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Effects of Rice Hull and Different Fertilizer Sources on the Growth and Yield of Carrot (*Daucus carota* L.) In Abakaliki.

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Abstract:*The effects of rice hull and different fertilizer sources on the growth and yield of carrot were evaluated at Abakaliki, in an asymmetrical 3 x 4 factorial experiment in three replications. Factor A was three rates of rice hull: 0ton ha^{-1} rice hull, 30ton ha^{-1} rice hull, and 60ton ha^{-1} rice hull whereas factor B was four fertilizer sources: 0 fertilizer, 20ton ha^{-1} poultry manure, 20ton ha^{-1} dry slaughterhouse refuse, and 300kg ha^{-1} NPK 15:15:15.The 60ton ha^{-1} rice hull had highest values for all parameters evaluated: days to 50% germination 11.75days, plant height 41.04cm, leaf number 9.92, root girth 9.48cm, root weight 92.75g, root length 16.65 cm, non-marketable root 226.70g, marketable root 1.257kg, and total root yield 1.484kg as compared to the 0ton ha^{-1} rice hull which produced the least values of all the parameters. The 20ton ha^{-1} poultry manure treated plants had the highest values for all attributes evaluated: plant height 41.58cm, leaf number 10.00, root girth 9.79cm, root length 16.60cm, root weight 94.07g, non-marketable root 223.20g, marketable root 1.282kg, and total root yield 1.506kg as compared to the 0 fertilizer kg ha^{-1} that produced the lowest values of plant height 34.98cm, root girth 8.18cm, root length 14.88cm, root weight 86.18g, non-marketable root 178.13g, and total root yield 1.379kg except for non-marketable root 1.196kg produced by the 300kg ha^{-1} NPK 15:15:15 fertilizers and leaf number 8.33 produced by the 20ton ha^{-1} dry slaughterhouse refuse. Organic manures prolonged germination as 20ton ha^{-1} dry slaughterhouse refuse had more days (13.11) as compared with the 0 fertilizer kg ha^{-1} that had fewer days (8.78). The 60ton ha^{-1} rice hull x 20ton ha^{-1} poultry manure treated plants produced the maximum values for all attributes evaluated except for the 60ton ha^{-1} rice hull x 20ton ha^{-1} dry slaughterhouse refuse which had more days (14.33) to 50% germination whereas the 0ton ha^{-1} rice hull x 0 fertilizer kg ha^{-1} treated plants produced the minimum values for all attributes evaluated. Both rice hull and different fertilizer sources are excellent soil amendment materials, and are recommended for farmers of this zone, particularly the 60ton ha^{-1} rice hull and 20ton ha^{-1} poultry manure for efficient carrot production.*

Keywords:*Carrot, poultry manure, dry slaughter house manure, NPK 15:15:15 fertilizers, rice hull.*

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I. Introduction

Carrot (*Daucus carota* subspecies *sativus*L.) belongs to the family Umbeliferae and is one of the major root vegetables used as salad and cooked vegetable in (Chadha, 2003). The carrot is a root vegetable, usually orange in colour, though purple, black, red, white, and yellow cultivars exist (Sifferlin, 2018).South-western Asia especially Afghanistan particularly is said to be the main center of origin of this crop as the biggest morphological diversity in this crop has been found to occur in this region. Similarly, the wild forms are also seen in Europe. Carrot is a prevalent cool season root vegetable cultivated in temperate countries mainly during spring and summer season while in tropical region during winter season (Surbhi *et al.*, 2018). Carrot is a rich source of beta carotene, a precursor to vitamin A which prevents infection, some forms of cancer and improves vision (Chadha, 2003). They also contain vitamin C, thiamin B_1 and riboflavin B_2 (Fritz, 2013). Carrot is used for many medicinal properties; it is said to cleanse the intestines and as diuretic, remineralization, antidiarrheal, an overall tonic and anti-anemic. Carrot is rich in alkaline elements which purify and revitalize the blood. It has significant antioxidant constituents for the maintenance of health and protection from coronary heart disease and anti-cancer property (Robards *et al.*, 1999 and Velioglu *et al.*, 1998).

Organic production continues to be one of the fastest growing food sectors globally (IFOAM, 2018), and is often promoted as a sustainable alternative to conventional agriculture (Seufert *et al.*, 2017). The organic vegetable market is being largely driven by increased consumer demand for organic food (Apaolaza *et al.*, 2018; Ditlevsen *et al.*, 2019; and Niggli, 2015), as it is perceived to be healthier and safer for the environment (European Commission, 2019; Orsini *et al.*, 2016; and Tuomisto *et al.*, 2012). The yield gap in horticulture has been shown to vary a lot between experiments comparing organic and conventional systems (Kniss *et al.*, 2016; Lesur-Dumoulin *et al.*, 2017 and Reganold *et al.*, 2016). Two global meta-analyses concluded that across all crops the average yield of organic production is 20–25% lower than conventional production, whereas vegetables can have up to even 33% lower yields in an organic system (DePonti *et al.*, 2012 and Seufert *et al.*, 2012).

Rice husk is one of the most widely available agricultural wastes in many rice producing countries of the world and poor handling of waste often results in emission of methane and leachate while open burning by the farmers generate CO_2 and other local pollutants (Hossain *et al*., 2018). FAO, (2000) reported that over 1.5 million metric tonnes of rice mill wastes are produced in West Africa. In Nigeria, since rice husk dumps are commonly found around rice mills, during the harmattan (dry season) the rice husk dust is carried by wind to contaminate the environment. Also, during the rainy season; leachate from such dumps contaminates surface and ground water. Adubasim *et al*., (2018) observed positive effect of rice husk in enhancing pH, organic matter, magnesium and available phosphorus as an aerator in media formulation. Anikwe, (2000) used rice husk dust to ameliorate the physical properties of clay soils and found out that it increased total porosity, saturated hydraulic conductivity, reduced bulk density and penetration resistance. Rice hull is a natural source of silicon, according to Patel *et al*., (1987) as cited in (Jayawardana *et al.*, 2016) the silicon content in raw rice husk is 10.3 (w/w% in wet basis). Silicon is beneficial for plants in terms of growth (Kamenidou *et al*., 2008), yield (Ghasemi *et al*., 2013), resistance to biotic stress (Huang *et al*. 2011) and abiotic stresses (Savant *et al*., 1999). According to Essoka *et al.*, (2014), the characterization of the rice husk showed that they were very rich in organic carbon, total nitrogen, available phosphorus, and the exchangeable bases especially calcium and magnesium. Again, optimum yields were obtained from 35ton ha^{-1} and 40ton ha^{-1} rice hull application and highest plant height from 30ton ha^{-1} rice hull treatment plots. Although the area of organic vegetable production has increased more than six-fold worldwide during recent decades (Ponisio *et al.*, 2014), the performance and benefits of organic agriculture need further research. Hence, this research was conducted to investigate the effects of rice hull and different fertilizer sources on the growth and yield of carrot, the appropriate rate of rice hull amendment, and the best fertilizer source for carrot productivity.

II. Materials And Methods

2.1 Experimental site

The field experiments were conducted at the experimental farm of Faculty of Agriculture and Natural Resources Management, Ebonyi State University, Abakaliki in the derived savannah zone of Southeastern Nigeria. The site is located at Latitude 06^0 19' 407" N and Longitude 08^0 07' 831" E of the equator at an elevation of 477m above sea level. The climate is characterized with daily temperature range of 22^0C to 32^0C. The area has a pseudo-bimodal rainfall pattern which starts from April, breaks at August and finally stops at November. The annual rainfall ranges from 1700mm – 2000mm with a mean of 1800mm (EBADEP, 2005).

2.2 Experimental design

The experimental design was a 3 x 4 factorial experiment laid out in a Randomized Complete Block Design (RCBD) in three replications. Factor A was three rates of rice hull: 0ton ha^{-1} rice hull, 30ton ha^{-1} rice hull, and 60ton ha^{-1} rice hull whereas factor B was four fertilizer sources: 0 fertilizer, 20ton ha^{-1} poultry manure, 20ton ha^{-1} dry slaughterhouse refuse, and 300kg ha^{-1} NPK 15:15:15. The total rice hull, poultry manure, dry slaughter house refuse, and NPK 15:15:15 used were 155.52kg, 25.92kg, 25.92kg, and 0.387kg respectively. The area was 7.6 m x 21.9 m (166.44 m^2) with thirty-six raised flat beds measuring 1.2 m x 1.2 m (1.44 m^2) constructed into three blocks of twelve beds with 0.5m spacing within beds in a block, 1m between blocks, and 1m border rows and Seeds of carrot “Touchon IRR-3360” were sown on the beds. The crop was thinned to two plants per a stand with a spacing of 10cm x 30cm within and between rows on a bed which gave a population of 96 plants per bed. Clearing, bed preparation, and weeding were done manually and weeding was carried four consecutive times every four weeks. The vegetative parameters collected were days to 50% germination (from the 6^{th} day to the 20^{th} day), plant height using a meter rule and leaf number at 12^{th} week. Harvesting was done at the 16^{th} week and root weight (g) per plant, marketable root (kg) per bed, non-marketable root (g) per bed, and total root yield (kg) per bed were measured with a weighing balance while root girth and root length (cm)were measured with a measuring tape.

2.3 Data analysis

All the data collected were statistically analyzed using the analysis of variance (ANOVA) as described by Obi, (2002) for factorial experiment, while separation of treatment mean effects was done using ducan multiple range test (DMRT) as outlined by (David, 1955).

III. Results

The result indicated that rice hullsignificantly ($p \leq 0.05$) influenced all growth parameters of carrot (Table 1). The 60ton ha^{-1}rice hull had the maximum number of days to 50% germination (11.75days), highest number of leaves (9.90), and tallest plant height (41.10cm) while the 0ton ha^{-1}rice hull had the least values (9.92days), (8.50), and (35.60cm) respectively.

Table 1: Effect of rice hull on the vegetative parameters of carrot

Rice hull	Days to 50% germination	Leaf number	Plant height (cm)
0 rice hull	9.92^{c}	8.5^{b}	35.6^{c}
30ton rice hull	11.08^{b}	9.4^{a}	38.5^{b}
60ton rice hull	11.75^{a}	9.9^{a}	41.1^{a}
F-LSD ($p \leq 0.05$)	0.64	2.34	0.83
CV	6.60	9.35	12.93

Fertilizer sourcessignificantly ($p \leq 0.05$) promoted all vegetative parameters of carrot (Table 2). The poultry manure treatment produced the highest number of leaves (10.00) and tallest plant height (41.60) but the dry slaughterhouse refuse produced the maximum number of days to 50% germination. Meanwhile, 0 fertilizer had the minimum number of days to 50% germination (8.78) and shortest plant height (35.00) but the dry slaughterhouse refuse produced thefewest number of leaves.

Table 2: Effect of fertilizer sources on the vegetative parameters of carrot

Fertilizer sources	Days to 50% germination	Leaf number	Plant height (cm)
0 fertilizer	8.78^{b}	9.0^{bc}	35.0^{c}
poultry manure	12.67^{a}	10.0^{a}	41.6^{a}
Dry slaughterhouse refuse	13.11^{a}	8.3^{c}	38.6^{b}
NPK 15:15:15 fertilizers	9.11^{b}	9.7^{ab}	38.5^{b}
F-LSD ($p \leq 0.05$)	0.73	0.96	2.7
CV	7.62	10.79	14.94

The result showed that rice hull was significant ($p \leq 0.05$) for all yield parameters of carrot (Table 3). The 60ton ha^{-1}rice hull had the widest root girth (9.50cm) per root, longest root length (16.60cm) per root, heaviest root weight (92.75g) per root, marketable root (1.26kg) per bed, non-marketable root (226.69g) per bed, and total root yield (1.49kg) per bedwhile the 0ton ha^{-1}rice hull had the least values (8.30cm), (14.60cm), (85.68g), (1.19kg), (179.70g), and (1.37kg) respectively.

Table 3: Effect of rice hull on the yield parameters of carrot

Rice hull	Root girth (cm)	root length (cm)	root weight (g)	Marketable root (kg)	Non-marketable root (g)	Total root yield (kg)
0 rice hull	8.300^{c}	14.600^{c}	85.680^{c}	1.191^{b}	179.700^{c}	1.371^{c}
30ton rice hull	9.000^{b}	15.600^{b}	88.750^{b}	1.218^{b}	201.570^{b}	1.421^{b}
60ton rice hull	9.500^{a}	16.600^{a}	92.750^{a}	1.258^{a}	226.690^{a}	1.485^{a}
F-LSD ($p \leq 0.05$)	0.370	0.800	2.620	8.72	0.030	0.040
CV	4.210	6.930	9.520	20.99	1.080	1.210

The fertilizer sources significantly ($p \leq 0.05$) improved all yield parameters of carrot (Table 4). The20ton ha^{-1}poultry manure produced the widest root girth (9.80cm) per root, longest root length (16.60cm) per root, heaviest root weight (94.07g) per root, heaviest marketable root (1.282kg) per bed, heaviest non-marketable root (223.19g) per bed, and heaviest total root yield (1.506kg) per bed while the 0 fertilizer had the leastroot girth (8.20cm),shortest root's length(14.90cm), lightestroot weight (86.18g), lightest non-marketable (178.12g), and lightest total root yield (1.379kg); though, the dryslaughterhouse refuse had the least marketable root (1.196kg).

Table 4: Effect of fertilizer sources on the yield parameters of carrot

Fertilizer sources	Root girth (cm)	root length (cm)	root weight (g)	Marketable root (kg)	Non-marketable root (g)	Total root yield (kg)
0 fertilizer	8.200[c]	14.900[b]	86.180[b]	1.199[b]	178.120[c]	1.379[b]
Poultry manure	9.800[a]	16.600[a]	94.070[a]	1.282[a]	223.190[a]	1.506[a]
Dry slaughterhouse refuse	9.200[b]	15.300[b]	89.090[b]	1.212[b]	214.250[a]	1.426[b]
NPK 15:15:15 fertilizers	8.500[c]	15.600[b]	86.900[b]	1.196[b]	195.040[b]	1.391[b]
F-LSD ($p \leq 0.05$)	0.430	0.920	3.030	10.070	0.040	0.050
CV	4.860	8.000	10.990	24.230	1.240	1.400

Rice hull x fertilizer sources significantly ($p \leq 0.05$) influenced all growth parameters of carrot (Table 5). The 60ton ha^{-1}rice hull x 20ton ha^{-1} dryslaughterhouse refuse had the maximum number of days to 50% germination (14.33days) and the 60ton ha^{-1}rice hull x 20ton ha^{-1} poultry manure produced the highest number of leaves (12.30) and tallest plant height (47.10cm). While 0ton ha^{-1}rice hull x 0 fertilizer produced the minimum number of days to 50% germination (8.33days), shortest plant height (28.00cm), and fewest number of leaves (7.70) which was the same with the 0ton ha^{-1}rice hull x 20ton ha^{-1} dryslaughterhouse refuse.

Table 5: Rice hull x fertilizer sources interaction effect on the vegetative parameters of carrot

Rice hull x fertilizer sources	Days to 50% germination	Leaf number	Plant height (cm)
R_0F_0	8.33[d]	7.70[c]	28.00[c]
R_0F_1	11.00[b]	9.00[bc]	37.70[b]
R_0F_2	11.67[b]	7.70[c]	38.90[b]
R_0F_3	8.67[cd]	9.70[bc]	37.80[b]
R_1F_0	8.67[cd]	9.70[bc]	37.40[b]
R_1F_1	13.33[a]	8.70[bc]	39.90[b]
R_1F_2	13.33[a]	9.00[bc]	38.20[b]
R_1F_3	9.00[cd]	10.00[b]	38.60[b]
R_2F_0	9.33[cd]	9.00[bc]	39.50[b]
R_2F_1	13.67[a]	12.30[a]	47.10[a]
R_2F_2	14.33[a]	8.30[bc]	38.60[b]
R_2F_3	9.67[c]	9.30[bc]	39.00[b]
F–LSD ($p \leq 0.05$)	1.28	1.67	4.7
CV (%)	13.19	18.7	25.87

KEY:R_0 = 0ton ha^{-1} rice hull, R_1 = 30ton ha^{-1} rice hull, R_2 = 60ton ha^{-1} rice hull F_0 = 0 fertilizer, F_1 = 20ton ha^{-1} poultry manure, F_2 = 20ton ha^{-1} dry slaughter house refuse, and F_3 =300kg ha^{-1} NPK 15:15:15.

The result indicated that rice hull x fertilizer sources significantly ($p \leq 0.05$) influenced all growth parameters of carrot (Table 6). The 60ton ha^{-1}rice hull x 20ton ha^{-1} poultry manure produced the widest root girth (10.60cm) per root, longest root length (18.20cm) per root, heaviest root weight (98.67g) per root,heaviest marketable root (1.33kg) per bed, heaviest non-marketable root (252.57g) per bed, and heaviest total root yield (1.58kg) per bed while the0ton ha^{-1}rice hull x 0 fertilizer had the least values (7.00cm), (13.10cm), (82.53g), (1.16kg), (158.47g), and (1.32kg) respectively.

Table 6: Rice hull x fertilizer sources interaction effect on the yield parameters of carrot

Rice hull x fertilizer sources	Root girth (cm)	root length (cm)	root weight (g)	Marketable root (kg)	Non-marketable root (g)	Total root yield (kg)
R_0F_0	7.00[f]	13.10[d]	82.53[e]	1.16[d]	158.47[g]	1.32[e]
R_0F_1	9.20[bcd]	16.00[b]	90.60[bc]	1.26[b]	194.00[e]	1.45[bc]
R_0F_2	8.90[cd]	14.40[cd]	84.80[de]	1.17[d]	189.93[ef]	1.36[de]
R_0F_3	8.10[e]	15.00[bc]	84.80[de]	1.18[cd]	176.40[f]	1.36[de]

R_1F_0	8.80^{de}	15.40^{b}	85.90^{cde}	1.20^{bcd}	174.03^{fg}	1.38^{cde}
R_1F_1	9.60^{bc}	15.60^{b}	92.93^{b}	1.26^{ab}	223.00^{bc}	1.49^{b}
R_1F_2	9.10^{bcd}	15.60^{b}	89.43^{bcd}	1.22^{bcd}	214.63^{cd}	1.43^{bcd}
R_1F_3	8.50^{de}	15.80^{b}	86.73^{cde}	1.20^{bcd}	194.63^{e}	1.39^{cde}
R_2F_0	8.70^{de}	16.20^{b}	90.10^{bc}	1.24^{bc}	201.87^{de}	1.44^{bc}
R_2F_1	10.60^{a}	18.20^{a}	98.67^{a}	1.33^{a}	252.57^{a}	1.58^{a}
R_2F_2	9.70^{b}	16.00^{b}	93.03^{b}	1.25^{b}	238.20^{ab}	1.49^{b}
R_2F_3	9.00^{bcd}	16.10^{b}	89.20^{bcd}	1.21^{bcd}	214.10^{cd}	1.43^{bcd}
F–LSD ($p \leq 0.05$)	0.74	1.6	5.25	0.07	17.53	0.08
CV (%)	8.42	13.86	19.05	2.15	41.98	2.42

KEY:R_0 = 0ton ha^{-1} rice hull, R_1 = 30ton ha^{-1} rice hull, R_2 = 60ton ha^{-1} rice hull F_0 = 0 fertilizer, F_1 = 20ton ha^{-1} poultry manure, F_2 = 20ton ha^{-1} dry slaughter house refuse, and F_3 = 300kg ha^{-1} NPK 15:15:15.

IV. Discussion

4.1 Vegetative growth parameter

Rice hull significantly influenced vegetative growth as compared to the 0ton ha^{-1}rice hull treatment. The rice hull plots produced plants with greater number of days to 50% germination, leaf number, andtallest plant height.This effect may be due to the sinking of the soil after the rice hull had been incorporated into the soil which buried the seeds deeper than the required depth and delayed the germination of the seeds.Moreover, the seeds of carrot are very small and can easily sink through the macro pores of the soil. Hence, implies that the sinking of the soil was due to the disturbance of the soil structure by the rice hull incorporation, because the structure of plot that did not receive any rice hull treatment was intact. This was in accordance with the works of Jeon *et al.,* (2010) and Varela *et al.,* (2013) which quantified that rice husk has the potential to be used as a soil amendment due to its ability to increase soil porosity. Again, Baiyeri *et al.,* (2019) observed that substituting topsoil with rice husk decreased the coarse sand content and increased the fine sand content of the media and the percentage clay content decreased as the volume of topsoil decreased. Also, Anikwe, (2000) determined that addition of rice husk at increasing doses to the clay textured soil decreased bulk density and increased porosity of soils. According to Essoka *et al.,* (2014) highest plant height was obtained from 30ton ha^{-1} rice hullapplication.

The fertilizer sources significantly improved all the vegetative growth parameters evaluated when compared to the 0 fertilizer except for the days to 50% germination. The 0 fertilizer and 300kg ha^{-1} NPK 15:15:15 plots had the minimum number of days to 50% germination whereas the organic manure treated plots delayed germination. This is because the soil structures were not disturbed by organic matters incorporation; thus, soil structures were intact which maintained the depth of sowing till germination. Hence, concurred with the findings of Lourdes*et al.,* (2017) which confirmed that organic amendments enhanced soil structure, infiltration, and reduction of soil losses. Again, was confirmed by FAO (Acessed, July, 2019) that crop residues left on the soil surface lead to improved soil aggregation and porosity, increase in the number of macropores, and greater infiltration rates. In addition, increased organic matter contributes indirectly to soil porosity (via increased soil faunal activity).Fertilizer sources greatly influenced leaf number and plant height, especially the poultry manurebecause soil nutrient is one of the most limiting factors in carrot production (Agbede *et al.,* 2017). These findings agreed with the works of (Agbede*et al.,* 2017; Habimana*et al.,* 2014; and Kankam*et al.,* 2014) which observed that poultry manure is an effective source of nutrients to carrot. This contradicted the work of Kiran *et al.,* (2016) which showed that NPK 15:15:15 produced the greatest number of leaves but agreed with that of Agyei *et al.,* (2017) which observed that poultry manure influenced number of leaves better than NPK 15:15:15. This effect may be due to soil structure in these different geographical entities; in Abakaliki, the soil is hard and heavy of which NPK fertilizers cannot easily lower the bulk density but poultry manure can easily increase the soil porosity, lower its bulk density and improve its fertility better than NPK fertilizers. Moreover, Adekiya *et al.,* (2017) reported that poultry manure lowered the bulk density from 1.52mg m^{-3} to 1.10mg m^{-3}, increased total porosity from 42.7% to 58%, increased moisture content from 10.4% to 14.7% and lowered the soil temperature from 32.1^{o}C to 25.9^{o}C.

In recapitulation, the rice hull x fertilizer sources interaction effect significantly promoted the vegetative growth of carrot particularly the leaf number and plant height though, it delayed germination of the seeds. All plots that received rice hull x fertilizer sources treatments had delayed germination as a result of the high porosity brought about by the organic materials incorporated in them. These were in agreement with the works of Adekiya *et al.,* (2009); Adeleye *et al.,* (2010); Agbede *et al.,* (2013, 2014); Dauda *et al.,* (2008); Mbah *et al.,* (2004); and Suresh *et al.,* (2004) which quantified that organic materials improved soil porosity, lowered the bulk density, and improved aeration of the soil. Although the days to 50% germination was minimized to a great extend due to the use of wood shavings (Wikihow, Accessed June, 2019) in covering the seeds during sowing which enhanced early germination (8.33 to14.33 days) as compared to 14 to 21 days of germination (Agrifarming, Accessed June, 2019).

4.2 Yield Parameters

Rice hull significantly improved all the yield parameters evaluated more than the 0ton ha^{-1} rice hull treatment. The rice hull plots produced plants with widest root girth, longest root length, heaviest root weight, marketable root, non-marketable root, and total root yield.Sudeshika,*et al*., (2018) stipulated that restriction of carrot roots during growth results in hard and misshapen roots and will favour translocation of assimilates to other plant parts;thus, it concurred with the results of this research. Since, the problem of restriction of the roots have been solved using rice hull to ameliorate the soil; it gave the crop treated with rice hull a favourable edaphic condition to perform better than the 0ton ha^{-1} rice hull plots.According to Jayawardana *et al.*, (2016) wet raw rice husk contains 10.3% silicon and Ghasemi *et al*., (2013); Huang *et al*., (2011), Kamenidou *et al*., (2008), and Savant *et al*., (1999) observed that silicon is beneficial for plants in terms of growth, yield, resistance to biotic and abiotic stresses; thus, it enabled this crop (carrot) thrived in this new environment. Rice husk increases organic matter content of planting medium when used as soil amendment (Adubasim *et al*., 2018; Mishra *et al*., 2017). Essoka *et al.,* (2014) observed that optimum yields were obtained from 35ton ha^{-1} and 40ton ha^{-1} rice hull application.

The uky.edu/hort/home-horticulture (Accessed, July, 2019) stipulated that poultry manure has more nitrogen (3.2%) and phosphorous (5.2%) than cattle manure (1.7%) and (1.2%) respectively.Moreover, Burhan El-Din, *et al.,* (2017) observed that organic fertilizers provide appropriate amounts of nutrients around the root area, resulting in increased nutrient absorption by the plant and thus an increase in root growth. This could be the reason for higher root yield from organic manure in this experiment. This research also agreed with the findings of Hassan, (2003) which confirmed that organic fertilizers improved the physical properties of the soil through increase in its granularity by combining organic matter with small clay granules, which increase the permeability, porosity, and aeration of the soil and provide the oxygen required for microorganism activity and root respiration.Adekiya *et al.,* (2017) also observed that poultry manure produced roots with larger diameters and longer lengths than other fertilizers which concurred with this experiment.

Finally, rice hull x fertilizer sources significantly improved all yield parameters better than the 0ton ha^{-1} rice hull x 0 fertilizer plots. Since, the volume of soil structure modification, nutrients accumulation zones, available water and air as well as microbial community influence water and nutrient uptake by plant roots (York *et al.,* 2016), it is crystal clear that quantity of nutrients influences the quality and quantity of carrot roots. The work of Baiyeri *et al*., (2019) proved that the combination of rice hull with poultry manure yielded better inwet biomass yield (total root yield) and average biomass weight of carrot when compared with those produced by the top soil which agreed with this experiment.Adubasim *et al*., (2018) observed positive effect of rice husk in enhancing pH, organic matter, magnesium and available phosphorus as an aerator in media formulation; thus, the use of rice hull is an ideal technique in ameliorating soil for carrot production. All the coefficient of variations of the parameters evaluated has smaller values (from 1.08% to 20.99% for rice hull, 1.24% to 24.23% for fertilizer sources, and 2.15% to 41.98% for rice hull x fertilizer sources interaction) which were similar to those of Feisal *et al.*,(2012). Since, Coefficient of variation (CV) indicates the degree of precision with which the treatments are compared, expresses the experimental error as percentage of the mean; hence, a good index of the reliability of an experiment. According to Gomez *et al.,* (1984) the higher the CV value the lower is the reliability of the experiment; hence, CV values of this experiment indicated that this work is very precise and reliable.

V. Conclusion

The results of the study indicated that both growth and yield parameters of carrot were significantly influenced by the application of rice hull and different fertilizers except that they delayed seed germination. Consequently, it is recommended that farmers in Abakaliki and Southeastern Nigeria should embark on carrotproduction using 60ton ha^{-1} rice hull and organic manures; particularly the poultry manure for maximum yield and sustainability of carrot.

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