**Effects Of Nutrient Sources And Variety On The Growth And Yield Of Three Cultivars Of Pepper (*Capsicum Annum* L.) In Southwestern Nigeria**

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**Abstract:** The effect of nutrient sources and variety on the growth and yield of three cultivars of pepper was investigated in a field experiment carried out at the Teaching and Research Farms of Federal University of Technology, Akure. Treatments were 3 x 3 factorial combinations of three cultivars of pepper (Bell pepper, Sweet pepper and Cayenne pepper) and three types of fertilizer (5t ha-1 poultry manure, 5t ha-1 organominerals and 2lts ha-1 liquid NPK 15:15:15 fertilizer). There was a control treatment with no fertilizer application. The treatments were replicated three times. The results showed that varietal effects were significant on some plant characters such as plant height, number of lateral branches, root length, number of days to 50% flowering, number of fruits and weight of fruits per plant. Nutrient sources significantly influenced growth parameters and yield attributes evaluated per plant compared to the unmanured plants. The applied nutrient sources brought about improvement in soil chemical properties; soil pH, total N, available P, organic matter and exchangeable cations were improved. It is evident from the study that pepper variety responded independently to nutrient source. Findings revealed that organominerals could be used for soil management as they improve soil nutrient status and could be used for sustainable pepper production in the study area. Application of organomineral gave the best performances on bell pepper.

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**Introduction**

Inherently poor soil fertility, depletion of soil nutrients as a result of continuous cropping and crop removal have been reported to reduce soil fertility which limit its yield and productivity. Most of the soils in Nigeria are strongly weathered and dominated by low-activity clay minerals with low nutrient status. Thus, they are adversely affected by sub-optimal soil fertility even as erosion causes deterioration of nutrient status and changes in soil organism’s population (Omotayo and Chukwuka, 2009; E. C. A. 2014).

Nigeria soil has a high potential for crop production but yield levels obtained under farmer’s conditions are usually low due to poor soil management and conservation method. This type of problem is solved through the use of either organic or inorganic fertilizer. Generally, excessive amounts of inorganic fertilizers are applied to vegetables in order to achieve a higher yield (Stewart *et al.,* 2005) and maximum value of growth (Dauda *et al*., 2008). However, the use of inorganic fertilizers alone may cause problems for human health and the environment (Arisha *et al* 2003). The use of inorganic fertilizer by resource-poor farmers is limited by its scarcity and cost (Akanbi *et al*., 2001) and untimely availability (Adedoyin, 1995). Also, cultivation with persistent application of inorganic fertilizers increases soil acidity and soil physical degradation which may reduce crop yield (Ojeniyi *et al*., 2007).

Organic manure can serve as alternative practice to inorganic fertilizers (Naeem *et al*., 2006) for improving soil structure (Dauda *et al*., 2008) and microbial biomass (Suresh *et al*., 2004). Organic manure serves as a store house for plant nutrient acting as a major contributor to cation exchange capacity and as a buffering agent against undesirable pH fluctuation (Ngeze, 1998). Sole application of organic nutrient sources may not be able to maintain and synchronize the required supply of nutrients to the growing plants for optimum crop production, because of relatively less quantity of plant-available nutrients and more time needed for mineralization to release nutrients for effective plant uptake (Malhi *et al* 2013).

Nigeria is the largest producer of pepper (*Capsicum* spp) in Africa, accounting for about 50% of African production (Adamu, *et al* 1994) and Nigeria produced 695,000 metric tons from total area of 77,000ha (FAO, 2008). Although pepper is largely grown in many parts of Nigeria, but the bulk of its production is found in the drier Savanna zone and derived Savanna areas of the Northern Nigeria (Erinle, 1989).

Pepper is the world second most important vegetable- crop after tomato (AVRD, 1989). Consumption of pepper accounts for about 20% of the average vegetable consumption per person per day in Nigeria (Alegbejo 2002), making it an indispensable part of the daily diet of millions of Nigerians owing to its increase in popularity and demand (Adesina *et al* 2014). It is used extensively in food flavouring in the daily diet of over 1.2 million Nigerian irrespective of their socio-economic status. It is used as spice in the preparation of soup and stew (Benson *et al* 2014), used as a condiment and extensively in flavouring of processed meat, colouring certain food preparation (Alabi, 2006). It was also discovered to be a good source of medicinal preparation for black vomit, tome for gout and paralysis (Knott and Deanon, 1967).

Pepper being a heavy feeder of NPKand the need to increase production as indicated by the ever increasing demand for pepper throughout the year, which has been hampered as result of inherent low soil fertility due to continuous cropping and demand for land use, the study therefore is to evaluate the growth and yield of pepper and soil chemical properties as influenced by nutrient sources and pepper varieties.

**Materials and methods**

***Experimental site and soil analysis***

A field experiment was conducted at the Teaching and Research Farms, Federal University of Technology, Akure, Ondo State, Nigeria located at geographical coordinates of 5° 15ʼ N and 5° 12ʼ E. Optimum rainfall ranged from 1100mm – 1300m per annum, temperature 22°C - 30°C and relative humidity is 80% which are considered adequate for pepper production. The site was under fallow for 18 months after cassava had been harvested, the site was covered with *Eurphobia* spp*.* and *Aspillia* spp.

Prior to planting and at crop maturity, six core samples were collected at 15-cm depth of the soil to have a composite sample that was mixed, air–dried and crushed to pass through a 2-mm sieve and analyzed for its texture and chemical properties. Soil pH in water was determined in a 1:2.5 (w/v) soil:water suspension (Ibitoye, 2006). Organic C was determined by chromic acid digestion and spectrophotometric analysis (Heanes, 1984). Total N was determined from a wet acid digest (Buondonno *et al* 1995) and analyzed by colorimetric analysis (Anderson and Ingram, 1993). Exchangeable Ca, Mg, K and Na were extracted using the Mehlich procedure and determined by atomic absorption spectrophotometry. Available P was extracted by the Bray-1 procedure and analyzed using the molybdate blue procedure described by Murphy and Riley (1962). Soil particle analysis was determined by Bouyoucos hydrometer method using Sodium hexametaphosphate as the dispersing agent (Gee and Bauder, 1986).

The result of the analysis is presented in Table 1. The soil used for the experiment was slightly acidic at pH 5.50. The organic matter content of the soil was low at 1.53g/kg. The total N content and the available P and the exchangeable K contents were also low. It had 0.62% N; 3.85mg/kg P and 0.36 cmol/kg K. The soil texture was sandy loam which inferred that the experimental soil was of good drainage and aid good plant root penetration (Eleduma and Sanni, 2015). The sandy loam texture of the soil would also encourage rapid leaching of cations into the subsoil from the surface soil (Amhakhian et al 2010). The fertility status of the soil revealed low major nutrient elements below critical level required for sustainable crop production. This implies that cropping the soil without fertilizer use will not be economical.

***Land preparation, Crop Management and fertilizer application***

The experimental site was ploughed, harrowed and prepared into slightly raised seedbeds of 3 x 2m dimension separated by 1m discard, preparatory to transplanting of the pepper seedlings. The seedbeds were fortified by high ridges to keep applied nutrients from being washed into other plots. The total area used was 481m2.

Seeds of pepper were sourced from Ondo State Agricultural Development Project, Akure and were raised in nursery, for six weeks before being transplanted onto experimental plots. In the nursery, the seedlings were shaded against direct impact of solar radiation. The nursery were kept weed free and watered every other day. Prior to seedling transplant into the field, the soil was heavily watered to enhance easy seedling removal. Vigorous seedlings were then transplanted onto the experimental plot at 6 weeks old and spaced 50 cm x 70 cm.

2lts ha-1 NPK 15:15:15 liquid fertilizer, 5t ha-1 organomineral and 5t ha-1 poultry manure were the nutrient sources applied as the treatment. For plots that were to receive poultry manure (PM), the nutrient sources were incorporated a week to seedling transplant, while for those plots to be amended with organomineral and NPK 15:15:15 liquid fertilizer, were applied 2 weeks after seedling transplant using ring method and foliar application method respectively.

Weed control was done manually at 3, 6 and 9 weeks after transplanting to avoid competition with the pepper seedlings. Dithane M45 at 10g/5lts and Lamdacyahalothrin at 50ml/15lts were applied at vegetative stage to control fungal infection and insect pest infestation (IAR&T, 2000).

***Experimental design, Data collection and Statistical Analysis***

The design of the experiment was 3 × 3 factorial arrangement fitted into randomized complete block design with three replications. Treatments were combination of 3 cultivars of pepper (Bell pepper, Sweet pepper and Cayenne pepper) and 3 types of nutrient sources (5t ha-1 Poultry manure (PM), 5t ha- 1 organomineral and 2lts ha-1 NPK 15:15:15 liquid fertilizer). There was also control in which no fertilizer or manure was applied.

Data on plant height, root length, number of branches and number of leaves were determined per plot as means of five randomly sampled plants within the middle row. Other parameters taken include number of days to 50% flowering, biomass, number of fruits and fruit weight. The growth and yield parameters collected were subjected to analysis of variance (ANOVA) using GLM procedure in SAS (2004). Treatment means found to be significantly different from each other, were separated by Duncan Multiple Range Test (DMRT) at p < 0.05 (Gomez and Gomez 1984).

**Results and discussion**

**Table 1: Experimental site properties before planting**

|  |
| --- |
| **Properties value Rate** |
| pH (H2O) 5.50 Strongly acidic |
| Organic carbon (g/kg-1) 1.53 Very low |
| Organic matter (g/kg-1) 2.64 Low |
| Total N(g/kg-1) 0.62 Low |
| Available P (mg/kg-1) 3.85 Low |
| **Exchangeable bases** |
| Na2+ (cmol/kg-1) 0.38 Very low |
| K+ (cmol/kg-1) 0.36 Moderate |
| Ca2+ (cmol/kg-1) 4.3 Low |
| Mg2+ (cmol/kg-1) 1.7 |
| **Particle size** |
| Sand (%) 76.40 |
| Clay (%) 16.50 |
| Silt (%) 6.10 |
| Textural classification sandy loam |

***Experimental soil analysis***

Pre-cropping soil properties are shown in Table 1. Analysis of the texture and chemical properties of the soil showed that the soil was strongly acidic, sand loamy in texture and seemingly low in fertility based on the rating of FMANR, (1996) as reflected by low organic carbon, organic matter, total N, available P and exchangeable bases. Consequently, optimum crop growth and yield cannot be achieved without supplementary nutrients through soil amendment in form of organic manures and/or inorganic fertilizer (Sanni, 2014).

The low fertility status of the soil is a true reflection of most ultisols of humid environment that are strongly weathered of low activity clay mineralogy and high acidity due to intense precipitation with its associated erosion and leaching in the environment (Enujeke, 2013). The slightly acidic nature of the soil could be adduced to the coarse nature of the soil which should have enhanced leaching of exchangeable bases and to the continuous cropping history of the site (Ayeni and Adetunji, 2010).

***Effects of nutrient sources and varietal on the growth parameters***

***Number of leaves***

The response of number of leaves/plant of pepper to nutrient sources and variety is shown in Tables 3 and 4. Nutrient sources significantly (P<0.05) influenced number of leaves compared to control plot. Plants that received 5 t ha-1 of organomineral and NPK liquid fertilizer were outstanding in number of leaves/plant with mean value of 249.11 and 249.78 respectively, while plants grown without fertilization had the lowest number of leaves/plant with mean value of 112.98 (Table 4). Pepper varieties do not significantly (P>0.05) affect the number of leaves produced by the plant (Table 3). Law-Ogbomo and Remison (2008) reported that uptakes and utilization of applied fertilizers significantly enhanced number of plant leaves. The enhancement in the number of leaves by fertilizer application was a precursor to greater amount of assimilate and thus allowing more translocation to the berry. Changes in number of leaves are bound to affect the overall performance of the plant as the leaves serves as the photosynthetic organ of the plant. Increase in number of leaves leads to better utilization of solar radiation (Law-Ogbomo and Remison, 2008).

***Plant height***

Plants’ heights as influenced by nutrient sources and pepper variety are presented in Tables 3 and 4. Pepper grown without manure or fertilizer application had the shortest height with mean value of 35.0cm. Application of 5 t ha-1 organomineral resulted in substantial increase in plant height (55.44cm) giving the tallest plant, followed by PM (51.56cm). The superiority in plant height of pepper based on nutrient sources was organomneral>NPK>poultry manure>control (Table 4). Statistically, there exists significant difference (P<0.05) between pepper grown with fertilizer compared to control. This might be due to the availability of N required for plant growth and development. Pepper variety significantly (P<0.05) influenced plant height; with Bell pepper being the tallest (51.40cm), followed by Cayenne pepper (46.80cm) and Sweet pepper being the shortest with the mean value of 42.20cm (Table 3). Increase in plant height with fertilizer application treatment resulted in retention of appreciable amount of assimilates in the stem for node and leaf production. The height of plant is an important growth character directly linked with the productive potential of the plant. Saeed *et al* (2001) opined that plant height is positively connected with productivity of plant such as increased number of branches. This accounted for higher number of leaves in the treated plants. More plant height due to better usage of sunlight in competing with weeds have positive effect on fruit yield and total dry matter (Duman, 2006).

***Number of branches***

Results obtained from the study showed that Cayanne pepper recorded the highest number of branches (22.90) and was significantly different from all other varieties (Table 3). Nutrient sources had similar value of branches while organomineral, NPK and poultry manure were statistically the same and different from pepper that do not received fertilizer application (Table 4). Number of branches of pepper is significantly affected by manuring. Pepper growing on amended soil performed better than the plant on the control plots. This shows that fertilizers applied to the soil were readily available and in the best form for easy absorption by the plant roots, hence there was a boost in the morphological growth of the plant. This support the findings of Law-Ogbomo and Egharevba, (2010) who reported that number of branches associated with various soil amendments were at par and significantly different from control.

***Root length***

Root length development was not significantly (P<0.05) influenced by pepper variety, while nutrient sources significantly affect root length development (Table 3). Result presented in Table 4 showed that, pepper that received 5 t ha-1 organomineral recorded the longest root (32.22cm) followed by NPK liquid fertilizer (30.89cm) and pepper with no fertilizer recorded the shortest root length (16.89cm). The Nitrogen and Phosphorus fortification due to nutrient sources may have resulted in a corresponding greater Nitrogen and phosphorus release for probable plant uptake through enhanced microbial mineralization of organic nutrients and consequently more massive rooting. Organomineral and poultry manure can increase soil porosity which led to lower soil bulk density that permits better root growth. Good root system enhances above ground growth and development that finally causes higher yield production and higher dry weight (Salehabadi *et al*., 2014).

***Effects of nutrient sources and varietal on pepper yield attributes***

***Days to Flowering***

There was significant difference (p<0.05) between the varieties and nutrient sources with respect to the number of days to flowering (Tables 3 and 4). Table 3 showed that Bell pepper and Cayenne pepper were the earliest to flower (74.4 and 74.5 DAT) with sweet pepper flowering last (85 DAT). On the other hand, data presented in Table 4 showed that pepper with no fertilizer application flower late (81.33 DAT), while Pepper planted on Organomineral fertilized plot flowered early at 73.33 DAT closely followed by pepper planted on plot amended with NPK (78.33 DAT) and poultry manure (78.89 DAT). This implies that fertilizer application provide added advantage with respect to days to flowering. The early flowering of pepper to different sources of nutrient might be due to acceleration of the vegetative phase through the simulative effect of the absorbed nutrients on photosynthesis process which certainly reflected positively on both vegetative and flowering initiation (Kawthar *et al* 2010). The longest day to flowering in the control is as a result of insufficient P and K. Jilani *et al*., (2009) reported that a deficiency of major nutrients results in longer days to flowering. Ehaliotis *et al* (2005) had reported that Fe, Zn and Mn encourages vegetative growth, total chlorophyll and the photosynthetic rate of plants which enhance flowering and fruiting thus leading to an increase early fruit maturity.

***Number of fruits and fruits weight***

Pepper varieties responded positively to nutrient sources for number of harvested fruits and weight of fruits (Table 3). Bell pepper produced 51.80 fruits being the highest, followed by Sweet pepper which recorded 38.30 and Cayenne pepper produced the lowest number of fruits (22.50). Similar trend was observed with the fruit weight where Bell pepper recorded the maximum weight (479.70g) and pepper fruits produced by Sweet pepper had the lowest weight (213.10g). There was no significant difference in weight of fruits harvested from Cayenne pepper and Sweet pepper, but there existed significant difference when compared with fruit weight obtained from Bell pepper (Table 3). Number of fruits produced from pepper grown with manure/fertilizer in order of superiority was 5 t ha-1 organomineral > 5 t ha-1 poultry manure > NPK > control. Pepper that received 5 t ha-1 organomineral recorded the heaviest fruit weight (438.89g), NPK (357.56g), 5 t ha-1 poultry manure (306.11g) and pepper grown on plots that did not receive fertilizer application had the lowest pepper fruits weight (137.33g). Statistically, pepper that received fertilizer application recorded significantly different fruit weight compared to those that did not receive fertilizer application (Table 4). The influence of nutrient sources on pepper fruit weight might be due to the effect of N in increasing water content of vegetables. The increase in number of fruits and average weight could be attributed to the ability of nutrient sources to promote vigorous growth, increase meristematic and physiological activities in the plants due to supply of plant nutrients and improvement in the soil properties, thereby, resulting in the synthesis of more photo-assimilates, which is used in producing fruits. (Dauda *et al* 2008).

The results obtained from the study revealed that number of fruits per pepper variety was not significantly affected by the nutrient sources. This may be attributed to the reason that fruit bearing potential of a variety is controlled by its genetic makeup rather than the agronomic practices. Akinfosoye *et al.* (1997) reported that differential in yields of crops could be attributed to the choice of cultivar grown and its specific genetic make-up. Similarly, Adetiloye and Salau (2002) who worked on Soybean found that variation among Soybean varieties is due to differences in their genetic make-up. The non-significant effects of nutrient sources on number of fruits per plant recorded in this study confirmed the findings of Maqsood *et al.,* (2001).

Increased plant yield as observed with nutrient sources compared to pepper that did not receive fertilizer may also be due to increased soil aggregate stability which might have favored the beneficial microbes which in turn could have contributed to improve biomass production (Basso and Ritchie, 2005; Bwenya and Terokun, 2001). The significant effect due to organomineral application could be attributed to easy dissolution effect of released plant nutrient leading to improved nutrient status of the soil for crop uptake.

***Effect of Nutrient sources on post cropping soil chemical properties***

The initial pH of the experimental plot which was sandy loam was strongly acidic (5.50), low in organic carbon, available phosphorus, total nitrogen and exchangeable cations below critical level (Table 1). Under such conditions, the availability of the base forming cations is limited since the soil solution is mostly occupied by aluminium and hydrogen ions. It should therefore be expected that the fertility status of the soil would benefit from fertilizer application since manure is known to improve soil organic matter, as well as macro and micro-nutrient status of the soil (Adeniyan and Ojeniyi, 2003).

Table 2 shows the soil chemical properties at crop maturity after fertilization. The soil pH increased ranging from moderately acidic to slightly alkaline (5.67 – 8.11). The increment of soil pH with additions of nutrient sources could be attributed to the reduction of exchangeable aluminium in the acidic soils. This reduction is considered to occur through aluminium precipitation or chelation of organic colloids (Hue, 1992). Increased pH with organomineral and poultry manure additions could also be attributed to increased levels of exchangeable bases (K, Mg and Ca). Increasing the pH of acidic soils improves plant-availability of macro- nutrients while reducing the solubility of elements such as Al and Mn (Mucheru et al 2007; O’Hallorans et al 1997). The magnitude of the rise in soil pH varies depending on the type of manure, its rate of application and the buffering capacity of the soil (Haynes and Mokolobate 2001). However, pepper is tolerant to slightly acidic condition but a pH of 5.5-6.8 is preferable (Wang et al 2005). The application of organic and inorganic fertilisers marginally increased the organic carbon, total N and available P values. The increments were not significantly enough to improve the rating from low to moderate or medium nutrient status. The low values of total N and P could be as a result of crop uptake, immobilisation by microorganisms and nitrogen loss through volatilisation (Defoer *et al,* 2000). In spite of soil amendment, potassium level at crop maturity ranges from 0.32 – 1.76 cmol/kg and still remains at moderate level. Sodium level in the soil due to fertilizer application increased from 0.38 cmol/kg recorded at the commencement of the experiment to 0.40 -1.46 cmol/kg. Pepper variety affect the values of calcium and magnesium present in the soil. Sweet and Cayenne pepper varieties that received organomineral resulted in the decline of calcium and magnesium levels, while pepper varieties that received poultry manure and NPK improve the calcium and magnesium contents of the soil. The positive improvement of the experimental soil chemical properties is due to the fact that poultry manure and organomineral acted as a store houses for plant nutrients; also as major contributors to cation exchange capacity and as buffering agents against undesirable pH fluctuation (Ngeze, 1998).

***Interaction effect of nutrient sources and variety on the growth and yield of pepper***

The interaction effect of pepper varieties and nutrient sources on all the parameters accessed was significant except for pepper that did not receive fertilizer application (Table 5). The poor performances recorded from plants that did not received fertilizer application is due to the low nutrient status of the experimental site; the plants had to rely solely on the inherent soil nutrients which is low due to continuous farming on the land hence its nutrients might have been depleted. The poor result obtained from the control was an indication that no significant production could be made without fertilizer application. The positive influence of nutrient sources on the growth of the crop might be due to the release of the balanced nutrient contained in the materials. The improved growth parameters due to nutrient sources could be related to the release of mineral elements such as N, P, K and exchangeable cations (Ca, Mg and Na) to the soil by the different fertilizers used which established and maintained optimum soil physical condition for plant growth. The variation in growth parameters due to nutrient sources was considered to be due to variation in the availability of major nutrients (Sanni *et al* 2015).

The best growth and yield performances were observed from pepper that received organomineral compared to NPK and poultry manure. This may be attributed to increased and timely released and availability of nutrient elements. With the results from the study we opined that emphasis should be placed on the use of organomineral as plant nutrient sources for sustainable pepper cultivation and agent of soil management to improve soil nutrient status in the study area, as this will bridge the gap between non-availability and high cost of inorganic fertilizers and the problems associated with the use of organic manure.

Table 2: Soil chemical properties at crop maturity

pH OC OM N P Na K Ca Mg

(H2O) (g/kg) (g/kg) (g/kg) (mg/kg) (cmol/kg) (cmol/kg) (cmol/kg) (cmol/kg)

Treatments

OM/Sweet Pepper 5.99 1.49 2.58 0.72 5.07 0.42 0.50 3.90 1.60

OM/Cayenne pepper 5.77 1.40 2.41 0.70 5.28 0.40 0.33 3.20 1.10

OM/Bell pepper 6.18 1.30 2.64 0.66 5.54 0.40 0.35 4.60 1.90

PM/Sweet Pepper 5.37 0.79 1.35 0.69 2.67 0.47 0.42 5.10 2.30

PM/Cayenne pepper 5.54 1.40 2.41 0.72 3.15 0.49 0.44 3.80 1.70

PM/Bell pepper 6.15 1.72 2.97 0.76 6.19 0.43 0.43 4.60 1.60

NPK/Sweet Pepper 8.11 2.28 3.98 1.10 9.20 1.36 1.50 6.90 2.4

NPK/Cayenne pepper 5.67 2.24 3.86 0.80 2.23 0.45 0.48 4.20 2.0

NPKl/Bell pepper 6.13 1.72 2.97 0.78 3.15 0.48 0.44 5.10 2.2

Control/Sweet Pepper 7.58 2.20 3.96 1.28 16.12 1.46 1.76 7.8 3.0

Control/C. pepper 6.57 1.60 2.74 0.70 8.62 0.41 0.41 4.60 1.80

Control/Bell pepper 6.41 1.26 2.18 0.68 3.82 0.41 0.32 4.60 2.0

Table 3: effects of variety on the growth and yield of pepper

Plant height Root length No of lateral No of leaves Biomass Days to no of weight of

(cm) (cm) branches (g) a 50% fruits fruits (g)

flowering

Varieties

Bell pepper 51.4a 27.7a 14.0b 193.7a 10.7a 74.4b 51.8a 479.7a

Cayenne pepper 46.8ab 27.7a 22.9a 204.1a 10.6a 74.5b 22.5c 237.2b

Sweet pepper 42.2b 27.6a 18.6ab 189.5a 11.2a 85.0a 38.3b 213.1b

Mean followed by the same letter in each column for each parameter are not significantly different from each other by Duncan’s Multiple Range Test (DMRT) at 5% level of probability.

Table 4: Effects of different nutrient sources on the growth and yield of varieties of pepper

Plant height Root length No of lateral No of leaves Biomass Days to no of weight of

(cm) (cm) branches (g) 50% fruits fruits (g)

flowering

Treatments

Organo Minerals 5t ha-1 55.44a 32.22a 21.56a 249.11a 13.85a 81.33c 47.00a 438.89a

NPK 15:15:15 2 lts ha-1 51.56ab 30.89b 24.67a 249.78a 11.84ab 78.33a 37.33a 357.56ab

Poultry manure 5t ha-1 45.11b 27.22c 18.33a 171.22b 10.70b 78.89b 45.22a 306.11b

Control (No fertilizer) 35.00c 16.89d 9.44b 112.89c 6.91c 73.33d 20.67b 137.33c

Mean followed by the same letter in each column for each parameter are not significantly different from each other by Duncan’s Multiple Range Test (DMRT) at 5% level of probability.

Table 5: Interaction effects of different nutrient sources and variety on the growth and yield of varieties of pepper

Plant height Root length No of lateral No of leaves Biomass Days to no of weight of

(cm) (cm) branches (g) 50% fruits fruits (g)

flowering

Treatments

Bell pepper/OM 60.3a 35.0a 18.0bcd 228.0a 13.7ab 75.0f 67.3a 720.a

Bell pepper/NPK 57.3ab 30.7bcd 17.3bcd 228.78a 10.8abcd 78.0e 46.3bc 512.0b

Bell pepper/PM47.3abc 27.0de 12.0bcd 197.7ab 12.5abc 74.7f 67.3a 500.0b

Bell pepper/Control 40.7cde 18.0f 8.7d 120.3bc 5.7e 70.0g 26.3de 186.7cd

Cayenne pepper/OM 54,0abc 36.0a 23.3b 266.0a 13.3ab 75.0f 21.0e 296.7cd

Cayenne pepper/NPK 52.7abc 33.0abc 35.0a 263.67a 12.46abc 78.0e 23.3de 333.3c

Cayenne pepper/PM 44.7bcd 25.0e 23.7b 180.0abc 9.5bcde 75.0f 28.0cde 205.0cd

Cayenne pepper/control 35.7de 15.7f 9.7d 106.7c 7.3de 70.0g 17.7e 113.7d

Sweet pepper/OM 52.0abc 34.7ab 23.3b 253.3a 14.7a 85.0c 52.7ab 300.0cd

Sweet pepper/NPK 44.7bcd 29.0cde 21.7bc 257.0a 12.3abc 8.0a 42.3bcd 227.3cd

Sweet pepper/PM 43.3cd 29.7 19.3bcd 136.0bc 10.1bcde 87.0b 40.3bcd 213.3cd

Sweet pepper/control 28.7e 17.0f 10.0d 111.7c 8.0cde 80.0d 18.0e 111.7d

Mean followed by the same letter in each column for each parameter are not significantly different from each other by Duncan’s Multiple Range Test (DMRT) at 5% level of probability.

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