

# Original Research Article

## The Effect of Charcoal and NPK Fertilizer on the Growth of two Peppers varieties on the sandy loamy soil in Sinyea

### Abstract

This research shows the effect of charcoal + NPK fertilizer (combination of charcoal and NPK Fertilizer) on the growth of two pepper (*Capsicum annum* L.) varieties. The treatment levels were: control (no treatment), charcoal (450 g plot<sup>-1</sup>), NPK (112.5 g plot<sup>-1</sup>) and charcoal + NPK combination. The experimental plots were 32 in total with 1.5 squares meter each. The growth parameters considered were: plant height, number of leaves, number of branches, leaves length, leaves width and plant diameter. The data analyzed indicated that Local pepper performed better than Jalapeno pepper for all treatments. For plant height charcoal plots performed better than control with these means 28 cm, 64 cm and 72 cm for date 1, 2, and 3 respectively. The Local pepper performed better than Jalapeno in growth with these plant height means 31 cm, 86 cm, and 96 cm for date 1, 2, and 3 respectively. Bigger stem diameters were recorded for the Local pepper and even wider leaf. The Local pepper performed better than the Jalapeno pepper at all levels of growth.

Key words: *Charcoal, NPK fertilizer, Growth and Pepper.*

### 1: Introduction

The name pepper is widely known almost everywhere as spoken in English language. Pepper which scientific name *Capsicum annum* belonging to the family of Nightshade, which is a spicy and pungent vegetable. It is a flowering plant and a horticultural crop grown in backyard gardens. The spicy and pungent horticultural crop, pepper, history can be traced far back from 7500BC from the west particularly Southern America, where it was eaten as food. The crop was introduced into Europe by an explorer Christopher Columbus upon his returned from America and later spread to Asia and Africa. Before this crop was brought to Europe, a black pepper was used by Europeans as currency or medium of exchange. The cultivars of this crop vary according to the quantity of capsaicin present in it or how pungent is the crop. The capsaicin is the chemical compound that produces the burning and is mordacious to mammals not birds. Birds swallow this crop without feeling the burns but it react faster to mammals upon consumption. In regard to the varieties, some have less capsaicin like Belle and Jalapeno peppers while others have enough capsaicin that produces burns or pungent. The used of organic fertilizers for crop production have been traced far back from primitive farming activities to modern farming to essentially develop plants. The organic materials served as a host for microorganisms that

**Comment [H1]:** The experimental design used was not indicated. Indicate it in your abstract and number of replications.

**Comment [H2]:** Recast the statement

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36 provide nutrients to soil for plants uptake (Silva, Ranil and Fonseca, 2012). The economic values  
37 of organic manures have provided crops with essential NPK content, which is capable to enhance  
38 soil fertility. On the other hand, organic materials served as substrate for microorganisms which  
39 lead to an increase in microbial activity. Organic fertilizers significantly increase the soil carbon,  
40 nitrogen, pH, cation exchange capacity (CAC), and exchangeable calcium, magnesium and  
41 potassium which **invariably enhance crop yield and productivity**. Vesicular arbuscular  
42 mycorrhizal fungi (VAM) are widespread soil fungi that are capable of enhancing yield of  
43 several agricultural crops (Thanuji, 2002). They are important in ecological agriculture because  
44 of its benefits provided to majority of cultivars and the conservation of the environment by  
45 acting as bio-fertilizers, biological protectors and biological control agents (Azcon-Aguilar,  
46 Jaizme-Vega and Calvet, 2002). The difficulties faced by smallholder farmers are compounded  
47 by inadequate use of agricultural inputs to replenish the lost nutrients. **This inadequate** has been  
48 caused by shortage of capital and lack of access to credit facilities to enhance the purchasing of  
49 farm inputs and has hampered the use of inorganic fertilizers. The local economic policies and  
50 the slow global economy improvement have led to higher fertilizers prices. The result is  
51 expensive fertilizers which is contributing to low quantity fertilizer applications. The lower or no  
52 fertilizer application is contributing to poor crop productivities. This situation is made worse by  
53 continuous cropping without returning the plant residues back into the field (Heerink, 2005). Soil  
54 fertility depletion remains the major factor causing decline in crop productivity on smallholder  
55 farms. The infertility has resulted in low returns of agricultural investments, declining food  
56 security and higher prices of foods. Study has indicated that soil infertility is one of the results of  
57 soil erosion, removal of crop residues, **access rain fall** and continuous cultivation (Opala,  
58 Okalebo, Othieno and Kisinjo, 2009). **The horticultural crop productions in Africa are given**  
59 **serious alarm since malnutrition continues to strike the continent. The lack of balance diet is**  
60 **contributing to poor growth and mental incapability to the growing population. In order to tackle**  
61 **this situation in the evergreen continent of Africa, adequate attention is to be given to agricultural**  
62 **productivities for improvement of livelihoods and food security.**

**Comment [H5]:** invariably

**Comment [H6]:** This inadequate use of agricultural inputs

**Comment [H7]:** What does this represent?

**Comment [H8]:** It should be : Opala *et al.*, 2009

**Comment [H9]:** The objective of the work should be well stated

**Comment [H10]:** It should be: Materials and Methods

## 2. Methodology

### 65 Study Setting and Duration

66 The research was conducted on Cuttington University Agricultural Students Research site in a  
67 sandy loamy soil of Sinyea Township, Bong County, Liberia. The period covered by this  
68 research was from March 22, 2014 to October 10, 2014.

### 69 Research Population

70 The total experimental plots were 32, with a plot size of 1.5 m x 1.5 m. The plant population was  
71 288 plants planted in the field with spacing of 60 cm x 60 cm. Each plot contains 9 plants, 3 x 3  
72 in row and column. The total of 16 plots was assigned local pepper variety while 16 plots were  
73 also assigned the foreign pepper variety, Jalapeno. The following treatments were observed:  
74 control plots were 8, charcoal plots were 8, fertilizer (NPK) plots were 8 while charcoal with  
75 fertilizer plots were 8. The application rates were 450 g/plot and 112.5 g/plot of charcoal and  
76 NPK fertilizer respectively.

77 **Sampling Techniques**

78 A total of 3 (three) plants was randomly selected from each plot summing up to 96 plants  
79 considered for data collection. The Complete Randomize Block Design Method, CRBDM, was  
80 carried out in assigning plots with pepper varieties and fertilities level. The fertility levels were  
81 four (4), replicated two (2) times per block and with total of four (4) blocks.

**Comment [H11]:** It should be factorial fitted into CRBD

82 **Varieties and Fertility levels**

83 **Varieties:**

- 84 ➤ V1 = Local pepper (From Suakoko, Liberia)
- 85 ➤ V2 = Jalapeno pepper (From North Carolina, USA)

86 **Level of Fertilities**

- 87 ➤ C1 = Control (No Charcoal)
- 88 ➤ C2 = Charcoal (2 tons/ha)
- 89 ➤ F1= Control (No Fertilizer)
- 90 ➤ F2 = Fertilizer (150 g/ha)

91 **Methods of data collection**

92 Among the 9 plants in every plot, 3 plants were randomly selected for data collection. The plants  
93 selected for data collection were marked in every plot as plant 1 to plant 3 for continuation of  
94 data collection. This was done to remember plants selected for accurate data collection. The  
95 growth parameters considered for data collection were: plant height, number of branches,  
96 number of leaves, leaf width, stem diameter, and leaf length. The data were collected for three  
97 consecutive months.

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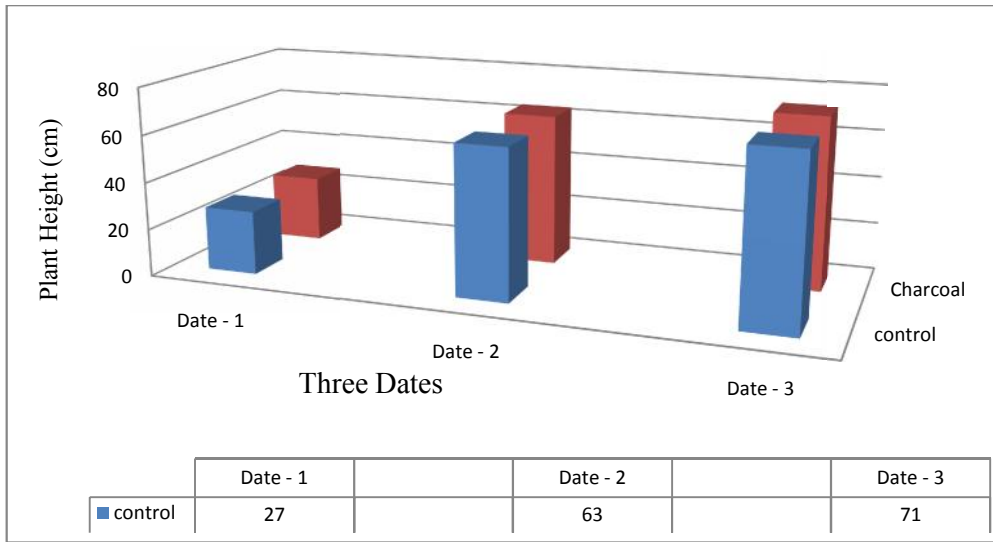
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### 3. Results and Discussions

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#### 3.1: Data Presentation and Analysis

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114 Figure 1: Charcoal effects on plant height at three (3) different dates

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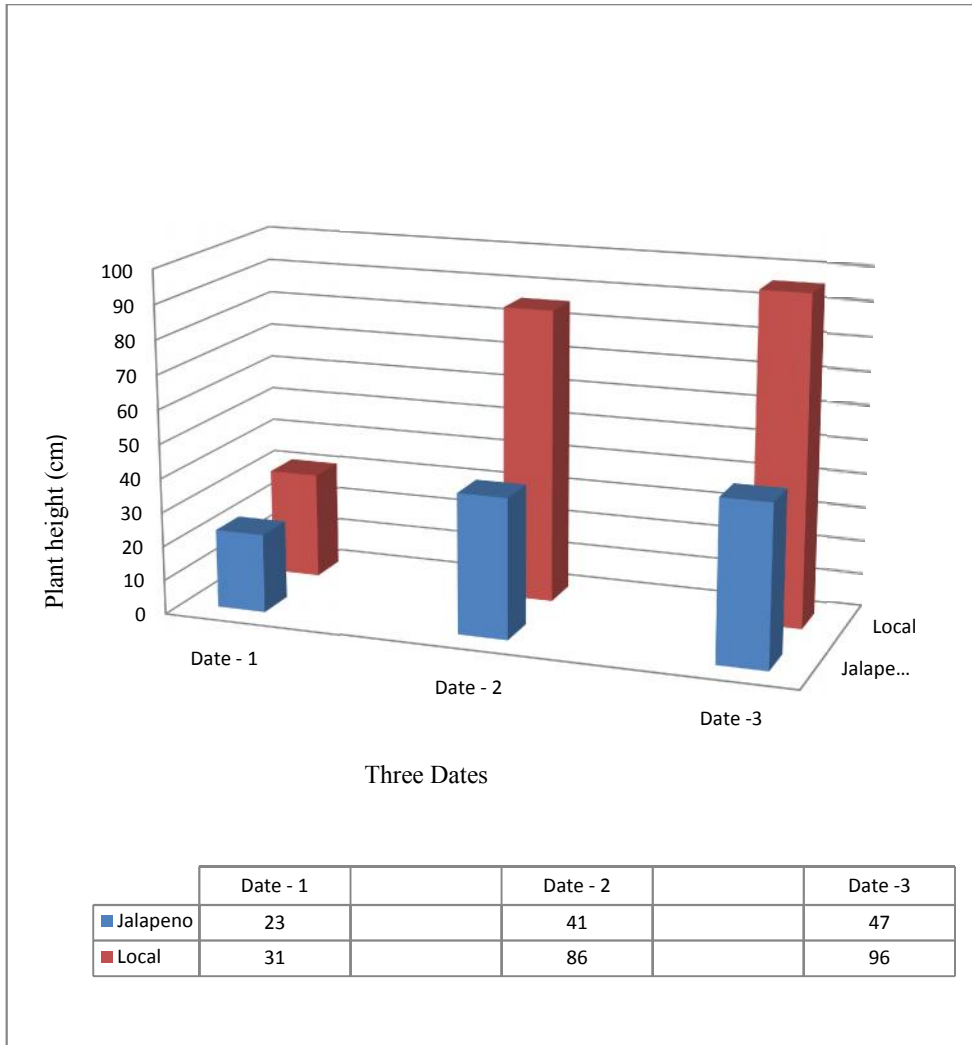
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Fig.1 showed the data results for the effects of charcoal on plant height at the three months of data collections. For the first month which is recorded as date 1, charcoal applied plots had the tallest plant height mean of 28 cm while the control plots had plant height mean of 27 cm. Date 2 showed that charcoal applied plots also performed better than the control with a mean plant height of 64 cm tall while control had 63 cm as mean plant height. The third date data showed that charcoal also had the tallest plant height mean of 72 cm over the control plot with 71 cm as plant height mean. The results indicated that the charcoal had better influence on the growth of the plant. The tallest plant height mean was observed in charcoal plots regarded of the variety of pepper. This result consented with a research conducted by Vantsis and Bond (1950) which concluded that wood charcoal increased plant dry weight and nitrogen fixation.



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Figure 2: Plant Height of two pepper varieties at three dates

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Fig. 2 revealed the plant height of two pepper varieties at three dates of data collection. Date one showed that the Local pepper had taller plant height mean than the Jalapeno with 31 cm while the Jalapeno pepper height mean was 23 cm. Date two data showed that the Local pepper also had taller plant height mean of 86 cm and the Jalapeno plant height mean was 41 cm. For date three, the Local pepper performed again better than the Jalapeno with the plant height mean of 96 cm while the Jalapeno plant height mean was 47 cm. The results showed that Local pepper performed better than the Jalapeno pepper in their growth analysis. The three months data clearly indicated the vigorous growth of the local pepper while the Jalapeno was struggling for survival.

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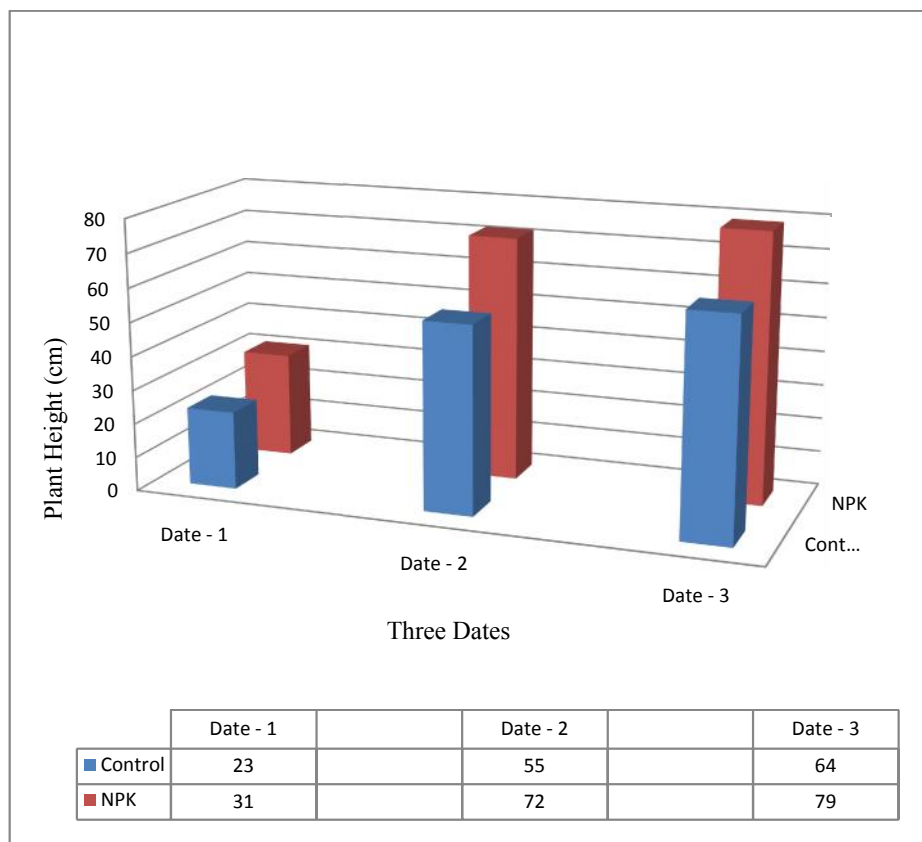
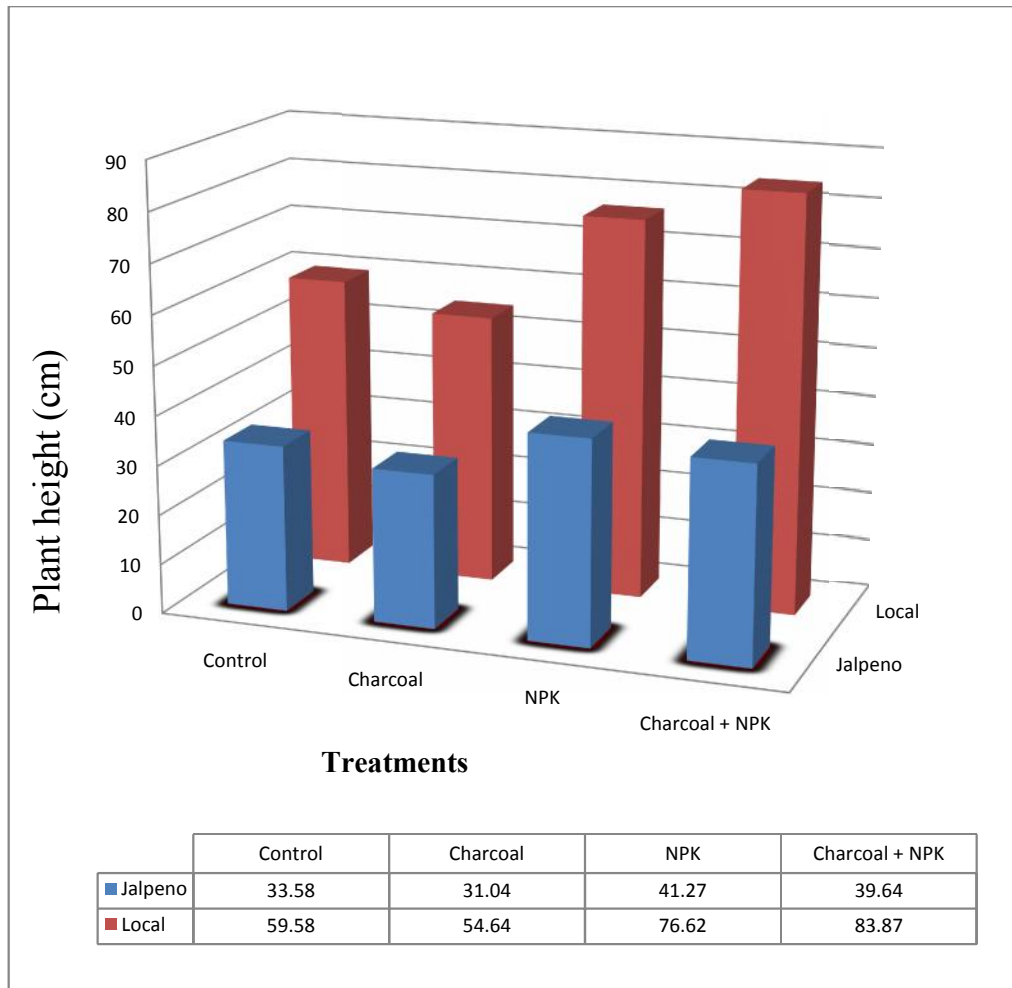
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Figure 3: NPK Fertilizer Effects on Pepper Plant Height at three dates

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139 Fig. 3 showed the NPK fertilizer effects on pepper plant height at three dates. Date one showed  
 140 that NPK fertilizer applied plots had taller plant height mean of 31 cm while the Control plots  
 141 had shorter plant with a mean of 23 cm. For date two, the NPK fertilizer also had taller plant  
 142 height mean of 72 cm compared to the Control plot with 55 cm as plant height mean. Date three  
 143 also showed that NPK fertilizer plots were superior in height than the Control plots with 79 cm  
 144 and 64 cm as plant height means respectively. The comparison of NPK fertilizer to Control  
 145 clearly showed that NPK is superior and performed better than the control. From all data  
 146 collected for the three months, it is very good in boosting plant growth. A research conducted by  
 147 Kumar and Yadav (2008) revealed that NPK fertilizer applied at higher doses maintain soil  
 148 fertility and raised crop growth and yields compare to N applied alone. Another research  
 149 conducted by Omotoso and Shitu (2007) disclosed that the application of NPK fertilizer on Okra  
 150 at the rate of 150 kg/ha and the ring method of application increased growth parameters.

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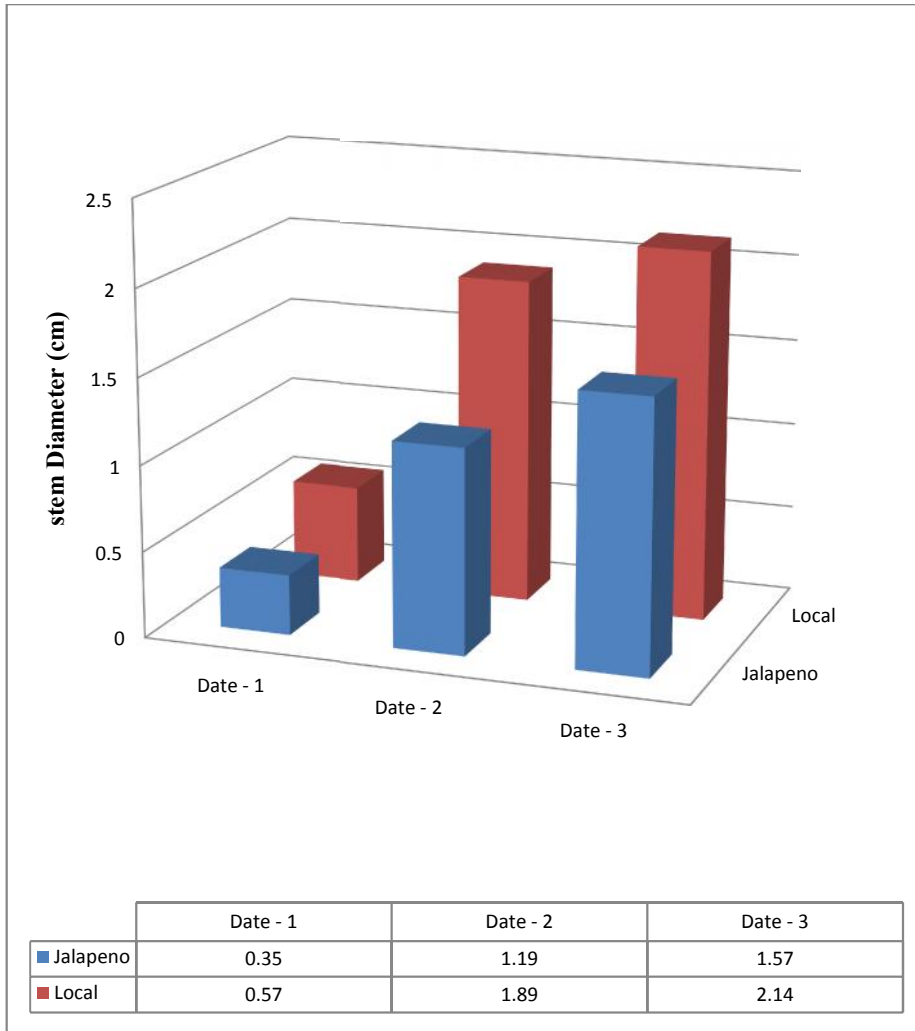
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Figure 4: four treatments effect on plant height

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Fig.4 showed that Local pepper performed better than the Jalapeno pepper for the four treatments applied. For the Local pepper, Charcoal + NPK had the highest plant height mean of 83.87 cm followed by the charcoal plots mean of 76.62 cm. Unexpectedly the control plots performed better than the charcoal plots for the same Local pepper with means of 59.58 cm and 54.64 cm respectively. For the case of the Jalapeno pepper also, NPK plots had the highest plant height mean of 41.27 cm while the charcoal + NPK had a mean of 39.64 cm. The charcoal plots had higher mean than the control plots of 31.64 cm and 33.58 cm respectively. The improvement of plant growth was greatly seen when charcoal was combined with NPK fertilizer. This showed that charcoal improves crop growth as stated by McCormack, Ostle, Bardgett, Hopkins and Vanbergen (2013) in their research conducted on Biochar in bioenergy cropping systems.



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Figure 5: Effect of charcoal + NPK on stem diameter of two pepper varieties on three dates

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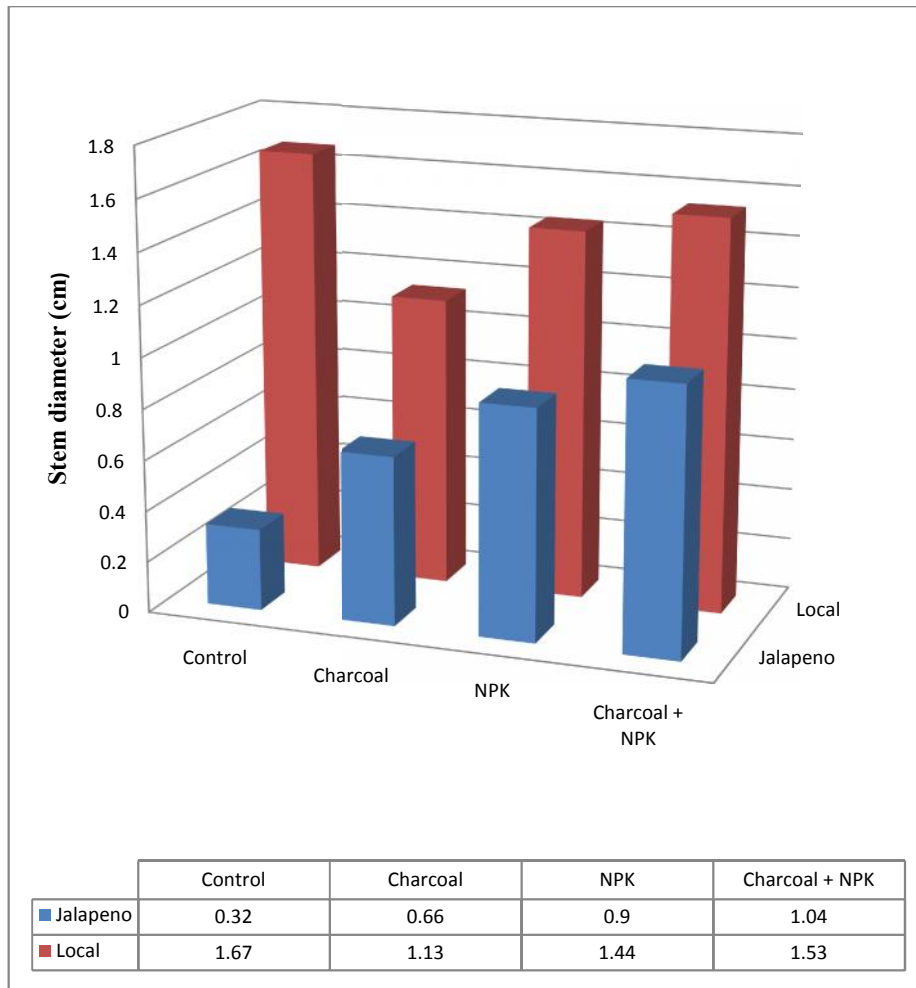
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Figure 5 revealed the stem diameters for the two pepper varieties on three different dates. From the data analyzed, the Local pepper had larger stems means than the Jalapeno pepper for the three dates. The local pepper had 0.57 cm, 1.89 cm and 2.14 cm as means for the three dates respectively. The Jalapeno pepper had 0.35 cm, 1.19 cm and 1.57 cm as mean stem diameter for the three dates respectively.

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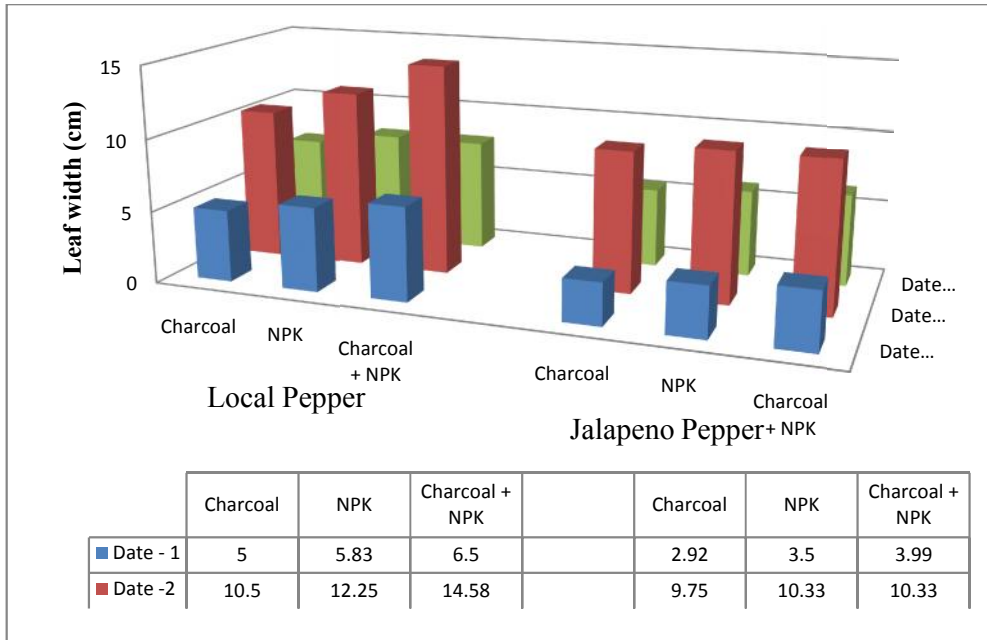
Figure 6: Four treatments effects on the pepper stems

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Figure 6 showed the four treatments results for the two pepper varieties. From the results analyzed, charcoal + NPK performed best for the two pepper varieties compared to other treatments. The control had a reverse result for the local pepper as it showed the biggest stem diameter mean of 1.67 cm. The NPK performed better than the charcoal plots. The Local pepper responded better than the Jalapeno pepper for all four treatments. With reference to Wanjari, Sigh and Ghosh (2004) work, NPK + Farm Yard Manures (FYM) significantly increase crop productions as seen in Figure 6 on the Charcoal + NPK for both pepper varieties. The tallest plant height means were recorded for charcoal + NPK applied plots.

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Figure 7: Three treatments effects on leaf width for the two pepper varieties for three dates

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187 Figure 7 showed the outcomes of treating peppers with three treatments of charcoal, NPK  
 188 fertilizer and charcoal + NPK. The results indicated that charcoal applied plots performed lower  
 189 with the following results for local pepper as 5 cm, 10.5 cm and 6.99 cm as leaf width means for  
 190 date 1, 2 and 3 respectively. The NPK applied plot had the following means of 5.83 cm, 12.25  
 191 cm and 7.83 cm for date 1 to date 3 respectively for the same leaf width. The charcoal + NPK  
 192 showed superior results for all three dates as 6.5 cm, 14.58 cm and 7.83 cm as means width  
 193 respectively. Also for the Jalapeno, charcoal + NPK performed superior than the three  
 194 treatments. The widest leaf mean was recorded for the local pepper during date 2 of data  
 195 collection for charcoal + NPK fertilizer treatment. For economic consideration, charcoal  
 196 application to crops influences growth as recorded by Al-Kaisi and Grote (2007).

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#### 4. Conclusions and Recommendations

##### 199 Conclusions

200 Generally taller plants were observed in charcoal applied plots than no charcoal applied plots.  
 201 Charcoal + NPK applied plots had the tallest plants than only NPK or charcoal alone. Local  
 202 variety had taller plants than Jalapeno especially when charcoal and NPK were applied.  
 203 Generally charcoal applied plots had taller plants, longer and wider leaves, and bigger stem  
 204 diameter with more numbers of leaves on it. Similarly, charcoal applied plots had higher number  
 205 of pods which were longer and heavier than no charcoal applied plots. In conclusion, Local

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206 pepper performances were far superior to the Jalapeno pepper for all treatments. Subsequently,  
207 charcoal + NPK gave the best result in terms of growth of pepper crop.

## 208 **Recommendations**

209 From the finding of this research, I recommend the following:

- 210 1. Extension programs shall be designed to convey this information to farmers about the use  
211 of charcoal in crop production.
- 212 2. More research work can be conducted on process of improving soil fertility as to enhance  
213 crop productions.
- 214 3. This research work can be carryout on different crops to substantial the finding.

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**Comment [H24]:** The references should follow author's guide

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