The growth and yield performance of Habanero pepper (*Capsicum chinense*) supplied with Urea Fertilizer on in Delta State, Nigeria

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Abstract

The growth and yield performance of Habanero pepper (*Capsicum chinense*) supplied with Urea Fertilizer was carried out in Research Farm, University of Delta Agbor, Delta state, Nigeria. Soil samples in study location were analyzed for their physical and chemical properties to determine their nutrient status. Field trial on the growth and yield performance of Habanero pepper was carried out. The following urea treatments were applied at 0kg/ha, 75kg/ha, 125kg/ha, 175kg/ha and 250kg/ha. The design was a randomized complete block with three replicates. The parameters measured were plant height, number of leaves per plant, leaf area and stem girth at 2, 4, 6, 8 and 10 weeks after transplanting (WATP). Habanero pepper yield was measured. Application of urea at the rate of 75kg/ha significantly increased Habanero pepper in plant height, number of leaves per plant, leaf area, and stem girth at 10 weeks WAT. Habanero pepper response to 125kg/ha of urea was highest in terms of yield, but not significantly different from urea treatment of 75kg/ha. Based on the findings of the study, it was concluded that the application of 125kg/ha of urea was the best in term of yield while in terms of cost the application of 75kg/ha is more economical in Agbor, Delta State, Nigeria.

Keyword: Growth characters, Habanero pepper, Treatment, Urea, Yields.

Introduction

Habanero pepper (*Capsicum chinense*), is a corrugated fruited hot pepper and a member of the Solanaceae family and the genus Capsicum. It is an annual herb or shrub with many branches. It is widely cultivated in the tropics and subtropics, for its pungency, flavor, color, taste, export potential, capsaicin and oleoresin contents and it is an important vegetable crop consumed all over the world (Erinle, 2009). Habanero pepper is widely distributed across the tropical and subtropical areas including America, either as wild or cultivated forms (Ado and Asiribo, 2019). Although, pepper is largely grown in many parts of Nigeria, however, the major area of its production is Northern Nigeria. (Erinle, 2009). Many names have been given to the crop according to the region in which it is grown in Nigeria. It is commonly called "*Rodo" (Capsicum chinense)* in Yoruba, "*Osse"* in Igbo, "*Barkono/Tasshi"* in Hausa. Habanero pepper is common in Nigeria with a medium corrugated fruited hot pepper *(Capsicum chinense)* (rodo) (Eshbaugh, 2003). Yield improvement programs of Habanero pepper have indicated that it performed better than others in terms of yields under certain environmental condition (Mattel *et al*., 2001). The unripe fruits are green or purple in colour but turn red, orange, yellow or brown when ripe (Udoh *et al*., 2005). Habanero pepper is an important crop species in all parts of the world. It is one of the most important vegetable crops grown in Nigeria and other parts of the humid and semi-arid tropics (Aliyu, 2000). The vegetable is commonly used as condiment (Alabi, 2006), and is popular in all kinds of cookery as pungent specie. It is also used in seasoning sauces and soup and other dishes. As a medicinal plant, the crop is also used in the prevention and treatment of cold and fever (Udoh *et al.,* 2005). Pepper like other vegetables crops contributes nutrients that may be lacking in other food materials hence improve food intake (Gayathri *et al.,* 2016).

The maintenance of high pepper yield under intensive cultivation in Delta State, Nigeria is possible through the use of organic fertilizers (Adediran and Banjoko, 1995). The yield of pepper can be sustained in Delta State with chemical fertilizer. Zemenchik and Albrecht (2002) recognized that pepper, are fertilized to supply nutrients that are not present in sufficient quantities in soil. Hence, the purpose of an adequate fertilization programe to supply year-in and year-out the amount of fertilizer that will sustain maximum pepper yield.

Mineral elements are essential in sustaining the physiological process, controlling growth and development of plants (Harper, 1983). Cooke (1982) reported that the amount of nutrients taken up by a crop depends on the type of plant and yield. It has been established that pepper readily responds to artificial fertilization (Carsky, 1991). Potassium deficiency in Habanero pepper is generally found in tropical soils with low- activity clay such as oxisols, ultissols and inceptisols, as well as in alfisols derived from sandstone. After land clearing, the alfisols have a reasonable level of exchangeable K, but often show a significant K response in the second year of planting, because of low K reserved in the parent material (Kang and Okeke, 1984). Potassium deficiency may cause necrosis or interveinal chlorosis. K^+ is highly mobile and can aid in balancing the anion charges within the plant. It serves as an activator of enzymes used in photosynthesis and respiration.

Some of the problems associated with the soil for the cultivation of Habanero pepper in Delta Area are deficiencies in nutrients, leaching and continuous cropping (Corliss, 1991). In order for pepper to reach its full production capacity, there is need to address nutrient deficiency. Reports on the adaptation, nutrient requirements and response of pepper to urea fertilizer in Delta State are limited. Consequently, there is need to provide information on the missing link for better production of pepper in Delta State. This information is needed by agricultural extension agencies in the study area to properly advise the farmers in other to enhance their production capability with regards to yield and income. This will in return alleviate the poverty status of the farmers. Hence, it is necessary to evaluate the growth and yield performance of Habanero pepper (*Capsicum chinense*) in Delta State, Nigeria. Thus, the aim of this study was to determine the effect of fertilizer (urea) application on the growth and yield of Habanero pepper.

Materials and Methods

Experimental location

The study was conducted 31st March, 2023 at the onset of the rain at the University of Delta's Teaching and Research Farm in Agbor. The rainfall regime show, a double maximum which is separated by comparatively low total rainfall (dry period) in August called August break. The length of wet season lasts for at least seven months or 220-250 days with an average of 159 rain days. Temperature is very high during the day (3ºC to 5ºC) but cooler at night (Iloji, 2003)

Experimental material

Habanero pepper (*Capsicum chinense*) seeds were received from Ministry of Agriculture Agbor, Delta State, which also supplied the urea fertilizer.

Nursery practices

Seeds of habanero pepper were first sown on a prepared bed from secondary forest near the experimental site on 15th of February, 2023 at the Teaching and Research Farm, University of Delta, Agbor. The seeds were broadcast and mulched to reduce evapouration. The nursery was watered twice daily (morning and evening).

Experimental design

Five levels (0, 75, 125, 175, and 225kgha^{-1}) of urea fertilizer were laid out in a randomized complete blocks design (RCBD) with three replicates.

Land preparation

The land for the experiment was cleared manually and the debris removed without burning. It was mapped and demarcated into plots. The individual plot size was 1.35x1.2m with a spacing of 0.5m within plots and between replicates. A total of fifteen (15) plots with twenty (20) plants each were involved to give a total of three hundred (300) plants an equivalent of 24,333 plants/ha were used with a total land area of 0.003ha.

One week after transplanting, urea was administered to the plant according to the rates of application. Weed management was done manually using hoe at 3rd and 7th weeks after planting (WAP) and subsequent weeding was done by rouging.

Soil analysis

Before sowing/thining, the soil was surveyed; soil augers were used to gather composite soil samples from 0 to 15cm deep from the experimental location. Samples were taken to laboratory, bulked, air dried, and sieved with a 2mm mesh sieve. Bulked samples were treated and tested for physical and chemical properties parameters (Okalebo *et al* (2002)

Data collection: Data were collected on the vegetative and yield parameters.

Vegetative characters: Collections of vegetative parameters commenced at two weeks after transplanting (WAT) and were obtained every two weeks till the 10th week after transplanting. Four plants were tagged in the net plot for data collection.

The vegetative characters collected included: height (cm), number of leaves per plant, stem girth (cm) leaf area/plant, and yield.

Statistical analysis

All data collected for Habanero pepper were analysed using analysis of variance (ANOVA) at 5% level of significance and means were separated with Dancan's Multiple Range Test (DMRT), when F – ratio was significant (Steel and Torie, 1980).

Results

Soil Physical and Chemical Properties analysis: The soil used for the experiment can be described as sandy-loam, deficient in organic carbon, low in nitrogen, available phosphorus, and exchangeable bases. (Table1).

Plant height (cm)

Plant height of Habanero pepper as influenced by urea fertilizer application is presented in Table 2. Habanero pepper (*Capsicum chinense*) increased in height throughout the period of sampling among the treatments. At 10 WAT, crops fertilized at 75kg/ha were the higher (29.52cm) while the control had the shortest plant (21.00cm) ($p<0.05$).

Number of leaves plant^{-1}

The fertilizer applied significantly influenced the number of leaves plant^{-1} of *Capsicum chinense* at 10 WAT (Table 2). At 10 WAT, the value ranged from 28.00 to 65.00 number of plant^{-1} for plants fertilized with 175kg/ha and 75kg/ha respectively.

Table 1: Pre-planting soil physical and chemical parameters of the experimental site

Parameters	Values prior planting
Sand	93.4
Silt (gkg^{-1})	4.0
Clay (gkg^{-1})	2.6
Textural class	Sandy loam
Organic carbon (gkg^{-1})	0.84
Total nitrogen (gkg^{-1})	0.07
Available phosphorus (mgkg^{-1})	8.32
Exchangeable calcium (cmolkg^{-1})	1.62

Exchangeable potassium (cmolkg^{-1})	0.11
Exchangeable sodium (cmolkg^{-1})	0.78
Total Exchangeable base (cmolkg^{-1}) [$Ca2^{+} + Mg2^{+} + K^{+} + Na^{+}$]	1.47
Total Exchangeable Acidity (cmolkg^{-1}) [$Al^{3+} + H^{-}$]	0.80
Effective cation exchange capacity (cmolkg^{-1})	1.78
Base saturation %	60.37

Values with the same letter (s) superscript indicated in columns are not significantly differently different; using DMRT at 5% level of significance, ns; not significant.

Stem girth

The stem girth of habanero pepper is presented in Table 2. There were significant differences among the treatments through out the sampling periods. At 10 WAT, the value ranged from 2cm for plants without fertilizer treatment and 3.13cm for plants fertilized with 175kg/ha.

Leaf area plant^{-1}

Urea fertilizer significantly affected the leaf area/plant of the crop throughout the period of sampling (Table 2). At 10 WAT, the mean varied from 40.82 to 72.26cm^2. Crops fertilized at 75kg/ha had the highest at 2 weeks after planting. leaf area/plant was highest in treatment which received 75kg/ha and 225kg/ha crops gave the highest and least leaf area/plant values of 72.26cm^2 and 40.82cm^2, respectively at 10 WAT.

Fresh yield

Two rates (175 and 225kh/ha) of urea fertilizer applied did not yield significantly more fresh fruits than the unfertilized plants (Table 3). Plants treated with 125kg ha^{-1} yielded more fresh plants (2.33 t ha^{-1}) than other rates except fresh yield from plants treated with 75kg/ha urea.

Discussion

The highest nitrogen released from the urea fertilizer applied was not attributed to the highest plant height evidenced from the present study, Ademola *et al*. (2009). This implies that pepper plant does not require a lot of urea to develop its vegetative growth phase. Samadi (2006) reported that inadequate potassium supply retards the

Table 2: Effect of urea fertilizer on the growth parameters of Habanero pepper.

	WAT				
Treatment(kg/ha)/ Parameter	**2**	**4**	**6**	**8**	**10**
Plant height					
0	11.23^{b}	13.5^{d}	18.75^{d}	20.25^{c}	21.00^{d}
75	13.25^{ab}	18.5^{b}	25.00^{b}	29.25^{a}	29.52^{a}
125	16.5^{a}	20.25^{a}	26.75^{a}	28.15^{ab}	28.25^{ab}
175	13.5^{ab}	16.00^{c}	20.13^{c}	22.41^{b}	22.75^{d}
225	12.00^{b}	13.75^{d}	19.25^{cd}	23.5^{b}	25.15^{c}
Mean	13.3	16.2	22.18	25.03	24.73
Number of leaves per plant					
0	14^{a}	18^{c}	27^{c}	27^{c}	43^{c}
75	14^{a}	22^{b}	32^{b}	42^{ab}	65^{a}
125	14^{a}	27^{a}	46^{a}	54^{a}	61^{ab}
175	14^{a}	18^{c}	25^{c}	25^{d}	28^{d}
225	12^{b}	14^{d}	22^{d}	34^{c}	51^{b}
Mean	13	19.	30	36.	20
Stem girth					
0	2.20^{a}	1.05^{b}	1.76^{b}	2.45^{ab}	2.45^{ab}
75	1.00^{b}	1.50^{b}	2.50^{a}	3.00^{a}	3.13^{a}
125	1.00^{b}	1.75^{a}	2.63^{a}	2.88^{a}	3.03^{a}
175	1.08^{b}	1.50^{a}	2.53^{a}	2.40^{b}	2.00^{b}
225	1.83^{ab}	1.33^{b}	2.00^{a}	2.38^{ab}	2.38^{ab}
Mean	1.42	1.43	2.28	2.62	2.60
Leaf area per plant					
0	16.54^{d}	23.63^{c}	40.90^{c}	48.85^{d}	53.42^{bc}
75	27.49^{a}	40.56^{a}	62.43^{a}	85.58^{a}	72.26^{a}
125	23.56^{b}	41.41^{a}	59.80^{ab}	65.68^{b}	56.05^{bc}
175	19.85^{c}	31.5^{b}	52.31^{ab}	51.89^{c}	61.82^{b}
225	22.01^{c}	28.14^{bc}	51.36^{ab}	50.34^{c}	40.82^{d}
Mean	21.89	33.05	53.36	60.47	56.87

Values with the same letter (s) superscript indicated in columns are not significantly differently different; using DMRT at 5% level of significance, ns; not significant.

Table 3: Effect of urea fertilizer on the fresh plant yield (t ha-^{1}) of Habanero pepper.

Treatments (kg ha^{-1})	Fresh plant yield (t ha^{-1})
0	1.45^{b}
75	2.25^{a}
125	-2.33^{a}
175	1.28^{c}
225	1.02^{d}
Mean	1.41

Values with the same letter (s) superscript indicated in columns are not significantly differently different; using DMRT at 5% level of probability, ns; not significant.

vegetative development of plants which may not affect the production of vegetative plant materials but also the development of organs and the filling storage tissues with photosynthesis. Stem girth did not respond to higher rates of urea treatments. This observation was earlier reported by Alonge *et al*. (2007) who reported that higher levels of nitrogen applied will not increase the stem girth of Habanero pepper above the control.

Leaf area respond to lower rate of urea application and show negative response at higher rate of application as evidenced from study. This shows that the crops do not utilize the applied nutrients for the growth and development (Kaeppler *et al.*, 1998).

Generally, treatments with higher rates do not give fresh plant fruit. Though, growth characters are attributed to the genetic make- up. Crops treated with urea at 75 and 125kgha^{-1} gave the highest fresh plant yield. This finding is not in agreement with the reports of Fatima *et al,* (2007) who observed significant higher fresh pepper seed from fertilized crops than the control

Conclusion

The soil was sandy-loam, , deficient in organic carbon, low in nitrogen, available phosphorus, and exchangeable bases. Therefore, nitrogen applications are important in the management of the soils of the study area due to its deficiency of nutrients. Nitrogen was highly effective in improving the growth factors. From the study, it was observed that the best rate of urea fertilizer at 75kg/ha performed better in terms of fresh fruit yield and therefore recommended for growth and yield of Habanero pepper in Agbor, Delta State.

Conflicts of Interest

The author declares that there are no conflicts of interest regarding the publication of this paper. and yield of Habanero pepper in Agbor, Delta State.

Acknowledgments

The authors appreciate the Department of Agriculture Education, Faculty of Education, University of Delta, Agbor for approval given to us to use their facilities in conducting this research work**.**

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