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Differential Response Of Three Carrot Genotypes To Different Levels Of Organic And Inorganic Fertilizer Application In Southern Derived Savanna Zone Of Nigeria

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This study was conducted at landmark University during the period of 2015 and 2016 to assess the differential response of three Carrot genotypes to different levels of Organic and Inorganic fertilizer application in Southern Savanna Zone. The experiment was conducted using a Randomized Complete Block Design with three replications. Data collected on leave number, fresh leave weight, plant height and fresh root weight were subjected to analysis of Variance. Different between means were partitioned using Duncan Multiple Range test at 5% probability level (p = 0.05). The study revealed that at application of 36.8kg/ha of NPK 15:15:15 and 1t/ha of organic manure the three carrot genotypes responded differently and significantly for fresh root yield. However, there was no significant differential response to organic manure application for leaf number, but there was significant differential response under the application of 71.60kg/ha of NPK 15:15:15. All the three Carrot genotypes responded differently and significantly at application of 1t/ha of organic manure for plant height. At all levels of both Organic and Inorganic manure applications, all the three Carrot genotypes responded differentially for root yield either significant or non-significant at different levels of application. Highest Carrot root yields (40.87t/ha, 41.48t/ha and 41.58t/ha) were recorded by Varieties, ALBAKA NOMA and ROHAMA NOMA under the organic manure regime. Future study should focus on the identification of required level of manure for optimal production of individual Carrot genotypes rather than general recommendation for all the Carrots genotypes.

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Key words: *Carrot, genotypes, manure, genotypes, levels of manure, response*

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Introduction

Carrot (Daucas carota L.) is one the major vegetable cultivated world- wide. The two cultivated types of carrot are Eastern (Asiatic) and Western carrots (Martin et. al., 2004). Carrot (Daucus carota var. sativus) is a member of the Umbelliferae family. Carrot is one of the most popular and ancient vegetable crops in the world. Carrots probably originated in Asia around northwest India. Cultivation of carrots for medicinal purposes began 2000 to 3000 years ago. They were used for a myriad of medicinal purposes including stomach ulcers, abscesses, bladder, liver and kidney problems, to aid in childbirth and even as aphrodisiacs. Cultivation of roots for consumption dates back to 600 A.D. when purple root types were grown in the area currently known as Afghanistan.

It is a biennial plant but grown as annual which has a hollow, erect, very short stem and quadripinnate leaves which can grow up to 30cm in length. Carrot has a main tap-root which becomes tuberous with absorbent hairs but without secondary roots. The roots may grow up to 20cm in length and attain a diameter of 3-4cm. It is made up of a central cylinder (core) which is more or less fibrous and an external part (cortex) which is tender and of a deeper colour than the inner core (De Lannoy, 2000). Carrots are relatively tolerant of a wide variety of temperatures but prefer cooler agro-climatic conditions where temperature varies between 15.6 and 21.1oC during growth period (Rubatzky et al., 1999). High temperature favors increased

shoot growth at the expense of root growth. However, when air temperature rises above 28oC, top growth is reduced and roots may become stronger in flavor (Libner, 1989).

Hot, sunny days can injure or kill young plants. Long periods of hot weather may depress carrot yields, cause strong terpinoid flavor and bitter taste in roots, and result to short and blunt roots.

Muck soils or loose, friable sandy loam soils are ideal for carrot production. Although heavier soils are not ideal, carrots can successfully be grown on heavy-textured soils under irrigated conditions. Short, blunt types are often grown on heavier soils. Sandy loam soils allow proper growth and development of a long, smooth, straight root. Soils with excessive stones, pebbles and debris can cause forked or misshapen roots. Soils should also be well drained as carrots will not perform well under water-logged conditions. Sites should be selected that have loose, friable soils to a depth of 12-14 inches without pebbles. Deep sandy soils can also be used although they may require more frequent irrigation.

Carrot is among the profitable vegetable product to promote due to its high nutritional value. However, its productivity is reduced slowly due to poor application of fertilizers, both commercial and organic manures, poor agronomic practices, diseases and attack of some insects (Rhoda, 2008). Carrot has relatively high demand for soil nutrients especially potassium and nitrogen (Bendel et al., 1992); the increased production in Nigeria has become feasible by the application of sufficient plant nutrients to depleted soils to improve soil fertility.

Both organic and inorganic fertilizers have their major roles they play on the growth and yield of carrot. Indiscriminate use of inorganic fertilizer changes physical, chemical and biological properties of soil and can cause health hazards due to the toxic residual effects. However, Organic fertilizer improves soil structures, stimulates soil biological activity and enhance the solubility of phosphorus applied as fertilizer in the soil (Stevenson and Ardakani, 1972). However, the main constraint in using organic fertilizer in most part of the world is the determination of appropriate rate for a specific variety of crop so that it remains with acceptable yield quantity and quality (Allemann and Young, 2001).

The purpose of this study therefore were to (i) Compare the differential response of three carrot genotypes to organic and inorganic manure application. (ii) determine which of the two types of fertilizer (organic or inorganic) is better for high yield performance of carrot.

Materials And Methods

The field experiment was conducted at the Teaching and Research Farm of Landmark University, Omu-Aran, Kwara State (Latitude 8^0 9^0 0" N and Longitude 5^0 61^0 0" E) located at the Southern Guinea Savannah Zone of Nigeria. The area has maximum temperature of 36^0c to 33^0c and the minimum temperature of 28^0c to 22^0c. The humidity of the area is high (47-43%) all year round except in January when the dry wind blows from the north. It has an annual rainfall pattern which extends between the months of April and October with average annual rainfall of between 600mm – 1500mm. the peak rainfall is in May – June and September – October while the dry season is between November and March.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three (3) replications. Each plot was three rows, 2m long, 50cm between and within row spacing respectively. There were total of 18 plots all together where organic and inorganic manure were randomly allotted. The application of Fertilizer were carried out two weeks after the Carrot seedlings were transplanted.

The following Varieties of Carrot were used for the study; Alheri noma, Albaka noma and Rahama noma.

The treatment combination used for the Inorganic Fertilizer application includes Alheri noma +0kg/ha of NPK 15:15:15 fertilizer (T1), Albaka noma +0kg/ha of inorganic fertilizer (T2), Rahama noma +0kg/ha of NPK 15:15:15 fertilizer (T3), Alheri noma +35.8kg/ha of NPK 15:15:15 NPK 15:15:15 (T4), Albaka noma +35.8kg/ha of NPK 15:15:15 fertilizer (T5), Rahama noma +35.8kg/ha of NPK 15:15:15 fertilizer (T6), Alheri noma +71.6kg/ha of NPK 15:15:15 fertilizer (T7), Albaka noma +71.6kg/ha of NPK 15:15:15 fertilizer (T8), Rahama noma +71.6kg/ha of NPK 15:15:15 fertilizer (T9). While those for Organic treatment combinations were as follow; Alheri noma +0kg/ha of poultry manure(T1), Albaka noma +0kg/ha of poultry manure(T2), Rahama noma +0kg/ha of poultry manure(T3), Alheri noma +1t/ha of poultry manure(T4), Albaka noma +1t/ha of poultry manure(T5), Rahama noma +1t/ha of poultry manure(T6), Alheri noma +2t/ha of poultry manure(T7), Albaka noma +2t/ha of poultry manure(T8), Rahama noma +2t/ha of poultry manure(T9).

Cultural Practices

These are the following activities that took place for both the inorganic and organic manure experimentation on the field:

Carrots seeds were nursed in the nursery for four weeks before transplanting them to main site. Poultry manure were applied two weeks before the Carrot seedlings were transplanted . The NPK Fertilizer were applied a week after the seedlings were transplanted. Hand weeding were carried out regularly. The field were irrigated twice daily till maturity period.

Data were carried out on

Plant Height

The height of the plants per plot were measured in centimetre at 50,70 and 90 days after transplanting using meter rule from ground level to the tip of the highest growing point and the means were recorded.

Number Of Leaves

Ten randomly selected Carrot plants per each experimental plot were taken for leave count at 50, 70, 90 days after transplanting. The average number of leaves counted were recorded.

Fresh Root Weight

Immediately after harvest, the total Carrots roots obtained from each treatment plot were taken and their fresh weight were measured with the help of a beam balance.

Fresh Leaf Weight

After harvest, leaves were detached manually with hands and fresh weight was measure and average weight was measured per plant.

Proximate Analysis of Carrot roots

Proximate analysis of the roots of Carrots were carried out at the central Laboratory of Landmark University, Omuaran, Nigeria. Samples of the Carrot roots were oven dried, grinded, and analyzed for nutritional component under the Parten D analyzer

Data analysis.

Data collected were subjected to Analysis of Variance (ANOVA) using S.A.S, 2000, the significant treatment means were compared using Duncan Multiple Range Test (DMRT) at 0.05 level of probability.

Result And Discussion

Table 1: Soil physical and chemical properties prior to planting (0-15cm)

Parameter	Value
Particle size	
Sand (%)	76.12
Silt (%)	12
Clay (%)	11.88
Textural class	Sandy loam
pH (H_2O) 1:1	5.25
Total Nitrogen (%)	0.16
Organic Carbon (%)	1.88
Organic Matter (%)	3.24
Exchangeable bases	
K (cmol/kg)	0.23
Na (cmol/kg)	0.66
Ca (cmol/kg)	3.97
Mg (cmol/kg)	1.32
$Al^{+}H$ (cmol/kg)	0.07
ECEC (cmol/kg)	6.25
Available Phosphorus (mg/kg)	21.12

Table 2: Mean fresh leave weight of three varieties of Carrot under two levels of Organic and Inorganic Fertilizer and control

Treatments	Varieties of Carrot		
Inorganic/level of application (Kg/ha)	ALHERI NOMA (g/plant)	ALBAKA NOMA (g/plant)	RAHAMA NOMA (g/plant)
0.00	43.02^{c}	44.45^{c}	42.04^{c}
35.80	51.58^{ab}	59.04^{ab}	55.73^{ab}
71.60	59.47^{a}	63.96^{a}	57.30^{a}
Organic Manure/level of application (t/ha)			
0.00	43.44^{c}	45.73^{c}	43.23^{c}
1.00	54.56^{ab}	60.32^{a}	55.54^{ab}
2.00	60.43^{a}	62.01^{a}	59.34^{a}

Means followed by the same letter(s) within a column are not significantly different according to Duncan's Multiple Range Test.

The pre-planting soil analysis is as shown in Table 1. The pH of the soil was strongly acidic, the Nitrogen content of the soil was very low, the available Phosphorus was high, and the exchangeable K was at moderate while the exchangeable Na, Ca, and Mg are all suitable. The organic Carbon and Organic matter are adequate. The soil is high in with relatively low values in both silt and clay; hence the textural class is Sandy loam

Table 2 showed the mean fresh leave weight per plant of three varieties of Carrot under two levels of Organic and Inorganic Fertilizer and control. All the three Carrot varieties ALHERI NOMA, RAHAMA NOMA and ALBAKA NOMA significantly responded differentially to the two levels of Inorganic manure and the control (35.80kg/ha, 71.60kg/ha and 0kg/ha) of N.P.K.15:15:15 respectively for fresh leave weight per plant. However, highest fresh leave weight per plant was obtained by Variety ALBAKA NOMA under the application of 71.60kg/ha of N.P.K.15:15:15. Similarly, under the Organic manure application regimes, the three Carrots Varieties responded significantly and differentially for fresh leave weight at application of 1t/ha of poultry manure. The same variety produce the highest leave weight per plant (ALBAKA NOMA) under the application of both Inorganic and Organic Fertilizer application. This is an indication that different carrot Varieties behave differently at different level of fertilizer application in relation to vegetative growth.

Table 3:Mean leave number of three varieties of Carrot under two levels of Organic and Inorganic Fertilizer application and the control

Treatments	Varieties of Carrot		
Inorganic/level of application (Kg/ha)	ALHERI NOMA (no)	ALBAKA NOMA (no)	RAHAMA NOMA (no)
0.00	11.76^{ab}	11.33^{ab}	10.90^{a}
35.80	12.23^{ab}	12.30^{ab}	13.76^{ab}
71.60	15.22^{a}	14.80^{ab}	15.90^{a}
Organic Manure/level of application (t/ha)			
0.00	11.33^{ab}	10.58^{b}	11.49^{ab}
1.00	17.82^{a}	16.23^{a}	18.70^{a}
2.00	16.65^{a}	16.33^{a}	15.54^{a}

Means followed by the same letter(s) within a column are not significantly different according to Duncan's Multiple Range Test.

Comparatively, average leaf numbers counted on carrot plants under the application 71.60 Kg/ha of N. P.K 15:15:15 was significantly ($p < 0.05$) higher than control for Variety ALHERI NOMA (Table 2). However, the were no significant differential response for Variety ALBAKA NOMA under the two levels of Inorganic fertilizer application and the control. The mean number of leaves counted on carrot plants under application of 1 and 2 tons per hectare Organic fertilizer were significantly higher than control for the three varieties of the carrots. However, there were non-significant differential response by the three carrots varieties to the two levels of Organic fertilizer application and the control, however, numerical, there were differential response to the application of both Inorganic and Organic manure by the three Carrot Varieties . Higher and significant number of leave counts were recorded by the three Carrots Varieties under the two levels of organic Fertilizer application and the control compare to Inorganic manure application. The number of the leaves of the three varieties of Carrot increased differentially with increase in both Organic and Inorganic Fertilizer application. This could be due to the effect of high nitrogen supply, which promotes vegetative growth (IFA, 2005).

Table 4: Mean Plant Height of three varieties of Carrot under two levels of Organic and Inorganic Fertilizer application and the control

Treatments	Varieties of Carrot		
Inorganic/level of application (Kg/ha)	ALHERI NOMA (cm)	ALBAKA NOMA (cm)	RAHAMA NOMA (cm)
0.00	35.63^{a}	36.58^{a}	34.36^{c}
35.80	43.30^{ab}	41.83^{ab}	44.90^{ab}
71.60	54.05^{a}	52.25^{a}	50.03^{a}
Organic Manure/level of application (t/ha)			
0.00	37.35^{a}	36.52^{b}	36.33^{b}
1.00	45.23^{ab}	47.51^{ab}	48.23^{a}
2.00	52.23^{a}	51.78^{a}	51.55^{a}

Means followed by the same letter(s) within a column are not significantly different according to Duncan's Multiple Range Test.

The three Carrot varieties did not significantly respond differentially to the two different levels of Inorganic Fertilizer application for plant height (Table 4). However, numerically, but not significantly, higher plant height were differentially obtained by the three Carrot Varieties under the two levels of Inorganic manure application. All the three varieties of Carrot recorded differential increase in plant height with increase in fertilizer application per hectare. Similarly, under the Organic Fertilizer regime, there were continuous increase in plant height among the three Carrot Varieties with increase in organic manure application per hectare. This could be due to the improvement in soil structure and enhanced nutrient and moisture availability and uptake that may have favored plant growth due to application of organic fertilizer (Hailu et al., 2008). The three Carrot Varieties also significantly responded differently to Organic manure application at the two levels of treatments and the control.

Table 5: Mean fresh Root weight of three varieties of Carrot under two levels of Organic and Inorganic Fertilizer application and the control

Treatments	Varieties of Carrot		
Inorganic/level of application (Kg/ha)	ALHERI NOMA (t/ha)	ALBAKA NOMA (t/ha)	RAHAMA NOMA (t/ha)
0.00	32.50^{b}	31.40^{b}	30.70^{b}
35.80	33.80^{b}	36.48^{ab}	33.34^{b}
71.60	39.08^{a}	39.35^{a}	38.74^{a}
Organic Manure/level of application (t/ha)			
0.00	32.30^{b}	31.90^{b}	31.90^{a}
1.00	35.68^{ab}	38.66^{a}	41.58^{ab}
2.00	38.98^{a}	41.48^{a}	40.87^{a}

Means followed by the same letter(s) within a column are not significantly different according to Duncan's Multiple Range Test.

All the three Carrots Varieties responded differentially to both organic and inorganic manure application for root yields (Table 5). Highest root yield (39.35kg/ha) was recorded by Variety ALBAKA NOMA at application of 71.60kg/ha of N.P.K. 15:15:15, while Variety ALHERI NOMA ranked second with 39.08kg/ha root yield under the same application regime. Carrot root yield increased among three Carrot Varieties by increasing the N.P.K application from 0kg/ha – 71.60kg/ha. This is an indication that the three Carrot Varieties responded to increase in Fertilizer application. Moreover, under the application of Organic Manure, the three Carrot Varieties responded differential and Significantly to different levels of Organic Manure application. It was also observed that increase in application of the Organic Manure resulted to increase in root yield per hectare among the three Carrots varieties. Contrary to what was observed under Inorganic Fertilizer regime, highest root yield per hectare was obtained by Variety RAHAMA NOMA at application of 1t/ha of Organic Fertilizer, while the Variety ALBAKA NOMA that ranked first under Inorganic Fertilization regime now ranked second under Organic manure application. This is an indication that carrot respond differently to Organic and Inorganic Manure application. The study also revealed that different Carrot Varieties will perform differently at different levels of both Organic and Inorganic Fertilizer application.

Conclusion

From this study, it is apparent that the recommendation of fertilizer for optimum yield of Carrot root should not be limited to Crop per se. but on the Varietal bases.

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