International Scholars Journals

African Journal of Virology Research ISSN 3421-7347 Vol. 9 (3), pp. 001-004, March, 2015. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Effect of organic root plus (biostimulant) on the growth, nutrient content and yield of amaranthus

AKANDE M.O.

Institute of Agricultural Research and Training, P.M.B. 5029, Moor Plantation, Ibadan, Nigeria. E-mail: michaelojoakande@yahoo.com.

Accepted 10 November, 2014

The effectiveness of organic root plus (biostimulant) was compared with conventional fertilizer on the growth and yield of amaranthus in a glass house study. The treatments consisted of control, full rate each of biostimulant and fertilizer, and combination of fertilizer with biostimulant at full and half rates. The urea, single super-phosphate and muriate of potash were applied at 100 kg N, 60 kg P_2O_5 and 30 kg K/ha (fertilizer full rate) respectively, while biostimulant was applied at the rate of 40 litres/ha. The results obtained showed that the use of organic biostimulant alone was not as effective as that of fertilizer alone in most of the parameters considered. The conventional fertilizer had percentages increases of 38 and 82, 19 and 73, 35 and 3, in number of leaves, plant height and leaf area in the first cycle and regeneration, respectively, over the sole use of biostimulant. Complimentary application of biostimulant with mineral fertilizer promoted the vegetative growth, nutrient composition, root development and yield of amaranthus. When full rate of biostimulant was combined with full rate of mineral fertilizers, the number of leaves, plant height, leaf area and shoot yield were increased 15 and 11%, 27 and 14%, 7 and 5%, 15 and 15%, in the first cycle and at regeneration, respectively, over the mineral fertilizer. The combinations of the two materials at various ratios were also effective.

Key words: Biostimulant, fertilizer, amaranthus.

INTRODUCTION

The environment in which the rooting system grows is considered to be very important in enhancing high crop production. Soil with inadequate care will definitely cause poor root formation and consequently low nutrient absorption by plant. Fertilizer has been known to improve amaranthus production. In order to ensure succulence, and therefore, quality, vegetable growth should be rapid and un-interrupted. Consequently high rate of fertilization are use in vegetable production to promote vigorous growth and crop quality (Maynard, 1979). Response of leafy amaranthus, celosia and corchorus to NPK fertilization in south western Nigeria has been reported by Olufolaji (1980) who found that 70 kg N, 34 kg P and 26 kg K/ha gave the highest fresh yield, dry matter yield and plant height.

Root biostimulant (Organic Root plus) according to the manufacturer is a natural organic biostimulant specially formulated for root development of some agricultural crops. Virtually very little work has been done on the use of organic biostimulant on agricultural crops because it is a new product from Slavo Nigeria Limited. Moreover, there is no information on the effect of Organic root biostimulant on amaranthus. Adediran et al. (2005) reported that there was a significant difference in the growth performance and yield of tomato due to fertilizer and biostimulant application. The authors further stated that the use of high rate of fertilizer application can be reduced by supplementing with root biostimulant, and that the yield of tomato was highest when fertilizer was supplemented with biostimulant. Since the effects of such root biostimulant on the performance and mineral composition of amaranthus has not been reported in Nigeria, this experiment therefore has the following objectives: To test the effect of organic root biostimulant

Table 1. Nutrients status of the soil prior to experimentation.

Properties	Value
Sand (%)	74.50
Silt (%)	16.30
Clay (%)	10.20
PH	6.07
Exchangeable bases (cmol/kg)	
Ca	6.17
Mg	5.17
K	0.09
Na	0.13
H^+	0.10
CEC (cmol/kg)	15.47
Base saturation (%)	99
C (%)	1.79
N (%)	0.18
Available P (mg/kg)	4.83

alone and in complement with inorganic fertilizer on the growth performance and mineral composition of amaranthus.

MATERIALS AND METHOD

The Experiment was carried out at the Institute of Agricultural Research and Training, Moor Plantation, Ibadan using concrete minipits. The dimensions of the concrete minipits are 1.12 m x 0.54 m with a depth of 0.22 m and were perforated at the bottom for drainage. The soil used was collected from the Institute experimental field at Ibadan. Bulked soil sample was taken and analysed for some selected physical and chemical properties prior to experimentation. The organic root biostimulant as stated by the manufacturer is composed of 3% total N, 5% available P_2O_5, 6% soluble potash (K_2O), 7.2% peat humic substances, 3% cold water kelp extract and 0.3% vitamin B (thiamine).

The experiment consisted of eight treatments which are: control, full rate of biostimulant, full rate of fertilizer, full rate of biostimulant plus full rate of fertilizer, full rate of biostimulant plus half-full rate of fertilizer, full rate of fertilizer plus half-full rate of biostimulant, half-full rate of fertilizer plus half-full rate of biostimulant, full rate of biostimulant plus full rate of N and K fertilizers. The urea, single super phosphate and muriate of potash fertilizers were applied at equivalent rate of 100 kg N, 60 kg P_2O_5 and 30 kg K_20/ha respectively as full rate. Full rate of biostimulant was applied at equivalent volume of 40 litres/ha. Randomized complete block design was used for the experiment with three replications. Each minipit represented a plot. The seeds of Amaranthus cruentus were planted by drilling in two rows 20 cm apart on each minipit. The seedlings were thinned to twenty per plot after establishment. The treatments were applied at three weeks after germination. The biostimulant solution was soil applied. All the necessary cultural operations were carried out. Growth parameters on five tag crops were taken per plot. These include plant height, number of leaves, leaf area, root length and shoot fresh yield. Leaf samples were taken for chemical analysis. First harvesting was done at six weeks. The stems were cut leaving a few centimeters above the ground level for regeneration. After regeneration, it was allowed to grow for two weeks to test the residual effect after which it was harvested. However, the root of all crops were carefully uprooted and washed with water and aid dried. The root length, root fineness and dry matter were also determined.

Soil and plant analysis

Soil particle size distribution was determined by hydrometer method (Bouyoucos, 1962), soil pH in soil/water using ratio of 1:1, organic matter by the dichromate oxidation method (Walkley and Black, 1934), available P by Bray 1 method (Bray and Kurtz, 1945), exchangeable cations by ammonium acetate extraction, total N by Kjeldahl procedure, and cation exchange capacity was by summation of exchangeable bases and exchangeable H.

The Leaf samples were oven-dried at 60°C and ground in a Wiley Steel mill for chemical analysis. The samples were ashed in a muffle furnace at a temperature of 450°C. This was extracted with 0.1 N HCl and was determined using the Vanado molybdate method (Jackson, 1958).

RESULTS AND DISCUSSION

Table 1 shows the nutrient status of the soil prior to experimentation. The soil is Sandy Loam and classified as Paleustalf. It is characterized by low level of Organic matter and Potassium. The total Nitrogen and available P are medium.

Growth parameters

The effect of treatment application on the number of leaves, plant height and leaf area are presented on Table 2. Application of treatment significantly increased the number of leaves, plant height and leaf area in the first cycle and at regeneration. The number of Leaves, plant height and Leaves, area in control treatment were remarkably low compared to other treatments. Application of treatment on number of leaves resulted in an increased ranging from 14-36% in the first-cycle and 27-56% at regeneration respectively. With respect to leaf area the increase ranged from 13.2-30.5% and 14-32% for first cycle and at regeneration respectively. It was observed that biostimulant alone was only superior and equally as effective as complement with the two materials in some cases. The number of leaves produced at first cycle was far less than what was obtained at regeneration. This was probably due to profuse branchings observed at regeneration with consequent increased in the number of leaves.

Nutrients concentration in plant

The influence of treatments on nutrients concentration of plant is presented on Table 3. The treatments had positive effect on nutrient concentration of plant. Highest leaf N concentration occurred in plants treated with fertilizer alone in the first cycle and at regeneration. Leaf

Table 2. Effect of biostimulant and/or fertilizer treatments on number of amaranthus leaves, plant height and leaf area.

Treatments	No. of leaves		Plant height (cm)		Leaf area (cm^2)	
	First Cycle	Regeneration	First Cycle	Regeneration	First Cycle	Regeneration
Control	18d	30f	27b	35cd	417c	398c
Biostimulant (BS)	24bc	60d	31ab	40c	544bc	715ab
Fertilizer (Fert)	33ab	109a	37ab	69ab	735ab	735ab
BS + ½ Fert	35ab	52e	45a	47bc	721ab	701ab
½ BS ½ Fert	34ab	76c	42a	45bc	724ab	705ab
½ BS ½ Fert	29b	83b	43a	78a	630b	610b
BS + Fert	38a	121a	47a	70a	783a	770a
BS+NK	32ab	78c	48a	60b	738ab	718ab

Means having the same letter within a column are not significantly different (P=0.05) according to Duncan multiple range Test (DMRT).
NK: N and K fertilizer.

Table 3. Effect of *biostimulant* and/or fertilizer treatments on nutrient concentration in shoot of *amaranthus.*

Treatment	First Cycle					Regeneration				
	N	P	K %	Ca	Na	N	P	K %	Ca	Na
Control	1.31c	0.32c	.183c	0.53c	0.22b	0.80c	0.14b	0.12b	0.42b	0.20b
Biostimulant (BS)	2.09ab	0.60ab	2.13b	0.83a	0.35a	1.41ab	0.20ab	2.15a	0.80a	0.31a
Fertilizer (Fert)	2.19a	0.76ab	3.03a	0.77ab	0.29ab	1.95a	0.22ab	2.53a	0.65ab	0.24ab
BS + ½ Fert	1.92b	0.67ab	2.62ab	0.60b	0.28ab	1.20b	0.22ab	2.78a	0.62ab	0.30b
½ BS + Fert	1.82b	0.86a	2.85ab	0.65b	0.32a	1.22b	0.24ab	2.68a	0.87a	0.30b
½ BS + ½ Fert	2.03ab	0.64ab	2.78ab	0.73ab	0.28ab	1.37b	0.27a	2.73a	0.83a	0.27ab
B + Fert	2.07ab	0.83a	3.18a	0.65b	0.34a	1.40ab	0.23ab	2.67a	0.77a	0.25ab
B+NK	2.01ab	0.50b	2.80ab	0.77ab	0.30a	1.25b	0.20ab	2.45a	0.38b	0.25ab

Means having the same letter within a column are not significantly different (P=0.05) according to Duncan multiple range Test (DMRT).
NK: N and K fertilizer.

P increased from 0.32% in the control plants to 0.86% in the plants treated with half-full rate of biostimulant plus full rate of fertilizer in the first cycle while at regeneration P increased from 0.14% in the control plants to 0.27% in the plants treated with half-full rate of biostimulant plus half-full rate of fertilizer. The highest leaf K concentration (3.18%) was observed in the plants that received full rate of biostimulant and full rate of fertilizer in the first cycle while at regeneration the highest was 2.78% that was observed in the plants treated with full rate of biostimulant plus half-full rate of fertilizer. In general, fertilizer and biostimulant application significantly increased nutrient composition of amaranthus.

Root development and yield of amaranthus

The influence of treatments on root development and yield of amaranthus is presented on Table 4. In term of root development, statistically, the effect of treatments applied on root development gave significant difference in all the parameters considered. With respect to root length, combine use of fertilizer and biostimulant greatly affected the root length compared to biostimulant alone while effect on control was the least. The root fineness increase over control ranges from 23 to 54%. The plants treated with half-full rate of fertilizer plus half-full rate of biostimulant showed the highest value of root fineness and was observed to have a well developed tap root. This was follow by the plant that was treated with biostimulant alone, but in this case profuse and massive fine root growth that was observed. Also the tap root was not well developed.

In term of yield of amaranthus, there was a significant treatment effect on fresh shoot yield of amaranthus. The yields ranged from 13-41% in the first cycle and 19-64% at regeneration. The yields in the first cycle across the treatments were more than the yields obtained at regeneration. The full rate of fertilizer plus full rate of biostimulant gave the highest fresh shoot yield in the first

Table 4. Effect of biostimulant and/or fertilizer treatments on root development and yield of amaranthus.

TREATMENT	Root length (cm)	Root fineness (cm/g)	Fresh root weight (g)	Dry root weight (g)	Fresh shoot yield (g)	
					1st cycle	Regeneration
Control	21.6c	0.53d	27.7c	5.43d	355d	64d
Biostimulant (BS)	32.1ab	1.19ab	35.0b	11.07c	463cd	95c
Fertilizer (Fert)	33.3a	1.07b	46.7a	18.79a	780b	260ab
BS + ½ Fert	31.6ab	0.96bc	36.0b	11.86c	798b	288a
½ BS + Fert	33.9a	0.97bc	46.7a	15.49b	650c	153bc
½ BS + ½ Fert	32.5ab	1.76a	36.3b	18.18a	711bc	300a
BS + Fert	34.9a	0.85c	43.0ab	15.99b	899a	158bc
BS+NK	28.8b	1.03b	32.3bc	17.05ab	845a	208b

Means having the same letter within a column are not significantly different (P=0.05) according to DMRT.
NK: N and K fertilizer.

cycle whereas at regeneration it was full rate of fertilizer. The control gave the least values at both instances.

CONCLUSION

It could be concluded that the use of organic biostimulant alone and in complement with fertilizer has proved to be effective because it stimulated profuse shoot growth and massive root development of amaranthus. Consequently, it increased nutrients composition of plant hence, increased in growth and yield.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Institute of Agricultural Research and Training, Obafemi Awolowo University, for providing the facilities for this work. Also the assistance of member of staff of Soil Chemistry/ Fertility Laboratory of the Institute is greatly appreciated.

REFERENCES

Adediran JA, Akande MO (2005). Effect of organic root plus (biostimulant) on nutrient content , growth and yield of tomato. Nigerian Journal of Soil Sci. 15: 26-36.

Bray RH, Kurtz LK (1945). Determination of Total Organic and available Forms of Phosphorus in soil. Soil Sci. 59: 39-45.

Bouyoucos GJ (1962). Hydrometer method improved for making particle size analysis of Soils. Soil Sci. Soc. Am. Proc. 26: 464-465.

Jackson ML (1958). Soil Chemical Analysis. Prentice – Hall Inc. Englewood

Cliffs NJ, Maynard (1979). Organic dressing in Vegetable garden. Abstracts on Tropical Agriculture, Amsterdam Netherlands, Vol. 7: (1) p 197.

Olufolaji AO (1980). The effect of varieties, spacing and Fertilizer on the growth and development of Amaranthus spp and Celosia Argential. M Phil Dissertation, University of Ibadan.

Walkley A, Black CA (1934). An examination of the Degijareff method for determining soil Organic matter and a proposed modification of the Chromic Acid titration method. Soil Sci. 37:29-38.