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COMPARATIVE ASSESSMENT Of Effect Of *MORINGA OLEIFERA* leaf EXTRACT AND N.P.K (20:10:10) FERTILIZER ON THE GROWTH AND HERBAGE Yield Of *AMARANTHUS HYBRIDIS* IN THE GUINEA SAVANNAH ZONE OF NIGERIA.

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ABSTRACT

The trial carried out to determine the effect of *Moringa* leaf extract and N.P.K (20:10:10) on the herbage yield of *Amarnthus hybridis* was carried out at Vegetable Farmers' Association Garden, Kubwa, Abuja, Nigeria. Randomized complete block Design (RCBD) with 3 replications was used. Data collected include plant height, number of leaves per plant, fresh root weight, and herbage yield, Results showed that *Moringa oleifera* extract enhanced the status of some basic elements in the soil. Soil pH of the plots that received *Moringa* leaf extract increased from 5.4 to 6.4 while in control plots, the pH decreased from 5.4 to 5.3. Application of *Moringa* leaf extract at one week interval increased plant height by 18% in the first trial and by 30% in the second experiment while its application at 2 weeks interval increased plant height by 14% in the first trial and by 27% in the second trial. Application of N.P.K (20:10:10) fertilizer at the rate of 50kg ha^{-1} increased the plant height by 20% in the first trial and by 33% in the second experiment while at 100kg ha^{-1}, plant height increased by 23% in the first trial and 36% in the second. Highest herbage yields of 17.3 t ha^{-1} in the first experiment and 18.6 t ha^{-1} in the second experiment were obtained when *Moringa* leaf extract was applied in combination with 50 kg ha^{-1} of N.P.K fertilizer,

Keywords: *Moringa oleifera,* Trial, Herbage Yield, Cytokinin, monogeneric Family, Fertilizer, Growth, Extract, Zeatin,

INTRODUCTION

As the country enters into deep economic recession, prices of commodities including the agricultural inputs are rising at alarming rate. As a result, about 60% percent of the rural farmers who are the major food producers in the country are unable to get access to the basic farm inputs such as fertilizers for food production. Hence there are cases of food crises in most homes. Although farmers through extension services and other basic trainings had been informed about the negative consequences of the use of chemical fertilizers but there has not been significant cheap alternative means of soil fertility maintenance available to them. The price of the recommended Organic fertilizer in the market is double that of the chemical fertilizer.

In the light of the above problem, Scientists had identified some fallow plants which are capable of improving the fertility of the soil either by growing along with the component crops or through the use of their extracts. *Moringa oleifera* is one of such plants and its extract is low – cost and environmentally friendly, (Anyaegbu,2014). The plant is the most widely cultivated species of a monogeneric family, the *Moringaceae*, that is native to the sub-himalayan tracts of India, Pakistan, Bangladesh and Afghanistan, (Jed and Fahey,2005) This rapidly-growing tree (also known as the horseradish tree, drumstick tree, Benzolive tree, kelor, Marango, Mlonge, Moonga, Mulangay, Nébéday, Saijhan, Sajna or Ben oil tree), was utilized by the ancient Romans, Greeks and Egyptians; it is now widely cultivated and has become naturalized in many locations in the tropics including Nigeria. According to Fuglie (1999) the many uses for *Moringa* include: alley cropping (biomass production), animal forage (leaves and treated seed-cake), biogas (from leaves), domestic cleaning agent (crushed leaves), blue dye (wood), fencing (living trees), fertilizer (seed-cake), foliar nutrient (juice expressed from the leaves), green manure (from leaves), gum (from tree

trunks), honey- and sugar cane juice-clarifier (powdered seeds), honey (flower nectar), medicine (all plant parts), ornamental plantings, bio-pesticide (soil incorporation of leaves to prevent seedling damping off), pulp (wood), rope (bark), tannin for tanning hides (bark and gum) and water purification (powdered seeds). *Moringa* seed oil (yield 30-40% by weight), also known as Ben oil, is a sweet non-sticking, non-drying oil that resists rancidity. It has been used in salads, for fine machine lubrication, and in the manufacture of perfume and hair care products (Tsaknis et al 1999). In the West, one of the best known uses for *Moringa* is the use of powdered seeds to flocculate contaminants and purify drinking water (Berger et al,1984, Gassenschmidt et al 1995 and Olsen (1987)), but the seeds are also eaten green, roasted, powdered and steeped for tea or used in curries (Gassenschmidt 1995).

In the field of Agriculture and Biological Sciences, *Moringa oleifera* has been described as a "Fertility Plant". This is as a result of its confirmed positive contribution in soil fertility maintenance for the benefit of the companion crops in an alley or the positive effect of its extracts on the growth of arable crops. Fresh *Moringa oleifera* leaves contain a substance known as Zeatin, a cytokinin related hormone, (Fuglie 2000). Cytokinin is a plant hormone, It regulates cell division and stimulates leaf expansion, (Precious, 2006). It enhances food production as it is involved in cell growth and differentiation and its exogenous supply delays senescence of crop plants.

Effect of *Moringa oleifra* leaf extract on onions,bell pepper, soybeans, sorghum, coffee, tea, mellon and maize had been reported by Fuglie, (2000), on *Telfaria occidentalis* by Anyaegbu et al (2013), on *Solanum melongena* by Anyaegbu, (2014, and on *Abelmoschus esculentus* (okra) by Anyaegbu and Ezeibekwe, (2016). The effect of *Moringa* extract on other crops is unknown.Therefore, the objective of this study is to determine the effect of *Moringa* leaf extract on the herbage yield of *Amarnthus hybridis*, whether differences in

time of its application will have a significant effect on the growth of the plant and to determine if the extract will be a suitable alternative to chemical fertilizer in the production of *Amaranthus* vegetable.

MATERIALS AND METHOD

This experiment was conducted at the Vegetable Farmers' Association Garden, Kubwa, Abuja, Nigeria, in the early and late growing seasons in 2016. Abuja, the Federal Capital Territory is located in the Guinea Savannah of the West Africa. Rainy season starts in April and ends in October, and the average daily temperature ranges from 28^0C to 30^0C in the dry season and can be as high as 40^0C or more especially in Gwagwalada area. Annual rainfall ranges from 1100mm to 11300mm, humidity of 14% at the period of planting, and wind at 10km/h North East. Its soil is clay loam with a quick moisture regime (Afisol soil).

The Experimental material was the seeds of *Amaranthus hybridis* obtained from the local market. Prior to the field operations, a temporary Nursery was established for the raising of the seedlings. Seeds of *Amaranthus* were sown on the prepared nursery beds and regularly watered. After nursery establishment, the experimental site was cleared manually and the experimental layout of Randomized Complete Block Design with 3 replications was established. Each replicate contained six beds each measuring 2m x 1m. Thus a bed constituted a plot. Hence, there were 18 plots in the whole trial. Each replicate was separated from each other by a 1m alley and intra plot spacing was 50cm. The experimental layout covered an area of 14.5m x 5m.

The experimental treatments consisted of; i. Control – No *Moringa* extract and no fertilizer,

ii. *Moringa* Extract at 2 weeks interval + 50kg, ha^{-1} N.P.K. 20:10:10 iii. *Moringa* extract at 1 week interval + 50kg ha-1, iv. *Moringa* extract alone at 2 weeks interval, v. *Moringa* extract alone at 1 week interval,
vi. N.P.K. (20:10:10) 50 kg ha^{-1}, vii. N.P.K.(20:10:10) 100Kg ha^{-1}.

In the preparation of the leaf extract, 20kg of leaves of *Moringa oleifera* was mixed with 675 ml of ethanol. The suspension was ground and stirred vigorously to help maximize the amount of the extract. The solution was filtered by wringing the solution using Chinese cloth. The extract was then diluted with water at a ratio of 1:32 (v/v) as recommended by Fuglie, (2000) and applied directly onto plants (from the tip to the soil surface under each stand). The rate of application was 30ml per plant.

Transplanting of *Amaranths* seedlings into their respective plots in the field took place two weeks after sowing at spacing 50 cm × 20 cm. Fertilizer was applied by broadcasting method, a day to transplanting. Each vegetable bed contained thirty plants out of which six in the net plot (1mx40cm at the middle of each plot) were used for data collection. Data collection commenced from 2 weeks after transplanting and was done weekly till the sixth week. Data collected include, plant height, number of leaves per plant, fresh root weight, and herbage yield. Data collected were subjected to analysis of variance (ANOVA) and treatment means were separated by Duncan multiple range test (DMRT).

RESULTS AND DISCUSSION

Table 1 shows the result of the pre-planting physic- chemical analysis of the soil studied. The soil was clay and acidic. The values of all the basic elements; total nitrogen, available phosphorus, potassium, calcium and magnesium of the experimental soil were below the critical values. Farmers in this area are practicing block farming and are engaged in continuous cropping system for commercial vegetable production, notably *Amaranthus* species,

Telfaria occidentalis and *Telanium triangulare*. The farming practice consequently has resulted to low availability of soil organic matter as evidenced by value of organic carbon. The continuous cropping system being practiced by farmers with the low organic matter content in the area may have been responsible for the acidity of the soil. Nwaka, (2012) and Esu, (2010) classified the soil in the Guinea Savanna as Alfisols, well drained and strongly acidic. However, after the second year of the trial, post harvest soil analysis showed that the status of some basic elements was enhanced especially in the plots that received *Moringa* leaf extract, (Table 2). The pH of the plots that received *Moringa* Extract increased from 5.4 to 6.4 while in control plots and plots that were treated with N.P.K fertilizer, the pH decreased from 5.4 to 5.3 and 5.2 respectively. The physical properties of the experimental site were not influenced by the application of *Moringa* leaf extract as they remained the same before and after the trials.

Plant height of *Ammaranthus hybridis* as affected by *Moringa* Extract and NPK fertilizer (20:10:10) is shown in Table 3. There were significant differences ($P>0.05$) in plant height values obtained with the application of *Moringa* extract and NPK during the first and second growing seasons. Generally all stands of *Amaranthus* that were sprayed with *Moringa* extract irrespective of time of application showed significant height increases when compared with those grown in the control plots. Application of *Moringa* leaf extract at one week interval increased plant height by 18% in the first trial and by 30% in the second experiment while its application at 2 weeks interval increased plant height by 14% in the first trial and by 27% in the second trial. This significant height increases in *Amarathus* plant with application of *Moringa* extract lent credence to the report of Fuglie (2000) that Fresh *Moringa oleifera* leaves contain a substance known as Zeatin, a cytokinin related hormone which is implicated in regulation of cell division, differentiation and cell

growth. Phiri (2010) reported increase in hypocotyls length of wheat by 14.9% with application of *Moringa. oleifera* leaf extracts. Foidl et al (2001) also reported an improved crop performance in response to application of *Moringa* leaf extracts. Improved growth performance of *Ipomea batata* Sweet potato with application of *Moringa* leaf extracts has also been reported by Anyaegbu, (2016) .
Comparatively, in this study, application of N.P.K (20:10:10) fertilizer at the rate of 50kg ha^{-1} increased the plant height by 20% in the first trial and by 33% in the second experiment while at 100kg ha^{-1}, plant height increased by 23% in the first trial and 36% in the second trial respectively. However greatest height per plant of 48.8cm in the first trial and 46.1cm in the second trial were obtained from *Amaranthus* stands that received a combination of *Moringa* leaf extract and NP.K fertilizer applied at the rate of 50 kg ha^{-1}.(Table 3).

The highest plant height obtained from the above combination may be probably due to favourable nutrient mineralization of this fertilizer as a result of the influence of the mineral component in the *Moringa* leaf extract. The control plants produced the shortest plants as they had to rely on the native soil fertility which from the result of chemical analysis was relatively not fertile.

Table 3 also shows that *Moringa* leaf extracts significantly ($P>0.05$) enhanced the production of leaves and maintained the trend observed in plant height at both first and second planting. Precious, (2006) indicated that zeatin content in *Moringa* leaf extract regulates cell division and stimulates leaf expansion. Changes in the number of leaves are bound to affect the overall performance of *Amaranthus* as the leaves serve as photosynthetic organ of the plant. The increase in root weight suggested that root growth parameters were differentially affected by application of *Moringa* extract.

With respect to the effects of *Moringa oleifera* leaf extract at different times of application and the N.P.K fertilizer on the herbage yield of *Amarnthus hybridis* at first and second planting, all the treatments differed significantly (P < 0.05) from the control (Fig 1). The herbage yield of *Amaranthus* in both first and second trials were in the order, *Moringa* extract at 1 week interval + 50kg ha-1> N.P.K.(20:10:10) 100Kg ha^{-} > *Moringa* Extract at 2 weeks interval + 50kg, ha^{-1} N.P.K > Moringa extract alone at 1 week interval > N.P.K. (20:10:10) 50 kg ha^{-1}>control. Herbage yield was least (p>0.05) without application of fertilizer. This confirmed the findings of Olowoake, (2014), who reported the application of organic,mineral and organomineral fertilizer for enhancement of *Amaranthus cruentus* yield.

Stands of *Amaranthus* treated with *Moringa* extract alone at 1 week interval produced 44% herbage yield over those in the control plots in the first trial and 36% in the second trial while the application alone at 2 weeks interval produced 32% more herbage yield than that obtained in the control plots and 28% in the second trial.
Comparatively, application of N.P.K fertilizer alone produced 38% more herbage yield over that of the control in the first trial and 43% in the second trial while the application at 100 kg ha^{-1} alone produced 61% more herbage yield in the first trial and 60% in the second trial. Thus, the increase in herbage yield with NPK fertilizers application reconfirmed the role of fertilizer in promoting vegetative growth in leafy vegetables, (Tijani-Eniola, et al, 2000).
Highest herbage yields of 17.3 t ha^{-1} in the first experiment and 18.6 t ha^{-1} in the second experiment were obtained when *Moringa* leaf extract was applied in combination with 50 kg ha^{-1} of N.P.K fertilizer.

Perhaps the *Moringa* extract promoted favourable nutrient mineralization of this fertilizer at 50 kg ha^{-1} instead of at 100 kg ha^{-1}.

CONCLUSION

Results of the trial showed that *Moringa oleifera* extract enhanced the status of some basic elements in the soil. pH of the plots that received *Moringa* extract increased from 5.4 to 6.4 while in control plots, the pH decreased from 5.4 to 5.3. Application of *Moringa* extract at one week interval increased plant height by 18% in the first trial and by 30% in the second experiment while its application at 2 weeks interval increased plant height by 14% in the first trial and by 27% in the second trial. Application of N.P.K (20:10:10) fertilizer at the rate of 50kg ha^{-1} increased the plant height by 20% in the first trial and by 33% in the second experiment while at 100kg ha^{-1}, plant height increased by 23% in the first trial and 36% in the second. Highest herbage yields of 17.3 t ha^{-1} in the first experiment and 18.6 t ha^{-1} in the second experiment were obtained when *Moringa* leaf extract was applied in combination with 50 kg ha^{-1} of N.P.K fertilizer. Considering the high cost of chemical fertilizer coupled with the negative effects they have on the soil, underground water and the environment, the use of *Moringa* extracts is a suitable alternative in the production of this vegetable although as seen in the result of this study, its combination with N.P.K fertilizer at a rate as low as 50 kg ha-1 gave best performance of the vegetable crop.

Table 1: Pre-planting physicochemical properties of the soil in the Experimental site

Elements	Values
Clay	38%
Silt	14%
Sand	50%
Textural class	Clay loam
pH (ratio 1:2:5)	5.4
Organic carbon	2.3%
Total nitrogen	1.15%
Available phosphorus	32.0ppm
Exchangeable cations ($cmolkg^{-1}$)	
Ca	2.8
Mg	1.42
K	1.12
Na	1.36

Table 2: Physio chemical properties of the soil as influenced by *Moringa oleifera* leaf Extract and N.P.K (20:10:10) Fertilizer.

Treatments	Soil Proprties										
	pH	org.C	N	P	K	Mg	Ca	Na	Sand	Silt	Clay
		< g/kgha^{a-1}>		ppm ←		Cmol kg^{-1}		>			
Control – No *Moringa* extract and no fertilizer,	5.3	1.31	0.3	25.2	0.4	0.7	1.6	1.87	50	16	34
Moringa Extract at 2 weeks interval + 50kg, ha^{-1} N.P.K	5.7	1.50	1.8	18.9	1.2	1.3	1.7	0.81	48	16	33
Moringa extract at 1 week interval + 50kg ha-1	6.3	2.21	1.2	18.8	1.5	1.40	2.0	1.0	48	16	34
Moringa extract alone at 1 week interval,	6.4	1.4	1.1	12.8	1.4	1.33	2.0	0.76	49	16	33
N.P.K. (20:10:10) 50 kg ha^{-1}	5.3	1.1	2.0	28.6	1.1	1.02	1.8	1.4	48	16	35
N.P.K.(20:10:10) 100Kg ha^{-}	5.2	0.8	1.6	30.5	1.2	0.97	1.5	1.2	48	16	33

Table 3: Growth Characters of *Amaranthus hybridus* as influenced by Moringa oleifera leaf Extract

Treatments	Growth Characters Height/No. of leaves/Fresh Root wt					
	Plant (cm)		plant		(g)/plant	
	A	B	A	B	A	B
Control – No *Moringa* extract and no fertilizer,	28.2g	20.4g	72f	53.1g	18.5f	10.1f
Moringa Extract at 2 weeks interval + 50kg, ha^{-1} N.P.K.	33.4f	30.2f	125.7c	123.2c	27.1d	24.3d
Moringa extract at 1 week interval + 50kg ha-1	48.8a	46.1a	162.5a	159.7a	39.7a	33.4a
Moringa extract alone at 2 weeks interval	37.2e	35.5e	108.4e	98.6f	22.6e	20.4e
Moringa extract alone at 1 week interval,	40.6d	38.5d	110.2d	106.6e	28.2d	20.3e
N.P.K. (20:10:10) 50 kg ha^{-1}	42.5c	40.2c	123.4c	118.5d	30.9c	28.5c
N.P.K.(20:10:10) 100Kg ha^{-}	45.1b	43.7b	154.3b	150.9b	33.2b	30.6b

Means having the same letters along the columns are not significantly different, DMRT (P>0.05)

A = First Experiment

B = Second Experiment

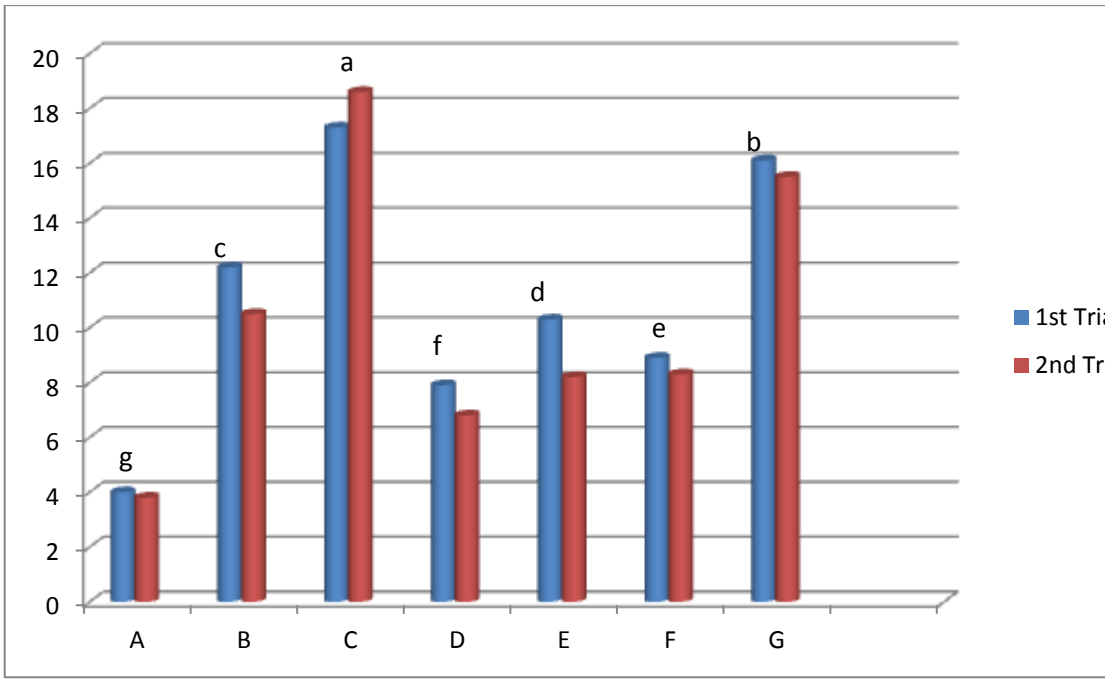

Fig1, Herbage yield (t ha^{-1}) of *Amaranthus hybridis* as influenced by *Moringa oleifera* leaf extract and N.P.K (20:10:10)

(a --- g are levels of significance, DMRT, P>0.05)

A = Control – No *Moringa* extract and no fertilizer,

B = *Moringa* Extract at 2 weeks interval + 50kg, ha^{-1} N.P.K.

C = *Moringa* extract at 1 week interval + 50kg ha-1

D = Moringa extract alone at 2 weeks interval

E = Moringa extract alone at 1 week interval,

F = N.P.K. (20:10:10) 50 kg ha^{-1}

G = N.P.K.(20:10:10) 100Kg ha^{-}

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