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HYDROPONICS PRODUCTION OF CUCUMBER AS SOIL FARMING ALTERNATIVE IN NIGERIA

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ABSTRACT

The constant farmers-herders clash has predisposed farmers to insecurity in Nigeria thereby making farming in open field difficult. The hydroponics system has gained popularity in the cultivation of vegetable crops around the World. However, in Nigeria, there is dearth of information on hydroponics usage as an alternative to soil farming. Hence, the need to investigate the suitability of producing cucumber in Nigeria using the hydroponics system compared to soil. Seeds of three cucumber varieties were grown in cocopeat substrate and topsoil in a 3 (genotypes) by 2 (substrate) factorial experiment laid in a completely randomized design with 3 replicates. Each plant was fertigated with 100 ml of liquefied poultry manure weekly and was watered every 3 days till harvest. Data were taken on the number of leaves, plant height, leaf area, days to flowering and fruiting, number of fruits and average fruit weight. Data collected were analyzed using ANOVA and differences in the treatment means were separated using least significant differences at 5% level of significance. Result obtained showed significant differences among genotypes in the growth and yield parameters with Poinset having the highest number of fruits (6.88±0.57) and fruit weight (275.00±17.03), while the substrate effect was not significant.

INTRODUCTION

Nigerian farmers predominantly practices shifting cultivation (Lawal, 2014) to ensure the basic nutrients in the soil are adequate enough to support the growth of the crops cultivated. However, the sole use of soil for agricultural purposes comes with its constraints ranging from pests and diseases, weed versus crops competition for space and nutrients, environmental pollution and the increasing rate of insecurity in the country due to farmers and herders clashes (Muhammed & Baba, 2019). The above mentioned farming constraints have led to the increasing advocacy for an alternative means of crop production.

The above mentioned constraints can be circumvented by the adoption and practice of soilless farming system (hydroponics). The hydroponics system is much adapted to different environmental conditions as the green house condition can be adjusted at will, and has the ability to increase yield and quality of produce (Verdonck et al., 1983) and ensures the optimum use of nutrient and water (Savvas & Lenz, 2000). The cucumber (Cucumis sativa L.) is an important vegetable in the diet of Nigerians, however, the production requires extreme soil fertility management to obtain high yield. This requires intensive soil management to achieve, but with the hydroponics system, the nutrient and water regimes can be controlled with ease (Paul, 2000).

The term hydroponics being defined as the cultivation of crops in any substrate other than soil. The availability of these substrates in an area is essential in choosing the one suitable for production in the locality. Although, different substrates have been successfully utilized in crop production, there is dearth of information on the use of cocopeat substrate in producing cucumber using the hydroponics system in Nigeria. Hence, this study aims at investigating the effectiveness of the use of cocopeat substrate in cucumber production in Nigeria while comparing it with Nigerian topsoil.

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METHODS

Experimental Set Up

Three varieties of cucumber (Poinset, Calypso and Murano) seeds and twenty-four troughs of drip system hydroponics troughs were purchased from the Soilless farmlab seed company, Abeokuta. Cocopeat in block form was purchased from Afri-Agri Company, Lagos. The buffered cocopeat blocks were dissolved in water. The cocopeat was used to fill in 12 hydroponics troughs with perforations beneath for drainage purposes, while the remaining 12 troughs were filled with sterilized topsoil. The hydroponics troughs comprises of 8 litres capacity with 4 segments of 2 litres capacity each. Poultry droppings were sourced from Ajayi farm, Ibadan. The poultry manure was allowed to dry for one week, 1 g of the poultry manure was ground into fine particles and liquefied by soaking them in 1 Litre of water for two days. For the plants fertigation, 100 ml of the nutrient was used to fertigate each plant once per week and watering was done every 3 days till harvest. 2 litre capacity buckets were filled with the cocopeat and the cucumber seeds were sown directly, it was watered at 3 days' interval and inspected daily for the germination of the seeds. At one week interval, the germinated seedlings were transferred to the hydroponics set up.

Experimental Design

The experiment was a 2 (substrates) by 3 (varieties) factorial laid in a completely randomized design (CRD) with 3 replicates.

Data Collection and Statistical Analysis

At bi-weekly intervals, data were taken on the plant height, number of leaves and leave area, while the number of days to 50 % flowering, days to fruiting, number of fruits harvested and the fruit weights were collected. Data collected were analysed using ANOVA (SAS 9.0 version) and differences in treatment means were separated using least significance differences at 5 % level of significance.

RESULTS

The results obtained from this study on the agronomic performances of the three genotypes evaluated shows that there were significant differences among the genotypes on the plant height, number of leaves and leaf area at both 2 and 4 weeks after planting (Table 1). The height of the Calypso genotype at two weeks (15.55±0.85) and four weeks (25.09±1.07) respectively were significantly higher than the rest genotypes. The number of leaves of Calypso genotype at 2 weeks old (4.75±0.21) was not significantly higher than Poinset (4.38±0.21), but they were both significantly higher than the Murano (3.25±0.21), while at 4 weeks old, the number of leaves of the Calypso (9.50±0.38) was significantly higher than both Murano and Poinset genotypes. Also, the leaf area of the Calypso genotype (19.43±0.68) at 2 weeks old was significantly higher than both Murano and Poinset, however, at 4 weeks old, there were no significant differences between the leaf area of the Calypso genotype (23.53±0.83) and the Poinset genotype (21.60±0.83), but they were both statistically higher than the Murano genotype (13.60±0.83).

Table 1. Agronomic performance of three genotypes of cucumber in hydroponics system

Genotypes	Plant height (cm)		Number of leaves		Leaf area (cm^2)	
	Week 2	Week 4	Week 2	Week 4	Week 2	Week 4
Calypso	15.55a	25.09a	4.75a	9.50a	19.43a	23.53a
Murano	10.88b	13.89c	3.25b	6.75b	5.10c	13.60b
Poinset	8.00c	20.83b	4.38a	7.75b	15.48b	21.60a
$LSD_{(0.05)}$	2.53	3.18	0.62	1.13	2.02	2.47
SE	0.85	1.07	0.21	0.38	0.68	0.83

Means with the same alphabet down the group are not significantly different from each other at 5 % level of significance. LSD: Least significant differences, SE: Standard error

There were no significant differences among the genotypes on the number of days taken by the three genotypes of Calypso, Murano and Poinset to reach 50% flowering (Table 2). However, it took the Murano genotype an average of 57.13±1.02 days to produce its first fruit, which was significantly higher than both Calypso (50.13±1.02) and Poinset (52.13±1.02) to produce their first fruits respectively. The number of fruits produced per plant by the Poinset genotype (6.88±0.57) was significantly higher than both Calypso (1.50±0.57) and Murano (2.13±0.57) respectively. Also, the weight of the cucumber fruits produced by Poinset (275.00±17.03) was significantly higher than both Calypso (171.25±17.03) and Murano (140.00±17.03) respectively.

Table 2. Yield parameters of three genotypes of cucumber in hydroponics system

Genotypes	Days to 50% Flowering	Days to Fruiting	Number of Fruits	Fruit Weight (g)
Calypso	36.00a	50.13b	1.50b	171.25b
Murano	38.38a	57.13a	2.13b	140.00b
Poinset	35.25a	52.13b	6.88a	275.00a
$LSD_{(0.05)}$	4.2	3.03	1.69	50.59
SE	1.41	1.02	0.57	17.03

Means with the same alphabet down the group are not significantly different from each other at 5 % level of significance. LSD: Least significant differences, SE: Standard error.

The results obtained on the effect of the substrates used on the growth parameters of cucumber plants shows that the height of the plants at 2 weeks after planting was significant, and the topsoil (12.87±0.69) was significantly higher than the cocopeat (10.08±0.69) (Table 3). However, the plant height at 4 weeks after planting, number of leaves at 2 and 4 weeks after planting and leaf area at 2 and 4 weeks after planting respectively were not significant between topsoil and the cocopeat. Also, the two substrates were not significantly different from each other in the yield parameters evaluated (Table 4).

Table 3. Effect of substrates and substrate by genotype interactions on the growth parameters of cucumber

Substrates	**Plant height (cm)**		**Number of leaves**		**Leaf area (cm^2)**	
	Week 2	Week 4	Week 2	Week 4	Week 2	Week 4
Topsoil	12.87a	4.08a	14.07a	21.18a	7.83a	20.38a
Cocopeat	10.08b	4.17a	12.60a	18.68a	8.17a	18.77a
$LSD_{(0.05)}$	2.07	0.51	1.65	2.6	0.93	2.02
SE	0.69	0.17	0.56	0.88	0.31	0.68
Genotype*Substrate	NS	NS	NS	NS	*	*

Means with the same alphabet down the group are not significantly different from each other at 5 % level of significance. LSD: Least significant differences, SE: Standard error

Table 4. Effect of substrates and substrate by genotype interactions on the yield parameters of cucumber

Substrate	**Days to 50% Flowering**	**Days to Fruiting**	**Number of Fruits**	**Fruit Weight (g)**
Topsoil	36.92a	54.08a	3.75a	176.25a
Cocopeat	36.17a	52.17a	3.25a	214.58a
$LSD_{(0.05)}$	3.43	2.48	1.38	41.31
SE	1.16	0.83	0.46	13.9
Genotype*Substrate	NS	*	*	NS

Means with the same alphabet down the group are not significantly different from each other at 5 % level of significance. LSD: Least significant differences, SE: Standard error.

DISCUSSIONS

The calypso genotype showed superior performance to other genotypes in the agronomic parameters evaluated at the early growth stages. However, as the plants age, the poinset genotype developed up to the calypso. The differences in the agronomic growth rate are as a result of the differences in their genotypic make up, and this agrees with the findings of Saheb et al. (2017). Despite, the superior agronomic characters shown by the calypso genotype, the flower and fruit development was faster in poinset, and this reflected in the highest number of fruit produced and their weight obtained from the poinset genotype as the fruits had more time to develop physiologically. However, the fruit weight obtained from the three genotypes is within the value recorded by Saheb et al. (2017) who worked with more genotypes.

According to Colle et al. (2017), the size and shape of cucumber fruit is an important trait for its marketability, and these traits are determined by physiological processes during ovary and fruit growth (Tanksley, 2004) and studies have shown a correlation between the two by localizing their quantitative trait loci (QTL) (Weng et al., 2015). This account for the differences in fruit sizes observes in the three genotypes studied.

Different substrate types have been reportedly used in cucumber production through the hydroponics system (Sarwar et al., 2018) and growing media affects plants morphology and productivity significantly (Ghazvini et al., 2007). In this study, both the cocopeat and topsoil substrates used performed equally in terms of the agronomic and yield parameters of the genotypes studied, and this strongly supports the findings of Sarwar et al. (2018) who reported a non-significant yield between topsoil and cocopeat substrate.

CONCLUSION

This study seeks to investigate the effectiveness of cocopeat substrate use in the hydroponics production of cucumber in Nigeria as a means of establishing an alternative to soil farming system. The findings so far showed that the cocopeat can be effectively used in the hydroponics production of cucumber in Nigeria with poinset producing biggest fruit among the genotypes and showing high adaptability to hydroponics farming. This opens up an alternative means of vegetable farming in Nigeria within ones home confinement with maximum security to circumvent the continued farm land disagreement with the herders. However, with cocopeat substrate being imported into the country as it's not being produced locally, it is important to investigate other locally sourced substrates as an alternative to hydroponics production of different vegetables in Nigeria.

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