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Contents

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Editorial: Personal priorities for organics to realise its potential

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Organics extends the boundaries of food and nourishment, beyond the naïve limits of production and profit – into the less quantifiable and broader areas of quality, values, responsibility, and caring for the wellbeing of all, future generations, the planet and all of life. Thus, to shift from conventional to genuine organic production requires much more than just learning about alternative techniques – it requires the ongoing development of our human potential, and this requires identifying and acknowledging and healing from our psychological wounding, and transforming the maladaptations that have enabled us to survive in a world that values power and control over love and enabling individuals to realise their potential. If organics is to have a future, I believe that it will require those involved to embrace rather than deny and postpone addressing this understanding.

In fact, I think that organics, like all other 'good' alternatives, is being held up and limited in its development by the denial and discomfort associated with discussing and addressing the urgent need for this essential personal and socio-cultural healing and transformation.

A good starting point is to set aside some time to gain a better understanding of relationships and relating: within oneself, with others, with the non-human world, and about the complexities of relationships within that world.

As a researcher, I spent much of my life trying to understand relationships within the soil, and between arthropod pests and their natural controls and other things that can limit them – both areas of enormous complexity, and about which we still have only a very rudimentary knowledge.

Yet, from working with farmers, I found that some were much more successful than others, for example in relating to soils and pests, yet all seemed to have access to roughly the same information. I came to distinguish between what I recognised as information-based 'cleverness' (which could be measured) from experience and intuition-based 'wisdom' (which can't be measured).

So I started to wonder how to enable the development of this kind of wisdom. I noticed that the 'wise farmers' tended to be calmer, more attentive to and interested in whatever was going on around them, especially in nature. They had favourite places in nature, and times of day and times of year. Such discernment requires one to be more at peace within oneself, more fully present in the moment, and open to deep reflection and creative possibilities.

I first observed this in a very preliminary way while being taught gardening by my grandfather, who lived with us in England. He had had a very limited education, but he was impressively wise. I experienced him choosing when, where and how to plant the various crops we grew (which always grew well), with both great 'knowing', yet being unable to explain why! A favourite moment was from when I was only three, and he had exclaimed that "today's the day I'm going to plant the taters (potatoes)" – I, like any small child had asked "why gramps" – he took my hand and we walked out into the garden, and he looked up into the sky and exclaimed "woor", and then gazed at the soil, and uttered "arrr" – and this was his total answer to me! Subsequently I have come to regard this wisdom element (common, from my experience, in all great organic farmers) as the essential 'woor and arrr factor.

Subsequently, when I also trained as a psychotherapist, I recognised these same qualities in individuals who had successfully recovered from past hurts and become more internally integrated as whole beings. And my experience was that everyone can achieve this, but sadly relatively few in the population take the time to do this, and usually only because of experiencing a trauma or other personal difficulty, or because someone else suggests that they do this. I actually first investigated this area only because a colleague, who became depressed when her mother died, went into therapy. Being curious, I decided to go for a single session. I was blown away by my introduction to a whole other world that I was pretty much unaware of – essentially it was the hidden 'me' that I was largely unaware of! I can't say that getting to know the deeper 'me' was easy (and my investigations continue!), but it has been amazingly enriching and has given enormous meaning to my life; and enabled me to be much more helpful to others.

I won't go on about this as I have written about it elsewhere; so I have selected a few of my writings in the bibliography below; and I have listed a few of my favourite psychology references for those who are ready to embark on this journey of investigation into the depths of one's being, which can be more exciting than reading the best detective novels – and the 'endings' (or pauses along the road) are always more personally meaningful! Happy travels.

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Growth and yield of okra (*Abelmoschus esculentus* L.) as influenced by NPK, jatropha cake and organomineral fertiliser on an Alfisol in Ilorin, Southern Guinea Savanna of Nigeria

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Abstract

A field experiment was conducted at Kwara State University, Malete, Ilorin, Nigeria during 2013 growing seasons to study the growth and yield of okra (*Abelmoschus esculentus*) as influenced by NPK, jatropha cake and organomineral fertiliser on an Alfisol in Ilorin. The four treatments tested were; control, NPK, jatropha cake and organomineral fertiliser. The treatments were replicated three times in a randomised complete block design. Each treatment was applied at 100kg N/ha. The experiment lasted for over three month crop cycles. The parameters assessed were significantly influenced ($p<0.05$) by the applied fertilisers. Results of the experiment indicated that applications of organomineral Grade A fertiliser significantly ($p< 0.05$) increased plant height, stem girth, number of leaves, number of flower per plant, fruit weight and fruit yield as compared to NPK, jatropha cake and control. Okra fruit weight values obtained from organomineral Grade A, NPK and jatropha cake were 235.3, 207.7 and 157.7g respectively. Fruit yield values obtained from organomineral Grade A (6.53 t/ha) was also significantly ($p< 0.05$) higher than that of NPK values (5.75 t/ha). Although mineral fertiliser is cost effective, it is difficult to procure and cannot substantially redress the physical fragility of the soil. However, organomineral Grade A and jatropha cake are cheap, readily available and environmentally friendly as fertilizers. In conclusion, this study showed that organomineral Grade A applied at 100 kg N/ha could be effectively used as alternative to mineral fertiliser in growing okra on an Alfisol of Ilorin, Nigeria.

Keywords: *Abelmoschus esculentus*, fertiliser, growth, jatropha, yield.

Introduction

Okra, *Abelmoschus esculentus* (L) (Moench), is a multipurpose-use crop of the family of Malvaceae. It is grown in all agro-ecological zones in Nigeria mainly for its immature fruits, which is eaten as a cooked vegetable or added to soups and stews as a thickener (Tindale, 1983, Akanbi, 2002). Leaves, buds and flowers are also edible. Dried seeds are nutritious foods, with up to 20% protein (Martin et al., 1981). Okra is often grown continuously on the same piece of land, especially near urban centres. This leads to loss of soil fertility, reduced nutrient uptake and drastic fall in yield.

Most farmers in the tropics have adopted the use of mineral fertilisers, but the intensive use of this over time could constitute a setback to soil fertility (Phicot, et al., 1981, Isherwood, 2000). Another major limitation to the usage of chemical fertilisers is due to the adverse effects they have on plant quality and disease susceptibility. A continual dependence on chemical fertilisers may be accompanied by a fall in organic matter content, increased soil acidity, degradation of soil physical properties and increased rate of erosion due to instability of soil aggregates (Olowoake & Ojo, 2014).

However, the supply of inorganic fertiliser is inadequate and the farmers lack sufficient money to procure the fertiliser and, when supplied, the supply is often late. Inorganic fertilizer costs and the other constraints deter farmers from using them in the recommended quantities and in balanced proportions (Babatola et al., 2002). Unlike inorganic fertiliser, some organic fertilisers are cheap, easy to come-by, generally safe to use, are not poisonous and may be environmentally friendly. However, they must be applied to the crop in large quantities because the nutrient concentration is very low compared with inorganic fertiliser which would definitely result to high transportation cost of manure materials.

The prospect of obtaining enough chemical fertiliser to meet the requirements of the increasing population in the tropics is remote (Law-Ogbomo 2013). The current price of fertiliser calls for its economic utilisation to meet specific requirements of crops. The current world-wide shortage of fertiliser and its anticipated adverse effect on food production has made many countries to explore the value of organic manure to reduce pressure on the demand for mineral fertiliser as complementary use.

Research studies have shown that the use of inorganic fertiliser in combination with organic materials is able to give the desired higher and sustainable crop yields than the sole use of inorganic fertiliser or animal manure. (Ogunlade et al., 2011).

Total reliance on inorganic fertiliser or organic materials alone as fertiliser may not be realistic, use of organic fertiliser should be employed so as to sustain soil fertility management strategy for okra production. Several sources of organic materials and residues abound in Nigeria which can be processed, packaged and made available as branded organic fertiliser at a cheap rate for home gardening, horticulture and farming as a whole (Olowoake & Adeoye, 2010). Hence, the prospect of jatropha cake and organomineral as organic fertilisers needs to be further evaluated in greater details. jatropha cake contained up to 58% of crude protein by weight (Achtena et al., 2008). The percentages of nitrogen (N), phosphorous (P), and potassium (K) were 3.2-4.5%, 1.4-2.1%, and 1.2-1.7%, respectively. The presences of these elements were recognised as the organic nutrients sources that are even higher than that of chicken or cow manure (Srinophakun et al., 2012).

Some studies showed that organomineral fertiliser gave significant increases in yield of okra (Akanbi et al., 2004) and watermelon (Ojo et al., 2014). There is little or no information on the usage of jatropha cake and organomineral fertiliser for the production of okra in Ilorin, North-central Nigeria. The objective of this work is to investigate the growth and yield of okra as influenced by NPK, jatropha cake and a commercially available organomineral fertiliser on an Alfisol in Ilorin, Southern Guinea Savanna of Nigeria.

Materials and methods

The study was carried out at the Teaching and Research Farm of Kwara State University, Malete, Ilorin, Nigeria. The farm extends from latitude 8°71’ N and longitude 4°44’ E. The climate is characterised by distinct wet and dry seasons with a mean annual temperature that ranges from 25-28.9 °C. In addition, the annual mean rainfall is about 1,150 m, exhibiting a double maximal pattern between April and October of every year. The Kwara State University land area forms part of the South Western sector of Nigerian basement complex, a zone of basement reactivation and plutonism during the Pan-African urogeny (Olaniyan, 2003).

The treatments consisted of three fertiliser types; Grade A (compost amended with mineral fertiliser, Aleshinloye Fertilizer Company, Ibadan, Nigeria), jatropha cake, NPK 15-15-15 and control (no soil additive). The results of analyses of the Grade A fertiliser and jatropha cake are summarised in Table 1. Costs for the fertiliser products were: USD 11.9 for 50 kg Grade A; USD 10 for 50 kg Jatropha cake cost, 28.5 USD for 50 kg NPK 15-15-15 (USD 1 approximately NGN 210 as at April 2015).

Table 1. Chemical composition of Grade A organo-mineral fertiliser and jatropha cake used for cultivation of okra.

Nutrient element	Concentration	
	Grade A fertiliser	Jatropha cake
N (g kg^{-1})	50.9	34.1
P (g kg^{-1})	44.0	0.7
K (g kg^{-1})	10.8	2.2
C (g kg^{-1})	232.6	4.9
Mg (g kg^{-1})	1.9	8.39
Ca (g kg^{-1})	27.7	0.3
Na (g kg^{-1})	3.5	0.08
Fe (mg kg^{-1})	715.2	2.1
Zn (mg kg^{-1})	1.5	0.08
Mn (mg kg^{-1})	93.3	0.01
Cu (mg kg^{-1})	14.9	0.02

The fertilisers were applied at the rate of 100 kg N/ha (Oshunsaya, 2010). Grade A and jatropha cake were applied a week before planting while inorganic fertiliser was applied a day to planting. Three seeds of okra were planted and latter thinned to one plant per stand at two weeks after sowing, giving a spacing of 60 cm x 30 cm. The experiment was randomised complete block design with three replications. Each plot size was 2.7 m x 2.1 m (5.67 m^2) with 48 plants per plot. Weeding was carried out using a hoe and the plot was kept free of weeds throughout the experiment.

Six out of the competitive plants per plot were tagged for determination of growth parameters. Collection of data commenced from 8 weeks after planting and growth parameters collected include plant height, stem girth. Harvesting of pods commence at 8 weeks after planting, Young pods were harvested 4 days after flowering. The harvesting was carried out over a period of six weeks. Yield parameters taken were; number of flowers per plant, percentage fruit set, number of fruits per plant and mean fruit weight.

Prior to land preparation, soil samples from the top 0 -15 cm were collected from the experimental site for laboratory analysis. The samples were randomly collected to represent the experimental area. A small sub-sample was air dried ground and sieved to pass through a 2 mm sieve for physical and chemical characterisation of the soil. The soil sample was analyzed for soil texture, pH, organic carbon, total N, extractable P, exchangeable levels of Ca, Mg, Na and K, and cation exchange capacity. Soil texture was determined by the Bouyoucos hydrometer method (Juo, 1978). Soil pH was measured electrometrically in a 1:2.5 soil-water suspension (McLean, 1982). Organic carbon was determined by rapid dichromate oxidation method. Total nitrogen was determined by the Micro Kjeldahl method (Bremner & Mulvaney, 1982), whereas extractable P was determined by Bray 1 Method (Bray & Kurtz, 1945). Exchangeable levels of Ca, Mg, K and Na were determined by the atomic absorption spectrophotometer following the procedures outlined by Wilde et al. (1979). Cation exchange capacity was determined by the ammonium acetate saturation method (Thomas, 1982). The plant data collected were subjected to analysis of variance (ANOVA) and treatment means were separated by Duncan Multiple Range Test (P<0.05) using SAS Institute (2010).

Results and discussion

The results of the soil analysis are presented in Table 2. The soil was loamy sand and slightly acidic. The soils were low in organic carbon (OC), total N and Potassium. The concentrations of exchangeable bases were generally low. The concentrations of these nutrients are below the recommended critical values of the nutrients in the soil of Guinea Savanna (Aduloju, 2004; Aduayi et al., 2002). It could be inferred from these results that the soils are of low fertility levels, justifying the need for additional fertiliser input to boost the yield of okra.

Table 2. Physico-chemical properties of teaching and research farm.

Parameters	Soil test value
pH	6.5
Organic C (g kg^{-1})	1.5
Total N (g kg^{-1})	2.20
P Bray (mg kg^{-1})	11.3
Exchangeable bases (cmol kg^{-1})	
K	0.3
Mg	0.3
Na	0.7
Ca	1.1
Extractable micronutrients (cmol kg^{-1})	
Fe	51.7
Zn	2.2
Mn	69.5
Cu	0.7
Textural Class (cmol kg^{-1})	
Sand	844
Silt	94
Clay	62
Textural class	Loamy sand

Growth parameters as affected by organic amendments and NPK are shown on Table 3. The study showed that fertiliser types significantly affected the growth plant height, number of branches stem girth and number of leaves of okra plant. There were significant differences (p<0.05) in plant height values obtained from the treatment of Grade A, jatropha cake and NPK during the growing period (Table 3).

The plant amended with Grade A gave the highest plant height value of 44cm while jatropha cake gave the least value (34 cm) excluding the control. The highest plant height recorded from Grade A may probably due to favourable nutrient mineralisation of this fertiliser as a result of the influence of the mineral component on the organic (Adeoye et al., 2008; Makinde et al., 2010; Oke et al., 2012).

With respect to the number of leaves all the fertiliser treatments differed significantly ($p<0.05$) from control. Grade A significantly enhanced the production of leaves and number of leaves value ranged from 9.0 cm in Grade A to 4.3 cm in control. There were no significant differences ($P<0.05$) on number of leaves for plot treated with jatropha cake and NPK. The higher number of leaves produce from Grade A over the NPK throughout the growing period could be due to sustaining release of nutrients from the former over the latter (Ogunlade, et al., 2011, Ojo et al., 2014).

Application of Grade A, jatropha cake and NPK had significant effect on the stem girth of okra. The fertilisers treatments were significantly ($p<0.05$) higher than stem girth of control. However, Grade A produced the highest stem girth of 3.5 cm which was 34.3 % greater than the control. Organomineral grade A had significantly ($p<0.05$) highest number of branch compared with the other treatments throughout the growing period. NPK and jatropha came second and it was significantly better than control. The number of branch obtained from Grade A treatment may probably due to faster release of nutrient than those of other fertilisers. The result obtained in this study reconfirmed the work of Akanbi et al, (2004) who reported that application of organomineral fertiliser significantly increased the growth of okra.

Table 3. Effects of fertilisers on growth parameters of okra. Means with the same letter in the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level.

Treatment	Height (cm)	Stem girth (cm)	Number of leaves	Number of branches
Control	31.0d	2.3c	4.3c	4.0c
Grade A	44.0a	3.5a	8.3b	9.0a
Jatropha cake	34.0c	2.5b	7.3b	7.3b
N P K	40.0b	2.7b	9.0a	8.0b

Table 4 shows the effects of different fertilisers on the component of yield of okra. All the treatments differed significantly ($p<0.05$) from the control. The number of flower per plant was significantly different among the fertiliser treated plants. The control plant gave significantly lower numbers of flower per plant. The percentage fruit set and fruit weight were all significantly affected by Grade A.

Okra fruit production was observed to be more favoured by the organomineral fertiliser than mineral fertiliser. This is in line with the similar to the works of Sridhar & Adeoye (2003), Akanni et al, (2011) and Olowoake & Ojo (2014) who reported that the combinations of organic and mineral fertiliser perform better on crop yield than when each of them is solely used. This indicated that the combined use of organic and inorganic nutrient management strategy is certainly good substitute for enhancing soil fertility and crop productivity (Oke et al., 2012). The reduction in the yield and some yield components from the plants that received NPK fertiliser as compared to plants under organomineral Grade A might be due to the leaching and runoff effect on the applied mineral fertiliser which makes N unavailable to plants especially during fruit production (Olowoake et al., 2013).

Table 4. Effects of fertiliser treatments on the components of yield of okra. Means with the same letter in the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level.

Treatment	Flowers/plant	% fruit set	Fruit weight (g)	Fruit yield (t/ha)
Control	5.0c	67.9d	45.7d	1.26d
Grade A	9.4a	82.1a	235.3a	6.53a
Jatropha cake	6.0b	71.4c	157.7c	4.38c
NPK	8.0a	78.6b	207.7b	5.75b

Conclusions

Result of the present study indicated that the application of organomineral Grade A (combination of both organic and chemical fertiliser) gave the overall best performance of okra. Although, the result of the laboratory analysis of jatropha cake showed that it has high percentage of N. The low performance of the jatropha cake on the okra could be due to slow rate of decomposition of jatropha cake compared with NPK and organomineral fertiliser.

More so, the use of Grade A fertiliser could serve as an alternative to the use of mineral fertiliser. This is because for most of the growth and yield components, organomineral fertiliser gave the highest significant values when compared to mineral fertiliser in terms of cost and availability.

From the experiment carried out it is recommended that organomineral fertiliser Grade A at 100 kg N/ha should be used as a source of fertiliser for the production of okra in Alfisol of Ilorin, Nigeria.

In summary, it can be deduced that amended compost showed a promising potential for improving growth and yield performance of okra. Hence, Grade A should be promoted for sustainable okra production for poor resource farmers.

Acknowledgments

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The effect of organic fertilizers on growth and yield of broccoli (*Brassica oleracea* L. var. *italica* Plenck cv. Top Green)

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Abstract

The research was undertaken to study the effect of application of different rate of organic fertilizers on broccoli. There were five treatments in total consisting of inorganic, organic fertilizers and blank control. The organic treatment included compost applied with three different rates of chicken manure tea (CMT) i.e. (0 ml/week, 100 ml/week and 200 ml/week) and the remaining two treatments were inorganic fertilizer treatment and blank control. The vegetative parameters measured were stem diameter, leaf number, leaf diameter, plant weight and height. In all the vegetative parameters measured, the inorganic fertilizer treatment gave the highest mean value which was statistically significantly different from other treatments except for leaf diameter which was statistically similar to CMT 200 ml and compost treatment. The result showed that the head yield of inorganic fertilizer was statistically highly significant over organic treatments, but there was no significant difference between inorganic fertilizers and 200ml CMT/week and compost treatments. The highest yield was obtained from inorganic fertilizer with the yield of 12.12 t/ha and the least from control with yield of 9.29 t/ha respectively. The positive dose-response pattern of the CMT applications suggests that there is good potential to further optimise this soil amendment. Also, an economic analysis of the costs and benefits of the high performing organic treatments would be valuable.

Keywords: chicken manure tea; yield; broccoli; organic; inorganic.

Introduction

Growing organic vegetable is a rapidly growing industry and the concerns over the pesticides residues in food and the environment has resulted to increase in demand for organic food. Organically grown foods are perceived as better quality, healthier and more nutritious than conventional counterparts (Warman and Havard, 1997). On the other hand, the relatively slow mineralization of the composts and other organic fertilizers limits the effective nitrogen utilization (Hartz *et. al.*, 2000). The low availability of nitrogen in organic fertilizers is the main underlying factor contributing to the low yield in organic farming and as per Badgley *et. al.* (2007) 'The principal objections to the proposition that organic agriculture can contribute significantly to the global food supply are low yields and insufficient quantities of organically acceptable fertilizers'.

However, liquid organic fertilizers like poultry manure tea and compost tea have been found to contain nitrogen mainly in inorganic form like ammonia (Price and Duddles, 1984; Gross *et al.*, 2007) and can provide nutrients instantly to the plants much like the chemical fertilizers. Not much information is available on fertigation of crops by manure teas.

Broccoli (*Brassica oleracea L.*var. *italica*) belongs to family Brassicaceae. It is a fast growing crop and requires high nitrogen input. It is one of the most important crops as it is highly nutritious vegetable with abundant vitamins and minerals such as vitamin A and C, carotenoids, fiber, calcium, and folic acid (Paradis, *et al.* 1995; Michaud *et. al.*, 2002). Broccoli and other brassica vegetables have high content of glucosinolates (Zhao *et al.*, 2007) which has cancer-fighting properties. Broccoli buds are rich source of minerals especially K, S, P, Mg and micro-elements (Aboul-Nasr and Ragab, 2000).

The aim of this investigation was to evaluate the productivity of broccoli with organic fertilizers and compare with mineral fertilizing.

Methodology

The study was conducted under field conditions in the research field of the Vegetable Division, Maejo University, Thailand. Before planting, soil samples consisting of approximately ten cores across the diagonal of the soil layers 0–30 cm deep of the experimental field were taken to determine the amount of NPK and other properties.The experiment was laid out in randomized complete block design (RCBD) and the treatments were replicated three times. Broccoli *(Broccoli oleraceae L.* var. *italica*) cultivar 'Top Green' was cultivated as the experiment plant. The broccoli seeds were sown in plastic nursery trays filled with peat as the growing media and raised inside greenhouse. After one month, the seedlings were transplanted in the field at a spacing of 60 cm (row) by 40 cm (plant) on raised beds.

The compost was prepared by Passively Aerated Window Method (FAO, 2003).The C/N ratio of the raw materials was maintained at 1:30. The compost mixture was placed inside heavy duty polythene bag having a dimension of 2 m in height and 0.8 m wide. One perforated plastic pipes, each having four rows of 1.27 cm (FAO, 2003) diameter holes drilled in it, was inserted into the compost bag for aeration. The mouth of the bag was closed and the upper ends of the inserted pipes were exposed to the open air to facilitate aeration in the interior of the compost pile. The composting was carried for one month and then cured for additional one month. The chicken manure tea (CMT) was prepared by "Bucket Method" as described by Ingham (2005). A total of twenty kg fresh poultry manure was collected every week from the Maejo University Dairy Farm. The manure was then put in a burlap sack, tied with string and placed in the bucket without it touching the floor with the help of horizontally placed sticks. Then twenty litres of de-chlorinated water (1:1 W/V) was added into the bucket. As a food source for beneficial microorganisms during fermentation period, one litre of molasses were added. The lid of the bucket was partially closed and stirred twice (once each in the morning and evening) daily and after fifteen days, the tea was steeped and used in the experiment plot.

Treatments

There were five treatments in total,

1. Compost,
2. Compost and chicken manure tea (100 ml/week),
3. Compost and chicken manure tea (200 ml/week),
4. Inorganic fertilizers, and
5. Control (without fertilizers).

The compost at the rate of 100 g/m^2 was mixed with the soil during the bed preparation in all the organic plots. The chicken manure tea was applied on weekly basis starting from the day of transplanting at the rate of 0 ml/m^2, 100 ml/m^2 and 200 ml/ m^2 in treatment no.1, 2 and 3 respectively. The mineral fertilizers were applied at the rate of 42.73 g urea, 31.76 g P_20_5 and 26.96 g K_20 per meter square as per the soil analysis report and the recommendation of the Oregon State University (2004).

Measurements

Vegetative growth characteristics were measured on a random sample of ten plants, taken from each experimental bed and the following data were recorded: plant height, leaf number per plant, stem diameter, leaf diameter and plant weight. All broccoli heads of each plot were harvested at marketable stage and the following variables measured: head yield (t/ha), mean head weight (g/plant), head diameter (cm), and head compactness (head diameter/head weight in grams).

Statistical analysis

The data collected in the experiment were statistically analysed with SAS Version 9.0 statistical software program. Analysis of variance (ANOVA) was done on every measured parameter to determine the significance of differences between means of treatments. Means for each parameter were separated by the least significant difference (LSD) test at $P \leq 0.05$.

Results

1. Nutrient content in composts and chicken manure tea

The Table 1 shows the nutrient composition of compost, chicken manure tea, soil in organic plot and in inorganic plot. Composts were analysed for its nutrient content after 68 days of composting. Chicken manure tea (CMT) was analysed after fermenting for 14 days. It has already been established by Rai (2010) that the 15 days old CMT had the higher nitrogen content over the one that was fermented for 21 days. According to Gross *et al.* (2008), all the uric acid in the chicken manure is degraded to ammonium by this period and it will just result in loss of ammonium through ammonification. A similar method was used to prepare the tea and only the 14 days old sample were analysed for nutrient content. The CMT had an NPK content of 0.15%, 0.04% and 0.82% respectively, with a pH of 6.96.

Table 1. Nutrient content in composts and chicken manure tea.

Organic fertiliser treatment	pH	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Carbon (%)	C:N ratio
Compost	6.27	0.60	1.43	0.58	7.90	13.93
Chicken manure tea	6.96	0.15	0.04	0.82		
Organic plot	6.11	0.08	0.03	0.007	0.85	10.24
Inorganic plot	6.31	0.09	0.03	0.016	0.91	10.40

2. Vegetative growth

The highest value of all the vegetative parameters that were measured was found in the inorganic treatment (Table 2). The differences in the value were statistically significant over the rest of the treatments (*P*=0.05). Its mean plant weight was 1329 g. The control gave the least vegetative growth. However, its vegetative growth was statistically similar to treatment no. 1 (compost). Treatment no. 3 showed the highest vegetative growth among the organic treatments. However, the values were statistically similar to treatment no. 2. The treatment no. 2 in turn had all its vegetative growth values statistically similar to treatment no. 1 except for plant weight.

Table 2. Effect of organic fertilizers and mineral fertilizers on vegetative growth.

	Treatments	Stem diameter (cm)	Leaf number per plant	Leaf diameter (cm)	Plant weight (g)	Plant height (cm)
1	Compost	3.60cd	20.73cd	22.38b	1062.18c	51.79cd
2	Compost & CMT (100ml/week)	3.70cb	22.13bc	22.48b	1145.67b	52.62cb
3	Compost & CMT (200ml/week)	3.85b	23.18b	23.22a	1198.71b	54.50b
4	Inorganic fertilizers	4.03a	27.20a	23.76a	1329.23a	61.03a
5	Control	3.42d	19.36d	22.19b	1011.83c	49.98d
	f-test	**	**	**	**	**
	CV%	3.858	6.55	2.1	4.03	3.37

Means within the column with the same letter were not significantly different at *P*=0.05 by the Least Significant Difference (LSD).

The numbers of leaves per plant were recorded from seven days after transplanting until harvest (Figure 1). The greatest numbers of leaves were recorded in inorganic treatment throughout the growth period. Initially, leaves number per plants from the organic treatments and control were similar but there was gradual increase in difference in new flushes as the recording continued. Treatment no. 3 recorded the highest numbers of leaves from among the organic treatments followed in order by treatment no 2, treatment no. 1. The control had the fewest leaves per plant.

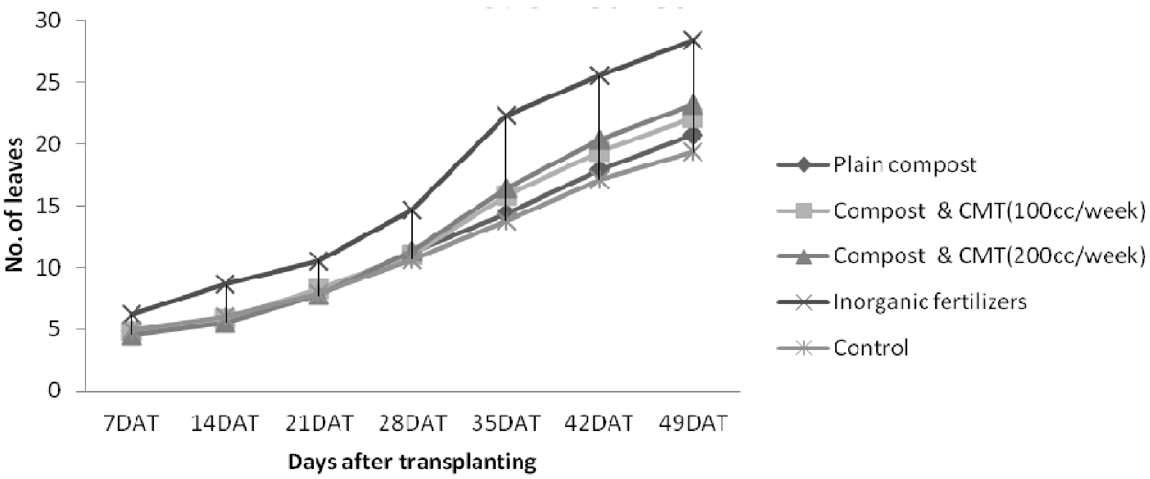

Figure 1. Leaves numbers per week from different treatments.

The plant height measurement also reflected the same trend (Figure 2) where the inorganic treatment had the tallest plants starting from the first week after transplanting. Similarly, the shortest plants were recorded from control, while the treatment no. 3 recorded the tallest plants among organic treatments.

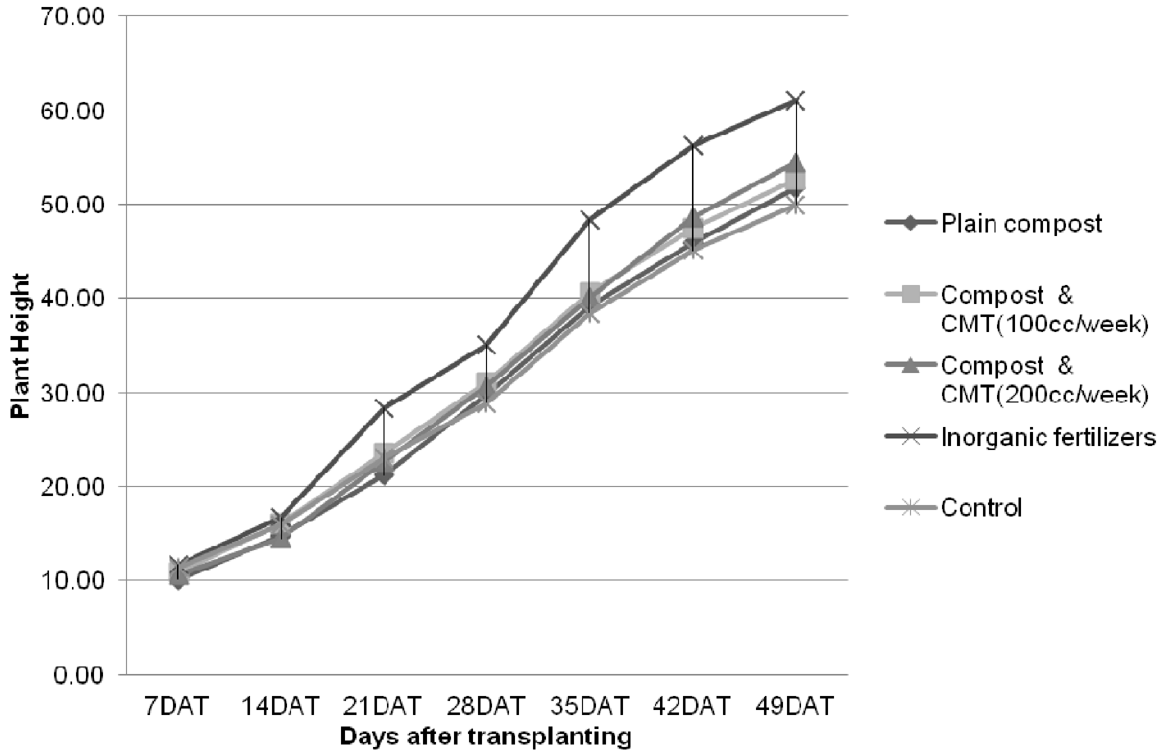

Figure 2. Plant height at weekly interval from different treatments.

3. Head yield

As indicated in Table 3, the highest yield was obtained from inorganic fertilizer treatment with a yield of 12.12 t/ha and the lowest from the control treatment with a yield of 9.27 t/ha. There was no statistical difference in yield between the inorganic treatment and the compost and CMT 200 ml treatment. Among the organic treatment, the highest yield was obtained from CMT 200ml and compost with a yield of 11.59 t/ha followed by CMT 100 ml and compost, and compost with a yield of 10.63 t/ha and 9.59 t/ha respectively. The yield in organic treatment increased with the increase in level of CMT being applied. On the other hand, application of compost alone to the soil did not show noticeable increase in the yield. The difference in yield between different levels of CMT was statistically significant. It can be deduced that chicken manure tea (liquid organic fertilizer) provided adequate nutrients to the plant at the early crop stage.

Table 3. Effect of organic fertilizers and mineral fertilizer yield and compactness coefficient.

Treatment		Head weight (g)	Head weight (g/m^2)	Head yield (t/ha)	Compactness (g/cm)
1	Compost	239.83c	959.33c	9.59c	17.69c
2	Compost & CMT (100 ml/week)	265.63b	1062.50b	10.63b	19.15b
3	Compost & CMT (200 ml/week)	289.87a	1159.48a	11.59a	20.33a
4	Inorganic fertilizers	302.90a	1211.60a	12.12a	20.46a
5	Control	231.83c	927.32c	9.27c	17.31c
	f-test	**	**	**	**
	CV%	4.445	4.445	4.445	4.722

Means within the column with the same letter were not significantly different at *P*=0.05 by the Least Significant Difference (LSD).

The highest compactness co-efficient value of the broccoli head was shown by inorganic fertilizer with a value of 20.46 g/cm followed by CMT 200 ml and compost, CMT 100 ml and compost, compost and control with value of 20.33 g/cm, 19.15 g/cm,17.69 g/cm and 17.3 1g/cm respectively. The head compactness coefficient increased with the increased in nitrogen availability (Wojciechowska, 2005).

Discussion

In all the vegetative growth parameters measured, inorganic fertilizers showed the highest value and the control had the lowest value. Among the organic fertilizers, the highest value of all the parameters measured in descending order was CMT 200 ml/week + compost, CMT 100 ml/week + compost, compost. The greater vegetative growth of the broccoli plant with inorganic fertilizers treatment may be attributed to its readily available N in high content. The amount of nitrogen and other nutrients applied in inorganic plot is much higher than the organic treatments i.e. by almost twenty times. Soil nitrogen fertilizer application increased the head weight, head diameter, plant weight and plant height of broccoli (Yildirim, 2007).

Likewise, plots fertilized with CMT (both 200 ml and 100 ml/week) also showed good vegetative growth without any indications of nutritional stress. With the increase in dose of CMT, there was increase in vegetative growth. This healthy growth of plants treated with CMT may be attributed to the presence of readily available form of nitrogen (ammonium) which was supplemented every week. A similar trend was observed by Fayed (2010), who found that the CMT significantly increased the vegetative parameters of the Roghini olive trees. Further, El-Tantawy (2009) found that farmyard compost tea increased the height and leaf area of potato plant.

These effects of manure tea on plant growth may be related to the important role of nitrogen, phosphorus and potassium in plant tissues which reflects on its vegetative growth. They play a vital role in photosynthesis, carbohydrate transport, protein formation, control of ionic balance, regulation of plant stomata and water use activation of plant enzymes and other processes (El-Sawy *et al*., 2000; El-Dissoky, 2008). CMT contains all three of these nutrients and was made available to the plants through its application. Gross *et al*. (2008) found that ammonium was the major form of nitrogen present in the extract solutions from all manure types and that the nitrogen released after the 14-day extraction by the different methods from the different manures ranged between 50% and 85%. This result confirms that organic liquid fertilizers like CMT contains instant plant nutrients and is suitable for short duration vegetable crops.

However, the plants in compost treatment showed statistically similar vegetative growth to that of control in terms of stem diameter, head diameter and leaf diameter. It was found that the plants were of shorter size with the plant weight much lower than the other organic treatment's. The total nutrient might not have been adequate due to the low amount of compost applied. For vegetable cultivation, compost application rates of 10-60 t/ha on a dry weight basis, are recommended for vegetable production, although applications as low as 7 t/ ha. have shown positive effects on vegetable yields (Roe, 1998). Other factor for low vegetative growth might be the slow mineralisation properties of nutrients in compost as the nutrients are in organic form (Hue, 1997). The higher C:N ratio for compost only would suggests that slower mineralisation could have occurred. It was found that only 10% to 50% of the total nitrogen in solid manure/compost was available for plant uptake within the season of application and this fraction decreases with the extent of decomposition (Gale *et al*., 2006).

The yield in organic treatment increased with the increase in level of CMT being applied. On the other hand, application of compost alone to the soil did not show noticeable increase in the yield. The difference in yield between different levels of CMT was statistically significant. The increase in the total yield resulting from application of the chicken manure tea may be attributed to the presence of readily available form of nutrient i.e. ammonia and nitrate (Gross *et al*., 2008) and also to its property to enhanced soil aggregation, soil aeration and water holding capacity, offers good environmental conditions for the root system of broccoli plants. This better availability of soil nutrients and favourable soil condition resulted in healthy plants with large vegetative growth, which lead to higher yield and head diameter. The highest yield was obtained in inorganic treatment due to availability of readily available nutrient in high quantity. The lowest yield in control is due to the insufficient supply of plants in nitrogen resulting in reduction of plant productivity (Shangguan *et al*. 2000, Lawlor 2002). The link between head compactness measurement and an increase in nitrogen was observed here, and this has been reported elsewhere (Wojciechowska, 2005).

Conclusion

The treatment with compost and 200 ml CMT/week showed the best result in terms of yield, head compactness co-efficient and vegetative growth characteristics among the organic treatments. Thus it can be concluded that to obtain higher yield, this is the best treatments from among the organic fertilizers combination studied, though it was not as effective as the mineral fertilizer treatment for some growth variables. The positive dose-response pattern of the CMT applications suggests that there is good potential to further optimise this soil amendment. Also, an economic analysis of the costs and benefits of the high performing organic treatments would be valuable.

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Economic costs and returns from organic farming in Oyo state, Nigeria

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Abstract

The study evaluated the costs and returns of organic farming using the farmers in Akinyele Local Government of Oyo state, Nigeria as case study. An interview schedule was administered to the respondents to elicit useful information. The analysis was based on input and output data collected from one hundred and eighty farmers selected at random from the area from which eighty-eight used organic farming, fifty-eight used non-organic farming and thirty-four used both farming systems. The data were analysed using descriptive statistics, Duncan Multiple Range Test (DMRT), t-test group statistics and gross margin analysis. Results of the analysis indicated that 57.8% of the respondents were male, 66.1% were married and all the respondents had formal education either at primary, secondary or tertiary level. Furthermore, 48.9% of the respondents adopted organic farming system, 32.2% adopted non-organic farming system while 18.9% adopted both organic and non-organic farming systems. From the gross margin analysis done, both organic and non-organic farming are profitable. However, it is more profitable to produce vegetable and maize organically. Costs related to fertiliser and the post-harvest preservation and sales was higher in non-organic farming, whereas the cost of crude farm implements and labour was higher in organic farming. There should be an intensified awareness to improve the level of participation of farmers in organic farming, recommendation of organic products to people, and government policies that encourage farmers to go into organic farming, especially by making their products readily disposable in already prepared market at encouraging prices.

Keywords: benefits, constraints, conventional farming, environmental effects, cost of production, product damage.

Introduction

The adoption of non-organic farming by farmers over time can be traced to solving the problem of insufficient food to meet the growing world population. This system of farming is a shift from the traditional means of farming. It was done to fast track growth and enhance rapid crop development, check the effect of pest threat to crop production and reduce or prevent competition of crops with unwanted plants. This method of production was widely accepted by farmers either at a small scale or large scale level of production because to an extent, it made farming activities break even depending on the size of production, and it also met the timely requirement of food for the growing population. Over time, it was realized that the effects of the chemicals used in the course of farming have lots of negative effects on both the environment and health of man, hence the need to discourage such practice and encourage the other alternative, organic farming (Kutama *et al*., 2013).

The United States Department of Agriculture (USDA) defines organic farming as a farming system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives to the maximum extent feasible, or the farming system that relies on crop rotations, residues, animal manure, legumes, green manure, off-farm organic wastes, and the aspects of biological pest control measures, soil productivity and tilt, to supply plant nutrients and to control insects, weeds and other pests (Alvares *et al*., 1999). According to the Organic Organization (HDRA, 1998), organic farming involves using techniques to achieve good crop yields without harming the natural environment or the people who live and work in it. Organic farming works in harmony with nature rather than against it. It keeps and builds good soil structure and fertility as well as controls pests, diseases and weeds. Organic farming also involves careful use of water resources and good animal husbandry.

According to the International Federation of Organic Agriculture Movements (IFOAM, 2006), organic farming is a production system that sustains the health of soils, ecosystems and people. Its production systems are based on specific and precise standards of production which is based on the goal of achieving optimal agro-ecosystems which are socially, ecologically and economically sustainable to our existence. Organic farming combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

Organic farming does not mean going back to traditional methods of farming, though some of the farming methods used in the past is still useful today. It takes the best of the traditional methods and combines them with modern scientific knowledge. Organic farmers do not leave their farms to be taken over by nature; they use all the knowledge, techniques and materials available to work with nature, hence creating a healthy balance between nature and farming. Through this, the farmer strikes a balance between nature and farming where crops and animals can grow and thrive, meeting the time requirement (HDRA, 1998).

Organic farming is one a promising option in meeting the challenges of alleviating poverty, increasing incomes and enhancing trade, while at the same time protecting the environment. It is a promising trade, sustainable development opportunity, and a powerful tool for achieving the Millennium Development Goals (MDGs), particularly those related to poverty reduction and the environment. On an organic farm, each technique would not normally be used on its own; the farmer would use a range of organic methods at the same time to allow them to work together for maximum benefit. For example the use of green manure and careful cultivation, together provide better control of weeds than if the techniques were used on their own.

Organic farmers often diversify their businesses by growing several crops at one time, often having both livestock and field crops, and sometimes value-added enterprises as well. The diversification reduces economic risk. Also, enterprise diversification makes it easier for farms to be more self-sufficient in terms of nutrients, livestock feed, soil organic matter and energy. According to Kutama *et al*. (2013), many experienced organic farmers have crop yields as high as, or higher than, the average conventional yields. However, the average organic crop yields are often lower than the average conventional yields. Differences between average yields reflect not only different farming systems but the differences in experience.

Kutama *et al*. (2013) also revealed that the most challenging time is the transition period as farmers switch from conventional to organic agriculture. During this period, the price premium is absent and yields are low. Sometimes farmers can receive a minor price premium for transitional production, with a price higher than conventional prices, but lower than the certified organic prices. During the early stages of conversion, some farmers have reported drops in yields of up to 30%. Later, yields tend to increase with the number of years under organic management as farmers gain experience and the soil improves. Some farmers find that the yields rebound within just a few years; this is most likely to happen with farmers who were using only minimal inputs. Other farmers, who were very dependent on herbicides, fertilizers and pesticides, find that it takes up longer for their yields to recover.

Duffy *et al*. (2002) revealed that organic agriculture has become a major industry in the last decade, driven by increasing consumer demand, price premiums, and improving market opportunities. From the research done on growing certain crops with both the organic and non-organic farming system, it was observed that non-organic farming reduced the soil's pH while organic farming kept it at the optimum range. Also, the yields through organic farming were higher than the conventional non-organic farming system.

With reference to the Nigerian situation, research done on organic and non-organic Vegetable Farming in Benue Valley of North Central Nigeria by Agbulu and Idu (2008)revealed that about 98% of the organic vegetable farmers used plant and animal refuse as compost, about 99% agreed that these manures are produced through locally fabricated biodigester, 96% attested to the fact that fabrication of biodigester requires high level of skills and endogenous knowledge and through this, about 98% of the farmers agreed that there is continuous supplies of vegetables to the open market. About 93% of non-organic vegetable farmers utilized chemical fertilizers only. These farmers have no input or control in the manufacturing of these fertilizers as attested by 97% of them. Because of their inability to control supply of these fertilizers, about 82% asserted that there is inconsistency in the supply of vegetables to the open market. About 81% of these farmers agreed that they do not require special skills to be proficient in the utilization of chemical fertilizers since manual guides explain the methods of application.

There are studies detailing the effects and side effects of pesticides upon the health of farm workers (McCauley *et al*., 2006). Through these studies, organophosphate pesticides have become associated with acute health problems such as abdominal pain, dizziness, headaches, nausea, vomiting, as well as skin and eye problems (Echobichon, 1996). In addition, it has been found that pesticide exposure is associated with more severe health problems such as respiratory problems, memory disorders, dermatologic conditions, cancer, depression, neurological deficits, miscarriages, and birth defects (Engel *et al.,* 2000).

Having followed the trend of how organic farming has been introduced to farmers over time, there is a need to encourage the farming system ahead of the non-organic one in order to enhance good health of consumers, both in the long and short run; and promote a sustainable agricultural system which by definition meets the needs of the present generation without jeopardizing the needs of future generations. As revealed by Duffy *et al.* (2002), organic agriculture has become a major industry driven by increasing consumer demand. If organic farming is to be promoted more among farmers, the need to look into its economic feasibility to enhance a farming system that is economically sustainable, both to the farmers and to the society as a whole, is of paramount importance. The analysis of the costs and returns to organic farming is hence the focus of this study.

It is good to know that organic agriculture is both beneficial to the producer as well as to the consumer. inorganic fertilisers may be easy to use and may result in high yield but they pose some dangers to the soil, the environment and the consumer. As revealed by Willer and Kilcher (2009), organic farming is beneficial to the producers in the following ways; better income (premium price on organic produce), reduced cost of production on long term (as synthetic pesticides, herbicides and fertilizer are not used), good health (safe for farmers' household including children and pregnant women), and enhance the resistance of the crops against pests and climate change. The desire to consume organic products is also as a result of the benefits to consumers and the environment, hence there is high tendency of making good sales from organic products.

This study therefore analyses the cost incurred in the course of organic farming, taking into account the commonly produced and prominently grown crops with organic farming and also the returns from investment in the production of these crops through organic farming. Specifically, the study examined the practice of organic farming by farmers in the study area, determined the costs and returns to organic farming and hence the profitability, and compared organic farming system to non-organic farming system in terms of profitability to the farmers.

Materials and methods

The study area is Akinyele Local Government Area of Oyo State and it is one of the eleven local governments that make up Ibadan metropolis. It was created in 1976 with its administrative headquarters in Moniya, though most of the administrative staff reside in the interior of Ibadan metropolis. The Local Government is the second largest local government in Ibadan and it shares boundaries with Afijio Local Government Area to the north, Lagelu Local Government Area to the east, Ido Local Government Area to the west and Ibadan North Local Government Area to the south. It occupies a land area of 464.892 square kilometers with a population density of 516 persons per square kilometer. It lies on latitude 7.7°N and longitude 3.8°E of the equator.

The predominant vegetation zone in Akinyele Local Government area is rain forest with a loamy soil type. Using 3.2% growth rate from 2006 census figures, the 2011 estimated population for the Local Government is 247,417 persons. Places of great significance in the Local Government include Federal School of Statistics, Amuludun FM, Adekunle Fajuyi Barracks (Odogbo cantonment), National Institute of Social and Economic Research (NISER), International Institute for Tropical Agriculture (IITA) among others. The locations and villages under Akinyele Local Government Area include: Ajibode, Orogun, Sasa, Ojo, Idi-Ose, Moniya, Igbo-Oloyin, Gbanda, Akinyele, Ijaiye, Olorisa-Oko, Jarija, Onidundun, Saw-Mill, Tose, Isale-Awero, Eni-Osa, Arulogun, Alabata, Ikereku, Laniba, Ojo-Emo, Ajibade, Aroro, Oboda, Labode, Onidundu, Isabiyi, Irepodun, Elekuru, Ojedeji, Okegbemi, Mele, Amosun, Iwokoto, Talonta, Idi-Oro, Aroro and others.

The Local Government Area is dominated by farmers though some of the residents are into petty trading, transport business, local engineering, teaching, blacksmithing, and so on. Although the area is dominated by the Yorubas among other resident tribes, there are also some expatriate farmers from neighbouring African countries such as Benin Republic and Togo who have come to take advantage of the fertile agricultural land. The Local Government area is dominated by illiterates or semi-literates, and the villagers are of Christianity, Islamic and Traditional religion background. The Local Government is endowed with land suitable for the cultivation of crops like cassava, maize, yam, palm oil and so on. Also fruits and vegetables like orange, mango, banana, pineapple, tomatoes, and etcetera are also doing well in the area. Most of the rural farmers transport their farm produce to the central markets of Ibadan for sales, either with the aid of middle-men or directly by themselves.

One hundred and eighty farmers were randomly selected from the study area for the purpose of this study. Data were collected through the use of a structured questionnaire which is divided into three sections. The first section sought information on socio-economic characteristics of the farmers while the second section dealt with farmers level of involvement in organic farming taking cognizance of how long the farmer has adopted organic farming and his/her knowledge about the environmental effects of both organic and non-organic farming. The third section sought information on the expenses incurred in the production and the returns accrued from investment in organic or non-organic farming, as the case may be.

Descriptive statistics were used to describe the socio-economic characteristics of the respondents, assess the level of involvement of farmers in organic farming, assess the postharvest activities attached to either of the farming systems adopted and also to extract information about the farmers' perceived benefits and constraints for either farming system. Duncan's Multiple Range Test (DMRT) was used in the analysis of means of expenses incurred in the production and the returns accrued from investments. T-test group statistics was used to analyse the farmers' profitability with respect to their various adopted method of production and also to make comparison between the level of profitability of organic and non-organic system of farming.

Gross Margin analysis in the study was carried out using the farmers' total revenue recorded from produce sales and total costs incurred from production, GM = TR – TC, where GM = Gross Margin, TR = Total Revenue and TC = Total Cost. Results are given in Nigerian Naira, where USD1 equals about ₦200.

Results and discussion

Socio-economic characteristics of farmers

Table 1 shows that out of the 180 respondents 57.8% were male while 42.2% were female. This implies that the larger percentage of the respondents were males, hence the level of participation of males in crop farming was more than the level of participation of females. Table 1 also shows that 33.3% were in the age range of 20–30 years, 50.6% were in the age range of 31–40 years, while 16.1% were older than 40 years. This means that more (83.9%) of the farmers were in the very active working age, that is, between ages 20 and 40. This may have effect on the productivity, hence influencing profitability. About 26% of the respondents were single, 66.1% were married, 5.6% were divorced, while 2.2% were widowed. The high percentage of married respondents means that the farmers with their families were settled for farm work. For education level, 14.3% of the respondents had primary school education, 32.2% had secondary education, and 53.3% had tertiary education. The respondents were literate, with the highest percentage of them having tertiary education. This may have an effect on the respondents' awareness of the effect of farming materials on their environment; hence this may affect the farming method adopted. About two-thirds were Christians, one third were Muslims, while only 2.2% belonged to African Traditional Religions. This shows that Christianity and Islam are predominant in the study area.

In terms of main occupation, 4.4% of the respondents were civil servants, 73.3% were farmers, 5.6% were fishermen, 6.7% were students, 2.2% were tailors, while 7.8% were teachers (Table 1). This affirms the fact that most of the residents of the study are into farming as main occupation. About 2% of the respondents earned less than ₦10,000 monthly, the majority (50%) earned between ₦10,001 – ₦20,000 monthly, 16.7% earned between ₦20,001 – ₦30,000 monthly, 18.3% earned between ₦30,001 – ₦40,000 monthly, while 2.8% earned between ₦40,001 – ₦50,000 monthly. Also, 10% of the farmers earned more than ₦50,000. From the results, 65% of the respondents cultivated between 0.4 and 1.0 hectares of land, 32.8% cultivated between 1.1 and 2.0 hectares of land, while 2.2% cultivated more than 2 hectares of land. The analysis reveals that the highest percentage of the respondents cultivated the lowest acres of land; this might be because most of the farmers are into farming because of household food security.

Table 1. Distribution of respondents by socio-economic characteristics.

Variable	Frequency	Percentage	Cumulative percentage
Gender			
Male	104	57.8	57.8
Female	76	42.2	100.0
Age (years)			
20-30	60	33.3	33.3
31-40	91	50.6	83.9
>40	29	16.1	100
Marital status			
Single	47	26.1	26.1
Married	119	66.1	92.2
Divorced	10	5.6	97.8
Widowed	4	2.2	100.0
Level of education			
Primary	26	14.4	14.4
Secondary	58	32.3	46.7
Tertiary	96	53.3	100.0
Religion			
Christianity	120	66.7	66.7
Islam	56	31.1	97.8
Traditionalist	4	2.2	100.0
Major occupation			
Civil Servant	4	2.2	2.2
Clerk	4	2.2	4.4
Farming	132	73.3	77.8
Fishing	10	5.6	83.3
Student	12	6.7	90.0
Tailoring	4	2.2	92.2
Teaching	14	7.8	100.0
Average monthly income (₦)			
< 10, 000	4	2.2	2.2
10, 001 - 20, 000	90	50.0	52.2
20, 001 - 30, 000	30	16.7	68.9
30, 001 - 40, 000	33	18.3	87.2
40, 001 - 50, 000	5	2.8	90.0
> 50,000	18	10.0	100.0
Total land area cultivated (ha)			
0.4 – 1.0	117	65.0	65.0
1.1 - 2.0	59	32.8	97.8
> 2.0	4	2.2	100.0

Producers' involvement in organic farming

Table 2 shows that 49% of the respondents adopted organic farming system in the last planting season, 32% adopted non-organic farming system, while 19% adopted both organic and non-organic farming systems. Table 2 further shows that 72.8% of the respondents indicated that they engaged in farming because of household food security, 63.9% because of profit making, and 27.2% because of achievement of a particular level of income. From the result of the analysis, majority of the farmers were concerned about making food available for their families, hence reducing the cost of family maintenance especially with food provision, this might result in the adoption of organic farming because of the health benefit of organic farming materials on humans. On the other hand, those concerned about making profit might be motivated in adopting non-organic farming since this method of farming is less stressful for farmers.

Table 2 reveals that 98% of the respondents were aware that there is improvement and conservation of the soil's structure through the use of organic materials for farming; 91% were aware that there is enhancement of growth of soil's biological components; 51.7% were aware that there is little or no damage to the environment water system; and 78% were aware that maintenance and increase of the long term fertility of the soil can be achieved through the use of organic materials. The results imply that large percentages of the respondents were aware of the environmental effects of the use of organic farming materials on the soil and the environment water system and this might be responsible for the high acceptance of organic farming in the study area.

About 54% of the respondents indicated that they were aware that there is contamination of neighbouring water bodies in case of erosion through the use of inorganic materials for farming; 46.1% were aware of successive disruption of soil structure; 41.7% were aware of the health hazards on the farmers and the consumers; and 39.4% were aware of the contamination of food products. The analysis revealed that most of the farmers were not fully aware of the environmental implications of the use of inorganic materials for farming and this might be responsible for the continuous use of non-organic farming by the farmers.

Table 2. Producers' level of involvement in organic farming.

Variable	Frequency	Percentage
The farming system adopted in the last planting season		
Organic	88	48.9
Non-organic	58	32.2
Both	34	18.9
Reasons for farming		
Farming for household food security	131	72.8
Farming for profit making	115	63.9
Farming to achieve a particular level of income	49	27.2
Awareness of the environmental effect of organic materials		
Improvement and conservation of the soil structure	176	97.8
Enhancement of the growth of the soil biological component	164	91.1
Little or no damage to the environment water system	93	51.7
Maintenance and increase of the long term fertility of the soil	141	78.3
Awareness of the environmental effect of inorganic materials		
Contamination of the neighbouring water bodies in case of erosion	97	53.9
Successive disruption of soil structure	83	46.1
Health hazards on the farmers and the consumers	75	41.7
Contamination of the food products	71	39.4

Different crops were grown in the previous planting season, and this was done individually for organic and non-organic farming. The distribution of farmers based on the crops is shown in Table 3. The table reveals that through organic farming, 5.0% of the respondents cultivated cassava, 41.7% cultivated maize, 20.0% cultivated vegetables, and 4.4% cultivated yam. However through non-organic farming, 13.9% cultivated cassava, 20.5% cultivated maize, 7.8% cultivated vegetable, 2.8% each cultivated banana, pepper, and plantain, and 2.2% cultivated yam.

Table 3. Distribution of farmers by major crops grown in the last planting season and the respective farming system used for their cultivation.

Crops	Organic farming		Non-organic farming	
	Frequency	Percentage	Frequency	Percentage
No response			85	47.2
Cassava	9	5.0	25	13.9
Maize	75	41.7	37	20.5
Vegetable	36	20.0	14	7.8
Banana	-	-	5	2.8
Pepper	-	-	5	2.8
Plantain	-	-	5	2.8
Yam	8	4.4	4	2.2
Total	180	100	180	100

Costs and returns on production

For this analysis, costs and returns were grouped into three based on the crops grown; maize, vegetables and other crops. This is because the percentage of farmers that cultivate maize and vegetable through organic means were high. From the earlier analysis, the farming means employed by respondents can be categorized into three; organic, non-organic and both (that is organic and non-organic). The means of expenses incurred in production and the returns that accrued from investment in the three categories are shown in Table 4. Non-organic farming system had significantly higher mean of total cost of non-organic pesticides and fertilizer than that of organic farming system and those that engaged in both farming systems (P<0.05). However, there is no significant difference in total cost of pesticide and fertilizer between those that engaged in both farming systems and total cost of fertilizers in organic farming system (P<0.05).

Also, there was no significant difference in the mean total cost of crude farm implements of respondents that engaged in organic, non-organic and those that engaged in both farming systems (P<0.05). Organic farming system was significantly higher in the mean labour cost in the course of production than others (P<0.05). However, there was no significant difference in labour cost in the course of production between non-organic farming system and those that engaged in both farming systems (P<0.05).

Organic farming system was significantly higher in the total revenue generated from vegetables than that of non-organic farming system (P<0.05). However, there was no significant difference in total revenue generated from vegetables between organic farming system and those that engaged in both farming systems (P<0.05). Also, organic farming system was significantly higher in the total revenue generated from maize than that of non-organic farming system (P<0.05). However, there was no significant difference in total revenue generated from maize between organic farming system and those that engaged in both farming systems (P<0.05).

Additionally, non-organic farming system was significantly higher in the total revenue generated from other crops than others (P<0.05). However, there was no significant difference in total revenue generated from other crops between organic farming system and those that engaged in both farming systems (P<0.05). Finally, respondents that engaged in both farming systems significantly had higher average after production cost attached to preservation and sales than others (P <.05). However, there was no significant difference in average after production cost attached to preservation and sales between organic farming system and non-organic farming system (P<0.05).

Table 4: Means of expenses incurred in the production and the returns accrued from investment in the three categories of farming system.

Statistics	Mean (± standard deviation)[1]		
	Organic	Non-organic	Both
Total cost of organic fertilizer/inorganic pesticides and fertilizer (₦)	6,452 (± 5,208)[b]	11,551 (± 4,316)[a]	6,600 (± 2291)[b]
Total cost of crude farm implements (₦)	5,503 (± 5,149)[a]	5,352 (± 2,409)[a]	4,412 (± 1,041)[a]
Average labour cost in the course of production (₦)	26,400 (± 16,321)[a]	17,400 (± 11,860)[b]	10,000 (± 1,372)[b]
Total revenue generated from vegetable (₦)	25,778 (± 16,865)[a]	15,298 (± 5,286)[b]	31034 (± 1,290)[a]
Total revenue generated from maize (₦)	42,437 (± 31,843)[a]	26,316 (± 8,570)[b]	36,667 (± 17,856)[a]
Total revenue generated from other crops (₦)	145,800 (± 67,804)[b]	238,429 (± 304,293)[a]	91666.67 (± 62,812)[b]
What is the average after production cost attached to preservation and sales (₦)?	13,758 (± 13,021)[b]	18,295 (± 8,823)[b]	30833.33 (± 23,390)[a]

[1] Means with same letter across the row are not significantly different (DMRT at P<0.05)

On the other hand, Table 5 shows a t-test comparison between organic and non-organic farming systems based on the expenses incurred in production and returns that accrued from investment. Table 5 shows that respondents who engaged in non-organic farming system had significantly higher total cost of pesticides and fertilizer (P<0.001). Also, respondents who engaged in organic farming system had higher total revenue generated from vegetables (P<0.001). In addition, respondents who engaged in organic farming system had higher total revenue generated from maize (P<0.001). Further, respondents who engaged in non-organic farming system had higher total revenue generated from other crops (P<0.05). Finally, respondents who engaged in non-organic farming system had higher average after production cost attached to preservation and sales (P<0.05).

Table 5. T-test comparison between organic and non-organic farming systems based on the expenses incurred in production and returns accruing from investment.

Parameters	Farming system	Mean ± SD[1]	*P*
Total cost of organic fertilizer/inorganic pesticides and fertilizer (₦)	Organic	6,452 (± 5,208)	
	Non-organic	11,551 (± 4,316)	<0.001
Total revenue generated from vegetable (₦)	Organic	25,778 (±16,865)	
	Non-organic	15,298 (± 5,286)	<0.001
Total revenue generated from maize (₦)	Organic	42,437 (± 3,1843)	
	Non-organic	26,316 (± 8,570)	<0.001
Total revenue generated from other crops (₦)	Organic	145,800 (± 67,804)	
	Non-organic	238,429 (±304,293)	<0.05
Average income after production costs for preservation and sales (₦)?	Organic	13,758 (± 13,021)	
	Non-organic	18,295 (± 8,823)	<0.05

[1] SD = standard deviation

Gross margin analysis

Table 6 indicates that it is more profitable to produce vegetable and maize organically, while it is more profitable to produce other crops non-organically. Likewise, cost of fertilizer and the after production cost attached to preservation and sales was higher in non-organic farming, whereas the cost of crude farm implements and labour was higher in organic farming. Using the figures in Table 6, the gross margin for organic farming (n = 88) was ₦88,392.00 per farmer per growing season, and ₦177,562.00 per farmer per growing season for non-organic farming (n = 58). Both organic and non-organic farming are profitable, although the gross margin for organic farming was about half that of the non-organic farming.

Table 6. Table of the total expenses incurred in the production and the total returns accrued from investment in both organic and non-organic farming systems.

Statistics	Organic	Non-organic
Total cost of organic fertilizer/inorganic pesticides and fertilizer (₦)	200,000	566,000
Total cost of crude farm implements (₦)	407,200	310,400
Average labour cost in the course of production (₦)	1,320,000	435,000
Total revenue generated from vegetable (₦)	719,000	232,000
Total revenue generated from maize (₦)	2,673,500	500,000
Total revenue generated from other crops (₦)	7,290,000	11,683,000
Average income after production costs for preservation and sales (₦)	976,800	805,000

Postharvest miscellaneous issues

Table 7 shows that 19.9% of the respondents recorded little product damage in organic farming system, while 22.6% of respondents recorded little product damage in non-organic farming system. Moreover, attitude of farmers and pre-harvest activities were not responsible for product damage in organic farming system. Meanwhile, 2.7% of the farmers indicated post-harvest activities, rodent attack (8.2%), and weather conditions (8.9%) as factors responsible for product damage. Also, 3.4% of the respondents indicated that attitude of farmers, post-harvest activities (2.7%), pre-harvest activities (6.8%) and weather condition (6.2%) could be responsible for product change in non-organic farming system. Finally, rodent check and accurate weather forecast can help check product damage in organic farming system. However, product damage could be checked through good storage and accurate weather forecast in non-organic farming system. Also, proper handling of products after harvest, proper soil care and management of soil texture are important.

Table 7. Questions on product damage.

Questions	Organic Frequency	Percentage	Non-organic Frequency	Percentage
Was there any record of product damage?				
Yes	37	25.3	42	28.8
No	51	34.9	16	11.0
If yes, how much product was damaged				
Little	29	19.9	33	22.6
Much	0	0.0	5	3.4
No response	59	40.4	20	13.7
What could be responsible for the damage?				
Attitude of farmers, weather and rodent attack	0	0.0	5	3.4
Postharvest activities	4	2.7	4	2.7
Pre-harvest activities	0	0.0	10	6.8
Rodent attack	12	8.2	0	0.0
Weather conditions	13	8.9	9	6.2
No response	59	40.4	30	20.5
How can the product damage be checked?				
Accurate weather forecast	5	3.4	9	6.2
Good storage	0	0.0	10	6.8
Proper handling of products after harvest	4	2.7	4	2.7
Proper soil care and rodent check	4	2.7	0	0.0
Proper weather forecast	0	0.0	5	3.4
Rodent check	8	5.5	0	0.0
Soil texture	4	2.7	0	0.0
No response	63	43.1	30	20.5
Total	88	60.3	58	39.7

Perceived benefits and constraints of organic farming

Table 8 shows that 27.8% of the respondents perceived that organic farming (produce) enhances healthy body system, little or no chemical in food and soil preservation (5.6% each), soil sustainability (4.4%), land sustainability (2.8%), and good harvest (2.2%). Results also show that 11.0% of the respondents perceived that organic farming is stressful. And it is energy and time consuming (2.2%), also, maintenance from weed (31.7%) and insufficient fund (7.8%) constrain organic farming.

Table 8. Benefits and constraints of organic farming.

Questions	Frequency	Percentage
What are the perceived benefits of organic farming?		
Enhance healthy body system	50	27.8
Good robust harvest	4	2.2
Human health and soil sustainability	8	4.4
Land sustainability	5	2.8
Little or no chemicals on food	10	5.6
Soil preservation	10	5.6
What are the perceived constraints of organic farming?		
Cultivation stressful	20	11.0
Energy and time consuming	4	2.2
Insufficient fund	14	7.8
Maintenance from weed	57	31.7
No response	85	55.0

Perceived benefits and constraints of non-organic farming

About 2.2% of the respondents indicated that one of the perceived benefits of non-organic farming is crop suitability, 7.2% indicated that there is no cultivation stress, 7.8% indicated that it is time saving (Table 9). About 8% of the respondents indicated that a perceived constraints of non-organic farming is the lack of funds, 2.2% indicated inadequate machinery, and 2.8% noted the occurrence of water pollution.

Table 9. Benefits and constraints of non-organic farming.

Questions	Frequency	Percentage

What are the perceived benefits of non-organic farming?		
Crop suitability	4	2.2
No cultivation stress	13	7.2
Time saving	14	7.8
No response	149	82.8
What are the perceived constraints of non-organic farming?		
Lack of fund	14	7.8
Lack of knowledge of the effect on health	8	4.4
Inadequate machineries	4	2.2
Water pollution	5	2.8
No response	149	82.8
Total	180	100

Conclusion

Large percentages of the respondents were aware of the environmental effects of the use of organic farming materials on the soil and the environment water system hence this might be responsible for the high acceptance of organic farming in the study area. From the study, it can be concluded that respondents perceived organic farming to be more beneficial to the environment and for human consumption compared to non-organic farming whose farming inputs have negative externalities on both the environment and human (producers and consumers). Hence, organic farming systems are used by the farmers despite the constraints of the system which discourage farmers, especially when crop production is carried out primarily for making an income.

According to the findings of the research work, the following recommendations are made:
1. There should be an intensified awareness to improve the level of participation of farmers in organic farming.
2. The government should also support the awareness campaign and recommend consumption of organic products to people.
3. There is need for government policies that encourage farmers to adopt organic farming practices, especially by making their products readily disposable in already prepared markets with premium prices.
4. Farmers should ensure that organic production is quality driven, hence they should adopt good production and management practices that are not in diluted with the use of chemicals, so as to increase organic market share.
5. It is also advisable that intending organic producers should consider starting with the production of vegetable and maize since it has the highest market potential compared to non-organic farming. This will encourage these intending producers to produce more using organic system since they will be economically motivated and not discouraged.

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