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RESEARCH ARTICLE

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Effects of Cow dung and N. P.K Fertilizer at different levels on the Growth performance and Nutrient Composition of *Moringa oleifera*

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ABSTRACT

The study was carried out to assess the growth performance and nutritional value of Moringa oleifera. Supply of nutrients required for optimum growth of Moringa oleifera can be a limitation to its cultivation. A pot experiment was conducted to investigate the effects of organic and inorganic fertilizers at two levels; NPK 15:15:15 (5g and 3g) and cow dung (10g and 15g) in five replicates. The experimental design was completely Randomized Design (CRD). Growth parameters measured include number of leaves per plant, plant height (cm), and stem girth (cm). Proximate analysis of air dried leaves was done to determine the percentage protein, Ash, moisture, fat, fiber and carbohydrate. Result shows that 5g NPK 15:15:15 at week 10 produced more leaves of 178, tallest plant of 66.95cm, and the highest stem girth value of 2.28cm as compared to other treatments. NPK 15:15:15 produced the highest Ash (7.60%), protein (27.70%), fat (2.03%) and fiber (11.80%) while the control plant produced the highest carbohydrate (67.13%) and moisture (6.10%). This study concludes that vegetative growth and nutrients of Moringa oleifera were best supported by 5g NPK which is statistically significant ($p<0.05$) as compared to other treatments.

Keywords: Organic, inorganic, proximate analysis, *Moringa oleifera.*

INTRODUCTION

In recent times, *Moringa oleifera* has gained a lot of popularity due to recent discoveries of its usefulness to mankind, resulting in rapid growth in interest for the plant. *Moringa oleifera* belongs to the monogeneric family of shrubs and trees, called *Moringaceae*[1]. The tree originated from Agra and Qudh in Northwestern region of India, South of the Himalayan Mountain. The tree has spread to almost all tropical belt because it is drought- resistant [2]. *Moringa oleifera* is called the "Miracle Tree" for good reasons. *Moringa oleifera* leaves, pods, flowers, fruits, roots, bark, and seeds can be utilized in water treatment, as food supplement and the extract can be used against bacterial or fungal skin infections. The need to meet nutritional requirements through adequate food supplies and proper selection of diet has been a basic determinant of stability and progress human being requires in pursuing essential functions such as growth, development and reproduction [3]. *Moringa oleifera* is one of the lesser known vegetables found in Nigeria ecosystem. The leaves possess remarkable nutritional and medicinal qualities. They contain high amount of vitamin C, which fights a host of illnesses including colds and flu; vitamin A, which acts as a shield against eye disease, skin disease, heart ailments, diarrhea, and many other diseases; Calcium, which builds strong bones and teeth and helps prevent osteoporosis; Potassium, which is essential for the functioning of the brain and nerves, and Proteins, the basic building blocks of all our body cells [4].

Furthermore, *Moringa oleifera* leaves contain all the essential amino acids in a good proportion, which are the building blocks of proteins, hence it could be a great boon to people who do not get protein from meat. *Moringa oleifera* even contains argenine and histidine 'two amino acids" especially important for infants, who are unable to make enough protein for their growth requirements [4]. The protein quality of *Moringa oleifera* leaves compares very well with that of milk and eggs [5].

Moringa oleifera is adapted to a wide range of soil types but it does well in a well-drained loam to clay loam soil. *Moringa oleifera* is drought tolerant and does not withstand prolong water logging. It prefers a neutral to slightly acidic soil reaction. The temperature requirement is 26-40^{0}C and annual rainfall of at least 500mm [6]. Fertilizer helps in the fast growth of *Moringa oleifera*, enhancing its ability to produce healthy plant [7]. When crops are planted year in, year out, the minerals in the soil are depleted especially nitrogen, phosphorus and potassium. *Moringa oleifera* needs potassium for growth and plant resistance to drought and disease. Plants turn nitrogen into carbohydrates, amino acid and protein needed for good growth [8]. Despite the enormous potential of *Moringa* trees, information is still scanty on the fertilizer requirement that will bring about proper growth and nutritional quality of the plant. Consequently, this study was conducted to assess the growth response of *Moringa oleifera* to different rates of inorganic and organic fertilizer, with the objective of determining the rate that supports optimum plant growth and nutritional qualities.

MATERIALS AND METHODS

2.1 Experimental Design

A pot experiment was carried out in 2015 at Trail Afforestation Research Station Afaka, Kaduna, Nigeria. The area has a bimodal rainfall pattern with a rainy season between April and August and a shorter rainy season from September to early November. The effect of organic and inorganic fertilizer on the growth and nutritional composition of *Moringa oleifera* was investigated. The experiment was arranged in a Completely Randomized Design (CRD) with five replicates. Top soil was filled into each of the twenty five polythene bags. One seed was planted each into each of the polythene bags at a depth of 3cm, the soil was affirmed and watered immediately for proper plant establishment. Each seedling received 400 ml of water two times daily until they were 17 days old when the treatments began. All the seedlings continued to be subjected to the same watering regime throughout the experimental period. Two levels of N:P:K 15:15:15 (3g and 5g), two levels of cow dung (10g and 15g) and zero level for control experiment were applied to the plant. *Moringa oleifera* growth was assessed by the number of leaves per plant, plant height (cm) and stem girth (mm). The plant height was determined using meter rule, stem girth by vernier caliper while the number of leaves per plant was determined by counting.

2.2 Proximate Analysis

The proximate compositions of the dried *Moringa oleifera* leaves were determined using standard analytical methods. All measurements were done in replicates and values presented in percentage.

2.2.1 Ash content determination

The ash content was determined using the method described in Association of analytical chemist (AOAC, 1995). Five grams (5g) of the sample was weighed into a crucible in a muffle furnace and heated at 550^{0}C for six hours until it became gray ash. The dish was removed from the muffle furnace using crucible tong and placed in a desiccator to cool. When cooled it was re-weighed and the weight of ash was obtained by the difference.

2.2.2 Moisture content determination

The moisture content of the samples was determined using Association of analytical chemist method [9]. The Petri-dish was washed thoroughly and placed in oven to dry. 5g of the sample was then placed in a pre-weighed Petri dish, and then placed in an oven to dry at 105^{0}C for two hours. The dish and dry sample were transferred to a desiccator to cool at room temperature before being weighed again. The experiments were repeated until constant weight was obtained.

2.2.3 Fat content determination

Fat was determined using soxhlet fat extraction method as described by [10]. 250ml boiling flask was washed thoroughly and dried in oven at 105^{0}C for 30 minutes and then placed in a desiccator to cool. 2g of the dried sample was then weighed accurately into labeled thimbles. Cooled boiling flask was filled with 200ml of petroleum ether and boiled at 40-60^{0}C. The extraction thimble was plugged lightly with a cotton wool and the boiling flask

containing the petroleum ether was placed in the extraction thimble to boil and the soxhlet apparatus was allowed to reflux for six hours. The thimble was removed carefully, and the petroleum ether on top of the container was collected and drained into another container for reuse. When the flask was free of petroleum ether, it was removed and boiled for an hour at 105^{o}C. It was finally transferred from the oven into a desiccator to cool before weighing.

2.2.4 Fibre content determination

Crude Fibre content was determined by Weende's method as described by [11]. Two grams (2g) of the sample was weighed into a 250ml conical flask and 200ml of 1.25% H_2S0_4 was added and the mixture was boiled under reflux for 30minutes. The solution was filtered with whatman filter paper; the residue was rinsed thoroughly with hot water until it was no more acidic when tested using pH paper. The residue was transferred into a 250ml beaker and 200ml of 1.25% NaOH was added and boiled for 30minutes in a digestion apparatus after which it was filtered and rinsed with distilled water until the filtrate was neutral when tested with pH paper. The residue was transferred into a crucible and placed in electric oven at 100^{o}C for eight hours to dry. It was then removed and placed in a desiccator to cool before weighing. After weighing, the sample was incinerated, cooled in a desiccator and reweighed.

2.2.5 Carbohydrate determination

The carbohydrate content of the test sample was determined by estimation using the arithmetic difference method.

%CHO = 100 – (% fat. + % ash + % fiber + % protein).

RESULTS AND DISCUSSION

Number of leaves per plant

Average number of leaves per plant tends to increase across all treatments over the weeks irrespective of the fertilizer used (table 1). N: P: K 15:15:15 (5g) produced the highest number of leaves (178) at week 10 while the lowest leaves of 34 were obtained from control plant at week 4. The differences in leaves yield between N: P: K 15:15:15, cow dung and control plant is statistically significant ($p < 0.05$) using Duncan multiple range.

Table1: Effects of N: P: K 15:15:15and cow dung on leaves count

	Weeks			
Treatments (g)	4	6	8	10
T_1	89^{e}	103^{d}	134^{d}	178^{e}
T_2	55^{a}	91^{e}	131^{e}	167^{d}
T_3	47^{b}	87^{c}	116^{c}	121^{a}
T_4	43^{d}	75^{a}	110^{a}	113^{b}
C	34^{c}	51^{b}	94^{b}	103^{c}

Source: Field experiment, 2015

a,b,c,d,e means within a column with different superscripts are significantly different (P<0.05)

Key:T_1 (N:P:K 15:15:15 5g); T_2 (N:P:K 15:15:15 3g); T_3 (cow dung 15g); T_4 (cow dung 10g), ; C (control).

Table 2: Effects of N:P:K 15:15:15 and cow dung on plant height (cm)

	Weeks			
Treatments (g)	4	6	8	10
T_1	49.40^{d}	58.10^{e}	65.80^{e}	66.95^{e}
T_2	45.00^{b}	54.20^{d}	60.40^{d}	62.00^{d}
T_3	44.72^{a}	49.40^{a}	54.35^{a}	56.40^{a}
T_4	43.80^{c}	47.60^{b}	52.00^{b}	53.59^{b}
C	39.38^{e}	42.80^{c}	47.60^{c}	49.20^{c}

Source: Field experiment, 2015.

a,b,c,d,e means within a column with different superscripts are significantly different (P<0.05)

Plant height

Application of cow dung and N:P:K 15:15:15 increased the height of *Moringa oleifera* over the weeks (table 2). Tallest plant of 155.60 cm at week 10 was produced by 5g N:P:K 15:15:15 while the shortest plant of 39.38cm was produced by control plant. The differences in height yield between N:P:K 15:15:15,, cow dung and control plant is statistically significant ($p < 0.05$) using Duncan multiple range.

Stem girth

The stem girth tends to increase as growth progressed irrespective of fertilizer application (table 3). The highest stem girth value of 2.28 cm at week 10 was observed in plant that received 5g of N:P:K 15:15:15 while the lowest stem girth value of 0.91 cm was observed at week 4 in control plant. There is no significant differences ($p<0.05$) between the stem girth observed in cow dung and that of control plant but there is significant differences ($p<0.05$) between that of N:P:K 15:15:15 .

Table 3: Effects of N:P:K 15:15:15 and cow dung on stem girth (cm)

	Weeks			
Treatments (g)	4	6	8	10
T_1	1.02^{c}	1.34^{c}	1.75^{a}	2.28^{c}
T_2	0.92^{b}	1.30^{d}	1.65a	2.02^{b}
T_3	0.92^{b}	1.24^{a}	1.56^{a}	1.78^{a}
T_4	0.90^{b}	1.22^{a}	1.44^{a}	1.76^{a}
C	0.91^{b}	1.22^{a}	1.08^{a}	1.76^{a}

Source: Field experiment, 2015

a,b,c,d,e means within a column with different superscripts are significantly different (P<0.05)

Proximate analysis

Table 4 shows the proximate analysis of 3 different dried leaves of *Moringa oleifera* treated with N:P:K 15:15:15 (5g), Cow dung (15g) and control.

Table 4: Effect of N:P:K 15:15:15 and cow dung on nutrient composition of *Moringa oleifera* leaves.

	%					
Treatments (g)	Ash	Moisture	Protein	Fat	Fiber	Carbohydrate
N:P:K 15:15:15	7.60^{c}	5.70^{b}	27.70^{c}	2.05^{b}	11.80^{c}	45.15^{a}
Cow dung	6.50^{b}	5.40^{a}	12.55^{b}	1.50^{a}	11.40^{b}	62.66^{b}
Control	5.85^{a}	6.10^{c}	12.13^{a}	2.30^{c}	5.50^{a}	67.13^{c}

a,b,c means within a column with different superscripts are significantly different (P<0.05)

DISCUSSION

Vegetative growth of *Moringa oleifera* was better enhanced by the application of N: P: K15:15:15 (5g) as it produced the highest number of leaves which was significantly higher than other treatments using Duncan multiple range ($p<0.05$). According to [12] application of nitrogen and phosphorus to *Moringa* trees will encourage root development as well as leaf canopy growth. The plant height and stem girth in N: P: K 15:15:15 (5g) treated seedlings was significantly higher than other treatments across all the weeks. The highest plant (66.95 cm) treated with N: P: K 15:15:15 (5g) at week 10 in this research is higher than that obtained from poultry manure (42.60cm) as reported by [13].

A large number of reports on the nutritional qualities of *Moringa* tree now exist in both the scientific and the popular literature. The proximate analysis of dried *Moringa oleifera* in this research revealed that N:P:K 15:15:15 produced the highest % ash, crude protein, crude fat and fiber which is statistically significant ($p<0.05$) than other treatments. The carbohydrate and moisture contents (%) in control plant on the other hand is significantly higher ($p<0.05$) than other treatments.

Ash on food determines largely the extent of mineral matter likely to be found on food substance. The ash content of *Moringa oleifera* leaves from N:P:K 15:15:15 treated (7.60%) and cow dung (6.50%) were higher than (6.00%)

reported by [14], (3.8%) by [15]but lower than (7.93%) as reported by [16]. The highest % moisture (6.10%) obtained from control plant is lower than (9.00%) as reported by [14]and (14.8%) by [15]. *Moringa oleifera* leaves in this research contained appreciable % of crude protein (27.70%) from N:P:K 15:15:15 treated seedlings. This value is higher than (17.01%) as reported [17], but similar to the findings (27.51 %) of [18]. Crude fat value of *Moringa oleifera* leaves (2.30%) from control plant was higher than 0.5% reported by [19]. The value of fiber obtained from *Moringa oleifera* leaf (11.80 %) from N:P:K15:15:15 treated was higher than 9.25% and 3.5% as reported by (Iboke*t al.,* 2008) and [20] respectively. Carbohydrate content of *Moringa oleifera* leaf (67.13%, 62.66% and 45.15%) in N:P:K 15:15:15, cow dung and control plant respectively were higher than 38.21% [14] and 43.88% [16].

CONCLUSION

The study concludes that N:P:K 15:15:15 and cow dung are valuable sources of fertilizer for the growth of *Moringa oleifera* because they have greatly improved performance of treated plants over the control. However, N:P:K 15:15:15 proved more superior to cow dung manure because it produced better attributes such as leaves count, stem girth and plant height than its counter parts produced. Proximate analysis shows that dried *Moringa oleifera* leaves is a good source of important nutrients and thus, the plant might be explored in a viable supplement in both animal and human food.

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