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Comparative Effect of Sesasons, Organomineral Fertilizer Ratios and Profitability of Cucumber Production (Cucumis Sativus L.) in Southwest Nigeria

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ABSTRACT

Ensuring an adequate good nutritional supply has been a major concern of mankind over the millennia, and even in today's modern world of great scientific and technological achievements. Fruits and vegetables are of great nutritional value and they are sources of vitamins and minerals, thus, essential components of human diet. Premise to the above challenge there is the need to evaluate the economics production of cucumber under different agronomic management in order to encourage local production among small holder farmers. Experiment to document the productivity of cucumber was in early and late cropping seasons of 2016 at Teaching and Research Farm of Obafemi Awolowo University (OAU), Ile-Ife, Nigeria. The experimental design was a split-plot laid out in a Randomized complete block design (RCBD) with three replications. The main plot include; four vine trailing methods (Staked, Trellised, Mulch and control) while sub-plots were six levels of organomineral fertilizers fortified in ratios (1:3, 1:1, 3:1 of organic with inorganic fertilizer;, 100% NPKha-1, 100% Organic Nha-1 and 0% Nha-1 as a control). The fertilizers were aimed to give 100% kg Nha-1. Data were collected on fruit yield per plot and yield was converted to hectare. The data collected were subjected to analysis of variance (ANOVA) using (SAS, 2003). Means of significant treatments were separated using the Duncan`s Multiple Range Test (DMRT). Also, gross margin analysis was carried out to know the profitability of the production seasons of cucumber. The data obtained from the experiments show that type of vine management and fertilizers significantly affected the yield of cucumber. Among the vine trailing methods investigated mulched method significantly enhanced the yield and subsequently produced the higher number of fruits and resulted in higher fruit yield per hectare. Ratio 1:1 combination of inorganic and organic fertilizers resulted in the highest number of cucumber fruits and economic return. Therefore, for effective production of cucumber, application of organic and mineral fertilizers at the ratio 1:1 with the use of straw mulching resulted in higher yield and better revenue. In addition, gross margin analysis reviewed that late raining season production of cucumber gives more income compared with early season production.

Keywords: Vine trailing, amendments, marketable and gross margin.

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INTRODUCTION

Ensuring an adequate good nutrient supply has been a major concern of mankind over the millennia, and even in today's modern world of great scientific and technological achievements (Busari *et. al*., 2015). Diets are inadequate for about five hundred million people all over the world (FAO, 2001). Fruits and vegetables are one of the great nutritional value and they are sources of vitamins and minerals, thus, essential components of human diet. Kra and Bani (1988) revealed that fruits form a substantial percentage (about 25%) of the major food crops cultivated in the tropics and so it is the source of livelihood for a considerable section of the population.

The study by Food and Agricultural Organization (FAO, 1992) estimated that about 790 million people are chronically undernourished in the developing regions of the world. Specifically, daily food consumption consists of mainly cereals, roots and tubers. This poor feeding habit expose people to infections and such disease as typhoid fever, heart, liver and kidney disease due to poor body defense mechanisms. Fruits like cucumber (*Cucumis sativus* L.) have been found to play a very important role in the nutrition and health (Hulme, 1971; Nagy and Shaw, 1980) especially as they contain substances which regulate or stimulate digestion, act as laxatives or diuretics, pectins and phenoic compounds which play a part in regulating the pH of the intestines. Although it is less nutritious than most fruits, it is still a very good source of vitamins A, C, K, B6, potassium and also provides dietary fibres, pantothenic acid, magnesium, phosphorus, copper and manganese (Vimala *et al.,* 1999).

Cucumber production provides new and profitable sources of income for farmers. The cucumber production can be of importance to small- medium scale farmers since these crops are well suited to smallholdings and family enterprises (Serageldin, 2004) and are often adaptable to urban areas (Smith *et al*., 2004). Cucumber has a comparative advantage over cereal crops when land is scarce and labor is abundant, which is often the case in developing countries. Studies from the developing countries of Asia and some countries in Africa consistently show that farmers engaged in the production of fruits and vegetables earn higher net farm incomes than those that are engaged in cereal production (Abedullah *et al*., 2002; Cock and Voss, 2004; Francisco, 2004). Cucumber production contributes to the overall growth of markets and agri-businesses in rural economies. Studies show that the agro-industrialization process has been faster for nontraditional products such as cucumber fruits (Escobal *et al.,* 2000; FAO, 1997). Consequent upon this, there had been increased trade and commercial activities surrounding these commodities (Egharevba, 1995).

In spite of the importance in the diet, per capita consumption of cucumber fruits in the developing world is only 100 g compared with 220 g in the more advanced countries (Messian, 1992). In the continual fight against hunger and malnutrition, significant increase in cucumber production must be achieved through the use of better vine management practices with less cost of production. While farmers are desirous in growing cucumber they have little knowledge about the agronomic management and the economy of production. There is the need to properly identify and document the production technology in order to enhance the cultivation to meet the nutritional need of the increasing population. From the premise above, this paper therefore assess the seasonal effect and other agronomic management practices coupled with the economic benefits involved in cucumber production in rainforest location of Nigeria.

Materials and Methods

The study was conducted during early and late (February – April and August - October) seasons of 2016 at the Teaching and Research Farm of the Obafemi Awolowo University, Ile-Ife, Nigeria- situated within the rain forest zone on latitude 7^{θ} 28'N and longitude 4^{θ}33'E at an elevation of about 200 m above sea level. The location

experiences approximately 7 months (April-October) of bimodal rainfall and 5 months (November – March) of dry season annually with slight irregularity in the rainfall distribution pattern occurring between April-October. Mean rainfall for 2016 was 1683.7 mm. The experimental plots were previously cropped to maize (*Zea mays* L) and was allowed to rest for one cropping season before the experiments. Pre-planting soil samples were collected using an Auger to soil depth of about 15cm and was analysed for physical and chemical analyses. The soil belongs to Iwo series derived from coarse-grained granite gneiss parent rock and classified as Ultisol (low base status forest soils). It is well drained, grayish brown to brownish red with predominantly high low acidity clay-kaolinite (Harpstead, 1973). The growing horizon was generally loamy, acidic (pH 6.50 to 6.60) and with K 0.02-2.06 C mol kg^{-1}, N 0.06-0.09%, and available P 23.03-31.16 $mgkg^{-1}$.

Cucumber, *Marketmore* 76 cultivar, was used, and it was obtained from a local commercial seed company. The experiment was laid in a split plot arrangement in a Randomized Complete Block Design (RCBD) with 3 replications. The main plots was trailing methods (staked, mulched, trellised and control) and sub-plot were six organomineral fertilizers (1:3, 1:1, 3:1 of organic with inorganic fertilizer;, 100% NPKha-1, 100% Organic Nha-1 and 0% Nha-1 as a control). The land was disk plowed twice and harrowed once using a disc harrow and raised beds were made using African hoe. Each plot was 2.5 x 2.5 m and seeds were sown at two seeds per hole at inter- and intra-row spacing of 0.5 x 0.5 m corresponding to 80,000 plants ha^{-1}. The fertilizer treatments were applied in a split applications at two and four weeks after sowing (WAS) using the ring method. Weed control was done manually. Insect pest and fungi were controlled when pest incidence were observed using Insecticide (*Cypermethrine,* 10EC a.i) and Fungicide (*Mankozeb* 75% a.i) applied at the rate of 40 ml per 20 liters of water. The spraying started from 3, 4 and 5 weeks after sowing. All agronomic operations were cost to determine the production cost.

yield parameters data were taken from rows 3 and 4 (net row) and 10 randomly harvested fruits were selected for number of fruits per plot, fruit length, fruit circumference and fruit yield and yield parameters ha^{-1} was determined as described by Oloyede *et al*. (2013). Marketable fruits were determined based on uniformity in color, size and shape and undamaged by pests or disease and it were sold at the current market price. The data collected were subjected to analysis of variance (ANOVA) using SAS, (2003 version) and significant means were separated using Duncan Multiple Range Test (DMRT). Also, Gross Margin Analysis was done by deducting production cost from total revenue, algebraically GM = GFI – TVC. Where GM = Gross margin, GFI = Gross farm income, TVC = total variable cost.

Results and Discussion

The soil analysis revealed that the soil was slightly acidic, (pH 6.6 in water (CH_2O) and pH 6.1 in Calcium chloride ($CaCl_2$)), very low in organic carbon (0.96%), organic matter (1.66%) and total nitrogen 0.06. The low nutrient content in these sites might due to the effects of continuous cropping of the experimental field to various arable crops which might have depleted soil nutrients through several process of nutrient uptake by plant (Adepetu *et al*., 2014). It has been noted by Adepetu *et al*. (2014) that some nutrients are temporarily immobilized by microorganisms which were responsible for organic matter decomposition. Available P was 23.03 mg kg^{-1} and was high when compared with the critical value of 10^{-16} mg kg^{-1} for southwestern Nigeria (Sobulo *et al*., 1972). This could be as a result of immobile nature of P in soil (Sobulo *et al*., 1972). The rainfall and temperature pattern during the seasons ranged from 41.4 to 212.2 mm, maximum temperature ranged from 27.1 to 33.9ºC and minimum temperature ranged from 21.1 to 23.9ºC which are typical example of the region.

The effects of vine trailing methods treatments significantly affected the yield parameters of cucumber during the early season Table 3. However, the effects of fertilizers were no noted in the first season. The reason could be as a result of continuous rainfall during the growth and development of the crop which may have led to leaching of available nutrients. The trailing methods and fertilizers interactions were not significantly different. The effects of trailing methods treatments show a positive effect on yield and yield parameters Table 3. Fertilizers effects were observed to be positively affected the yields and yield parameters of cucumber. The effects of trailing and fertilizers interactions were observed to affects the number of fruits per plot and fruit weight. Among the four trailing methods investigated mulch method affected the number of fruits, fruit length and fruit weight at the early season. However, mulching method did not significantly different from trellis methods at early and late seasons Table 4. The organomineral ratios positively improved all the yield parameters Table 4. The application of 100% NPK produced the highest number of fruits, fruit length, fruit diameter and fruit weight per plot which could be as a result of immediate mineralization of the nutrients for the plants to assess without delay. However, 100%organic did not performed better when compared with 100%NPK but they are not significantly different from each other except on number of fruits and yield at both seasons. The 1:1 treatment signicantly improved the yield and yield parameters when compared with other treatments used which could be as a result of the mixture of the two nutrients needed by the plants and subsequently improve the soil and make the soil more fertile as a result of early establishment of the plants because of the inorganic mineral present which make it possible for the plants the assess the nutrient required during the early growth and developments and organic manure will be releasing the nutrient gradually for the plant to make use off. Untreated, (control) plot showed the least effect when compared with other treatments investigated in both seasons.

Table 3. The number of fruits/plant, fruit length, fruit diameter, fruit weight and ton/ha was significantly influenced by different methods of vine trailing while fertilizer effects was not noticed except on number of fruit /plant. The interactions between the vine trailing methods and fertilizers was not significantly different from each other. The effects of vine trailing methods and fertilizers ratios significantly improve the morphological parameters Table 4. Among the four methods of vine tailing methods, trellised method significantly improve all the parameters at 4WAP follow by stake and mulch. At 5WAP, trellis continue to perform better when compare with other methods investigated. However, unstaked had the poorest result due to exposure to the soil borne diseases and insect pest attack. The performance of the trellis could be as a result of raising the plant above the ground level without having a direct contact with the soil where pest and diseases could be a problem. The 100%NPK and 1:3 did not statistically different from each other, however, control plots shows the least results. The yield and yield parameters was influenced by vine trailing methods and fertilizers Table 5. Mulching method produce the highest number of fruit/plant and highest ton/ha as a result of well spread, naturally grown without been disturbed and has no direct contact with the soil which could have reduced the fruit quality and marketability of the fruits. More so, trellis and stake method were not different from each other statistically. However, unstake method produce the least yield ton/ha. Among the five ratios of fertilizers applied, 1:1 produce longer fruit length and yield (ton/ha) which could be a double nutrients that available to the plant compare to other single treatments. The 100% NPK produce highest number of fruit/plant though it is not significant different from 1:1 at early season.

Table 3. ANOVA table showing the mean square of yield of cucumber during the early and late seasons of 2016 cropping seasons

TRMT	EARLY SEASON						LATE SEASON					
SV	DF	NF	FL (cm)	FD (cm)	FW (g)	TON (t/ha)	DF	NF	FL (cm)	FD (cm)	FW (g)	TON (t/ha)
REP	2	62.51	1.51	0.91	125680.63	41.68	2	36.35	3.78	9.47	22431.15	7997.75
VM	3	606.83**	58.30*	33.47**	84715.95	164.64*	3	256.01**	8.69*	8.97**	17845.41*	85.45**
Error A	6	10.94	15.21	1.76	70538.15	37.84	6	14.44	4.36	2.17	3503.79	0.65
FERT	5	79.51	11.09	1.00	12311.03	47.61	5	287.09**	12.12**	1.91	9886.06*	3.75**
VM X Fert	15	47.08	19.08	0.48	2673.99	30.62	15	76.05**	5.5	2.61	8663.2*	0.311
Error B	40	14.05	15.80	0.86	62642.74	24.95	40	23.87	3.08	1.94	3274.4	1.99
Total	71						71					

Key: WAP= weeks after planting, SV= source of variation, DF= degree of freedom, NF= number of fruit, FL= fruit length, FD=fruit diameter, FW=fruit weigth, REP= replication, VM=vine management, Fert= fertilizers

Table 4. Mean separation of yield of cucumber during early and late seasons of 2016 cropping seasons

TREATMENT	EARLY SEASON					LATE SEASON				
VINE MGT	NF	FL (cm)	FD (cm)	FW (g)	Ton (t/ha)	NF (cm)	FL (cm)	FD (cm)	FW (g)	Ton (t/ha)
U	5.33c	17.23b	14.97	209.78b	3.59c	9.27c	19.99b	16.47b	217.82b	5.34c
S	6.22b	18.36b	14.63b	238.15a	5.63b	14.61b	21.00ab	16.47b	264.48a	7.61ab
T	7.05b	17.79b	14.62b	347.36a	5.73b	13.50b	21.60a	17.87a	285.11a	6.61b
M	18.44a	21.27a	17.45a	283.98a	10.70a	18.44a	21.27a	17.44ab	284.02a	8.51a
FERTILIZER										
0	6.50d	17.68a	15.14a	280.9a	3.95c	5.58d	19.35b	16.60a	209.00a	6.02b
1:3	10.17ab	17.73a	15.89a	328.5a	7.04ab	13.66c	20.69ab	16.97a	276.85a	8.19ab
1:1	12.33ab	19.20a	15.53a	357.3a	9.04a	19.25a	21.07a	17.06a	264.27a	8.62a
3:1	9.25bcd	18.27a	15.15a	283.6a	5.19b	14.83bc	21.95a	17.23a	278.93a	7.64ab
100%ORG	7.42cd	20.08a	15.25a	343.5a	5.06b	12.25c	20.63ab	16.78a	258.04a	7.41ab
100%NPK	12.92a	19.09a	15.53a	301.1a	8.18ab	18.16ab	22.11a	17.75a	290.05a	7.09ab

TABLE 5. EFFECT OF VINE MANAGEMENT ON CUCUMBER YIELD IN EARLY AND LATE SEASON

	Early Season					**Late Season**			
Item	**Amount**	**UNSTAKED**	**STAKED**	**TRELLISED**	**MULCHED**	**UNSTAKED**	**STAKED**	**TRELLISED**	**MULCHED**
Seed (3 kg/ha)	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000
Tractor operation	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500
Insecticides	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Rope	0.00	0.00	0.00	1,500	0.00	0.00	0.00	1,500	0.00
Trailing of vines	2,000	0.00	0.00	2,000	0.00	0.00	0.00	2,000	0.00
Stake cutting	2,500	0.00	3,200	1,000	0.00	0.00	3,200	1,000	0.00
Labour	0.00								
A, planting	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
B, insecticides spraying	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
C, harvesting	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
D, weeding	12,000	12,000	12,000	12,000	3000	12,000	12,000	12,000	3000
Vine mgt.	0.00	0.00	2,500	2,500	0.00	0.00	2,500	2,500	0.00

Harvesting bags	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Transportation	0.00	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Miscellaneous	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
TOTAL VARIABLE COST		**149,000**	**154,700**	**156,000**	**140,000**	**149,000**	**154,700**	**156,000**	**140,000**
Land (rent)	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Hoe	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
Cutlass	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Basket	700.00	700.00	700.00	700.00	700.00	700.00	700.00	700.00	700.00
Watering can	850.00					850.00	850.00	850.00	850.00
Pumping machine	25000.00					25,000	25,000	25,000	25,000
TOTAL FIXED COST 13,000		**13,000**	**13,000**	**13,000**	**13,000**	**38,850**	**38,850**	**38,850**	**38,850**
Yield t/ha		3.59	5.63	5.73	10.70	5.34	10.61	6.61	10.90
Price/ ton		100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Gross income		359,000	563,000	573,000	1,070,000	534,000	1, 061,000	661,000	1,090,000
Gross margin		210,000	409,000	417,000	930,000	**385,000**	**907,700**	**505,000**	**950,000**

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