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Effects of Soil Amendments on Growth and Yield of Pepper (*Capsicum Frutescens* L.)

Adewoyin O.B[1]., Fagbayide S.D[2] And Oluwafemi M.O[3].
*[1 &3]Department of Horticulture, *[2] Agricultural Engineering
Federal College of Agriculture, Akure, Ondo State Nigeria

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Abstract
Research was conducted at the Federal College of Agriculture, Akure between March and August 2010 and 2011 to evaluate the effects of organic and mineral fertilizers on growth and yield of pepper. Pepper seeds were obtained from department of Agronomy University of Ibadan and raised for six weeks in the green house before transplanting to the field at a spacing of 70 cm x 50 cm inter and intra row spacing respectively. The treatments were poultry manure at 5 ton/ha, organomineral fertilizers at 3.0 tons/ha, liquid fertilizer at 1,400 litres/ha and control (no fertilizer application). The treatments were laid out in a randomised complete block design replicated four times. Growth and yield parameters such as plant height stem girth, fruit yield, number of fruits, number of leaves and number of branches was investigated. Results showed that there were significant increase (P<0.05) in the growth and yield parameters. Organomineral fertilizer gave the highest response, followed by Boost extra, poultry manure and control (no fertillizer) had the least in terms of improved growth and fruit yield of Capsicum frutescens. For the organomineral the number of leaves, plant height, stem girth and fruit yield ranged from 139 -313, 22.3 – 56.7cm, 2.3 – 4.5cm^2, 6.0 - 1.8, and 3.1 t/ha respectively while for the control 87 – 192, 20.4 – 49.8cm, 1.6 – 4.3cm^2 , 3.0 – 14.0 and 1.0 t/ha. The percentage increased in yield and growth parameters of organomineral fertilizer compared to control treatment are as follows: 38.7%, 12.2%, 14.0%, 22.2% and 16.9% respectively.

Key words: *Soil Amendment, Growth, Yield, pepper fruits, fertilizers.*

Introduction

Pepper (*Capsicum* sp.) is one of the most widely used spices in the world. Pepper production has increased in recent years worldwide. Nigeria is known to be one of the major producers of pepper in the world accounting for about 50% of the African production (Erinle, 1989). The good soils and weather can readily support the good growth and production of pepper in Nigeria (Adigun, 2001). Pepper grown in Nigeria is in high demand because of its pungency and good flavour. It can readily be dried, ground and packaged for export. Exportation of pepper in Nigeria has once been reported as a lucrative business (Erinle, 1989, Adigun, 2001). Pepper consumption in Nigeria accounts for 40 percent of the total vegetable consumed per day (Erinle, 1989). A total of 100-200ha is being assigned to pepper production annually in Nigeria.

Pepper is utilized mostly for culinary purposes and seasoning. It also has medicinal uses, internally as a stimulant and carminative and externally as a counter- irritant. Although,

pepper is widely cultivated throughout Nigeria, yields obtained by peasant farmers are often very low (Adigun, 2001). Production constraints such as low soil fertility, weeds and incidence of diseases are the major problems. Comparatively, yield in the developing countries is about 10 – 30% of the developed countries (Grubben and Tahir, 2004). Pepper can be grown as a rain-fed crop or raised entirely under irrigation in areas with very low amount of rainfall. The moisture content of the soil and the prevailing temperature has important effects on the growth and yield of pepper. In general, the maximum growth and production of pepper occur between a temperature range of 18^{o}C and 30^{o}C (Grubben and Tahir, 2004).

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 nutrients such as nitrogen, phosphorus and potassium (Akande *et al.*, 2008). 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 conditions and high crop yield. They serve as growth regulator, stimulating hormones or biostimulant (Akande *et al.*, 2008). Fertilizers also serve as. growth regulators in form of organic compounds that are widely used to improve production and quality of agricultural crops. Through their application, the absorption of nutrient elements from the soil is maximize. Organic compounds which contain hormones have been found to play important roles in crop production such as rapid vegetative growth, initiation of flowering and fruiting and reproduction of many crops including pepper (Onofeghara,1981). The effect of these compounds on the crops may be positive or negative depending on the concentration applied. Several studies have been reported 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 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, therefore this study aim at investigating the effect of some soil amendment practices on growth and yield of pepper.

Materials and Methods

The experiment was carried out at the experimental site of Federal College of Agriculture, Akure, Ondo State, Latitude 7° 16N' and Longitude 5° 14 E'. The study locations characterised 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. The annual rainfall of the location during cultivation varied from 1100 - 1300mm and temperature range of 27^{o}C – 32^{o} C.

The total nitrogen was determined by the microkjedahl method while available soil phosphorus was extracted by the Bray P1extractant. The soil K, Ca, Mg and Na were extracted using neutral normal NH_4OAc at soil solution ratio 1:10. (AOC, 1990)

The experimental design was randomized complete block design replicated four times. Cured poultry manure was collected from organic fertilizer unit of the college. Organomineral fertilizer and Boost extra additives were purchased from Agro chemical industry. The treatments applied were poultry manure at 5 ton/ha, organomineral fertilizers at 3.0 tons/ha, liquid fertilizer at 1,400 litres/ha and no fertilizer. The treatments were applied two weeks after transplanting. Growth and yield parameters such as plant height, stem girth, fruit yield, number of fruits and number of leaves were measured at weekly interval. At fruit maturity, ripe fruits were harvested at 5 days interval and weighed to obtain fresh fruit weight. Data generated were subjected to statistical analysis of variance (SAS, 1994) and means were separated using least significant difference (LSD).

Results and Discussion

The results of the physical and chemical analysis of the soil used prior to the commencement of the experiment are presented in Table 1. The soil available phosphorus, the exchangeable bases and CEC were very low (Agboola and Corey, 1973) the soil is sandy loam with pH slightly acidic. The organic matter, organic carbon and total nitrogen of the soil were relatively low. From the result, it can be deduced that the soil is low in fertility and therefore, there is need for fertilizer application to boost crop production.

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

Properties	Values
pH	6.2
Ca (cmol kg-1)	1.18
Mg (cmol kg-1)	0.96
Na (cmol kg-1)	0.34
K (cmol kg-1)	1.06
CEC (cmol kg-1)	3.90
Zn (mg kg-1)	5.40
Available P (mg kg-1)	6.8
Organic C (%)	0.86
Organic matter (%)	1.54
Total N (%)	0.87
Sand (%)	64
Silt (%)	19
Clay (%)	17

The effect of poultry manure, organic mineral fertilizer and Boost extra are shown in table 2. At sixth weeks after transplanting, pepper plants treated with organomineral fertilizer had plant height of 38.4cm followed by Boost extra (35.3cm) while poultry manure had a plant height of 34.8cm and control 34.0cm. At twelve WATP, treatment with organomineral had tallest plant height of 56.7cm followed by Boost extra (52.8cm) and poultry manure had a plant height of 54.8cm, control 49.8cm. The control treatment had the least value compared to other treatments, this could be as a result of growing of crops continually on the same piece of land which had led to soil nutrient depletion and low fertility status of the soil. This observation agreed with the findings of Wang *et al* (1999)

who worked on critical levels for soil pH in sedimentary soil of Southwest Nigeria and reported that extensive cultivation and continuous use of the same piece of land without fertilizer application resulted in sharp decline in soil pH and poor soil nutrient status.

Table 2. Effect of soil amendment on plant height of pepper plant

Weeks after transplanting	Organomineral cm	Boost Extra cm	PoultryManure cm	Control cm
2	22.3	21.1	19.3	20.4
4	26.7	32.4	27.9	25.2
6	35.3	38.8	34.8	34.0
8	45.9	49.2	44.9	44.9
10	51.6	52.9	48.3	48.1
12	56.7	54.8	52.8	49.8
LSD	1.0	1.3	1.2	1.0

Table 3. Effect of soil amendment on stem girth of pepper plant

Weeks After Transplanting	Organomineral cm^2	Boost Extra cm^2	Poultry manure cm^2	Control cm^2
2	2.3	2.1	1.7	1.6
4	24	3.4	3.0	2.8
6	3.2	3.5	3.5	2.9
8	3.9	3.9	3.9	3.2
10	4.4	4.3	4.3	3.8
12	4.5	4.4	4.3	4.0
LSD	0.1	0.3	0.1	0.2

The effect of organomineral, poultry manure, boost extra are shown in table 4. At twelve weeks of transplanting treatment with organomineral had stem girth of 4.5cm^2, treatment with Boost extra had 4.4cm^2 while poultry manure had 4.3cm^2 , and control had 4.0cm^2. This observation agreed with the work of Adediran *et al* (2003) who worked on effect of organic waste and method of composting compost and yield two vegetable crops and concluded that organic manures released their nutrient slowly but regularly and it improved the soil physical properties for good tilts and structure.

Table 4. Effect of soil amendment on number of branches of pepper plant

Weeks After Transplanting	Organomineral	Boost Extra	Poultry manure	Control
2	6.0	5.0	4.0	3.0
4	8.0	7.0	6.0	6.0
6	12.0	10.0	9.0	8.0
8	15.0	12.0	11.0	11.0
10	17.0	14.0	13.0	12..0
12	18.0	17.0	15.0	14.0
LSD	0.5	0.4	0.5	0.4

There were significant increase ($P<0.05$) in the yield parameters among the treatment used. Table 6, showed the effect of organomineral, boost extra, poultry manure, and control on pepper fruit yield. Treatment with organomineral fertilizer gave the highest yield response, followed by Boost extra, poultry manure and the control.

Table 5. Effect of Soil Amendment on Leaves of Pepper Plant

Week After Transplanting	Organo mineral	Boost Extra	Poutlry Manure	Control
2	139.0	105.0	95.0	87.0
4	202.0	189.0	164.0	122.0
6	252.0.	224.0	179.0	132.0
8	269.0	241.0	199.0	158.0
10	292.0	264,0	244.0	169.0
12	313.0	288.0	250.0	192.0
LSD	0.3	0.4	0.3	0.4

Table 6 : Fruit Yield (t/ha)

TREATMENTS	t/ha
Organo mineral	3.7a
Poutlry Manure	2.8c
Boost Extra	2.1
Control	1.0
LSD	0.5

Conclusion

The significant increase in growth and yield of pepper plant treated with organomineral fertilizer compared to other treatment could be attributed to the combined effect of organic materials fortified with mineral fertilizer to improve and hasten the release of nutrients for plant use. This was followed by boost extra which is in liquid form which releases nutrient rapidly but had no positive effect on soil structure and organic matter content of the soil. The poultry manure treatment was significantly low due to the slow release of the nutrients to plant.

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