Final Report
Saratoga Horticultural Research Endowment
2013-2015

Ornamental plant trials for the new California landscape: Evaluating industry introductions for sustainable characteristics on reduced water

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Executive Summary

In these trials 16 perennial landscape plant species, (9 new cultivars and 7 underutilized species/cultivars), were evaluated for overall performance on a range of reduced irrigation levels in clay loam soil in the hot interior Central Valley of California. All plants were grown in-ground for 2 years; 12 of the species in full sun and 4 under 50% shade. Planting in October 2013 was followed by an establishment period of irrigation at 80%-100% of reference evapotranspiration (ET_0) and 25% management allowable depletion through April 2015. Plants were then subjected to 1 of 4 different levels of reduced irrigation at 20%, 40%, 60%, or 80% of ET_0 during the dry season through the first week of October 2015. During the deficit irrigation season they were evaluated across treatments for growth, health and vigor, overall appearance, flowering, pest tolerance, and disease resistance. From these assessments, irrigation recommendations are made for their use in the landscape.

Introduction

Plant performance trials are a critical step in the introduction and promotion of new or unfamiliar ornamental plants. Research by these investigators and others have shown that plants in landscapes will survive and even thrive on much less than expected irrigation levels, but finding the optimal range of irrigation may make the difference between acceptable appearance and plant failure (Reid, et al, 2012, 2013; Shaw and Pittenger, 2004). Most ornamental plant trials provide a high-maintenance environment (fertilizers, pest control, and ample water) to remove all outside obstacles to plant performance (Plant Trials Database, 2014). Only in the west have plant trials focused on more rigorous growing conditions such as reduced water and no chemical inputs (Hilaire, et al. 2008).

Since California has enacted the Water Efficient Landscape Ordinance (WELO) and subsequent revision related to the drought, it has become incumbent upon landscape managers and homeowners to be more aware of how much water plants really need in order to preserve the aesthetic and ecosystem services of urban landscapes in the most conservatively irrigated manner

possible. Currently, the most effective tool widely available for estimating the water needs of landscape plants, and to which WELO refers, is the UCANR-hosted website *Water Use Classification of Landscape Species* (WUCOLS IV, 2014). In order to make our research compatible with the WUCOLS-style of plant water use classification, we have geared our trials to water usage levels corresponding to reference evapotranspiration, or ET_0, the total amount of water lost from a reference plant (well-watered tall fescue turfgrass) and the surrounding soil. This is the same reference used by WUCOLS in its classifications of water-use ranges corresponding to low, moderate or high water use. The results then become easily translated into useful recommendations on plant water use for these new varieties as they enter the marketplace.

The plants in this trial reflect the direction we have taken since their inception to engage the nursery industry in gearing their programs toward the sustainable landscape market in the West, and to build on the value the trials offer to the grower, retailer, and landscape end-user. We have enhanced this engagement by presenting the trials at a variety of venues, showcasing our method of irrigation and the best of the low-water plants we have evaluated. We have also begun and expanded our Open House Ratings Days during the last two years where a variety of clientele join us in the field to rate the trials plants (at the beginning, middle, and end of the trial period) and have an informal dialog with us about landscape plants and their irrigation needs. At our final event this year at the end of September we had 48 participants from the following fields: academia, breeding, wholesale nursery, retail nursery, landscape design, landscape architecture, landscape maintenance and construction, city parks, 2 school districts, public gardens, and UC Master Gardeners. Dave Fujino's role with the California Center for Urban Horticulture has continued to be vital in connecting us with both growers and outreach opportunities. Below are examples of events where the PI has presented and the Saratoga Horticultural Endowment has been featured as the sponsor of this research just in the last year.

June 2016, *Ornamental plant trials for the sustainable urban landscape: Evaluating performance on reduced water*, ISHS 6th International Symposium on Landscape & Urban Horticulture, Athens, Greece.

May 2016, *Low-water Use Plant Choices & UC's Reduced Water Plant Performance Trials*, California Landscape Contractors Sierra Chapter Meeting, Modesto, CA.

March 2016, *Beautiful Plants for Low-Water Landscapes*, Cuyamaca College Sustainable Landscape & Turf Conference, El Cajon, CA.

October 2015, *Low-water Plants for Central Valley Landscapes,* Resilient Landscaping Workshop, Fresno, CA.

August 2015, *UC Landscape Plant Irrigation Trials: evaluating new introductions on reduced irrigation for summer-dry climate,* 3rd International Plant Trials Conference in conjunction with the Far West Trade Show, Portland, OR.

June 2015, *UC Landscape Plant Irrigation Trials* and *Karrie's Favorites: Great Low-water Plants,* Orange County Master Gardener Continuing Education class. Irvine, CA.

May 2015, *Plants for a Low-water Landscape*, San Diego County Water Authority, 2 one-day workshops on landscape water conservation for agency personnel, UC Master Gardeners, and landscape professionals, San Diego, CA.

May 2015, *Staying Green in a Drought*, keynote presentation for the Northern California Community Association Institute annual educational meeting, Stockton, CA.

Research Methods

In October 2013, most species were planted in the UC Davis trials field which has clay loam soil and is in USDA zone 9, *Sunset* zone 14 (Table 1). The three *Phlox* cultivars and the *Westringia* 'Sorrento Coast' were planted in spring 2014, as it was deemed advisable to give these potentially frost-tender cultivars a warm growing season before going into winter. Twenty-four plants of each cultivar or species were placed 2 meters apart in rows 2 meters apart. The rows were covered with 3 inches of bark mulch, and 2 2-gallon/hour drip emitters were laid beneath the mulch in the root zone of each plant. Plants were placed according to a randomized complete block pattern in two blocks to provide 6 of each species on each of the 4 irrigation treatments.

The irrigation was based on percentages of reference evapotranspiration, or ET_0, as described in Water Use Classification of Landscape Species IV (WUCOLS IV, 2014.) All plants were given water at 80% - 100% of ET_0 during the first year and a half to encourage establishment of a deep, healthy root system. During the subsequent irrigated growing season (May through October 2015), all of the plants received the same amount of water when irrigated to replace 43% of the soil's water holding capacity (the percentage of plant available water in a silty clay loam at field capacity), but how often they received it was determined by their designated water-use percentage of ET_0. The hypothesis is that plants using water at a particular percentage of ET_0 will take longer to use up the plant available water in the soil, provided water loss to evaporation is minimized with mulch. Data from the local UC Davis California Irrigation Management System station (CIMIS) was used in a water budget to determine the irrigation timing for each treatment (http://wwwcimis.water.ca.gov/).

The percentages of ET_0 used in this trial were 20% (low), 40% (moderate-low), 60% (moderate), and 80% (high). The frequency of irrigation for 2015 is shown in Table 2.

Plant width, length, and height measurements were taken monthly. A plant growth index (PGI) was calculated to quantify the growth of plants under different irrigation levels using the formula [(l +w)/2 +h]/2, where *l*, *w*, and *h* represent length, width, and height of the plant (Irmak, Suet et al, 2004). To account for differences in plant size not related to irrigation differences, a relative PGI was calculated for each plant each month during the deficit irrigation treatments using the formula PGI_m/PGI_i, where PGI_i stands for the initial PGI, and PGI_m stands for the specific monthly PGI. Means across treatments were compared using ANOVA and Tukey's HSD.

Qualitative performance ratings (on a scale of 1-5) were taken monthly in the following categories: foliage appearance, flowering abundance, pest tolerance, disease resistance, vigor, and overall appearance (the "WOW" factor). A description of the ratings is shown in Table 3.

Table 1. Irrigation trials plants for 2013-2015

2013-2015	**FULL SUN**	
Cooperator	**Botanical name**	**Common name**
San Marcos Growers	*Chondropetalum tectorum*[1]	Small cape rush
	Solanum xanti 'Mountain Pride'*	Purple nightshade
Tuffy Plants	*Dianella caerulea* 'DBB03' Cassa Blue™	Blue flax lily
	Lomandra longifolia 'LM300' Breeze™	Dwarf mat rush
Tree of Life Nursery	*Prunus ilicifolia**	Holly-leaved cherry
	*Rhus ovata**	Sugar bush
EuroAmerican	*Phlox* Paparazzi 'Adele'[2]	Creeping phlox Paparazzi series
	Phlox Paparazzi 'Jagger'[2]	
	Phlox Paparazzi 'Levine'[2]	
NewFlora/Kordes Roses	*Rosa* 'Cream Veranda'®	Cream Veranda® rose
	Rosa 'Kardinal™ Kolorscape'®	Kardinal™ Kolorscape® rose
Ball Ornamentals	*Westringia hybrida* 'Gem Variegated'[2]	*Westringia* Sorrento Coast
	SHADE	
San Marcos Growers	*Correa pulchella* 'Pink Eyre'	Pink Australian fuchsia
	Dianella caerulea 'King Alfred'	Blue flax lily
	Ribes viburnifolium 'Spooners Mesa'*	San Diego evergreen currant
Ball Ornamentals	*Lomandra* 'Lomlon'	Lomandra 'Lime Tough'

1. Replacement plants were incorrectly labeled (were in fact *Chondropetalum elephantinum; see discussion*); uneven numbers and different species did not allow statistical analysis
2. Plants did not survive winter in large enough numbers to perform any analysis.

* Denotes CA native/native cultivar

Table 2. 2015 Deficit Irrigation Frequency Details – May to October 2015

Irrigation % of ET_0	# of Irrigations	Dates of Irrigation	Total water applied (in.)
SUN			
80	11	5/7, 5/23,6/5, 6/18, 7/1, 7/13, 7/25, 8/9, 8/22, 9/7, 9/24	30
60	8	5/12, 6/2, 6/18, 7/5, 7/22, 8/9, 8/27, 9/19	22
40	5	5/23, 6/18, 7/14, 8/9, 9/8	13.7
20	2	6/23, 8/11	5.5
SHADE			
80	4	5/13, 6/14, 7/15, 8/26	11
60	3	5/25, 7/5, 9/6	8.2
40	2	6/17, 9/8	5.5
20	1	9/27	2.7

Table 3. Description of quality ratings

RATING	5	4	3	2	1
Foliage	perfect to excellent; plant is in full leaf with no signs of leaf burn, disease or insect damage, and has an appealing shape and uniformity	same as 5 except for minor tip burn, edge damage, or minor damage to only a few leaves that does not much affect the overall appearance	acceptable but not its best; non-uniform; minor damage to all leaves that is less evident from a distance, or severe damage to no more than 25% of plant	unacceptable; moderate damage to most of the plant or major damage to more than 25%; plant is declining and may not recover; may be extremely non-uniform	unacceptable; close to dead
Flowering	full, glorious bloom; the height of bloom for the species	61-80% of plant in bloom	41-60% of plant in bloom	21-40% of plant in bloom	1 bloom open to 20% in bloom
Pest Tolerance/ Disease Resistance	no visible damage	minor to moderate damage to one or two leaves or stems, or only very minor damage to a few leaves (<25%)	minor damage to many of the leaves or flowers; appearance still acceptable from a distance (25-50%)	major damage ; appearance unacceptable (51-75%)	severely damaged and probably dying (>75% affected)
Vigor	pushing out a lot of new growth from every growing point	pushing out new growth from many growing points	Plant is surviving and healthy, but not pushing out much new growth, if any	Plant is very small for the species or unhealthy, and declining	Plant is barely alive; close to death
Overall Appearance	An impressive plant; everything works 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.	a very attractive plant; may be a 5 when in bloom, or just a very nice species that lacks the WOW factor or is not quite at its prime	Acceptable but nothing special; may be past or not quite to its prime; might be better if more uniform; may be described as an 'okay' plant.	unacceptable for any of the above reasons	completely unacceptable and not likely to improve

Results and Discussion

Table 4 summarizes the average overall appearance ratings at each irrigation level for each species. Unless flowering is compromised, the combination of highest rating and lowest irrigation level is the recommended rate of irrigation for that species. Where there were no significant differences between treatments for the overall appearance ratings, the range of irrigation levels that produced ratings ≥4 is shown. Rather than just recommend the lowest rate, the range is included to show it may be grown successfully in more than one hydrozone. Plants may be labeled as not recommended (NR) for several reasons found in the individual species discussion. Plant growth index (PGI) and relative plant growth index (rPGI) charts, monthly average quality ratings tables for each species, and photos are included in the Appendix. Although data was collected for a full year (10/14 – 10/15), the charts and tables have been excerpted for clarity to show just the months affected by deficit irrigation treatments. Discussion of individual species follows Table 4.

Table 4. Average annual overall quality ratings on 4 ET_0-based irrigation treatments for 15 perennial landscape species in 2015.

PLANT NAME	Overall Rating on each ET_0 % (1-5)				Recommended rate (ET_0 %)
	80	60	40	20	
SUN					
Chondropetalum tectorum	3.7	3.3	3.3	4.3	**20**
Dianella 'Cassa Blue'	3.8	3.8	4.0	3.3	**40**
Lomandra 'Breeze'	2.6	3.1	2.7	2.8	**NR[1]**
*Prunus ilicifolia**	2.4	3.8	3.1	2.5	**60[3]**
Phlox Paparazzi 'Adele'	1.5	1.6	2.2	1.7	**NR[1]**
Phlox Paparazzi 'Jagger'	2.4	2.1	1.3	Ø	**NR[1]**
Phlox Paparazzi 'Levine'	2.2	2.3	1.8	1.5	**NR[1]**
*Rhus ovata**	3.0	3.7	4.2	3.9	**40**
Rosa 'Cream Veranda'	3.3	3.1	3.7	3.4	**40[3]**
Rosa 'Kardinal Kolorscape'	4.2[2]	4.3	3.9	4.1	**20-80**
Solanum xanti 'Mountain Pride'*	2.8	2.6	3.2	2.4[2]	**NR[1]**
SHADE					
Correa pulchella 'Pink Eyre'	4.1	4.2	4.1	4.1[2]	**20-80**
Dianella 'King Alfred'	3.8	4.0	3.5	3.9	**60**
Lomandra 'Lomlon'	4.4	4.3	4.4	4.5	**20-80**
Ribes viburnifolium 'Spooners Mesa'*	4.0	4.2	4.1	4.2	**20-80**

1. Not recommended
2. Treatment with the highest average irrigation-related flowering rating
3. See discussion

*CA native/ native cultivar

Ø = total mortality on this irrigation level

Tables and Figures referred to in this section are found in the Appendix.

SUN SPECIES

Chondropetalum tectorum

Significant results for this South African species were somewhat derailed. Because of time considerations, we replaced some of our initial mortality with plants obtained from a grower different than the original supplier but closer to home. We later found them to be of a different species, namely *Chondropetalum elephantinum*. (For a thorough explanation of the issue, see Randy Baldwin's discussion here: http://www.smgrowers.com/info/chondropetalum.asp.) While we were unable to apply any significant statistical analysis to growth parameters, irrigation didn't seem to significantly affect relative growth of either species. Quality ratings for both species at the end of the trials were highest on the lowest irrigation level of 20% of ET_0 (Figure 1b), making it the recommended rate for either of these species.

***Dianella caerulea* 'DBB03' Cassa Blue™**

This evergreen Australian perennial with bluish gray leaves showed no significant differences in growth between irrigation treatments (Figures 14a-b). All treatment levels were completely free of pests or signs of disease, but showed some minor tip burn which we attributed to boron sensitivity, since boron is present in our water. Flowering began in March, peaked in April (Figure 2a), and continued through July. The only irrigation-related differences between treatments for flowering were seen in June, where 60% plants had marginally higher ratings than other treatments, and in July, where all but the lowest irrigation level still showed some bloom (Table 5). However, the best overall appearance through the season was on the 40% treatment (Figure 2b), which was enough water to keep foliage looking fresh without accumulating much tip necrosis. The average height and width at the end of 2 years was 25.5" x 34" (78.5 x 87 cm).

***Lomandra longifolia* 'LM300' Breeze™**

The first thing that should be said about this dwarf mat rush is that there was uneven recovery from the recommended late winter/early spring pruning which resulted in either bare centers or uneven re-growth of several plants on each treatment (Figure 3a). Only one or two plants on any treatment ever actually attained an acceptable appearance; most struggled with tip burn and pale, washed-out leaves resulting in ratings that never averaged close to good (Table 6; Figure 3b). There were no differences in growth between the treatments (Figures 15a-b). The average size of this plant at the end of the trials was 20" high x 42.5" wide (51 x 108 cm). We had previously grown this cultivar in the trials, but from much smaller stock. We concluded at the time that cultivars of this species, which is native to coastal woodlands of Australia, would perform better in afternoon or light shade. The grower, however, wanted to try larger plants in full sun. Our original conclusion remains unchanged; this plant is not recommended in full sun for hot, interior locations.

Prunus ilicifolia

Uneven mortality before irrigation treatments began (50% mortality for the 40% ET_0 treatment; 33% for the 20% ET_0 treatment) confounded significant statistical analysis of the growth parameters for this California native species. Only the highest irrigation treatment had additional mortality during the treatment period. Additionally, although all plants came from one nursery, there were several plants with seemingly significant morphological differences (leaf size

and shape; overall plant shape) leading us to believe they may have been a subspecies (Figures 4a - d). For the purposes of this report, all plants were evaluated together, since we were unsure if that level of leaf variance was possible within the species if, for instance, they were grown from collected seed. From this data set, there did not appear to be any significant differences in relative growth between treatments (Figure 16b), while the best overall appearance was found on 60% of ET_0 (Table 7). This may initially be surprising until one considers that the natural distribution of the plant is along the *coastal* chaparral and woodland areas. The CalFlora website (www.CalFlora.org) lists its suitable growing areas as those with July highs of 96°F, while Central Valley high temperatures in July and August usually will reach 100°F or more for several to many days. However, if one considers that the plants on the 60% treatment also happened to be the largest (and probably most robust) plants going into the treatment period, it is hard to draw any conclusions about size with respect to irrigation. The average foliage ratings were very good on all treatments, showing a strong resistance to disease and pest pressure, but the non-uniformity of the plants within treatments led to downgraded overall appearance on most irrigation levels. This level of irregularity would make it suitable only to very informal garden settings. Average height and width at the end of the trial was 38" x 39" (97 x 97.5 cm).

***Phlox* Paparazzi® Series 'Adele', 'Jagger', and 'Levine'**

These three cultivars of groundcover or moss phlox will be discussed together, since their results were very similar. After our generously wet winter they showed promise early in the spring with a nice flower show, but they soon succumbed to the heat and infrequent irrigation regime (Figures 5a-f). No analysis of growth parameters between treatments was possible due to mortality across treatments for all three cultivars that ranged from 33-100% (Tables 8a-c). Since all mortality was after the onset of treatments, our assumption is that these phlox cultivars do not develop extensive enough root systems to withstand a deficit irrigation schedule with infrequent application. This supposition is supported by the observation that after an irrigation event, a plant that had almost completely died sometimes sent up a new leaf or two. However, because of their very poor performance, we cannot recommend these plants in a deficit irrigation application; they may perform better on shallower, more frequent irrigation. Anecdotally, one or two of each cultivar of these were also planted in a demonstration garden bed in Stockton that received weekly irrigation at about 50% ET_0, and they performed acceptably without the mortality we observed in our field trial.

Rhus ovata

Sugar bush is a Southern California native evergreen shrub that had mortality issues during the establishment phase of our trial, losing 2-3 plants on each treatment before the irrigation period in 2015. The 80% of ET_0 treatment lost an additional plant in May 2015 and one in October, and the 20% ET_0 treatment lost an additional plant in each of September and October (Figure 6c) for a final count of only 2 - 4 plants on each treatment, with only the 60% treatment retaining 4 plants. ANOVA and Tukey's HSD revealed significance only in October's relative plant growth index between treatments 80% and 20% at $p \leq 0.5$, and between 40% and 20% at $p \leq 0.1$, although with the small remaining sample size, we do not have a high level of confidence in this conclusion (Figure 17a). Overall average size at the end of the trial revealed the largest plants on the lowest treatments (Figure 17b): with an average height and width of 56" x 80.5" (142 x 204.5 cm). Quality ratings were unequivocally higher on the two lower levels of irrigation (Table 9), but overall appearance was decidedly non-uniform making this plant most suitable to

informal garden settings. Given the high rate of mortality for this species both before and during the trial period, it may not be advisable to plant it in soils as heavy as the silty clay loam of the current trials location. It may be beneficial to investigate comparative mortality in different soil types and with different irrigation regimens; we would have done so this year had we been able to locate plants in sufficient quantity to include them in a trial designed to determine that.

***Rosa* 'Cream Veranda'®**

The 'Veranda' series of roses was bred by Kordes roses to be smaller than standard shrub rose varieties and suitable for beds near porches. This was indeed a diminutive shrub rose with peachy-cream colored flowers and fairly clean foliage (Figures 7a). The average height and width at the end of the season was just 18" x 26" (46 x 66.5 cm). There were no significant differences in growth between treatments (Figures 18a-b). Although it bloomed on all irrigation treatments from March through October (when it was removed,) the best flushes were in April, July, and September. The highest overall quality rating throughout the year was at 40% of ET_0, a result we have found on other landscape roses (Table 10). The one major flaw of this rose was its tendency to break from its dense small habit by sending up awkward, long canes that ruined its uniformity (Figure 7b). This one feature caused its downgrade on overall appearance. A home gardener might not find this habit too annoying to correct with hand shears, but it would be highly inconvenient in a commercial setting or mass planting where some consistent uniformity is desired.

***Rosa* 'Kardinal™ Kolorscape'®**

The Kolorscape® collection of roses was bred to be a self-cleaning, disease free landscape rose, and in our trial it proved itself to be just that. Reaching an average height and width of 39" x 45" (98.5 x 114.5 cm), it bloomed from April through October with rates of flowering on the lowest treatment as high as those on the highest treatment. Because the flowers open up widely at full bloom, they were frequented by a wide variety of pollinators. Growth showed no significant differences between treatments (Figures 19a-b). Thrips feeding was marginally higher on the lowest treatment, but overall appearance was only moderately affected by the end of the summer. While thrips were found on all treatments, the vigorous dark green foliage did not show the damage except upon close examination. There was some edge burn on a few plants in each treatment beginning in July, which we attribute to boron accumulation, and a couple of plants on the lowest treatment were showing water stress by the end of summer. However, this was not the case with all plants on that treatment, as can be seen from the comprehensive ratings (Table 11) and the photographs (Figures 8a - b). The slightly lower ratings on the 40% treatment are more reflective of plants that were less vigorous from the start than from irrigation effects.

***Solanum xanti* 'Mountain Pride'**

This California native cultivar of purple nightshade also had mortality issues beginning before establishment, but only the two higher treatments had mortality after treatment irrigation began in 2015. It was also a highly variable plant in form and size; on each treatment some plants grew very large and vigorous (e.g.: 36"H x 108"W) while others stayed half that size, making average height and width almost meaningless. There was some level of flowering all year with occasionally spectacular shows of bloom (Figures 9a-b), and the plants were heavily visited by pollinators throughout the year (Figure 9c-e). There was also a tendency for

individual branches or even half a plant to die between one month and the next for inscrutable reasons (Figure 9f). (Verticillium wilt? Turkeys?) The only significant difference in growth was between the relative plant growth index for the month of October when the 40% treatment was significantly greater than the 20% treatment at $p \leq 0.1$ (with 3 reps on each) using ANOVA and Tukey's HSD (Figure 20b). While a vigorous specimen of this plant might fit into a naturalistic landscape scheme, overall we would not recommend it as a reliable landscape species in this region, since it was unpredictable and did not consistently achieve a high overall appearance rating on any irrigation treatment during the April to October time frame (Table 12).

SHADE SPECIES

***Correa pulchella* 'Pink Eyre'**

This small Australian shrub cultivar was a consistently high performer on all irrigation levels in our trials. There were no significant differences in growth or overall appearance ratings between treatments with all levels achieving an average overall appearance of 4.0 (very good) or above Table 13; Figures 21a-b). What is significant to note is that the lowest irrigation treatment in the shade received no irrigation until almost the end of the trial period on September 27! They reached an average height and width of 36.5" x 57" (93 x 146 cm). Since flowering for this species occurs in the fall through winter, the flowering during the trial period attributable to irrigation was only evident in October, when the fascinating result was that the 80% treatment had 3 plants in bloom, the 60% treatment had 4 plants in bloom, the 40% treatment had 5 plants in bloom, and the 20% had all 6 plants in bloom. The flowering ratings are not included in the quality ratings table, since all the plants had very few blooms open and were mostly in bud, which would have resulted in a universal rating of '1'. The pink, bell-shaped flowers were an attractive feature for a long period of time in the fall and winter preceding treatment and would be an asset to the low-water shade landscape (Figures 10 a-b).

***Dianella caerulea* 'King Alfred'**

Another Australian native cultivar, this was a lovely, lush, grass-like plant with pale violet blue flowers on long stalks which were followed by bright purple berry-like fruits (Figures 12a-b). Flowering was not dense enough to be the major feature of the plant, however, and the stalks, which came up straight beginning in March, had a tendency to lodge toward the southeast by May (Figure 12c). We attribute this to our prevailing winds from the northwest in spring. In a more protected area, or even with higher solar radiation (potentially yielding shorter, stouter stalks), this may not be a problem. Any apparent differences in growth between treatments were statistically insignificant (Figures 22a-b); average height and width at the end of the trial was 43" x 61" (111 x 154.5 cm). A moderate mealybug infestation appeared late in the trial period in September (Figure 12d). While one plant on each of the highest treatments had some level of the pest, the two lower irrigation treatments had two (20% ET_0) and 3 (40%) plants seriously affected. For this reason, the 40% ET_0 treatment had significantly lower pest tolerance and overall appearance ratings (Table 14). There seemed to be some field-position related effect, but the difference couldn't be completely correlated to that. Due to the double stress of the pest pressure and lower irrigation level, the overall appearance of the two lowest levels in October was really unacceptable. Our recommended level of irrigation for this cultivar is 60% ET_0, which for us in a moderately heavy soil was a deep soak every 6 weeks, or three times during the summer.

***Lomandra* 'Lomlon'**

We will note here that this plant's genetics are controversial, and it is currently marketed under both the names 'Lime Tough' and 'Lime Tuff'. We previously evaluated this cultivar in full sun when it was being marketed under the name 'Bushland Green', and it received high marks, especially on the lowest irrigation level. The American patent holder wanted to see how it would perform in shade as well. The most notable difference was that the form became less stiffly upright and more relaxed and fountain-form in the shade, while the color was also a somewhat deeper lime green (Figures 13a-b). The plants consistently received high overall ratings scores on all treatments, with the lowest irrigation level once again scoring marginally highest (Table 15). No significant differences in size between treatments were found (Figures 23a-b). The ability to thrive in sun or shade on any irrigation level makes this Lomandra one of the most adaptable plants to the landscape that we have evaluated.

***Ribes viburnifolium* 'Spooner's Mesa'**

Having previously evaluated the species in our trials, we were curious to see what differences this cultivar might display. The straight species tends to send out long new stems with leaves scattered somewhat far apart, so the most notable difference of 'Spooner's Mesa' was the shorter internodes, making the average size somewhat smaller, and the overall appearance more dense, uniform, and appealing. The pleasantly herbal fragrance the foliage emits when brushed up against also seemed more pronounced. There were no significant differences in growth between treatments (Figures 24a-b). Quality ratings were unaffected by irrigation level and were consistently very good throughout the summer (Table 16), making this a great candidate for the low-water shade garden (Figures 11a-b). As with the straight species, this cultivar did not flower during the two years of the trial. The average height and width at the end of the trial was 28" x 70" (71.5 x 178 cm).

Concluding remarks

Through the years of these trials we have found it fascinating that so many species show no differences in relative plant growth between widely differing irrigation amounts and frequencies. A few plants will use as much water as is provided and add size accordingly, although quality isn't always higher and some pest issues, like late season aphids or mealybugs, may be more prevalent or damaging on a higher or lower (stressed) treatment. More often it seems that species that are adapted to summer drought are simply programmed to grow a certain amount or at a certain rate during the warm, sunny days of summer, and additional water provides no added value to these plants. These trials are only 2 years long, and additional years in the trial might show up long-term differences not apparent right away. However, what we have seen again in the 2013-2015 trial is that well-established plants can perform their ecosystem and aesthetic services on very low levels of irrigation applied infrequently. These guidelines should provide great hope for the future of a beautiful, livable urban environment.

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APPENDIX

Figure 1a. *Chondropetalum tectorum* in May 2015 on 20% ET_0.

Figure 1b. *Chondropetalum tectorum* in October 2015 on 20% ET_0.

Figure 2a. ***Dianella*** **'Cassa Blue' in bloom in April 2015 before the start of treatments**

Figure 2b. ***Dianella*** **'Cassa Blue' on 40% of ET_0 in October 2015.**

Figure 3a. ***Lomandra*** **'Breeze' specimen exhibiting not uncommon poor re-growth into May 2015.**

Figure 3b. ***Lomandra*** **'Breeze' on 60% ET_0 in Oct. 2015; good specimen- tip burn still apparent.**

Figure 4a &b. *Prunus ilicifolia* with differing leaf morphology –photos roughly to scale.

Figure 4c. *Prunus ilicifolia* (with wide leaves, above left) in October 2015 on 60% of ET_0; overall form is mounding.

Figure 4d. *Prunus ilicifolia* (with smaller leaves) in September 2015 on 60% ET_0; strikingly different overall form than wide-leaved specimens; strong natural central leader.

Figure 5a. *Phlox* 'Adele' in bloom March 2015 before treatment.

Figure 5b. *Phlox* 'Jagger' in full bloom in April 2015 before treatment.

Figure 5c. *Phlox* 'Levine' in full bloom April 2015 before treatment.

Figure 5d. *Phlox* 'Adele' in June 2015 on 40% of ET_0 treatment.

Figure 5e. *Phlox* 'Jagger' in June 2015 on 60% of ET_0 treatment.

Figure 5f. *Phlox* 'Levine' in June 2015 on 40% of ET_0 treatment.

Figure 6a. *Rhus ovata* in September 2015 on 40% of ET_0 treatment.

Figure 6b. *Rhus ovata* in September 2015 on 20% of ET_0.

Figure 6c. *Rhus ovata* on 20% ET_0 dying suddenly in September 2015 (not same plant as above).

Figure 7a. Close-up of *Rosa* 'Cream Veranda' ® blooms in April 2015.

Figure 7b. *Rosa* 'Cream Veranda'® in full bloom in June 2015 on 40% of ET_0.

Figure 7c. *Rosa* 'Cream Veranda'® in September 2015 on 20% ET_0 with a long cane.

Figure 8a. *Rosa* 'Kardinal™ Kolorscape'® in October 2015 on 20% of ET_0.

Figure 8b. *Rosa* 'Kardinal™ Kolorscape'® in October 2015 on 80% of ET_0.

Figure 9a. *Solanum xanti* 'Mountain Pride' in full bloom in March before treatments.

Figure 9b. *Solanum xanti* 'Mountain Pride' in July 2015 on the recommended 40% ET_0.

Figure 9c. Cluster of bees on *Solanum xanti* 'Mountain Pride' in January.


Figures 9d –e. Pollinators visiting *Solanum xanti* 'Mountain Pride' in October.

Figure 9f. Section die-off of *Solanum xanti* 'Mountain Pride' August 2015 on 20% ET_0.

Figure 10a. ***Correa pulchella*** **'Pink 'Eyre' beginning to bloom in October 2015 on 20% ET_0.**

Figure 10b. ***Correa pulchella*** **'Pink 'Eyre' flowers close up.**

Figure 11a. ***Ribes viburnifolium*** **'Spooner's Mesa' in October 2015 on 20% of ET_0.**

Figure 11b. ***Ribes viburnifolium*** **'Spooner's Mesa in October 2015 on 60% of ET_0.**

Figure 12a. ***Dianella caerulea*** **'King Alfred' in September 2015 on 60% of ET_0.**

Figure 12b. ***Dianella caerulea*** **'King Alfred' with flowers and berries in June 2015.**

Figure 12c. *D. caerulea* 'King Alfred' in June 2015with lodged flower stalks to the northeast.

Figure 12d. *D. caerulea* 'King Alfred' in October 2015 on 20% of ET_0 with mealybug.

Figure 13a. *Lomandra* 'Lime Tough' in the shade in September 2015.

Figure 13b. *Lomandra* 'Lime Tough' in full sun in October 2014 on 20% ET_0.

NOTE: In this entire section, lower case letter superscripts are only used for ratings categories that showed significant differences between treatments. Recommended rate(s) are in bold print.

Table 5. Average Monthly Quality Ratings for *Dianella caerulea* 'Cassa Blue'™ in 2015 on 4 ET_0-based irrigation levels.

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	AVG
Foliage								
80%	4.0	4.0	4.0	3.7	3.8	3.8	3.7	3.9
60%	3.5	3.5	3.3	3.7	3.7	3.8	3.7	3.6
40%	3.8	4.0	4.0	4.0	3.8	3.8	4.5	4.0
20%	3.8	3.8	3.5	3.3	3.7	3.3	3.7	3.6
Flowering								
80%	2.6	2.0	1.2	1.0				1.8
60%	4.0	2.5	1.6	1.0			1.0	1.9
40%	3.8	2.3	1.4	1.0				1.9
20%	3.1	1.0	1.3				3.0	1.9
Pest Tolerance								
80%	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
40%	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
Disease Resistance								
80%	5.0	4.8	5.0	5.0	5.0	5.0	5.0	5.0
60%	5.0	5.0	5.0	4.5	5.0	4.8	5.0	4.8
40%	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	4.7	4.5	4.8
Vigor								
80%	4.0	3.5	4.0	4.2	4.0	4.0	3.8	3.7
60%	4.7	3.8	3.8	4.3	4.7	4.8	4.0	4.0
40%	4.0	3.8	3.8	4.2	4.5	4.3	4.0	3.8
20%	4.3	4.0	3.7	3.5	3.5	3.5	3.3	3.6
Overall Appearance								
80%	4.3	3.6	3.9	3.8	3.7	3.8	3.8	3.8[a]
60%	4.3	3.8	3.8	3.7	3.8	3.8	3.7	3.8[a]
40%	4.3	3.7	4.2	3.8	4.0	3.7	4.5	**4.0[a]**
20%	3.9	3.3	3.5	3.3	3.3	3.3	3.2	3.3[b]

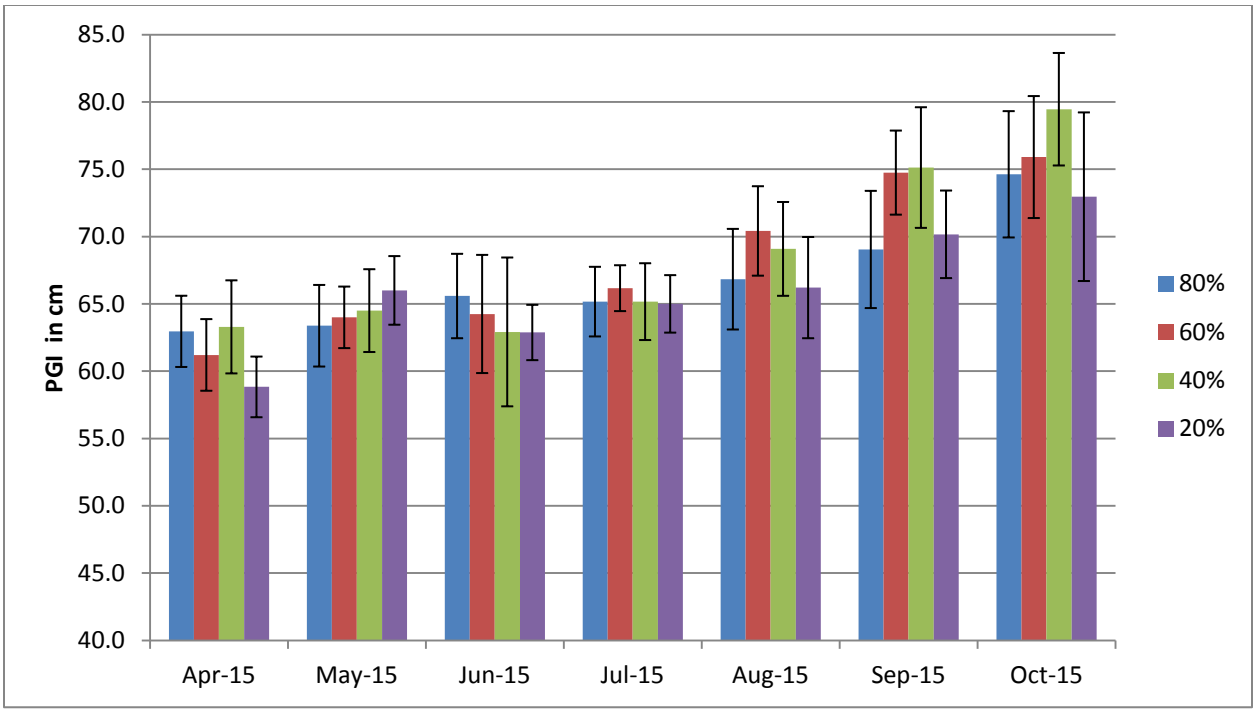

Figure 14a. Average monthly plant growth index of *Dianella caerulea* 'Cassa Blue'™ in 2015 on 4 ET_o–based irrigation levels. Bars represent ± 1 SE. No significant differences using ANOVA and Tukey's HSD.

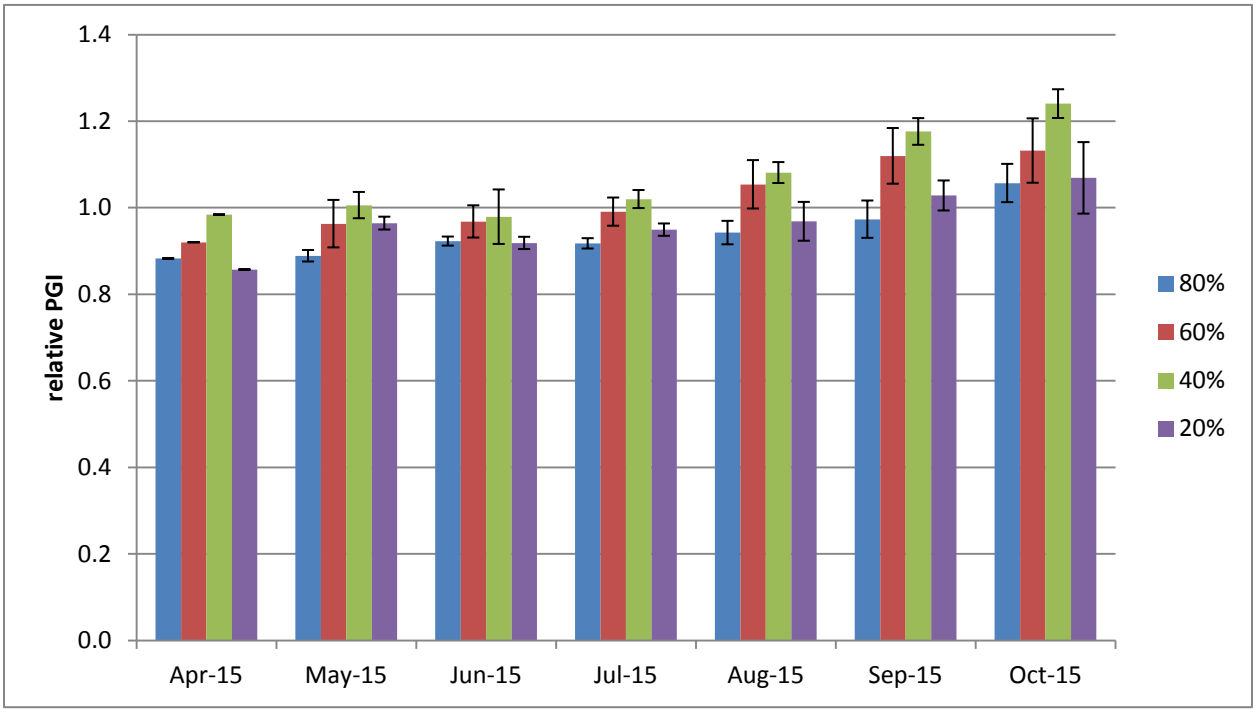

Figure 14b. Average monthly relative plant growth index of *Dianella caerulea* 'Cassa Blue'™ in 2015 on 4 ET_o–based irrigation levels. Bars represent ± 1 SE. No significant differences using ANOVA and Tukey's HSD.

Table 6. Average Monthly Quality Ratings for *Lomandra longifolia* 'Breeze'™ in 2015 on 4 ET_0-based irrigation levels.

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	AVG
Foliage								
80%	2.5	2.7	3.2	2.8	3.2	3.0	2.7	2.9
60%	3.2	3.6	3.4	3.4	3.6	3.2	3.2	3.4
40%	3.0	3.2	3.2	3.3	3.3	3.2	3.0	3.2
20%	3.0	3.0	3.3	3.3	3.2	3.2	3.0	3.1
Flowering								
80%	3.2	2.5	2.7	3.0	3.5	5.0	4.0	3.4
60%	3.5	3.3	3.7	3.5	3.5	4.0	2.3	3.4
40%	3.5	2.3	2.0		3.0		2.5	2.7
20%	1.7	2.3	5.0	3.0	5.0	2.3	3.0	3.2
Pest Tolerance								
80%	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
40%	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	4.2	4.9
Disease Resistance								
80%	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	4.6	5.0	4.9
40%	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	4.2	4.9
Vigor								
80%	2.8	2.2	3.0	2.8	3.2	3.3	2.8	2.9
60%	3.2	3.2	3.4	3.4	3.8	3.6	3.4	3.4
40%	2.8	2.7	3.2	3.2	3.3	3.3	3.3	3.1
20%	3.0	2.8	3.0	2.8	3.0	3.2	3.2	3.0
Overall Appearance								
80%	2.2	2.0	2.7	2.7	3.0	3.2	2.7	2.6
60%	2.8	2.8	3.0	3.1	3.4	3.4	3.2	3.1
40%	2.2	2.4	2.7	2.8	3.0	2.8	3.0	2.7
20%	2.5	2.7	2.7	2.8	2.7	3.2	3.0	2.8

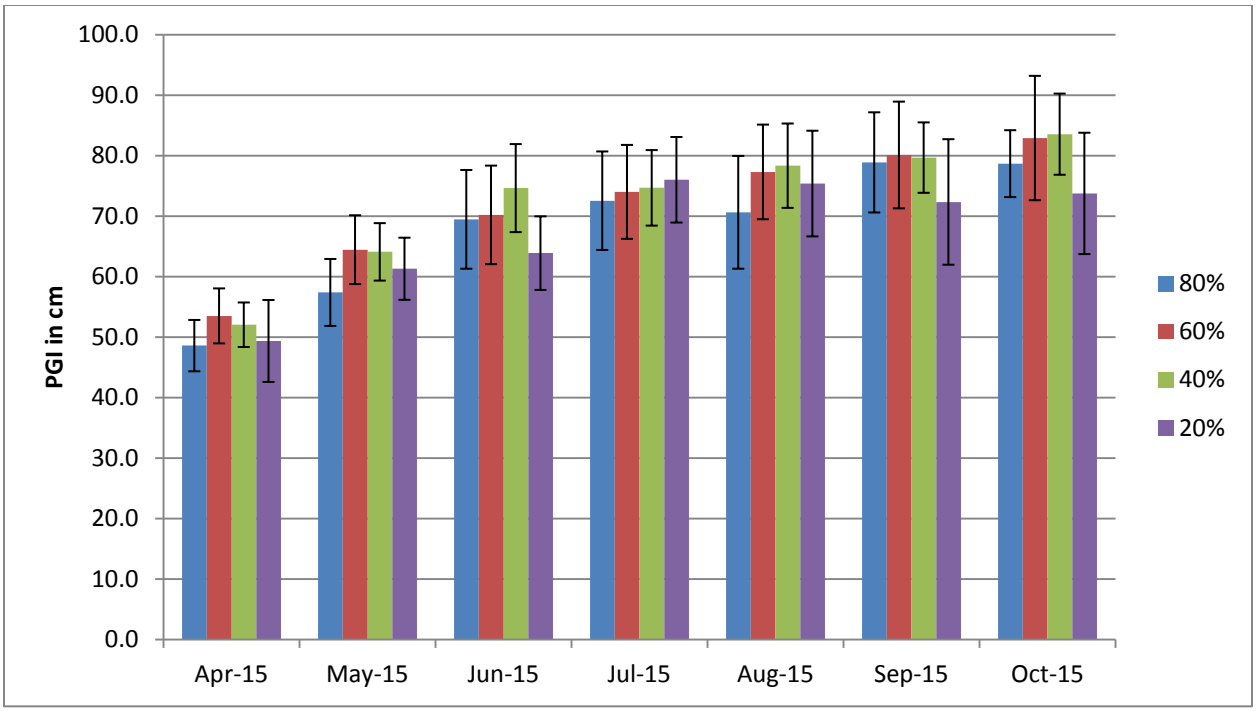

Figure 15a. Average monthly plant growth index of *Lomandra longifolia* 'Breeze'™ in 2015 on 4 ET_0-based irrigation levels. Bars represent ± 1 SE. No significant differences using ANOVA and Tukey's HSD.

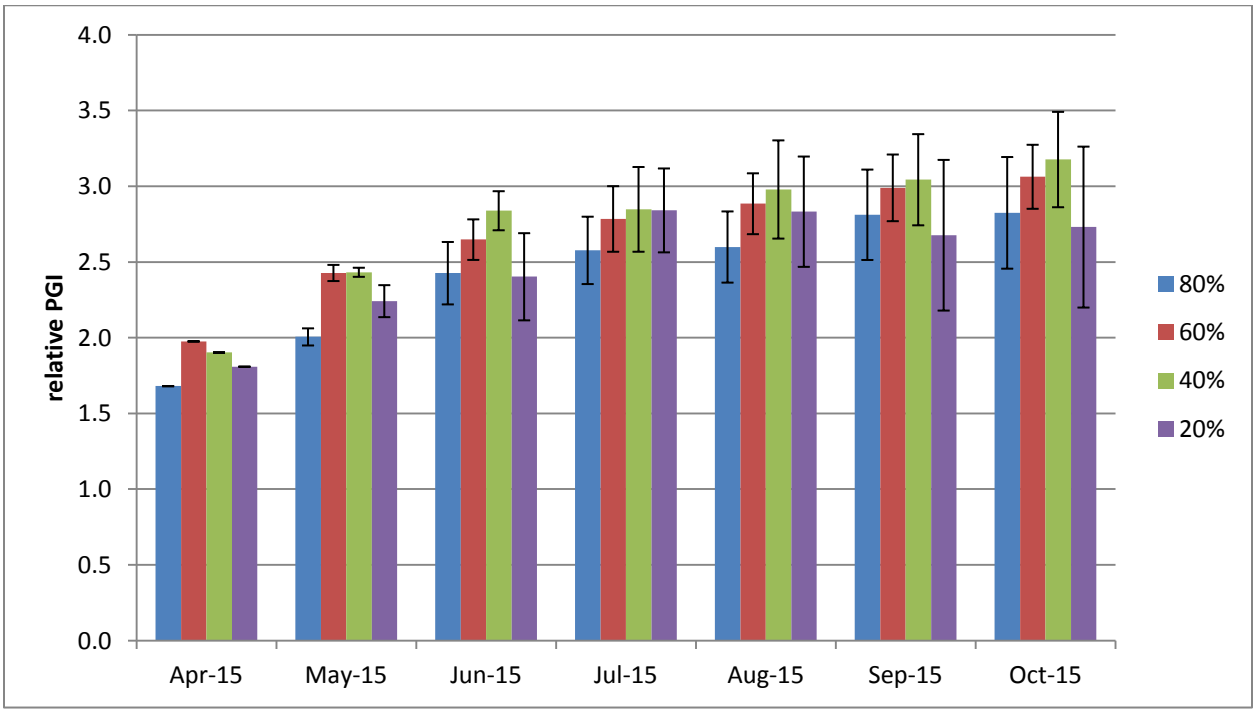

Figure 15b. Average monthly relative plant growth index of *Lomandra longifolia* 'Breeze' in 2015 on 4 ET_0-based irrigation levels. Bars represent ± 1 SE. No significant differences using ANOVA and Tukey's HSD.

Table 7. Average monthly quality ratings for *Prunus ilicifolia* in 2015 on 4 ET_0-based irrigation levels.

	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	AVG
Foliage									
80%	2.3	3.0	3.1	3.8	4.2	4.3	4.0	3.2	4.0[b]
60%	4.2	4.5	4.4	4.7	4.7	4.8	4.7	4.1	4.7[a]
40%	4.0	4.7	4.3	4.7	4.3	4.3	4.3	3.9	4.4[a]
20%	3.8	3.5	4.0	4.2	4.0	4.0	4.3	3.5	4.2[b]
Flowering									
80%	3.0							1.9	3.0
60%		1.0						0.8	1.0
40%		1.5						1.0	1.5
20%		1.0						0.6	1.0
Pest Tolerance									
80%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.5	5.0
60%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.5	5.0
40%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.4	5.0
20%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.4	5.0
Disease Resistance									
80%	3.8	4.0	4.7	5.0	4.5	4.7	5.0	4.1	4.5[c]
60%	5.0	5.0	5.0	5.0	4.8	5.0	5.0	4.4	5.0[a]
40%	5.0	5.0	5.0	4.7	4.3	5.0	5.0	4.3	4.8[b]
20%	4.5	5.0	5.0	4.2	5.0	5.0	5.0	4.2	4.8[b]
Vigor									
80%	1.5	2.0	2.2	2.7	3.3	3.2	3.2	2.4	2.5[c]
60%	3.7	4.2	4.3	4.2	4.7	4.8	4.7	3.9	4.2[a]
40%	3.0	3.0	3.0	3.7	4.0	4.0	4.0	3.1	3.5[b]
20%	1.8	2.0	2.0	2.0	2.4	3.0	3.0	2.0	2.2[c]
Overall Appearance									
80%	1.7	1.9	2.0	2.5	3.0	2.8	2.8	2.2	2.7[c]
60%	3.3	3.9	3.7	3.5	3.8	3.7	3.8	3.3	**3.8[a]**
40%	3.0	2.8	3.0	3.0	3.3	3.3	3.7	2.8	3.2[b]
20%	2.0	2.3	2.3	2.4	2.6	2.4	2.8	2.1	2.6[c]

1. March ratings are included here to show flowering period, though it is pre-treatment and not irrigation related during this trial period.

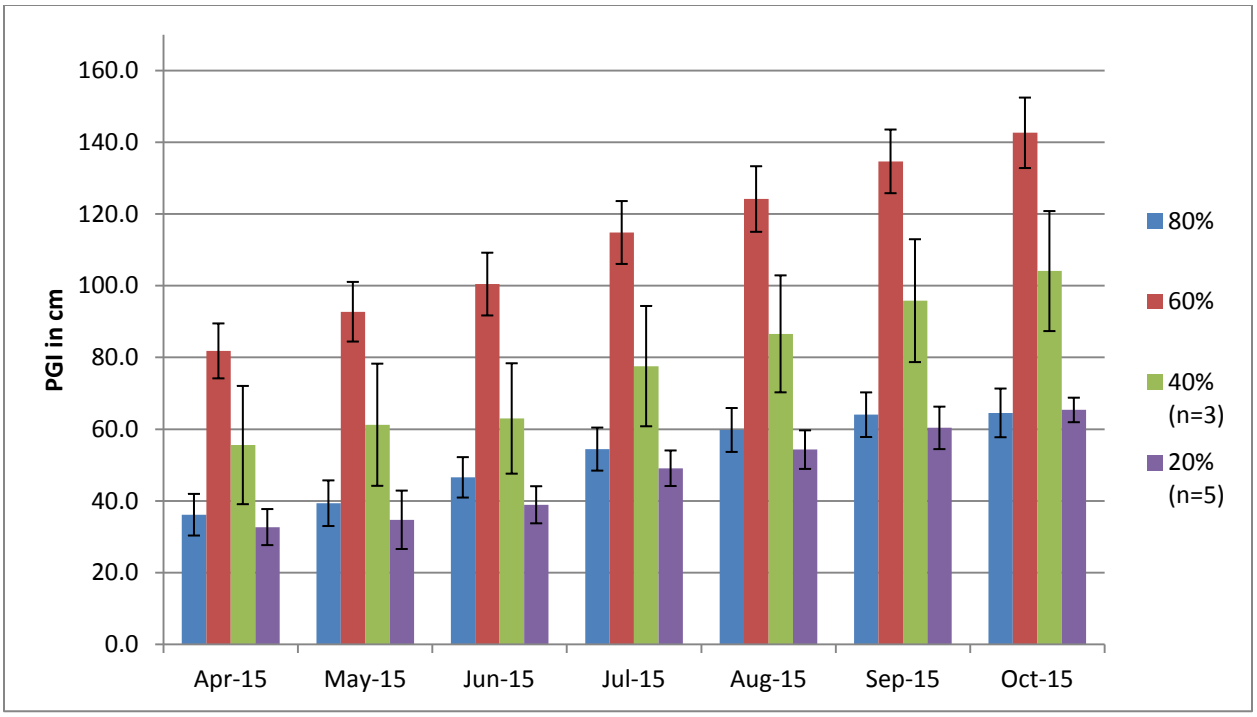

Figure 16a. Average monthly plant growth index for *Prunus ilicifolia* in 2015 on 4 ET_0-based irrigation levels. Bars represent ± 1 SE. No significant differences using ANOVA and Tukey's HSD.

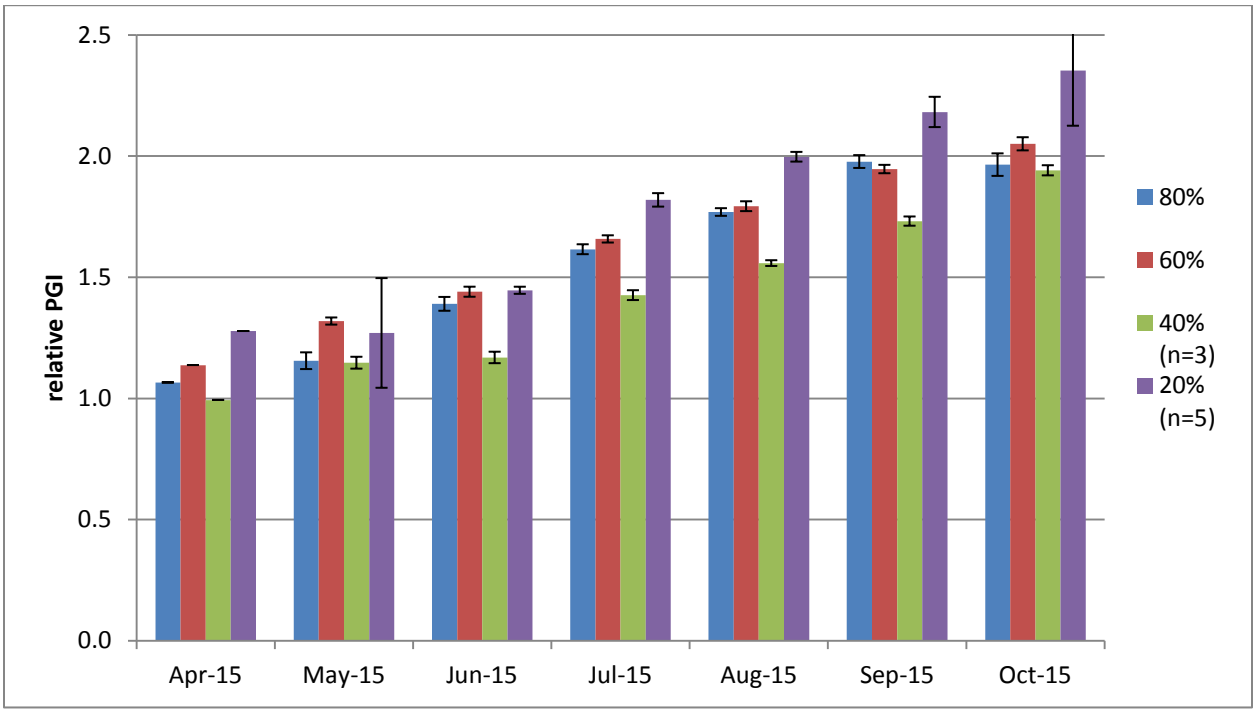

Figure 16b. Average relative plant growth index for *Prunus ilicifolia* in 2015 on 4 ET_0-based irrigation levels. Bars represent ± 1 SE. No significant differences using ANOVA and Tukey's HSD.

Table 8a. Plant mortality during treatment period in 2015 for *Phlox* Paparazzi 'Adele'.

	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Rate(%)
80%			3			50
60%		3	1	1		83
40%	1	1	1			50
20%		**2**			1	75

Table 8b. Plant mortality during treatment period in 2015 for *Phlox* Paparazzi 'Jagger'.

	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Rate (%)
80%			1	1	**2**	67
60%			2			33
40%			3		2	100
20%		2	2	2		100

Table 8c. Plant mortality during treatment period in 2015 for *Phlox* Paparazzi 'Levine'.

	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Rate (%)
80%					1	17
60%			2	1		33
40%			1		3	67
20%			3	1	1	83

Table 9. Average monthly quality ratings for *Rhus ovata* in 2015 on 4 ET_0-based irrigation treatments.

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	AVG
Foliage								
80%	3.8	3.9	3.8	4.0	4.0	3.5	4.3	3.9 [c]
60%	4.6	4.4	4.8	4.8	4.0	4.0	3.8	4.3 [b]
40%	4.7	4.7	5.0	4.7	5.0	4.3	4.3	4.7a[a]
20%	4.0	4.3	4.5	4.8	4.8	4.0	4.5	4.4[ab]
Flowering								
80%								
60%				3.0				3.0
40%								
20%			3.0					3.0
Pest Tolerance								
80%	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
40%	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
Disease Resistance								
80%	4.5	4.3	4.3	4.5	4.0	4.0	4.0	4.2
60%	5.0	4.8	5.0	4.8	4.8	4.0	3.8	4.6
40%	5.0	5.0	5.0	5.0	5.0	4.3	4.3	4.8
20%	4.5	4.5	5.0	4.8	4.8	4.0	4.5	4.6
Vigor								
80%	3.5	3.5	4.0	3.8	3.3	2.8	3.3	3.4
60%	4.5	4.0	4.8	5.0	4.5	4.5	4.3	4.5
40%	4.7	4.3	4.7	5.0	5.0	5.0	4.7	4.8
20%	4.0	4.0	4.3	4.3	4.5	4.0	5.0	4.3
Overall Appearance								
80%	3.0	3.3	3.3	3.3	2.8	2.3	3.0	3.0 [c]
60%	3.8	4.0	4.0	4.0	3.8	3.4	3.0	3.7 [b]
40%	4.0	4.2	4.3	4.0	4.5	4.0	4.2	**4.2** [a]
20%	3.3	3.9	3.9	3.9	4.0	3.7	5.0	3.9[ab]

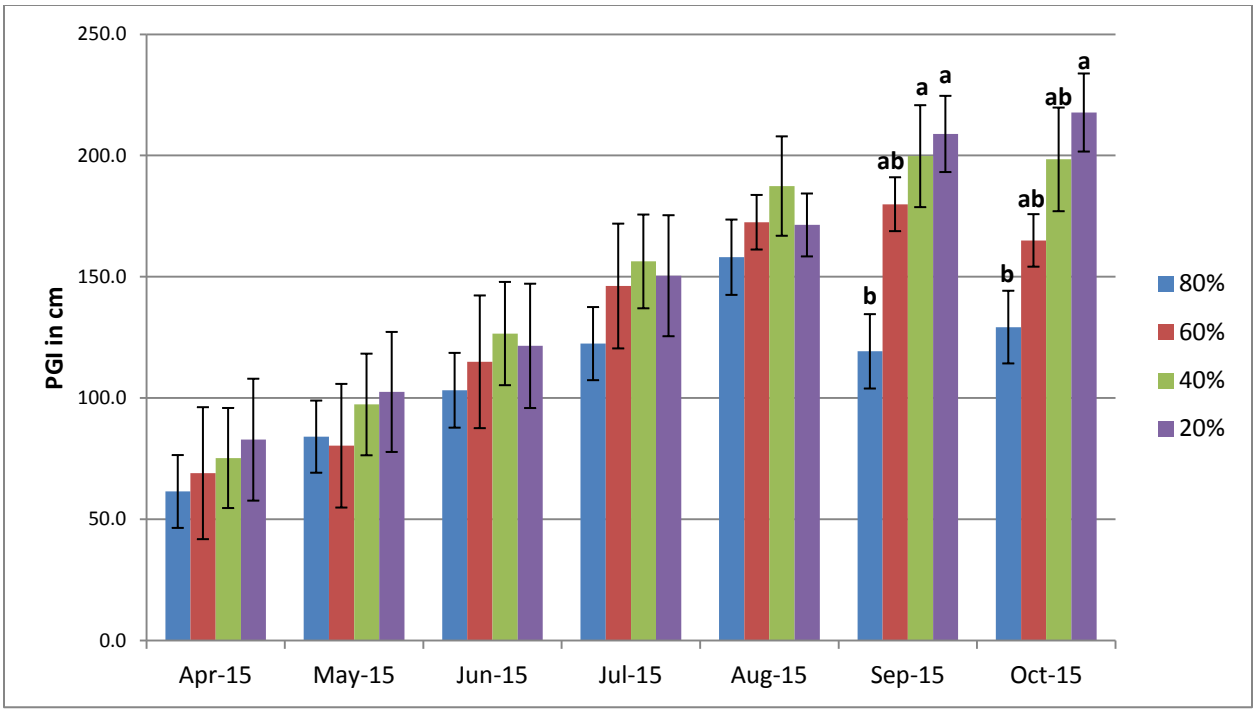

Figure 17a. Monthly average quality ratings for *Rhus ovata* in 2015 on 4 ET_0-based irrigation treatments. Bars represent ± 1 SE. Lower case letters indicate significant differences at p≤0.01 using ANOVA and Tukey's HSD.

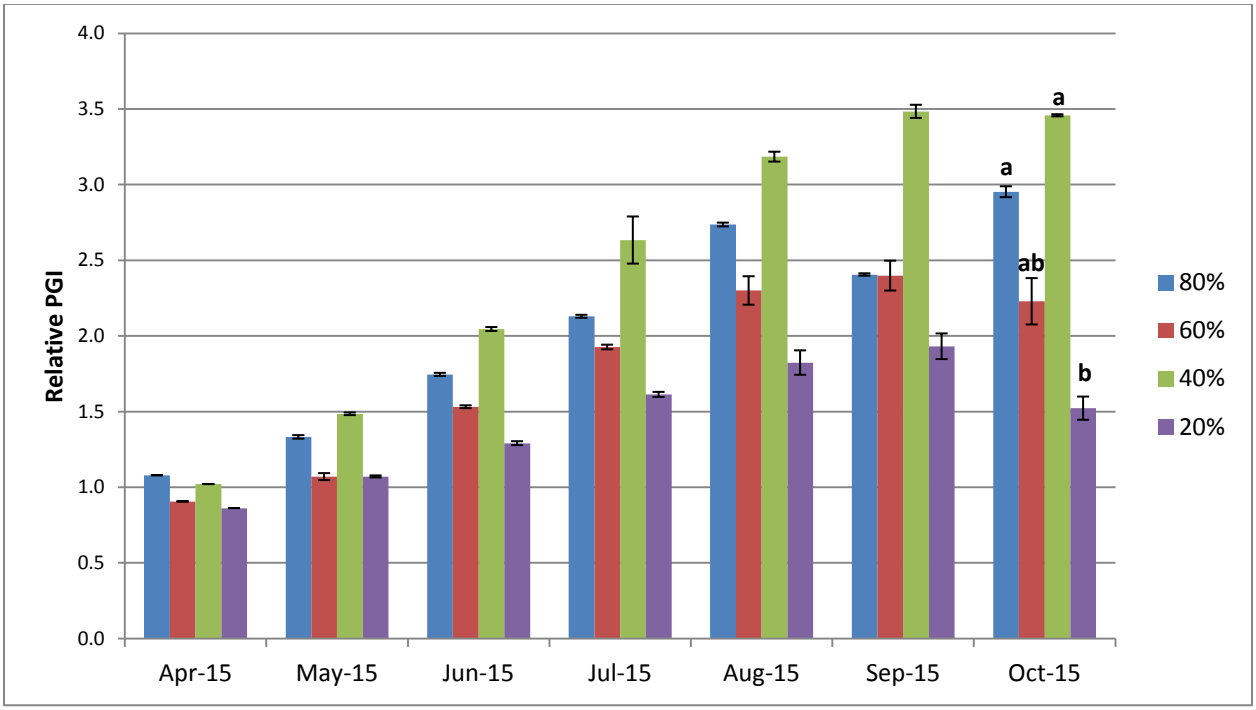

Figure 17b. Monthly average relative plant growth index for *Rhus ovata* in 2015 on 4 ET_0-based irrigation treatments. Bars represent ± 1SE. Significant differences only in October between treatments 80% and 20% at p ≤ 0.5, and between 40% and 20% at p≤ 0.1using ANOVA and Tukey's HSD.

Table 10. Average monthly quality ratings for *Rosa* 'Cream Veranda'®.

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	AVG
Foliage								
80%	4.7	4.8	5.0	4.6	4.2	3.4	3.2	4.3
60%	4.3	4.8	4.8	4.8	3.7	3.8	3.5	4.3
40%	4.9	4.7	5.0	4.6	3.2	3.4	3.6	4.2
20%	4.7	4.8	4.3	4.8	4.0	3.3	3.2	4.2
Flowering								
80%	2.0	1.8	1.3	1.6	1.4	2.3	1.6	1.7
60%	3.8	2.0	1.8	1.8	1.5	3.6	1.6	2.3
40%	3.6	1.0	2.6	2.0	1.0	3.4	1.2	2.1
20%	2.6	1.8	1.8	1.8	1.0	3.2	2.3	2.1
Pest Tolerance								
80%	5.0	5.0	5.0	5.0	4.8	4.2	3.8	4.7
60%	5.0	5.0	5.0	5.0	4.8	4.3	4.7	4.8
40%	5.0	5.0	5.0	5.0	4.6	4.2	4.4	4.7
20%	4.8	5.0	5.0	5.0	5.0	4.2	4.0	4.7
Disease Resistance								
80%	5.0	5.0	5.0	5.0	4.4	3.6	3.6	4.5
60%	4.7	5.0	4.8	4.8	4.5	4.0	4.2	4.6
40%	5.0	5.0	5.0	5.0	4.2	3.4	3.8	4.5
20%	4.8	5.0	4.5	4.8	4.3	3.5	3.8	4.4
Vigor								
80%	2.7	3.3	2.7	3.4	3.4	3.4	3.6	3.2[bc]
60%	3.0	3.1	2.8	3.2	2.5	3.0	3.3	3.0[c]
40%	4.2	3.6	4.2	4.0	4.0	3.6	4.2	4.0[a]
20%	3.1	3.7	3.2	3.5	3.0	3.7	3.3	3.3[b]
Overall Appearance								
80%	3.2	3.5	3.2	3.5	3.3	3.2	3.0	3.3[b]
60%	3.3	3.2	3.0	3.5	2.8	3.3	2.7	3.1[b]
40%	4.4	3.9	3.9	3.8	3.4	3.2	3.4	**3.7[a]**
20%	4.0	3.8	3.2	3.8	3.2	3.2	2.7	3.4[ab]

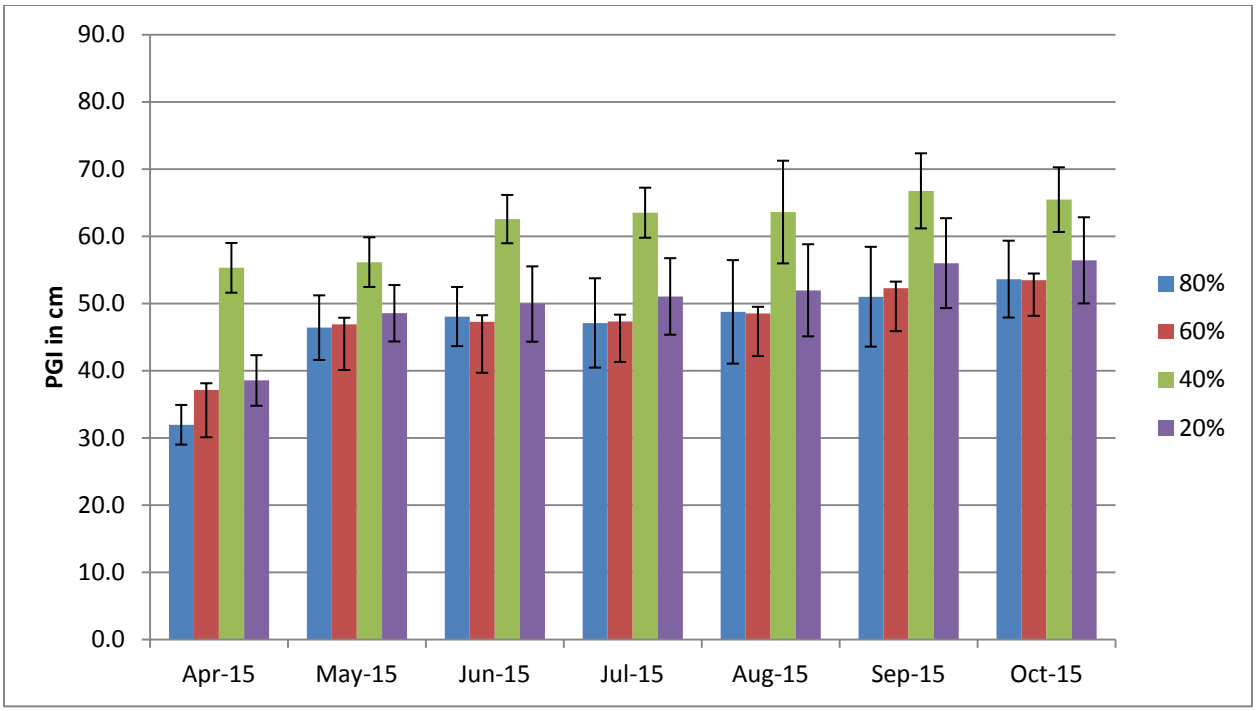

Figure 18a. Average monthly plant growth index for *Rosa* 'Cream Veranda'® in 2015 on 4 ET_0-based irrigation treatments. Bars represent ± 1SE. No significant differences using ANOVA and Tukey's HSD.

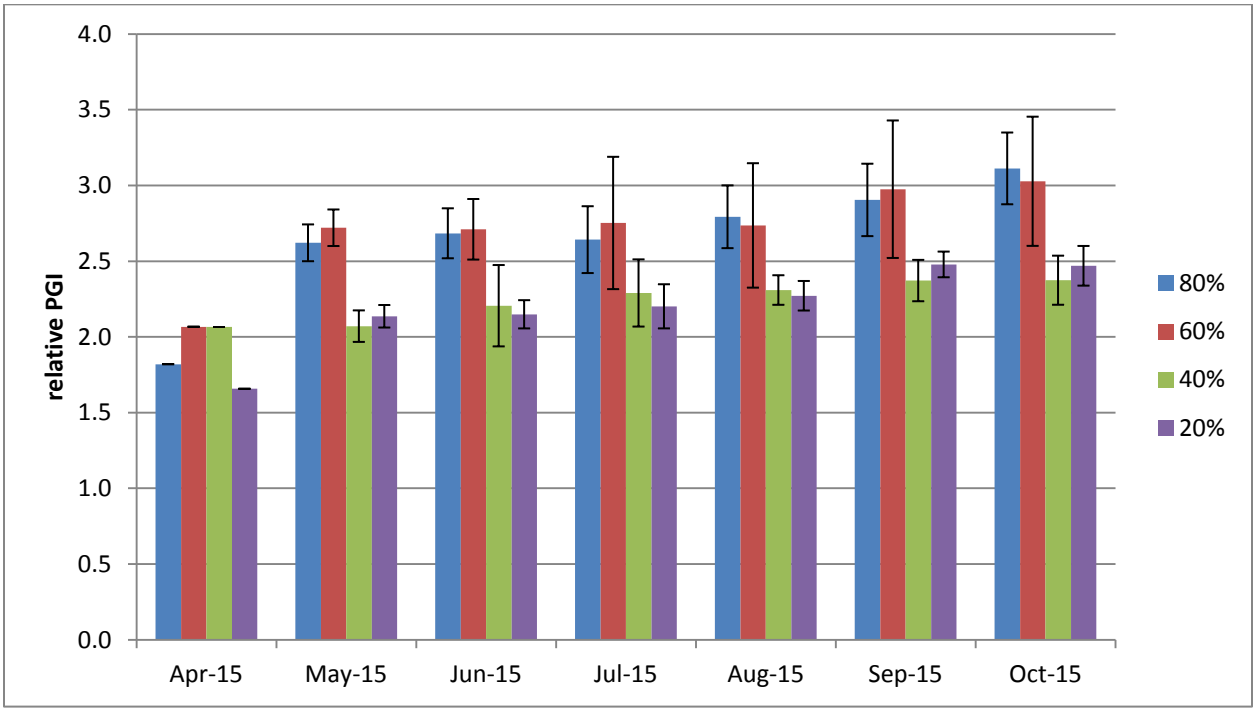

Figure 18b. Average monthly relative plant growth index for *Rosa* 'Cream Veranda'® in 2015 on 4 ET_0-based irrigation treatments. Bars represent ± 1SE. No significant differences using ANOVA and Tukey's HSD.

Table 11. Average monthly quality ratings for *Rosa* 'Kardinal™ Kolorscape'® in 2015 on 4 ET_0-based irrigation levels.

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	AVG
Foliage								
80%	4.2	4.8	4.5	4.2	4.2	3.5	3.5	4.1
60%	4.5	4.3	4.3	4.5	4.3	3.5	4.0	4.2
40%	4.1	4.3	4.3	4.3	4.3	3.5	3.3	4.0
20%	4.4	5.0	4.3	3.8	3.7	3.2	3.2	3.9
Flowering								
80%	3.7	3.0	3.6	3.2	3.5	2.7	2.7	3.2
60%	2.5	2.7	3.2	3.0	2.5	3.3	2.5	2.8
40%	2.3	2.8	2.5	2.3	3.2	2.8	2.5	2.6
20%	3.5	3.0	3.3	3.2	2.2	2.8	3.2	3.0
Pest Tolerance								
80%	5.0	5.0	5.0	5.0	5.0	4.3	3.8	4.7
60%	5.0	5.0	5.0	5.0	4.2	3.8	4.3	4.6
40%	5.0	5.0	5.0	5.0	5.0	4.3	4.2	4.8
20%	5.0	5.0	5.0	3.2	4.8	4.0	3.8	4.4
Disease Resistance								
80%	4.2	4.8	4.8	4.8	4.2	3.3	3.8	4.3
60%	4.8	4.7	4.5	4.7	3.5	3.5	4.2	4.3
40%	4.7	4.7	4.3	4.3	4.7	3.7	3.8	4.3
20%	4.7	5.0	4.7	3.5	4.0	3.2	4.0	4.1
Vigor								
80%	4.0	4.1	4.2	4.3	4.5	4.7	4.8	4.4
60%	4.4	4.5	4.5	4.8	4.7	4.7	4.7	4.6
40%	3.0	3.4	3.5	4.0	3.8	2.7	3.8	3.5
20%	4.2	4.1	4.7	4.5	4.2	4.0	3.8	4.2
Overall Appearance								
80%	4.2	4.3	4.3	4.3	4.7	3.7	4.2	4.2
60%	4.3	4.3	4.2	4.6	4.2	4.2	4.1	4.3
40%	3.9	3.6	4.1	4.0	4.0	3.8	3.8	3.9
20%	4.5	4.3	4.5	4.4	3.8	3.3	3.8	4.1

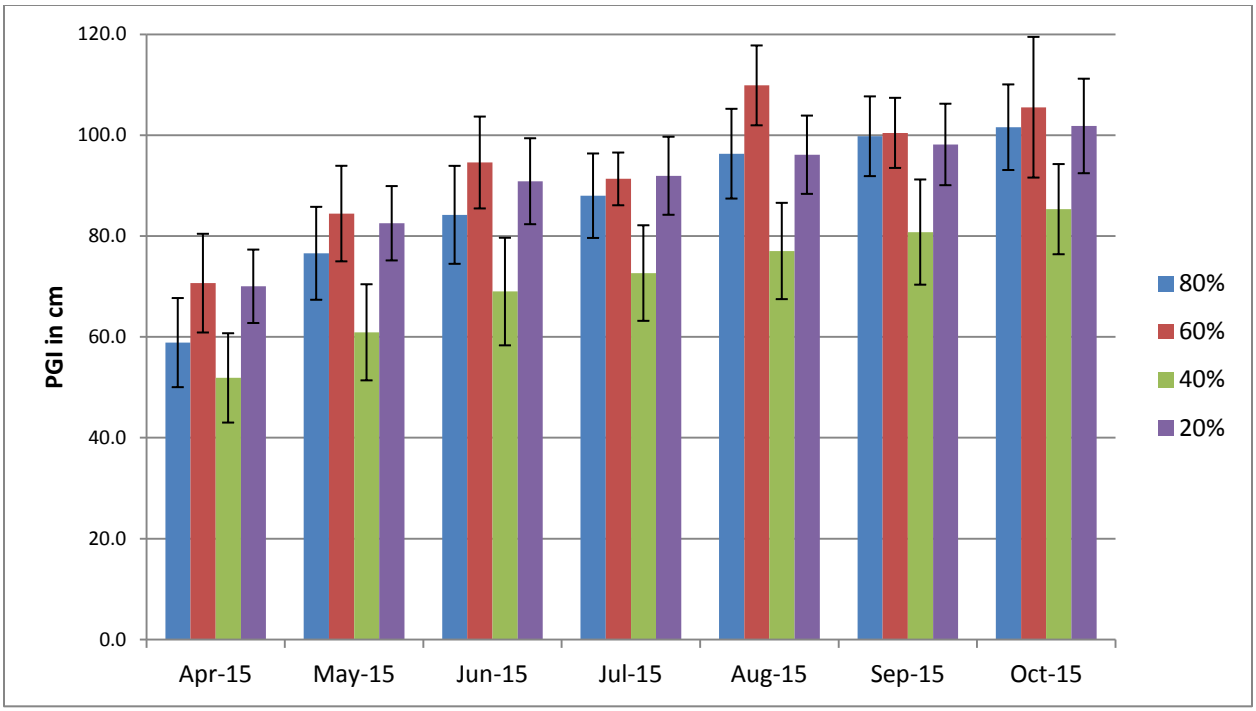

Figure 19a. Average monthly plant growth index for *Rosa* 'Kardinal™ Kolorscape®' in 2015 on 4 ET_0-based irrigation levels. Bars represent ±1 SE. No significant differences using ANOVA and Tukey's HSD.

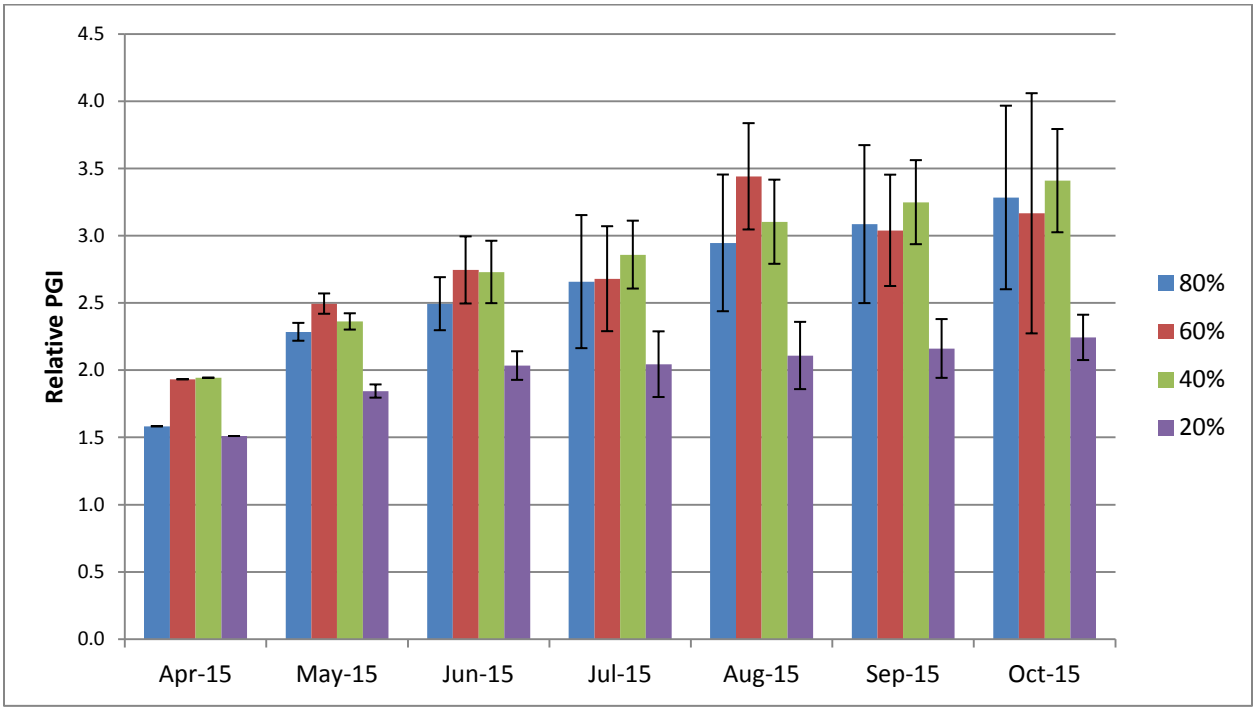

Figure 19b. Average monthly relative plant growth index for *Rosa* 'Kardinal™ Kolorscape®' in 2015 on 4 ET_0-based irrigation levels. Bars represent ±1 SE. No significant differences using ANOVA and Tukey's HSD.

Table 12. Average monthly quality ratings for *Solanum xanti* 'Mountain Pride' in 2015 on 4 ET_0-based irrigation levels.

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	AVG
Foliage								
80%	2.8	3.2	3.5	4.0	2.5	2.3	3.3	3.1[b]
60%	3.9	3.8	3.4	2.6	2.2	1.8	2.8	2.9[b]
40%	3.5	4.0	3.3	3.7	3.3	2.7	3.7	3.5[a]
20%	3.3	3.2	3.0	3.3	2.3	2.3	2.3	2.8[b]
Flowering								
80%	1.8	3.0	3.0	4.0	2.5	2.5	3.5	2.9[b]
60%	2.6	3.0	5.0	2.7	1.0			2.9[b]
40%	1.0	3.3	3.0	2.3	2.3	3.0	1.0	2.3[b]
20%	2.3	4.5	4.5	4.0	5.0	2.5	5.0	4.0[a]
Pest Tolerance								
80%	5.0	5.0	5.0	5.0	5.0	2.8	4.0	4.5
60%	5.0	5.0	5.0	5.0	4.6	2.0	4.3	4.4
40%	5.0	5.0	5.0	5.0	5.0	2.7	5.0	4.7
20%	5.0	5.0	5.0	5.0	3.5	2.5	3.8	4.3
Disease Resistance								
80%	4.4	5.0	4.0	4.0	5.0	5.0	3.7	4.4
60%	5.0	4.4	4.0	4.6	5.0	5.0	4.5	4.6
40%	4.0	4.3	5.0	3.7	5.0	5.0	4.3	4.5
20%	4.3	5.0	5.0	3.5	4.5	5.0	4.0	4.5
Vigor								
80%	2.2	2.6	3.0	4.0	2.5	3.3	3.7	3.0
60%	3.7	3.2	4.2	3.0	2.6	2.3	2.5	3.1
40%	2.7	3.3	3.3	3.3	3.3	3.3	3.7	3.3
20%	2.8	3.8	3.3	3.5	3.0	2.8	2.5	3.1
Overall Appearance								
80%	2.6	2.8	3.0	3.3	2.5	2.3	3.3	2.8[ab]
60%	3.6	3.2	3.1	2.4	2.0	1.8	2.0	2.6[ab]
40%	3.0	4.0	2.8	3.0	3.0	3.0	3.3	**3.2** [a]
20%	2.5	3.0	2.8	2.5	2.0	2.0	2.3	2.4 [b]

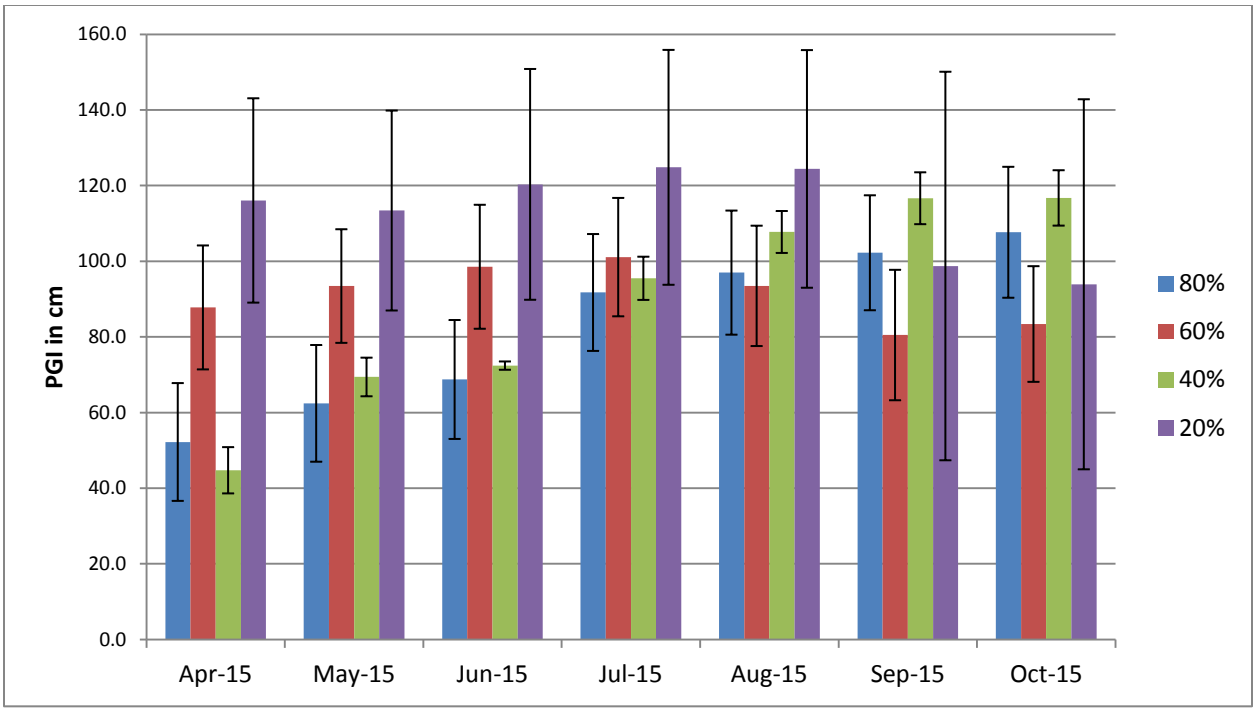

Figure 20a. Average monthly plant growth index for *Solanum xanti* 'Mountain Pride' in 2015 on 4 ET_0-based irrigation levels. Bars represent ±1 SE. For all treatments n=3. No significant differences between treatments using ANOVA and Tukey's HSD.

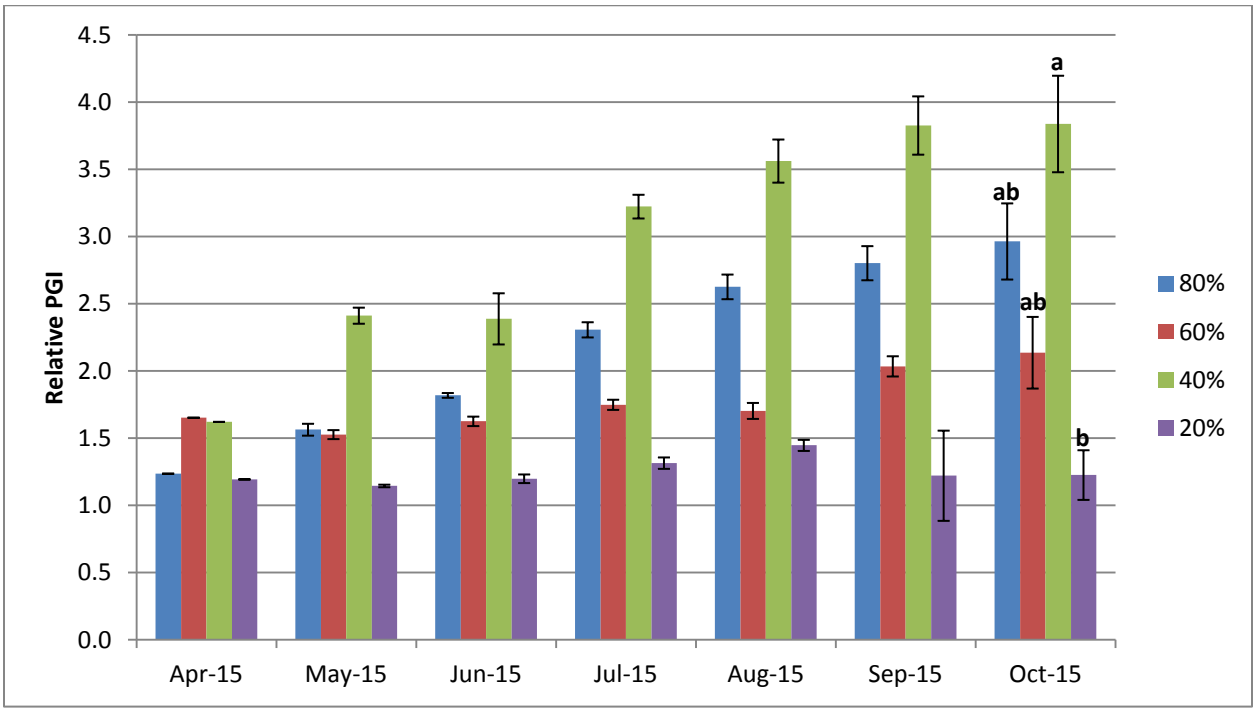

Figure 20b. Average monthly relative plant growth index for *Solanum xanti* 'Mountain Pride' in 2015 on 4 ET_0-based irrigation levels. Bars represent ±1 SE. For all treatments n=3. 40% treatment was significantly greater than 20% at $p \leq 0.01$ using ANOVA and Tukey's HSD.

SHADE SPECIES

Table 13. Average monthly quality ratings for *Correa pulchella* 'Pink Eyre' in 2015 on 4 ET_0-based irrigation levels

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	AVG
Foliage								
80%	5.0	5.0	5.0	5.0	5.0	4.8	5.0	5.0
60%	4.8	4.8	4.8	4.8	4.8	4.7	4.8	4.8
40%	5.0	4.8	5.0	5.0	4.8	5.0	5.0	5.0
20%	5.0	4.8	5.0	5.0	4.8	5.0	5.0	5.0
Pest Tolerance								
80%	5	5	5	5	5	5	5	5.0
60%	5	5	5	5	5	5	5	5.0
40%	5	5	5	5	5	5	5	5.0
20%	5	5	5	5	5	5	5	5.0
Disease Resistance								
80%	5	5	5	5	5	5	5	5.0
60%	5	5	5	5	5	5	5	5.0
40%	5	5	5	5	5	5	5	5.0
20%	5	5	5	5	5	5	5	5.0
Vigor								
80%	3.8	3.9	4.5	4.2	3.8	4.0	4.0	4.0
60%	4.6	4.2	4.5	4.5	4.2	4.3	4.3	4.4
40%	4.5	4.4	4.5	4.5	4.0	4.6	4.7	4.5
20%	4.6	4.4	4.4	4.8	3.9	4.3	4.3	4.4
Overall Appearance								
80%	4.4	3.8	4.3	4.1	3.8	4.2	4.0	4.1
60%	4.5	4.2	4.2	4.3	4.0	4.0	4.4	4.2
40%	4.6	4.0	4.2	4.2	3.8	4.2	4.0	4.1
20%	4.6	4.0	4.3	4.1	3.8	4.2	4.0	4.1

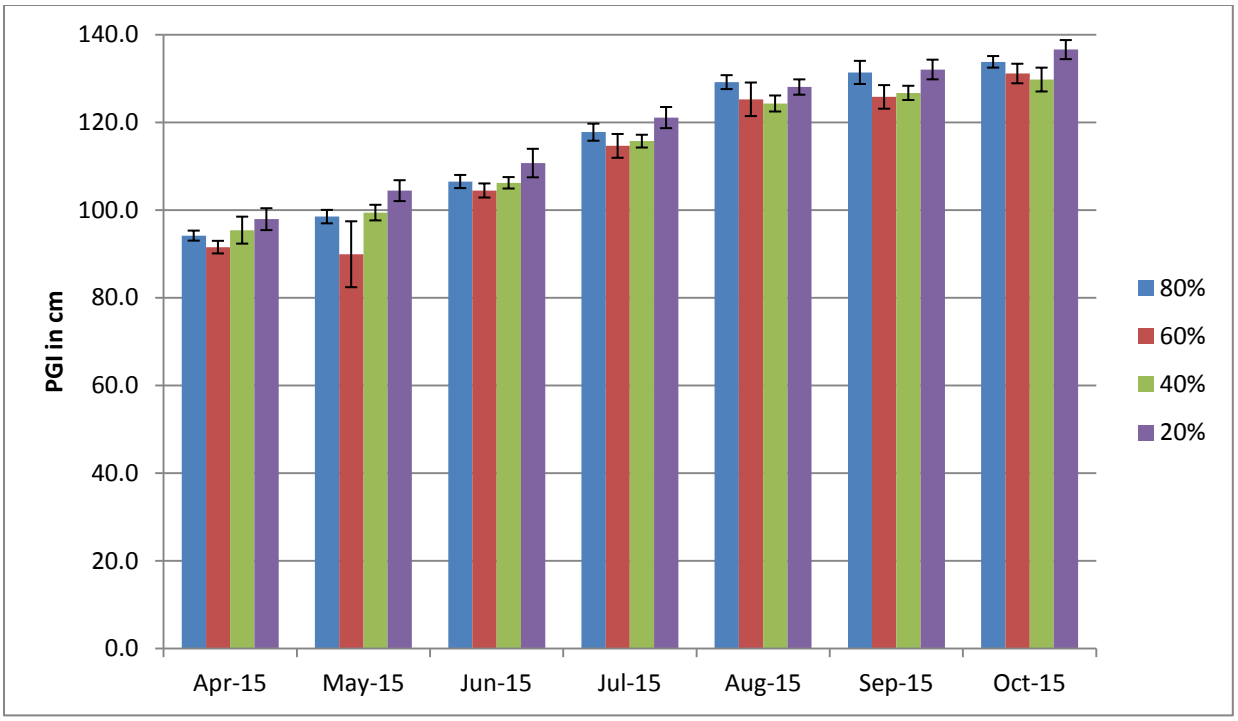

Figure 21a. Average monthly plant growth index for *Correa pulchella* 'Pink Eyre' in 2015 on 4 ET_0-based irrigation levels. Bars represent ±1 SE. No significant differences using ANOVA and Tukey's HSD.

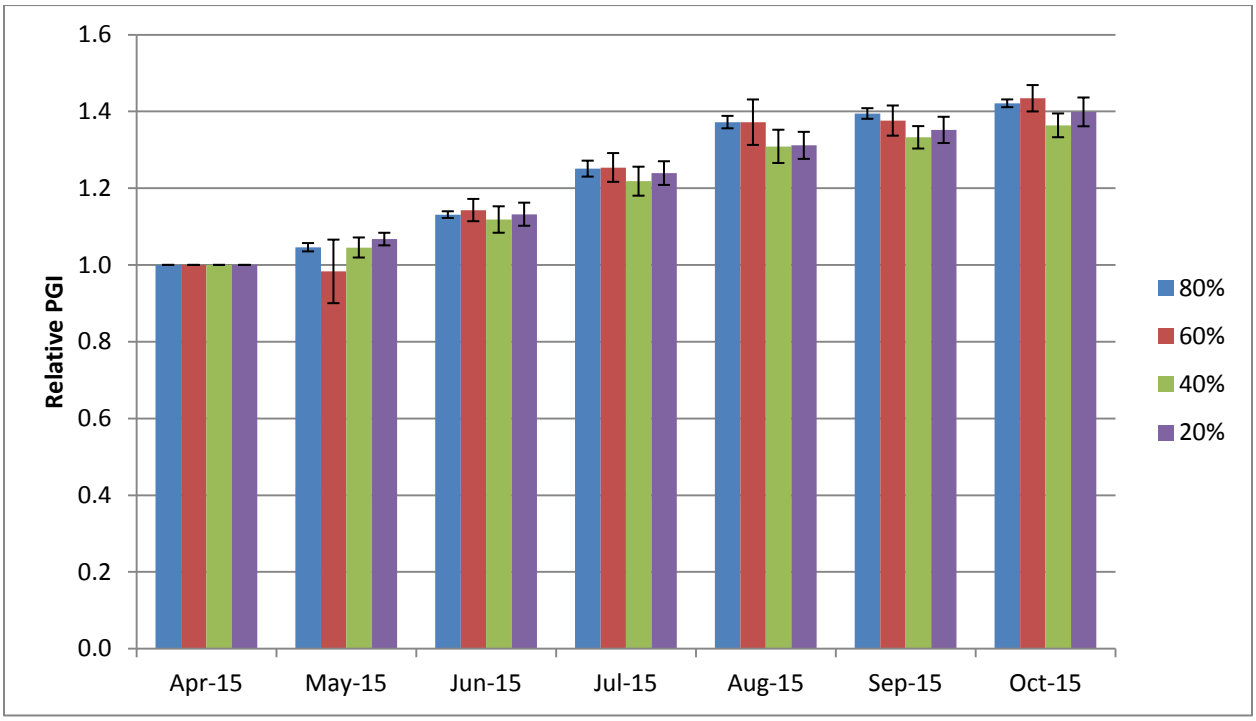

Figure 21b. Average monthly relative plant growth index for *Correa pulchella* 'Pink Eyre' in 2015 on 4 ET_0-based irrigation levels. Bars represent ±1 SE. No significant differences using ANOVA and Tukey's HSD.

Table 14. Average quality ratings for *Dianella caerulea* 'King Alfred' in 2015 on 4 ET_0-based irrigation levels.

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	
Foliage								
80%	4.2	4.0	3.8	3.3	3.8	3.6	3.5	3.8
60%	4.0	4.0	3.9	4.1	3.8	3.7	3.5	3.9
40%	4.3	4.1	3.6	2.8	2.8	3.2	3.0	3.4
20%	4.0	4.0	3.8	3.3	3.5	3.3	3.7	3.7
Flowering								
80%	1.2	0.7	1.4	1.0	1.0	1.0	1.0	1.0
60%	1.4	1.0	1.7	1.0		1.0	1.0	1.2
40%	1.3	1.2	1.3	1.0		1.0		1.1
20%	1.2	1.0	1.3	1.0		1.0	1.0	1.1
Pest Tolerance								
80%	5.0	5.0	5.0	4.0	5.0	4.0	3.8	4.5
60%	5.0	5.0	5.0	4.7	4.5	4.3	4.3	4.7
40%	5.0	5.0	4.5	3.4	5.0	3.6	3.2	4.2
20%	5.0	5.0	4.8	4.2	5.0	4.0	4.0	4.6
Disease Resistance								
80%	5.0	5.0	5.0	5.0	4.7	5.0	4.5	4.9
60%	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
20%	5.0	5.0	5.0	5.0	4.5	5.0	5.0	4.9
Vigor								
80%	4.4	4.1	4.3	3.8	4.0	4.8	4.3	4.3
60%	4.5	4.3	4.4	4.1	4.2	4.2	4.3	4.3
40%	4.8	3.8	4.4	3.8	3.6	3.6	4.0	4.0
20%	4.7	4.3	4.5	3.8	4.2	4.5	4.3	4.3
Overall Appearance								
80%	4.6	4.1	4.2	3.3	3.5	3.3	3.4	3.8[ab]
60%	4.5	4.0	4.3	3.8	3.6	3.9	4.2	**4.0** [a]
40%	4.5	4.0	3.7	3.2	2.8	3.2	2.9	3.5 [b]
20%	4.8	4.4	4.2	3.3	3.3	3.8	3.3	3.9[ab]

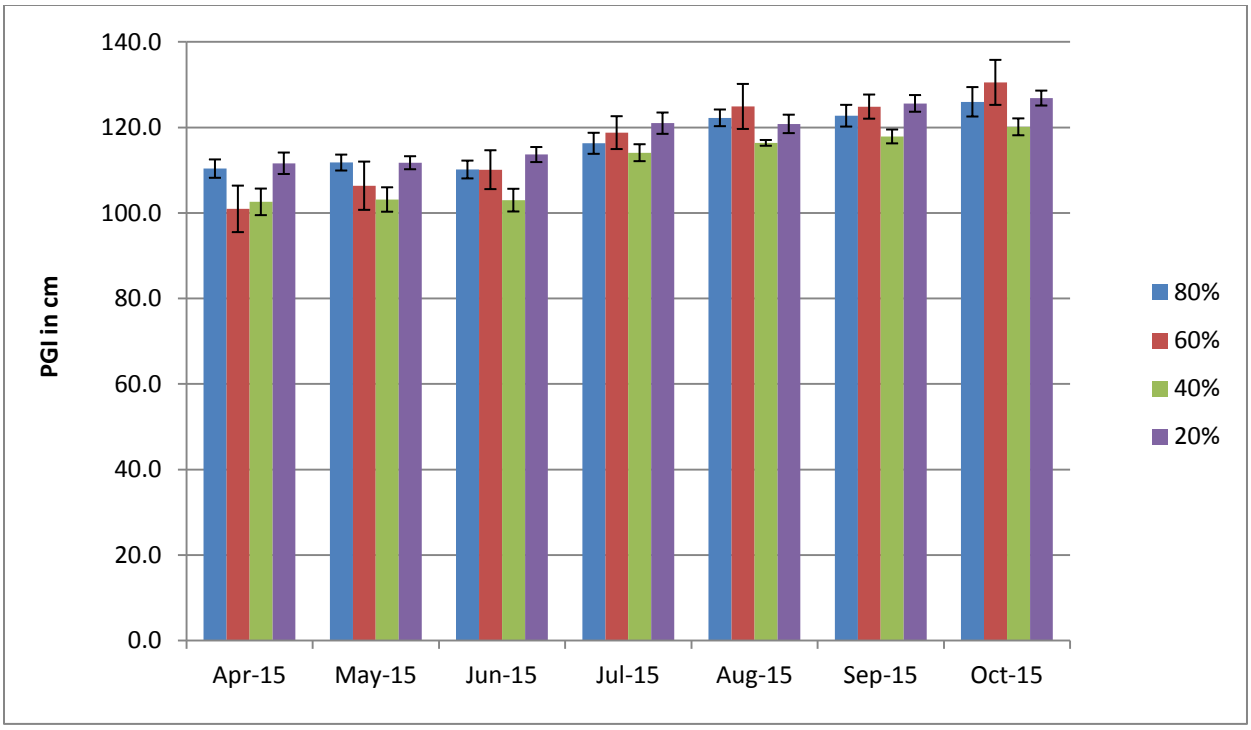

Figure 22a. Average monthly plant growth index for *Dianella caerulea* 'King Alfred' in 2015 on 4 ET_0-based irrigation levels. Bars represent ±1 SE. No significant differences using ANOVA and Tukey's HSD.

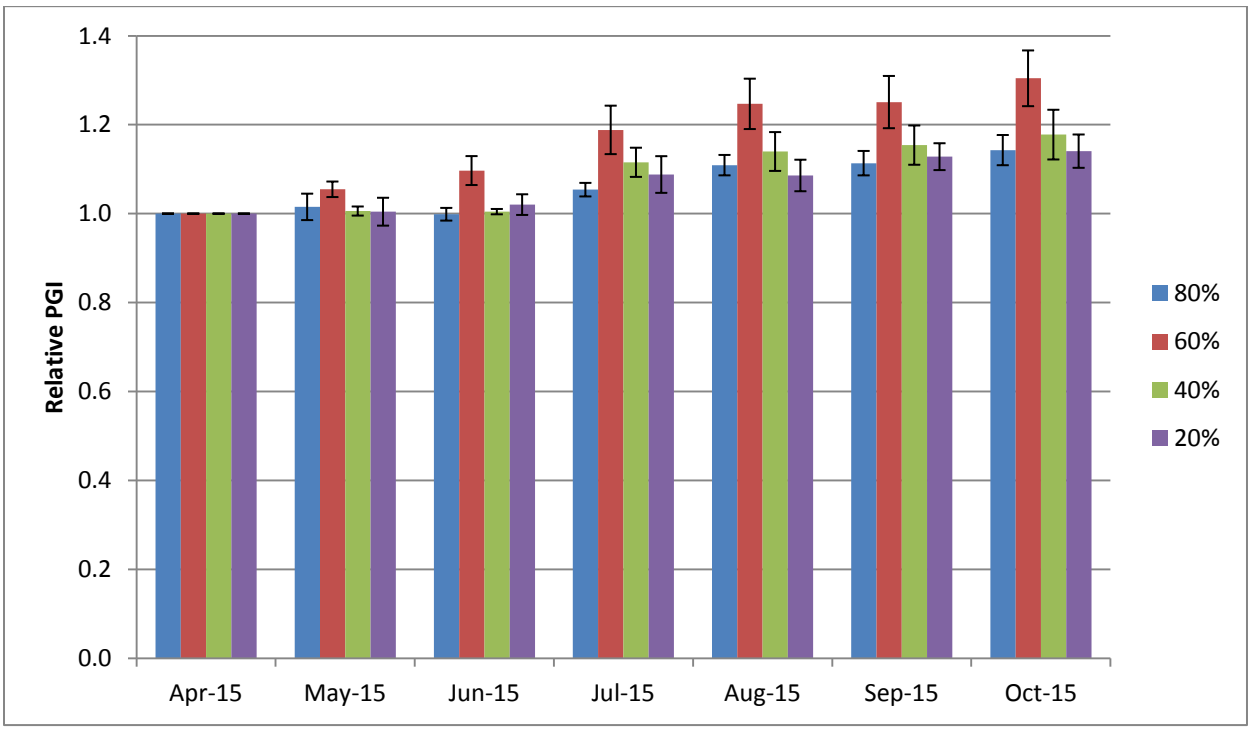

Figure 22b. Average monthly relative plant growth index for *Dianella caerulea* 'King Alfred' in 2015 on 4 ET_0-based irrigation levels. Bars represent ±1 SE. No significant differences using ANOVA and Tukey's HSD.

Table 15. Average monthly quality ratings for *Lomandra* 'Lomlon' in 2015 on 4 ET_0-based irrigation levels.

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	AVG
Foliage								
80%	4.1	4.1	4.0	4.2	4.0	4.0	4.0	4.0
60%	4.2	4.0	4.0	4.0	4.0	4.3	4.0	4.1
40%	4.1	4.0	4.0	4.3	4.2	4.0	4.0	4.1
20%	4.3	4.0	4.2	4.2	4.3	4.3	4.2	4.2
Flowering								
80%	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.1
60%	1.5	1.0	1.0	2.0	1.0	1.0	1.0	1.2
40%	1.4	1.3	1.0	1.0		1.0	1.0	1.1
20%	1.5	1.3	1.0	1.7	1.0	1.0	1.0	1.2
Pest Tolerance								
80%	5.0	5.0	5.0	5.0	4.5	5.0	5.0	4.9
60%	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
20%	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	5.0	5.0
60%	5.0	5.0	5.0	5.0	4.9	5.0	5.0	5.0
40%	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
Vigor								
80%	4.3	4.0	4.6	4.2	4.6	4.6	4.2	4.3
60%	4.1	4.0	4.2	4.3	4.2	4.3	4.5	4.2
40%	4.4	4.0	4.6	4.5	4.3	4.6	4.5	4.4
20%	4.5	4.2	4.7	4.7	4.3	4.5	4.5	4.5
Overall Appearance								
80%	4.4	4.2	4.8	4.2	4.3	4.8	4.3	4.4
60%	4.5	4.2	4.3	4.1	4.2	4.0	4.6	4.3
40%	4.3	4.3	4.4	4.0	4.2	4.7	4.7	4.4
20%	4.7	4.5	4.8	4.4	4.3	4.4	4.7	4.5

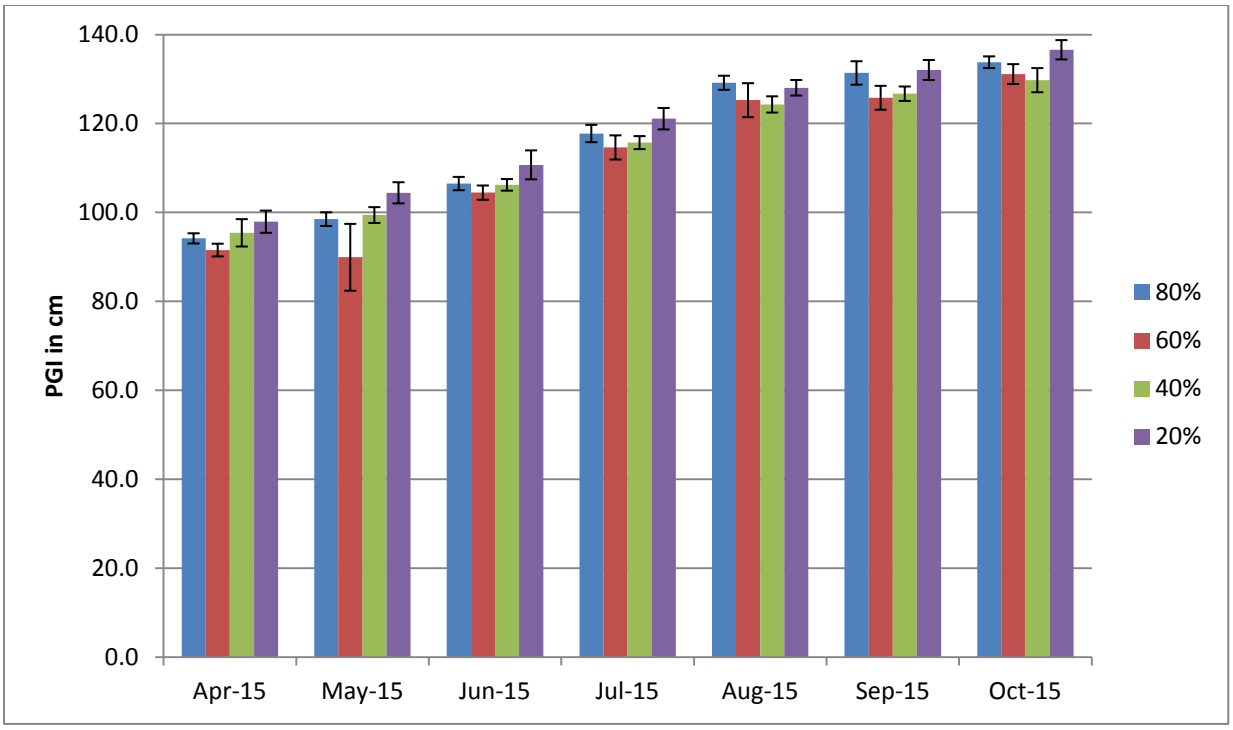

Figure 23a. Average monthly plant growth index for *Lomandra* 'Lomlon' in 2015 on 4 ET_0-based irrigation levels. Bars represent ±1 SE. No significant differences using ANOVA and Tukey's HSD.

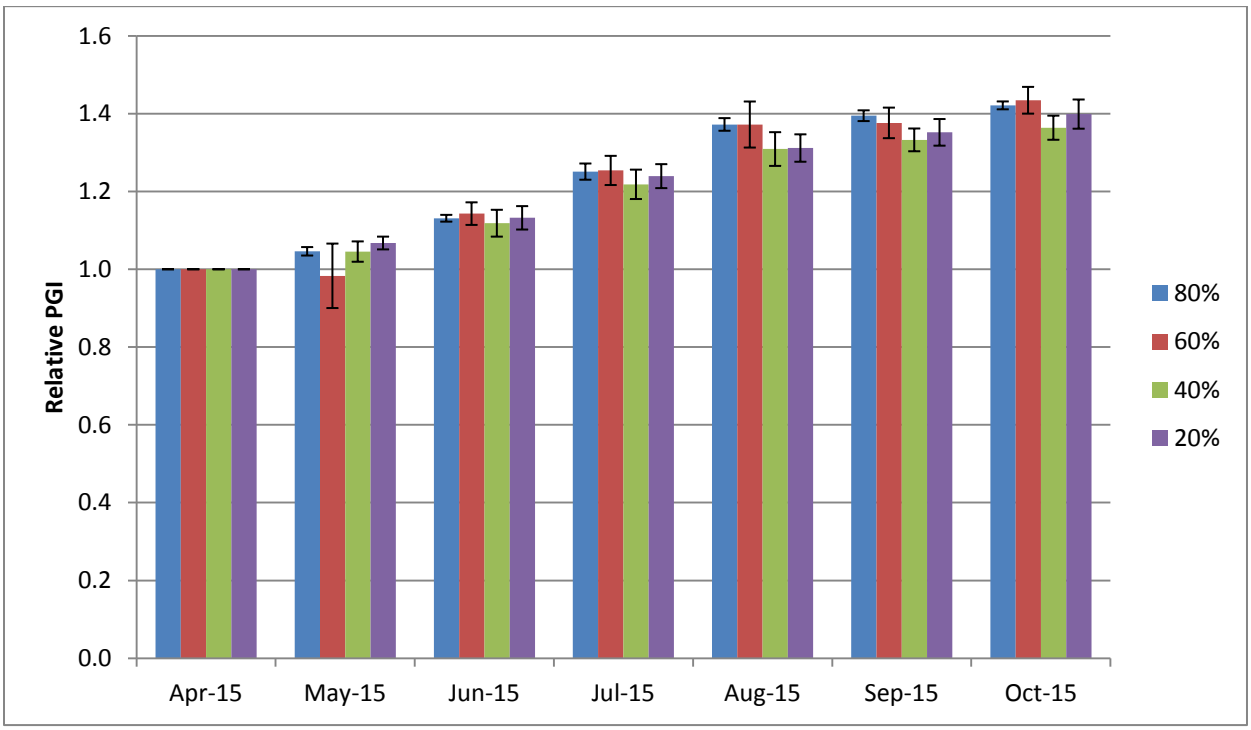

Figure 23b. Average monthly relative plant growth index for *Lomandra* 'Lomlon' in 2015 on 4 ET_0-based irrigation levels. Bars represent ±1 SE. No significant differences using ANOVA and Tukey's HSD.

Table 16. Average monthly quality ratings for *Ribes viburnifolium* 'Spooner's Mesa' in 2015 on 4 ET_0-based irrigation treatments.

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	AVG
Foliage								
80%	4.9	5.0	5.0	5.0	5.0	4.3	4.5	4.8
60%	4.9	5.0	5.0	4.8	5.0	4.8	5.0	4.9
40%	5.0	4.8	4.8	4.8	5.0	5.0	4.8	4.9
20%	4.8	4.9	4.9	5.0	5.0	5.0	5.0	5.0
Pest Tolerance								
80%	5.0	5.0	5.0	5.0	5.0	4.5	5.0	4.9
60%	5.0	5.0	4.7	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
20%	5.0	5.0	5.0	5.0	5.0	5.0	4.8	5.0
Disease Resistance								
80%	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
40%	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
Vigor								
80%	4.3	4.3	4.5	4.5	4.2	4.3	4.7	4.4
60%	4.3	4.4	4.4	4.6	4.3	4.5	4.8	4.5
40%	4.7	4.4	4.5	4.6	4.7	4.2	5.0	4.6
20%	4.3	3.8	4.7	4.5	4.3	4.3	4.0	4.3
Overall Appearance								
80%	4.3	4.2	4.0	3.7	3.5	3.7	4.4	4.0
60%	4.3	4.3	4.2	4.3	3.7	4.4	4.5	4.2
40%	4.3	4.0	4.2	4.0	3.8	4.0	4.2	4.1
20%	4.6	4.2	4.3	4.0	4.2	4.0	4.0	4.2

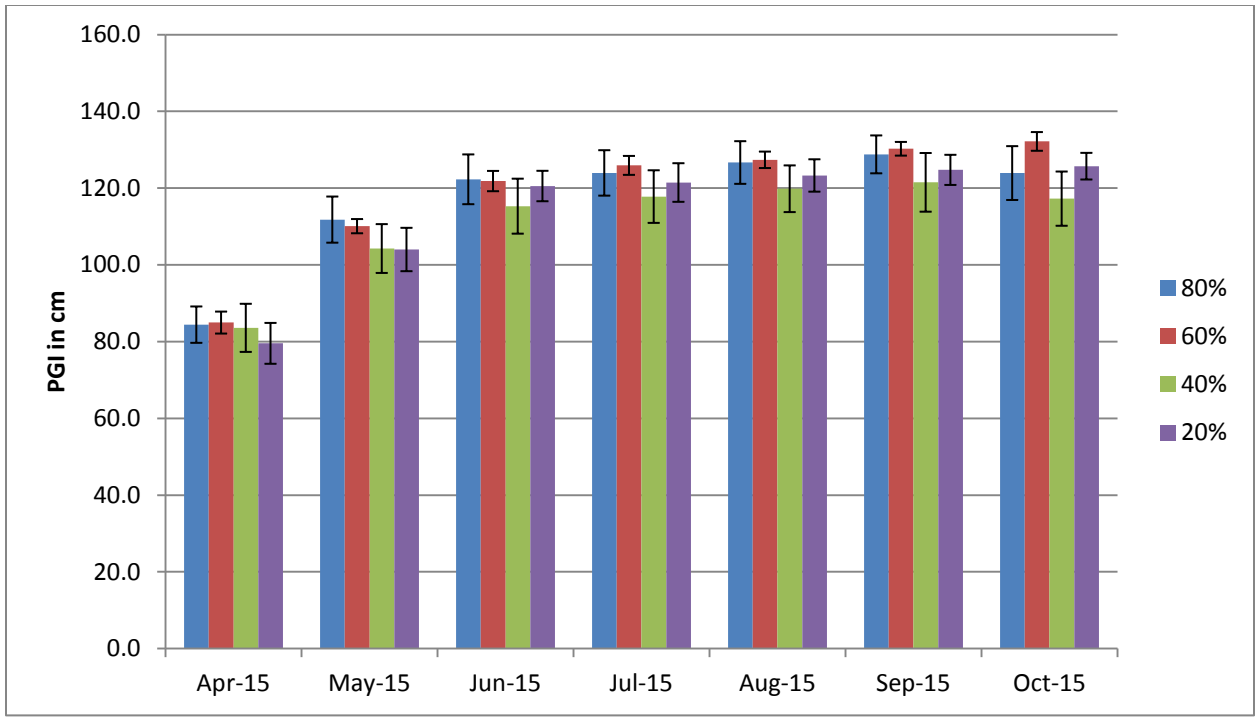

Figure 24a. Average monthly plant growth index for *Ribes viburnifolium* 'Spooner's Mesa' in 2015 on 4 ET_0-based irrigation levels.

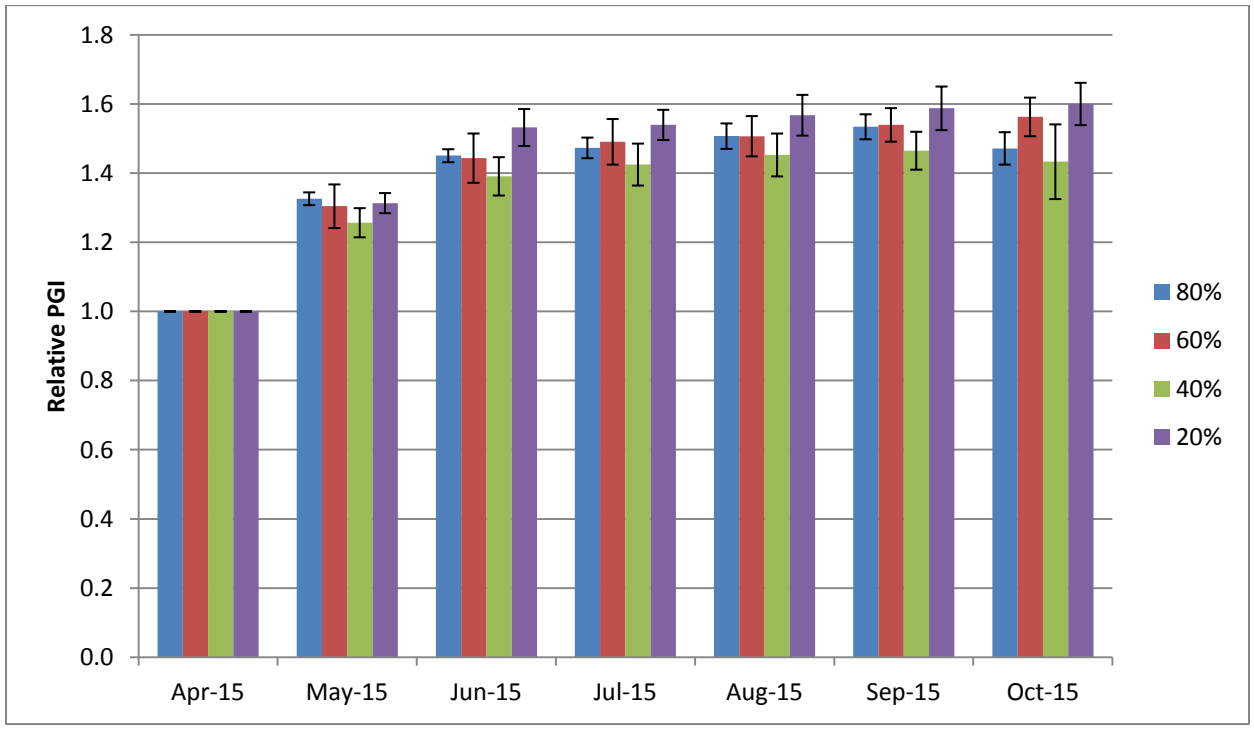

Figure 24b. Average monthly relative plant growth index for *Ribes viburnifolium* 'Spooner's Mesa' in 2015 on 4 ET_0-based irrigation levels.