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PRODUCTION OF WATERLEAF IN A SOIL AND SOILLESS SYSTEMS USING SINGLE AND DOUBLE NODE CUTTINGS

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ABSTRACT

The general acceptability of waterleaf and its profitability as a vegetable has promoted its high demand in Nigeria. However, rural farmers depend on conventional farming systems for production with a low output. This calls for an alternative technique besides the conventional method to boost production and meet market demand. This study, therefore, evaluated the yield response of waterleaf cuttings to soil and soilless systems. Single and double nodal cuttings were cut from one-month-old waterleaf plants and planted in 4 kg cocopeat substrate and topsoil each, mixed with 250 g poultry manure each and arranged in a 2 (level of nodal cuttings) by 2 (substrate) factorial experiment laid in a completely randomized design with three replicates in 2 cycles. The plants were watered every other day. At harvest, data were collected on the Root Weight (RW), Shoot Weight (SW), and Leaf Weight (LW). Data collected were analyzed using ANOVA and differences in means were separated using least significance differences at 5% significance level. The substrate type was insignificant in the growth and yield parameters. However, the RW, SW and LW differed significantly between the nodal cuttings and ranged from 9.1±2.8 g to 21.2±2.8 g, 12.0±4.5 g to 27.0±4.5 g and 10.7±3.1 g to 21.9±3.1 g, respectively in the first cycle. The RW, SW and LW, also ranged from 10.1±1.8 g to 20.5±1.8 g, 12.7±3.0 g to 24.8±3.0 g, and 11.7±3.0 g to 23.7±3.0 g in the second cycle of production.

INTRODUCTION

Waterleaf (*Talinum triangulare*) is a leafy vegetable that originated from tropical Africa and grown in many countries including Asia, South America and West Africa (Tindall, 1983). Urban residents usually see it as a weed during the raining season because of its widening survival range. Like other leafy vegetables, it is widely cultivated in home garden to improve nutritional deficiency of less privilege family and mostly consumed in the southern part of Nigeria (Udoh et al., 2005). It plays a major role in eradicating malnutrition in Africa because it is a rich source of calcium, phosphorous, iron, protein and vitamins (Tata et al., 2016).

The nutritional value and the affordability of the crop have made its demand higher among other common staple fibrous leafy vegetables. In southern Nigeria, it is used as herb for treating ailments and contagious diseases including measles and stomach upsets (Udoh et al., 2005). It performs well as fodder for raising giant snails (Ebenso & Okafor, 2002). Waterleaf is an important vegetable both as food and as raw materials for industries, which also serves for economic interest (Nya et al., 2010). In the past, the consumption of vegetable in Nigeria had been on the increase and currently estimated between 22 and 47.5 kg/person/year. The general acceptability of the vegetable by all classes of people and its profitability among other vegetables has promoted its cultivation by unemployment youths and the women of the rural population in the southern part of Nigeria.

In West Africa, forecasters indicate that the urban population will reach 63% by 2050, enhancing the needs for effective urban and sub-urban agricultural production systems to complement rural systems. In addition, cultivation of this crop may provide additional income especially for female farmers. This therefore calls for a technique, beside conventional

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method, which serves as alternative for massive production of waterleaf to meet the larger population as earlier projected. With the current security challenges in Nigeria coupled with urbanization, the call for the adoption of hydroponics system at home garden becomes increasingly relevant to meet the demand for vegetables in the country. This study therefore evaluated the morphological and yield response of waterleaf cuttings to soil and soilless systems.

MATERIALS AND METHODS

Experimental setup

Buffered cocopeat substrate (5 kg block form) were purchased from Afri-Agri Company in Lagos State, Nigeria. The cocopeat was dissolved in 30 litres of water and poured into 12 hydroponics troughs of 8 litre capacity. Another twelve (12) troughs were filled with topsoil. Single and double node vine cuttings of one-month-old growing waterleaf plants were harvested. The vines were planted in the soil and soilless (cocopeat) troughs. Each substrate in the troughs were mixed thoroughly with 250 g poultry manure. The plants were watered three times a week for four (4) weeks before harvesting. The experiment was carried out twice.

Experimental design

The experiment was a 2 (number of nodes) by 2 (substrate) factorial laid in a completely randomized design and replicated three times.

Data Collection and Statistical Analysis

Bi-weekly, morphological data were taken on the plant height (cm), internode length (cm), number of leaves, and number of nodes, while at harvest, the number of new leaves, number of flowers and plant weight were collected. Data collected were analysed using analysis of variance (SAS 9.0 version) and differences in treatment means were separated using least significant differences at 5% level of significance.

RESULTS

Plant Height (cm)

Table 1 shows that there were no significant differences between the substrates, nodal explants and the interaction between the substrates and nodal explants on the plant height in the first cycle of cultivation. However, at two weeks after planting, the height of waterleaf plants grown in the cocopeat substrate (22.67±1.37) cm was significantly taller than the ones grown in the soil (15.42±1.37) cm in the second growing circle.

Number of Nodes

On the number of nodes, there were no significant differences between the substrates, nodal explants and the interaction between the substrates and nodal explants on the nodal production by the plants in both first and second cycle of cultivation (Table 2).

Table 1. Effect of substrates and explants nodal level in the height of waterleaf plants

Substrates	Plant height (cm)			
	Cycle one		Cycle two	
	Two weeks	Four weeks	Two weeks	Four weeks
Cocopeat	22.70a	31.83a	22.67a	29.67a
Topsoil	14.20a	28.17a	15.42b	27.33a
LSD(0.05)	9.32	13.4	4.46	11.75
SE	2.86	4.11	1.37	3.6
SubxNodes	122.88ns	96.33ns	117.19*	16.33ns
Double	19.12a	32.33a	19.25a	31.00a
Single	17.78a	27.67a	18.33a	26.00a
LSD(0.05)	9.32	13.4	4.46	11.75
SE	2.86	4.11	1.37	3.6

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Lead Significant Differences, SE: Standard Error, SubxNodes: Substrate by Nodes Interaction

Table 2. Effect of substrates and explants nodal level in the number of nodes produced by waterleaf plants

Substrates	Number of nodes			
	Cycle one		Cycle two	
	Two weeks	Four weeks	Two weeks	Four weeks
Cocopeat	13.00a	32.00a	17.17a	28.50a
Topsoil	6.50a	24.50a	10.83a	21.67a
LSD(0.05)	7.82	12.15	6.49	19
SE	2.39	4.02	1.99	5.83
SubxNodes	36.75ns	154.08ns	21.33ns	114.08ns

Double	12.00a	39.67a	17.83a	32.83a
Single	7.50a	16.83a	10.17b	17.33a
LSD(0.05)	7.82	12.15	6.49	19
SE	2.4	4.02	1.99	5.83

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Lead Significant Differences, SE: Standard Error, SubxNodes: Substrate by Nodes Interaction

Number of Leaves

There were no significant differences between the substrates, nodal explants and the interaction between the substrates and nodal explants on the number of leaves produced by the waterleaf plants in the first cycle of cultivation (Table 3). However, in the second production cycle, the plants grown in the cocopeat substrate produced significantly higher number of leaves (19.17±2.07) than the ones grown in topsoil (6.76±2.07).

Internodes (cm)

There were no significant differences between the substrates, nodal explants and the interaction between the substrates and nodal explants on the internodes of the waterleaf plants in both first and second cycle of cultivation (Table 4).

Biomass (g)

Table 5 showed that in both first and second growing cycles; the double node planting explants produced heavier roots (21.15±9.05) g, (20.48±1.76) g compared to the single node cut explants with root weights of 9.05±2.76 g and 10.07±1.76 g, respectively. The stem weight of the double node cut explants in the first (26.97±4.49) and second (24.82±2.96) g cycles were significantly heavier than the single node cut vines that produced 12.02±4.49 g in first cycle and 12.68±2.96 g, respectively. The leaf weight produced by the double node cut vines in first cycle (21.88±3.06) g and second cycle (23.72±2.98) g were significantly heavier than the double node cut vines in the first cycle (10.65±3.06) and second cycle (11.68±2.98) g, respectively.

Table 3. Effect of substrates and explants nodal level in the number of leaves produced by waterleaf plants

Substrates	**Number of leaves**			
	Cycle one		**Cycle two**	
	Two weeks	**Four weeks**	**Two weeks**	**Four weeks**
Cocopeat	16.33a	31.17a	19.17a	31.00a
Topsoil	11.17a	26.67a	6.76b	25.00a
LSD(0.05)	10.97	16.42	6.76	19.87
SE	3.36	5.25	2.07	6.09
SubxNodes	30.08ns	216.75ns	21.33*	147.00ns
Double	16.50a	39.50a	19.33a	35.83a
Single	11.00a	18.33a	11.67b	20.17a
LSD(0.05)	10.97	16.42	6.76	19.87
SE	3.36	5.25	2.07	6.09

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Lead Significant Differences, SE: Standard Error, SubxNodes: Substrate by Nodes Interaction

Table 4. Effect of substrates and explants nodal level in the internodes of waterleaf plants

Substrates	**Internode length (cm)**			
	Cycle one		**Cycle two**	
	Two weeks	**Four weeks**	**Two weeks**	**Four weeks**
Cocopeat	2.87a	3.83a	1.90a	2.08a
Topsoil	2.43a	2.90a	1.87a	2.05a
LSD(0.05)	1.4	1.15	0.69	0.65
SE	0.43	0.35	0.21	0.2
SubxNodes	0.16ns	0.05ns	0.03ns	0.003ns
Double	3.00a	3.37a	2.00a	2.13a
Single	2.30a	3.37a	1.77a	2.00a
LSD(0.05)	1.4	1.15	0.69	0.65
SE	0.43	0.35	0.21	0.2

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Lead Significant Differences, SE: Standard Error, SubxNodes: Substrate by Nodes Interaction

Table 5. Effect of substrates and explants nodal level in the biomass of waterleaf plants

Substrates	Root weight (g)		Stem weight (g)		Leaf weight (g)	
	Cycle one	Cycle two	Cycle one	Cycle two	Cycle one	Cycle two
Cocopeat	16.58a	17.07a	20.98a	21.57a	17.08a	20.25a
Topsoil	13.62a	13.48a	18.00a	15.93a	15.45a	15.15a
LSD(0.05)	8.99	5.74	14.66	9.65	9.97	9.73
SE	2.76	1.76	4.49	2.96	3.06	2.98
SubxNodes	2.25ns	2.17ns	5.47ns	17.28ns	0.01ns	15.41ns
Double	21.15a	20.48a	26.97a	24.82a	21.88a	23.72a
Single	9.05b	10.07b	12.02b	12.68b	10.65b	11.68b
LSD(0.05)	8.99	5.74	14.66	9.65	9.97	9.73
SE	2.76	1.76	4.49	2.96	3.06	2.98

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Lead Significant Differences, SE: Standard Error, SubxNodes: Substrate by Nodes Interaction

DISCUSSIONS

The findings of this study showed that the waterleaf plants grew at same rate (considering the agronomic parameters) in both the soil and soilless systems and the nodal explant levels in both cycles of production. This might be a result of the fertigation with poultry manure, which allowed the plants access to adequate nutrient for growth and development in both systems. Several research has established the usefulness of cocopeat substrate as a sufficient substrate for growing vegetables (Ahmad et al., 2011) as cocopeat substrate has high aeration capacity which allows easy root penetrations (Abad et al., 2002).

Vine cutting technology has become a common system of multiplying vegetative propagated crops (Essilfie et al., 2016) of which waterleaf can be propagated through in addition to seeds. In the first two weeks of growth, the double node explants outgrew the single node cuttings in the second production cycle. However, at the fourth week of growth, the single node cuttings grew at same rate with the double node cuttings. This shows that the double node cuttings established faster than the single nodal cuttings, but considering propagation ratios, the single node cuttings is higher. The findings of this research supports the work of Dumbuya et al. (2017).

The growth substrates had no effect on the biomass produced by the waterleaf plants in the two production cycles. Sarwar et al. (2018) had earlier reported the non-significance between topsoil and cocopeat in the production of vegetables. However, the double node cut vines produced heavier biomass in terms of root weight, stem weight and especially the leaf weight which is predominantly consumed by humans as vegetable soup and animals as folder. The double node cut explants benefitted from the early establishment in the accumulation of biomass compared to the single node cut explants. This supports the findings of Essilfie et al. (2016).

CONCLUSIONS

Both soil and soilless systems of cultivating waterleaf supported the production in the two cycles. However, there were no difference between the nodal explants on the agronomic parameters but the double node cuttings had an improved biomass production relative to the single node cut explants. Hence, waterleaf can be produced conveniently at ones convenience in the home garden to boost its availability.

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