EFFECTS OF BIOCHAR ON PRODUCTION OF PEPPER (*Capsicum annuum*) IN NEKEDE, OWERRI, IMO STATE NIGERIA

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ABSTRACT
The experiment was carried out at the Department of Agricultural Technology School Farm. The main aim is was to find out the effects of biochar on pepper (Capsicum annuum). The experiment was done in a randomized complete block design (RCBD). using an area of 10 x 27 m^2 (270m^2) and a plot 2 x 2 m^2 (4m^2) bed was prepared into 9 places and was replicated 3 times making 27 plots of beds. The manure was applied in 0, 5 and 10t/ha two weeks before planting. A total of 9 seedlings were planted on each bed plot and a total of 243 seedlings were on the plot. Data were collected on plant height, number of branches; stem growth, number of leaves. Measurement were taking 2, 4, 6, 8 and 12 weeks after transplanting. Means were separated using least significant difference at 5% level of probability. It was observed that all the parameters were significantly different with exception of 0t/ha. It was also observed that 10t/ha showed higher value than 0t/ha and 5t/ha effects. The plant highest height in 2 weeks after transplanting was 10.30 from 10/ha. In 4th week (16.83) and in 6th week (31.55) all from 10t/ha.

INTRODUCTION
The importance of pepper is quite unquantifiable. it is almost indispensible in human diet. This is why it becomes very important that we should produce it to the satisfy demand.

Pepper is domesticated species of plant, genus capsicum in the family *Solanacea* (Greenleaf, 1986). It originated from West Indices, Peru and Mexico and has spread across the tropics and sub-tropics. It potential use and benefit to mankind covers area such as food, medicine, plant based insecticides and finances (Dagnoke *et al.*, 2013).

Pepper is a crop that is highly needed in diet due to it richness in vitamin c. The colour aspect of the pepper increases the visual appeal of the food, making it more appetizing. The presence of capsinoid in the pepper gives it a very strong taste (Grubben and Denton, 2004). Pepper is used in our industries as a condiment in meat processing. The fruit being non pungent (sweet) makes it very suitable for salad or cooked as vegetables.

Pepper is also rich in vitamin A. The crop is used in traditional medicine at it contains capsaicin. Pepper is the second most important vegetable after tomato. It plays an important role in food digestion as it contains alkaloids that aid digestion. Also, it contains an ointment for relief of arthritis and neuropathic pains (Nwachukwu *et al.*, 2007).

Capsicum annuum is one of the key vegetable crops produced in West Africa, Nigeria and Cameroon has been exporting it. It supports the economic value of small holder producers in many part of Nigeria especially the north, where irrigation is practiced.

Pepper is widely recognized and tropical low land requires special agricultural strategies to guarantee their productivity and stability in production. Pepper is a highly valued commodity, which has the potential to improve the income livelihood of millions of small sale farmers.

The productivity of pepper has been on decrease for many years now. This is attributed to climate change, poor variety, poor cultural practices and effects of pest and diseases.

Better adoptable and well performing varieties with improved cultural practices could possibly boost pepper production. Unfortunately, the use of inorganic fertilizer e.g. NPK 15:15:15 is not affordable by the resource poor farmers in the country and beyond, hence, farmers have resorted to use organic manure like poultry manure and other organic manures. The use of the organic manures like poultry manure and farm yard manure have been in practice for ages, yet it is inadequate for mans use as the population is increasing, hence, there is need for more search on affordable and efficient organic manure like biochar.

Biochar is an incomplete combusted grinded charcoal. It has carbon up to 70%, nitrogen, hydrogen and oxygen 30% and other element in available form. Biochar is used as soil amendment in crop production and has a potential to reduce soil acidity and increase plant nutrient through increased cation exchange catalyst and immediate nutrient contribution to the soil (Lehmann *et al.*, 2008), Dodwine *et al.*, 2009 and Amonette and Josheph (2009) reported that the use of biochar in crop cultivation improves water holding capacity, increase sustainable carbon store and reduces green gas emission. Most of the subsistence farmers cannot afford high cost of improving low soil fertility (Gwenzi *et al.*, 2015) hence, the essence of the research. This experiment was

initiated to determine the growth and yield response of pepper in biochar application.

Major sources of organic manure

Natural occurring organic fertilizers includes animal waste from meat processing , slurry, guano, water hyacinth, weed and tannic silt, green manure crop and green leaf manure materials Cattle shed, water point, urine and slurry from biogas, human habitation waste , night soil, human urine ,urban town refuse , sewage , poultry litters, droppings of sheep and goats and slaughter houses.

Advantages of biochar

- The major benefit of biochar is that, it releases plant nutrients slowly. In addition reducing nutrient slowly, it also improves soil structure.
- It increases water holding capacity, slow in action, hence very difficult to other fertilizer plants.
- Biochar is renewable, biodegradable, eco-friendly overtime. Organic fertilizer makes soil and plant healthy and strong.
- It balances the soil ecosystem, boost plant health naturally. They undergo natural process of decomposition. The process of decomposition requires no chemical intervention. Organic fertilizers do not upset the balance in the soil because they do not leave behind any artificial compounds. It releases nutrients slowly and also sustainable (Kasha *et al.*, 2002).

Biochar utilization

Soil pollution occurs due to chemical fertilizers which however may increase crop yield, seed and nuts, fruit and cotton production but damages soil properties.

Fertilizer products supplement the nutrients already in the soil. Organic manures release nutrients slowly and usually contain many trace elements that are not found in most inorganic fertilizers.

Too much fertilizer can burn plant and leach into the ground water thereby causing pollution problems. Organic manures are safer to use because they are not as concentrated as the chemical fertilizers (IJLSPR, 2013). Biochar and other organic manures improves soil fertility and supplies crop with nutrients thereby maintaining or improving soil organic matter content. This objective is achieved through crop rotation, growing cover crops and application of plants and animal materials.

Nutrients harvested are replaced by the recycling of organic matter. Also, organic manures may act as energy source for micro organism in the soil which can improves soil structure and plant growth. Organic fertilizers protect agricultural land for a long time with erosion. The recycling of the organic matters contained in municipal solid waste is effective in conserving the organic matter level in the soil compared to inorganic fertilizer. The amount of NPK in organic manures is very small. The nutrient are not fast released (low mineralization), hence, the plant may not absorb them immediately and also very bulky.

MATERIAL AND METHODS

Field experiment; the research was conducted from November –January 2021 (late season cropping) at the teaching and research farm of the Federal Polytechnic Nekede, Owerri. The area is located in the tropical rain forest belt of south eastern Nigeria on latitude **$12^0$27'**N and longitude $7^0$2'E. The mean environmental temperature is 31^0 c , mean annual rainfall 2500mm, relative humidity of 80% and altitude of 50 -70m above sea level. The soil is formed from coastal plain sand and has low organic matter content (Onweremadu *et al.*, 2017).

Preparation of planting materials

Fruits of *Capsicum annum* were obtained from Imo state Agricultural Development Programme (ADP). The seeds were manually removed from the fruits and were dried. The seeds were later planted in a potted nursery, allowed for 6 weeks before transplanting.

Experimental layout and treatments;

The experiment was conducted in a sac bag containing loamy soil. This was done due to the extreme period of climatic dryness and for easy accessibility to irrigation through the school bore-hole.

The biochar was then applied two weeks before transplanting so as to allow mineralization to take place. It was a non-factorial arranged CRD (complete randomized design). It was replicated three times. The biochar was applied in 0, 5 and 10t/Ha respectively.

Planting : Seedlings were transplanted after 6 weeks in the nursery, transplanted one per bag at the spacing of 60cm x 60cm inter and intra row spacing giving a total of 27 plants per stand.

Weeding; This was done in the bag and placed in cleared place made weeding not necessary again.

Fertilizer application; Biochar application was applied the rate of 0,5 10t/h

Data collection; Data were collected from 1 tagged plants per plot selected at random. The parameters measured were as follows;

Plant height (cm); Plant height at 2, 4, 6 and 8 weeks after transplanting determined using meter rule.

Number of branches at 2, 4, 6 and 8 weeks. The number of primary, secondary and tertiary branches per plant were counted.

Stem girth (cm); this was done using a measuring tape round the stem.

Days to 50% flowering: This is the number of days in which half of the selected plant started to flowering, beginning from the day of first flowering.

Days to 50% fruiting; This is the number of days when 50% of the selected plants have fruited.
Fruit length (cm); Length of the fruit from the sample plant when harvested and measured using centimeter rule.
Fruit girth (circumference) cm; Diameter of the fruit from the sampling plants were measured using a measuring tape.
Fresh fruit yield per treatment; Matured pepper were plucked and kept differently from each plot, weighed and recorded using sensitive weighing balance in grams.
Statistical analysis; Data collected were subjected to analysis of variance (ANOVA) as described by Wahua (1999). Means were separated using fishers last significant difference (LSD 0.05) probability.

DISCUSSION

Table 1.0 Clinical composition of the biochar used in the research; below is the chemical composition of the biochar.

Nutrient element(s)	Composition %
Carbon (C)	70
Nitrogen (N), hydrogen (H) Oxygen (O)	30
Other elements	variable

Approximately 70 % of the biochar is made up of carbon. The remaining 30% consist of nitrogen, hydrogen and oxygen. Other elements are variables. The table shows that biochar contains nitrogen which is one of the important nutrients reared by crop especially cereals.
When they are added to the soil, the properties are improved.

Table 2.0 effects of biochar on plants height 2 weeks after transplanting (cm)

0t/ ha	5t/ ha	10t/ ha	Mean
5.67	6.07	6.87	6.20
6.07	7.07	7.13	7.72
7.00	8.30	10.30	8.10
Mean	6.20	7.72	9.16

LSD (0.05) , Biochar = 0.985

The table below shows the effects of biochar on plant height at 2 weeks after transplanting in (cm). the growth shows high significance in all the amended treatments. The 5t/ha and 10t/ha shows higher growth of the plant suggesting the effects (10.30) from 10t/ha was as a result of the biochar applied.
This value are in line with the finding of Nlebedim (2019) who stated that biochar gradual release nutrient in the soil and this can last long and remain in soil for hundreds and thousands of years. Increasing nutrient availability to plant.

Effects of biochar on plant height 6 weeks after transplanting.

Table 3; shows effects of biochar on plant height at 6 weeks after transplanting (cm).

	0t /ha	5t/ ha	10t/ ha	Mean
	12.10	20.10	25.10	19.06
	20.10	24.30	28.77	24.30
	28.10	24.40	31.55	28.00
Mean	20.10	22.90	28.40	

LSD (0.05) Biochar 0.985

The treatment plots showed significant difference. 10t/ha application had the highest value (31.55) followed by (28. 70) from same (10t/ha). 0t/ha showed least value (12.10). The increase in height of the amended plot is attributed to the nutrients present in the biochar. This is in agreement with Ayu *et al*., 2002 that application of biochar increased grain yield. Nlebedim (2019) concluded that biochar application ameliorated soil acidity and increase nutrient availability and yield through improved nutrient absorption.

Table 4.0 Effects of biochar on number of leaves 6 weeks after transplanting below.

	0t /ha	5t/ ha	10t/ ha	Mean
	7.30	12.00	27.00	15.43
	14.00	17.30	26.70	16.00
	22.70	22.00	28.00	24.23
	11.33	13.67	20.33	

LSD (0.05) Biochar 0.985

Table 4.0 shows effects of biochar on number of leaves 6 weeks after transplanting. The result shows a significant difference among the treatments plots. (28.00) was the highest value obtained from the table under 10t/ha while (27.00) came also from 10t/ha. The least value was (7.30) which came from 10t/ ha and 5t/ha plots is attributed to nutrient composition in the biochar. This is in agreement with Nlebedim (2019) finds that organic manure improves soil productivity through improvement in soil physical conditions such as soil structure and secondly though the nutrient supplied to the crops. Although, considerable variation in the percentage .nutrient composition of farm yard manure depends mainly on sources, handling and Management. The main nutrients supplied are nitrogen, phosphorus, potassium .and host of micronutrients Nlebedim (2019).

Effects of biochar on number pepper fruit at 12 weeks after transplanting.
Table 5 below shows number of pepper fruits at 12thweeks after transplanting.

	0t/ ha	5t/ ha	10t/ha	Mean
	25,00	30,00	40,00	31,67
	37,30	34,30	42,30	48,01
	40,70	46,00	57,70	47,47
Mean	37,33	42,10	46,66	

LSD (0,05) Biochar 0,985

Result showed that 10t/ ha treatment had the highest value of (57.70) followed by (46.00) from 5t/ha. The least value (25.00) was recorded from 0t/ha (control). The general increase in yield of fruit of the amended, so it is attributed to the nutrient availability in the organic manure (biochar). This is in agreement with Nlebedim (2019) that organic manure supplies some nutrients for plants and the carcass containing compounds are food for small animals and micro organism

Manures often improves the structure of soil and bind the particles together these structural improvement increases aeration , drainage and encourages good root growth by providing enough pores of the right size and preventing the soil from becoming too rigid .when when dry or completely waterlogged and contains varying percentage of nitrogen and nitrogen will require some days to naturalize incorporation into the soil in general, organic manure (biochar included) significantly increases the yield of crops Nlebedim (2019), they also improve soil structure, aeration, soil moisture holding capacity and water infiltration Nlebedim (2019).

CONCLUSION

Biochar is a grinded charcoal that undergoes incomplete combustion, it contain plants nutrients with carbon having the highest value of 70% , it contains nitrogen and other nutrients which aids plant growth and yield , it also helps to reduce acidity and improves soil physico-chemical properties,

It really shows an increase in the growth of pepper, it application in 10t/ha recorded the highest growth and yielding all the parameters, hence, should be recommended for pepper production in Nekede Owerri, Imo state

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