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Full Length Research Paper

Evaluating the Role of NEB-33 Fortified Fertilizers in Pepper Cultivation

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A two year field study was conducted in Institute of Agriculture Reasearch and Training experimental field at Ibadan, Nigeria to evaluate the effects of NEB-33 fertilizer additive on the growth and yield of chilli pepper (Capsium fruitscen). Treatments consisted of control, NPK, poultry manure (PM), organomineral fertilizer (OM), cow dung (CD) and their combinations with NEB-33. The organic fertilizers were applied at the rate of 5 t ha^{-1}, while NPK 15:15:15 was applied at the rate of 90 kg N ha^{-1} and NEB-33 was applied at the rate of 5.6 kg ha$^{-1.}$ Randomized Complete Block Design (RCBD) was used for the experiment and was replicated three times. Results show that treatments significantly (P>0.05) improved growth and yield of chilli pepper. Number of leaves, plant height, leaf area, stem girth, number of branches, number of fruits, and fruit yield ranged from 129 - 170, 30.4 – 44.2 cm, 20.7 – 35 cm^2, 2.0 - 2.7 cm^2, 12 – 17, 392 – 682 and 1.01 – 3.08 t ha^{-1} respectively. Percentage increase in number of leaves, plant height, leaf area ranged from 5.4 – 70%, 17.8 – 48.7% and 3 – 73.4%, respectively, in treated plant over control. In terms of total number of fruit yield, percentage increases were 15, 7 , 13 and 27% respectively in NPK + NEB, CD + NEB, PM + NEB and OM + NEB whereas in case of fruit yield, percentage increases were 17, 9, 8 and 12%, respectively, for NPK + NEB, CD + NEB, PM + NEB and OM + NEB over their sole application.

Key words: Efficiency, growth regulators, NEB-33 additive, organic and inorganic fertilizers, pepper yield.

INTRODUCTION

Fertilizers are very important inputs in crop production when other inputs such as weed control, good land preparation and high yielding varieties were right. Crop yields can be doubled through balanced use of chemical fertilizers. In fact the effect can also be more when combined with organic fertilizers that provide slow release of other nutrients not supplied through chemical fertilizer sources. The purpose of fertilizer use is to remove the limitation to crop growth that would be caused by an inadequate supply of nutrients in the soil (Alan, 1993). However, there are some organic materials and soil conditioners used to improve soil physical and chemical condition and yields. They serve as growth regulator, stimulating hormones or biostimulant. They are also fertilizers additives. Growth regulator in form of organic compound is widely used to improve production and quality of agricultural crops. It also helps the crop to maximize absorption of nutrient elements from the soil. Organic compounds which contain hormone have been found to play important role in the vegetative growth and reproduction of many crops including pepper (Onofeghara, 1981). However, the effect of the compounds on the crops may be positive or negative depending on the concentration applied. Several studies have been report-ed on the use of organic compounds to enhanced crop production.

Akande and Adediran (2004) reported positive responses of okra and tomato to complimentary use of terralyt plus with mineral fertilizer. Adediran et al. (2005) reported a greenhouse and field studies conducted on the effect of organic root plus (biostimulant) on nutrient content, growth and yield of tomato (*Lycopersicon lycopersicum* Mill). Complimentary application of organic root plus with mineral fertilizer promoted both the vegetative growth, root development and fruit yield of tomato.

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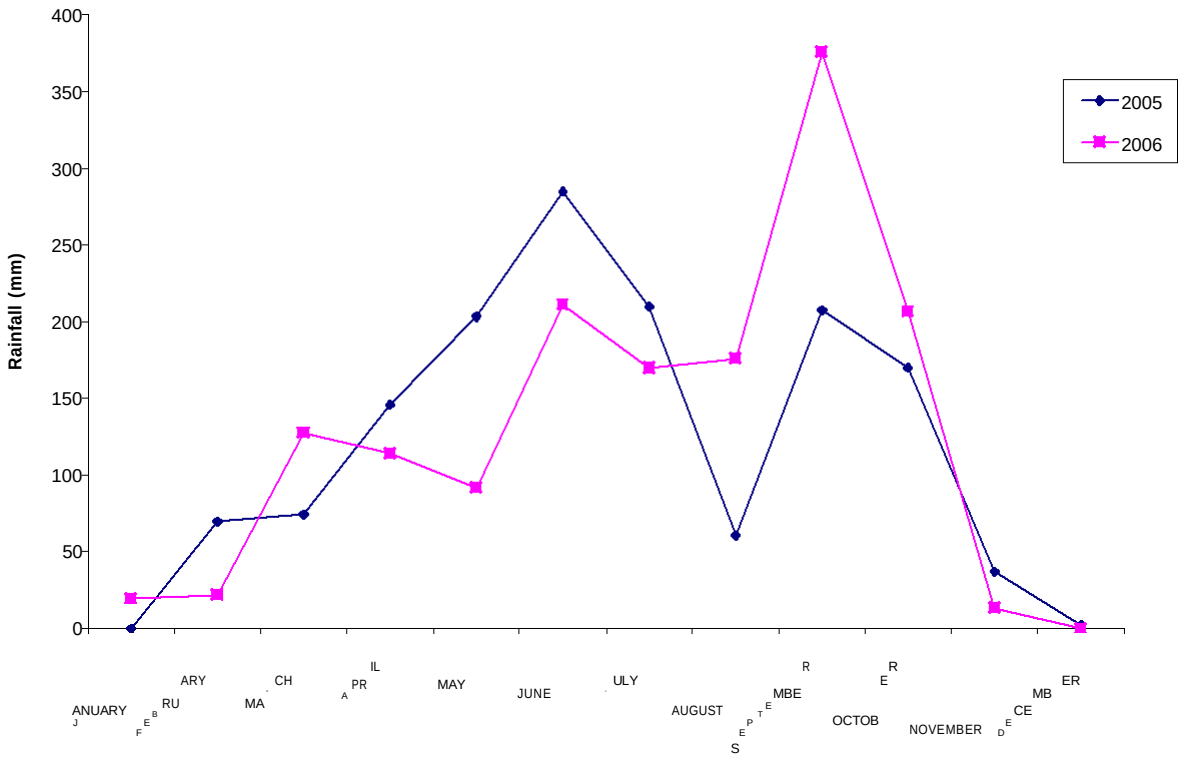

Figure 1. Monthly rainfall distribution in Ibadan for 2005 and 2006.

Akande (2006) reported effect of biostimulant on the growth, nutrient content and yield of amaranthus in a greenhouse study. Complimentary application of biostimulant with mineral fertilizer promoted the vegetative growth, root development, nutrient composition and yield of amaranthus.

Nutrient enhancing balancer – 33 (NEB-33) fertilizer additives is an organic, non toxic feeding stimulant that has been tested and proved to be effective on many crops and vegetables in the United State of America. NEB is used as complementary to organic and inorganic fertilizers in order to increase the efficiency of these fertilizers by improving the soil properties and making available the plant nutrients needed by crops. NEB -33 can be used to increase the efficiency of fertilizers. It shows this in complementary use with N.P.K. fertilizer on growth and development of cropping plant (Haiyang, 1997). Since no work on NEB has been reported in Nigeria, there is need to evaluate the efficacy of NEB-33 fertilizer additives on organic, inorganic fertilizers and performance of pepper.

MATERIALS AND METHODS

The experiment was carried out at Institute of Agricultural Research and Training, [I.A.R.&T] Moor Plantation Ibadan on Latitude 7° 22.5[1] N and Longitude 3° 50.5[1] E in the rainforest vegetation of Nigeria. The town is characterized by a bimodal rainfall pattern with a long rainy season, which usually starts in the late March while the short rainy season extends from September to early November after a short dry spell in August. Figure 1 showed the monthly rainfall distributions for 2005 and 2006.

Evaluation of NEB-33 fertilizer additive was carried out on the field at Ibadan, during the rainy seasons of 2005 and 2006. Prior to field experimentation bulked soil samples were randomly taken from top soil [0 – 15 cm depth] for assessment of soil physical and chemical properties. The site was ploughed and harrowed. Cured poultry manure and cow dung manure were collected from organic fertilizer unit of the institute. Also organo-mineral fertilizer, NPK 15:15:15, NEB-33 fertilizer additives were collected from the same unit of the institute. There were nine treatments which consisted of control, NPK, poultry manure, organo-mineral fertilizer, cow dung and their respective combinations with NEB-33. The organic fertili-zers were applied at the rate of 5 t ha^{-1}, while the NPK was applied at the rate of 90 kg N ha^{-1} and NEB-33 was applied at the rate of 5.6 kg ha^{-1}. The experiment was laid out in randomized complete block design (RCBD) replicated three times. Each plot measured 3.6 m x 2.2 m with 1m distance between the blocks and 0.5 m between the plots. Seedlings were planted at 90 cm x 50 cm inter and intra row spacing respectively.

Pepper seeds (*Capsicum fruitscen*) were purchased from Nigeria Institute of Horticultural Research and Training (NIHORT) Ibadan. Seeds were planted at the nursery for a period of 4 weeks before it was transplanted to the field. A mixture of metolachlor and metobromuron at 5 L/ha and paraquat at 1 L/ha were sprayed prior to planting to control weeds. Subsequent manual weeding with hoe were carried out at 12 and 16 weeks after transplanting. The organic fertilizer (cow dung, poultry manure and organomineral fertilizer) were applied at the rate of 5 tonnes / ha at two weeks before transplanting. N.P.K. 15: 15: 15 was applied at the rate of 90 kg/ha applied at 2 weeks after transplanting by drilling method. When insect attack was noticed on pepper foliage it was sprayed with nuvacron insecticide.

Table 1. Physical and chemical properties of this soil prior to cropping.

Properties	Value
pH	5.90
Ca (cmol kg^{-1})	1.34
Mg (cmol kg^{-1})	0.98
Na (cmol kg^{-1})	0.38
K (cmol kg^{-1})	1.08
CEC (cmol kg^{-1})	4.10
Zn (mg kg^{-1})	5.80
Available P (mg kg^{-1})	7.10
Organic C (%)	0.88
Organic matter (%)	1.52
Total N (%)	0.90
Sand (%)	68
Silt (%)	16
Clay (%)	16

Agronomics parameters taken were plant heights, number of leaves, numbers of branches, and stem girth at 8 weeks after application of treatments. At fruit maturity, ripe fruits when reddish in colour were harvested at 7 days interval and weighed to obtain fresh fruit weight.

The experiment was reestablished in 2006 on the same plots. The experimental treatments, design, plot layout and spacing used in 2005 were maintained. Soil samples were randomly taken with auger at depth 0 – 15 cm on plot basis prior to planting 2006 and each sample was analyzed for chemical properties. Neither ploughing nor harrowing was done. The site was hoed prior to planting and seedlings trans-planted in 2006. Treatments were reapplied in 2006. All the previous year cultural operations were subsequently carried out.

Chemical analysis of soil

Particle size distribution was determined by the hydrometer method (Bouyoucos, 1962) using sodium hexameta-phosphate as dispersing agent. Soil pH was determined in distilled water at soil to water ratio 1:1 using glass electrode on an EIL 7020 pH meter. Exchangeable bases (K, Na, Ca and Mg) were determined by extraction with neutral normal NH_4OAc at soil: solution ratio 1:10. Potassium, calcium, and sodium in the extract were read by flame photometer while magnesium was determined by atomic absorption spectrophotometer. Soil exchangeable acidity was determined by titration of normal KCl extracted acidity against 0.05 N sodium hydroxide to a pink end point using phenolphthalein as indicator (Kitson and Mellon, 1994). Cation exchange capacity was obtained by summation of exchangeable cations (K, Na, Ca, and Mg) and exchange acidity. Available P was determined using 0.03 N NH_4F in 0.025 N HCl as extractant (Bray and Kurtz, 1945). Organic carbon was determined by wet oxidation with sulphuric acid (Walkley and Black, 1934).

Data generated were subjected to statistical analysis of variance and means were separated by Duncan Multiple Range Test (SAS, 1994).

RESULTS

Characteristics of soil used

The results of the physical and chemical analysis of the soil used prior to the commencement of the experiment are presented on Table 1. The soil is sandy loam with pH slightly acidic. The organic matter, organic carbon and total nitrogen were relatively low. The soil available phosphorus, the exchangeable bases and CEC were very low (FPDD, 1989). It can be deduced from the result that the soil is low in fertility and therefore, there is need for fertilizers application to boost crop production.

Effect of treatment on agronomic parameters

The effects of treatments on numbers of leaves, height, leaf area, stem girth and number of branches are presented on Table 2. Significant ($P<0.05$) treatments effects were observed in the numbers of leaves, height and leaf area whereas stem girth and number of branches were not significantly different. In terms of number of leaves, the highest number of leaves was obtained in plant treat-ed with NPK + NEB and was closely followed by plant treated with OM + NEB. Control had the lowest number of leaves.

Number of leaves increases by 19.7, 6.6, 5.0 and 11.6%, respectively, in NPK + NEB, CD + NEB, PM + NEB and OM + NEB over their sole application. Percen-tage increases in treated plant over untreated control ranged from 5.4% to 70%. In terms of plant height, tallest plant was produced from the treatment that received NPK + NEB which was not significantly different from plant treated with sole use of PM. Plant height increases by 21.4, 10.9, 5.0 and 6.1%, respectively, in NPK + NEB, CD + NEB, PM + NEB and OM + NEB over their sole use. Percentage increases in treated plant over untreated control ranged from 17.8 to 48.7%.

In the case of leaf area, largest leaf was produced by the plant that was treated with NPK + NEB and was closely followed by the plant that received sole NPK. Leaf area increases by 8.1, 11.0, 13.2 and 20%, respectively, in NPK + NEB, CD + NEB, PM + NEB and OM + NEB over their respective sole application. Percentage in-creases in treated plant over untreated control ranged from 6.3 to 73.4%.

In terms of stem girth and number of branches, treatment application did not produce any significant difference. Although, a close inspection of the result show a slight increases in complementary use of the various fertilizer with NEB compared to their sole application.

Effect of treatment on total number of fruits and fruit yield

Significant ($P<0.05$) treatments effects were obtained in total numbers of fruits and fresh fruit yields (Table 3). In terms of total numbers of fruits, the highest value was obtained in plant treated with OM + NEB and was closely followed by the plant treated with PM + NEB. The lowest value was from the control. There were increments of 15, 7, 13 and 27% in NPK + NEB, CD + NEB, PM + NEB and

Table 2. Effect of treatment on height, number of leaves, leaf area stem girth and number of branches of pepper plant in field trial (pooled data for 2 years).

Treatment	Number of leaves	Heights (cm)	Leaf area (cm^2)	Stem girth (cm^2)	Number of branches
Control	129c	30.4b	20.7b	2.0	12
NPK	142b	36.4b	33.2a	2.4	15
NPK +NEB-33	170a	44.2a	35.9a	2.7	18
CD	136b	35.9b	29.2b	2.2	15
CD + NEB-33	145b	39.8b	32.4b	2.5	14
PM	141b	40.5a	22.0b	2.4	16
PM + NEB-33	148b	42.9b	28.9b	2.5	17
OM	138b	38.3b	27.4b	2.2	13
OM + NEB-33	154ab	40.7b	32.4a	2.3 NS	15 NS

Means having the same letter(s) are not significantly different according to Duncan Multiple Range Test.

Table 3. Effect of treatment on total number of fruits and fruit yield (pooled data for 2 years).

Treatment	Number of fruits	Fruit yield (t/ha)
Control	392c	1.01d
NPK	409b	1.87c
NPK + NEB-33	469b	2.19bc
CD	485b	2.26b
CD + NEB-33	515ab	2.46b
PM	511ab	2.69ab
PM + NEB-33	576ab	2.89ab
OM	539ab	2.75ab
OM + NEB-33	682a	3.08a

Means having the same letter(s)are not significantly different according to Duncan Multiple Range Test.

OM + NEB, respectively, over their respective sole application.

In terms of fruit yield, the highest yield was obtained in OM + NEB and was closely followed by PM + NEB which is not significantly different from OM and PM. The trend was similar to the trend observed in total number of fruits. Yield increases of 17, 9, 8, and 12% were obtained in NPK + NEB, CD + NEB, PM + NEB and OM + NEB. The percentage increments in treatments over the control ranged from 9% in sole NPK to 205% in OM + NEB. It could be observed from the results that all treatments that received combinations of fertilizers plus NEB obtained a non significant higher value than sole application of individual fertilizers.

Soil chemical properties prior to second cropping in 2006

Prior to second cropping in 2006 (Table 4) the soil pH had increased from 5.9 prior to planting in 2005 to a maximum of 6.4 in plot that received sole application of NPK. On the whole, there was a decline in nutrients status of the soil across treatments, except for Zn which has increased across the treatments. There was a slight increase in soil available P in treatments CD + NEB, PM, and OM + NEB while all other treatments recorded a decrease. It is clearly shown from these results that treatments applied in 2005 did not have remarkable residual effect in 2006.

DISCUSSION

Growth regulator in form of organic compound is widely used to improved production and quality of agricultural crops. NEB-33 fertilizer additive is and organic, non toxic feeding stimulant that has been tested and proven to be effective on many crops in United State of America. It has been used to increase the efficiency of fertilizer. The positive response of pepper to applied fertilizer and NEB-33 fertilizer additives was due to initial low fertility status of the soil on which the trial was carried out. Treatments significantly increase number of leaves plant height and

Table 4. Residual effects of treatments on soil chemical properties prior to second cropping.

Treatment	pH	Na (cmol kg^{-1})	K (cmol kg^{-1})	Ca (cmol kg^{-1})	Mg (cmol kg^{-1})	CEC (cmol kg^{-1})	Zn (cmol kg^{-1})	Av. P (mol kg^{-1})	Org. C (%)	Org, M (%)	N (%)
Control	6.2ab	0.21c	0.27c	0.61c	0.61bc	2.13c	7.47	3.78	0.68	1.76	0.07
NPK	6.4a	0.28b	0.42ab	1.28ab	0.78b	2.87ab	8.53	4.49	0.74	1.28	0.07
NPK+ NEB-33	6.2ab	0.28b	0.41ab	1.42a	0.83ab	3.04a	7.46	5.80	0.72	1.23	0.07
CD	6.2ab	0.24	0.47ab	1.26b	0.78b	2.86ab	8.23	6.76	0.72^{f}	1.23	0.07
CD + NEB-33	6.1ab	0.34ab	0.43ab	1.14b	0.78b	2.79b	7.30	8.03	0.83	1.43	0.80
PM	6.2ab	0.33ab	0.46ab	1.27b	0.80ab	3.04a	6.16	7.78	0.77	1.33	0.80
PM + NEB-33	6.3ab	0.30ab	0.38b	1.31ab	0.68bc	2.78b	6.83	6.91	0.85	1.46	0.83
OM	6.2ab	0.26b	0.43ab	1.33ab	0.83ab	2.96ab	7.26	6.16	0.82	1.42	0.83
OM +NEB-33	6.1ab	0.38a	0.56a	1.38ab	0.98a	3.40a	8.07	8.21	0.88	1.51	0.09

Means having the same letter(s) in the same column are not significant different according to Duncan Multiple Range Test.

leaf area and a non significant increase in stem girth and number of branches which was translated to increase in pepper yield. Greater increase from complementary use of fertilizer plus NEB-33 could be due to efficiency of NEB -33 on various fertilizers applied and consequently on the performance of the pepper. Results corroborate the findings of Haiyang (1997), Akande and Adediran (2004), Adediran et.al. (2005) and Akande (2006). For instance, Haiyang (1997) reported a study on complementary use of NEB-33 and nitrate nitrogen on wheat grown in different soils (sandy loam, loam and clay soil) during the winter. The wheat treated with combination of nitrate nitrogen plus NEB-33 was much better in growth and yield than the wheat with nitrate nitrogen fertilizer applied solely at the seedling stage in plots on sandy loam, loam and clay soils. The effect on loam and clay soil was better than on sandy loam. The yield increase for crops treated with nitrate nitrogen plus NEB-33 fertilizer additives was 5.4% 12.8% and 11.4%, respec-tively, on sandy loam, clay soil and loam soils (Haiyang, 1997). In another trial, the effect of nitrate nitrogen and nitrate nitrogen plus NEB-33 on autumn crops was evaluated. Yield increases of 10.2%, 11.6% and 8.7% were observe on maize, cotton and sesame in plant treated with nitrate nitrogen plus NEB compared to sole nitrate nitrogen.

The results of this study show that the efficiency of NEB-33 fertilizer additive on fertilizers for crop production was remarkably enhanced through the activities of NEB -33 fertilizer additive. The complementary used of various fertilizers (organic and inorganic) plus NEB-33 was superior to sole application of the fertilizers and control. Therefore, it is advisable for farmers to adopt the use of NEB-33 to boost yield. Nevertheless, the choice of farmer to adopt the use of NEB-33 will depend on economic resources of the farmer and the availability of the NEB-33.

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