Effect of Irrigation Regime on Yield and Quality of Three Varieties of Taro (*Colocasia esculenta*)

Jensen Uyeda, Ted Radovich, Jari Sugano, Ali Fares and Robert Paull

Water use efficiency, characterized by the amount of water needed to produce a unit of plant material (Kirkham, 2004), is important for Hawaii's agriculture systems where water resources are limited. Many of our farming systems rely on county water for their irrigation needs, which are relatively expensive and can become limited during periods of drought. Evapotranspiration (ET) models which estimate the water lost from the soil and the plant can be used in combination with irrigation scheduling as a method for maximizing water use efficiency and reducing grower cost.

'Bun long', 'Lehua' and 'Pa'akala' taro being studied at the Waimānalo Experiment Station.

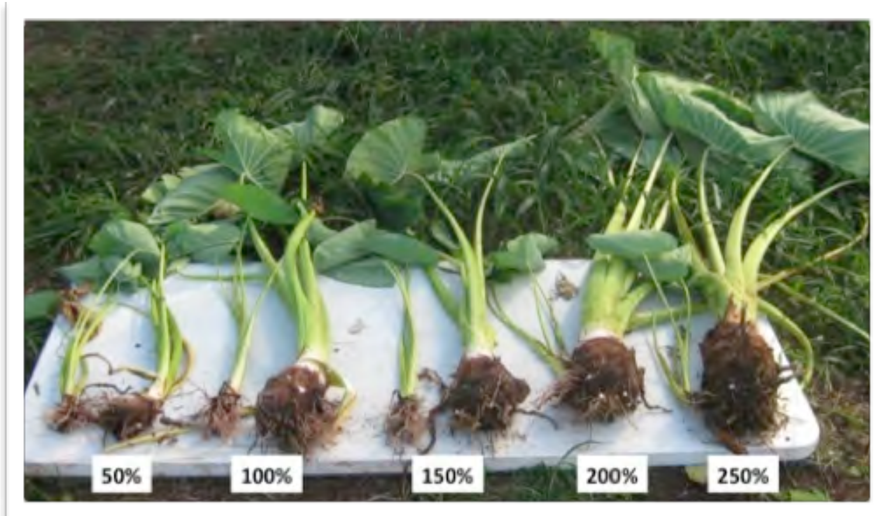
Taro, one of the least water efficient crops, is typically grown in flooded paddies or lo'i and has a water requirement of 15,000 to 60,000 gallons/acre/day (Watson, 1970). The large water requirements associated with lo'i-grown taro limits its production to areas near streams and rivers. Dry land taro production on the other hand has a lower water requirement of 4,000 to 9,000 gallons/acre/day (Uchida et al. 2008) and can be grown in areas similar to that of other agronomic crops. Although dryland taro is grown on a larger production area, its yield tends to be inferior to that of lo'i grown taro. Research has shown that corm yields increases with increased irrigation.

Given the need for maximizing water use efficiency of dryland taro production, we used a site-specific ET model to schedule irrigation for dryland taro. Specific objectives of this study were (i) to determine the yield response curve of taro to irrigation rates and (ii) to quantify the effect of irrigation rates on objective measures of quality.

Jensen Uyeda measures specific gravity of taro grown at the Waimānalo Experiment Station.

The experiment was conducted at CTAHR's Waimānalo Experiment Station. Irrigation rates were based on reference evapotranspiration (ET_0) calculated using a modified Hargreaves model (Wu, 2000) and site-specific air temperature and solar radiation. Five irrigation treatments were applied using a drip system equivalent to 50%, 100%, 150%, 200% and 250% of ET_0 replaced. Three commercial varieties ('Bun long', 'Lehua', and 'Pa'akala') were used as planting material. Plants were harvested seven months after planting at which the yield (fresh weight, leaf area, and cormel count) and quality (dry matter content, specific gravity or relative density) components were measured.

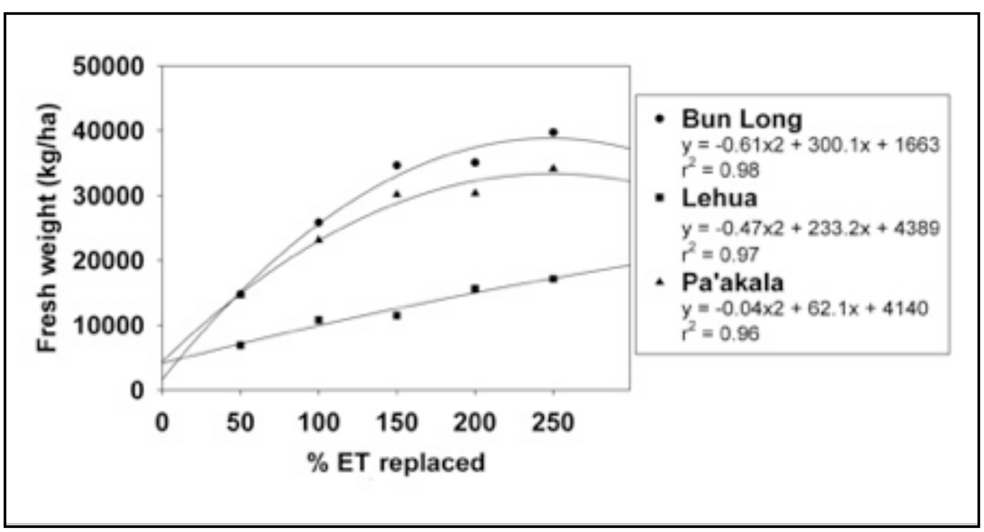
Our results showed no significant effect of irrigation on objective measures of quality. However, large yield responses were observed for all varieties. The magnitude of response of corm fresh weight to irrigation rates varied (Fig. 1). 'Bun long' and 'Pa'akala' showed the greatest response to increased irrigation, with 'Bun long' having the highest response, and no significant difference in yield between 150, 200 and 250% of ET_0 replaced. These two varieties are mainly grown in upland conditions where water is usually limited. On the other hand the lowest response to increased irrigation was observed by 'Lehua', which is typically grown in flooded conditions. Yields of 'Lehua' increased with increasing irrigation though the level of irrigation applied was not large enough for 'Lehua' to reach its critical yield level (i.e. 95% of maximum). This could also suggest that plants more adapted to upland conditions are more efficient at using water than varieties, which are more adapted to flooded conditions.



Growth responses of taro grown under different irrigation regimes.

We conclude that irrigating dryland taro at 150% ET_0 can maximize yield of 'Bun long' and 'Pa'akala'. Although, supplying irrigation up to 250% ET_0 to a lowland variety such as 'Lehua' did not result in

Fig. 1. Yield represented as fresh weight relative to Evapotranspiration replaced for three taro cultivars planted Apr. 2010 at the Waimānalo Research Station in Hawaii. Data points are treatment means of 20 values.



yields comparable to flooded systems. In addition, the potential to predict corm weight based on its relationship to percent ET_0 replaced can assist in crop modeling and irrigation scheduling to maximize water use efficiency of taro. Use of economic evaluations for cost benefit analysis is important when determining whether the increase in yield is worth the increase in water cost. Additional varieties suitable for poi manufacture should be evaluated and additional subjective quality measures (e.g. tasting) should be included in future evaluations.

References

Kirkham, M.B. 2004. Water-Use Efficiency. Encyclopedia of Soils in the Environment. 315-322.

Uchida, J., & P. Levin, & S. Miyasaka, & G. Teves, & J. Hollyer, & S. Nelson, & J. Ooka, 2008. Taro Mauka to Makai. College of Tropical Agriculture and Human Resources, University of Hawaii, Honolulu, Hawaii.

Watson, L.J. 1970. The Legal Importance of Water Requirments of Taro, Colocasia esculenta in Hawaii, Honolulu, Hawaii 1).

Wu, I., 1997. A Simple Evapotranspiration Model for Hawaii: The Hargreaves Model, CTAHR Fact Sheet EN-102.