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RESPONSE OF WATER LEAF VEGETABLE (*Talinum Trangulare Jacq*) TO NITROGEN AND ORGANIC FERTILIZERS IN CALABAR AREA OF SOUTH-EAST NIGERIA

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ABSTRACT

Investigations were carried out to determine the growth and yield responses of waterleaf (Talinium traingulare Jacq), a vegetable crop, to different sources and levels of nitrogen and organic fertilizers at the Teaching and Research Farm of the University of Calabar in a high rainfall area of Southeast Nigeria. The results showed as expected, that yield performance was better in manured than in control plots. Responses varied very widely with sources of manures in terms of vegetative growth and yields. Effects of the compound fertilizer (NPK) were supérior to single fertilizer (urea) and organic manure (cowdung) in that order. Average cumulative fresh weight of waterleaf under the different manurial regimes were 1.89kg, 1.65kg and 0.89kg for NPK, urea and cowdung respectively. Studies are, however, continuing to enable us elucidate current fertilizer rates as well as develop optimum fertilizer formulae for intensive Talinum cultivation in the zone.

Key words: **Water leaf vegetable, nitrogen and organic fertilizers, Southeast Nigeria.**

INTRODUCTION

The common waterleaf vegetable (*Talinum triangulare* jacq) is a dicotyledonous plant belonging to the family portulaceae. (Tindal, 1983). Of the fifteen species of this family occuring in the warmer regions of the tropics, only two varieties, (*Talinum triangulare* Jacq) and *Talinum portulaciffolium* (Rahl) have been identified in the West Coast of Africa (Hutchinson and Dalziel, 1954). However while *T. portulaciffolium* serves as ornamentals, *T. triangulare* is cultivated and consumed as a food component by humans. Water leaf is an important vegetable crop in the West African countries. It plays a vital role in the improvement of the resource-poor farmers not only economically through income generation, substitution of purchases and employment opportunities, but also nutritionally through provision of greater variety of food types and fresh foods. According to a Food and Agriculture Organization Report (FAO, 1968), a hundred grams of edible leaf portion Talinum contains 91% water, 25g calories 2.4g of protein, 0.4g fat, 4.0g carbohydrate, 1.0mg fibre 121mg calcium, 67mg phosphorous, 5.0mg iron, 0.08mg thiamine, 0.18mg riboflavin, 0.03mg niacin, and 31mg ascorbic acid. This is perhaps the reason whey Talinum leaves have been used over many years for the preparation of soups in many dishes for human beings and the vines used as fodder for livestock (Tindal, 1983). In Calabar specifically, Talinum leaves are also prepared as laxatives and curative portions for measles (Akpan, 1981).

A number of investigations (Akpan, 1981; Dimanochie 1997; Amalu and Oko 1998; Tarh, 1998) have shown that the water-leaf vegetable crop responds well to the application of nitrogenous, phosphatic, and potassium fertilizers. For example, the average leaf yield of water leaf vegetable crop in the Calabar area was estimated at about 350kg per hectare of farmers' plots (Dimanochie, 1997) while in similar fertilizer trial conducted in the same plots, Tarh (1998) obtained a higher yield average of 430kg/ha. This implied that there was an immense scope for increases in the output of this crop if appropriate agronomic practices were employed.

At present, researches on the effects of fertilizer application on the yield and quality of waterleaf vegetable are still in their infancy, though the crop is massively cultivated on the coastal plain sands of Calabar area in the South-eastern region of the country. For the foregoing realization and an apparent paucity of information, an inorganic-

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cum-organic fertilizer experiment was initiated and conducted over a two-year (1997 and 1998) period to find out the effect of different sources and levels of nitrogen and organic fertilizers on the water leaf vegetable crop in Calabar.

MATERIALS AND METHODS

The trials were conducted during two consecutive rainy seasons (1997 and 1998) at the University of Calabar Teaching and Research farm. The site had previously been cropped to soybean and then fallowed in 1996. This resulted in massive infestation of the site by several weed species, especially *Panicum maximum, Cynodon dactylon, Axonopus compressus, Aspilia afrikana, Centrosema pubecens and Euphorbia hirta.*

The cowdung materials and five composite soil samples taken from the top 15cm of the soil were analysed for some properties. Contents of nitrogen, phosphorus and potassium in the cowdung material were determined according to the AOAC (1965) procedures. Particle size fractions were determined by the Bouyocous hydrometer method (Day, 1965) using sodium hexa-metaphosphate as a dispersant. Soil pH was determined in a 1:2.5 soil: water suspension using glass electrode pH meter. Organic carbon was determined on 2 gram soil samples by the dichromate wet oxidation method of Walkey and Black as outlined by Jackson (1969). Total nitrogen was determined on samples (sieved through 0.5 mm mesh) by the Macro Kjeldahl method (Jackson (1969). Available phosphorus was extracted by the Bray No. 1 solution (Bray and Kurtz, 1945) and estimated by the molybdenum blue colour technique (Murphey and Riley, 1962). Exchangeable bases (K^+, Na^+, Ca^{2+}, Mg^{2+}) were determined form the extracts obtained after leaching the samples with one normal, neutral ammonium acetate (NH_4Oac) solution. Exchangeable K^+ and Na^+ contents were determined on the flame photometer, while Ca and Mg were estimated by the versenate titration method. Exchangeable acidity was extracted with one normal potassium chloride solution and estimated in the extract by titration (Mclean, 1965).

Stem cuttings of *Talimum triangulare* obtained locally were planted at a rate of one stem per stand spaced 5cm x 5cm in some 0.0004 ha (2 m x 2 m) plots giving a plant population of 4,000,000 stands per hectare. In 1997, eight treatments consisting of nitrogen, phosphorus, and potassium (NPK 1:1:1) mixed fertilizer at 20, 40, and 60 kg N/ha, Urea applied at 20, 40, and 60 kg N/ha, poultry waste at 10 tonnes/ha and a control (no manurial treatment) were employed and eac replicated thrice. However, in 1998, cow dun was used in place of poultry waste (poultry wast has become expensive while cowdung coul easily be procured at no cost). Cowdung wa applied at 10, 20 and 30 tonnes/ha resulting in te treatments altogether, each replicated thrice. Th respective treatments in both trials were laid ou in Randomized Complete Block (RCB) design and applied two - three weeks before planting c the stem cuttings.

Manual weeding of the plots was done using sma weeding hoes as necessary and a harvestin frequency of 21 days interval was maintaine throughout each season. Prior to harvesting fc fresh weight data, other agronomic parametei such as plant height, number of branches, numbe of leaves and length and breadth of the leave: were measured. Data were subjected to a analysis of variance (ANOVA) as described b Steel and Torrie (1960).

RESULTS AND DISCUSSION

The physical and chemical properties of the soi (Table 1) show that the sandy loam texture of th soils during 1997 had altered slightly to loam sand by 1998. This implied some lowering c amounts of clay and organic matter in the soils. I such textural conditions, the soils are generall non-cohesive and single grained. Chemically, th soils are generally acidic, low in organic matte total nitrogen and exchangeable bases, bu moderately endowed with available phosphoru The poor fertility status of the soils can b attributed to their composition of silicious lo activity clays, (Enwezor *et al* 1981) whi naturally are predominated by quartz sand a characterized by negligible influence of s

Table 1: Chemical composition of cowdung material and selected phisico-chemi properties of the soils at the University Teaching and Research Farm (199 1998)

Cowdung/Soil Sample Analysis	1997	1998
Cowdung Sample		
Nitrogen (%)	ND*	1.61
Phosphorus (%)	ND	0.31
Potassium (%)	ND	1.80
Soil Sample		
Particle Sizes		
Sand (%)	79.2	83.2
Silt (%)	7.1	5.1
Clay (%)	13.7	11.7
Chemical Properties		
pH (1:2.5 soil: water)	5.5	4.2
Organic Carbon (%)	3.2	1.5
Total Nitrogen (%)	0.08	0.12
Available phosphorus (ppm)	103.9	60.0
Exchangeable Potassium (meq/100gm)	0.05	0.17
Exchangeable Calcium (meq/100gm)	2.00	0.20
Exchangeable Magnesium (meq/100gm)	1.00	0.10
Exchangeable Sodium(meq/100gm)	0.04	0.10
Exchangeable Acidity (meq/100gm)	3.21	2.83

*ND - Not determined. **Values are means of composite samples.**

mineralogy and surface charge characteristics on soil behaviour (Juo, 1981).

The effects of different sources and levels of nitrogen on the growth characters of waterleaf vegetables are given in Table 2 for 1997 season. The sources of nitrogen affected plant height over the control when compared with both urea and poultry droppings. There were no differences between the effects of urea and poultry droppings over the control. The yield from the plots that received 60kg NPK per hectare was significantly superior to the untreated plots. There were no differences among the various levels of urea N in their effects on plant height. Of the three N-sources, only the NPK source had any significant effect on the number of leaves. The number of leaves was found to have increased with increasing levels of nitrogen. Leaf area increased from 0.93cm² for NPK 20kg/ha to 2.20cm² for the NPK 60kg N/ha.

In 1998 (Tables 3 and 4), all the nitrogen sources, regardless of their levels and harvest cuts were ineffective in increasing both the number of branches and number of leaves. The poor effects of sources of nitrogen in 1998 were thus similar to those produced in the 1997 trial. However, leaf area values of crops in the control plots 1998 were by far larger than those of crops in fertilized plots in 1997. Again leaf area was influenced more by urea-N than by either NPK-N or poultry dropping - N.

In Table 5 is presented the cumulative fresh weight yield data for the waterleaf crop as affected by nitrogen fertilizers and cow-dung manure in 1998. Generally, the levels of the different sources of nitrogen were not different from each other. However, when NPK at 60kgN per hectare was applied, fresh weight yield became higher at 3.37kg than all the other levels tested. This was followed by urea-N source at 20kgN per hectare which had 2.53kg. The effect of cow-dung applied at 10 tonnes per hectare and 20 tonnes per hectare on fresh weight yield was least of all as each had 0.80kg. Surprisingly, the control plot vegetable crops, which depended solely on available soil nutrients, out-yielded those on plots that received cow-dung (at all levels) as well as those on some of the plots that received various levels of treatment applications, 60kg/ha of NPK and 20kgN/ha of urea, produced yields which were superior to that (1.63kg) in control plots.

These results, however, seem to point to the need for a high level of the major nutrients as indicated by the influence of NPK at 60kgN per hectare which induced soil phosphorus and potassium deficiencies. Fresh weight yields of 1.10kg and 1.2kg for NPK (20kgN/ha) and NPK (40kg N/ha) respectively were also indicative of this assertion. Urea nitrogen source appears not to be as effective as NPK compound fertilizer. The waterleaf vegetable crop therefore would benefit more from a compound than from a straight nitrogen

Table 2: **Effect of nitrogen fertilizer and poultry manure on some vegetative growth characteristics and fresh weight of *Talinum triangulare* (1997)**

Treatment	Plant Height (cm)	Number of Leaves	Leaf Area (cm²)	Number of Branches	Fresh Leaf Weight (kg)
Control	14.30	4.30	0.36	15.00	5.60
NPK 20Kg N/ha	15.70	5.30	0.93	17.00	9.80
NPK 40Kg N/ha	17.70	6.00	1.60	16.00	10.70
NPK 60Kg N/ha	19.00	8.00	2.20	18.30	17.50
Urea 20Kg N/ha	14.30	5.30	0.66	16.00	8.50
Urea 40Kg N/ha	14.60	4.60	0.40	15.60	6.30
Urea 60Kg N/ha	14.30	5.00	0.63	15.60	6.10
Poultry droppings	14.30	4.60	0.50	15.00	5.13
LSD 0.05	2.02	1.33	NS	NS	3.80

Table 3: **Effect of nitrogen fertilizer and cattle manure on vegetable growth characters and fresh weight of *Talinum trangulare* (Ist cut, 1998).**

Treatment	Plant Height (cm)	Number of Branches	Number of Leaves	Leaf Length (cm)	Leaf Width (cm)	Leaf Area (cm²)	Fresh Weight (kg)
Control	18.4	3.6	35.0	4.2	1.6	7.00	1.1
NPK 20Kg N/ha	15.8	2.9	30.0	3.6	1.2	4.6	0.8
NPK 40Kg N/ha	14.4	3.0	26.5	3.2	1.2	4.0	0.7
NPK 60Kg N/ha	19.7	2.7	26.3	3.7	1.7	9.0	1.9
Urea 20Kg N/ha	16.0	2.7	26.3	3.7	1.7	9.0	1.9
Urea 40Kg N/ha	10.3	2.4	21.3	37	1.4	5.5	0.6
Urea 60Kg N/ha	16.0	5.5	33.3	3.9	1.4	6.1	1.0
Cowdung 10t/ha	14.1	3.1	28.5	3.2	1.2	4.0	0.5
Cowdung 20t/ha	12.6	2.8	23.2	2.9	1.0	3.3	0.6
Cowdung 30t/ha	13.2	3.1	26.4	3.5	1.3	4.8	0.6
LSD 0.05	3.84	NS	6.82	NS	NS	NS	NS

Table 4: **Effect of nitrogen fertilizer and cattle manure on vegetative growth characters and fresh weight yield of *Talinum triangulare* (2nd cut, 1998).**

Treatment	Plant Height (cm)	Number of Branches	Number of Leaves	Leaf Length (cm)	Leaf Width (cm)	Leaf Area (cm²)	Fresh Weight (kg)
Control	16.0	2.9	19.2	3.4	1.3	4.9	0.5
NPK 20Kg N/ha	12.4	2.3	16.3	2.9	1.2	4.0	0.3
NPK 40Kg N/ha	11.0	2.0	16.4	2.0	0.9	1.9	0.5
NPK 60Kg N/ha	13.7	2.5	20.0	3.4	1.2	4.6	1.1
Urea 20Kg N/ha	14.9	2.3	16.6	3.5	1.3	4.1	0.9
Urea 40Kg N/ha	12.0	2.2	16.5	2.9	1.1	3.8	0.4
Urea 60Kg N/ha	13.5	2.2	15.5	3.1	1.2	4.2	0.5
Cowdung 10t/ha	11.1	2.1	15.1	2.5	1.0	2.8	0.2
Cowdung 20t/ha	9.6	1.9	15.1	2.5	1.0	2.8	0.2
Cowdung 30t/ha	11.6	2.8	21.9	3.3	1.2	4.1	0.6
LSD 0.05	NS	NS	NS	NS	NS	NS	NS

Table 5: **Cumulative fresh weight yield of *Talinum triangulare* as affected by nitrogen fertilizer cattle manure (1998).**

Nitrogen Fertilizer/organic Manure	Cumulative Fresh Weight (kg)
Control	1.63
NPK 20Kg N/ha	1.10
NPK 40Kg N/ha	1.20
NPK 60Kg N/ha	3.37
Urea 20Kg N/ha	2.53
Urea 40Kg N/ha	0.93
Urea 60Kg N/ha	1.50
Cowdung 10t/ha	0.80
Cowdung 20t/ha	0.80
Cowdung 30t/ha	1.08
LSD 0.05	NS

fertilizer. This implies that only the large-scale or medium scale farmer may benefit from the advantages of this often scarce and expensive fertilizer. The yields obtained via the application of cow-dung, though not as high as those from mineral fertilizers, cannot be totally put aside as unprofitable. Resource-poor farmers can make moderate profits from use of cow-dung materials, especially as they are relatively readily available and are obtainable at no monetary cost.

The results of this investigation showed varied growth and yield responses of waterleaf vegetable to different sources and levels of fertilization. The low fresh weights of vegetable from the control treatments in both 1997 and 1998 were therefore not surprising. Besides the pre-treatment soil analysis (Table 1) had shown that the major plant nutrients were low to severely deficient in the trial plots. The levels of soil nutrients may not have been sufficient to exert any positive influence on biomass yield. Responses to nitrogen, phosphorus and potassium treatments were generally high in 1997 and 1998 plantings. These were possibly because nitrogen is directly used in the synthesis of amino acids and hence in the synthesis of proteins while phosphates directly enter into the composition of nucleic acids. The chemical combination of nucleic acids with proteins may have resulted in the formation of nucleo-proteins as postulated by Hukkeri (1968).

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