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Evaluation of Sustainable Bio-Liquid Fertilizer (Supergro) on the Production of Fluted Pumpkin (*Telfairia occidentalis*)

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ABSTRACT: *Experiment was conducted at the green house Niger Delta University Teaching and Research Farm, to investigate the efficacy of Super gro on the growth and yield of Fluted pumpkin Telfairia occidentalis. Treatment levels of 0mL, 5mL, 10mL and 15mL were replicated three times in Completely Randomized Design (CRD) to assess on the following parameters in Centimeters (CM); vine length, number of leaves. Leaf Area in CM^2, and yield at 8 weeks after planting. Readings were taking at every 2 weeks intervals (2, 4, 6 and 8 weeks). Results revealed that supergro had significant effect ($P<0.05$) in all the parameters evaluated, particularly at 15mL treatments at week 8 when compared with the control. Vine length at 8WAP had (107.11cm;0mL 66.78 cm), Number of leaves (22.67 as against 9.98), Leaf Area cm^2 32.17cm^2 ; 23.36 cm^2) and Yield kg/ha^{-1} (1.69 kg/ha^{-1} ;0.43kg/ha^{-1}). SuperGro significantly influenced all the growth and yield parameters of fluted pumpkin Telfairia occidentalis as expressed from Turkey method of mean separation at 5% probability of significance.*

KEY WORD: *Telfairia occidentalis*, Completely Randomized Design (CRD), Bio-Liquid Fertilizer, Super Gro, Sustainable

INTRODUCTION

Background of the Study

Telfairia occidentalis commonly known as ugu, iroko or apiroko, ubong, umee, and umeke among the Igbo, Yoruba, Efik, Urhobo and Edo people of Nigeria. Fluted pumpkin is one of the most important and extensively cultivated vegetable plant by small scale farmers and income generating crops in many parts of African continent as reported by (Adebisi-Adelani *et al*., 2011). Fluted pumpkin is one of the commonest, popularly cut herbs grown in south-eastern Nigeria and belongs to the cucurbitaceace family as shown in its taxonomy classification. The crop originated from West Africa. It is a perennial climber grown for its leaves and seeds, which are very nutritiously important in human diet as reported by Nwauwa and Omona (2010). Fluted pumpkin does best at the lower altitudes and medium to high rainfall and do well on sandy soil provided fertilizer is applied either organic or inorganic, but has a more robust growth in rich well drained loamy soil.

When planting for leaves, the usual spacing is 50 x 50cm for a monocrop or occasionally even closer and some farmer's plant in the middle of a 1.20m- wide bed at 40cm spacing and others plant on a mound or supported with stakes asrevealed by (Nwauwa and Omona, 2010).

It was observed that low soil fertility is been identified as a major factor militating against the production of this crop in many tropical cropping systems where fertilizers and agricultural residues are not returned to the soil for it rejuvenation as stated by (Eteng, 2015; 2017). Agro ecosystems differ from natural ecosystems in larger amounts of biomass and nutrients are removed as crops are been harvested. However, there are standing principles of sound Agricultural principles to replace the lost nutrient via crop harvests by adding organic manure such as cow droppings, poultry manure etc. Application of organic manure improves the soil physical properties and helped to maintains soil organic matter contents all of which positively affect plant productivity as reported by (Nweke and Nsoanya, 2013). The application of poultry droppings, animal manure, sewage sludge and municipal waste to agricultural areable lands solves the problem of biodegradable waste disposal and also improves agricultural productivityas exposed by (Obasi *et al.,* 2008, Odoemelam and Ajunwa; 2008). Ekpo *et al*., (2011) investigated the effect of poultry droppings in soil on the uptake of some heavy metals in fluted pumpkin production with respects to the hazardious effect on human beings during consumpsion of the product, in addition with the continuous use of inorganic or commercial fertilizer may also posed a regarding fact that organic manure maybe effective to the growth and development of fluted pumpkin.because they are easily biodegradable Hence, this beautiful topic was chosen to boosted fluted pumpkin production: Evaluation on Sustatainable Bio-liquid fertilizer (Super Gro) on the Growth and Yield of fluted pumpk.in production.

Description of Fluted Pumpkin

Pumpkin plants are grouped as short lived annual or perennials vines with branching tendrils and broad lobed leaves development. The plant produces large yellow or orange flowers with a pepo fruit (berry with a thick rind) known as a thick rind) referred to as a pumpkin. It is gaining recognition in all parts of Nigeria especially in the North central states inclusive. It is generally regarded as a leafy and seed vegetable crop plant. The leaf has a high nutritional, medicinal and industrial values being rich in protein content of 29%, fat 18%, minerals and vitamins 20%. Apart from the leaves, the seeds can be cooked /roasted and eaten, or ground and added in soup. The oil content of fluted pumpkin in the seeds is useful in soap making and in cooking. Fluted pumpkin is one of the most important and extensively cultivated food and income generating crop in many parts of the African continent as expressed by (Adebisi-Adelani, *et. al.,* 2011). Fluted pumpkin farmers could make an important contribution to the national food supply, where a healthy and expanding market gardening industry exits. It becomes a safeguard against the lowering of health standards, necessary for productive output in an expanding economy in the Global World. Fluted pumpkin (*T. occidentalis* extract) could also be used as an alternative, longer-term, plant food-based supplementry strategy for iron deficiency anaemia treatment for both human and livestock as investigated from the research findings of (Natural Health, 2011).

Harvest and Postharvest Operation

Leaves are best harvested by pruning with knife and also by hand picking, but hand picking might damaged the plants and hindered its development of side shoots reported by (Ubani and Okonkwo, 2011). More than 20 harvests are possible within the production cycle of fluted pumpkin, and with good management practices when applied, the yield of fresh shoot could be up to 10 t/ha^{-1} (Alegbejo, 2012). The female plants are generally known to give better yield than male plants. Upon the setting of the fruits, the pods are harvested 9 weeks afterwards as shown by (Adetunji, 1997). Improper handling like tying and heaping of the harvested long shoots in bundles might result to damage faster of the leaves which should be managed with low cost effective approachin reducing post harvest losses., with the use of vegetable cane storage basket that is lined with jute bags. Also with the use of plant essential oils as presevative of harvested fluted pumpkin leaves to avoid post harvest losses.

Cleaning and preparation of ugu leaves.

Ugu leaves should be cleaned before cutting them up to avoid contamination. Wet cleaning with uncontaminated water inside a big bowl is the best. To ensure a better cleaning, the water and leaves are stirred. Vegetable leaves should not be allowed to soak for longer period as revealed by (Adam, 2013), but repeatedly washed with fresh water until the wash-water is free from dirt after removing the leaves. Then, the water can be drain using sieves.

Preservation of ugu leaves, pods and seeds is a good requirement, but has little attention, hence an Extensive work is yet to be done on the best methods for ugu preservation. However Nigerian Stored Product Research Institute (NSPRI) have developed Cane Storage Basket lined with Jute bags for preseveration of freshly harvested flted pumpkin leaves for one week or more and also Dr. Azawei Alamene 2018/2019 Academic Session at Depatment of Crop and Soil Science Facuty of Agriculture, Niger Delta University Wilberforce Island Bayelsa State Nigeria preserves the teseted crop with Plant Essential Oils inside the Cane Storage basket lined with the jute bags, this helped to prolong the shelf life of the freshly harvested fluted pumpkin leaves, at a room temperature. Food preservation does not involve engineering alone; rather it includes the relationship among engineering, nutritional, biochemical, microbiological, entomological, pathological and economic aspects as reported by (Ubani and Okonkwo, 2011). The fresh leaves start deteriorating immediately after harvest. The low shelf life is common to leafy vegetables because of high moisture content. Ugu leaves can be stored at the same temperature range of 1.11-3.33^{o}C recommended for storing DGVs, and should not be stored together with other fruits and vegetables that give off ethylene gas to avoid wilting and quick spoilage, while in storage (Adams, 2013). Ubani and Okonkwo (2011) observed that the leaves can only be kept for 6 days at 29.1^{o}C and 64.5% The use of evaporative coolant system was also investigated to extend the shelf life of ugu for 5 days as revealed by (Iwagwu *et al*, 2013). Sun drying of green leafy vegetables leads to decrease in vitamin C content as reported by (Oboh and Akindahunsi, 2004). Water stress could be alleviated by sealing the vegetable leaves with thin plastic film and this will restrict loss of chlorophyll, soluble protein and ascorbic acid (Lazan *et al*, 1987 and Nwufo, 1994). Also, wrapping with dried leaves extend the shelf life of leaves that are not wet for few days. The seeds

are usually left with the pod until their utilisation. The pods are kept under shade or on top of wooden support in barns. With proper care and routine checks, to avoid rodent attack, pods can also stored for up to 4 months. Mechanical damaged pods should be sorted out and disposed of as soon as possible to avoid seed damage.

Problems of Chemical fertilizer Fluted Pumpkin Production

Despite the importance of fluted pumpkins in Nigerian diet, farmers are facing a lot of challenges concerning its production; especially on the soils of guinea savanna agro ecological zones. Rapid depletion of soil nutrients and poor physical condition of the savanna soils constituted strong limitations to crop production as stated by (Salako., 2003). Also, soil fertility depletion in small holder farm is the fundamental cause of declining per capita food production as reported by (Sanch *et al*., 2010). Therefore, these soils must be supplemented with adequate macronutrients in other to keep them productive as shown by (Ndor *et al*., 2012). The shortage and high cost of inorganic fertilizers have limited their use for crop production among the peasant farmers in Nigeria, hence alternative approach was applied because, chemical fertilizers alone generate several deleterious effects to the environment and human health and they should be replenished in every cultivation. This is because; the synthetic fertilizer is rapidly lost by either evaporation or by leaching in drainage water and it causes dangerous environmental pollution as narrated by (Aisha *et al*., 2007). Continuous usage of inorganic fertilizer affects soil structure. Hence, organic Bioliquid fertilizer Super Gro was utilized as alternative to mineral fertilizers for improving soil structure investigated by (Dauda *et al*., 2008). Therefore, there is the need for increased dependence on the use of Bio-liquid fertilizers Super Gro asorganic waste such as farmyard manure, crop residues and poultry manure for crop production. In fact, cow dung manure has been adjudged to be the most valuable of all manures produced by livestock (Omisore *et al*., 2009).

Organic Manure and Super gro

Manure is an organic matter used as fertilizer in Agriculture. Manure improves the fertility of the soil by adding organic matter and lots of nutrients generating microorganisms such as bacteria that are trapped by other bacteria in the soil to enhance soil fertility for adequate production of different crops. Organic manure can be produced from series of waste such as; Poultry dropping, swine dung, cow dung, food waste etc. Food waste could be regarded as pure streams of waste and they constitute a major burden to the environment such as odour emanation, vermin attraction, toxic gas etc.

Poultry manure is an excellent organic fertilizer that contained about 3.5% nitrogen, 1.5-3.5% micro nutrients. (Mohammet *et al*. (2000) unlike mineral fertilizers, it adds organic matter to the soil which improves soil structure, nutrient retention, aeration of soil moisture holding capacity and water infiltration which enhances the growth of the cucumber plant (Deksissa *et al*., 2008). Poultry manure adequately supplies phosphorus to plants than other organic manure sources (Garg and Bahla. 2008) and contains essential nutrient element associated with high photosynthetic activities and thus promotes roots and vegetables growth of the cucumber plant and others as reported by (John *et al.*, 2004). Organic manure repairs infertile soil as it improves the soil texture,

colour, mineral availability to plant, water retention ability and survival of microorganisms (Khalid *et al.*, 2014).

Supergro is 100% new generation organic liquid fertilizer that is made from poultry droppings, sea bird guano and organic matter with absolutely no chemicals was added to it for the improvement of agricultural development. It's 100% safe to use on any vegetables and of course the rest of your garden. Supergro can be applied to any plant, tree, vegetable and even grass that required fertilization.SuperGro assists more water to reach the roots of the plant and stays there, optimizing plant growth in less time. It's a source of fertilizer to protect and for healthy growth of Agricultural and farm products. It's also a naturally wetting agents, penetrable, spreader and sticker that has no chemical. It increases the production of food and cash crops.

Among the important indigenous vegetables, *Telfairia occidentalis* seems to be widely eaten in Nigeria and cultivated for its edible succulent's shoots and leaves. This thus makes fluted pumpkin a daily necessity intake by humans which often leads to it scarcity. In recent years, to increase the yield of the crop on the use of organic manure especially cow dungs as it enhances growth and yield of fluted pumpkin with minimal to zero effects unlike inorganic fertilizers. The use of synthetic fertilizer has been observed to cause the destruction of soil texture, structure which leads to soil acidity as a results of increased in concentration, this practices could no longer hold owned adverse effects on soil fertility status, thus resulting in lower yield of crops (Akanbi *et al*., 2010). All these gives rise to reduce crop yields as a results of soil degredation and nutrients imbalance. However, the use of farm input such as Super gro has become a necessity in carrying out a successful fluted pumpkin production by farmers. Super gro is environmental friendly as it is formed from the mixture and dissolution of organic sources of manure such as poultry dropping, cowdung etc and therefore, can be used to increase the production of crops. Objectives of this research work focussed on the following. To investigate the effect of Supergro on the vegetative growth and yield of fluted pumpkin (*Telfairia occidentalis).* To compare the individual effect of the different concentration levels of Supergro on the growth and yield of fluted pumpkin (*Telfairia occidentalis)*

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the green house of the Research and Teaching Farm of Niger Delta University Wilberforce Island, Bayelsa State. The site is located at Latitude 40, 52' and 50, 42' North and longitude 60, 9' and 100, 8' East of the Equator, and falls within the humid tropical climate with a mean annual temperature of 26^0 C (Alagoa,1999).

Experimental Design and Treatments

The experiment was laid out in a Completely Randomized Design (CRD) with four treatment levels which were replicated three times giving a total number of 36 stamds of fluted pumpkin

polythene bags. The levels of the treatment are as follows; 0mL (control) (A), 5mL of super gro (B), 10mL of super gro (C) and 15mL of super gro (D).

Planting Materials and Super Gro procurement

Planting materials were the seeds of fluted pumpkin and super gro were procured from registered agro inputs selling shop at Yenagoa, Bayelsa State.

Preparation of Soil and Bags for Planting

A total number of 36 polythene bags were used in the experiment in which each bag measures a dimension of 25cm x 25cm x 40cm. Soil samples used were obtained from the Niger Delta University Teaching and Research Farm. Soils were muddled and mixed thoroughly using a shade to obtain a uniform soil in all bags and bags were placed 1m apart from each polythene bad.

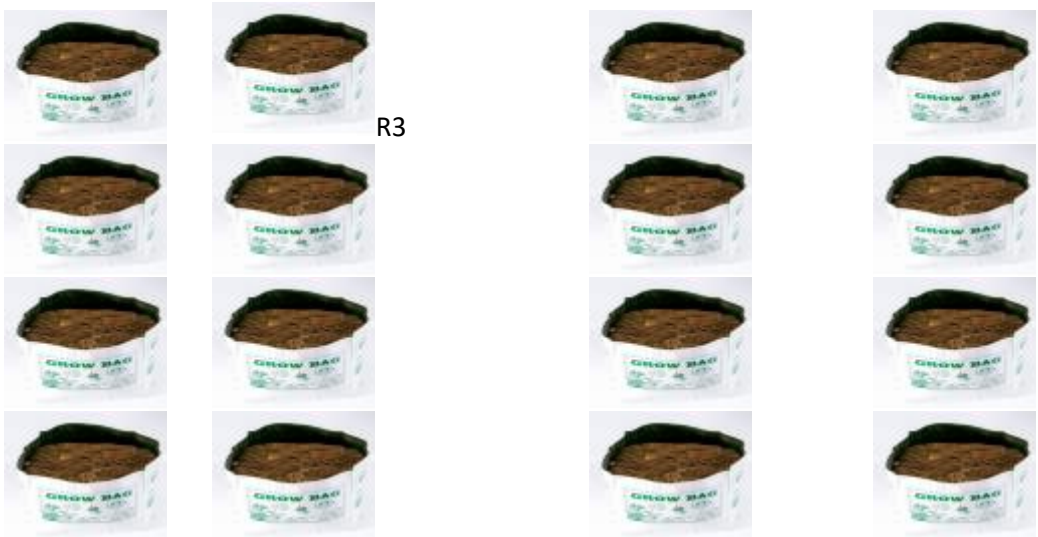
Application of Treatment

Super Gro treatment were applied to the tested crop by foliar application method by spraying the respective levels (0ml, 5ml, 10ml and 15ml) on the crop planted at the polythene bags,after the respective quantities were measured.

Experimental layout

Treatment levels of Super Gro were arranged in CRD and replicated three times.

Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
	 R1		
			
	 R2		
			
			



Cultural practices.

Weed control

Weeding was carried out manually at the green house with the use of hand at two weeks interval after planting to circumvent competition between the plant and weeds for sunlight, space, nutrients and air in the green house which was geared towards obtaining optimum growth and yield.

Data Collection

The following data were collected during the course of the experiment: Vine length (cm), Number of leaves, Leaf area (cm^2), and Yield at harvest (kg/ ha^{-1}).

Vine Length (cm)

Vine length of fluted pumpkin was taken using a tape with a ruler calibrated in centimeter to measure from the base of the vine to the tip and the values were recorded per stand for each experimental unit.The average value for each of the experimental unit were calculated and recorded.

Number of Leaves

This was done by manually counting the number of leaves for the sampling unit and the values were recorded per stand for each experimental unit. The average value for each of the experimental units were also calculated and recorded.

Leaf area (Cm^2)

This was collected using a measuring rule to measure the length and width of the 5^{th} leaf per plant for each sampling unit and the values were recorded per stand for each experimental unit and the leaf area was obtained by multiplying the length,by breadth x the coefficient value of 0.91. The average value for each of the experimental unit was calculated and recorded accordingly.

Yield at Harvest (t/ha)

This was obtained by summing up the weights of all the harvested leaves in kilogram from each experimental units per treatment and later converted to tons per hectare.

Statistical Analysis

The data collected was subjected to analysis of variance (ANOVA) and means were separated using Turkey method at 5% significance level of probability by using Minitab 2019 software.

RESULTS AND DISCUSSION

Effect of SuperGro on Vine Length (cm) at 2, 4, 6 and 8 Weeks After Planting (WAP)

There was significant treatment effect (Super Gro) on vine length of fluted pumpkin when compared to the freshly harvested fluted pumpkin leaves (Control). However there was significant trend on the different concentration levels as the week increases. Vine length of fluted pumpkin increases at 15 mL of SuperGro application at 8 WAP, when compared with the other weeks after planting (WAP) along side with the control. 8 WAP at 15 mL of Super Gro had 107.11cm; 10 mL recorded 104.11 cm; 5 mL obtained 72.33 cm; 0mLbeen the untreated freshly harvested fluted pumpkin leaves had 66.78 cm respectively. Similar trend was observed at the rest weeks after planting. Generally, in all the weeks control had the least mean value of fluted pumpkin vine length as shown in Fig.1

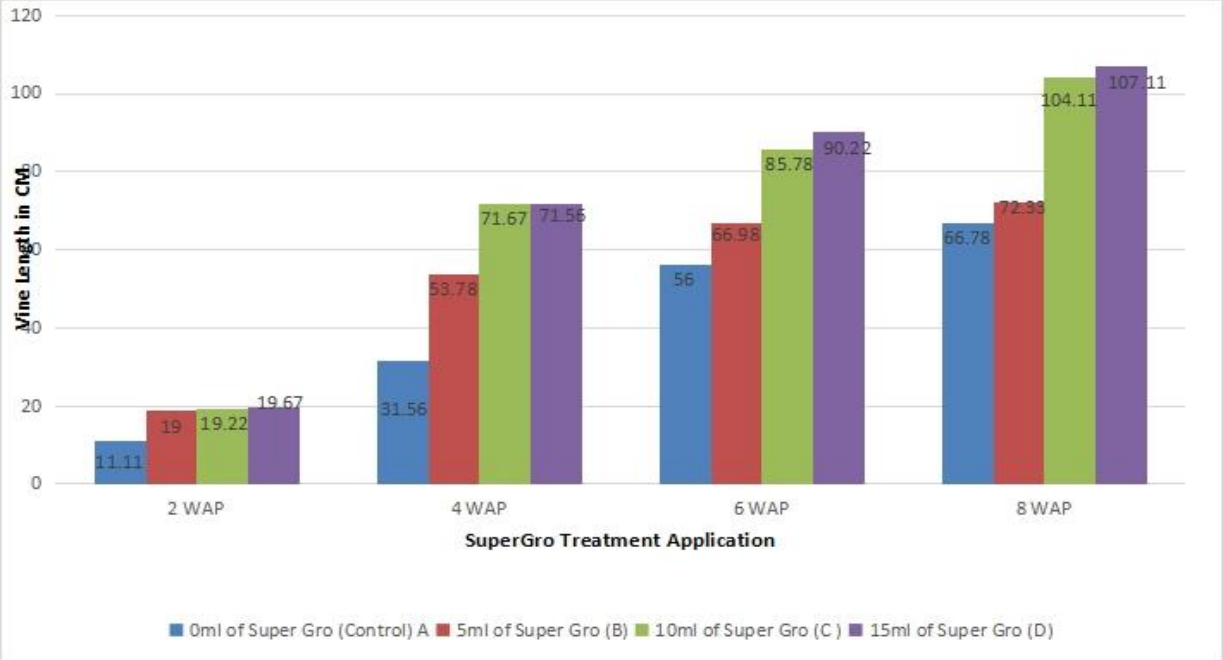


Fig 1: Effect of SuperGro on Vine Length (cm) of fluted pumpkin at 2,4,6 and 8 Weeks after Planting (WAP)

Effect of Super Gro on Number of Leaves of Fluted pumpkin at 2, 4, 6 and 8 Weeks After Planting (WAP)

The application of Super Gro different concentration levels significantly influenced the number of fluted pumpkin leaves. The trend of leaf formation was significantly influenced the fluted pumpkin leaf formation was very attractive as shown in Fig. 2. Figure 4.2 had similar significant treatment effect with Fig.1. However, number leaves at 8 WAP, at 15mL had 22.67;10 mL recorded 22.67; 5 mL had 16.78 and 0mL recorded 9.98 respectively

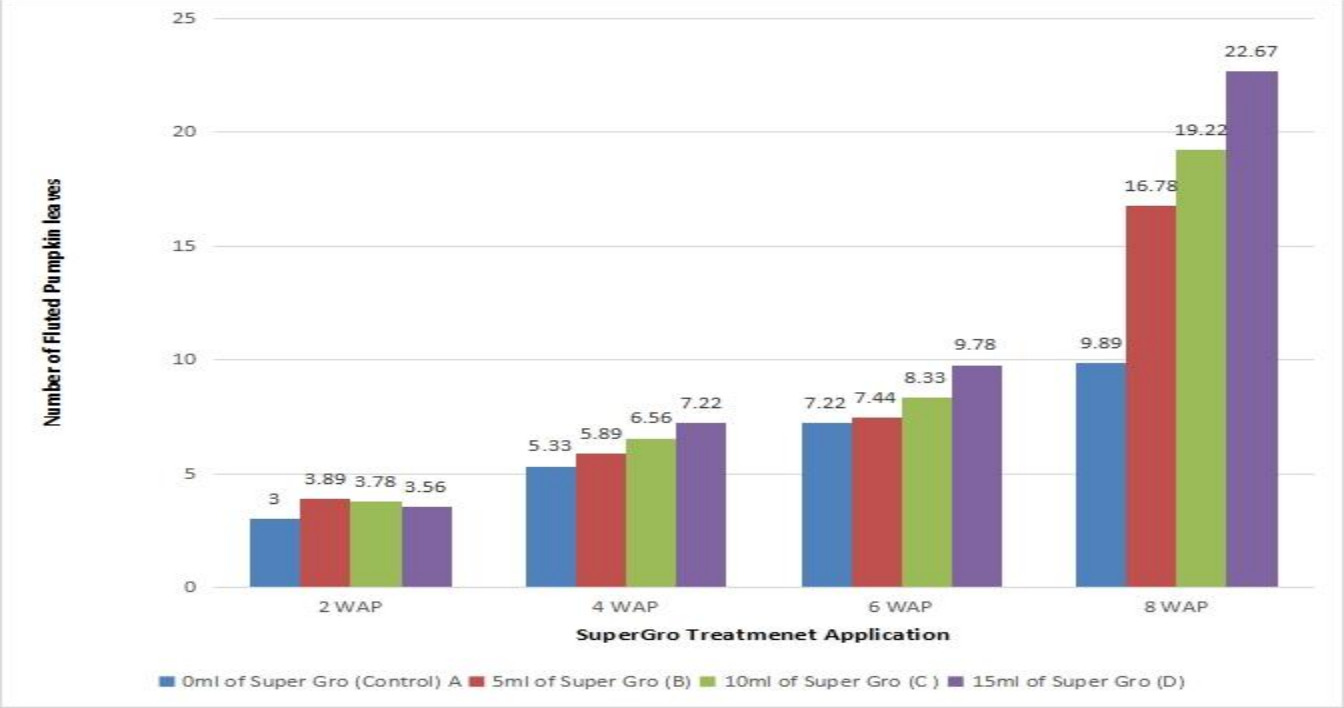


Figure 2: Effect of Super Gro Number of Leaves of Fluted Pumpkin at 2,4,6 and 8 Weeks after Planting (WAP)

Effect of Super Gro on Leaf Area (cm^2) of Fluted Pumpkin at 2, 4, 6 and 8 Weeks After Planting (WAP)

.Application of Super Gro significantly influenced Leaf Area CM^2 of fluted pumpkin within the experimental sampling size by the different concentration of the Super Gro applied, particularly at 4 WAP-8WAP. The control had the least Leaf Area as shown in Fig.3.. 4 WAP (15 mL had 32.17cm^2 ; 10 mL=29.24cm^2 ; 5 mL recorded 28.52 cm^2 and 0 mL had 23.36 cm^2) at 6 WAP Leaf Area was recorded as thus (15 mL had 35.38 cm^2 ; 10 mL =33.34 cm^2 ; 5 mL =32.52 cm^2 and 0 mL =29.33 cm^2). Finally at 8 WAP, (15 mL=42.51cm^2 ; 10 mL=40.02 cm^2; 5nL=36.83 cm^2 and 0 mL =29.33 cm^2). Leaf Area of fluted pumpkin increased at the higher concentration levels of super Gro application

;c

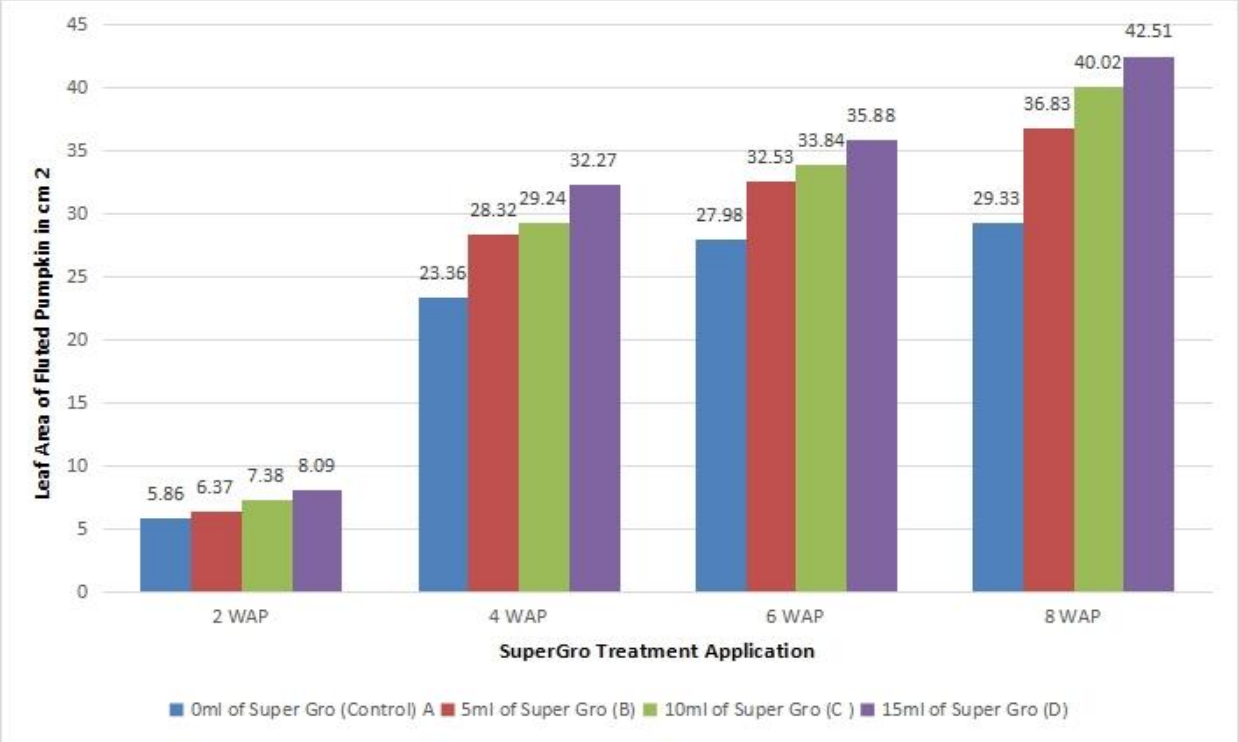


Figure 3: Effect of SuperGro on Leaf Area (cm^2) at 2,4,6 and 8 Weeks after Planting (WAP)

Effect of Super Gro on Yield (kg/ha^{-1}) of fluted pumpkin after harvest.

The mean yield per experimental unit for each treatment is shown in figure 4.4 below. The highest mean yield was obtained from the treatment with 15ml of Super gro having 1.69kg/ha of fluted pumpkin followed by 10ml of Super gro (1.46kg/ha), 5ml of Super gro (1.29 kg/ha) and least from the control with $0.43kg/ha^{-1}$. The experimental units applied with 15ml of Super gro yielded better than any other treatment which is as result of the nutrient content embedded in it. It is also reported by Lawal (2000); increase in growth and yield components of fluted pumpkin as a result of application of fertilizer to enhanced the productivity of these research findings which is in conformity with some researchers findings as revealed below. All the individual treatments differ significantly from one another in terms of mean yield according to the Turkey method of means separation at 5% probability level of significance.

Generally, results of the study conform with the findings of Idem *et al.,* 2012 which they noted that crop response to fertilizer application is affected by nutrient reserve in the soil. According to them, crops response to fertilizer application in soil with very low nutrient content than soil with high nutrient reserve. Organic fertilizer apart from releasing nutrient element to the soil, it has also shown to improve other soil chemicals physical properties which enhances crop growth and development (Ogbonna, 2008; Dauda *et al.,* 2008 and Uko *et al*., 2009).

The growth parametres were greatly influenced by the application of the different levels of SuperGro liquid organic fertilizers, since fluted pumpkin is a vegetables whih made its production to require nitrogenous fertilizers for its optimum growth. These findings are in accordance with some literature citation on the report of Mbagwe and Ekwealor 1990 that organic fertilizers apart from releasing nutrient elememts to the soil has also showed to improve other soil chemical properties which enhanced to improve crop groth and development.

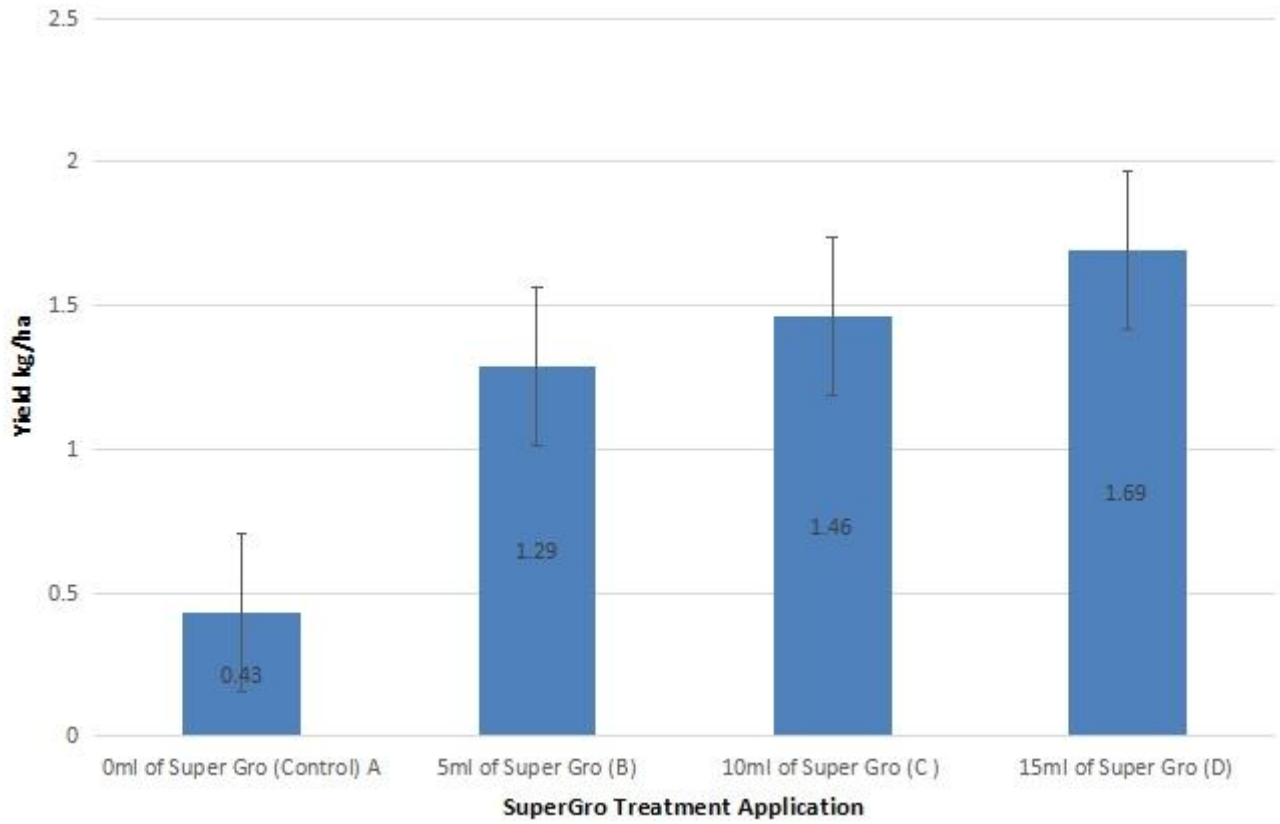


Fig 4: Effect of SuperGro on Yield (kg/ha^{-1}) of fluted pumpkin after harvest

CONCLUSION AND RECOMMENDATION

Conclusion

The growth parameters at week 2, 4, 6, and 8 after planting were significantly higher at the treated stands of fluted pumpkin with 15ml of Super gro were significantly different ($P<0.05$) from the rest treatment concentration levels and the least mean values were always obtained from the control at 2 weeks after planting and Bio-liquid fertilizer Super gro to the fluted pumpkin in the green house, 15ml of Super gro had the highest mean on vine length of 19.67cm and it is significantly not different from 5ml and 10ml of Super gro but significantly different from the control, had the

least mean vine length according to the Turkey method of means separation at 5% probability level of significance.

The highest mean yield was obtained from the treatment with 15ml of Super gro having 1.69kg/ha^{-1} of fluted pumpkin followed by 10ml of Super gro (1.46kg/ha), 5ml of Super gro (1.29 kg/ha) and least from the control with 0.433/ha^{-1} Generally, there is global trend towards organic farming, in reducing environmental pollution, waste recycling and poverty alleviation. The use of poultry manure and other organic manure based fertilizers such Super agro as alternative sources of soil nutrients replenishment and amendment can assist to achieve the objectives of sustainability and productivity of agricultural output to circumvent food shortage and malnutrition as well as to ensure food security.

Recommendation

From this research the following recommendations were made;

1. 15ml of Super gro had better influence on the growth and yield of fluted pumpkin, it is therefore, preliminarily, recommended that, it should be used as an alternative means of soil nutrient restoration and amendment in the production of fluted pumpkin, because it is also human and environmental friendly, because it has no negative side effect.
2. Further research should also be carried out on these different levels or rates at higher levels of Super gro used to know their respective impact on the growth and yield of fluted pumpkin and other vegetables.

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APPENDIXES

Appendix 1

VINE LENGTH AT 2 WAP (cm)

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	12	20	22	21
1	11	17	23	23
1	12	19	15	12
2	10	20	18	20
2	12	21	15	17
2	11	20	20	19
3	12	19	21	21
3	10	20	25	22
3	10	15	14	22
Total	**100**	**171**	**173**	**177**
Mean	**11.11**	**19.00**	**19.22**	**19.67**

ANOVA

Sources of Variation	D.F	SS	M.S	Fcal	Ftab
Total	35	704.75			
Treatment	3	454.31	151.44	19.35	2.92
Error	32	250.44	7.83		

***Significant at P< 0.05

Appendix 2
VINE LENGTH AT 4 WAP (cm)

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	30	61	70	99
1	40	49	75	80
1	30	50	71	90.5
2	35	61	65	67
2	27	51	76	70
2	29	62	77	60
3	35	45	74	59
3	32	50	69	58.5
3	26	55	68	60
Total	**284**	**484**	**645**	**644**
Mean	**31.56**	**53.78**	**71.67**	**71.56**

ANOVA

Sources of Variation	D.F	SS	M.S	Fcal	Ftab
Total	35	12163.81			
Treatment	3	9762.31	3254.10	43.36	2.92
Error	32	2401.50	75.05		

***Significant at P< 0.05

Appendix 3
VINE LENGTH AT 6 WAP (cm)

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	61	99	92	100
1	55	80	90	98
1	60	90.5	80	94
2	65	67	82	90
2	56	70	90	85
2	57	60.875	89	90
3	45	59	80	84
3	45	58.5	90	75
3	60	18	79	96
Total	**504**	**602.875**	**772**	**812**
Mean	**56.00**	**66.99**	**85.78**	**90.22**

ANOVA

Sources of Variation	**D.F**	**SS**	**M.S**	**Fcal**	**Ftab**
Total	35	12397.7			
Treatment	3	6955.58	2318.53	13.63	2.92
Error	32	5442.13	170.07		

***Significant at P< 0.05

Appendix 4
VINE LENGTH AT 8 WAP (cm)

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	70	107	122	126
1	69	90	106	127
1	67	95	107	106
2	80	69	94	96
2	60	76	94	90
2	65	65	103	97
3	65	66	93	106
3	67	60	94	103
3	58	23	124	113
Total	**601**	**651**	**937**	**964**
Mean	**66.78**	**72.33**	**104.11**	**107.11**

ANOVA

Sources of Variation	D.F	SS	M.S	Fcal	Ftab
Total	35	19414.75			
Treatment	3	11879.42	3959.81	16.82	2.92
Error	32	7535.33	235.48		

***Significant at P< 0.05

Appendix 5
NUMBER OF LEAVES AT 2 WAP

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	3	4	3	3
1	3	4	4	3
1	3	4	4	3
2	3	3	4	4
2	3	4	3	4
2	3	4	4	4
3	3	4	4	4
3	2	4	5	4
3	4	4	3	3
Total	**27**	**35**	**34**	**32**
Mean	**3.00**	**3.89**	**3.78**	**3.56**

ANOVA

Sources of Variation	D.F	SS	M.S	Fcal	Ftab
Total	35	12.88889			
Treatment	3	4.22	1.41	5.20	2.92
Error	32	8.67	0.27		

***Significant at P< 0.05

Appendix 6
NUMBER OF LEAVES AT 4 WAP

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	6	6	6	5
1	5	5	6	6
1	6	5	5	6
2	4	5	6	7
2	6	6	7	7
2	5	6	7	8
3	5	7	7	8
3	6	7	8	9
3	5	6	7	9
Total	**48**	**53**	**59**	**65**
		5.89		
Mean	**5.33**		**6.56**	**7.22**

ANOVA

Sources of Variation	**D.F**	**SS**	**M.S**	**Fcal**	**Ftab**
Total	35	48.75			
Treatment	3	18.08	6.03	6.29	2.92
Error	32	30.67	0.96		

***Significant at P< 0.05

Appendix 7
NUMBER OF LEAVES AT 6 WAP

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	6	7	8	13
1	8	7	7	11
1	8	7	8	10
2	7	8	8	9
2	7	6	8	8
2	6	7	8	8
3	8	8	9	8
3	8	8	9	11
3	7	9	10	10
Total	**65**	**67**	**75**	**88**
Mean	**7.22**	**7.44**	**8.33**	**9.78**

ANOVA

Sources of Variation	D.F	SS	M.S	Fcal	Ftab
Total	35	77.63889			
Treatment	3	36.31	12.10	9.37	2.92
Error	32	41.33	1.29		

***Significant at P< 0.05

Appendix 8
NUMBER OF LEAVES AT 8 WAP

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	8	14	16	26
1	10	15	18	24
1	10	16	20	21
2	9	19	23	25
2	9	16	26	19
2	9	18	17	20
3	11	18	18	28
3	12	17	17	22
3	11	18	18	19
Total	**89**	**151**	**173**	**204**
Mean	**9.89**	**16.78**	**19.22**	**22.67**

ANOVA

Sources of Variation	D.F	SS	M.S	Fcal	Ftab
Total	35	992.3056			
Treatment	3	788.31	262.77	41.22	2.92
Error	32	204.00	6.38		

***Significant at P< 0.05

Appendix 9
LEAF AREA AT 2 WAP (cm^2)

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	7.28	7.28	7.28	7.28
2	7.28	7.28	8.19	5.46
3	5.46	7.28	10.92	5.46
4	5.46	5.46	5.46	13.65
5	5.46	7.644	7.28	13.65
6	5.46	5.45	7.28	7.28
7	5.46	3.64	5.46	7.28
8	5.46	6.006	7.28	5.46
9	5.46	7.28	7.28	7.28
Total	**52.78**	**57.32**	**66.43**	**72.8**
Mean	**5.86**	**6.37**	**7.38**	**8.09**

ANOVA

Sources of Variation	**D.F**	**SS**	**M.S**	**Fcal**	**Ftab**
Total	35	152.1311			
Treatment	3	26.97	8.99	2.30	2.92
Error	32	125.16	3.91		

***Significant at P< 0.05

Appendix 10
LEAF AREA AT 4 WAP (cm^2)

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	22.3	19.75	29.12	21.66
1	22.3	20.38	29.12	37.31
1	29.12	25.84	33.58	36.4
2	22.3	29.12	21.02	36.4
2	22.3	26.21	24.84	41.77
2	25.48	29.85	36.4	36.4
3	21.84	33.95	41.77	29.12
3	22.3	33.58	21.84	29.12
3	22.3	36.19	25.48	22.29
Total	**210.24**	**254.87**	**263.17**	**290.47**
Mean	**23.36**	**28.32**	**29.24**	**32.27**

ANOVA

Sources of Variation	D.F	SS	M.S	Fcal	Ftab
Total	35	1469.666			
Treatment	3	369.77	123.26	3.59	2.92
Error	32	1099.89	34.37		

***Significant at P< 0.05

Appendix 11
LEAF AREA AT 4 WAP (cm^2)

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	34.81	29.48	40.95	29.48
1	29.12	29.85	29.49	40.13
1	16.65	29.12	29.12	29.48
2	29.12	32.76	30.76	26.57
2	29.12	36.4	26.57	45.96
2	29.85	29.85	29.48	40.13
3	29.85	29.12	45.22	45.9
3	24.21	30.21	36.12	29.12
3	29.12	45.96	36.86	36.12
Total	**251.85**	**292.75**	**304.57**	**322.89**
Mean	**27.98**	**32.53**	**33.84**	**35.88**

ANOVA

Sources of Variation	D.F	SS	M.S	Fcal	Ftab
Total	35	1520.827			
Treatment	3	302.30	100.77	2.65	2.92
Error	32	1218.53	38.08		

***Significant at P< 0.05

Appendix 12
LEAF AREA AT 8 WAP (cm^2)

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	35.46	34.67	45.33	37.87
1	30.23	34.44	38.43	48.66
1	18.12	35.82	35.66	37.43
2	31.22	36.42	36.23	35.25
2	32.32	38.43	31.26	49.64
2	30.21	35.26	34.67	48.66
3	31.11	34.64	48.25	49.34
3	24.22	34.22	40.55	35.46
3	31.12	47.54	49.77	40.26
Total	**264.01**	**331.44**	**360.15**	**382.57**
Mean	**29.33**	**36.83**	**40.02**	**42.51**

ANOVA

Sources of Variation	**D.F**	**SS**	**M.S**	**Fcal**	**Ftab**
Total	35	1896.181			
Treatment	3	882.98	294.33	9.30	2.92
Error	32	1013.20	31.66		

***Significant at P< 0.05

Appendix 13
YIELD at Harvest (kg/ha)

Replicate	Control (A)	5ml Super gro (B)	10ml Super gro (C)	15ml Super gro (D)
1	0.2	1.3	1.6	1.6
1	0.5	1.2	1.4	1.6
1	0.6	1.3	1.5	1.7
2	0.3	1.4	1.4	1.6
2	0.4	1.2	1.4	1.8
2	0.5	1.2	1.5	1.7
3	0.4	1.3	1.6	1.7
3	0.6	1.4	1.3	1.8
3	0.4	1.3	1.4	1.7
Total	**3.9**	**11.6**	**13.1**	**15.2**
Mean	**0.43**	**1.29**	**1.46**	**1.69**

ANOVA

Sources of Variation	D.F	SS	M.S	Fcal	Ftab
Total	35	8.41			
Treatment	3	8.09	2.70	269.67	2.92
Error	32	0.32	0.01		

***Significant at P< 0.05