

The Effects of Irrigation and Fertilizer on Vetiver Establishment

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Abstract

Vetiver is touted for use in many soil and water conservation practices to reduce run-off, soil erosion, and to stabilize steep slopes. In order to perform these functions the plants must close in and form a barrier that will channel water and hold soil. Experiments at Kunia, Mililani and Waimanalo show the effects of irrigation and fertilizer on vetiver establishment. Irrigation was shown to have the greatest effect on establishment of vetiver, and only slightly noticeable changes were due to fertilizer. Irrigation was most important in dryer conditions and less in the areas that received greater annual rainfall, however still necessary in order to form an adequate barrier in time for the winter rains.

Introduction

Vetiver (*Chrysopogon zizanioides*, syn. *Vetiveria zizanioides*) is a nonfertile, noninvasive perennial clump grass. The 'Sunshine' variety used in Hawai'i is native to South India, although it is widely cultivated in tropical and semi-tropical regions of the world. Due to its sterile seeds it must be propagated asexually, and was evaluated for invasiveness by the Hawaii-Pacific Weed Risk Assessment and Pacific Island Ecosystems at Risk and received a very low score (-8) for potential to become invasive.

Vetiver is central to many soil and water conservation applications, erosion control, slope stabilization, prevention and treatment of contaminated waste water, phytoremediation and bioremediation, as well wetland and marginal land restoration. After seven years at Kunia, irrigated Sunshine cultivar grew to a maximum height of six feet. Vetiver can grow to a height of up to 8 feet and unlike most grasses does not grow

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to form a horizontal mat of roots, but rather has a deep vertical root system with an estimated depth up to 4 meters. This depth of roots helps to stabilize steep slopes, stream banks, and terraces and greatly reduces the risk of erosion. About 5 months after planting, vetiver quickly fills in to form a barrier that can be used in place of permanent more costly structures. The barrier can be used to channel water, as well as catch soil to prevent run off. Vetiver is easy to grow and requires very little maintenance aside from some irrigation and occasional pruning to maintain a healthy looking hedge.

Materials and Methods

Vetiver slips were collected from existing plantings at Hawaii Agriculture Research Center in Kunia, which were originally obtained from the USDA Hoolehua Plant Material Center on Molokai. Monthly plantings started in March 2009 and continued to March 2010 at three different sites: Kunia, Mililani, and Waimanalo. Each plot was 10 feet in length and contained 20 vetiver plants evenly spaced 6 inches apart, and planted about 4 inches deep, (Picture 1). Four treatments consisted of factorial combinations of irrigated, unirrigated, fertilized and unfertilized plots. The unirrigated plots were given water for the first 14 days after transplanting to help minimize transplant shock and allow them to become established. The irrigated plots were drip-irrigated as required at 85 percent of Class A open pan evaporation. Data was collected monthly including weather data, height measurements, tiller counts, and rate of close-in as determined by the space occupied by the stools relative to the 10 ft. row, (Picture 2). The fertilized plots received a single application of 16-16-16 and gypsum at 300 lb/acre.



Picture 1. Vetiver plant spacing

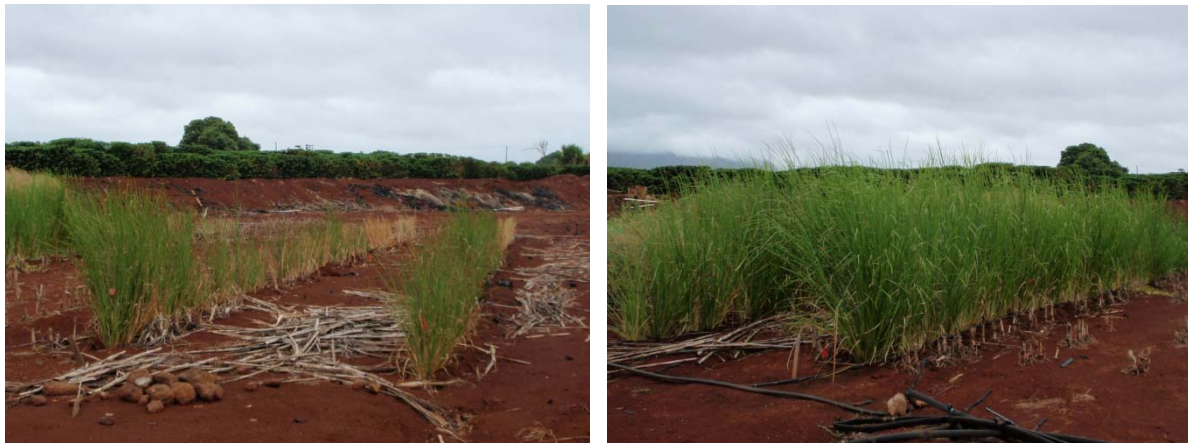


Picture 2. Measuring height and % close-in

Results and Discussion

Irrigation and fertilizer were examined for their effectiveness in rapid establishment of a living barrier and/or increasing the health of vetiver. The three planting sites have different rainfall amounts but similar distribution patterns, with a winter wet season and a summer dry season. Waimanalo receives the highest annual rainfall amount, approximately 47.8 inches, followed by about 37.6 inches at Mililani and about 30

inches at Kunia. Areas with higher rainfall had more clouds, less sunlight and less evapotranspiration. The different rainfall amounts affect the level of irrigation needed for vetiver to become established and close in to form a barrier. Higher rainfall generally resulted in quicker growth in height as well as new tiller growth, increasing the rate at which it closed in to form a barrier (Figure 1). Irrigation had the most significant effect on plant height growth as well as tiller growth which results in a quicker rate of close-in. At all three sites, there were significant differences in height, tiller count, and rate of close-in between the irrigated and unirrigated plots (Picture 3).



Picture 3. Unirrigated fertilized, and unirrigated unfertilized plots (left) vs. irrigated unfertilized, and irrigated fertilized plots (right) respectively at Kunia.

The average number of tillers in a 10-foot plot with evenly spaced plants needed to achieve the desired rate of 100% close-in is approximately 300. The first planting of vetiver in March of 2009 achieved this rate after approximately 5 months (Picture 4). The rate of vetiver growth and close-in also varies by season. In all 3 locations faster growth and establishment was seen during the spring and summer months, as compared to fall and winter when growth rates fell (Figures 2, 3, 4). It is recommended in Hawaii that vetiver be planted no later than July to allow enough time for the plant to establish and form a barrier before the winter rains.



Picture 4. March planting of vetiver after 5 months of growth, picture taken in August at the Millani site.

Conclusion and Recommendations

Irrigation seemed to have the most dramatic effect on the overall plant growth, health and survival. As demonstrated in Picture 3, the effect of irrigation is significant, especially in areas of low rainfall. It is recommended that vetiver planted in areas of low rainfall be cared for and irrigated until a barrier is fully established. Vetiver that is not irrigated will survive if planted during the rainy season, but will have high mortality rates if planted during the dry season. Although the effect of irrigation was more dramatic in the dryer climate of Kunia than at Mililani and Waimanalo, the data shown in Figures 2, 3 and 4 show similar results with regards to seasonal growth. When planted in spring and summer, vetiver tends to grow at much faster rates when properly irrigated. When planted at least 5 months before expected winter rains, irrigated vetiver will serve as an effective erosion control mechanism. Fertilizer did not seem to have as strong of an effect on vetiver growth and health, likely due to the fertile soils at each location. It is recommended that a soil sample is done through the University of Hawaii to determine soil fertility when planning to use vetiver on soils with unknown nutrients. It is likely that poor subsoil areas may need to use fertilizer to help vetiver establish.

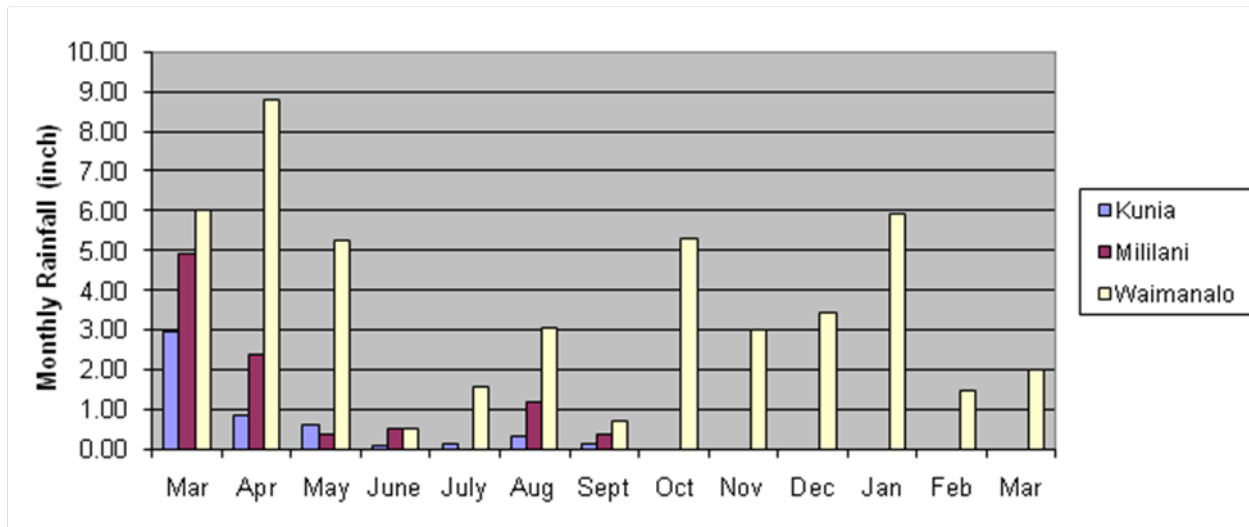


Figure 1. Weather data showing average temperatures and rainfall totals for March 2009 - March 2010.

Tabular Data for Figure 1:

2009	Kunia			Mililani			Waimanalo		
	Temperature Max °F	Temperature Min °F	Rainfall inches	Temperature Max °F	Temperature Min °F	Rainfall inches	Temperature Max °F	Temperature Min °F	Rainfall inches
Mar	78.3	63.9	2.95	na	na	4.90	76.1	66.6	6.03
Apr	79.7	64.0	0.86	na	na	2.38	77.1	66.8	8.78
May	84.7	65.6	0.62	na	na	0.37	80.8	68.4	5.24
June	86.0	70.0	0.07	na	na	0.52	83.0	73.1	0.52
July	86.2	71.1	0.14	na	na	na	84.0	73.9	1.57
Aug	87.0	72.1	0.30	na	na	1.18	84.5	74.9	3.05
Sept	87.5	70.6	0.14	na	na	0.36	85.3	73.7	0.70
Oct				na	na		85	74	5.32
Nov				na	na		81.2	72.2	3.01
Dec				na	na		79.2	64.7	3.41
Jan				na	na		79.4	66.0	5.94
Feb				na	na		78.1	64.1	1.48
Mar				na	na		78.3	67.9	2.01

Note: Mililani data not available from June 23 to Aug 3, 2009. September data only until the 17th.

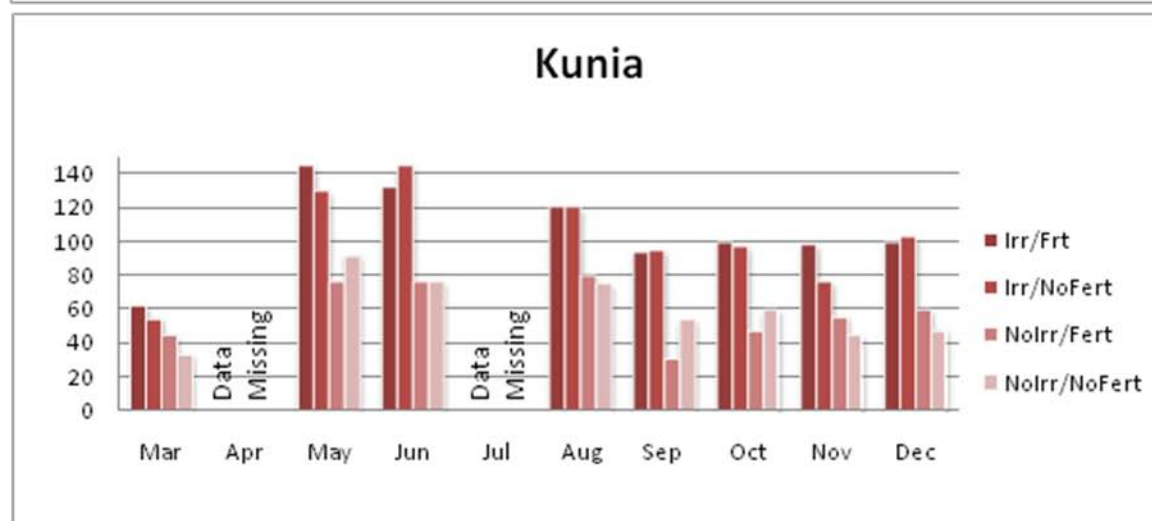
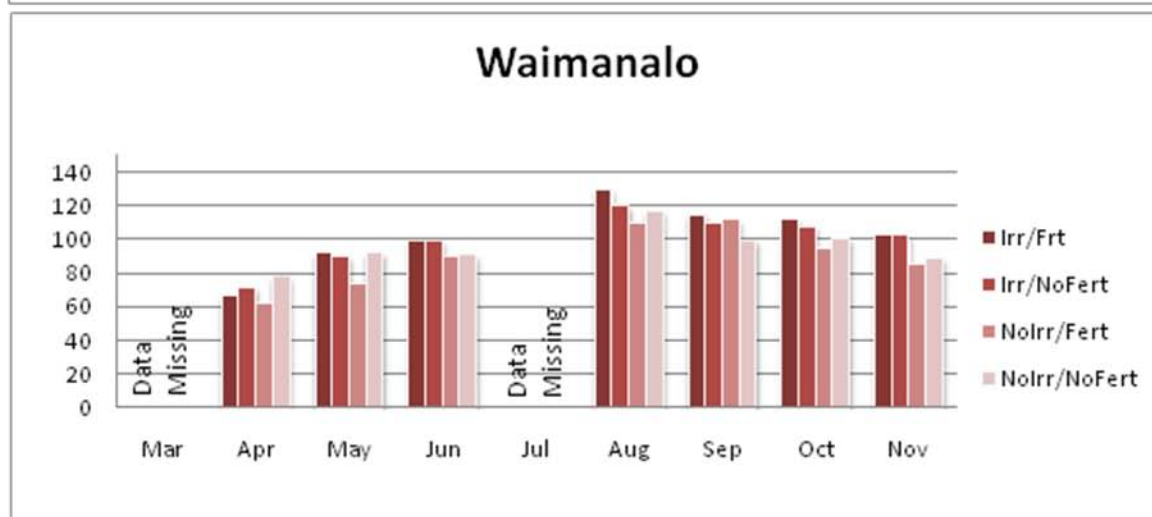
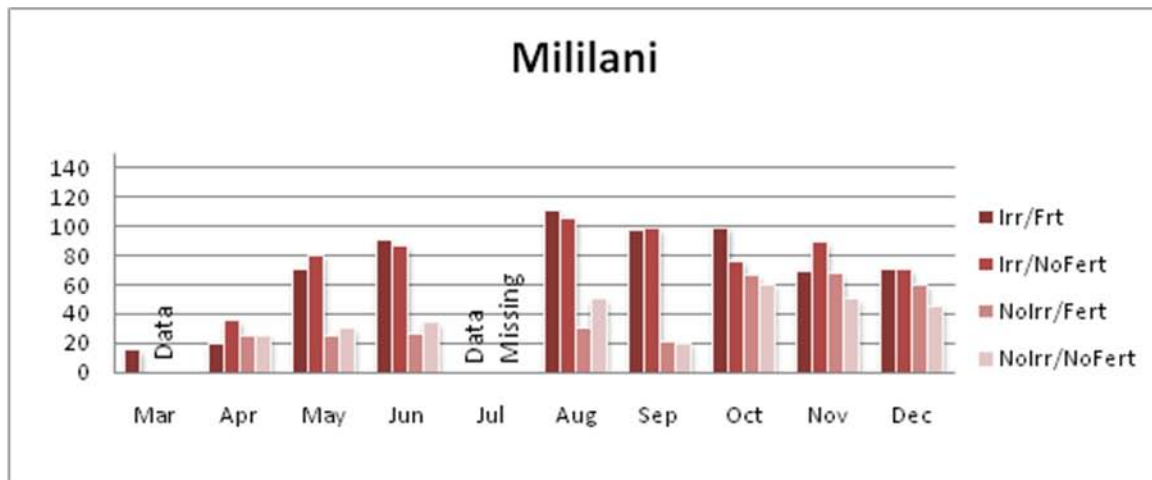


Figure 2. Height (cm) 90 days after each months planting. 1 row x 20 plants .

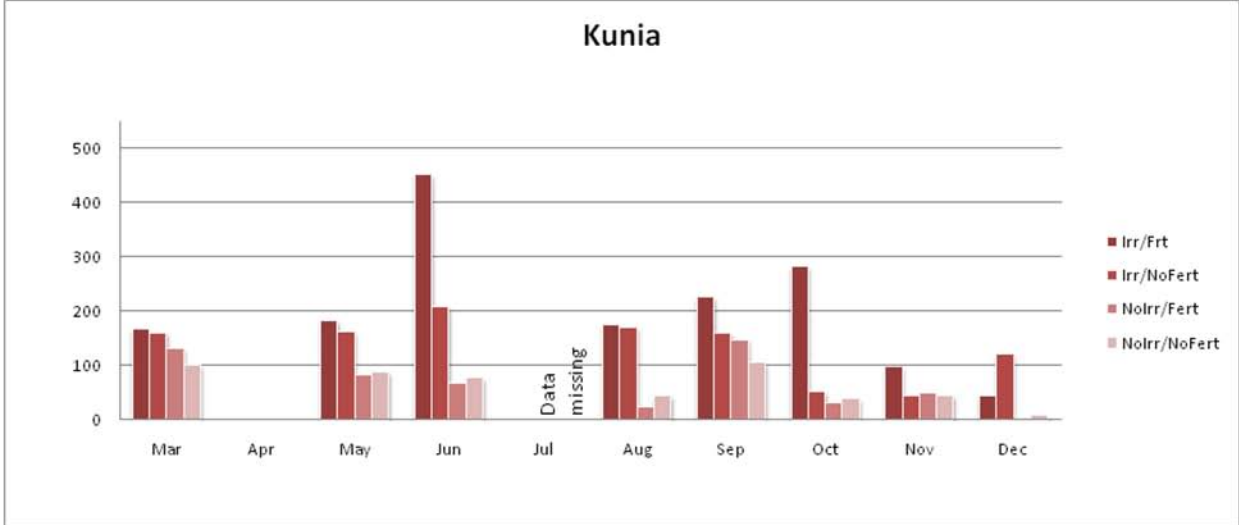
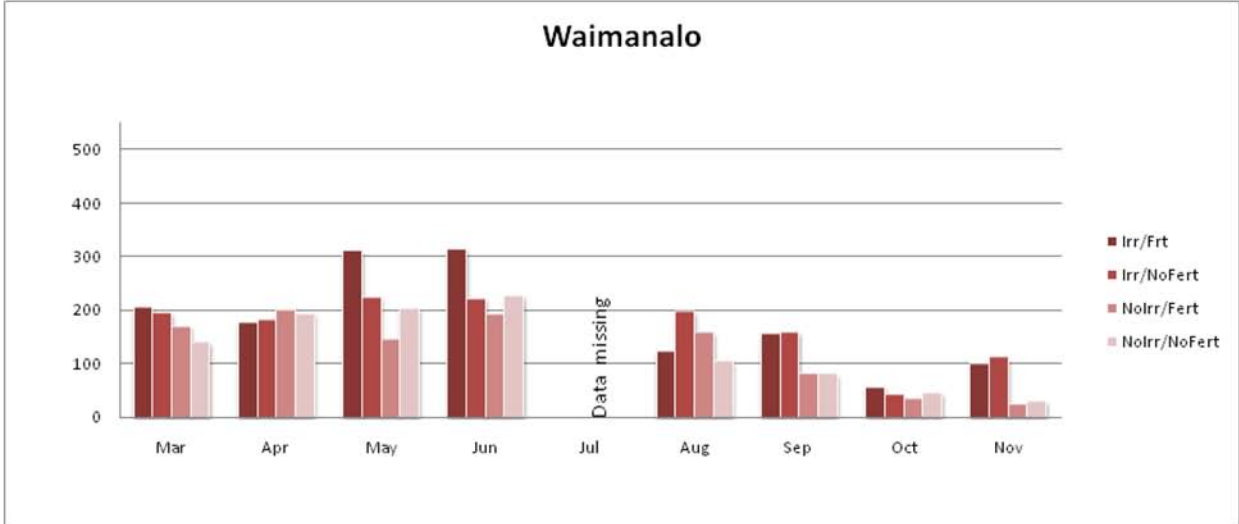
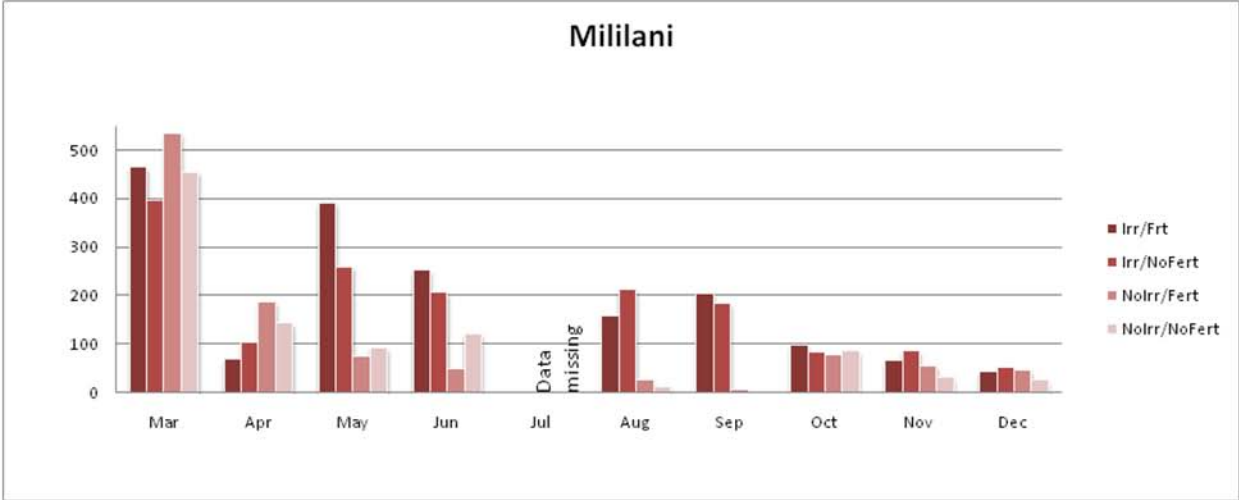


Figure 3. Shoot counts 90 days after each months planting. 1 row X 20 plants.