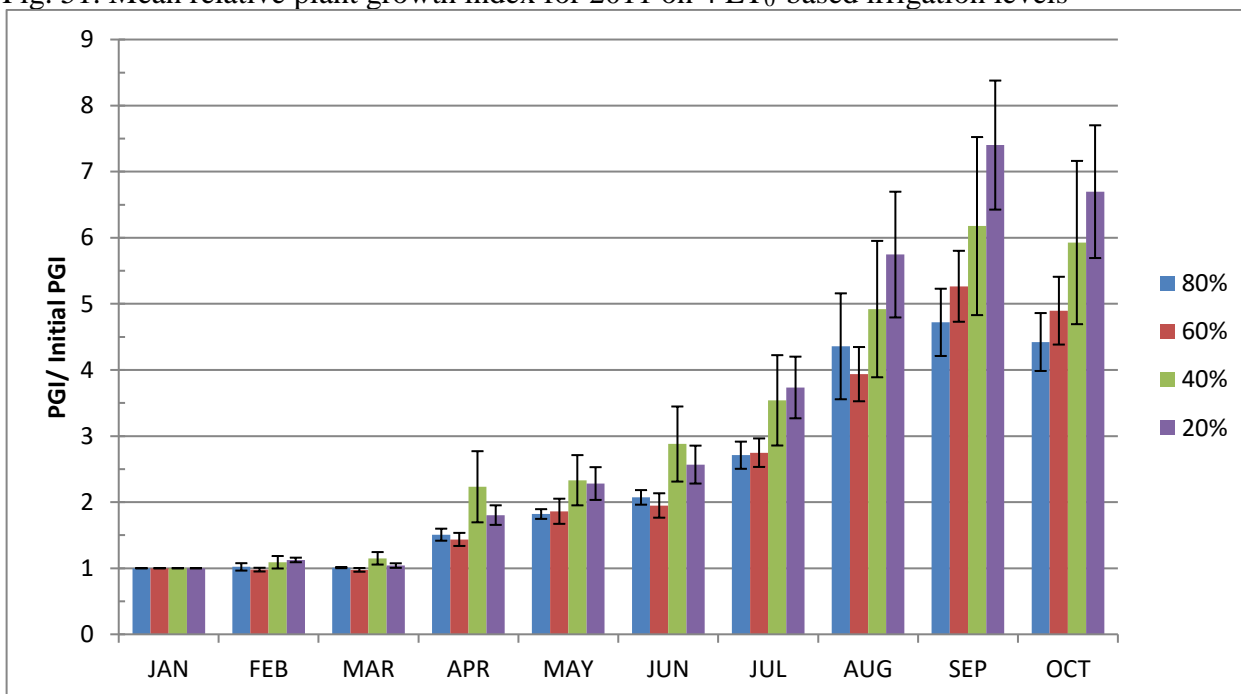
***Trachelospermum* ‘Star of Toscane’**

Fig. 50. Mean plant growth index in cm for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE.

Fig. 51. Mean relative plant growth index for 2011 on 4 ET₀-based irrigation levels



Error bars represent ± 1 SE.

Table 30. 2010-2011 Mean quality ratings in 6 categories on 4 ET₀-based irrigation levels

<i>Trachelospermum jasminoides</i> 'Star of Toscane'											
foliage	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	AVG
80%	2.9	3.1	2.7	2.9	4.4	4.2	4.0	4.8	4.7	5.0	3.9
60%	3.2	2.8	2.8	2.7	4.4	4.0	4.0	5.0	5.0	4.9	3.9
40%	2.8	2.4	3.1	2.6	4.1	4.0	4.0	5.0	4.7	5.0	3.8
20%	2.8	2.2	2.1	2.4	4.6	4.0	4.0	5.0	5.0	5.0	3.7
flowering											
80%					1.0	1.5	2.0	1.0	1.0		1.3
60%					1.0	1.0		1.2	1.5	1.0	1.1
40%					2.0	1.5	3.4	1.0	1.0	1.0	1.7
20%					1.0		2.0	1.0	1.0	1.0	1.2
pest resistance											
80%	2.8	3.3	2.8	2.8	4.8	4.3		5.0	4.9	5.0	4.0
60%	3.2	2.8	2.8	2.7	4.8	4.0		5.0	5.0	4.9	3.9
40%	3.1	2.6	3.1	2.8	4.8	4.0		5.0	5.0	5.0	3.9
20%	3.0	2.6	2.2	2.4	5.0	4.0		5.0	5.0	5.0	3.8
disease resistance											
80%	3.6	3.3	2.9	3.0	4.8	4.5		4.8	4.9	5.0	4.1
60%	3.4	3.4	2.8	3.2	4.6	4.4		5.0	5.0	5.0	4.1
40%	3.2	2.4	3.2	2.8	4.2	4.2		5.0	4.7	5.0	3.9
20%	3.0	2.4	2.2	2.6	4.6	4.4		5.0	5.0	5.0	3.8
vigor											
80%	3.1	2.7	2.9	2.8	4.7	4.5	4.2	5.0	4.9	4.8	4.0
60%	2.2	2.4	2.4	2.6	3.8	3.5	3.9	4.6	4.4	3.8	3.4
40%	2.0	2.6	2.6	2.4	4.0	4.0	3.6	4.5	4.1	4.1	3.4
20%	1.6	1.7	2.0	2.0	3.3	3.1	3.5	4.0	3.5	3.4	2.8
overall appearance											
80%	2.9	2.8	2.7	2.8	4.6	4.2	4.1	5.0	4.7	5.0	3.7
60%	2.9	2.6	2.6	2.6	4.1	3.7	3.5	4.6	4.7	4.2	3.6
40%	2.5	2.4	2.6	2.5	4.0	3.8	3.4	4.6	4.4	4.1	3.6
20%	2.2	2.0	2.0	2.1	3.9	3.5	3.3	4.4	4.2	3.6	3.5