Evaluation of Mixture Productivity and Economic Profit of Inter Cropped Garden Egg and Okra as Influenced by Application of *Moringa oleifera* Extracts, Poultry Manure and N.P.K Fertilizer in Cropping Systems of Farmers in North Central Nigeria.

Anyaegbu Polycarp Ozobia
anyaegbupoly@yahoo.com

Abstract

The plant height of Okra was significantly (p> 0.05) greater under intercropping than in sole cropping. The highest plant height, number of leaves and leaf area per plant were obtained from stands of Okra that were treated with aqueous foliar spray of Moringa extracts though not significantly (p>0.05) different from those that received poultry manure and N.P.K fertilizer. The growth parameters of garden egg were not significantly (p>0.05) affected by intercropping in both 2012 and 2013 respectively. Stands of Okra applied with Moringa oleifera extracts under sole cropping system produced 76% and 70% more pods than the stands in the control plots in 2012 and 2013 while those under intercropping produced 76% and 74% than those in the control plots in 2012 and 2013 respectively. Also in 2012 and 2013, the pod yield of okra treated with Moringa extracts was 90% and 86% greater than those in the control plots under sole cropping situations while under inter cropping it was 90% greater than the control. Intercropping depressed number of pod per plant in 2012 by 4% and 2013 by 2% while pod yield was depressed in 2012 and 2013 only by 6% respectively. Like in Okra, the fruit production of garden egg was significantly (p>0.05) influenced by Moringa oleifera extracts. The highest fruit yield was recorded from stands treated with Poultry manure although not significantly different from those given N.P.K. fertilizer and aqueous Moringa leaf extracts. The Land Equivalent Ratio (LER) values of the okra/garden egg intercrops except those of the control plots were greater than unity in both years of cropping. On the average, the LER of the intercrops that were applied with Moringa eatracts in 2012 and 2013 were 1.44 and 1.46, indicating 44% and 46% yield advantage over the sole crops. There is economic prospect in the use Moringa extracts in the production of okra and garden egg under both cropping systems.

Keywords: Okra, Garden egg, *Moringa oleifera*, NPK fertilizer, cropping systems, Land Equivalent Ratio

Introduction

Any system of cropping that can increase the rate of crop yield and lower the cost of production will provide economic opportunity for farmers. Intercropping has been identified as a promising system that results in an effective use of land and other resources (*Remison, 1982b*), efficient utilization of water and soil nutrients(*Sharma et al., 1979*) and reduction in the cost of production (*Bijay et al., 1978).* It has also gained wide acceptability among farmers in tropical countries (*Norman, 1970; Okigbo and Greenland, 1976; Willey,1979*) because of its economic advantages (Ilobinso1976*; Baker, 1979; Dittoh; 1985, Adeniyi; 1988, 1990)*resulting from the symbiotic association of legumes intercropped with other crops(*Enyi, 1973; Dalal, 1974;Haizel, 1974; Ahmed and Gunasema, 1979).* The system, (*Wolfe, 2000*) allows complementary interaction of component crops that have greater system resilience, reduce disease transfer, (*Wolfe2000* and deliver environmental benefits such as soil and water conservation,(*Gilley et al 2002).*

Statistics has shown that 60% of Okra grown in Nigeria are produced under intercropping system,(*Ofosu and Lambert,2007*; Ijoyah and *Jimba,2011*). In the North central zone of Nigeria especially the Federal Capital Territory (FCT), Abuja, majority of the farmers grow most of their arable crops under sole cropping situation. Some however practice block farming; a situation where a piece of land is divided into blocks and sole cropping is done in each block. However few of the farmers, especially non indigenes who migrated from the Southern part of the country and settled in FCT for farming, practice intercropping systems. Presently a greater number of the indigenous farmers have embraced inter cropping system as a result of concerted efforts of the Agricultural Development Program me (ADP) through extension service programmes and short term training mounted by Federal Ministry of Agriculture and International Institute of Tropical Agriculture, (IITA), Abuja.

Presently the pressure on land in FCT for urbanization and other infrastructural development is significantly affecting the available land area for farming; hence it becomes imperative for the farmers to adopt intercropping as the major cropping system in FCT. *Tariah and Wahua, (1985)* indicated that land use is maximized by growing many crops on the unit of land. Garden egg and Okra are among the major vegetable crops being grown in the FCT under sole cropping situation. Garden egg is greatly consumed in the FCT and represents the main source of income by producing households. Giri junction in FCT, Abuja, located along Zuba/Lokoja road is a very popular international market for garden egg and okra respectively. Travelers to the southern part of the country buy in large quantities, tones of garden egg fruits and okra either for sale or for different forms of celebrations.

The farmers, mostly subsistence farmers, have been maintaining sustained productivity of both crops in the FCT. Thus farmers' effort needs to be encouraged especially by looking for a cheap alternative means of soil fertility maintenance. *Anyaegbu,(2013*), reported that while farmers in the FCT spend 20% for purchase of inorganic fertilizers, 15% percent goes into weed control.
Moringa oleifera is one of such alternative for soil fertility maintenance being investigated to ascertain its effect on growth and yield of crops and thus can be promoted among farmers as a possible supplement or substitute to inorganic fertilizer,(*Phiri, 2010)*.

Therefore the trial was designed to assess the effect of *Moringa oleifera* extracts on garden egg and Okra production under intercropping and sole crop situations, looking into the mixture productivity of the crops and evaluating the economic profit of using *Moringa oleira* as an alternative to NPK fertilizer in the production of garden egg and okra.

Materials and Method

The study, an on – farm trial was carried out at Giri, Federal Capital Territory (FCT), Abuja, Nigeria during the planting seasons of 2012 and 2013 respectively. The study area (8^0 21'N and 6^O 25'E), falls within the Guinea Savannah agro ecological zone of Nigeria. The metrological information of the area during the planting season showed an average temperature of 33^0C, 14% humidly and annual rainfall 1300 – 1600mm. The experimental site was under one year fallow following *Ipomea batata* sole cropping. In each year the experimental site was cleared manually and land preparation done according to the traditional farming system of the area, (clearing, burning of stubborn grasses, herbs and packing). Following land preparation, the experimental layout of Randomized Complete Block Design (RCBD) with 3 replications was established. Each replicate contained 18 plots and a plot measured 2 x 2m separated from each within the replicate with a 0,5m pathway and between replicates by one meter alley. Thus a total of 54 plots were used in the study.

Prior to planting, soil samples for proximate soil analysis to determine the initial nutrient status of the soil were collected within 0 -15cm and 15cm – 30cm. After harvest, soil samples were collected to assess the effects of the *Moringa oleifera* extracts, N.P.K fertilizer and poultry manure on the soil properties. Each composite was air dried and sieved through a 2mm mesh before the chemical analysis, (Tables 3 and 4). Soil pH was determined at the ratio of 1:1 in distilled water. The pH in the 1MKCL solution was also determined.

Garden egg seedlings were first raised in temporary nursery prior to the period of planting. Planting of both crops was done simultaneously at the first week of April. Planting spacing for both crops in both sole crop and intercrop plots was 50cm x 50cm giving a population of 40,000 stands per hectare. Thus a sole crop plot of either *Solanium* or *Abelmoschus esculentus* contained 25 stands while the inter crop plot contained 50 stands. The experimental treatments of which effects were estimated include, Factor A; Cropping Systems, (Sole crop *Solanium*, sole crop *Abelmoschus*, and intercropping of *Solanium* and *Albelmoschus*) and Factor B; (Aqueous solution of *Moringa* leaves and twigs, Solid extracts of *Moringa* leaves and twigs, Solution from the decoction of the *Moringa* barks and cut branches, N.P.K. (200 Kg ha^{-1}) Poultry droppings of layers (5 t ha^{-1}) as recommended by *Anyaegbu* (2013) and Control). The various treatment were factorially organized and fitted into the Experimental Design (RCBD) used in the trial. The treatment combinations (18) used in the trial include; Sole crop Okra/ Aqueous solution of leaf extract, sole crop Okra/ solid leaf extracts, sole crop Okra/ Bark decoction, sole crop Okra/ N.P.K., Sole crop Okra/ Control, Solecrop Garden egg/ Aqueous solution of leaf extract, Sole crop Garden egg/ Solid leaf extract, Sole crop Garden egg/ Bark decoction, Solecrop Garden egg/ N.P.K., Sole crop Garden egg/ Control, Inter crop (garden egg+ Okra)/ Aqueous solution of leaf extract, Inter crop (Garden egg+ Okra)/Solid leaf extract, Inter crop/Bark decoction, inter crop/N.P.K., and Inter crop/ Control. The inclusion of N.P.K. fertilizer and Poultry manure was to compare their individual effects with those of *Moringa* extracts.

The Aqueous solution of *Moringa* leaf extract was prepared by pounding measured quantity of *Moringa* leaves and twigs in a mortar. For each bundle of 2 kg crushed 20 liters of water was poured into it, stirred properly for about 5 minutes and allowed to stay for 30 minutes and then filtered by placing in a pot and wringing out the liquid. The solid substance left after filtration was also kept as experimental treatment, (Solid extract). For bark and cut stem decoction, the barks of the felled stands of *Moringa* and cut branches (4kg) were cut into smaller bits, put into a bowl of water (20 liters) and allowed to stay for 48 hours.

In treatment application, for plots receiving poultry manure, application was done 4 days before planting to allow the manure to set properly. Each plot received 2 kg of the manure. For Foliar application, the aqueous solution of the leaves and twig extracts was sprayed evenly on the stands from the tip to the base of the plants. 10 liters of the aqueous solution was sprayed per plot at two weeks interval until the plants started fruiting and then once in 3 weeks during the fruiting period. For the stands receiving the solution obtained from the decoction of the barks and cut branches 10 liters of the solution was poured evenly at the base of the stands in the plot at two weeks interval until fruiting commenced and at 3 weeks interval until the trial was called off. In solid leaf extract application. Each stand received a heap of the extract around it, 2cm away from the base and in 10cm radius. The process was repeated as done in the foliar application. In N.P.K. application, each plot received 0.08kg of the fertilizer.
In all control plots, no application was done in them.

Data taken for okra included plant height at flowering (measured at the distance from the soil surface to the tip of the top most leaf), number of leaves /plant, leaf area at 50% flowering (determined by the length – width method as described by *Wahua 1985*), number of pods/plant and fruit yield. Data taken for *Solanium melongina* included plant height at flowering, number of leaves per plant, leaf area per plant, number of fruits/plant and fruit yield. Data on pre-planting soil analysis and post harvest analysis, Land Equivalent Ratio (LER), Land Equivalent Coefficient (LEC) and Gross margin analysis were also collected. All data were statistically treated using the analysis of variance (ANOVA) for Randomized Complete Block Design (RCBD), $Xij = \mu + Ti + \beta j + \sum ij$; where Xij = Trial SS, μ = Population mean = 0, Tij = Experimental Treatment effects, βij = Block effect and $\sum ij$ = Error terms. Duncan's Multiple Range Test (DMRT >0.05) was used for treatment separation. Land Equivalent Ratio (LER) and Land Equivalent Co efficient (LEC) were determined as described by Willey (1985) using the formula;

$$LER = \frac{\text{Intercrop yield of crop A}}{\text{Sole crop yield of A}} + \frac{\text{Inter crop yield of crop B}}{\text{Sole crop yield of crop B}}$$

$$LEC = \frac{\text{Intercrop yield of crop A}}{\text{Sole crop yield of A}} \times \frac{\text{Inter crop yield of crop B}}{\text{Sole crop yield of crop B}}$$

Results and Discussion

Table 1 shows the mineral contents of the *Moringa oleifera* parts used in the trial and Table 2, the chemical properties of the Poultry droppings of 48 weeks old layers. From the analysis, there is an indication that the various parts of the plant contained high amount of both macro and micronutrients apart from the carbon and hydrogen components of the organic matter. Thus from the pre planting and post harvest soil analyses as compared with the

control, there is an increase in the mineral content of the soil as a result of the application of the *Moringa* extracts which in turn improved the growth performance of the crops. A report by *FAO (2010*) suggested that the use of organic fertilizers derived from *Moringa oleifera* seed processed with the right procedure can increase the density and richness of indigenous invertebrates, specialized endangered soil species, beneficial arthropods, earthworms, symbionts and microbes. *Anyaegbu, et al (2013*) had earlier reported that after the nutrient up- take by the plants, the nutrient status of the soil including the soil pH remained higher than its original status prior to planting. Their report was exactly in line with the results of this study on the fertility status of the soil. Higher contents of the macro and micro nutrients recorded in the plots applied with poultry manure also indicate that the soil was significantly improved by the application. *Hussein (1996*) had earlier reported that application of poultry manure increased soil pH, organic matter and available phosphorous, microbial activity in the nutrient metabolism. The soil pH in plots treated with N.P.K fertilizer was considerably low compared with the areas that received *Moringa* extracts and poultry manure.
Remarkably the nutrient status of the soil after post harvest analysis was higher in the sole crop plots than in the intercrop plots. In the intercrop plots, as the two crops were growing on a unit of land unlike in the sole crop, they would compete favourably for the available nutrients and by operating on different trophic levels, the volume of the nutrients depleted in the intercrop plots would definitely be higher than that taken from the sole crop plots. The nutrient status of the soil was extremely poor in the control plots especially after harvest as observed in the control plots of the inter crop plots.

The growth parameters of Okra as influenced by *Moringa oleifera* extracts,Poultry and N.P.K fertilizer in both inter cropping and sole cropping situations is shown in Table 5 while that of Garden egg is shown in Table 6. The plant height of Okra was significantly ($p > 0.05$) greater under intercropping than in sole cropping. The greater population of plants under intercropping and competition for light and other growth resources might have induced higher plant growth of Okra. Although the number of leaves per plant was not significantly ($p>0.05$) affected by intercropping, the leaf area per plant was significantly ($p>0.05$) greater in sole crop stands than in the intercropped stands. This might be competitive effect for growth resources when both crops were in a mixture. Garden egg could have exhibited shading effect on Okra due to its branching systems. *Muoneke and Mbah (2007*) in their work on productivity of cassava/okra intercropping systems, reported that the reduction in Leaf Area Index of intercropped cassava stands was due to reduction in their surface leaf area even with more leaf production.

Conversely the growth parameters of garden egg were not significantly ($p>0.05$) affected by intercropping in both 2012 and 2013 respectively. This implied that the inter specific competition between the two crops did not affect garden egg significantly. Irrespective of the cropping systems, the highest plant height, number of leaves and leaf area per plant were obtained from stands of Okra that were treated with aqueous foliar spray of *Moringa* extracts though not significantly ($p>0.05$) different from those that received poultry manure and N.P.K fertilizer. This was followed by those stands that were treated with solid leave extracts and solution from *Moringa* bark decoction. The aqueous foliar spray on the leaves would be assimilated directly in to tissues of the affected plants and hence trigger off immediate and enhanced vegetative development of the plants. The vegetative growth of both crops was also improved with the application of solid leaf extracts and the solution from the bark decoction. The results obtained on the vegetative growth of okra as influenced by the *Moringa* extracts (Table 5) were similar to that of garden egg, (Table 6).
The effects of the *Moringa oleifera* extracts, Poultry manure and N.P.K. fertilizer on the yield and yield components of Okra and Garden egg in both cropping systems and years (2012 and 2013) of cropping were significant ($p>0.05$), Tables 7 and 8. Stands of Okra applied with *Moringa oleifera* extracts under sole cropping system produced 76% and 70% more pods than the stands in the control plots in 2012 and 2013 while those under intercropping produced 76% and 74% than those in the control plots in 2012 and 2013 respectively. Also in 2012 and 2013, the pod yield of okra treated with *Moringa* extracts was 90% and 86% greater than those in the control plots under sole cropping situations while under inter cropping it was 90% either way. *Rao et al (1983*) reported that juice extracted from the leaves of *Moringa oleifera* can be used to make foliar nutrient capable of increasing crop yield by 38%. *Anyaegbu,(2013*) reported enhanced growth performance of *Telfaria occidentalis* with the application of *Moringa* extracts. Intercropping depressed number of pod per plant in 2012 by 4% and 2013 by 2% while pod yield was depressed in 2012 and 2013 only by 6% respectively. The results implied that inter cropping did not significantly ($p > 0.05$) influence yield of okra.

Similarly, intercropping did not affect the fruit production and fruit yield of Garden egg, (Table 8). Like in Okra the fruit production of garden egg was significantly (p>0.05) influenced by *Moringa oleifera* extracts. However, the highest fruit yield was recorded from stands treated with Poultry manure although not significantly different from those given N.P.K. fertilizer and aqueous *Moringa* leaf extracts. The superiority of poultry manure has been confirmed by *Hsich and Itsu (1993*) and *Jinadasa et al* (1997). The yields of both crops in the control plots were greatly poor and this was an indication that the soil nutrients had been seriously depleted due to continuous cropping in the area.

The mixture productivity of okra and Garden egg as influenced by *Moringa* extracts , poultry manure and N.P.K. fertilizer is shown on Table 9. Generally the effects of the treatments when compared with the controls were significant, (p>0.05). The Land Equivalent Ratio (LER) values of the okra/garden egg intercrops except those of the control plots were greater than unity in both years of cropping. While the yield advantage in this study ranged from 36% to 55% in 2012, it ranged from 36% to 60% in 2013. On the average, the LER of the intercrops that were applied with *Moringa* eatracts in 2012 and 2013 were 1.44 and 1.46, indicating 44% and 46% yield advantage over the sole crops. In the control plots, the LERs of 0.8 in 2012 and 0.7 in 2013 signified very poor performance of the crops, an indication that the soil in the area needs amendment. Thus using extracts from any part of *Moringa* plant will help immensely in boosting the fertility of the soil hence increased crop yield. However highest LER of 55% in 2012 and 60% in 2013 were recorded from stands that were given poultry manure. The superiority of poultry manure over other experimental treatments may be due to its higher nitrogen contribution.
To additionally evaluate the mixture productivity of the mixture, LEC, was used in this study, Table 9. As explained by *Adetiloye, et al (1982*), a LEC of 0.25 is the minimum expected value from a mixture before a yield advantage is declared. Oder wise in addition to yield disadvantage of the mixture, the neighborhood effect between them is highly competitive. In this study, the LEC ranged from 0.23 in the control plots to 0.78 in poultry treated inter crops in 2012 and from 0.21 to 0.77 in 2013. The above minimum expected value of LEC which signified good neighborhood effects or competitive complimentarity, obtained from okra/garden egg mixtures given *Moringa* extracts confirmed the assertion that *Moringa oleifera* is a fertility crop. *Jason (2013*), noted in his write- up that *Moringa* leaf extract contains a plant growth hormone called Zeatin which has been reported to increase yields by 25 – 30% for nearly any crop. Jason added that the compound leaves and stems of *Moringa* make excellent fertilizer.

Economically the Benefit Cost Ratio in all control plots was less than those that were treated with *Moringa* extracts, poultry manure and N.P.K fertilizer respectively, (Table 10). This indicates that using *Moringa* extracts as fertilizer is economically acceptable. Thus while a farmer makes a gain of ₦11.6, ₦8.9 or ₦11.8 for every one kobo when he used *Moringa* extracts as fertilizer, he incurs a loss of ₦- 2 for every kobo he invested without improving the soil fertility of the farm.

Table1. Proximate Analysis of Parts of *Moringa oleifera* used in the study per 100 gram.

Components	Fresh Leaves	Bark Powder
Moisture (%)	75.0	45.4
Calories	92	35
Protein (g)	6.7	5.8
Fats (g)	1.7	0.8
Carbohydrate (g)	13.7	5.3
Fiber (g)	0.9	23.3
Ca(mg)	440	1,221
Cu(mg)	1.1	0.87
Fe (mg)	7.0	19.8
K(mg)	259	456

Mg (mg)	24	25
P(mg)	70	136
S(mg)	137	23

Table 2. Chemical Properties of the Poultry Manure used in the study

Element	Percentage(%)
Magnesium	1.95
Calcium	6.96
Phosphorus	1.30
Sodium	0.62
Nitrogen	1.37
Potassium	0.52
Organic Carbon	27.2
Organic matter	50.5
Carbon- Nitrogen Ratio	19.8

Table 3. Pre – planting Soil physic –chemical properties of the experimental site in 2012 and 2013.

Parameters	Value
pH in water (1:2.5)	5.4
% Organic matter	0.55
% Nitrogen	0.41
P(ppm)	6.20
K (Cmol kg^{-1})	0.45
Ca (Cmol kg^{-1})	0.48
Mg (Cmol kg^{-1})	2.15
Na (Cmol kg^{-1})	1.14
Clay (%)	28.5
Silt (%)	14.3

Table 4. Soil physic- chemical Properties of the Experimental Site after harvest in 2012

		Parameters									
Cropping Systems	Applications	pH	N	P	K	Ca	Mg	Na	OM	Clay	Silt
	Foliar	5.6	0.43	7.2	0.47	0.51	2.41	0.87	0.52	28.5	14.3
	Solid leaf extract	6.3	0.45	7.4	0.48	0.56	2.45	0.56	0.66	28.5	14.3

Sole Okra	Bark decoction	6.3 0.46 7.1 0.54 0.57 2.40 0.56 0.54 28.3 14.2
	N.P.K	5.1 0.45 8.6 0.59 0.31 1.87 1.12 0.46 28.2 14,4
	Poultry	6.5 0.57 9.1 0.64 0.61 2.23 0.56 0.66 28.1 14.4
	Control	5.0 0.26 4.5 0.34 0.47 1.18 1.32 0.26 28.4 14.5
	Foliar	5.4 0.42 7.0 0.45 0.48 2.38 0.81 0.51 28.1 14.1
Sole Garden egg	Solid leaf extract	6.2 0.46 7.4 0.46 0.57 2.43 0.55 0.64 28.4 14.3
	Bark decoction	6.3 0.44 6.8 0.48 0.53 2.33 0.55 0.52 28.2 14.1
	N.P.K.	5.0 0.47 7.8 0.56 0.37 1.76 1.12 0.46 28.3 14.2
	Poultry	6.4 0.56 8.6 0.62 0.58 2.11 0.55 0.64 28,1 14.0
	Control	5.0 0.24 4.2 0.33 0.44 1.16 1.33 0.24 28.1 14.2
	Foliar	5.3 0.38 6.5 0.42 0.47 2.14 0.81 0.48 28.1 14.1
	Solid leaf extract	6.3 0.54 6.3 0.43 0.45 2.10 0.68 0.58 28.1 14.3
Inter crops	Bark decoction	6.4 0.47 7.4 0.42 0.46 2.08 0.67 0.48 28.3 14.0
	N.P.K.	4.8 0.52 9.87 0.54 0.46 2.13 1.01 0.38 28.3 14.32
	Poultry	6.2 0.50 7.12 0.48 0.45 1.87 0.62 0.59 28.3 14.21
	Control	5.0 0.38 5.52 0.33 0.41 1.76 1.69 0.32 28.2 14.22

Table 5. Growth parameters of Okra as influenced by *Moringa* extracts in both sole and Intercropped with Garden egg in 2012 abd2013.

Cropping Systems	Applications	2012 Height(cm)/ plant	2012 No. of leaves/ Plant	2012 leaf area/ (cm^2) plant	2013 Height(cm)/ plant	2013 No. of leaves/ plant	2013 Leaf area (cm^2)/ plant
	Foliar	80.5a	14.6a	220.2a	75.8b	14.8a	146.07
	Solid leaf extract	78.3b	13.8a	189.3c	71.4b	12.3a	151.6 c
Sole Okra	Bark decoction	78.9b	11.6b	2I2.5b	74.2b	12.2a	154.8c
	N.P.K	78.6b	12.8a	221.3a	76.2b	13.1a	176.4b
	Poultry	79.2ab	14.8a	223.8a	78.8ab	13.7a	188.5a
	Control	56.7e	9.6c	76.5d	58.4c	6.4b	55.8
	Mean	**75.4**	**12.9**	**190.6**	**72.6**	**12.1**	**145.53**
	Foliar	83.1a	14.3a	187.6c	83.1a	14.6att	140.7
Inter crop Okra	Solid leaf extract	71.2c	12.8a	209.4b	80.3a	13.0a	155.9c
	Bark decoction	75.5c	13.6a	215.9b	73.7b	12.7a	154.3c
	N.P.K.	80.3a	13.2a	212.1b	81.4a	13.5a	169.8b
	Poultry	82.6a	14.9a	218.8b	80.5a	13.9a	182.6a
	Control	61.4d	8.6c	47.9e	60.1c	7.9b	52.8
	Mean	**75.7**	**13.1**	**182.0**	**76.5**	**12.6**	**142.27**
	DMRT (P>0.05)						

Values bearing the same letters (a – f) in each column are not significantly different, DMRT($p>0.05$)

Table 6. Growth parameters of Garden egg as influenced by *Moringa* extracts in both sole and intercropped with Garden egg in 2012 abd2013.

Cropping Systems	Applications	2012 Height (m)/ plant	2012 No. of leaves/ Plant	2012 leaf area/ (cm^2) plant	2013 Height(cm)/ plant	2013 No. of leaves/ plant	2013 Leaf area (cm^2)/ plant

	Foliar	2.15a	38.4a	2.61a	2.12a	34.8b	2.37a	
	Solid leaf extract	1.14c	31.7b	2.22b	1.20b	33.3b	2.04ab	
Sole	Bark decoction	1.43b	36.4ab	2.23b	1.33b	33.2b	2.11b	
Garden egg	N.P.K	2.10a	38.7a	2.69a	2.02a	35.1b	2.48a	
	Poultry	2.22a	40.2a	2.81a	2.33a	38.7a	2.50a	
	Control	0.65d	12.5c	0.74c	0.68c	10.4c	0.66c	
	Mean	**1.62**	**32.32**	**2.15**	**1.61**	**25.37**	**1.94**	
	Foliar	2.11a	32.8	187.6	2.13a	33.6	2.09a	
Inter crop	Solid leaf extract	1.09c	37.2a	2.57a	1.18b	38.4b	1.92b	
Garden egg	Bark decoction	1.43b	35.3bc	2.21b	1.	32b	34.8b	1.47b
	N.P.K.	2.11a	37.8a	2.66a	2.16a	38.8a	1.89a	
	Poultry	2.09a	39.6a	2.84a	2.18a	40.1a	2.14a	
	Control	0.61d	11.3c	0.71c	0.70c	12.2c	0.61c	
	Mean	**1.57**	**26.37**	**1.83**	**1.61**	**26.38**	**1.21**	
	DMRT (P>0.05)							

Table 7. Yield and Yield Components of Okra as influenced by *Moringa* extracts in both sole and
intercropped with Garden egg in 2012 abd2013.

		Parameters				
		2012		2013		
Cropping Systems	Applications	No. of pods/ plant	Pod yield (t ha^{-1})	No. of pods/ plant	Pod yield (t ha^{-1})	
	Foliar	14.4a	5.2a	14.8a	4.8a	
	Solid leaf extract	12.2c	4.4b	10.3c	3.2b	
Sole	Bark decoction	14.5a	4.8ab	12.2b	4.6a	
Okra	N.P.K	14.9a	5.1a	14.6b	5.0a	
	Poultry	15.3a	5.3a	14.8b	5.1a	
	Control	5.6d	0.8d	6.7d	0.9c	
	Mean	**12.8**	**4.3**	**12.2**	**3.9**	
	Foliar	13.3b	4.5b	12.3b	4.1a	
Inter crop	Solid leaf extract	12.2c	3.3c	10.2c	3.2b	
Okra	Bark decoction	13.3b	4.2b	12.5b	3.4b	
	N.P.K.	13.3b	4.8ab	14.4a	4.2a	
	Poultry	13.5b	5.0a	14.9a	4.6a	
	Control	5.1d	0.7d	5.4e	0.6c	
	Mean	**11.8**		**3.8**	**11.6**	**3.4**
	DMRT (P>0.05)					

Table 8. Yield and Yield Components of Garden egg as influenced by *Moringa* extracts in both
Sole and intercropped with Okra in 2012 and 2013.

		Parameters			
		2012		**2013**	
Cropping Systems	Applications	No. of fruits/ plant	fruit yield (t ha^{-1})	No. of fruits/ plant	fruit yield (t ha^{-1})

	Foliar	14.2a	4.8a	11.8b	4.8a
	Solid leaf extract	10.7c	3.4b	10.3c	3.2c
Sole	Bark decoction	13.0b	4.8a	12.2b	4.6a
Garden egg	N.P.K	14.4a	5.1a	13.6a	5.0a
	Poultry	14.8a	5.3a	13.8a	5.1a
	Control	5.6d	0.5c	6.7d	0.9e
	Mean	**12.1**	**4.0**	**11.6**	**3.9**
	Foliar	14.6a	3.6b	12.4b	4.2b
Inter crop	Solid leaf extract	11.8c	3.2b	10.5c	2.7d
Garden egg	Bark decoction	14.5a	3.6b	13.2a	3.8b
	N.P.K.	14.2a	4.8a	13.6a	4.8a
	Poultry	14.8a	5.0a	13.9a	5.0a
	Control	4.6e	0.2c	6.5d	0.4f
	Mean	**12.35**	**3.4**	**12.18**	**3.5**
	DMRT (P>0.05)				

Table 9. Mixture Productivity of Okra and Garden egg as influenced by *Moringa oleifera* extracts and cropping systems in 2012 and 2013.

		Parameters			
		2012			2013
Cropping Systems	Applications	LER	LEC	LER	LEC
	Foliar	1	-	1	-
	Solid leaf extract	1	-	1	-
Sole	Bark decoctions	1	-	1	-
Okra	N.P.K	1	-	1	-
	Poultry	1	-	1	-
	Control	1	-	1	-
	Foliar	1	-	1	-
Sole	Solid leaf extract	1	-	1	-
Garden egg	Bark decoction	1	-	1	-
	N.P.K.	1	-	1	-
	Poultry	1	-	1	-
	Control	1	-	1	-
	Foliar	1.52	0.72	1.51	0.74
	Solid leaf extract	1.36	0.65	1.36	0.70
Inter crops	Bark decoction	1.44	0.76	1.52	0.76
	N.P.K.	1.53	0.77	1.52	0.77
	Poultry	1.55	0.78	1.60	0.81
	Control	0.8	0.23	0.7	0.21

Table 10. Economic analysis of the performance Okra and Garden egg as influenced by *Moringa oleifera* extracts under different cropping systems . Average of 2012 and 2013 trials

Cropping Systems	Applications	Total Revenue '000(N)	Variable Cost (N) '000	Gross Margin (N)'000	Benefit Cost Ratio (BCR)
	Foliar	171	31	140	4.5
	Solid leaf extract	164	31	133	4.3
Sole	Bark decoctions	185	31	154	5.0

Okra	N.P.K	186	33	153	4.6
	Poultry	188	34	154	4.5
	Control	15	21	-6	-0.3
	Foliar	189	31	158	5.1
Sole	Solid leaf extract	195	31	164	5.3
Garden egg	Bark decoction	201	31	170	5.4
	N.P.K.	216	34	182	5.4
	Poultry	297	36	191	5.3
	Control	17	21	-4	-0.2
	Foliar	402	32	370	11.6
	Solid leaf extract	346	32	284	8.9
Inter crops	Bark decoction	409	32	377	11.8
	N.P.K.	412	38	374	9.8
	Poultry	426	40	386	9.7
	Control	18	23	-5	-0.2

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