Irrigation Trials Results for Kurapia®

2012-2014

Performed by UC Davis/ UCANR

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Average Overall Appearance Rating for Kurapia
Year 2 on 4 levels of Reduced Irrigation

Overall Rating (1-5) on each $\%ET_0$				Recommended conservation irrigation rate
80	60	40	20	
4.0	4.3	4.0	4.2	20%

Research Methods

During the fall of 2012, 24 #1-sized plants of *Phyla (Lippia)nodiflora* (*Lippia* 'Kurapia S1', hereafter referred to as Kurapia) were planted in the ground in full sun on the University of California campus in Davis, CA, (USDA Zone 9b and Sunset zone 14). The soil in this field is characterized as Yolo clay loam, a fairly heavy soil. These plants were installed along with 14 other species for a 2-year evaluation period.

Plants were placed 2 meters apart in 1-meter wide planting beds covered with 3 inches of chipped wood mulch. Planted beds were separated by a 1 meter-wide non-mulched path between rows. Each row was supplied with 4 water lines corresponding to one of 4 irrigation treatments. Two 2-gallon/hour drip emitters attached to one of the four lines were installed under the mulch in the root zone of each plant. The plants and treatments were randomized throughout the fields in two complete blocks with a total of 6 repetitions of each irrigation treatment for each species. The field was manually weeded between rows and post- and pre-emergent herbicide was applied around the perimeter of the field as needed. Throughout the trial, no pesticide or fertilizer treatments were applied to the plants. The plants were established on irrigation at 80% of evapotranspiration (ET_0), as well as rainfall during fall 2012 through spring 2014. This irrigation level was to encourage the establishment of roots that reached deeply into the native soil.

Because of a dry winter and sporadic spring rains, all plants received irrigation on May 14, 2014 to fill the soil water reservoir and begin the deficit irrigation budgets. These treatments continued through October. Irrigation was based on reference evapotranspiration (ET_0) as reported online by the local California Irrigation Management Information System (CIMIS; http://wwwcimis.water.ca.gov/) using the weather station at the Davis campus. ET_0 is defined as the total amount of water loss from a reference plant (in this case, a well-maintained tall fescue) through evaporation and transpiration. There were four treatment levels: 80%, 60%, 40%, and 20% of ET_0, corresponding to high, moderate, moderate-low, and low irrigation levels, as described in *The Water Use*

Classification of Landscape Species IV (WUCOLS IV, 2014). An equal volume of water was applied at each irrigation equivalent to 43% of the soil's water holding capacity in the root zone (about 14.4 gallons) to a depth of 18 inches. This is the accepted percentage of plant available water for this soil type. The frequency of the irrigation was determined using a water budget for each treatment percentage of ET_0.

During the deficit irrigation treatments of 2014, the plants in full sun on 80%, 60%, and 40% of ET_0 were irrigated approximately every 2, 3, and 4 weeks, respectively. The 20% treatment received 2 irrigations, one in early July and another in late August. The only significant rain event during this time was 0.42 inches on September 29, when the trials were nearly over.

Measurements of length (l), width (w), and height (h) were taken monthly. These measurements were used to calculate a plant growth index (PGI = $[(l + w)/2 + h]/2$) (Irmak, S. et al., 2004). A relative plant growth index was also calculated (PGI/ initial PGI) and tracked to account for original plant size differences, and to evaluate the percentage of new growth along with final average plant size for each treatment. Because this plant grew so vigorously, we had to trim it twice to keep it from encroaching into the irrigated areas of adjacent plants. The first trimming was during the first year when plants were cut back to the edge of the planted bed; after measurements in June of the second growing season, each plant was again trimmed to a 1-meter diameter circle. For this reason, subsequent relative plant growth indexes are calculated from July's measurement (PGI/July PGI), and reflect the percentage of growth put on during the most critical irrigation phase of the trial.

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

Table 1. Irrigation frequency and dates for 2014 growing season

Irrigation % of ET_0	# of Irrigations	Dates of Irrigation (rainfall: 9/25, 0.42")
80	9	5/29, 6/12, 6/23, 7/5, 7/17, 7/31, 8/15, 8/29, 9/14
60	7	6/2, 6/20, 7/4, 7/21, 8/8, 8/27, 9/19
40	4	6/11, 7/5, 7/31, 8/29
20	2	7/1, 8/23

Table 2. 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 appearance	same as 5 except for minor tip burn, edge damage, or minor damage to only a few leaves	acceptable but not its best; 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	unacceptable; close to dead
Flowering	full, glorious bloom; the height of bloom for the species	51-75% of plant in bloom	26-50% of plant in bloom	11-25% of plant in bloom	1 bloom open to 10% in bloom
Pest Tolerance/ Disease Resistance	no visible damage	only very minor damage to a few leaves	minor damage to many of the leaves or flowers; appearance still acceptable from a distance	major damage ; appearance unacceptable	severely damaged and probably dying
Vigor	pushing out a lot of new growth from every growing point	pushing out new growth from most 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 at its prime	Acceptable but nothing special; may be past or not quite to its prime; often described as an 'okay' plant.	unacceptable for any of the above reasons	completely unacceptable and probably not going to improve

1. California Irrigation Management Information System, 2009, State of California, http://wwwcimis.water.ca.gov/cimis/welcome.jsp
2. Irmak, Suat, D.Z. Haman, A. Irmak, J.W. Jones, K.L. Campbell, T.L. Crisman. 2004. Measurement and Analyses of Growth and Stress Parameters of *Viburnum odoratissimum* Grown in a Multi-pot Box System. HortScience 39(6):1445-1455.
3. WUCOLS IV. 2014. Water Use Classification of Landscape Species. Regents of the University of California. 2014. http://ucanr.edu/sites/WUCOLS/

Results - Discussion

The first thing to note about Kurapia is its vigor. Each plant quickly outgrew the space allotted to it for the length of the trial and had to be cut back twice in two years to prevent it encroaching on nearby plants. In the first year the plants grew from an average of 42 cm across (16 in.) to 130 cm (52 in.) between April and November. During the deficit irrigation portion of the trials the second year, there were no significant differences in growth between treatments when measured as an overall plant growth index or a relative index.

The quality of the plant was not significantly affected by irrigation level either. The percentage difference in these ratings between treatments is very small, and does not represent a compromise in the overall health, vigor, or appearance of Kurapia. Flowering was slightly lower on the lowest irrigation treatment, but was still at a very acceptable level throughout the growing season. Since the flowers are small and not very showy, this was not an issue that affected its overall appearance. Although the flowers are not showy, they are attractive when the plant is in full bloom. They lose this attractiveness when they begin to turn brown, but should this plant be used in applications where it was viewed at close range, these could be removed with a string trimmer. The blooms were heavily visited by pollinators throughout the long blooming period.

Kurapia was unaffected by disease during this trial, and only very minor leaf-chewing by insects was observed. The extremely vigorous nature of the plant along with its vivid green color made this minor damage unnoticeable except upon the closest scrutiny.

The only major criticism of this plant is that its appearance was severely affected by frost beginning in late December. It generally died down from the edges, the centers went somewhat bare, and the long, stiff stems were unattractively exposed through March. It began to recover in late March, and by April all plants had grown back over the bare spots and had an acceptable appearance.

This cultivar of *Phyla nodiflora* shows extreme adaptability to irrigation levels, but due to its high performance level at the lowest irrigation rate in this trial, we would recommend that, once established, it be irrigated at the 20% level and no more than 40% level of ET_0, as additional water does not represent a significant gain in appearance or size. These recommendations are based on using ***drip irrigation in a clay-loam soil***, and may not be reproducible in lighter soils or with the use of overhead spray irrigation.

Results - Data

Kurapia Quality Ratings for Year 2 Growing Season, 2014

Table 3. Average monthly quality ratings for Kurapia during 2014 on 4 levels of ET_0-based irrigation

	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	AVG
foliage									
80%	4.7	4.5	4.7	4.2	4.0	3.8	4.0	3.6	**4.2**
60%	4.8	5.0	5.0	4.8	4.8	5.0	5.0	4.8	**4.9**
40%	4.3	4.6	4.7	4.7	4.9	4.4	4.4	4.3	**4.5**
20%	4.4	5.0	4.8	4.6	4.6	4.8	5.0	4.4	**4.7**
flowering									
80%	5.0	1.0	3.8	4.3	5.0	4.0	4.2	3.2	**3.8**
60%		1.0	5.0	5.0	5.0	4.3	5.0	3.0	**4.0**
40%	5.0	2.0	5.0	4.3	4.5	4.6	4.6	2.7	**4.1**
20%		1.0	4.7	4.3	4.5	4.3	4.0	2.8	**3.6**
pest tolerance									
80%	5.0	5.0	5.0	4.7	4.7	4.4	4.4	4.2	**4.7**
60%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
40%	5.0	5.0	5.0	5.0	4.9	5.0	5.0	5.0	**5.0**
20%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
disease resistance									
80%	5.0	4.7	4.8	4.8	4.8	4.6	5.0	5.0	**4.8**
60%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
40%	5.0	5.0	5.0	5.0	4.9	5.0	5.0	5.0	**5.0**
20%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
vigor									
80%	4.2	3.8	4.3	4.3	4.5	4.2	4.0	4.2	**4.2**
60%	4.3	4.5	4.5	5.0	5.0	4.8	5.0	4.8	**4.7**
40%	4.0	4.1	4.3	4.4	4.6	4.7	4.3	4.1	**4.3**
20%	4.2	4.6	4.8	4.8	4.6	4.6	5.0	4.4	**4.6**
overall appearance									
80%	3.5	3.8	4.0	3.8	4.2	4.2	4.0	4.2	**4.0**
60%	2.8	3.8	4.0	4.4	5.0	4.8	5.0	4.8	**4.3**
40%	2.6	3.4	3.9	4.3	4.9	4.7	4.3	4.1	**4.0**
20%	3.2	3.8	4.0	4.3	4.4	4.6	5.0	4.4	**4.2**

Kurapia Plant Growth Charts for Year 2 Growing Season, 2014

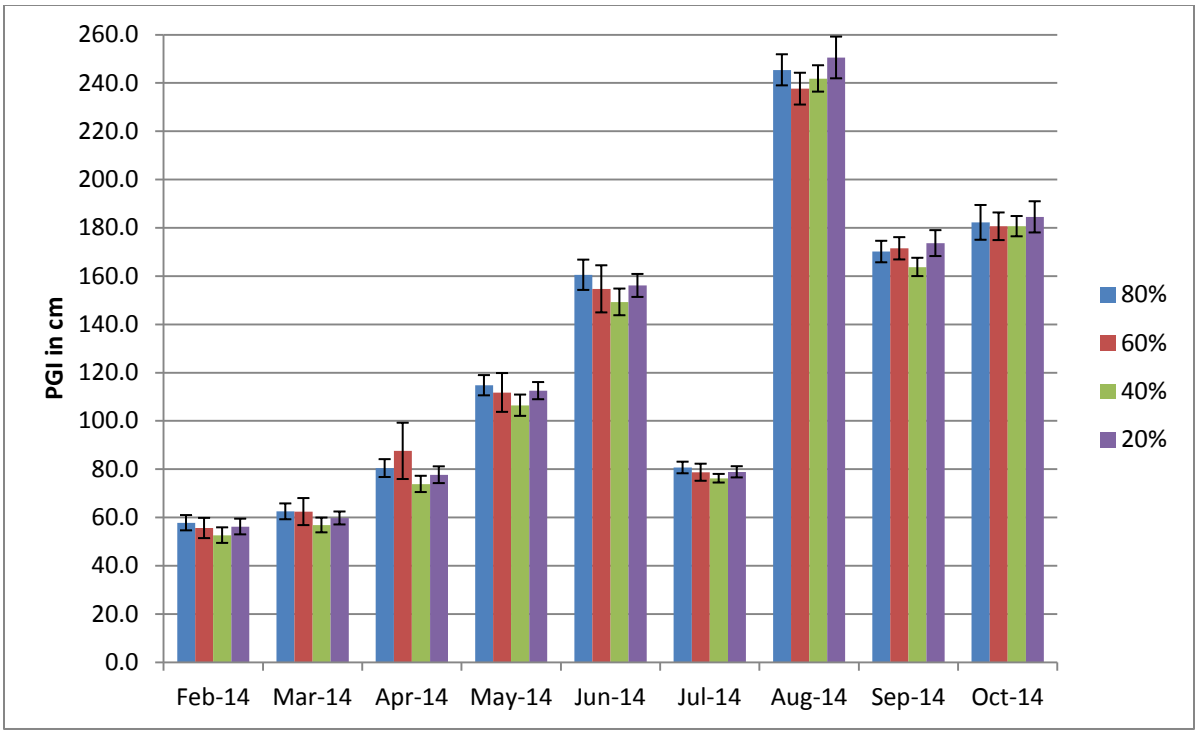

Figure 1. Plant growth index in cm for Kurapia on 4 levels of ET_0 -based irrigation
Error bars represent ± 1 SE; no sig. differences at $p \leq 0.5$ using ANOVA and Tukey's HSD

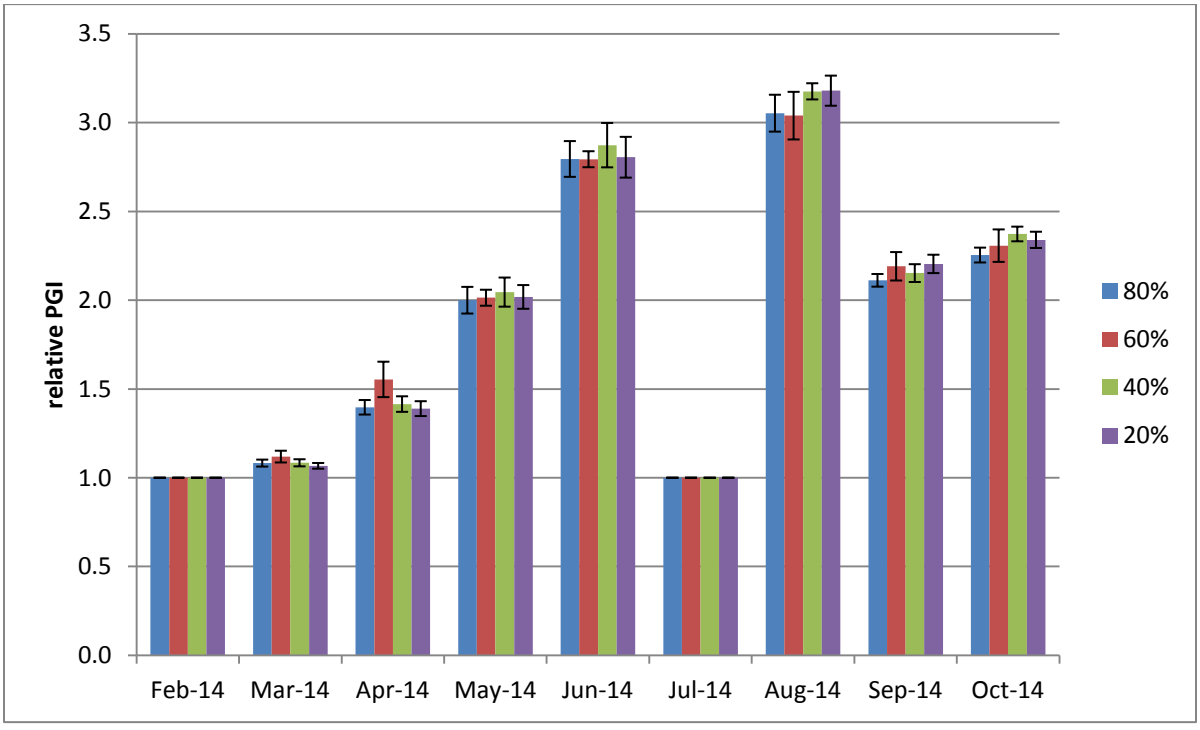

Figure 2. Relative plant growth index for Kurapia on 4 levels of ET_0 -based irrigation
Error bars represent ± 1 SE; no sig. differences at $p \leq 0.5$ using ANOVA and Tukey's HSD

Photos- (all photo credits: K. Reid)

Figure 3. Kurapia in Sept. 2013, after 1 year in the ground, trimmed to 1 m wide.

Figure 4. Kurapia in late March 2014, still showing winter damage.

Figure 5. Kurapia in late April 2014, recovered and filled in.

Fig. 6. Kurapia in May 2014, more than 1 m wide, blooming.

Fig. 7. Kurapia in June 2014, in full bloom, pruned to 1 m-wide circle.

Fig. 8. Kurapia on 40% of ET_0 irrigation in July 2014 already outgrowing its pruning.

Fig. 9. Kurapia on 80% of ET_0 completely outgrowing its allotted space by August 6, 2014.

Fig. 10. Kurapia on 20% of ET_0 in September 2014, still blooming around the edges with brown flower heads in the middle.

Fig. 11. Kurapia on 20% of ET_0 in October 2014. It has grown into adjacent plants 2 m away.

Fig. 12. Bee on Kurapia flower in May 2014.

Fig. 13. Butterfly on Kurapia in May 2014.

Fig. 14. Butterfly on Kurapia in May 2014.