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Effect of Different Watering Intervals on Water Leaf (*Talinum fruticosum*) Growth and Foliage Yield

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Abstract

Waterleaf (*Talinum fruticosum*) is a vegetable useful to millions of sub-Saharan Africans; eaten as a leafy vegetable and useful in herbal medicine. During the dry season waterleaf farming becomes tedious for growers because of the need to supply water to the crop. Knowledge of the adequate water requirements for waterleaf will lead to more precise application regime. This research explored a means to establish an adequate watering regime; by studying the effect of different watering regimes on growth and production of water leaf. The experiment was laid out in a completely randomized design with 10 replications. The treatments were 4 different watering intervals of 1-day, 3-days', 5-days' and 7-days. Parameters measured were plant height, leaf number, stem circumference and above ground fresh weight (FW). There was no significant effect of watering treatment on plant height and leaf number. Average fresh weight/plant across all treatments ranged from 1.4 -8.68 g/plant. There was a significant effect of watering regimes on the FW at 9 weeks after planting ($P=0.026$). Water application at 7-day interval produced FW of 8.68g/plant higher than the 3-day interval (2.65g/plant). No difference was observed between the 1, 3 and 5-day interval of watering. This result indicated that water supply at a frequency of 1-7 days may not influence leaf production/plant or plant height but may affect the overall FW/plant which has the potential to significantly affect foliage yield. Delayed application up to 7 days showed the most promising response with regard to FW yield, implying watering at a 1-3-day interval in the dry season could decrease foliage yield.

Key words: water leaf, fresh weight, water requirement

1.0 Introduction

Water leaf (*Talinum fruticosum*) is a perennial herb which belongs to the family of Talinaceae (fenzl) Doweld and the genus of *Talinum* Adans. It's botanical synonyms include: *Talinum triangulare* (jacq) wild, *Talinum crassifolium* (jacq).Wild. and *Portulaca fruticosa* L. It has different common names in different regions of the world. In west Africa it is called

waterleaf, in parts of Asia it is called Ceylon spinach and Philippine spinach. It is native to tropical and subtropical America (Khaing & Moe, 2019) and was introduced to West Africa. It is cultivated in tropical regions of Asia, Africa and America.

It is eaten as a leafy vegetable in most parts of South and Eastern Nigeria. Water leaf has a high potassium concentration in its leaves; it is also composed of calcium, carbohydrates, glycosides, starch, steroids and secondary compounds such as saponins, phenolics and flavonoids which are a natural source of antioxidants (Khaing & Moe, 2019).

Water leaf is useful in many ways; it has medicinal properties which make it suitable for treating ailments and anti-inflammatory reactions (Agnel & Shobana, 2012). In Nigeria specifically, it is a herbal treatment for high blood sugar level, dropsy, and oedema (Bioltif, 2020). In animal production Sanda & Oyiane (2015) observed that its aqueous extract increased poultry egg production.

It is a short duration crop of three months, which flowers throughout the year, and produces erect succulent stems and swollen roots (Khaing & Moe, 2019). Its short duration of growth makes it a favorable crop for quick subsistence and commercial production in Nigeria. *T. fruticosum* is the most variable species in its genus; it has differences in leaf shape, inflorescence branching, flower color; but it is not clear as to whether the cause of its variation is due to adaptation to various habitats or due to non-distinguished closely related taxa (Plants of the world online, 2021). It is identified as a widespread weed because of its resilience and ability to sprout in wild and abandoned locations...

It is however classified among the underutilized and unexplored vegetables of the world (Bhavithra et al., 2019). Most studies carried out on water leaf have focused on its medicinal, phytochemical properties (Aja et al., 2010; Bioltif & Edward 2020; Khaing & Moe, 2019; Sridhar & Pavithra, 2020). Some have looked at the yield and growth when influenced by fertilizers, agronomic practices (Emylia et al., 2018; Uko, 2013) but there is no known work on how water leaf- *T. fruticosum* responds to different watering regimes. A study by Iraya et al. (2006) showed that *Talinum paniculatum* a different species from *T. fruticosum* has the capacity to survive under drought conditions due to its Crassulacean acid metabolism but there is little literature about the drought tolerant capacity of *Talinum fruticosum* cultivated in South-Eastern Nigeria.

Water leaf will grow easily under warm temperature conditions but its cultivation is not without challenges. Waterleaf would thrive well if given adequate moisture but in the dry season watering in local communities can be expensive and laborious. Due to this, water leaf production slows down in the dry season and supply in the local food market is low. In the South-Eastern region of Nigeria; there is a dearth of information on the best agricultural practice for waterleaf, more specifically, there is insufficient research on the water requirements for water leaf. Knowledge on the adequate watering interval to achieve optimum production can reduce the labor, time and money spent on excessive watering during the dry season. This research explored means to establish an adequate watering regime for waterleaf by studying the effect of different watering regimes on growth and production of water leaf in the Obio Akpa farming community of Akwa Ibom State, South-Eastern Nigeria.

The objective of this study was therefore to assess the effect of different watering intervals on growth parameters (plant height and stem circumference) and foliage yield (leaf numbers, leaf and stem fresh weight) of water leaf.

2.0 Materials and Methods

The experiment was carried out at the Teaching and Research Screen House of the Faculty of Agriculture, Akwa Ibom State University, from October- December 2020. The experiment was laid out in a completely randomized design (CRD) with 10 replications. The treatments had 4 different watering regimes which were at: 1-day interval, 3 days' interval, 5 days' interval and 7 days' interval. These treatments were replicated 10 times to give a total of 40 experimental units.

Nursery bags (18cm in length and 13cm wide) were filled with topsoil (0-30 cm depth) of 4.3 kg. The top soil was collected from an area of land which was left fallow for 2 years. The soil in each nursery bag was mixed with 21.5 grams of poultry manure; this rate translates into 10 tones/ha recommended by Uko et al. (2013). Before mixing the manure with the soil in bags the manure was spread out for 7 days for further curing and a sample of it was packaged in plastic bags and sent to a laboratory for analysis. Two waterleaf cuttings of 10-15cm long were sown in bags. Watering commenced from the first day of planting. Plants in each nursery received a single water amount of 0.35 liters at each treatment application time. In the early stage of the plant growth, weeds in the plants were pulled out by hand as they emerged.

Data collection and analysis

Data collection began 5 weeks after planting (WAP) and subsequently every week until the 10th WAP. Data was collected on plant height (cm), number of leaves and circumference of stem (cm). Plant height was measured using a ruler and the stem circumference was measured using a string with a determined length. The aboveground fresh weight/plant (g) was measured 5WAP, 9WAP and 10WAP. Data was analyzed with the analysis of variance (AVOVA) using the software SPSS version 20 (IBM, Corp., 2011). When significant ($P < 0.005$) effects were found least-means were separated using the Tukey-kramer multiple comparison test.

3.0 Results and discussion

3.1 Agronomic parameters

Water leaf plants grew as tall as 7 cm (table 3.2). There were no significant differences observed between watering regimes on plant height throughout the growing season. Between weeks 7-10, watering treatment at the 7-day interval appeared to produce the tallest plants compared to other treatments but these differences were not statistically significant.

Table 3.1: Physical and chemical composition of poultry manure

Manure properties	Mean values
pH	8.06
EC ds/dm	1.49
Nitrogen %	1.18
Phosphorus mg/kg	1261.66
Potassium mg/kg	1261.66
Calcium mg/kg	1422.00
Magnesium mg/kg	1014.81
Sodium mg/kg	446.32
Organic carbon %	42.92

Table 3.2: Average plant height/plant (cm) at each week of measurement

Treatment	5WAP	6WAP	7WAP	8WAP	9WAP	10WAP
1 day	3.89±1.96	4.10±1.12	3.37±1.56	5.31±1.29	5.91±2.30	6.04±2.13
3 day	4.76±2.83	4.89±99	3.59±2.19	5.52±1.12	5.56±1.55	6.05±1.38
5 day	4.02±1.74	3.77±1.04	2.99±1.57	5.04±1.20	6.29±1.54	6.26±1.65
7 day	3.43±1.03	4.69±1.15	4.43±1.50	5.42±.93	6.58±1.39	7.14±2.54

Table 3.3: Average leaf number/plant across watering treatments

Treatment	5WAP	6WAP	7WAP	8WAP	9WAP	10WAP
1 day	3.00±1.67	4.60±3.23	10.55±6.28	3.70±1.18	10.33±6.84	13.11±6.94
3 days	3.10±2.42	4.90±3.76	7.80±3.87	4.25±1.86	7.31±2.99	9.28±4.51
5 days	3.44±2.38	4.39±3.28	17.06±14.06	4.72±1.20	11.06±6.62	15.98±8.72
7 days	4.14±1.55	6.36±1.75	14.82±6.20	5.68±2.59	14.82±10.75	16.16±7.89

WAP-Weeks after planting ±- Standard error of mean

There was no significant effect of watering regime on leaf number at each period of measurement. However, leaf number increased numerically as the weekly measurements progressed (table 3.3) but the difference in this increase was not confirmed statistically. As weekly measurements were taken immediately before each cut/harvest it could be inferred that cutting/harvest allowed for more vegetative growth and yield (Adhikari & Kendel, 2015; Thakur et al., 2018).

Leaf number and plant height in this work were generally low compared to other reports on water leaf. At 3WAP Fru et al. (2017) observed water leaf plants produced as many as 40 leaves/plant and grew up to 6 cm high. In addition, plants in this study produced fresh weight as high as 16 g/kg. Uko et al. (2013) recorded plant heights between 20 and 23 cm and average leaf numbers of 16-18 in a 2 year study. Water leaf has been reported to reach heights of 80-100 cm (Fontem & Schippers, 2004). It can be argued that the above compared studies are higher because plants were grown in the field and exposed to more space for root length/expansion, various rates of manure and fertilizer treatments. In contrast, to our study where the plants were grown in pots under a controlled environment. The non-significant effect of watering regimes on water leaf height and leaf number suggest that suspending water application to 7 days compared to more frequent applications of 1, 3 or 5 days will produce the same effect on plant height and leaf number.

Stem circumference was between the range of 1.4-1.49 cm in week 5 and 6 and increased to 1.9-2.08 cm in week 10 (table 3.4) . There were no differences between watering regime in week 5, 6, 7 8 and 10 but there was a significant effect of watering regime on stem girth in week 9 ($P=0.040$) (3,36) $F=3.066$. The 1 and 3-day watering interval produced stem circumference as low as 1.5 and 1.7cm but only the 3-interval was significantly lower than the 5-day interval which was as large as 2.03 cm. The 7 and the 5-day interval were not significantly different; implying that delayed water application at this stage of the plant must have been beneficial to increasing stem circumference.

Table 3.4: Average stem circumference/plant at each week of measurement

Treatment	5WAP	6WAP	7WAP	8WAP	9WAP	10WAP
1-day	1.44±.47	1.48±.21	1.00±.41	1.73±.18	1.73±.18	1.91±.38
3-day	1.48±.21	1.40±.55	1.05±.43	1.65±.31	1.59±.20	1.84±.31
5-day	1.46±.69	1.46±.69	1.07±.34	1.87±.48	2.03±.59	2.07±.51
7-day	1.45±.26	1.48±.22	1.38±.41	2.02±.59	1.89±.33	2.08±.44

Table 3.5: Above ground fresh weight/plant (g) at each week of measurement

Treatment	5WAP	9 WAP	10 WAP
1-day	1.40±0.276	4.05±.920	2.39±0.5120
3-day	1.25±0.186	2.65±0.578	1.50±0.378
5-day	1.89±0.261	7.33±2.564	3.28±0.786
7-day	1.77±0.312	8.68±1.416	4.55±1.255

WAP-Weeks after planting ± Standard error of mean

3.2 Fresh weight

Average fresh weight/plant across all treatments were 1.58 g/plant (5WAP), 3.05 g/plant (9WAP) and 5.71g/plant (10WAP). There was a pattern of increased fresh weight in the most delayed water applications (5 and 7-day interval) during the 3 weeks of measurement but this increase was not significant. However, at the 9th WAP water application at 7-day interval produced an above ground fresh weight of 8.68g/plant higher than watering at 3-day intervals (2.65g/plant).

No difference was observed between the 1, 3 and 5-day interval of watering. Delayed application until 7 days was the only treatment that produced fresh weight as high as 8.68g/plant suggesting that watering as frequently as 5,3 or 1 day interval may be detrimental to the overall fresh weight yield of waterleaf which is the interest of most growers in the study area. Waterleaf has been marked as a slightly drought tolerant plant because it exhibits the crassalacean acid metabolism (CAM) which allows closing of the leaf stomata at day to prevent moisture loss (Fontem & Schippers, 2004). Plants with this feature also develop root systems which lessen water loss in dry soil, enables absorption/conduction of water and high water uptake rates when soil moisture is restored (Nobel & North, 1996). It is possible that plants with more frequent watering were exposed to high water uptake rates that went a little above its optimum requirements for vegetative growth. The above ground fresh weight is composed of the vegetative parts of a plant including its stems, and leaves and the vegetative growth is affected by the photosynthetic rate. Stress accruing from excessive moisture has been proven to affect photosynthesis in crops (Bansal et al., 2010; Biswas & Kalra, 2018).

4.0 Conclusion

This study explored a means to establish an adequate watering regime for waterleaf during the dry season; by studying the effect of different watering regimes on the growth and production of water leaf. The results have shown that water supply at a frequency of 1-7 days may not influence the leaf production and plant height but will affect the above ground fresh weight/plant which could significantly impact fresh weight yield. Delayed application of water up to 5-7 days showed the most promising response in terms of fresh weight yield, implying that frequent watering at a 1-3-day interval in the dry season could decrease crop yield.

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