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Effects of Different Organic Manures on the Growth of Water Leaf (*Talinum triangulare Jacq)*

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Abstract*:- Talinum triangulare Jacq.* (Water leaf) is a leafy vegetable eaten in most countries in Africa in preparation of soups to enrich the starchy main dishes due to its tastes, medicinal uses such as anti-inflammation, anti-fungal, anti-bacterial properties. In Lagos State, Nigeria, where there is an increase in population and high demand for vegetables, farmers are faced with the challenges of which manure is best for growing vegetables and enhance financial remuneration. Thus, this study tends to determine the effects of different organic manures on the growth of water leaf and the best organic manure that will be suitable for its cultivation. Seeds were bought from Lagos State Agricultural Inputs Supply. Pig manure, poultry manure and cow dung were collected from a local farm in Lagos State; Growth experiments on *Talinum triangulare J.* were carried out in response to different organic manures at the greenhouse, Department of Botany, Lagos State University, Ojo, Lagos, Nigeria. The data collected were analyzed using Duncam Multiple Range Test at P<0.05. It was observed that seedlings grown in soil containing pig manure performed better and contained higher mineral elements compared to seedlings grown under other manure types used. In cow dung and poultry manure, not many differences were recorded as seedlings grown in these two manures were similar in leaf shape, leaf length, leaf width, plant height; and those in pig manure showed more morphological differences and chemical composition.

***Keywords*:-** *Talinum Triangulare. Morphological Characters (Leaf Length, Leaf Width, Plant Height), Spectrophotometer, Mineral Composition (Sodium, Iron, Zinc)*.

I. INTRODUCTION

Water leaf (*Talinum triangulare Jacq.*) is a plant to the family *Taliniaceae* and commonly found in humid tropics. It has been recognized in many countries of Africa; it is claimed to have South American origin but an African origin may not be doubted [1].Water leaf is an erect glabrous perennial herb (80-100cm tall), usually strongly branched; roots are swollen and fleshy. The leaves are alternate, simple, almost sessile and succulent [2].

Water leaf is eaten as vegetables many countries in Africa especially in preparations of slightly shiny soups and stews to support the starchy main dish. In South West Nigeria, where it is called *Gbure*, it is commonly cooked as *Efo* soup with ingredients as a delicacy. In Cameroon, where it is called *Bolki* and used in the preparation of Belok-soup and as treatment for measles but in Asia (India), it is used for treating diabetes. It is also used in treating common diseases such as contusion, inflammations and tumors; decoctions are used for painful eyes and to aid recovery from blows and falls [2, 3, 4, 5, 6]. Water leaf has been made into drugs such as tonic from its roots. It is often used as an ornamental plant or edging plants in gardens. Water leaf shows a whole range of medicinal properties such as anti-inflammation, anti-fungal and anti-bacterial properties [2].

Talinum triangulare grows best under humid conditions at a temperature of 30^0C. Water leaf grows better during raining season but slows down considerably during the dry season. They are mostly propagated through stem cuttings (10-15cm) but seed germination is inevitable [1, 7]. *T. triangulare* takes 3weeks from planting before first harvest; the first three harvests provide the best leaves for marketing. However, a well irrigated crop with good weeding, manure and pest and disease management can remain on field for about 180 days [8, 9]. The yield range is about 60t/ha fresh weight [10]. Thus, in other to fully achieve the desired yield stated; manure, an essential soil conditioner is necessary. Manure provides nutrients to the soil for the plants. Hence, a well managed manure application recycles the nutrients to the crops, improve soil quality and promote water retention capacity. Manures are often used in combination with crop rotation; cover cropping, green manure, liming and addition of other natural or biological friendly fertilizer and boosters [11].

It is specified that manure usage must not exceed recommended proportion and not applied when soil is frozen, snow-covered or saturated [12, 13]. Organic fertilizers are derived from animal matter, human excreta or vegetable matter [14, 15]. Several organic manures are known including poultry manure, compost, green manure, pig manure, cow dung and so on. Each of these manures has their specific compositions based on the sources [16]. For instance, poultry manure has an average nutrient content of 30.3percent (N- 2.63%, P_2O_5-1.4%) which varies with types of poultry birds such as broiler [17]. Agbede *et al.* [18] reported that poultry manure enhances soil retention and uptake of plant nutrients; and increases the number and diversity of soil microorganisms particularly in sandy soil. Compost is a key ingredient in organic farming and thus serves as conditional fertilizer adding humus acid and natural pesticides to the soil [14]. Green manure (made from pea, alfalfa etc) improves the overall soil quality [19]. Pig manure is relatively low in plant nutrients when compared to other types of manure; it

contains only 0.4 percent of nitrogen content [20, 21]. Cow dung is rich in minerals and ranges from greenish to brackish, often darkening after exposure to the air; it contains high level of ammonia [22, 23]. Hence, in Lagos State, Nigeria, where there is rise in population and great demand for vegetables (*Talinum triangulare*), many farmers are faced with the challenges of which manure is suitable for growing vegetables and thus, enhance yield and financial remuneration. Thus, this study determine the effects of different organic manures on the growth of *T. triangulare* and the best organic manure that will be best suitable for the cultivation and or growth of *Talinum triangulare.*

II. MATERIALS AND METHODS

Experiments were carried out in a greenhouse of the Botanical Garden, Department of Botany, Faculty of Science, Lagos State University, Ojo- Lagos, Nigeria for the periods of 10 weeks during 2015/2016 academic session. *Talinum triangulare Jacq.* (Water leaf) seeds were bought from Lagos State Agricultural Input Supply, Agric Bus-Stop, Ojo- Lagos State. The poultry manure was collected from a Poultry farm in Ojo, Lagos; the pig manure was collected from a local Piggery farm in Badagry, Lagos; the cow dung was collected from local farm in Ojo, near Alaba-Rago Market, Ojo, Lagos, and loamy soil was gotten from the Botanical garden of Lagos State University. The treatment used were as described by [24] for poultry manure and were adopted for both pig manure and cow dung and control.

A. Soil Preparation and Nursery

Mature seeds were sowed in a big bowl for four weeks; these were done by mixing the seeds with a well dried, clean loamy soil in a small container and were spread on the soil contained in the big bowl. The emergence of the seeds took 11days with watering done once in a day till it reaches maturity (time of transplanting).

B. Transplanting

Four buckets (depth and width) of loamy soils and poultry manure were sieved in a wheelbarrow using a ratio 4:1 and were shared into four different buckets containing 5Kg soil plus manure (4Kg of soil and 1Kg of manure). These were repeated for pig manure and cow dung respectively while the control contains only loamy soil and all the buckets were watered once a day for one week. Uniform seedlings of 4 weeks old were transplanted into the buckets respectively. The buckets were segmented into four in which each treatment has four replicates and light irrigation were given until the seedlings were well established.

C. Harvesting

The first harvest of the plants were collected from each treatment after carefully removed from the soil and washed with clean water (4 weeks after transplanting) and last harvest was done 7 weeks after transplanting. Prior to harvesting, the growth parameters-leaf length (cm), leaf width (cm), stem height (cm), stem girth (cm) and whole plant length (cm), fresh weight and dry weight of plant (shoot and root)] were determined. The dried weight of root and shoot of plants were taken after being oven dried (in Botany Research Laboratory) at temperature of 70 ^{0}C for two days and cooled. At the end of these harvests, a total of 64 plants were harvested. The Leaf Area (cm^2) and Leaf Area Ratio were determined and calculated respectively using the formulae of [25]:

Leaf Area = 0.853+ (leaf blade length x leaf breadth) x 8.7440.

Leaf Area Ratio = Leaf Area (cm^2)/Total Dry weight (g).

D. Laboratory Study/ Preparation of Acid digest

The digests of water leaf (*T. triangulare Jacq.*) was made for analysis using [26] method. 1g of freshly plucked water leaves (4th and 5th positions on main branches) were weighed into 100ml of nitric acid (HNO_3) and perchloric acid; and aliquots were used for the determination of Zinc, Lead, Chromium and Cadmium content. The mixture were placed on a hot plate at 50 ^{0}C for 15 minutes and the temperature was raised slowly to 200 ^{0}C. Heating continued till white dense fumes of perchloric acid disappeared after digestion; the content were cooled and filtered through a filter paper and then transferred to a 50ml volumetric flask and diluted with de-ionized water up to the mark. After the digests, each mineral element seen in a liquid form was kept in a test tube. At the end of the experiment, the pH level, magnesium, potassium, calcium, sodium, copper, zinc, iron, and phosphorus were determined on the leaves of *T. triangulare* used. The soils of each of the treatments were dried for 2days and the pH level and the total organic carbon determined.

E. Atomic Absorption Spectrophotometric Analysis

A beck-man atomic absorption spectrophotometer model 1233 equipped with hollow cathode lamp were used for the analysis of calcium, Magnesium, iron, copper, zinc, phosphorus and sodium. The instrument parameters were adjusted according to the manufacture's instruction, the hollow cathode lamps for selected minerals with wavelengths (Ca, P, Cu, Zn, Na, Mg and K at 0.7nm respectively and Fe at 0.2nm) were used as light source. The lamp current were set at Fe- 30mA, Na- 10mA, Ca-10mA, Cu-20mA, P-20mA, Zn- 20mA, Mg and K- 6mA respectively. Acetylene gas was used with 20pa pressure and air 45pa. The instruments were calibrated with standard solution and the samples were introduced to it by means of capillary tube and concentrated readings on the display unit were recorded.

F. Statistical Analysis

Data obtained from the study for various plant parameters was subjected to single univariate summary statistics such as the mean. Duncam Multiple Range Test was used to separate the means using SPSS version 17

III. RESULTS

A. Effects of Organic Manures on Vegetative Characters

In this study, the number of leaves on plants growing in pots with pig manure was significantly higher at $p<0.05$ than other plants growing in pots with other manure types (Table I) while; plants fertilized with poultry manure showed higher growth in the leaf length compared to other manure types used. Plants fertilized with pig manure showed higher leaf width compared to others. However, plants with cow dung showed higher growth in plant height when compared to other manure types throughout the harvest period of 4 weeks. In Table I plants fertilized with pig manure had higher significance on stem girth and root length while those with cow dung showed greater height of whole plant.

More so, in Table I, plants fertilized with pig manure had significantly higher fresh shoot and dry shoot weights while plants with cow dung showed a higher fresh root weight. Plants fertilized with pig manure and cow dung shows similar values of roots dry weight compared to poultry manure and control which were also similar throughout the harvest.

Plants fertilized with pig manure had higher fresh weight of the whole plant compared to others. The results on Table II revealed that plants fertilized with pig manure showed significantly higher leaf area and leaf area ratio at $P<0.05$ compared to other manure types in the experiment.

B. Effects of T Organic Manures on the Chemical Composition of Talinum Triangulare and Treated Soil after Harvest

The chemical analyses of the four treatment plants fertilized with (pig, poultry and cow manures and control were carried out on micro and macro nutrients(Na, K, Mg, Cu, Zn etc) are shown in Table III in the plant samples. This showed that plants fertilized with pig manure a higher significant mineral elements compared to other manure types. Table IV showed that soil treated with pig manure was more acidic (lower pH) than other soil treatments. Soil treated with poultry manure was significantly higher in conductivity and total organic matter; soil treated with cow dung had significantly higher total organic carbon while, soil treated with no treatment (control) and cow dung were highly significant in porosity (Table IV).

IV. DISCUSSION

Manure is an organic matter that is used to fertilize land, consisting of faeces and urine of domestic livestock. It varies in types and their faecal constituents [11] and it plays a vital role in the growth of plants because of improvement of soil oxygen and water retention capacity by promoting good soil structure and texture for plant utilization [13]. Hence, this study: effects of different organic manures on the growth of *Talinum triangulare* within duration of ten weeks showed distinct results on the morphological characters. The highest number of leaves and stem girth were observed in plants treated with pig manure respectively (Table 1), because plants fertilized with pig manures are rich in Magnesium nutrients compared to other types of manure used. Magnesium is a constituent of chlorophyll in green leaves; hence its highest presence might have been responsible for greater leaf growth in plants fertilized with pig's dung. The highest leaf length was in plants fertilized with poultry manure, and the higher content of minerals such as potassium found in the growing points of leaves, for formation of protein and carbohydrate could have been responsible. The highest stem height and whole plant height from plants fertilized with cow dung and these are due to low magnesium and high zinc contents. All these agreed with work of [27].

The longest root length and highest fresh weight of shoot were 10.90cm and 15.08g respectively (Tables I) because plants with pig manure had higher nutrient contents which serve as food storage for water leaf. The highest fresh weight of whole plant was also highly significant for plants with pig manure (Table 1). The largest leaf area ($633.74cm^2$) compared with the ($203.70cm^2$) were obtained for plants fertilized with pig manure and control respectively (Table 2) showed greater nutritional constituents found in pig manure; [see 28] and this suggestion is confirmed with the highest Leaf area ratio ($1267.49cm^2/g$) in plants fertilized with pig manure and least leaf area ratio ($259.37cm^2/g$) in the control plants (Table 2).

The analysis of the various micro and macro mineral elements found in *T.triangulare* showed that plants fertilized with pig manure contain significantly higher quantities of magnesium and potassium which supported their growth followed by those plants fertilized with poultry manure as against other manure types used (Table 3). This is because potassium helps solute accumulation and stomata movements for water uptake into the shoot and or leaves while magnesium a key constituent of chlorophyll for manufacture of starch therefore leaf and shoot growth [20, 21]. More so, it also showed that plants fertilized with pig manure contains higher nutrients suitable for consumption [9].

Analysis of treated soil of *Talinum triangulare* shows that soil fertilized with poultry manure had the highest pH level at 6.2 but the best pH level for water leaf ranged from 6.2-7.5 [1,7, 9, 10]. Highest conductivity was observed in poultry soil and conductivity is known as different soil present in treated and untreated soil used. Total organic matter in soils fertilized with poultry and pig manures might have been responsible for higher root dry weights growing in these soils. Therefore, it is likely that these plants are likely to be richer in carbohydrates and proteins. The highest porosity in both control and cow dung might have been due to larger amount of pores in them (Table 4).

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Treatment	Number of Leaves	Leaf Length (cm)	Leaf Width (cm)	Stem Height(cm)	Stem Girth	Whole Plant Height(cm)	Root Length(cm)	Fresh Shoot Weight(g)	Fresh Root Weight(g)	Dry Shoot Weight(g)	Dry Root Weight(g)
Control Wk 1	20.50^{a}	7.05a	3.60^{a}	19.30^{a}	0.45^{a}	26.20^{a}	6.90^{a}	4.13^{a}	4.75^{a}	0.10^{a}	0.33^{a}
Wk 2	20.75^{a}	7.03^{a}	3.48^{a}	22.20^{a}	0.45^{a}	29.48^{a}	7.28^{a}	4.40^{a}	5.73^{a}	0.00^{a}	0.58^{a}
Wk 3	27.00^{a}	7.30^{a}	3.20^{a}	18.83^{a}	0.38^{a}	33.18^{a}	5.80^{a}	6.48^{a}	7.06^{a}	0.08^{a}	0.63^{a}
Wk 4	25.25^{a}	7.40^{a}	3.35^{a}	28.08^{a}	0.40^{a}	35.45^{a}	7.38^{a}	6.70^{a}	7.63^{a}	0.08^{a}	0.93^{a}
Pig manure Wk 1	23.25^{b}	8.30^{a}	3.88^{a}	25.38^{b}	0.50^{a}	29.28^{a}	6.40^{a}	6.63^{b}	7.23^{b}	0.13^{a}	0.60^{b}
Wk 2	31.75^{b}	8.95^{a}	3.98^{a}	26.80^{b}	0.65^{b}	37.65^{b}	10.90^{b}	9.35^{b}	9.95^{b}	0.00^{a}	0.60^{a}
Wk 3	36.75^{b}	9.28^{b}	3.48^{a}	32.93^{b}	0.58^{b}	39.10^{a}	8.93^{b}	13.78^{b}	14.66^{b}	0.05^{a}	1.40^{b}
Wk 4	49.25^{c}	8.88^{b}	5.66^{c}	33.40^{b}	0.58^{b}	43.73^{b}	10.30^{b}	18.08^{c}	20.43^{c}	0.10^{b}	1.85^{b}
Cow dung Wk 1	18.50^{a}	7.80^{a}	3.70^{a}	23.50^{b}	0.48^{a}	29.55^{a}	6.05^{a}	5.33^{a}	5.71^{a}	0.13^{a}	0.33^{a}
Wk 2	22.00^{a}	7.45^{a}	3.38^{a}	27.23^{b}	0.43^{a}	34.35^{b}	7.13^{a}	5.65a^{a}	5.93^{a}	0.03^{b}	0.65^{a}
Wk 3	25.50^{a}	7.68^{a}	3.43^{a}	29.87^{b}	0.50^{a}	36.53^{a}	6.65^{a}	9.05^{b}	9.55^{ab}	0.10^{b}	1.05^{b}
Wk 4	31.50a	9.15^{b}	3.83^{a}	33.75^{b}	0.53^{a}	45.88^{b}	11.88^{b}	10.55^{a}	11.78^{a}	0.10^{b}	1.13^{a}
Poultry manure Wk1	22.55^{a}	7.78^{a}	3.53^{a}	25.75^{b}	0.55^{a}	33.85^{b}	8.10^{a}	6.85^{a}	10.50^{b}	0.10^{a}	0.55^{b}
Wk 2	28.00^{a}	8.28^{a}	3.58^{a}	26.63^{b}	0.63^{b}	34.10^{b}	7.48^{a}	8.53^{b}	9.13^{b}	0.03^{b}	0.63^{a}
Wk 3	34.00^{b}	9.40^{b}	3.85^{a}	32.40^{b}	0.48^{a}	41.13^{b}	8.73^{b}	12.78^{b}	13.61^{b}	0.08^{b}	0.83^{b}
Wk 4	43.25^{b}	9.40^{c}	4.05	32.17^{b}	0.48^{a}	38.85^{a}	6.18^{a}	14.08^{b}	15.16^{b}	0.08^{a}	1.08^{a}

Table 1:- Effects of Different Organic Manures on the Morphological Characters of *T. triangulare*

Means with the same letter are not significantly different at P<0.05 using Duncam Multiple Range Test, wk-week

	Average Leaf Area (cm^2)				Average Leaf Area Ratio (cm^2/g)			
Treatment	Week 1	Week 2	Week 3	Week 4	Week 1	Week 2	Week 3	Week 4
Control	222.43a	213.88a	203.70a	223.41a	801.33a	880.03c	483.93a	422.00c
Pig Manure	633.74c	304.97b	277.24b	337.54b	1267.49c	483.54a	318.63a	259.00ab
Cow dung	251.98a	220.68a	229.14a	305.78b	542.99a	659.37b	362.18b	436.00c
Poultry	384.35b	257.60b	320.40c	332.34b	508.00b	513.01b	369.38b	324.00b

Table 2:- Effects of Different Organic Manures on the Leaf Area and Leaf Area Ratio

Means with the same letter are not significantly different at P<0.05 using Duncam Multiple Range Test.

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Treatment		Control	Pig Manure	Cow dung	Poultry
Week 1	Na (ppm)	23.22	152.62	32.44	53.14
	K (ppm)	296.60	366.35	255.02	476.95
	Mg (ppm)	76.47	50.94	67.35	41.14
	Cd (ppm)	ND	ND	ND	ND
	Cu (ppm)	0.12	0.13	0.21	0.09
	Zn (ppm)	0.46	0.68	0.60	0.49
	Fe (ppm)	887.15	4.07	132.63	2.13
Week 2	Na (ppm)	23.76	49.29	37.29	15.28
	K (ppm)	346.48	296.63	690.85	387.32
	Mg (ppm)	59.99	81.93	53.58	152.63
	Cd (ppm)	0.02	ND	ND	ND
	Cu (ppm)	0.10	0.32	0.21	0.02
	Zn (ppm)	0.74	0.89	0.44	0.52
	Fe (ppm)	3.16	1.58	281.80	4.40
Week 3	Na (ppm)	36.21	32.94	52.32	67.41
	K (ppm)	503.65	659.92	633.53	1182.17
	Mg (ppm)	37.58	127.13	37.21	59.94
	Cd (ppm)	0.00	ND	0.025	ND
	Cu (ppm)	0.18	0.16	0.15	0.13
	Zn (ppm)	0.63	0.68	0.41	0.92
	Fe (ppm)	3.59	3.74	35.04	3.55
Week 4	Na (ppm)	48.53	48.21	15.51	67.41
	K (ppm)	271.42	993.43	303.96	1182.17
	Mg (ppm)	38.89	214.19	14.57	59.94
	Cd (ppm)	0.016	ND	ND	ND
	Cu (ppm)	0.32	0.07	0.29	0.16
	Zn (ppm)	0.52	1.16	0.36	0.84
	Fe (ppm)	2.59	93.78	4.43	2.49

Table 3:- Effects of Different Manures on the Chemical Analysis (Mineral Elements) of the Plant.

ND = Not Detected

Treatment	pH	Conductivity (µS/CM)	Total Organic Carbon	Total Organic Matter	Porosity
Control	5.7	2.12	12.18	4.32	40.00
Pig Manure	5.6	2.36	32.67	9.32	37.00
Cow dung	6.1	2.55	59.30	7.92	40.00
Poultry	6.2	2.63	4.00	11.18	30.00

Table 4:- Analysis of Treated soil after Fourth Week of Harvest

V. CONCLUSION

From the results of this study, it could be concluded that plants fertilized with pig manure produced significantly higher numbers of leaves, leaf width, stem girth, root length, shoot fresh weight and total plant fresh weight as against other manure types. Poultry manure produces higher significance in leaf length and plant height; and cow dung produced significantly higher in stem height compared to other manure types. Pig manure has the highest nutrient elements followed by the poultry manure and lastly cow dung. However, from the findings of this research, pig manure should be considered most preferred choice when soil enrichment for the cultivation of *T. triangulare* is considered. Hence, it may not be unreasonable to recommend that farmers should explore the mixture of the three manures for probable complete, good healthy growth and consequential higher harvest or yield of *Talinium triangulare* to meet the needs of consumers and boost financial remuneration.

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