



IMPACTS OF STORED HUMAN URINE CONCENTRATION ON VEGETATIVE GROWTH OF *TALINUM TRIANGULARE* L.

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ABSTRACT

This study evaluated the effect of 17-day stored human urine as an organic fertilizer on the vegetative growth of *Talinum triangulare* in Alihame Community, Nigeria. Three treatments consisting of stored human urine at 360.10 mL, 620.10 mL, and a control (0 mL) were arranged in a completely randomized design (CRD) with three replicates. Data were collected on plant height, number of leaves, number of branches, and stem girth at 11, 18, 25, and 30 days after planting. Chlorophyll content, relative water content, and fresh biomass yield of leaves, and shoots were determined at harvest (30 days). The results showed that, stored human urine significantly improved all measured growth parameters compared with the control. The 620.10 mL treatment consistently produced the highest values for plant height, leaf number, stem girth, chlorophyll content, relative water content, and fresh biomass. The findings indicate that 17-day stored human urine can serve as an effective organic fertilizer for enhancing the growth and productivity of *Talinum triangulare*. Its utilization can contribute to sustainable soil fertility management and reduced dependence on synthetic fertilizers.

Keywords: Human-urine, Organic, Fertilizer, *Talinum triangulare*, Growth, Soil-fertility

INTRODUCTION

Declining soil fertility remains a major constraint to crop production in many parts of Nigeria. Continuous cultivation, nutrient depletion, and environmental stress has reduced the productivity of agricultural lands, resulting in lower yields of vegetables and other food crops. Improving the productivity of existing farmland through sustainable nutrient management is therefore essential for enhancing food security and maintaining agricultural productivity (Brown, 2005). Human urine is a nutrient-rich biological resource containing nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, and other essential plant nutrients required for growth and development (Gensch, 2015). Fresh urine collected from healthy individuals is generally free from most pathogenic microorganisms, and short-term storage further reduces potential health risks through natural biochemical processes that inactivate pathogens (Höglund, 2001; Heinonen-Tanski *et al.*, 2007). Consequently, stored human urine has attracted attention as a low-cost and environmentally friendly fertilizer capable of improving soil fertility while promoting nutrient recycling (Gensch, 2015). *Talinum triangulare* is an important leafy vegetable widely cultivated in tropical regions for its nutritional and medicinal value (Fontem & Schippers, 2004). The leaves contain high moisture content and are rich in essential nutrients and bioactive compounds. Previous studies have reported its potential role in the management of cardiovascular disorders, obesity, gastrointestinal ailments, and other health conditions (Fontem & Schippers, 2004; Ogbonnaya & Chinedum, 2013). Owing to its economic and nutritional importance, improving the growth and yield of *T. triangulare* remains a priority for smallholder farmers.

Although several studies have demonstrated the fertilizer value of human urine in crop production, information on the use of 17-day stored human urine with high concentration for the cultivation of *Talinum triangulare* remains limited. This study was therefore conducted to evaluate the



effectiveness of different high concentrations of 17-day stored human urine on the vegetative growth of *Talinum triangulare*.

METHODOLOGY

Study Area

The experiment was conducted in Alihame Community, Agbor, Delta State, Nigeria, located within Ika South Local Government Area. The study was carried out during the 2023 rainy season.

Experimental Design and Planting Procedure

Mature seeds of *Talinum triangulare* were obtained from a home garden in Alihame Community. A completely randomized design comprising three treatments and three replicates was used. The treatments consisted of 0 mL (control), 360.10 mL, and 620.10 mL of 17-day stored human urine. Topsoil (0–10 cm depth) was collected from a cultivated area within the community and thoroughly mixed to obtain a uniform growth medium. Nine kilograms of soil were weighed into each 6-L plastic container. Early-morning urine was collected daily for four consecutive days in covered 4-L plastic containers and subsequently stored for 17 days before application. The stored urine was applied at rates of 360.10 mL and 620.10 mL per container, while the control received an equivalent volume of tap water. Immediately after treatment application, two seeds of *T. triangulare* were sown per container. Seedlings were thinned to one plant per container five days after germination. All plants were maintained under similar environmental conditions and watered twice weekly with 20 mL of tap water per container throughout the experimental period.

Growth Measurements

Plant height, number of leaves, number of branches, and stem girth were recorded at 11, 18, 25, and 30 days after planting. Plant height was measured from the soil surface to the shoot apex using a meter rule. The number of leaves and branches was determined by direct counting, while stem girth was measured at the base of the stem.

Determination of Chlorophyll Content

Leaf chlorophyll content was determined using the method of Arnon (1949) as cited in Nalini *et al.* (2024), with slight modifications. Fresh leaf tissue (5 g) was homogenized with 0.5 g of acid-washed sand and extracted with 80% acetone. The homogenate was centrifuged at 3,000 rpm for 15 minutes, and the absorbance of the supernatant was measured at 645 and 663 nm using a UV–Visible spectrophotometer. Chlorophyll concentrations were calculated as follows:

$$\text{Chlorophyll a (mg/mL)} = 12.7(A_{663}) - 2.69(A_{645})$$

$$\text{Chlorophyll b (mg/mL)} = 22.9(A_{645}) - 4.68(A_{663})$$

$$\text{Total chlorophyll (mg/mL)} = \text{Chlorophyll a} + \text{Chlorophyll b}$$

Determination of Relative Water Content

Relative water content (RWC) was determined according to Hasanuzzaman *et al.* (2020). Fresh leaf samples (10 g) were weighed to obtain fresh weight and immersed in distilled water for 2 hours to achieve full turgidity. The samples were blotted dry and reweighed to obtain turgid weight. Subsequently, the samples were oven-dried at 70°C to constant weight and weighed to obtain dry weight.

Relative water content was calculated as:

$$\text{RWC (\%)} = [(\text{Fresh Weight} - \text{Dry Weight}) / (\text{Turgid Weight} - \text{Dry Weight})] \times 100$$

Determination of Fresh Biomass Yield

At harvest (30 days after planting), plants were carefully harvested and separated into leaves and shoots. Each component was weighed immediately using a digital balance, and the values were recorded as fresh weight of leaves and fresh weight of shoots.

Statistical Analysis

Data were expressed as mean \pm standard deviation of three replicates. Statistical analysis was performed using one-way analysis of variance (ANOVA) in **IBM SPSS Statistics version 29.0** (IBM Corp., Armonk, NY, USA). Treatment means were separated using **Duncan's Multiple Range Test (DMRT)** at the 5% probability level where significant differences occurred. Statistical significance was determined at $p \leq 0.05$.

RESULTS AND DISCUSSION

The application of 17-day stored human urine significantly enhanced the growth performance of *Talinum triangulare* across all growth stages. At 11 days after planting, plant height was lowest in the control (2.90 cm), while urine-treated plants showed significantly higher values, with the 620.10 mL treatment recording the highest height (8.66 cm), closely followed by 360.10 mL (8.33 cm). This trend continued throughout the experiment. At 30 days, the 620.10 mL treatment achieved the tallest plants (38.53 cm), followed by 360.10 mL (36.40 cm), while the control recorded the lowest value (11.50 cm) (Table 1; Fig. 1A–C). The observed improvement suggested that stored urine enhanced nutrient availability, promoting vegetative growth and cell elongation.

Table 1: Attributes of 17-day Stored Human’s Urine in Soil on Plant Height (cm) of *Talinum triangulare* at 11, 18, 25.

Conc. of urine	0 mL	360.10 mL	620.10 mL
11 days	2.90±0.92 ^{bc}	8.33±0.74 ^b	8.66±0.36 ^a
18 days	6.87±1.12 ^{bc}	13.50±0.36 ^{ab}	17.47±0.35 ^a
25 days	11.33±1.61 ^c	27.43±0.35 ^b	31.40±0.30 ^a
30 days	11.50±1.57 ^c	36.40±0.20 ^b	38.53±0.35 ^a

Values= mean ± standard deviation; n =3, mean values with similar superscript in arrow are not significantly different, p ≤ 0.05.

Leaf production showed a strong dose-dependent response to urine application. At 11 days, control plants produced only 2.00 leaves, while 620.10 mL produced 51.33 leaves. By 25 days, leaf number peaked at 112.33 in the 620.10 mL treatment compared with 46.00 in 360.10 mL and 13.67 in the control. At harvest, the highest leaf number remained in the 620.10 mL treatment (158.00). This indicates that urine application significantly enhanced vegetative development, likely improving photosynthetic capacity and overall plant productivity.

Table 2: Attributes of 17-day Stored Human’s Urine in Soil on Number of Leaves of *Talinum triangulare*

Conc. of urine	0 mL	360.10 mL	620.10 mL
11 days	2.00±0.00 ^c	15.33±2.57 ^b	51.33±3.45 ^a
18 days	9.00±3.00 ^c	26.33±3.28 ^b	82.33±1.06 ^a
25 days	13.67±1.45 ^c	46.00±1.93 ^b	112.33±4.25 ^a
30 days	15.00±3.65 ^c	54.67±4.15 ^b	158.00±3.51 ^a

Values=mean ± standard deviation; n =3, mean values with similar superscript in a row are not significantly different, p ≤ 0.05.

Branch formation followed a similar trend. No branching occurred at 11 days, but at 18 days, the 620.10 mL treatment recorded 14.87 branches, followed by 360.10 mL (6.67), while the control recorded 0.67. At 30 days, branching increased to 33.67 in the 620.10 mL treatment, compared with 2.67 in the control (Table 3; Fig. 1A–C). This suggests that nutrient enrichment from urine stimulated meristematic activity and enhanced shoot development.

Table 3: Attributes of 17-days Stored Human’s Urine in Soil on Number of Branches of *Talinum. Triangulare*

Conc. of urine	0 mL	360.10 mL	620.10 mL
11 days	0.00±0.00 ^a	0.00±0.00 ^a	0.00±0.00 ^a
18 days	0.67±1.15 ^c	6.67±2.08 ^b	14.87±1.53 ^a
25 days	2.00±0.00 ^c	10.33±0.58 ^b	28.00±3.03 ^a
30 days	2.67±1.15 ^c	13.00±1.00 ^b	33.67±3.81 ^a

Values=mean ± standard deviation; n =3, mean values with similar superscript in a row are not significantly different, $p \leq 0.05$.

Stem girth also improved significantly with urine application. At 11 days, the control recorded the lowest stem girth (0.37 cm), while the 620.10 mL treatment recorded the highest (1.20 cm). At 30 days, stem girth reached 3.00 cm in the 620.10 mL treatment, followed by 2.67 cm in 360.10 mL and 1.40 cm in the control (Table 4; Fig. 1A–C). This progressive increase reflects improved structural growth due to enhanced nutrient uptake and assimilation.

Table 4: Attributes of 17-day Sored Human’s Urine in Soil on Stem Girth (cm) of *Talinum. Triangulare*

Conc. of urine	0 mL	360.10 mL	620.10 mL
11 days	0.37±0.06 ^{ac}	1.07±0.45 ^{ab}	1.20±0.56 ^a
18 days	0.87±0.06 ^{bc}	1.68±1.44 ^{ab}	2.41±0.30 ^a
25 days	1.33±0.25 ^{bc}	2.07±1.04 ^{ab}	2.53±0.31 ^a
30 days	1.40±0.17 ^{bc}	2.67±0.25 ^{ab}	3.00±0.10 ^a

Values=mean ± standard deviation; n =3, mean values with similar superscript in a row are not significantly different, $p \leq 0.05$.

At harvest (30 days), physiological parameters showed marked improvements. Chlorophyll content was highest in the 620.10 mL treatment (4.74 mg g⁻¹), followed by 360.10 mL (4.58 mg g⁻¹), and lowest in the control (1.22 mg g⁻¹). This indicates improved photosynthetic efficiency, likely due to increased nitrogen availability from urine. Similarly, relative water content increased with urine concentration, reaching 95.28% in 620.10 mL, 89.41% in 360.10 mL, and 42.56% in the control. This reflects improved water retention and physiological stability in treated plants.

Biomass production also increased significantly with urine application. The highest fresh leaf weight (20.71 g) and shoot weight (18.42 g) were recorded in the 620.10 mL treatment, while the control recorded the lowest values (2.07 g, 2.31 g, and 1.85 g, respectively) (Table 5; Fig. 1A–C). These results confirm that stored human urine substantially enhanced biomass accumulation and overall plant productivity.

Table 5: Attributes of 17-day Stored Human’s Urine in Soil on Leaf Chlorophyll Content (LCC), Leaf Relative Water Content (LRWC), Fresh Weight of Leaves (FWL), Shoots (FWS), and Roots (FWR) of *Talinum. triangulare* at Harvest

Conc. of urine	0 mL	360.10 mL	620.10 mL
LCC(mg/g)	1.22±0.02 ^{bc}	4.58±0.05 ^{ab}	4.74±0.14 ^a
LRWC(%)	42.56±0.22 ^c	89.41±0.11 ^b	95.28±0.12 ^a
FWL(g)	2.07±0.08 ^c	12.14±0.05 ^b	20.71±0.31 ^a
FWS(g)	2.31±0.04 ^c	9.87±0.06 ^b	18.42±0.03 ^a

Values =mean ± standard deviation; n =3, mean values with similar superscript in a row are not significantly different, $p \leq 0.05$.

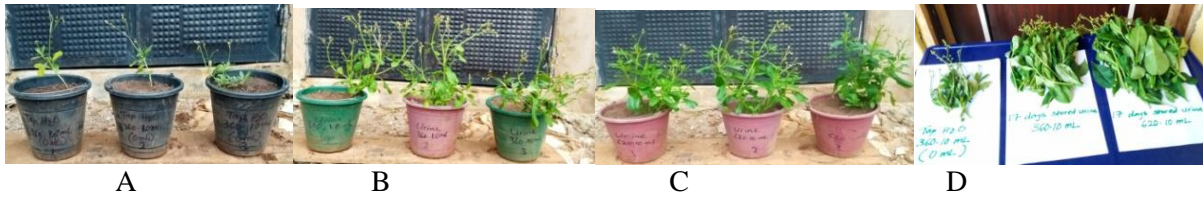


Plate 1: Thirty Days Growth of *Talinum triangulare* grown in 0mL (A) untreated-soil, 360.10 mL (B), 620.10 mL (C), and harvested leaves with shoots (.D)

The present findings are consistent with Sheneni *et al.* (2018), who reported improved plant height, leaf production, and stem girth in *Zea mays* following urine application. Similar positive effects have been documented in several crops, including *Hordeum vulgare*, *Triticum aestivum* (Jonsson *et al.*, 2004), *Zea mays* (Guzha *et al.*, 2005; Kassa *et al.*, 2010), *Spinacia oleracea* (Mnkeni *et al.*, 2005), *Brassica oleracea* (Pradhan *et al.*, 2007; Pradhan *et al.*, 2010a), *Cucumis sativus* (Heinonen-Tanski *et al.*, 2007; Pradhan *et al.*, 2009a), *Daucus carota* and *Beta vulgaris* (Mnkeni *et al.*, 2008), *Solanum lycopersicum* (Pradhan *et al.*, 2009b), and *Brassica botrytis*, *Brassica juncea*, *Solanum tuberosum*, and *Raphanus sativus* (Pradhan *et al.*, 2010b). Collectively, these studies confirm that high concentration of stored human urine is an effective nutrient source capable of improving crop vegetative growth.

Sheneni *et al.* (2018) reported plant mortality under high urine concentrations, while Dora *et al.* (2003) observed altered nitrogen accumulation in plant tissues. Furthermore, Pradhan *et al.* (2010b) noted that urine nutrient composition varies depending on diet, body size, physical activity, collection time, and environmental conditions. Despite these limitations, the present study demonstrates that 17-day stored human urine, particularly at 620.10 mL, significantly improves growth, physiological performance, and biomass production of *Talinum triangulare* in nutrient-deficient soil, confirming its potential as a sustainable and low-cost organic fertilizer.

CONCLUSION AND RECOMMENDATIONS

The use of 17-day stored (fermented) human urine as a soil amendment significantly improved the growth and physiological activity of *Talinum triangulare*. Fermentation was employed to stabilize nitrogen, reduce ammonia toxicity, minimize phytotoxic effects, and enhance nutrient availability for plant uptake. It also reduces odor and improves the overall agronomic safety and efficiency of the urine as an organic fertilizer. The study included three treatments: a control (0 mL) to represent natural soil conditions, and two urine application rates (360.10 mL and 620.10 mL) to assess dose-dependent effects. The results showed that plant growth increased with higher urine concentration, with the 620.10 mL treatment consistently producing the best performance across all measured parameters. Stored human urine proved to be an effective and sustainable nutrient source for improving crop growth in nutrient-poor soils. The application of 620.10 mL is therefore recommended for optimal growth of *Talinum triangulare*, while further studies should evaluate long-term soil fertility and sustainability.

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