Irrigation and Climate Zone Trials of UC Davis Arboretum All-Stars
2008-2009
Lorence R. Oki, Principal Investigator
Karrie Reid, Project Manager

INTRODUCTION

The irrigation trials field on the UC Davis campus was planted in the fall of 2007, with follow-up plantings in the spring of 2008 to replace some plants that failed the first winter. The plants were established on regular water at roughly 80% of ETo (reference evapotranspiration) throughout the first growing season. Irrigation was discontinued when winter rains were sufficient to maintain the soil moisture at an adequate level for plant establishment.

Deficit irrigation treatments began during the irrigated growing season of 2009, with the first irrigation occurring on June 2 to the highest level treatment. The four levels of irrigation correspond to 80%, 60%, 40%, and 20% of ETo. For the lowest treatment (20%), the plants were irrigated twice: 7/18 and 9/21. The 40% treatment received roughly once-a-month irrigation; the 60% level ranged from 18 to 23 days beginning June 9; the 80% treatment ranged from every 11 to every 16 days near the end of the season.

We began with 10 species as shown in the table below. However, *Viguiera parishii* developed an infestation of an eriophyid mite, a CDFA Q-rated pest, and had to be removed from the field under the supervision of the County Agriculture Inspector. A second species, *Sedum palmeri*, did not tolerate the heavy clay-loam field soils and only 2 of 24 specimens survived after the second winter. Although growth data for this plant in the irrigation field will not be included in this report for this reason, the Master Gardeners' evaluations and comments will be, though their survival rates were also low.

Plants were delivered to Master Gardener (MG) demonstration gardens beginning in the fall of 2007 for 2 species: *Muhlenbergia dubia* and *Sedum palmeri.* The rest of the plants were delivered in the fall of 2008, or for the newer county sites (Riverside, Orange, San Joaquin, and Los Angeles) in the spring of 2009. Although initially Master Gardeners measured plants monthly, the method was changed to quarterly measurements during 2009. Please note that these differences are reflected in the graphs showing the year's growth for the plants by county. Also note that the Master Gardener's growth data shows only the first establishment year, as those plants are now in their second year of growth.

DATA PRESENTATION

For each species, the irrigation trials growth graphs will be shown: plant growth index (PGI) in cm, and relative plant growth index (PGI compared to beginning PGI.) While the PGI graphs can show the different size obtained on different water levels or in different climate zones, the relative PGI normalizes the data for differences in the starting sizes of the plants. Standard error bars signifying +/- 1 SE are represented on the graphs of normalized data, but were not put into the graphs of simple plant growth indexes. Any significant differences can be ascertained from the first graph in each set, but, because the values are often quite close, the bars can obscure interesting, if statistically insignificant, trends in size related to irrigation treatment. It is possible that these trends would indeed become significant if we had space in the field for larger sample sizes for each treatment.

Quality ratings for the irrigated growing season by irrigation treatment will be accompanied by the Master Gardeners' quality ratings by county. All ratings are on a scale of 1 to 5, with 1 being the lowest and 5 the highest rating. The guidelines for rating 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 had an appealing appearance. A "1" would mean the plant was on its last legs and practically dead.
- A "5" for flowering would mean full, glorious bloom. A "1" would mean very poor, straggling bloom, damaged flowers, OR the plant is either just beginning to bloom with very few blooms open or finishing.
- A "5" for insect or disease resistance would mean no visible damage. A "1" would mean badly damaged and probably dying.
- A "5" for overall vigor would mean the plant is thriving, a "3" would mean it is surviving (not its best, but probably on its way back from transplant shock, animal browsing, mechanical damage or frost bite), and "1" would mean it is on its way out.

Field notes and MG comments will be summarized with each species. Keep in mind that for most species MG data will be for Year One, whereas the field irrigation data is for the end of Year Two.

It should be noted that not all counties have all the plants. The Los Angeles and Mariposa Counties' gardens are devoted to California natives. Several counties do not have space or proper sun/shade requirements for every species. It will be obvious from the graphs and tables where this is the case.

The 2009 irrigated growing season was the first time quality ratings were systematically taken in the irrigation trials field. Plants that had bloomed prior to the start of data collection do not have significant floral ratings, if any. In order to assess the affects of irrigation on spring flowering, the plants would have had to be grown an additional year.

Table 1 **Natives are marked with a ***

Scientific name	Common name	In demo gardens?
Acacia boormanii	Snowy River wattle	yes
Ceanothus pallidus 'Marie Simon'	'Marie Simon' California lilac	yes
Cercocarpus betuloides ssp. blanchae *	Island mountain mahogany	No (not available)
Iris 'Canyon Snow' *		yes
Leucophyllum langmaniae 'Lynn's Legacy'	Lynn's everblooming Texas sage	yes
Muhlenbergia dubia	Pine muhly	yes
Penstemon 'Margarita BOP"*	'Margarita BOP' Foothill penstemon	yes
Saponaria x lempergii 'Max Frei'	Max Frei's soapwort	yes
Sedum palmeri	Palmer's sedum	yes
Viguiera parishii	Goldeneye	ELIMINATED

Acacia boormanii Snowy River Wattle

Chart 1a (on all graphs, error bars represent +/- 1SE)

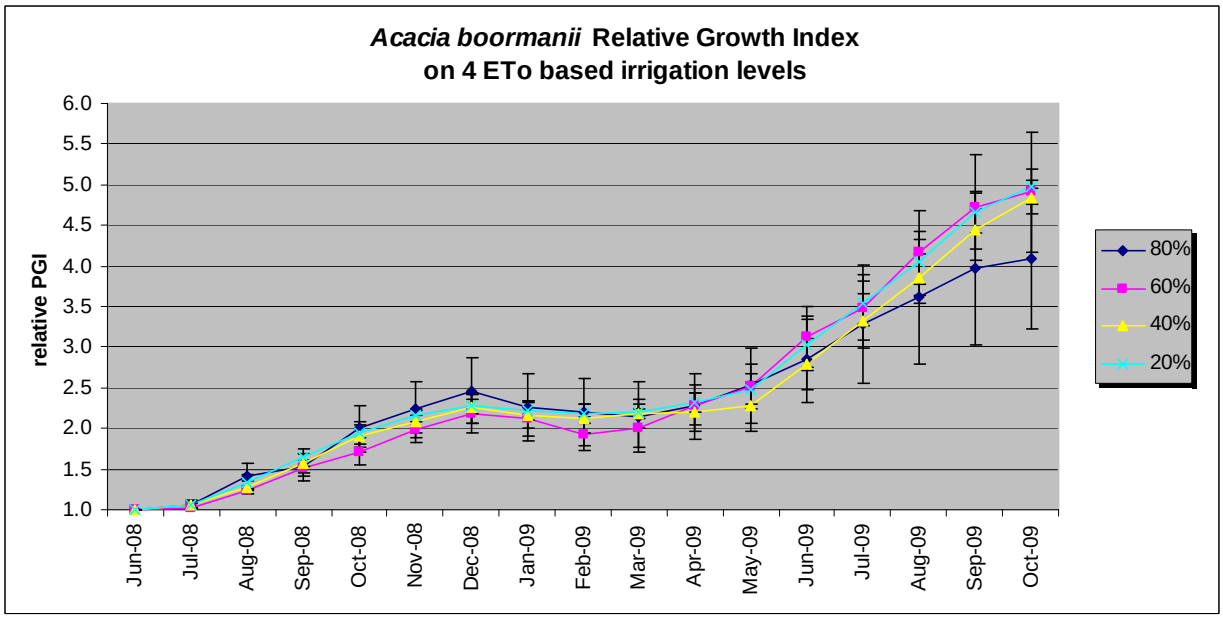
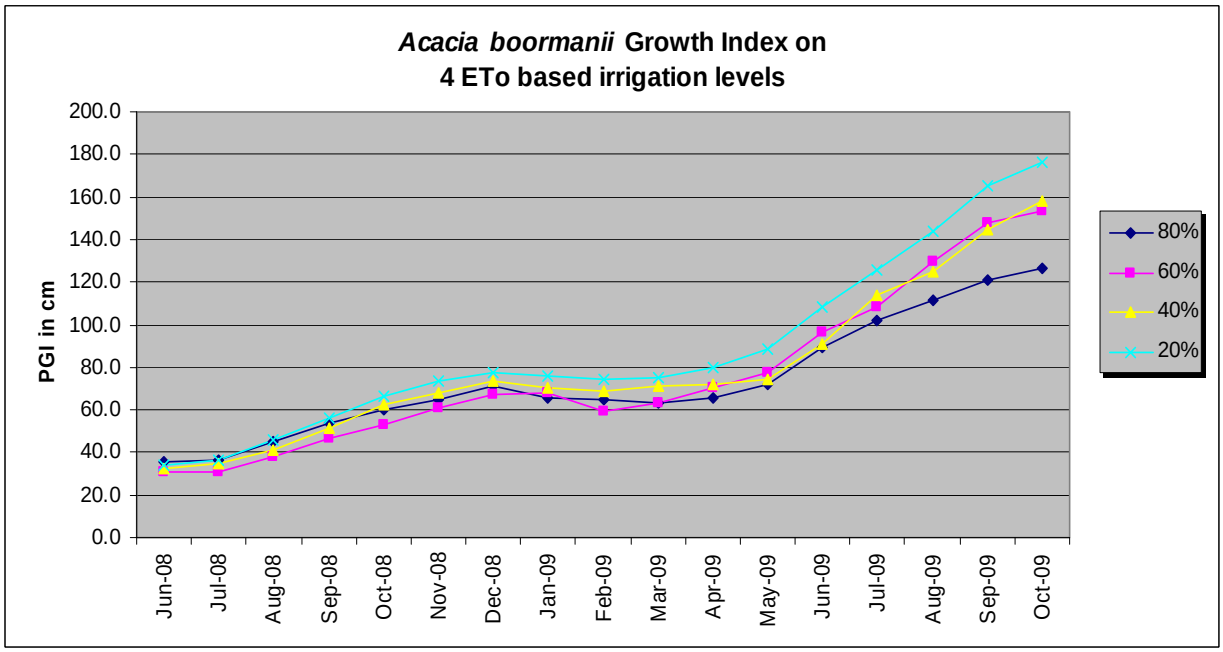


Chart 1b



Interestingly, the largest plants were, on average, provided the lowest irrigation treatment. However, when the measurements were transformed, the relative PGIs for plants receiving 20, 40, and 60% were all extremely close, and the PGI and RPGI of the 80% was affected by 2 small, struggling plants that brought down the averages. As can be seen from the ratings below, the most attractive plants were indeed on the lowest irrigation treatment.

QUALITY RATINGS DURING DEFICIT IRRIGATION

Table 1a (all ratings are based on a 1-5 scale)

SPECIES 1 - *Acacia boormanii*				
foliage	JUNE	JULY	AUG	SEPT
80%	3.0	3.6	3.4	3.8
60%	**4.6**	4.4	4.3	**5.0**
40%	**4.5**	4.8	**4.8**	4.5
20%	**4.6**	**5.0**	**4.8**	**5.0**
vigor				
80%	2.8	3.4	3.4	4.0
60%	4.4	4.3	4.3	4.8
40%	4.3	4.8	**5.0**	4.8
20%	4.6	**5.0**	**5.0**	**5.0**
average				
80%	2.9	3.5	3.4	3.9
60%	4.4	4.4	4.3	**4.9**
40%	4.4	4.8	**4.9**	4.7
20%	**4.6**	**5.0**	**4.9**	**5.0**

Highest values within 0.1 are bolded

IRRIGATION TRIALS QUALITY COMMENT SUMMARY

1. Foliage had yellowing and some consistent leaf drop from the older parts of the stems both winter and summer, except at lowest ETo. Values are consistently higher at lower levels of irrigation. Deep irrigation no more than monthly in the summer once established is recommended, and perhaps less frequently in heavy soil.
2. Lowest ETo showed reddish tips on new growth, which was quite attractive.
3. Overall a very attractive willowy form at this age.
4. In 2 years, average height and width grew from 13.5” X 12.5” to 56” X 65”.

MASTER GARDENERS’ YEAR 1 DATA

Table 1b (all ratings are based on a 1-5 scale)

***Acacia boormanii* Average Annual Quality Ratings for Year 1**									
Sunset zone	**14**	**22/23**	**18/19**	**14**	**17**	**24**	**21**	**9**	**Average**
County	Alameda	Orange	Riverside	San Joaq.	Santa Cla	SD-Flbrk	SD-ElCajon	Shasta	
Foliage	2.2	3.1	3.1	3.2	4.1	4.0	4.5	2.8	**3.4**
Flowering	5				1.1	1			**2.4**
Pest resistance	5	5	5	5	5	5	5	5	**5.0**
Disease resistance	4.8	5.0	5.0	5.0	5.0	5.0	4.9	4.7	**4.9**
Overall vigor	2.0	3.1	3.3	3.5	4.0	4.1	4.4	3.0	**3.4**
Overall AVG	**3.6**	**4.0**	**4.1**	**4.2**	**4.3**	**3.8**	**4.7**	**3.9**	**4.1**

Chart 1c

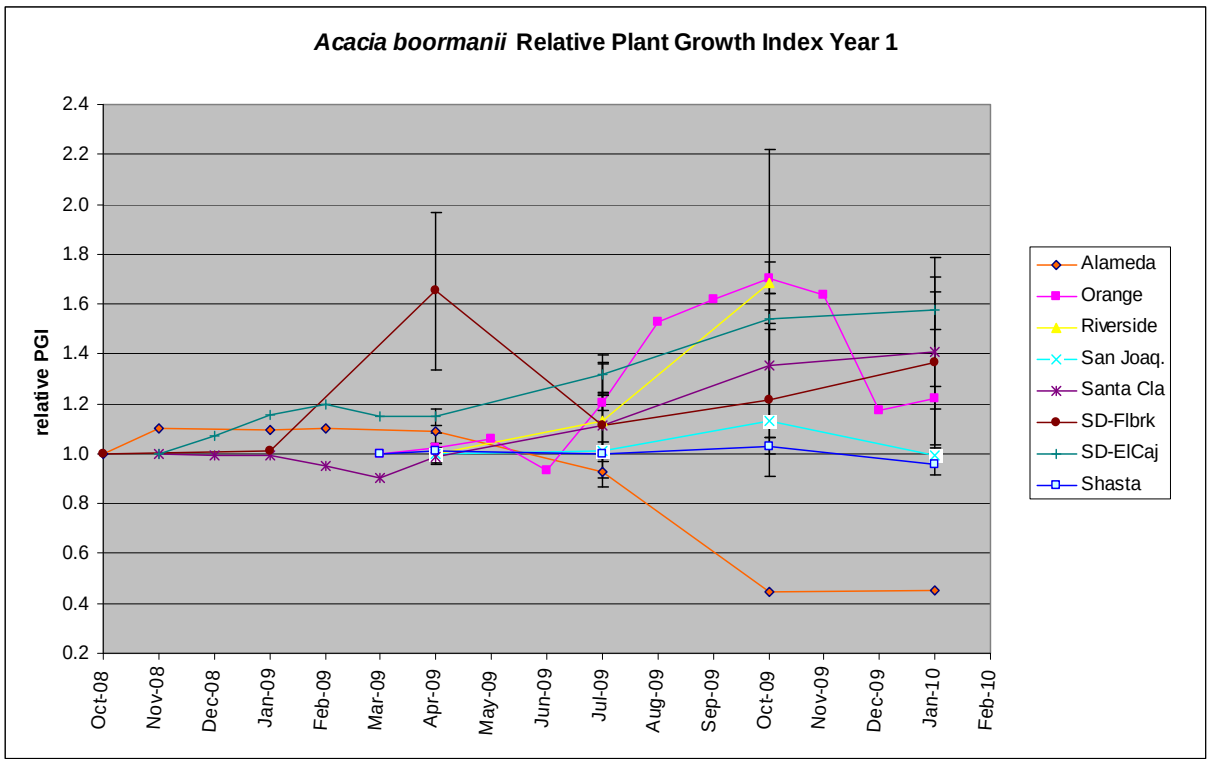
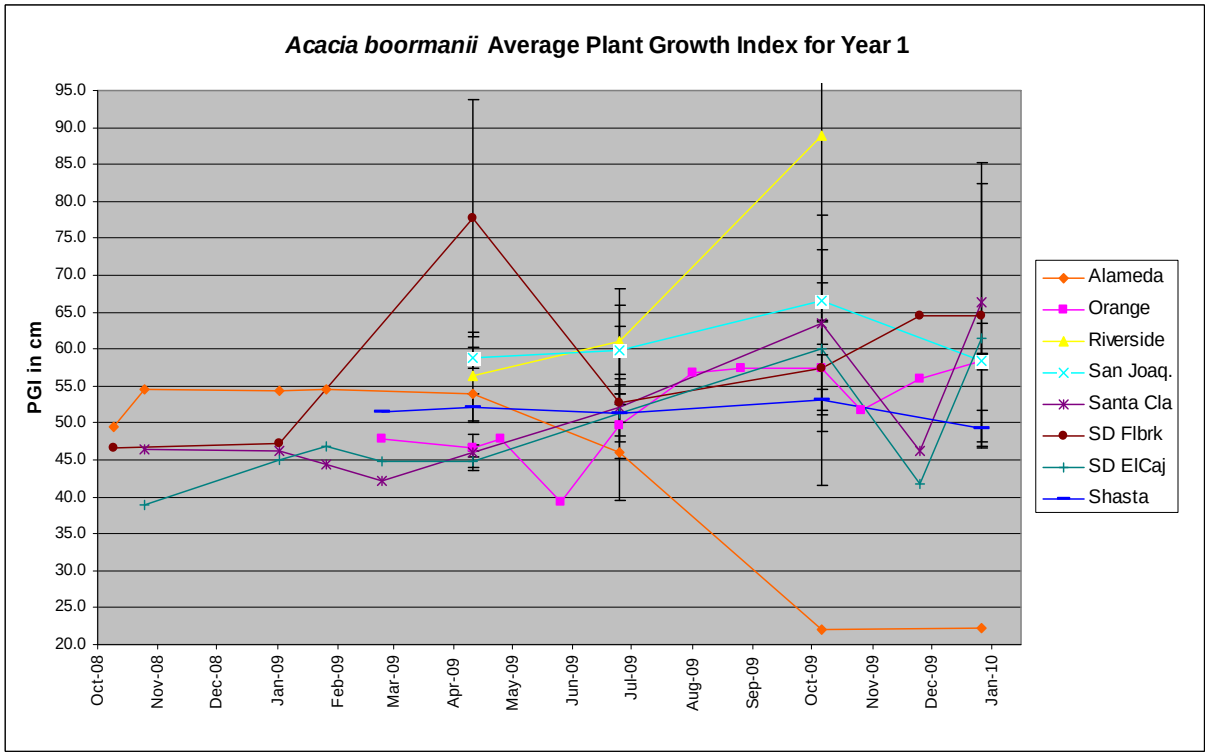
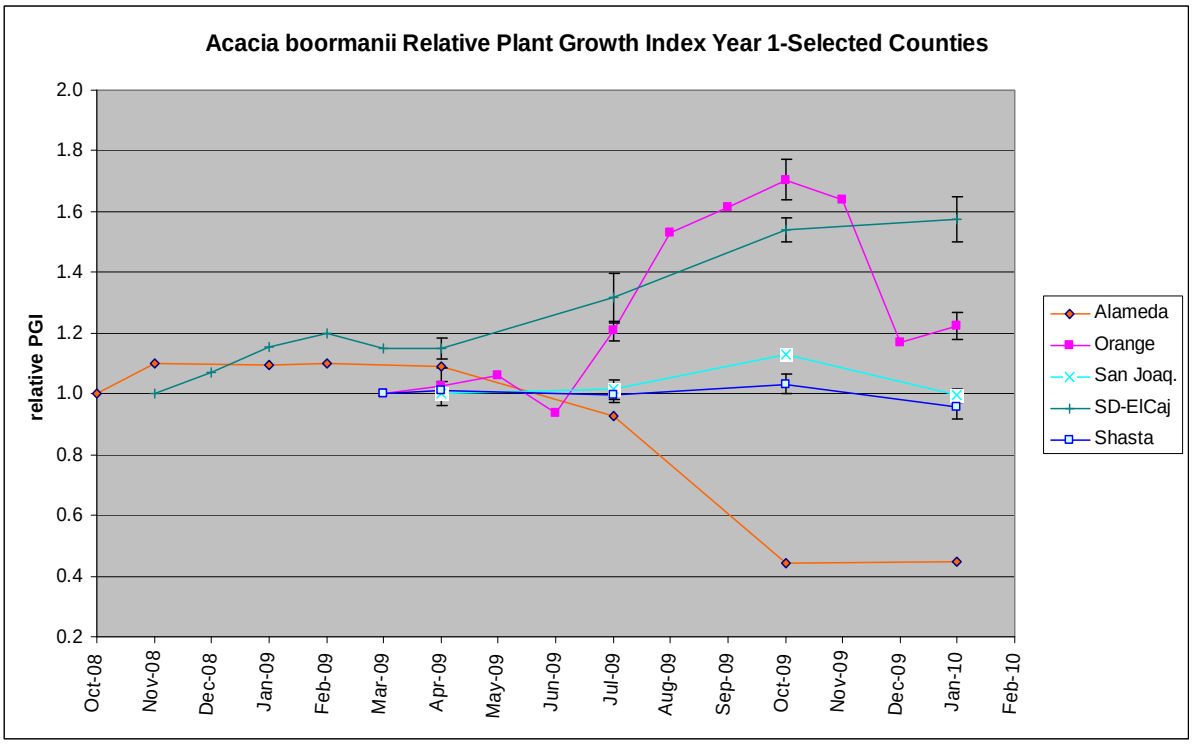


Chart 1d



Following is a representation of selected counties, showing some significant differences between regions during the establishment phase. Note that Alameda County had only 1 plant and therefore no standard error bars appear on those data points.

Chart 1e



MASTER GARDENER COMMENT SUMMARY

1. Most gardens had leaf yellowing and drop during the first months of establishment.
2. As expected, sufficient water was critical during first year.
3. Shasta County suffered severe frost damage this winter, but April's field notes showed it was recovering.
4. Flowering, if it occurred, was not significant the first year.
5. The average height and width at the end of the first year were: 25¼ " X 16½ ".

It will be very interesting to see how the plants perform this second year.

Ceanothus x *pallidus* 'Marie Simon'

Chart 2a (on all graphs, error bars represent +/- 1SE)

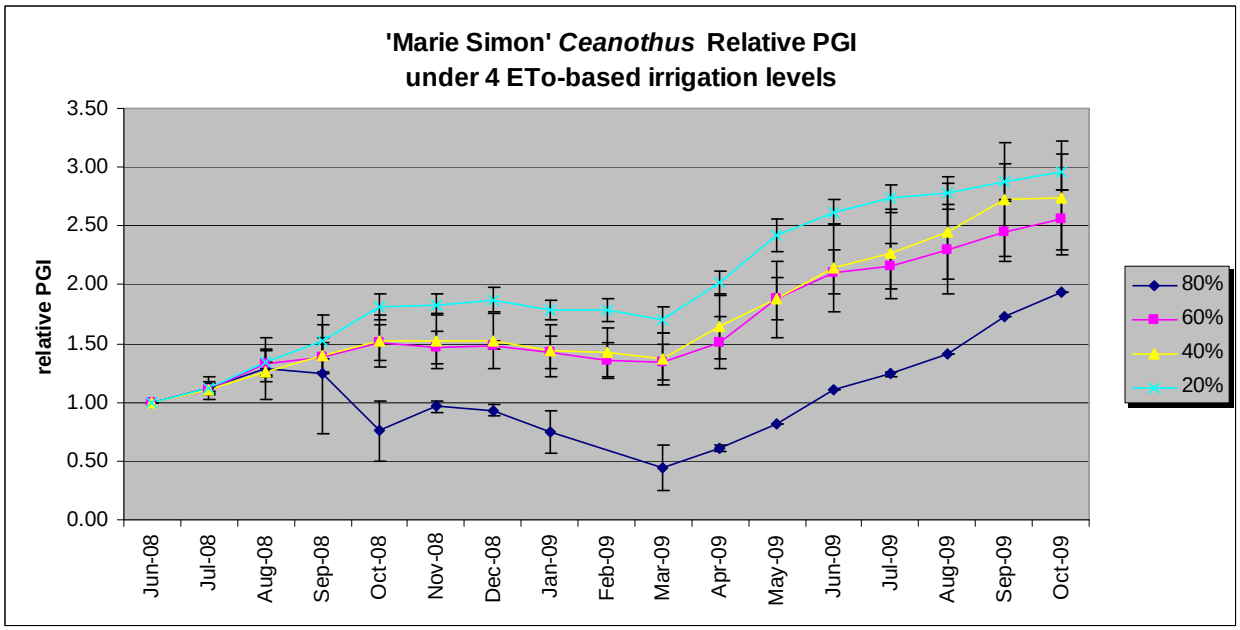
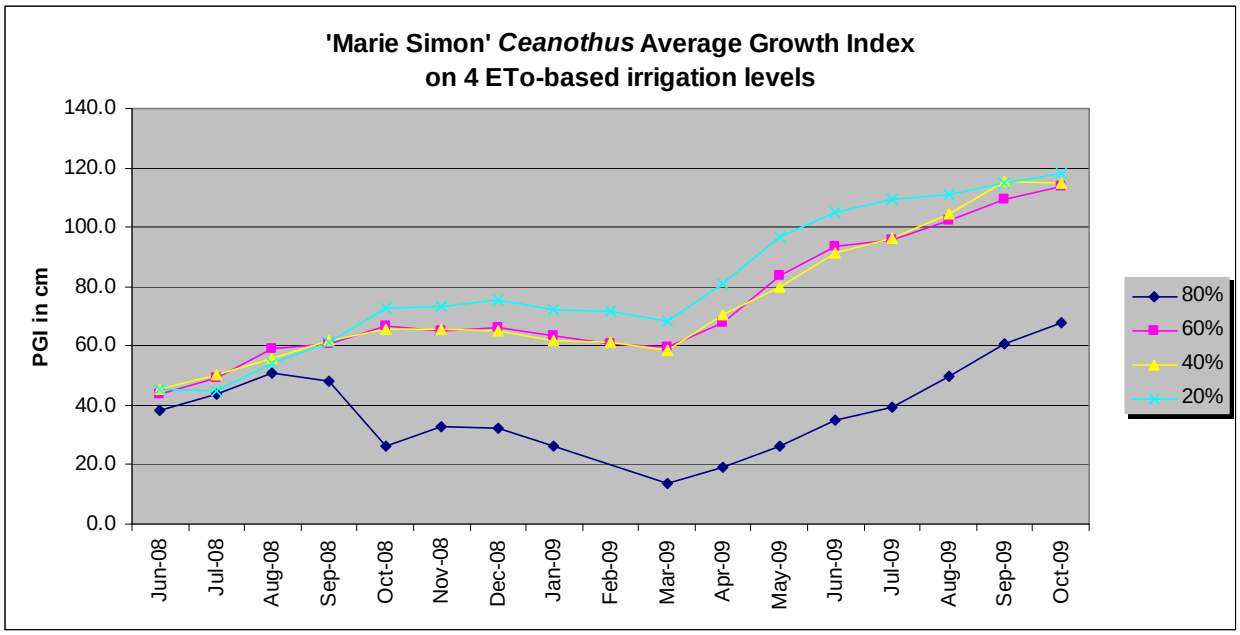


Chart 2b



The significant difference between treatments to be seen with this plant is between the 80% treatment and all the others. The difference between 20, 40, and 60% levels are statistically insignificant, though it is interesting that they do perform slightly better with each drop in summer water. We can confidently say that they will perform well on any level at or below 60% ETo.

In 2 years the average height and width grew from 20" X 13" to 36" x 53".

QUALITY RATINGS DURING DEFICIT IRRIGATION

Table 2a (all ratings are based on a 1-5 scale)

SPECIES 2 - *Ceanothus* x *pallidus* 'Marie Simon'				
foliage	JUNE	JULY	AUG	SEPT
80%	3.0	**4.5**	3.5	3.0
60%	4.2	4.3	3.5	3.3
40%	**4.8**	**4.4**	**4.3**	**3.6**
20%	4.6	4.3	3.9	3.3
flower				
80%				
60%		1.3	2.7	
40%		1.3	**3.5**	1.0
20%			1.7	
vigor				
80%	2.5	4.5	3.0	3.0
60%	4.3	4.5	2.7	3.8
40%	4.4	4.4	3.5	4.2
20%	**4.8**	**4.8**	1.7	**4.6**
average				
80%	2.8	**4.5**	3.3	3.0
60%	4.3	**4.4**	3.9	3.6
40%	**4.6**	**4.4**	**4.4**	**3.9**
20%	**4.7**	**4.5**	4.2	**4.0**

Highest values within 0.1 are bolded

IRRIGATION TRIALS QUALITY COMMENT SUMMARY

1. There was 83% mortality at 80% ETo; 0% at 60%; 16.7% (1 plant out of 6) at 40% and 20%.
2. Plants can be quite unattractive late in the winter, but recover quickly in early spring.
3. There was some edge burn on leaves as summer progressed that may be due to boron build-up from irrigation water.
4. Spring bloom was abundant, and the remaining wine-colored seed heads lasted for another couple of weeks, contrasting nicely with the dark red stems. A very attractive feature. For the plants with a repeat bloom, this just made for an extended attraction.
5. While the overall average quality of plants on 20 and 40% was comparable, there was a surprise repeat bloom late in the summer and into fall that was significantly showier at the 40% level.
6. The excellent performance of this plant at the lower levels makes it a candidate for no more than monthly summer watering, and perhaps less in heavy soils.

MASTER GARDENERS' DATA

Table 2b (all ratings are based on a 1-5 scale)

***Ceanothus* x *pallidus* 'Marie Simon' Average Ratings by County for 2009**										
Sunset Zone	14	7	7	22/23	18/19	15	23	21	9	
County	**Alameda**	**Mariposa**	**Nevada**	**Orange**	**Riverside**	**Santa Cla**	**SD-Pt. Loma**	**SD-El Cajon**	**Shasta**	Average
Foliage	3.5	4.4	3.1	2.8	3.1	3.1	4.1	3.1	3.8	**3.5**
Flowering	2.1	5.0		1.0	1.3	1.3	2.3			**2.2**
Pest resistance	4.8	5.0	4.8	4.5	5.0	4.4	5.0	4.6	4.6	**4.7**
Disease resistance	5.0	5.0	5.0	4.9	5.0	5.0	5.0	4.3	4.8	**4.9**
Overall vigor	3.5	4.9	3.3	2.7	3.0	3.1	3.8	3.4	3.9	**3.5**
Overall AVG	**4.0**	**4.8**	**4.1**	**3.6**	**3.9**	**3.6**	**4.3**	**3.9**	**4.3**	**4.1**

Chart 2c

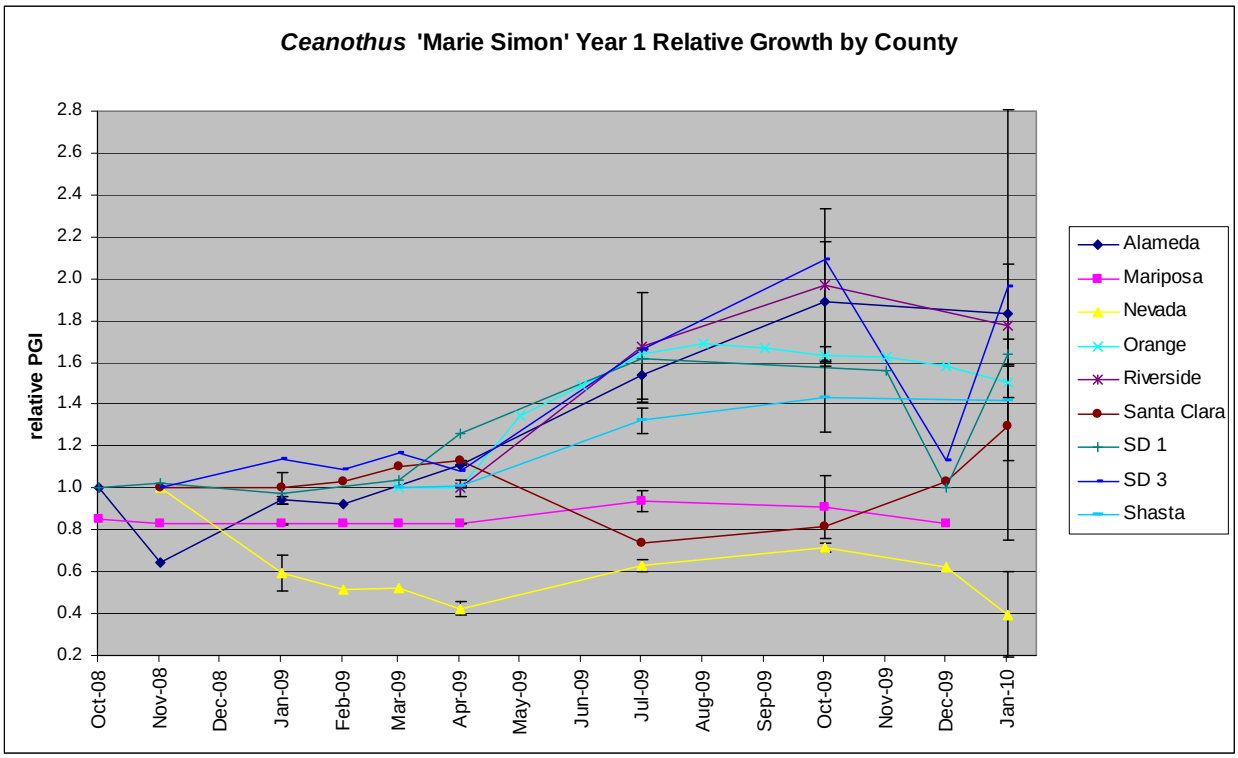
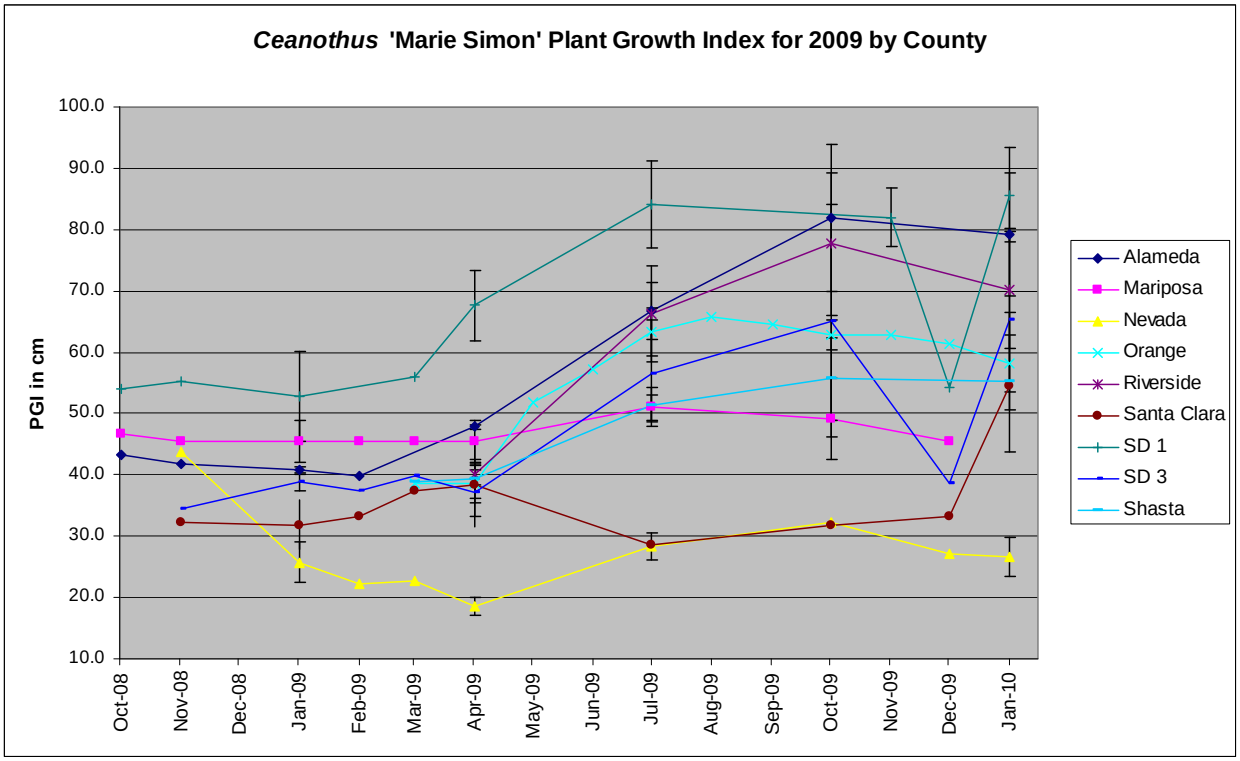


Chart 2d



MASTER GARDENER COMMENT SUMMARY

1. Alameda had aphid issues at end of year especially.
2. In Mariposa and Nevada Counties, the plants go completely deciduous and dormant in winter. They are also attractive to deer, which have nibbled but not killed them each fall.
3. Orange County had aphid infestation that was controlled with insecticidal soap, but the plants are showing lots of tip yellowing and die-back
4. Santa Clara County has lost 2 of three plants. May not have been vigorous from the beginning; there were issues with watering at Davis before plants were delivered.
5. Most counties had trouble with establishment. Many lost leaves and vigor before they recovered. Several counties also had trouble with unidentified insect damage on the leaves. This was in addition to the aphid damage in Orange Co.

Overall the Master Gardeners rated this higher than one might expect from their comments. It is difficult to know whether this is because they expect it to perform better in the future. The second year data will hopefully tell a clearer story where the demonstration gardens are concerned.

Cercocarpus betuloides var. blancheae Island Mountain Mahogany

Chart 3a (on all graphs, error bars represent +/- 1SE)

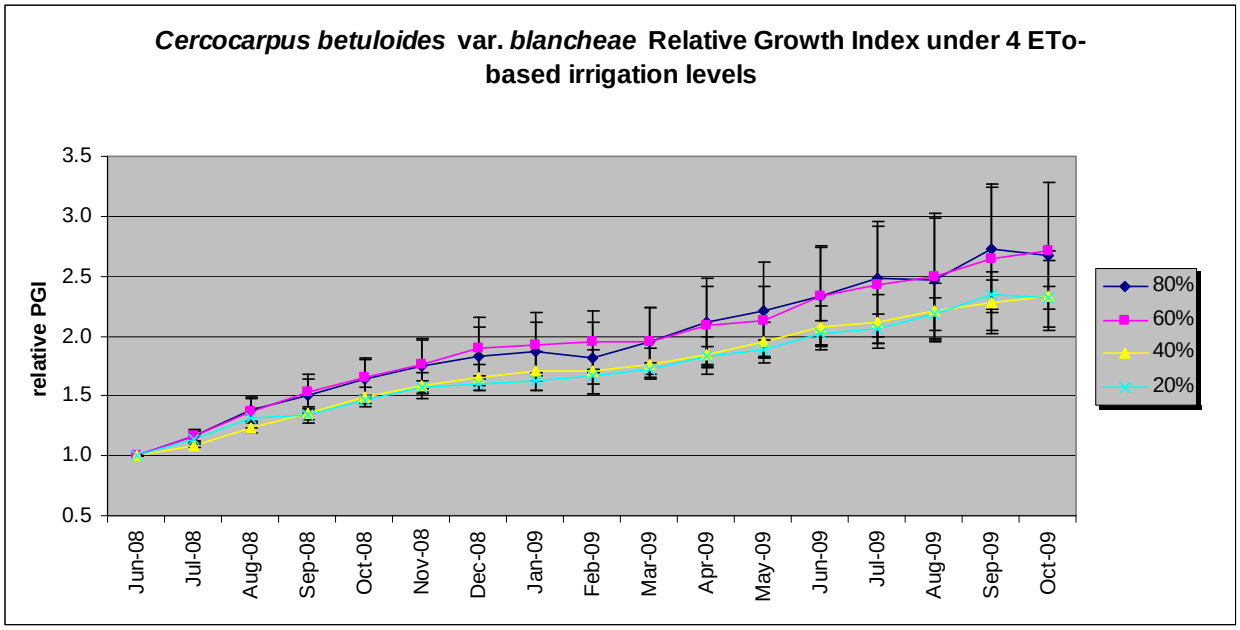
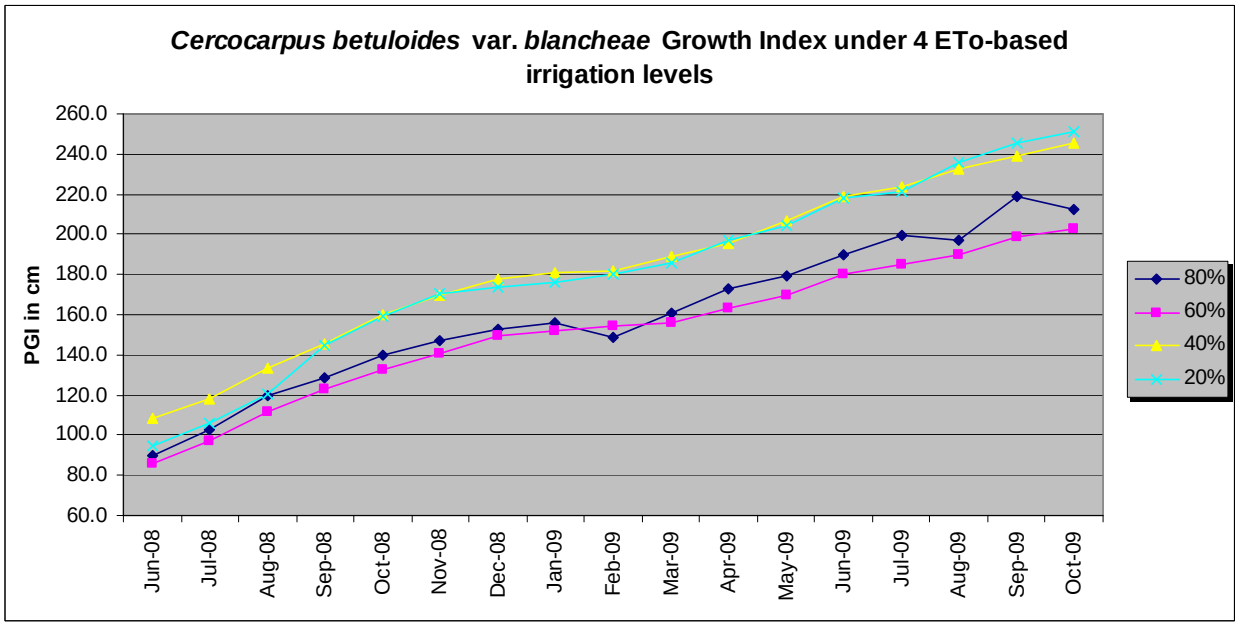


Chart 3b



There were no significant differences in relative plant growth indexes between any two irrigation treatments.

At the end of 2 years, average height and width grew from 39.5” X 35” to 8’ X 7 ‘.

QUALITY RATINGS DURING DEFICIT IRRIGATION

Table 3a (all ratings are based on a 1-5 scale)

Cercocarpus betuloides* var. *blanchae				
foliage	JUNE	JULY	AUG	SEPT
80%	3.6	3.5	3.9	**3.6**
60%	3.6	3.4	3.1	3.0
40%	3.7	**4.0**	3.5	**3.7**
20%	**4.0**	**4.0**	**4.0**	**3.6**
vigor				
80%	4.4	4.2	**4.8**	4.0
60%	3.8	3.9	3.6	3.4
40%	4.4	**4.9**	4.1	**4.4**
20%	**4.8**	**5.0**	**5.0**	**4.5**
average				
80%	4.0	3.9	4.3	3.8
60%	3.7	3.7	3.4	3.2
40%	4.1	**4.5**	3.8	**4.1**
20%	**4.4**	**4.5**	**4.5**	**4.1**

Highest values within 0.1 are bolded

IRRIGATION TRIALS QUALITY COMMENT SUMMARY

1. Overall these produced a really handsome, dense, tall shrub in 2 years. They would fit the niche of a tall, narrow shrub quite well.
2. Though the flowers were mostly inconspicuous, the seed heads gave the appearance of a general hairiness for weeks on the plants that flowered heavily. We found it interesting, but others might not like it. All treatments had a couple of plants that flowered and had seed heads.
3. Some plants did not flower at all, and those that did seemed to suffer temporary yellowing, and some scattered branch dieback immediately following seed set, possibly due to using up reserves. *Plants might benefit qualitatively from a nice shearing before seed set.*
4. Though high water certainly didn't harm this species, it performed so well on the lower levels, it should definitely be recommended to provide no more than monthly deep watering during the summer once established.

This plant was not placed in demonstration gardens because it was not available in sufficient numbers from the Arboretum, and was not commercially available.

Iris 'Canyon Snow'

Chart 4a (on all graphs, error bars represent +/- 1SE)

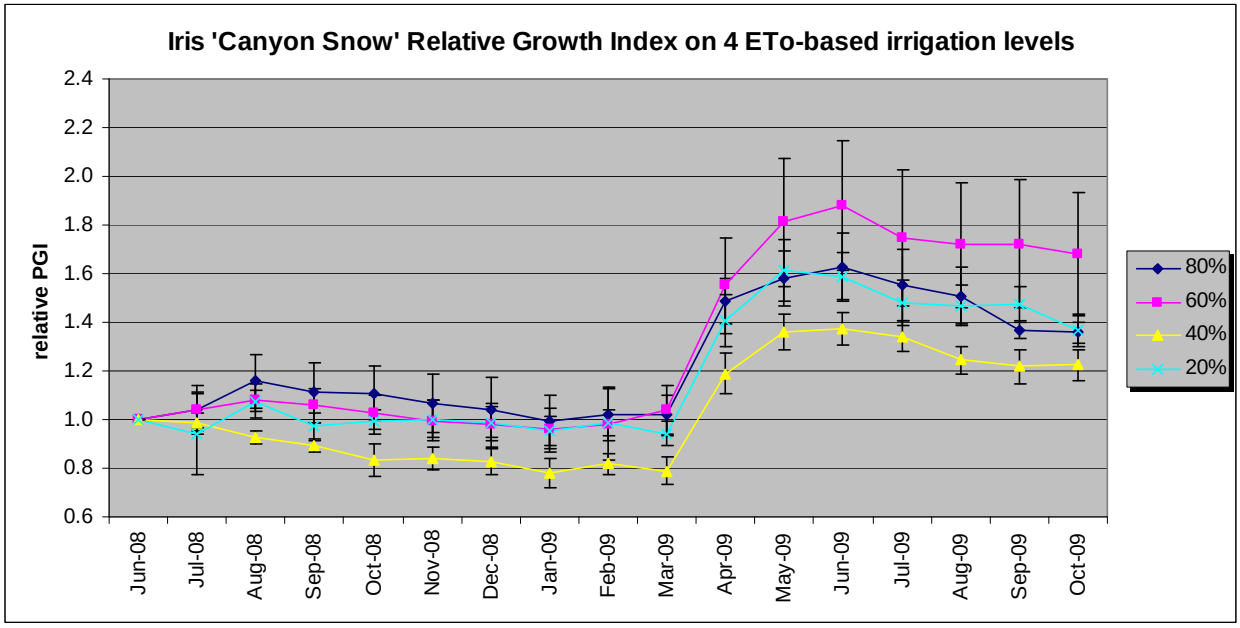
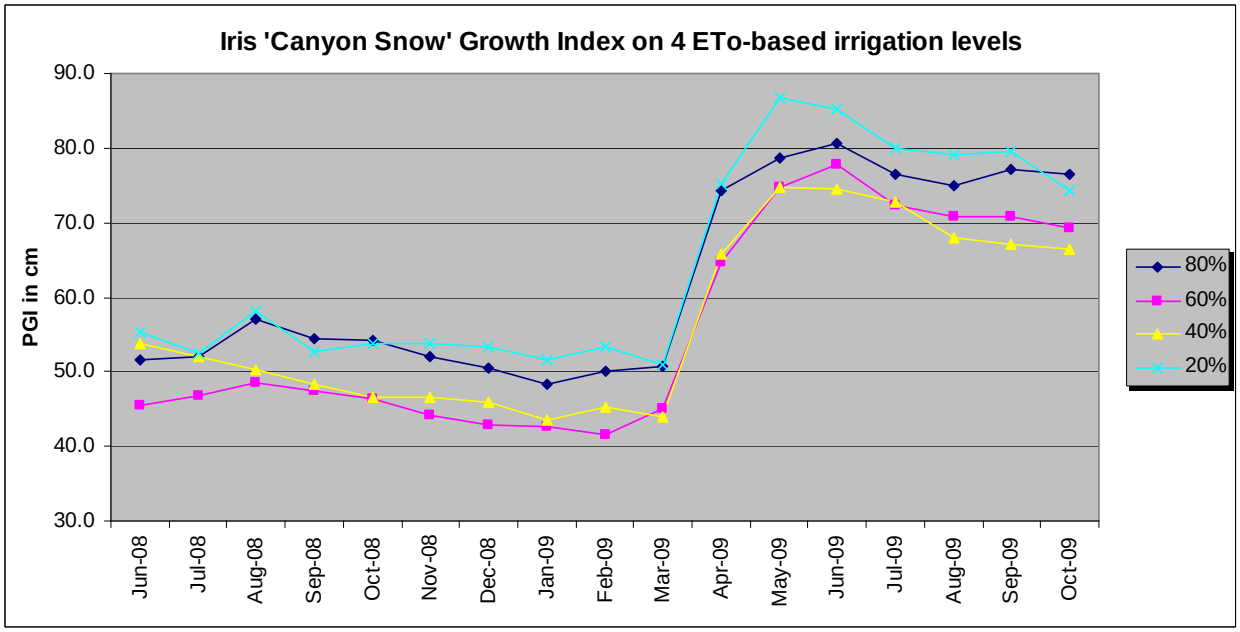


Chart 4b



The 40% irrigation treatment (roughly monthly) performed significantly more poorly throughout the growing year. The fact that the plants were performing worse before the irrigation treatments began may mean that the set of plants themselves were less vigorous to begin with.

If the 80% treatment line is removed from the Relative PGI graph, the October data shows a small but significant difference between the 60% treatment and the 20 and

40% treatments. For this reason, irrigation is probably best recommended at the 60% rate, or roughly every 2-3 weeks in summer for best performance, though the plants certainly survive with an acceptable appearance at the lowest rate. One large vigorous plant on the 80% treatment died completely between July and August.

At the end of 2 years, average height and width grew from 16" X 24.5" to 19" x 37".

QUALITY RATINGS DURING DEFICIT IRRIGATION

Table 4a (all ratings are based on a 1-5 scale)

***Iris* 'Canyon Snow'**				
foliage	JUNE	JULY	AUG	SEPT
80%	2.8	**3.5**	3.6	**3.4**
60%	**3.5**	**3.5**	**3.8**	**3.5**
40%	2.9	3.2	3.1	2.8
20%	3.0	**3.5**	3.5	3.0
vigor				
80%	**4.5**	4.0	**4.6**	**4.2**
60%	4.2	4.1	4.3	4.0
40%	3.9	4.0	4.0	3.5
20%	**4.5**	**4.8**	**4.5**	3.7
average				
80%	**3.7**	3.8	**4.1**	**3.8**
60%	**3.8**	3.8	**4.0**	**3.8**
40%	3.4	3.6	3.5	3.1
20%	**3.8**	**4.1**	**4.0**	3.3

Highest values within 0.1 are bolded

IRRIGATION TRIALS QUALITY COMMENT SUMMARY

1. All levels showed tip die-back and some dieback in the center of the plants as the summer progressed, but this may just be typical of Iris growth.

MASTER GARDENERS' DATA- YEAR 1

Table 4b (all ratings are based on a 1-5 scale)

Iris 'Canyon Snow' Average Annual Ratings by County-Year 1						
Sunset Zone	14	8	7	7	22/23	18/19
County	**Alameda**	**Fresno**	**Mariposa**	**Nevada**	**Orange**	**Riverside**
Foliage	3.3	4.5	4.3	4.1	2.2	3.5
Flowering	2.5	2.8	3.2			1.7
Pest resistance	5.0	5.0	5.0	5.0	4.9	4.9
Disease resistance	5.0	5.0	5.0	5.0	4.9	5.0
Vigor	3.5	5.7	4.5	4.7	2.2	3.6
Overall AVG	**4.1**	**5.0**	**4.6**	**4.7**	**3.6**	**4.0**

Table 4b –cntd.

Iris 'Canyon Snow' Part 2						
Sunset Zone	14	15	23	21	9	
County	**San Joaquin**	**Santa Clara**	**SD-Pt. Loma**	**SD–El Cajon**	**Shasta**	**AVG**
Foliage	2.6	4.5	3.6	3.6	2.7	**3.5**
Flowering	1.8	1.1		4.0		**2.4**
Pest resistance	5.0	5.0	5.0	6.1	4.9	**5.1**
Disease resistance	5.0	5.0	5.0	5.0	4.5	**4.9**
Vigor	2.5	4.5	3.4	3.7	2.8	**3.7**
Overall AVG	**3.7**	**4.4**	**4.3**	**4.6**	**3.7**	**4.3**

Chart 4c

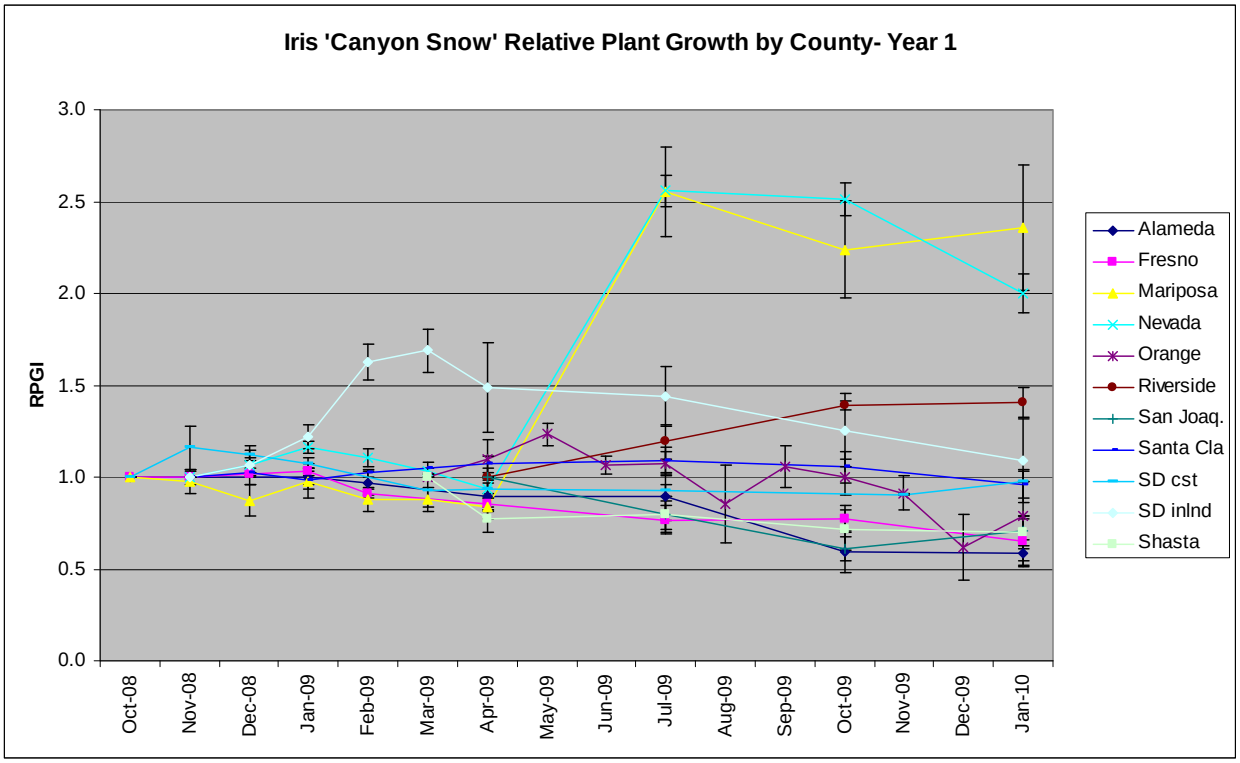


Chart 4d

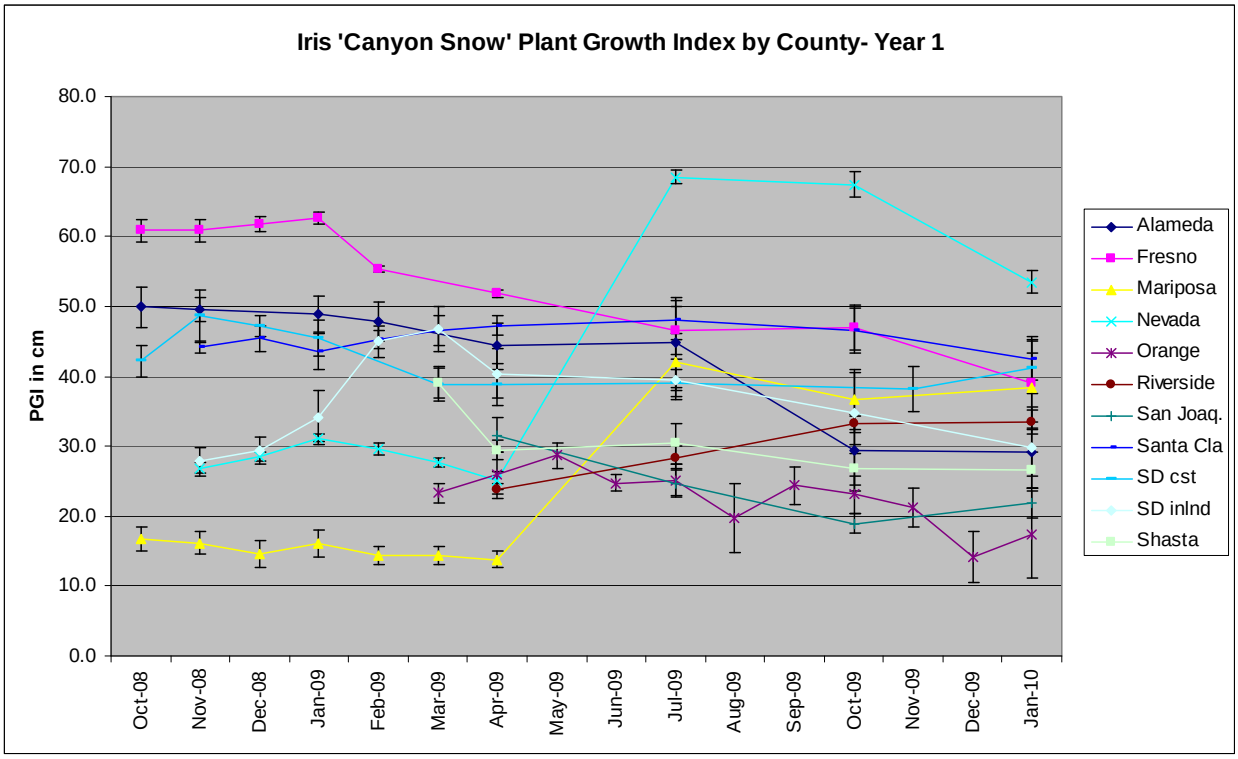
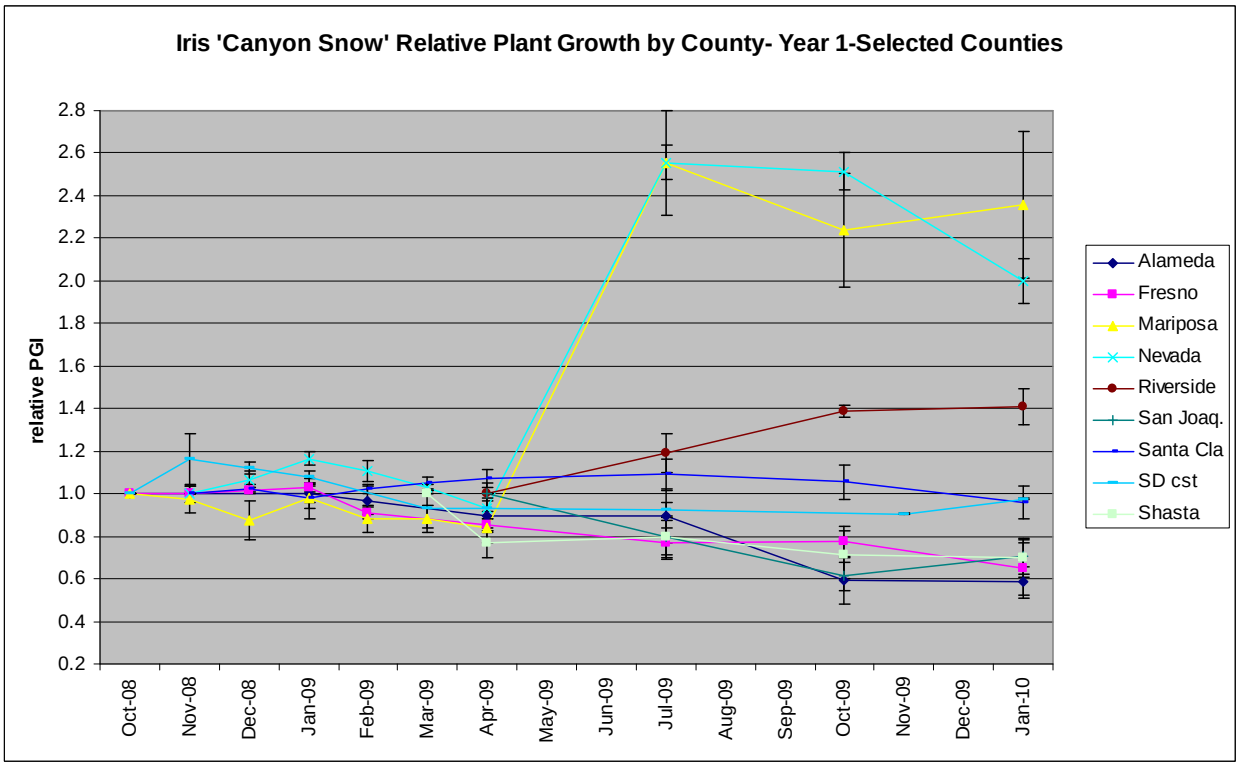


Chart 4e



MASTER GARDENER COMMENT SUMMARY

1. All had difficulty figuring out how much water to give the plants during establishment, which led to some loss of plants, and some initial die-back.

2. All commented on the need for removing dead and browning leaves and leaf tips; this is typical for iris plants after flowering and dormancy.

3. San Diego, San Joaquin, and Nevada Counties reported what they thought was sun damage on leaves in full sun areas. Plants with some shade were performing better at these locations.

The second Relative Plant Growth Index chart with selected counties shows some significant differences between locations during the establishment year. It is particularly interesting that though the foothill locations of Mariposa and Nevada Counties experienced snow and a shorter growing season, the Iris performed especially well there, flowering and increasing in size at twice the rate of lower elevation gardens. Shasta, San Joaquin, Alameda, and Fresno, right down the middle of the state, all performed the most poorly. The extreme dry heat of the summers may prove difficult in the establishment phase. Second year data will tell a more complete story, but recommendations for partial shade may be necessary for these locations.

Leucophyllum langmaniae 'Lynn's Legacy' Lynn's everblooming Texas sage

Chart 5a (on all graphs, error bars represent +/- 1SE)

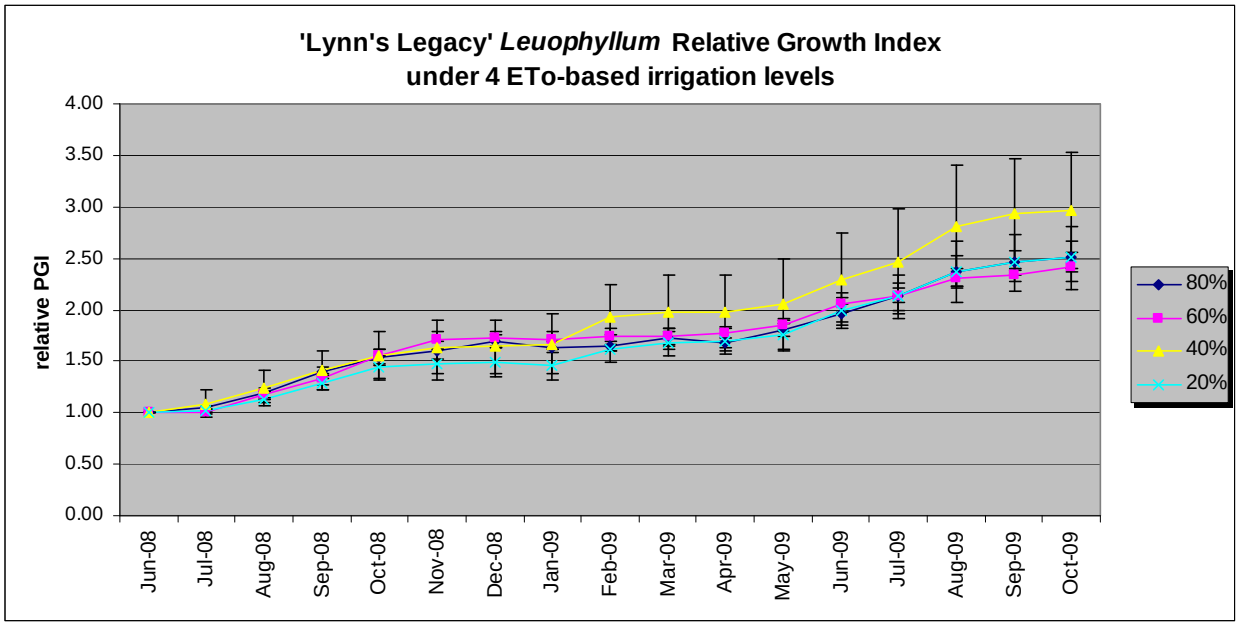
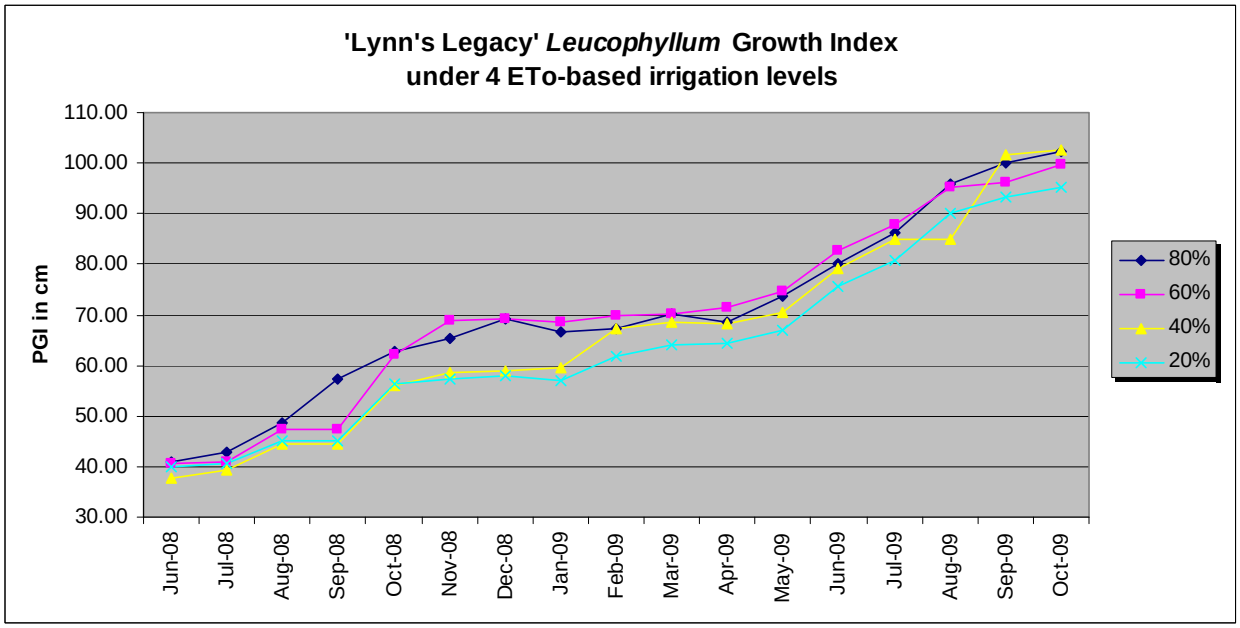


Chart 5b



There were no significant differences in growth between treatments for this species. At the end of 2 years, average height and width grew from 14" X 17" to 31" x 47".

QUALITY RATINGS DURING DEFICIT IRRIGATION

Table 5a (all ratings are based on a 1-5 scale)

***Leucophyllum* 'Lynn's Legacy'**				
foliage	JUNE	JULY	AUG	SEPT
80%	4.0	**4.9**	4.8	**4.0**
60%	4.0	4.5	4.5	3.5
40%	**4.2**	**5.0**	**5.0**	**4.0**
20%	3.8	4.6	4.1	3.6
flower				
80%	1.8	1.0	2.3	**5.0**
60%	2.0	1.0	1.3	4.8
40%	**2.3**	1.0	**2.7**	**5.0**
20%	1.8	1.0	1.8	4.8
vigor				
80%	4.8	**5.0**	4.8	**4.9**
60%	**5.0**	4.5	4.8	4.0
40%	**5.0**	**5.0**	**5.0**	**5.0**
20%	4.3	4.6	4.1	4.3
average				
80%	4.4	**4.9**	4.8	**4.4**
60%	**4.5**	4.5	4.6	3.8
40%	**4.6**	**5.0**	**5.0**	**4.5**
20%	4.0	4.6	4.1	3.9

Highest values within 0.1 are bolded

IRRIGATION TRIALS QUALITY COMMENT SUMMARY

1. 20, 60, and 80% ETo treatments had 33% mortality at end of June the second year. 40% ETo had 50% mortality. Establishment in the heavy soil was problematic.
2. Small, sporadic bloom all summer, but the plants were just beginning to burst at the end of September.
3. Mulch was applied in early June to two plants whose mulch was thinning. Both plants were on the 60% irrigation treatment and died within weeks. Roots near the surface may not have been able to tolerate both the water and extra mulch during the hot season.
4. Some yellowing and leaf drop were observed on all plants in the winter, but they recovered vigor and color in spring.
5. Some wooly aphids were present in spring, but did not cause significant damage.

MASTER GARDENERS' DATA- YEAR 1

Table 5b (all ratings are based on a 1-5 scale)

***Leucophyllum langmaniae* 'Lynn's Legacy' Average Annual Ratings by County-YR 1**									
Sunset Zone	14	7	22/23	18/19	23	24	21	9	
County	Alameda	Nevada	Orange	Riverside	SD-Pt. Loma	SD-Flbrk	SD-El Cajon	Shasta	AVG
Foliage	3.1	3.3	3.0	4.0	4.4	4.0	3.8	3.0	**3.6**
Flowering	2.2	3.0	2.6	3.5	2.9	1.9	1.8	1.0	**2.4**
Pest resistance	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
Disease resistance	5.0	5.0	4.8	5.0	5.0	5.0	5.0	4.7	**4.9**
Vigor	3.2	3.0	3.1	4.1	4.2	4.0	3.9	3.1	**3.6**
Overall AVG	**4.0**	**4.0**	**3.9**	**4.4**	**4.5**	**4.0**	**4.3**	**3.9**	**4.1**

Chart 5c

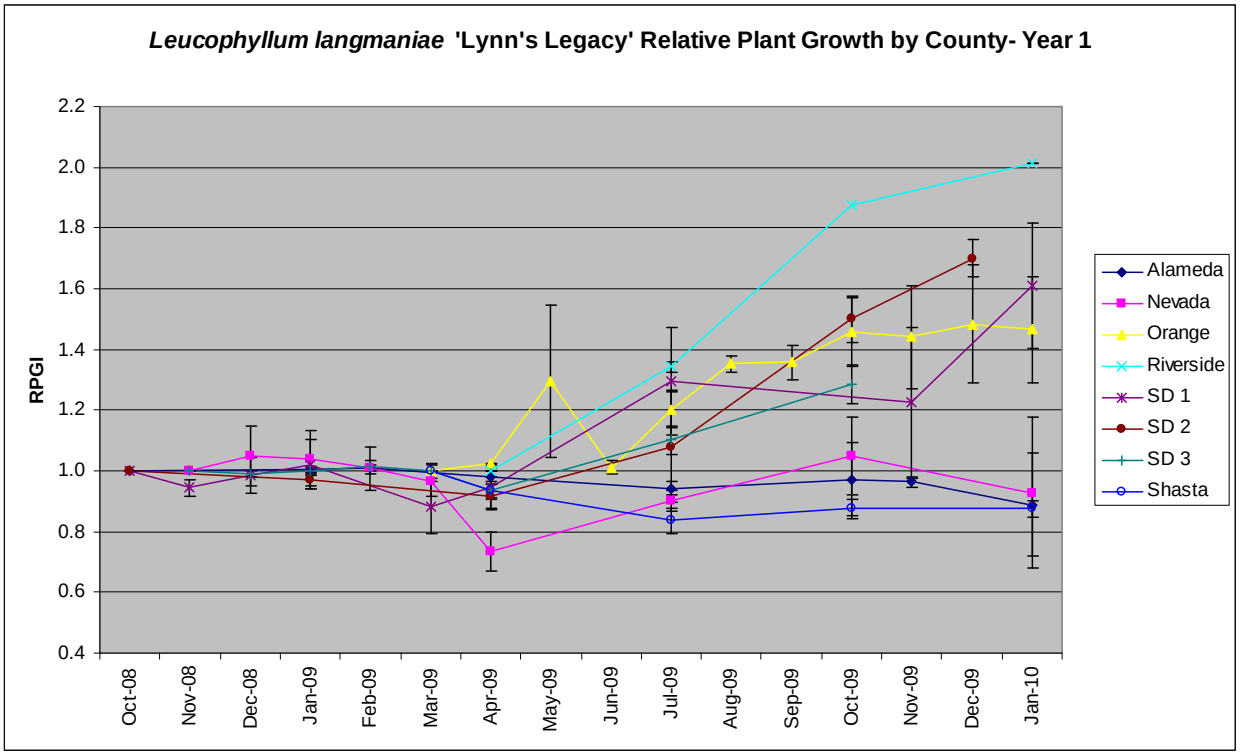
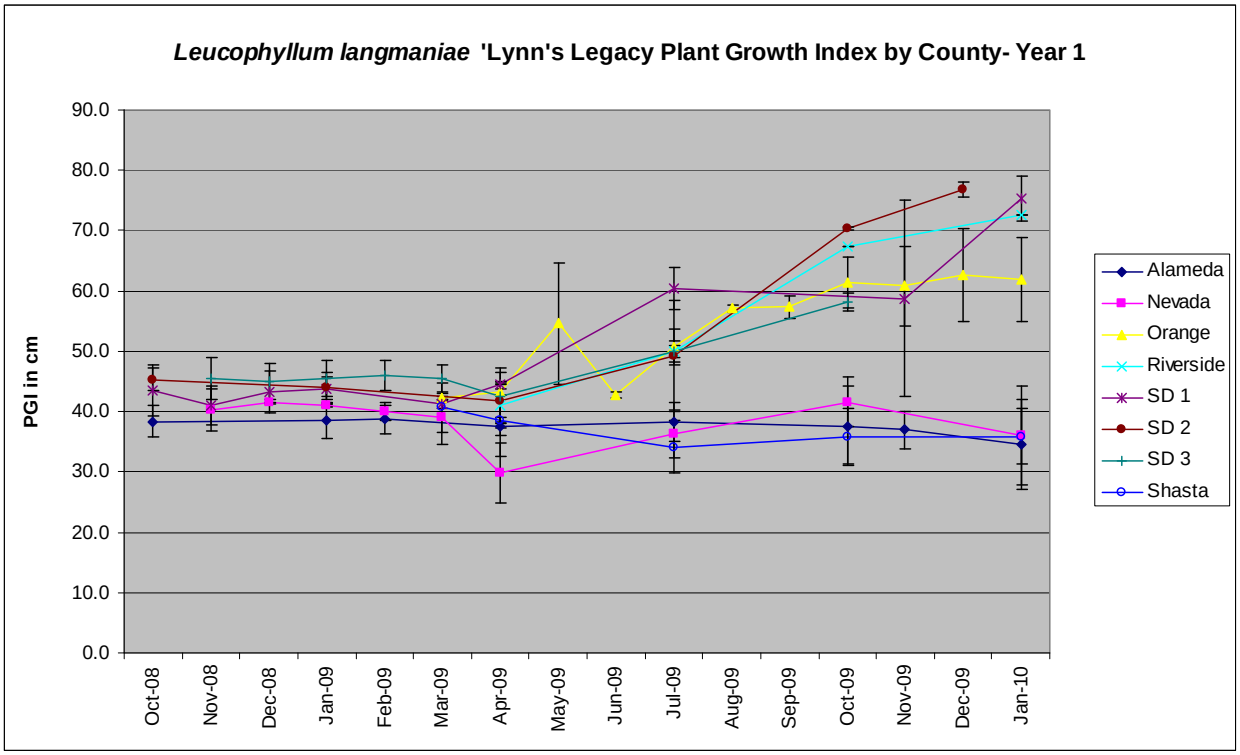


Chart 5d



MASTER GARDENER COMMENT SUMMARY

1. Despite extremely cold weather, snow, and unusual amounts of rain in Grass Valley, this plant began performing well near the end of the first year in the ground, and bloomed profusely from September to November.
2. All gardens had some trouble figuring out how much water to give during establishment. Giving it too much was the most common problem

All Southern California gardens did significantly better than all Northern California gardens, though Orange County had some problems with animal damage and irrigation in the beginning. It is noteworthy that all the SoCal gardens have well-drained sandy-loam or granitic based soils, while the others have soils with higher clay content. Clearly, when combined with our field observations, watering recommendations need to be made based on soil type. It might also be wise to recommend planting in raised beds or mounds for very heavy soils.

Muhlenbergia dubia **pine muhly**

Chart 6a (on all graphs, error bars represent +/- 1SE)

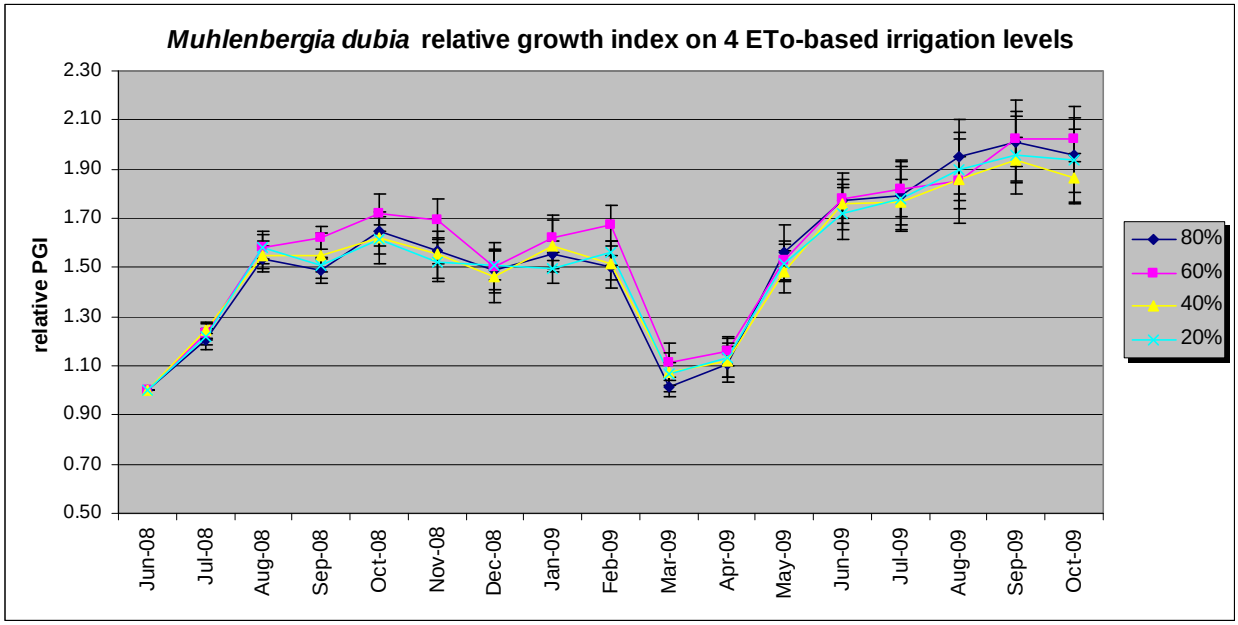
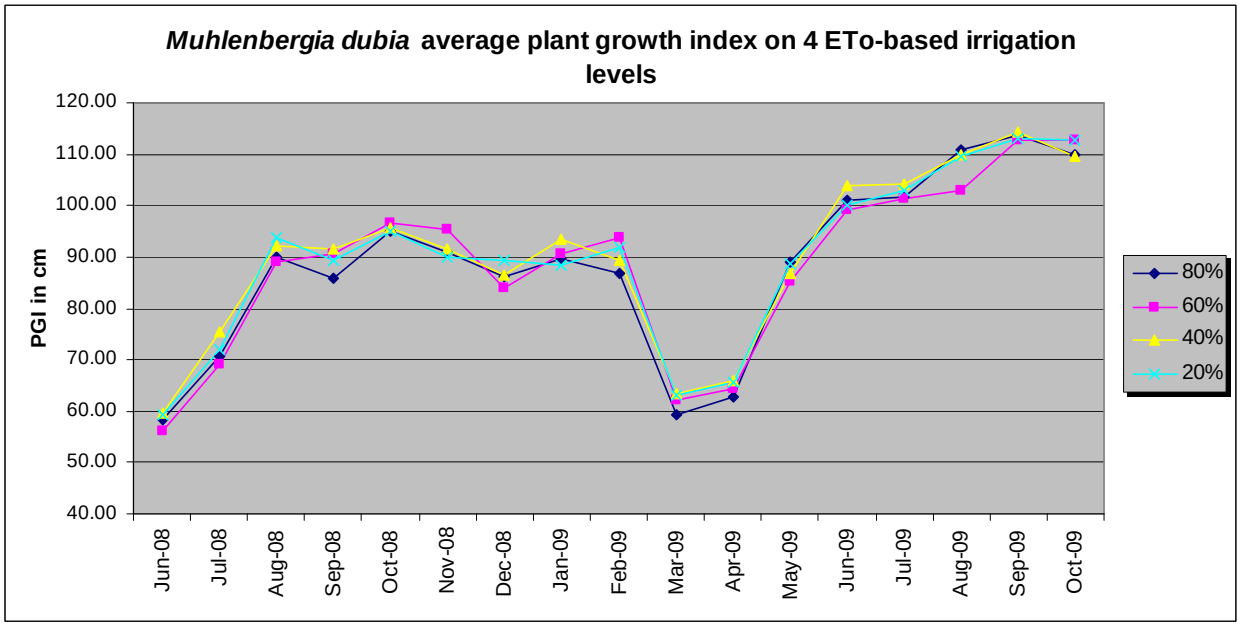


Chart 6b



There were no significant differences between irrigation treatments. The drop in March is reflective of shearing following the February measurements. If this plant can be grown on 20% ETo as successfully as on regular water, then it is extremely versatile in the landscape.

At the end of 2 years, average height and width grew from 18” X 28 to 30” x 58”.

QUALITY RATINGS DURING DEFICIT IRRIGATION

Table 6a (all ratings are based on a 1-5 scale)

Muhlenbergia dubia				
foliage	JUNE	JULY	AUG	SEPT
80%	3.8	3.8	**4.0**	3.8
60%	**4.2**	3.9	**4.0**	**4.0**
40%	3.8	3.9	**4.0**	3.8
20%	3.8	**4.1**	3.7	**4.1**
flower				
80%			3.3	**4.8**
60%		1.0	2.3	4.5
40%		1.0	**3.4**	4.5
20%			2.0	**4.8**
vigor				
80%	**4.7**	4.6	**4.7**	**4.7**
60%	**4.7**	4.5	4.5	**4.7**
40%	4.5	4.8	4.5	**4.7**
20%	**4.7**	**4.7**	4.5	4.5
average				
80%	4.2	4.2	4.3	**4.3**
60%	4.4	4.2	4.3	**4.3**
40%	4.1	4.4	4.3	**4.3**
20%	4.3	4.4	4.1	**4.3**

Highest values within 0.1 are bolded

IRRIGATION TRIALS QUALITY COMMENT SUMMARY

1. This plant was much preferred by rabbits
2. Overall, this was attractive year round. Plants were pruned to 4" in February.

MASTER GARDENERS' DATA- YEAR 1

Table 6b (all ratings are based on a 1-5 scale)

Muhlenbergia dubia average annual ratings 2008								
Sunset zone	14	8	7-central	7-north	23	21	17	
County	**Alameda**	**Fresno**	**Mariposa**	**Nevada/ Placer**	**SD-Pt. Loma**	**SD- El Cajon**	**Santa Clara**	**Average**
Foliage	4.2	4.4	4.8	4.0	4.9	4.2	4.8	**4.5**
Flowering		4.3	5.0	4.7	4.9		2.4	**4.2**
Pest resistance	4.9	5.0	5.0	4.9	5.0	5.0	5.0	**5.0**
Disease resistance	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
Overall vigor	3.7	4.1	4.9	4.1	4.8	4.4	4.7	**4.4**
Overall AVG	**4.4**	**4.5**	**4.9**	**4.5**	**4.9**	**4.6**	**4.4**	**4.6**

Table 6c (all ratings are based on a 1-5 scale)

***M. dubia* average annual ratings YR 1 for Newest Counties (2009)**					
Sunset zone	22/23	18/19	14	9	
County	**Orange**	**Riverside**	**San Joaq.**	**Shasta**	**Average**
Foliage	4.1	4.4	4.0	4.8	**4.3**
Flowering	5.0	4.6			**4.8**
Pest resistance	5.0	5.0	5.0	5.0	**5.0**
Disease resistance	5.0	5.0	5.0	5.0	**5.0**
Vigor	4.0	4.4	4.1	4.8	**4.4**
Average	**4.4**	**4.7**	**4.5**	**4.9**	**4.6**

Table 6d

***Muhlenbergia dubia* average annual ratings YEAR 2 (2009)**						
Sunset zone	14	8	7-north	23	21	
County	**Alameda**	**Fresno**	**Nevada/ Placer**	**SD- Pt. Loma**	**SD- El Cajon**	**Average**
Foliage	4.3	4.8	4.5	3.5	4.1	**4.2**
Flowering		4.0	4.8	3.2		**4.0**
Pest resistance	5.0	5.0	5.0	5.0	5.0	**5.0**
Disease resistance	5.0	5.0	5.0	5.0	5.0	**5.0**
Vigor	4.1	4.3	4.6	3.8	4.3	**4.2**
Overall AVG	**4.6**	**4.7**	**4.8**	**4.3**	**4.6**	**4.6**

MASTER GARDENER COMMENT SUMMARY

1. Some rabbit damage in some gardens.
2. Universally popular with MGs.
3. No pest or disease issues; once-a-year maintenance (shearing) is a benefit.

Chart 6c

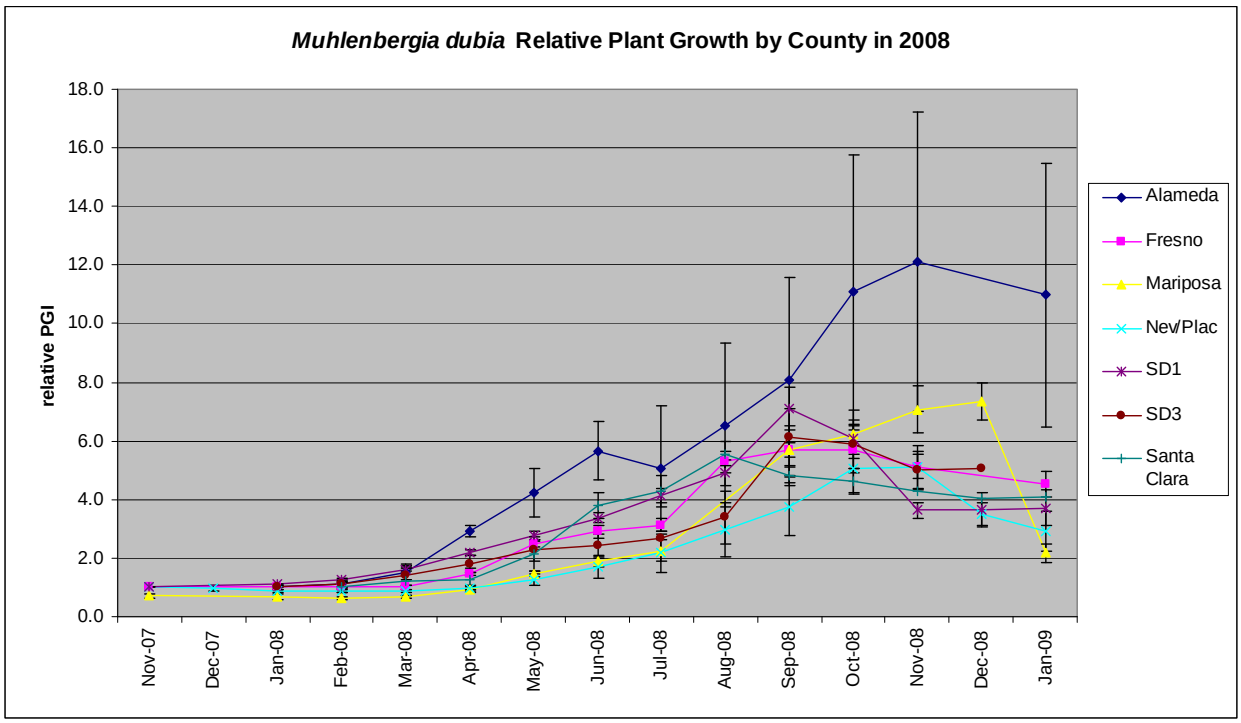


Chart 6d

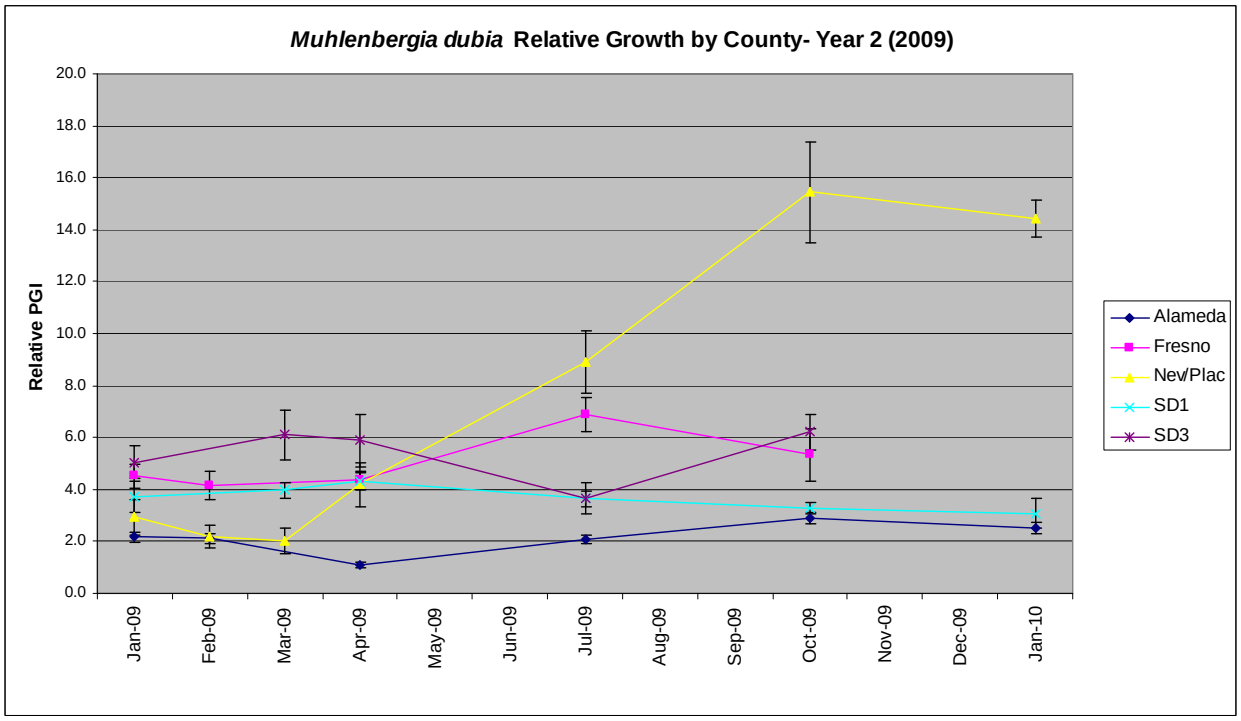


Chart 6e

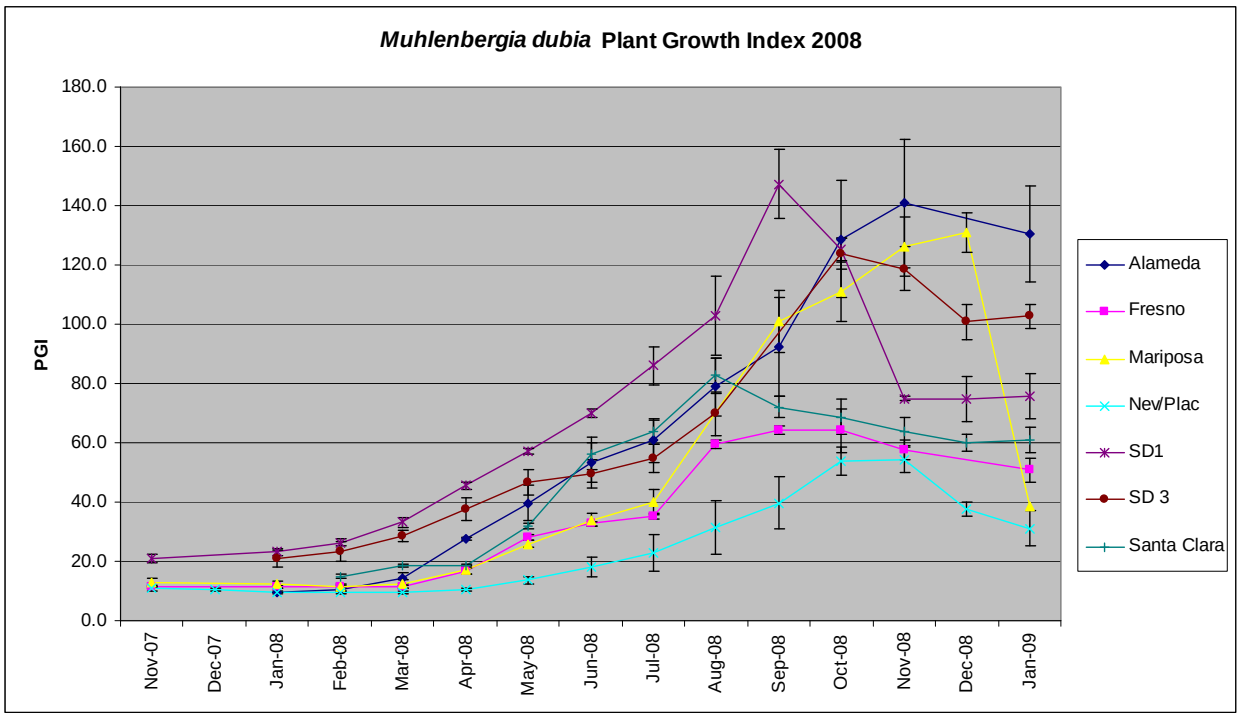
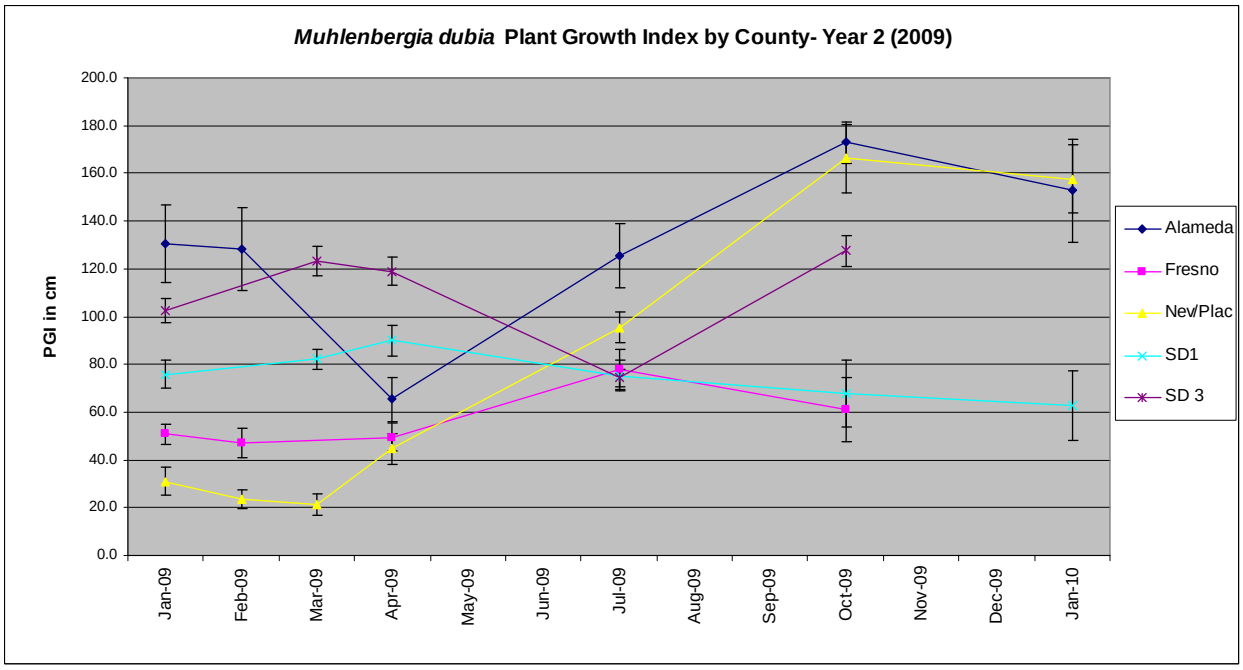


Chart 6f



Santa Clara and Mariposa inexplicably discontinued taking data after Year 1.

Penstemon heterophyllus 'Margarita BOP'

Chart 7a (on all graphs, error bars represent +/- 1SE)

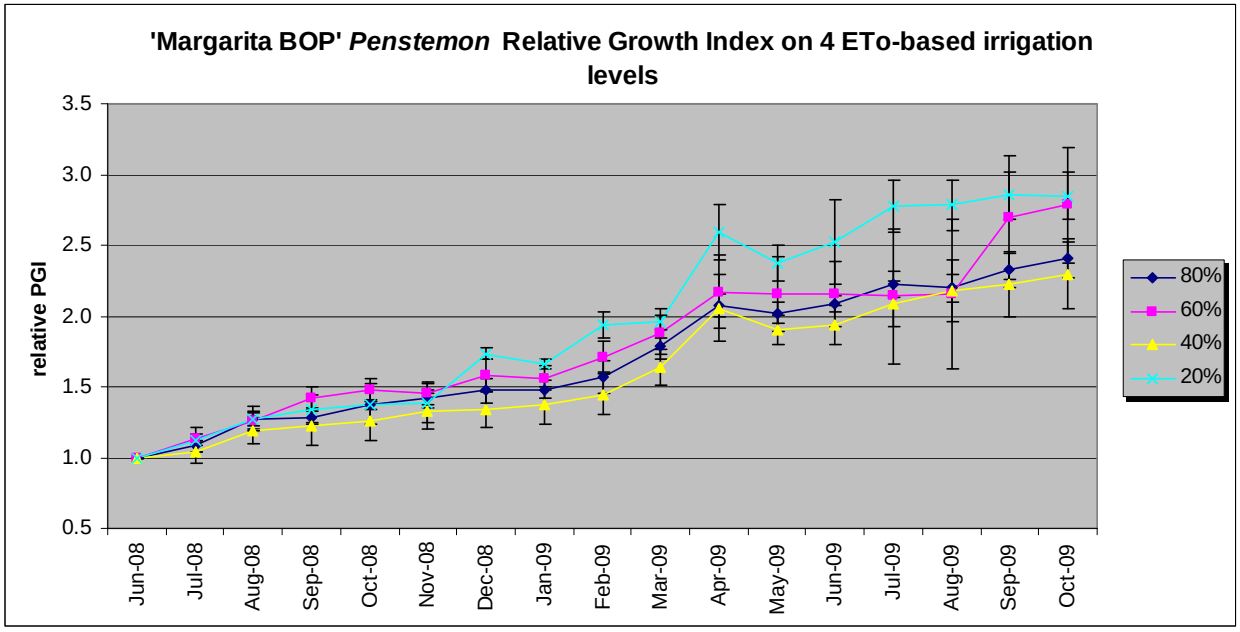
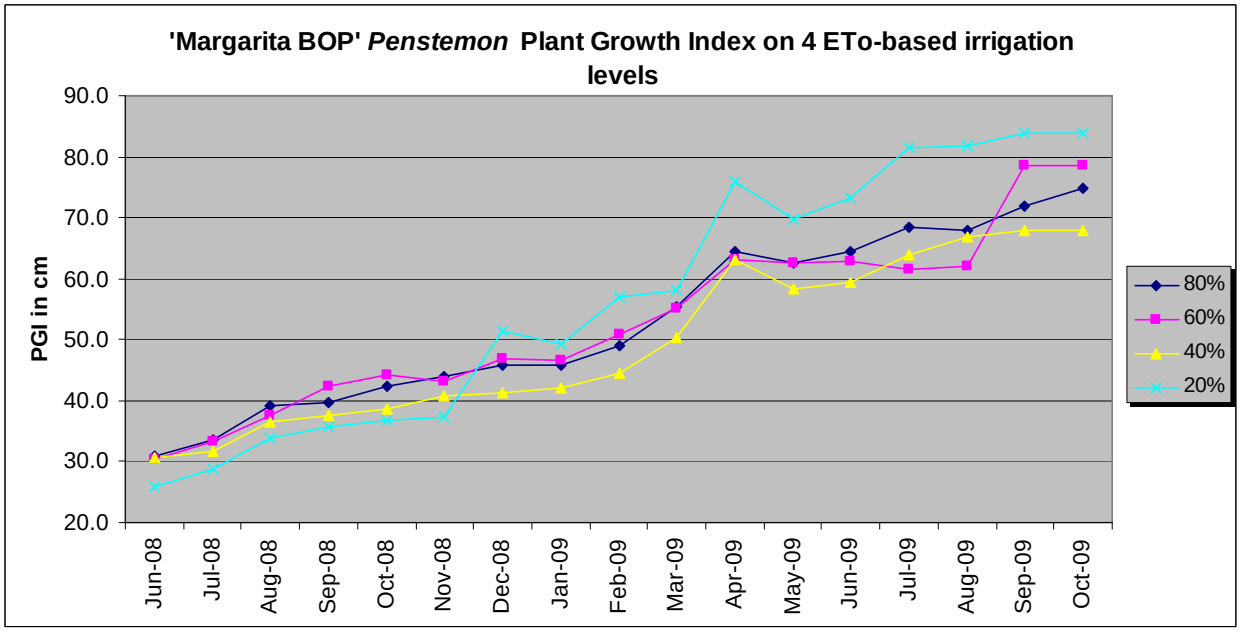


Chart 7b



Though it is difficult to see here, there is a small but significant difference between the 20 and 60% and the 40 and 80% treatments.

At the end of 2 years, average height and width grew from 7" X 16" to 13" x 47".

QUALITY RATINGS DURING DEFICIT IRRIGATION

Table 7a (all ratings are based on a 1-5 scale)

***Penstemon* 'Margarita BOP'**				
foliage	JUNE	JULY	AUG	SEPT
80%	4.0	3.8	4.2	**3.9**
60%	3.5	**5.0**	4.3	3.8
40%	4.3	4.0	3.6	3.8
20%	**5.0**	**5.0**	**5.0**	**4.0**
flower				
80%	2.7	2.7	1.7	**1.3**
60%	3.0	2.7	1.0	1.0
40%	2.8	2.4	1.3	1.0
20%	**3.7**	**3.2**	**2.0**	1.0
vigor				
80%	**4.8**	4.2	4.2	4.3
60%	3.5	4.7	4.7	4.3
40%	4.5	4.4	4.0	3.8
20%	**4.7**	**5.0**	**5.0**	**5.0**
average				
80%	4.4	4.0	4.2	4.1
60%	3.5	4.8	4.5	4.1
40%	4.4	4.2	3.8	3.8
20%	**4.8**	**5.0**	**5.0**	**4.5**

Highest values within 0.1 are bolded

IRRIGATION TRIALS QUALITY COMMENT SUMMARY

1. Needs deadheading after major bloom slows to maintain an attractive appearance.
2. Can get old and leafless in the center; would benefit from cutting back in spring to rejuvenate growth.

MASTER GARDENERS' DATA- YEAR 1

Table 7b (all ratings are based on a 1-5 scale)

Penstemon 'Margarita BOP' Average Annual Ratings by County for Year 1													
Sunset Zone	14	8		7	7	22/23	18/19	14	15	23	24	9	
County	Alameda	Fresno	LA	Mariposa	Nevada	Orange	Riverside	San Joaq.	Santa Cla	SD Pt. Loma	SD Flbrk	Shasta	AVG
Foliage	3.9	4.9	4.2	5.0	4.9	4.4	4.7	3.9	4.8	4.0	3.8	4.2	**4.4**
Flowering	2.3	3.6	3.3	2.3	2.9	2.4	2.9	2.3	2.1	3.0	1.8	2.8	**2.6**
Pest resistance	5.0	5.0	4.7	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
Disease resistance	5.0	5.0	4.8	5.0	4.9	5.0	4.9	5.0	5.0	5.0	5.0	4.9	**5.0**
Vigor	3.8	4.9	4.2	5.0	4.9	4.5	6.5	3.9	4.8	3.8	3.9	4.3	**4.5**
AVG	**4.1**	**4.9**	**4.4**	**4.9**	**4.7**	**4.5**	**4.8**	**4.1**	**4.5**	**4.3**	**3.9**	**4.4**	**4.5**

Chart 7c

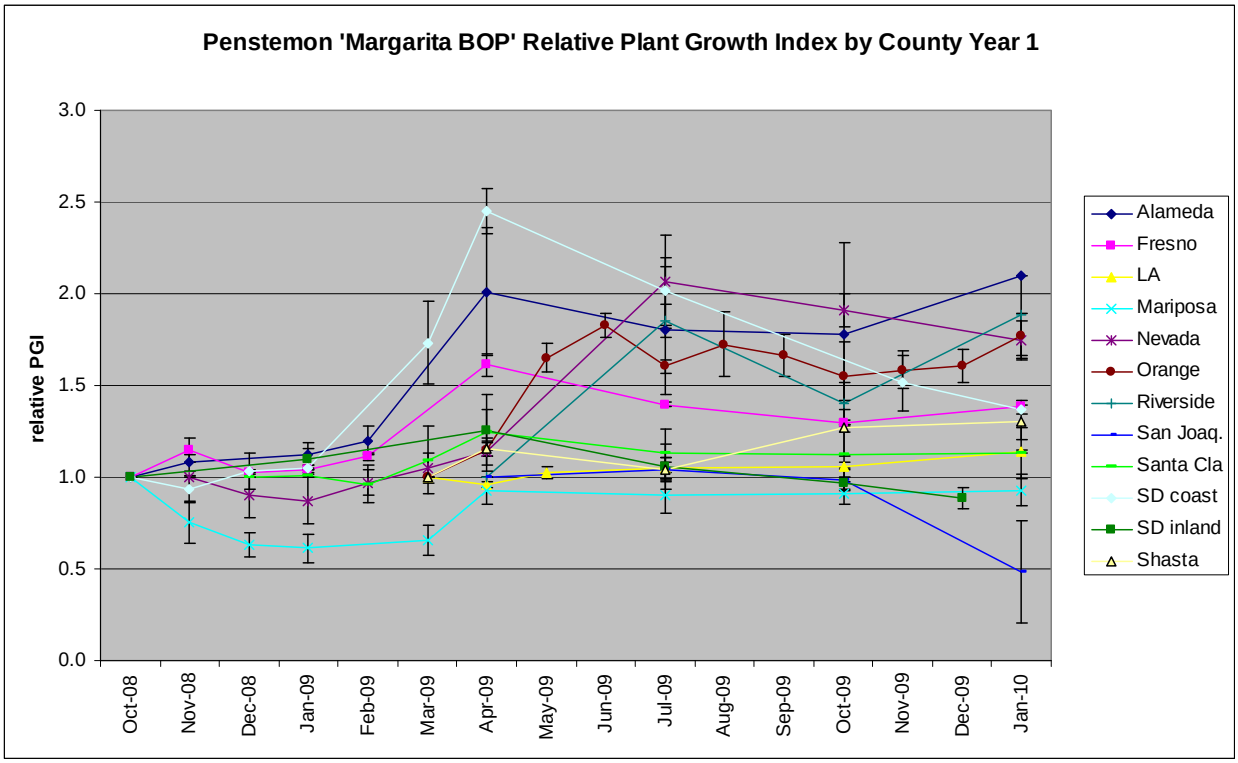
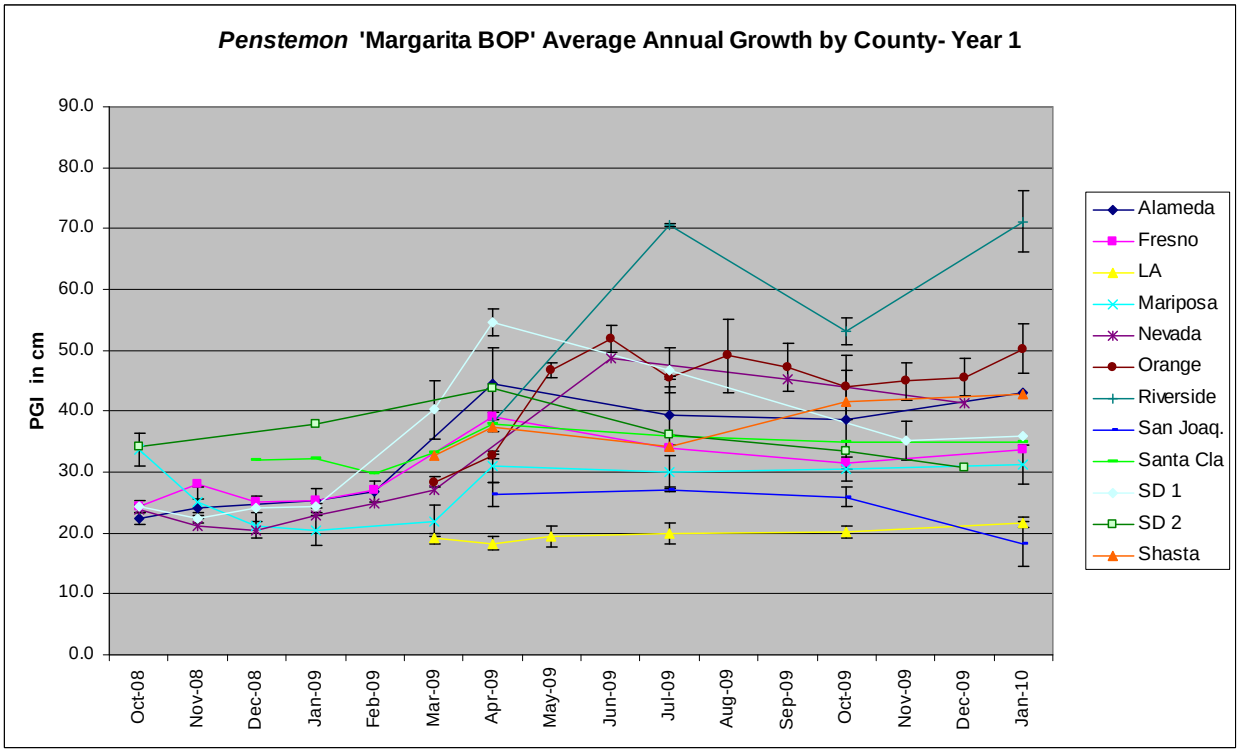


Chart 7d



MASTER GARDENER COMMENT SUMMARY

1. Variable performance in the first year.
2. Plants survived snowfall well.

There were some statistically significant differences between counties during the first year. Some of those differences were due to time of planting, irrigation failures and animal browsing, so it's difficult to draw meaningful conclusions from the first year's County data, but the standard error bars were included to show the differences in the results.

Saponaria x *lempergii* 'Max Frei' 'Max Frei' soapwort

Chart 8a (on all graphs, error bars represent +/- 1SE)

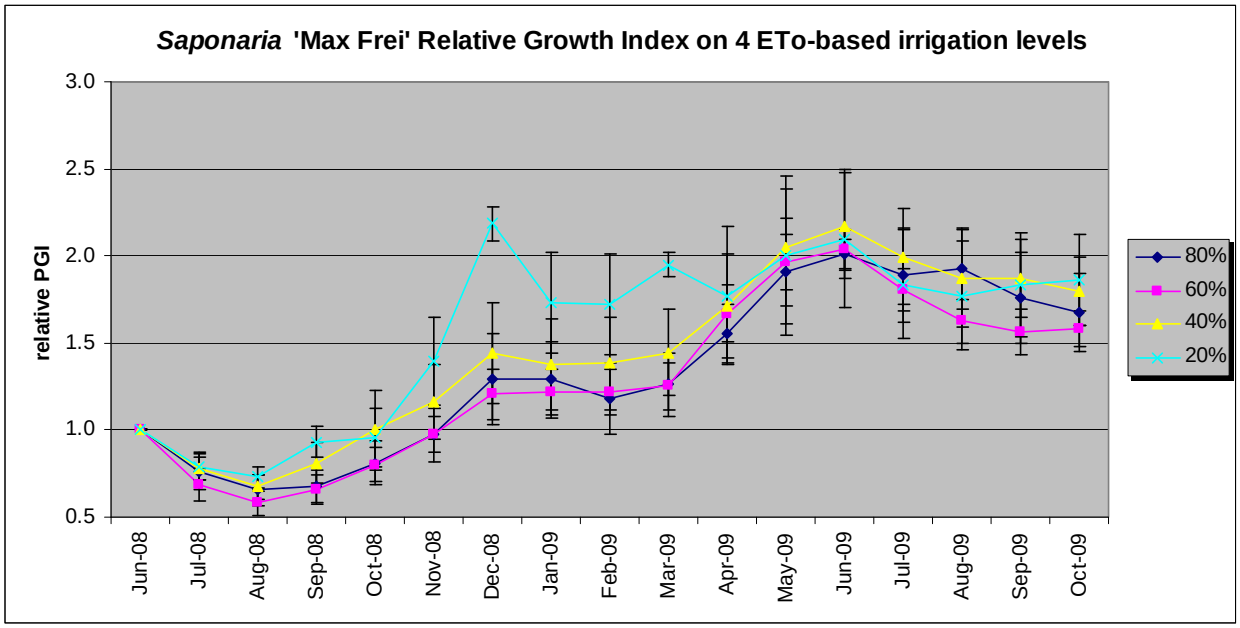
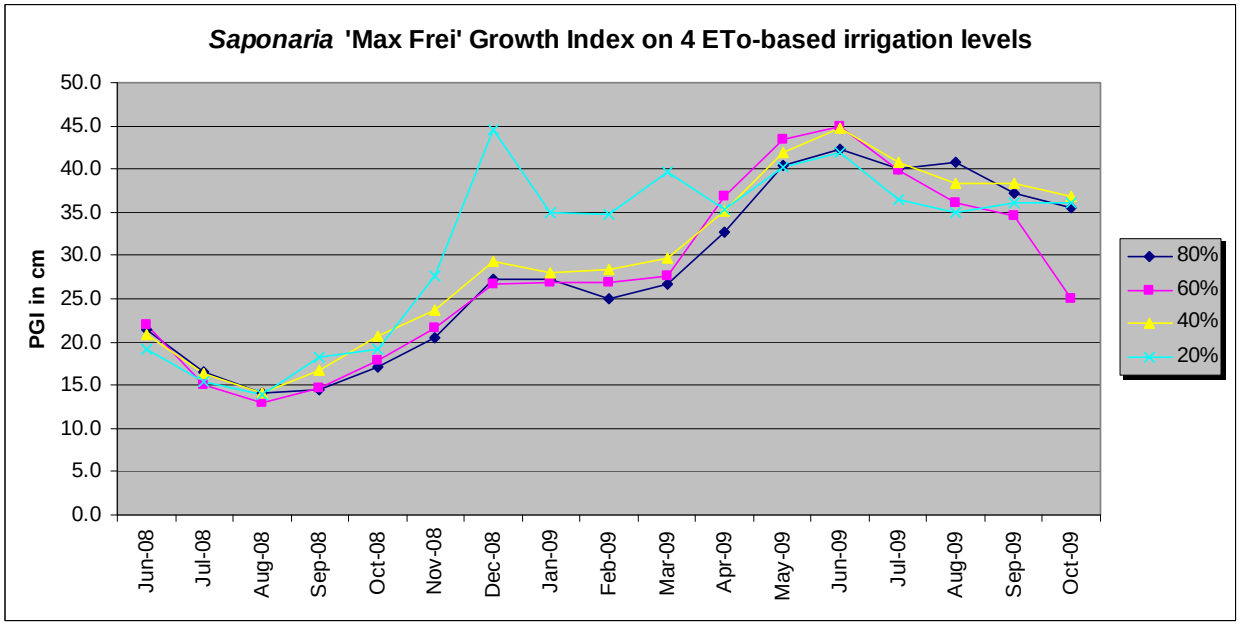


Chart 8b



There were no significant differences between treatments for this species.
At the end of 2 years, average height and width grew from 5" X 11" to 5" x 22".

QUALITY RATINGS DURING DEFICIT IRRIGATION

Table 8a (all ratings are based on a 1-5 scale)

***Saponaria* 'Max Frei'**				
foliage	JUNE	JULY	AUG	SEPT
80%	**3.7**	4.0	3.0	3.3
60%	3.0	3.0	2.3	3.0
40%	**3.8**	**4.2**	**3.2**	3.3
20%	3.0	**4.1**	**3.3**	**3.5**
flower				
80%	**3.8**	2.3	2.5	**2.8**
60%	2.8	2.2	**2.8**	1.6
40%	**3.7**	**3.2**	**2.7**	**2.8**
20%	3.4	2.4	2.2	**2.7**
vigor				
80%	4.2	**4.5**	**4.3**	**3.7**
60%	3.5	3.8	3.7	3.2
40%	**4.5**	4.3	**4.2**	**3.8**
20%	3.6	3.5	3.8	3.2
average				
80%	3.9	**4.3**	**3.7**	**3.5**
60%	3.3	3.4	2.9	3.0
40%	**4.1**	**4.3**	**3.7**	**3.6**
20%	3.3	3.8	**3.6**	3.3

Highest values within 0.1 are bolded

IRRIGATION TRIALS QUALITY COMMENT SUMMARY

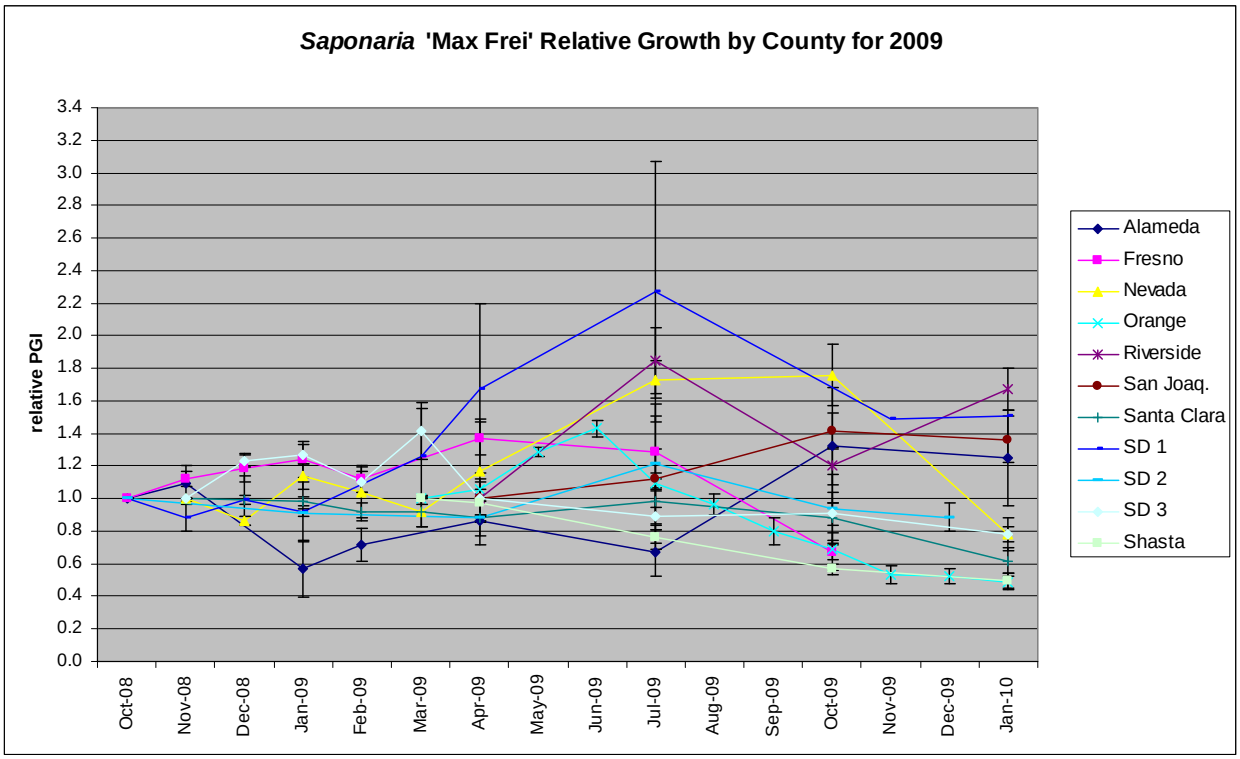
1. Unattractive at end of bloom cycle; deadheading is essential for continued good looks.
2. Some insect droppings were spotted in June, but the culprits had no lasting effects on the plants' health or appearance.
3. The one serious flaw of this plant is its stem brittleness. It breaks off VERY EASILY, though the plant always seems to recover and re-grow from the broken points.

MASTER GARDENERS' DATA- YEAR 1

Table 8b (all ratings are based on a 1-5 scale)

***Saponaria* 'Max Frei Average Annual 1st Year Ratings for 2009**												
Sunset Zone	14	8	7	22/23	18/19	14	15	23	24	21	9	
County	**Alameda**	**Fresno**	**Nevada**	**Orange**	**Riverside**	**San Joaq.**	**Santa Cla**	**SD-Pt. Loma**	**SD-Falbrk**	**SD -El Cajon**	**Shasta**	**AVG**
Foliage	3.8	4.7	4.1	2.3	3.3	3.5	4.1	4.4	3.4	3.6	2.8	3.7
Flowering	2.3	2.2	3.3	1.5	2.4	3.1	2.3	3.3	1.8	2.9	1.9	2.5
Pest resistance	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.8	5.0
Disease resistance	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.9	4.8	5.0
Vigor	3.0	4.4	4.3	2.4	3.1	3.7	4.1	4.0	3.6	3.7	2.9	3.5
AVG	**4.0**	**4.5**	**4.5**	**3.3**	**3.8**	**4.1**	**4.1**	**4.4**	**3.8**	**4.2**	**3.6**	**4.0**

Chart 8c



MASTER GARDENER COMMENT SUMMARY

1. The establishment year was complicated by breakage from foot traffic, animals, and the Master Gardeners themselves. This is reflected in the uneven trends in growth.
2. Though minor pest damage on spent calyxes was observed, no serious damage was noted from pests.

Year 2 data on the surviving specimens will tell more about the viability of these plants once established; differences between counties are still difficult to interpret. The only losses were in the coldest location (Grass Valley) during the first winter; three of five plants survived.

Chart 8d

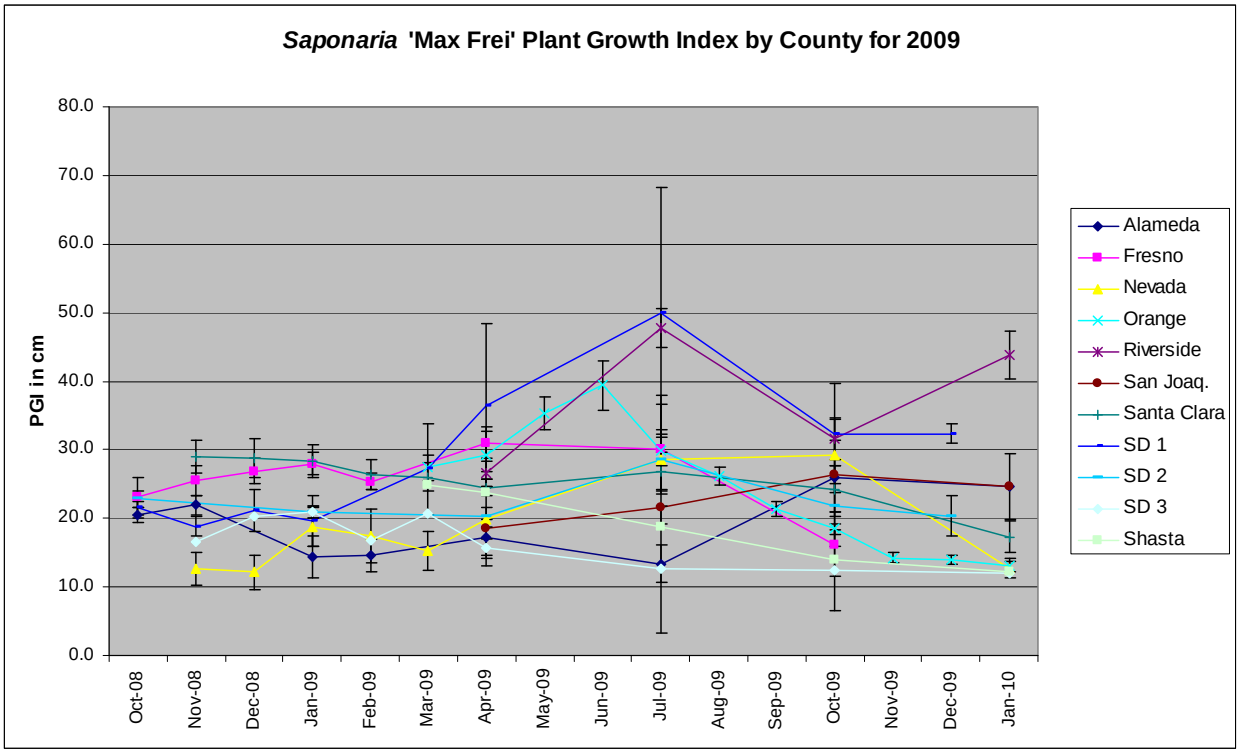
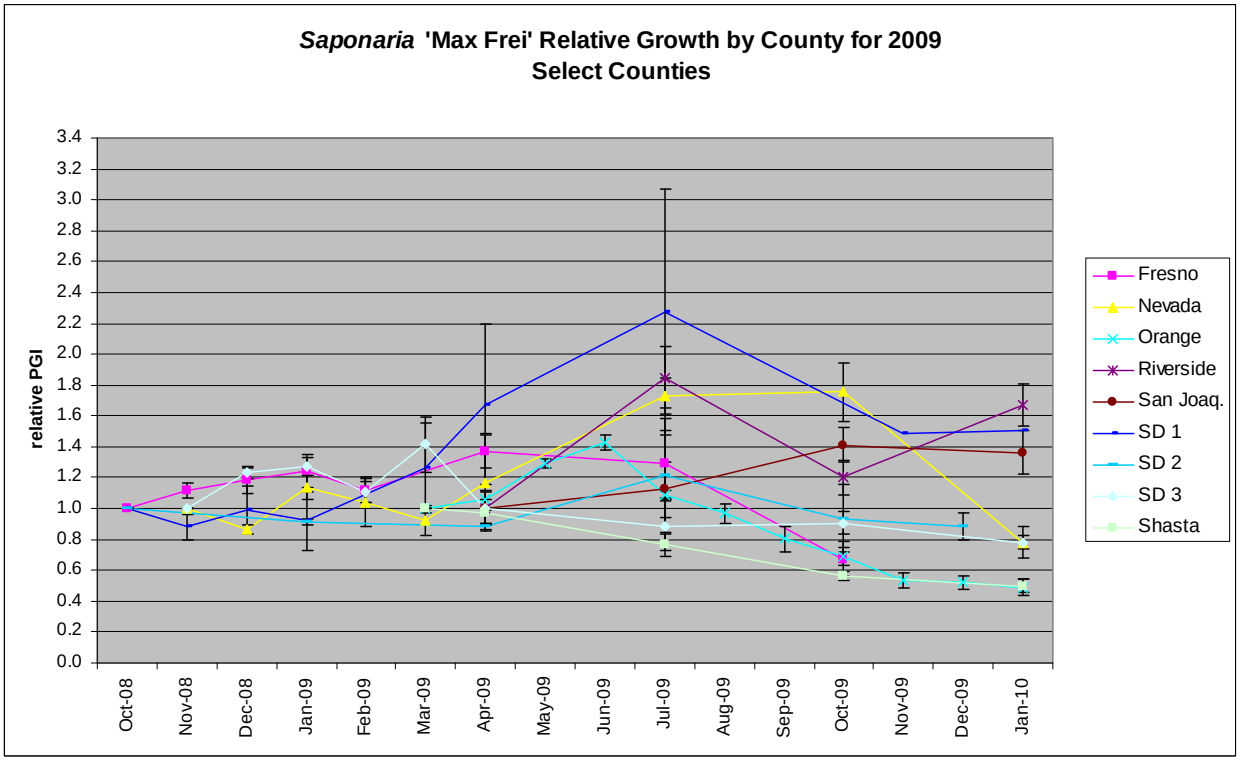


Chart 8e



Sedum palmeri **Palmer's sedum**

MASTER GARDENERS' COMMENT SUMMARY

The following include comments from those who have had the plants both 1 and 2 years.

1. The main complaint with all gardens was how fragile the stems were. This is a low-growing groundcover, and would be expected next to a walkway, however, it was easily broken by passersby and by animals.
2. It rotted easily if the soil was not elevated. All recommended a raised area, a slope, or pot culture.
3. The plants did not survive in Mariposa or Nevada County.
4. Three locations had aphids on the plants for at least two months, though only one location found them to disfigure the plants.
5. The plants grown in partial or filtered shade performed consistently better than those in full sun.
6. Another common observation was the tendency of the foliage to develop a sickly yellow hue after some time in the ground.

Overall this plant was not a success in the trials field or the Master Gardener Demo Gardens. This is a lovely, very slowly growing groundcover for partially shaded slopes, raised beds, or pots. However, it does not display the kind of "tough as nails" characteristics that are the foundation of the All-Stars.