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THE EFFECTS OF DIFFERENT LEVELS OF INORGANIC FERTILIZER (NPK 15:15:15,) ON GROWTH AND YIELD OF SWEET PEPPER (*CAPSICUM ANNUM*) IN MUBI, NIGERIA

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ABSTRACT

The effects of different levels of inorganic fertilizer (NPK 15:15:15,) on growth and yield of sweet pepper (Capsicum annum) in Mubi North was carried outto determine optimum level of inorganic fertilizer (NPK 15:15:15,) for the growth and yield of sweet pepper in Mubi North. Field experiment was conducted at the FAO /TCP farm ÁDSU Mubi in 2016which lies within Latitude 10^0 15N and Longitude 13^0 10 E and at an altitude of 696m above sea level. The effect of different levels (NPK 15:15:15) fertilizer were evaluated using the completely Randomized Block Design (CRBD) with five treatment levels replicated four times. Parameters such as plant height, number of branches, leaf length was taken at 10th WAT and fruit yield was taken at 10th, 12thand 14th WAT. There was significance difference at P (< 0.05) between the treatment levels on number of branches and fruit yield. Based on the findings, treatment A. (0kg of NPK 15: 15:15) gave the highest height of 27.48cm, treatment B. (75kg of NPK 15: 15:15) gave the highest leaf length of 8.85cm. Treatment C. (l00kg of NPK 15: 15: 15) gave the highest number of branches of 8.88cm, and treatment, F (150kg of NPK: 15: 15: 15) gave the highest fruit yield, and recommended for farmers in Mubi North.

INTRODUCTION

Pepper (Capsicum annum) is one of the most important solanaceous crop grown after tomato in Nigeria. Nigeria ranked fifth (5th) in the world as the major producer of pepper after China, Mexico, Turkey, and Spain (Norman, 1998). Pepper, which belongs to the family, Solanaceae, is believed to have been originated from tropical America, where it is being spread to Europe, and finally to all parts of the world. It is known in different countries by alternative names as sweet pepper, bell pepper, cherry, paprika pepper and pimento pepper (Janic, 1999). Pepper is of two species, the hot (chili) and the sweet pepper respectively. The grouping depends on the amount of active ingredients of pungency called capsicinoid. The sweet pepper is less pungent than the hot (chilli) pepper. Nutritionally, raw pepper are high in vitamin C, the puree of ripped pepper had about 2.5ing of ascorbic acid, 0.1mg of lycopene, 2% protein and traces of other minerals such as potassium, calcium, magnesium, iron and high level of capsicinoid, hence it is widely grown in Nigeria (Geoge, 2002). Vegetative growth of crops, especially vegetables is generally determined by climatic, agronomic, soil factors and proper spacing.

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Fertilizers are known to have significant influence on vegetative growth of crops and subsequently increased yield (Toungos, 2016)). Fertilizers composed of major elements - nitrogen (N), phosphorus (P) and potassium (K) (macro nutrients) and other micro nutrients, normally added in smaller amount (Merger, 2010). Fertilizers, especially NPK, promote vegetative growth and impartdeep green colour characteristics essentially for photosynthesis (Futulesset *al,* 2007). This study focuses the effects of different levels of inorganic fertilizer (NPK15:15:15,) on growth and yield of sweet pepper (capsicum annum) in Mubi North, Adamawa State, Nigeria.

Morphologyof Sweet Paper

Sweet pepper have erratic branching stem with a smooth hairless leaves. It has a solitary white flower which appears at each node. It produces fruits with a hallow berry of various shapes and sizes depending\on the ecology of its production and nutrient status. Pepper plant is not affected by photo-period. The sweet green bell-shaped peppers are the most popular field garden variety. Left to ripen, they turn red, yellow, orange and gain various levels of sweetness depending on the variety (Alabiri, 2001).

Uses of Sweet Paper

Peppers are good sources of vitamin A and vitamin C. These two anti-oxidants belongs to the group of nutrients that

neutralizes free radicals in the body fluids, reducing the risk of diseases. Pepper is known to have some medicinal values for various tropical fever and gout (Anyawu, 1989). It is commonly used as one of the indispensable ingredients (spice), curing stomach-ache, and used in many other dishes owing to its attached flavour, and aroma (Akande, 2006).

Raising Pepper Plant

Peppers are usually raised in nursery and are transplanted to the permanent site or field. Pepper germinates slowly at the nursery stage and this prolongs farm operations (Peet, 2003). Failure to raise nursery on time causes delay in transplanting, low productivity especially in the dry season. The need to improve the production of pepper in both seasons cannot be over-emphasized. However, there is low production and availability leading to high demand and high cost in the market.

Constraints in Pepper Production

Generally, the major constraint in crop production in Nigeria is declining soil fertility (Philips, 1997). In the past, soils have been maintained through long fallowing but presently, due to the population pressure especially on land, the fallow periods have been reduced drastically, resulting to declining in crop yield. The use of inorganic fertilizer alone to achieve high crop yield in Nigeria farming systems has been found to be unsustainable (Philips, 1997). Inorganic fertilizer is scarce and unaffordable by peasant farmers. In addition, soils of Northern Nigeria have low activity clays which are characterized by low Cat ion exchange capacity (CEC) and most fertilizer applied to these soils are lost to leaching, and the expected yields is most often not achieved. Some of the pressing problems affecting the production of pepper include pests and diseases during flowering and fruiting stages, poor storage and transportation which lead to post-harvest losses (Akande, 2006). If adequate nutrients are supplied under moderate moisture and temperature, uniform seedling growth will be fostered, reduces the wastage of resources, enhanced uniform plant establishment, growth and escapes adverse environmental stresses. In recent times, application of combined organic and inorganic fertilizer has been suggested as a more sustainable path-way to separate application of each organic and inorganic fertilizer (Adigun, 2005).

METHODOLOGY

Exper1mental Site

The experiment was conducted during the 2009 rainy season at the Technical Crop Project/Food and Agricultural Organization FAO/TCP farm of the Adamawa State University Mubi, which lies on latitude $10^0$15N and longitude $13^0$16E, and at an altitude of 696m above sea 1evel.

Nursery Preparation

A portion of land measuring 3rn x 2rn was selected within the farm site for nursery bed. Raised bed was prepared, and seeds were sown using the broadcasting method on the 3rd August 2009. The bed was mulched and irrigated daily for one week. As the seeds started germinating, the mulched materials were removed, and a temporary shed was provided. Seedlings were properly taken care of by daily watering and weeding through hand- picking until it was due for transplanting after 5-6 weeks.

Experimental Design and Treatments

The experimental design used was a Complete Randomized Block Design (CRBD) with four (4) replications, having five (5) treatments, that is, five different levels of inorganic fertilizer (NPK 15: 15: 15) on a plot size of 2m x 2m and on a total research area of 11m x 11m = $12m^2$. The treatment levels were as follows: 0kg P/ha, 75kg P/ha, l00kg P/ha, 125kg P/ha, l50kg P/ha respectively.

Land Preparation

The experimental site was cleared and ploughed manually using hoe. Thrashes, roots, and stones were removed, and the land was properly level.

Field Layout

The demarcation was done using measuring tape, pegs, hoe and hammer. The layout has a total area of 11m x11m giving $121m^2$, and has five (5) treatments which were replicated four (4) times, having a total number of 2m x 2m per plot size and lm spacing between plots to check effects of one treatment on the other and also a guard row of 0.25m.

Source of Seed

A trial seed was collected from Adamawa Agricultural Development Programme (ADADP) Mubi North, Zonal Office.

Transplanting and Spacing

Seedlings was transplanted on the 10^{th} September 2009 after about 5 weeks old in the nursery as they have attained a height of 5-7cm and have about 4-5 leaves. Prior to transplanting day, the seedling was thoroughly irrigated to ease the removal of the plants. The experimental layout was also irrigated to aid the moisture content of the soil, and to reduce heat stress to the newly transplanted seedlings. The transplanting was carried out in the evening hours using a hand-trowel to left up the seedlings. Fingers or a small pointed stick was used to open-up or drill the soil, so as to insert the seedlings at a depth of 4-5cm (naked root method) and at a spacing of 60cm x 30cm.
A total number of 22 plants per plot of $4m^2$ were obtained and a total plant population for the experimental field of $121m^2$ was 22 x 20 = 440 plant stands, given a total number of 4400000 plant stands per hectare.

Fertilizer Application

Based on the specification (levels) the following are the various levels of NPK (15:15:15) that was applied on each plot.

- Plot A = 0kg/ha
- Plot B = 75kg/ha was used = 75/15 x 100 = 500kg NPK/ha.

Therefore, 4m2 = 500/10,000 x 4m 0.02kg/ha

- Plot C = 100kg/ha 0.267kg/ha
- Plot D = l25kg/ha = 0.333kg/ha
- Plot E = l50kg/ha = 0.4kg/ha

Method of Application

Side placement was used by creating a groove (hole) 5cm away from the base of the plant. The application was done in split doses. The first dose was applied 3 weeks after transplanting that was on 28th September 2009, this was done after the first weeding. The second dose was carried out on the 20th October 2009, six (6) weeks after transplanting.

Weeding

Pepper is a poor competitor with weeds, so it is very necessary to keep the plant weed free throughout its growing period. First weeding was carried out on the 27th September 2009, just before the first dose of fertilizer application. The second weeding was done on 30th October 2009.

Irrigation

Base on the moisture level of the soil, additional supplement of water (irrigation) was carried out. The first application of irrigation water was done on 30th September 2009, based on the observation of the soil and it was carried out on daily basis for the first 4 weeks after transplanting and later on alternative basis.

Parameters Taken

- Plant height (cm)
- Number of branches
- Leaf length (cm)
- Fruit yield (fresh) weight (kg)

Plant Height: Plant height was taken from the base to the tip of the growing leaf using a meter rule. Each plant in each plot and in each replication was taken and the mean value was given as the height for that treatment.

***Number of Branches*:** For all survived plants in each of the plots and in each of replications, the number of branches was counted and the mean value was ascertained as the mean number of branches for the treatment.

***Leaf Length*:** A meter rule was used for measuring the length of the leaves in each plot and replications, their mean values were given for the treatment.

Weight of Fresh Fruit Yield (kg): The weight of fresh fruits yield was taken after each (series) harvest from each plots and in each replicates, the weight was taken using a sensitive scale balance (Model LG 201).

Harvesting: Under an ideal condition, pepper matures as from 10-12 weeks after transplanting. Mature pepper fruits shows green-reddish colour. The harvesting was carried out in phases; this is because the fruits do not mature at the same time. Two (2) weeks interval was given; this is based on the level of the management. The first harvest was on the 10th, November 2009 which was about ten (10) weeks after transplanting. While the second and third harvest was on the 30th November 2009 and 15th December 2009 respectively.

RESULT AND DISCUSSION

Statistical Analysis

Data collected were analysed statistically and subjected to Analysis of Variance (ANOVA) appropriate to Randomized Complete Block Design (RCBD) and treatment means were separated using Duncan's Multiple Range Test (DMRT) as described by statistical analysis system (SAS 2005). Pearson Correlation Coefficients was also used. The effects of different levels of inorganic fertilizer (NPK 15:15:15) on plant height, number of branches, leaf length, and fruit yield of sweet pepper (*Caspicum annum*) were taken and results presented.

Effect on Plant Height

The effect of the inorganic fertilizer (NPK 15:15:15) is presented in Table 1.The tallest height was recorded in treatment A (0kg) with 27.48cm, This could be as a result of the natural effects and nutrient composition; while treatment B (75kg) with 18.53cm recorded the lowest height respectively. Analysis of Variance also shows that growth inheight was not significantly influenced at (P <0.05).

Table 1. Effects of different levels ofNPK 15: 15: 15 on plantheight

Fertilizer Level	Plant height at 10 WAT (55 days) Mean	SD	SE
A - 0kg	27.48a	±15.88	±7.94
B - 75kg	18.53a	± 3.43	±1.72
C – l00kg	22.63a	± 1.68	±O.84
D - 125kg	20.80a	± 1.47	±0.74
E - 150kg	23.65a	± 7.52	±2.71
P(<0.05)	0.5756		

Source: Field work, 2016
Key:
NS = Not significant
CV = Coefficient variation
SE = Standard error
WAT = Weeks after transplanting

Note: Mean with same letters, are not significantly different according to Ducan's Multiple Range Test (DIVIRT) at (<0.05).

Effect on Number of Branches

The highest mean number of branches was recorded in treatment E (8.85) and the lowest in treatment B (5.15) respectively. This indicates that the higher the quantity of inorganic fertilizer added to the plant, the higher the number of branches produced hence more flowering and fruiting. This result supports the findings of Erinle (1990), who observed that the amount of inorganic fertilizer added in a cropping system affects not only yield, but also the amount of crop residues. There was significant difference between treatment E and others at P< 0.05as shown in Table 2.

Table 2: Effects of different levels of NPK 15:15:15 on number branches

Fertilizer Level	Number of Branches at 10th WAT (55 days) Mean	SD	SE
A - 0kg	6.50c	± 1.29099	± 0.64550
B - 75kg	5.15d	± 0.19149	± 0.09574
C – l00kg	7.08bc	± 0.67020	± 0.33510
D - 125kg	8.00ba	± 0.59442	± 0.29721
E - l50kg	8.85a	± 0.83467	± 0.69667
P(<0.05)	0.0001**		

Source: Field work, 2016
CV = 11.25%
SE = ± 0.400
** = Highly Significant at 1% level of probability

Effect on Leaf Length

The effects of different levels of inorganic fertilizer (NPK 15:15:15) was determined, and result as shown in Table 3, indicates that treatment C (8.88) has the highest mean of leaf-length while treatment A (7.23) has the lowest, however, Analysis of Variance showed a marked significant differences between treatments A and C at P< 0.05 as indicated in Table 3

Table 3. The effects of different levels of NPK 15:15:15 on leaf length

Fertilizer Level	Leaf length at 10 WAT (55 days) Mean	SD	SE
A – 0kg	7.23b	± 0.63443	± 0.31721
B - 75kg	8.33a	± 0.74554	± 0.37277
C - 100kg	8.88a	± 0.82209	± 0.41105
D - 125kg	8.75a	± 0.59161	± 0.29580
E - l50kg	8.73a	± 0.49917	± 0.24958
P(<0.05)	0.0183*		

Source: Field work, 2016
CV 7.98%
SE ± 0.33
* Significant at 5% level of probability

Effect on Fruit Yield

As the result shows, treatment E(l50kg) gave the highest mean yield of 600kg/ha and treatment A(0kg) gave the least mean yield of 250kg/ha of sweet pepper. This result in line with the findings of Geoge, (2002), that the selection of cropping system, proper management, and fertilizer application will give high yield at less cost which is the principal objectives of any farmer. From the results obtained above, therefore, it can be deduced that treatment E(l50kg) of (NPK 15:15:15) gives the highest yield of sweet pepper at a mean yield of 600kg/Pha. However, there is no significance difference between treatments D and E at P<0.05

Table 4: The effects of different levels of NPK 15:15:15 on fruit yield

Fertilizer Level	Fruit yield at 10^{th}, 12^{th}, 14^{th} WAT (kg/ha) Mean	SD	SE
A - 0kg	250.0b	± 66.332	± 33.166
B - 75kg	300.0b	± 40.825	± 20.412
C – l00kg	426.3ba	± 183.047	± 91.524
	550.0a	± 203.101	± 101.550
D - l25kg			
E - l50kg	600.0a	± 177.951	± 88.976
P(< 0.05)	0.0191		

Source: Field work, 2016
CV = 35.27%
SE = ± 74.99

Correlation between various parameters taken

Analysis of the correlation was also carried out to determine if there is correlation between the parameters observed. As indicted in Table 5, there is no correlation between most to the parameters. However, there is a strong correlation between the number of branches and fruit yield. This correlation signifies that the more the branches, the more the chances of the crop to flower and bear fruits

Conclusion and Recommendation

Conclusion

The trial revealed that sweet pepper responded to the different levels of inorganic fertilizer (NPK 15: 15: 15).

The highest mean value of growth and yield of sweet pepper was recorded in treatment E of the experimental plots with 600g at 150kg/ha. However, there was no ascertained limit to which inorganic fertilizer (NPK 15: 15: 15) should be applied in the production of *Caspicumannum.*Therefore, based on the results obtained from the study, 150kg/ha of inorganic fertilizer (NPK 15: 15: 15) can be adopted with good agronomic practices for the production of pepper by the farmers in Mubi North L.G.A.

Recommendation

- It is recommended based on the results that, 150kg/ha of inorganic fertilizer (NPK 15: 15: 15) can be adopted by farmers for higher yield.
- Government and Non-governmental organizations (NGOs) should encourage farmers to use NPK q for the production of pepper than relying solely on organic matter.
- Government should provide adequate fertilizers, early enough and at affordable price to farmers.
- This trial is open for further studies to determine the optimum level at which NPK 15: 15: 15 can be applied for higher yield in sweet pepper (*Caspicumannum*) production.

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