

WATERING FREQUENCY INFLUENCED GROWTH AND FOLIAR YIELD OF FLUTED PUMPKIN (*Telfairia occidentalis* F. Hook)

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ABSTRACT

The choice and system of production of tropical crops are determined by solar radiation and tropical rain cycles. But the recent challenges of climate change and the resultant erratic rainfall, coupled with the need for all-year-round production of crops has alerted the farmers to the need for other sources of irrigation water and also the need to establish the water use efficiency of individual crops to avoid wastages of irrigation water. Field and Screen house experiments were conducted simultaneously at the Teaching and Research Farm of the Akwa Ibom State University Obioakpa campus, to evaluate the effects of different watering regimes on the growth and foliar yield of fluted pumpkin. The experiment consisted of five irrigation intervals (1, 2, 3, 4 and 5 days) under two environmental conditions; the screen house and the open field. The experiments were 2 x 5 factorial and replicated three times. Results indicated significant positive effects of watering regimes on the growth and yield of fluted pumpkin. Plants that were watered daily and those that were watered at 2 to 3-day intervals demonstrated superior performances over those that were watered at 4 or 5-day intervals. The highest foliar yield (6.41 tons/ha in the field experiment and 6.23 tons/ha in the Screen house experiment) was obtained on plants that were watered daily.

Keywords: Watering frequency, Fluted pumpkin, *Telfairia occidentalis*

INTRODUCTION

Fluted pumpkin (*Telfairia occidentalis* F. Hook) is an important vegetable cultivated throughout the forested areas of West and East Africa, from Sierra Leone to Angola and up to Uganda in East Africa. (Udoh and Ndon, 2016). It is a member of the *Cucurbitaceae* family. It originated from South Eastern Nigeria (Uwa *et al.*, 2016.) where it has been integrated into the farming system of the people and is commonly intercropped with maize, cassava and yam. It is fast replacing egusi melon as a companion crop in most intercropping systems. Fluted pumpkin thrives in warm environments with plenty of sunshine

and a prolonged rainy season. Ekwere, *et al.* (2019) stated that the crop is very sensitive to nitrogen deficiency and therefore recommended heavy manure application. The application of high doses of fertilizer NPK and other soil amendment materials to marginal soils has also been recommended (Akpan *et al.*, 2022; Udounang, *et al.*, 2022).

Telfairia is cultivated for its edible succulent shoots and leaves, mainly by the Efik and the Ibibio tribes of South Eastern Nigeria. It is the vegetable of choice in the preparation of the popular Edikang ikong soup. Its presence in almost every part of Nigeria is intrinsically linked with the spread of the Ibibios to other

parts of the country (Uwa *et al.*, 2016).

Telfairia leaves are used as food supplements for recuperating patients. A proximate analysis by Akpasi *et al.*, (2023) revealed components of Telfairia leaves to include 70% carbohydrate, 29% protein, 1.8% fat, 1.7% dietary fiber, 7.9% ash, and 8.7% moisture. The seeds are edible and can be eaten roasted, boiled or ground into a paste as a soup thickener. Telfairia seed cake may be suitable to fortify foods, and the seed oil may be used for making margarine. The high oil contents of the seed make it a potential source of raw material for the vegetable oil industry. The fruit can be used as feedstuff for livestock. Telfairia is recalcitrant in nature, its fruit and seed storage is poor. This accounts for the recurrent scarcity of its seeds during the planting seasons.

Telfairia is a dioecious plant; flowerless individuals have also been observed (Willie and Amaechi, 2016). Males, females, and flowerless individuals all look alike at the vegetative stage of growth and cannot be differentiated from each other before sexual maturity. The female plants are much desired by farmers and consumers because of their succulent large leaves and the fact that they produce pods.

The major constraint against telfairia production during the dry season is water stress. Stress caused by drought can have a major negative impact on plant growth and development (Awobona *et al.*, 2020). The primary effect of water stress is a reduction in cell size, accompanied by a reduction in leaf expansion and closure of the stomata, which can interfere with photosynthesis. Plant water stress can result in lower yields and possible crop failure (Ugese and Odoh, 2016).

Fluted pumpkin is made up of about 95% water (Udoh and Ndon, 2016). Due to the high levels of water content in the cells, it is critically vulnerable to water stress and drought conditions. Its yield and yield quality

are negatively affected when subjected to drought.

Seed availability during the sowing season (April/May) is usually difficult because under rain-fed cultivation, the fruits are harvested between October and December and stored until sowing time. The pods have a poor shelf life, characterized by fruit decay and off-season seed germination within the pod, which makes the seeds very expensive at sowing time. It is expected however, that producing the crop under irrigation during the dry season could provide enough fresh fluted pumpkin vegetables at all times and sufficient fresh seeds for sowing in the future. Besides, during the early season planting, telfairia is found on almost every farm, its leaves therefore command the lowest price at this time. Commercial vegetable farmers therefore prefer to cultivate their crop during the dry season under irrigation. Unfortunately, the water use efficiency of Telfairia occidentalis has yet to be determined.

This research was conducted to establish the optimum watering interval, and by extension, the water use efficiency of fluted pumpkin cultivated under dry conditions.

MATERIALS AND METHODS

Two experiments were conducted between November, 2022 and March, 2023 at the Teaching and Research Farm of the Akwa Ibom State University, Obioakpa campus. Obioakpa is located between latitudes 4° 57' and 5° 23' N and longitudes 7° 45' and 8° 26' E. The experiment consisted of five irrigation intervals (1, 2, 3, 4, 5 days), under two environmental conditions; the screen house environment and the open field.

The Screen house experiment consisted of seventy-five cement bags perforated at the sides and bottom, and filled with top soil to a depth of about 45cm, and arranged in five rows (5 bags per row). Each row represented a treatment (irrigation regime). The treatments

were randomly allocated to the experimental units in a completely randomized design, and replicated three times. The bags were spaced 1.0m apart, and the replicates were arranged 1.2m apart. The telfairia seeds were sown at three seeds per bag and later thinned to two seedlings per bag. The seeds were planted in situ and buried 3-5cm deep.

The field experiment on the other hand, consisted of five sub plots which represented five watering regimes. Each treatment was randomly assigned to the subplots in a randomized complete block design, and replicated three times. Each sub plot measured 4m x 4m. The subplots were separated by paths (1.2m wide) while the replicates were separated by alleys measuring 1.5m wide. The telfairia seeds were sown 1.0m x 1.0m equivalent to 25 stands per subplot, and 10,000 stands/ ha. The total experimental area measured 24.8m x 15.0m (372.0m²). The telfaira seeds were planted in-situ and buried 3-5cm deep.

The telfairia pods were obtained from a farmer at the Cross River Basin Development Authority, Abak sub – station. (There are no improved varieties of fluted pumpkin). The pods were split open and the seeds were removed and air-dried under shed for 48 hours to enhance germination. Poultry manure (cured and pulverized) was applied at the rate of 5 tons ha⁻¹ + Lime (2tons/ha) according to

recommendations by Udounang *et al.*, 2022, The bags and the field were completely soaked with water 24 hours before sowing. Irrigation was again carried out 24 hours after sowing. But the water stress treatment started eight days after sowing (when the first shoot of fluted pumpkin had emerged). The watering regimes proceeded according to the treatment schedules. On each watering day the field was watered at field capacity with 12 litres of water per subplot, while each bag received 50cl. of water.

Data were collected on emergence percentage, vine length, number of leaves/plant, fresh weight of leaves/plant, dry weight of leaves/plant and total dry matter (tons/ha).

RESULTS

Physical and chemical properties of the soil used for the experiment.

Physical and chemical analysis of the soil of the study area prior to commencement of the experiment (Table 1.) shows that the soil is sandy loam, and acidic (pH 5.03). Exchangeable Potassium, Calcium, Magnesium and Sodium ions were 0.05, 2.38, 1.14 and 0.04 (cmol kg⁻¹) respectively. Nitrogen contents were 0.06%. The soil analysis results indicated that the soil was infertile and acidic. Hence the application of poultry manure (5tons/ha) + Lime (2tons/ha) at the commencement of the experiment.

Table1: Physical and Chemical properties of the soil samples taken at 0 – 15cm depth of the experimental site before the commencement of the experiment.

Parameter	Values
Sand (%)	89.10
Clay (%)	8.30
Silt (%)	2.60
TextureClass	SandyLoam
pH	5.03
Organic matter (%)	1.96
Total Nitrogen (%)	0.06
Available P (mg kg ⁻¹)	6.05
Exchangeable Bases (cmol kg ⁻¹)	
K	0.05
Ca	2.38
Mg	1.14
Na	0.04
Exchange Acidity (cmol/kg)	2.18
Effective Cation exchange capacity (cmol/kg)	5.06
Base Saturation (%)	71.04

Results also indicated significant positive effects of watering regimes on emergence, length of vines, number of leaves and foliar yield of fluted pumpkin. Plants that were watered daily had the highest emergence percentage (97.79% in the screen house and 95.86% in the field). (Table 2 a & 2b). The longest vines (7.72 cm) were produced in the field experiment on plants that were watered daily (W1). This was closely followed by 7.60cm long vines produced on plants that were watered every two days. Plants that were watered at 5 days intervals had the shortest vines (4.34 cm). There were no significant differences however, in length of vines among the plants that were watered daily and those

that were watered every 2 or 3 days (field experiment). But the screen house experiment indicated significant differences in vines length, between plants that were watered daily and those that were watered every 3 days, suggesting perhaps, that the soil in the field had better water holding capacity than the soil in the cement bags (screen house).

There were significant effects of watering regimes on leaf production of fluted pumpkin (Table 3a & 3b). Plants that were watered daily produced more leaves (104.01 in the field and 99.39 in the screen house). These were followed by 92.87 and 75.87 leaves produced in the field and screen house experiment respectively, on

plants that were watered every two days. The least number of leaves (41.36 in field plots and 44.92 in screen house), were produced on plants that were watered at 5 days intervals.

Fresh and dry weights of leaves as well as the total dry matter of fluted pumpkin were influenced by the watering regime (Table 4a & 4b). Plants that were watered daily gave the best performances, both in the field and in the screen house. The highest fresh weight of leaves /plant (145.87g in

the field and 130.03g in the screen house) were produced on plants that were irrigated daily, while the least, 69.24g in the field and 70.54g in the screen house, were recorded on plants that were watered at 5 days intervals.

The highest dry weight (1.27 tons/ha) was however, produced in the screen house on plants that were watered daily. That daily watering rate also produced the highest dry weight (1.25 tons/ha) in the field.

Table 2a. Effect of Irrigation regimes on the Vine Length (cm) of Fluted pumpkin in the Screen house

Irrigation Interval (days)	Emergence (%)	Vine length (m) (Weeks after sowing)			
		4	6	8	10
W5	83.75 ^b	3.19 ^c	3.67 ^c	4.27 ^c	5.64 ^b
W4	88.79 ^b	3.31 ^{bc}	4.47 ^c	5.16 ^b	5.93 ^b
W3	90.54 ^{ab}	3.56 ^{bc}	4.58 ^c	6.14 ^a	6.25 ^b
W2	96.36 ^a	4.21 ^{ab}	5.59 ^b	6.40 ^a	7.21 ^a
W1	97.79 ^a	4.57 ^a	6.50 ^a	6.88 ^a	7.49 ^a

W= watering regime of 1,2,3,4 or 5 day interval. Values with the same superscript along the same column are not significantly different at $P < 0.05$ probability level.

Table 2b. Effect of Irrigation regimes on the Vine Length (cm) of Fluted pumpkin on the field.

Irrigation Interval (days)	Emergence (%)	Vine length (m) (Weeks after sowing)			
		4	6	8	10
W5	86.73 ^b	2.53 ^d	3.64 ^b	3.85 ^c	4.34 ^c
W4	87.45 ^b	3.23 ^c	3.92 ^b	4.73 ^d	6.31 ^b
W3	85.19 ^b	3.27 ^c	4.67 ^b	5.48 ^c	7.42 ^a
W2	90.54 ^a	4.25 ^b	6.11 ^a	6.95 ^b	7.60 ^a
W1	95.86 ^a	5.69 ^a	6.28 ^a	7.65 ^a	7.72 ^a

W= watering regime of 1,2,3,4 or 5 day interval. Values with the same superscript along the same column are not significantly different at $p < 0.05$ probability level.

Table 3a. Effect of Irrigation regimes on the number of leaves of Fluted pumpkin in the screen house experiment

Irrigation Interval (days)	Number of leaves/plant (Weeks after sowing)			
	4	6	8	10
W5	16.60 ^d	17.56 ^c	36.62 ^d	44.92 ^c
W4	26.24 ^c	30.40 ^d	52.87 ^c	63.70 ^d
W3	28.69 ^{bc}	37.04 ^c	58.61 ^{bc}	70.48 ^c
W2	32.09 ^{ab}	45.42 ^b	62.12 ^b	75.87 ^b
W1	33.35 ^a	54.41 ^a	71.57 ^a	99.39 ^a

W= watering regime of 1,2,3,4 or 5 day interval. Values with the same superscript along the same column are not significantly different at $P < 0.05$ probability level.

Table 3b. Effect of Irrigation regimes on the number of leaves of Fluted pumpkin in the field experiment

Irrigation Interval (days)	Number of leaves/plant (Weeks after sowing)			
	4	6	8	10
W5	13.31 ^c	18.85 ^d	24.35 ^b	41.36 ^c
W4	20.36 ^d	29.06 ^c	51.45 ^b	60.63 ^d
W3	28.37 ^c	45.10 ^b	74.57 ^a	83.37 ^c
W2	34.34 ^{ab}	48.33 ^a	79.50 ^a	92.87 ^b
W1	38.83 ^a	49.03 ^a	86.61 ^a	104.01 ^a

W= watering regime of 1,2,3,4 or 5-day intervals. Values with the same superscript along the same column are not significantly different at the $P < 0.05$ probability level.

Table 4a. Effect of Irrigation regimes on the foliar yield of fluted pumpkin in screen house experiment

Irrigation Interval (days)	Fresh weight of leaves/plant (g)	Dry weight of leaves /plant (g)	Freshweight Of leaves (tons/ha)	Dry weight of leaves(tons/ha)	Total dry matter (tons/ha)
W5	70.54 ^b	18.14 ^c	3.46 ^d	0.74 ^d	0.93 ^c
W4	97.23 ^b	20.14 ^d	4.41 ^c	0.82 ^c	0.94 ^c
W3	104.05 ^{ab}	22.40 ^c	5.17 ^{bc}	0.86 ^{bc}	1.07 ^{bc}
W2	107.22 ^{ab}	24.51 ^b	5.89 ^{ab}	0.92 ^b	1.16 ^{ab}
W1	130.03 ^a	24.44 ^a	6.23 ^a	1.27 ^a	1.28 ^a

W watering regime of 1,2,3,4 or 5-day intervals. Values with the same superscript along the same column are not significantly different at $p < 0.05$ probability level.

Table 4b. Effect of Irrigation regimes on the foliar yield of fluted pumpkin in field experiment

Irrigation Interval (days)	Fresh weight of leaves/plant (g)	Dry weight of leaves /plant (g)	Fresh weight of leaves/plant (tons/ha)	Dry weight of leaves (tons/ha)	Total dry matter (tons/ha)
W5	69.24 ^d	19.16 ^d	3.01 ^d	0.62 ^d	0.93 ^b
W4	75.71 ^c	22.41 ^c	4.67 ^c	0.74 ^c	0.96 ^b
W3	92.84 ^b	24.36 ^b	5.31 ^{bc}	0.79 ^c	1.14 ^a
W2	97.62 ^b	25.21 ^b	5.84 ^{ab}	0.89 ^b	1.22 ^a
W1	145.87 ^a	26.73 ^a	6.41 ^a	1.25 ^a	1.31 ^a

W= watering regime of 1,2,3,4 or 5 day intervals. Values with the same superscript along the same column are not significantly different at $P < 0.05$ probability level.

Similarly, the highest total dry matter of fluted pumpkin (1.31 tons/ha in the field, and 1.28 tons/ha in the screen house) was produced on plants that were watered daily.

DISCUSSION

Fluted pumpkin contains about 95% water (Udoh and Ndon, 2016). Water stress therefore could have negative impact on its growth and development. The immediate impact of water stress is a reduction in cell size, closure of the stomata and impairment of the photosynthetic and other metabolic processes (Sun *et al.*, 2020; Wu *et al.*, 2022). Prolonged water stress may lead to the collapse of the cell walls, leading to wilting and death.

In this experiment, it was observed that plants that were watered daily performed better than those that were watered at 4 or 5 days intervals. For most growth and yield attributes considered in this experiment (vine length, fresh weight of leaves and total dry matter) there were no significant differences between plants watered daily and those that were watered at 2 or 3 days intervals. These results suggest that irrigation is a necessary component of dry season production of fluted pumpkin. The results agree with Ugesi and

Odoh (2016) who obtained the highest seedling emergence, and superior performances in *Moringa oleifera* seedlings at daily watering regime. Arogundade *et al.* (2020) also obtained the highest percentage emergence, number of leaves, plant height and stem girth of plantain on plots that were watered daily. However, Efreteui *et al.* (2022) reported that delayed application of water up to 5 -7 days significantly increased the above ground biomass yield of waterleaf, and that watering at 1 – 3 days interval could decrease foliar yield of waterleaf. Perhaps every plant species has unique water use efficiency threshold beyond which, further application of irrigation water is wasteful or detrimental to the plants growth and yield.

CONCLUSION

Irrigation is a necessary ingredient for a successful dry season production of fluted pumpkin. In this experiment, it was observed that plants that were watered daily or at two days intervals performed better than those on which watering was delayed for more than 3 days. Fluted pumpkin farmers in the study area were therefore advised to water their crops at one or two days intervals.

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