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Effect of EKOFERTILE bio-stimulant on growth and yield of okra

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INTRODUCTION

Okra is the fourth most popular vegetable after tomatoes, capsicum pepper and garden eggs in Ghana (Schippers, 2000). It is cultivated for its green non-fibrous fruits or pods containing round seeds. The fruits are harvested when immature and eaten as a vegetable. The seed of okra contains about 40% oil. Okra is also an important source of vitamins, calcium and potassium (IBPGR, 1990). Despite these benefits of okra, its' production is still not optimum due to a complex of nutrients constraints including the limited efficiency of the top-dressed fertilizers. The use of fertilizers is indispensable in alleviating nutrient constraints and is important in soil fertility management for improved crop production. However, most fertilizers are not optimally utilized by crops. The declining trend of cucumber yields can however be reversed, and production tremendously increased if strategies to increase the efficiency of use of the applied fertilizers, albeit in small quantities, are implemented. The use of bio-stimulants/growth activators has become one of the significant strategies presently being implemented to increase the physiological efficiency of plants to applied fertilizers. These bio-stimulants/growth activators, which are organic in nature, enhance plant growth and development when applied in small quantities (du Jardin, 2015). They enhance the plant's physiological system by improving cell division and cell enlargement resulting in better chlorophyll content and increased yield. Further, they increase plant nutrient uptake leading to enhanced fruit set, fruit numbers, fruit quality and general crop performance. Although bio-stimulants has been found very useful in vegetable crops production in several Latin American countries, its use in Ghana is very limited. The objective of the study was to determine the effects of different rates of EKOFERTILE bio-stimulant on the growth and yield of okra.

METHODOLOGY

Experimental location

The study was conducted at the Department of Horticulture, KNUST in buckets placed in the open from March to May, 2024. The site is in the semi-deciduous forest zone with elevation of 186m above sea level (ASL) and has a bimodal rainfall distribution. The major rainy season starts in late March and ends in mid-July. There is a short dry spell from mid-July to mid-September followed by the minor rainy season from mid-September to mid-November. The mean annual rainfall is 1500mm. The mean minimum and maximum temperatures are 21^0C and 31^0C respectively. The mean annual relative humidity is about 60% at noon and 95% in the morning. The soil used is ferric Acrisol.

Experimental design and crop management

The experiment was arranged in a randomized complete block design (RCBD). The treatments were (i) 115ul EKOFERTILE/plant (3.2 l/ha) (ii) 135ul EKOFERTILE /plant (3.8 l/ha) (iii) 155ul EKOFERTILE /plant (4.3 l/ha) (iv) 4g SOA Liquified/plant (111.1 kg/ha) as control. All treatments received 8g NPK as basal application two weeks after planting. Application of EKOFERTILE bio-stimulant was done two times, four weeks after emergence (WAE) and at flowering. For each EKOFERTILE treatment, half rate was applied at each of the two stages i.e. 4 WAE and at flowering. For the control, a top dressing using 4g of SOA was applied at the stage of flowering.

Each treatment had 8 buckets giving a total of 32 buckets in a replicate and 96 buckets for all the three replicates. Topsoil was sieved and steam sterilized after which the plastic buckets with dimensions (60 cm diameter and 60 cm depth) were filled with topsoil of weight 18.6kg. Three drainage holes were made under each bucket to ensure adequate drainage of excess water from the buckets.

Seeds of okra were planted on 24th March, 2024. All recommended cultural practices were strictly adhered to. Systemic insecticide, Golan, was applied at the rates of 50 ml per 15l water at fortnightly intervals against *Podagrica* spp., Grasshoppers, and Crickets. Weeds were handpicked every two weeks. Watering was done judiciously in the morning and in the late afternoons. The

soil in the buckets was occasionally stirred to ensure aeration. The harvesting of fruits was done at three days interval starting from 24th May, 2024.

Data were collected on plant height, stem girth, number of branches, number of leaves, leaf chlorophyl content, number of days to 50% flowering, number of flowers, number of fruits, mean fruit weight and fruit yield.

Data Analysis

Data collected was subjected to ANOVA using Statistix software version 10.0 and the differences between the treatment means were separated using the Tukeys HSD at 5%.

RESULTS

Effects of EKOFERTILE bio-stimulant rates on plant height, number of leaves and number of branches of okra

There were significant differences between the treatments for plant height, number of leaves and number of branches (Table 1). For all the parameters, plants treated with 3.2 l/ha EKOFERTILE were the tallest with the highest number of branches and leaves, significantly different from all the other liquefied fertilizer treatments. Plants with the shortest heights and least number of branches were recorded from the 4.3 l/ha EKOFERTILE treatment although they were not significantly different from those of the 3.8 l/ha EKOFERTILE treatment and the control. In addition, the control plants recorded the least number of leaves although they were not significantly different from those of the 3.8 l/ha EKOFERTILE.

Table 1. Effects of EKOFERTILE bio-stimulant rates on plant height, number of leaves and number of branches of okra

Treatments	Plant height (cm) 6 WAP	Number of leaves 4 WAP	Number of leaves 6 WAP	Number of branches 4 WAP	Number of branches 6 WAP
115ul EKOFERTILE/plant (**3.2 l/ha**)	40.67 a	9.0 a	15.0 a	3.3 a	4.3 a
135ul EKOFERTILE/plant (**3.8 l/ha**)	36.00 b	7.3 b	12.3 ab	1.7 b	2.7 b
155ul EKOFERTILE/plant (**4.3 l/ha**)	34.00 b	7.7 b	12.3 ab	1.0 b	2.0 b
4g SOA Liquified/plant (**111.1 kg/ha**) as control	37.67 ab	7.3 b	11.7 b	1.7 b	2.7 b
HSD 5%	4.345	1.33	2.79	1.05	1.05

Effects of EKOFERTILE bio-stimulant rates on stem girth of okra

There were significant differences between the treatments for stem girth of okra (Table 2). Plants treated with 3.21 l/ha EKOFERTILE had the biggest stem girth from 4 WAP, significantly different from all the other liquefied fertilizer treatments. The smallest stem girth was produced by the control plants treated with liquified SOA (111.1 kg/ha) which was similar to that produced by the 3.8 l/ha EKOFERTILE-treated plants at both 4 WAP and 6 WAP (Table 2).

Table 2. Effects of EKOFERTILE bio-stimulant rates on stem girth of okra

Treatment	Stem girth (cm) 4 WAP	Stem girth (cm) 6 WAP
115ul EKOFERTILE/plant (**3.2 l/ha**)	14.33 a	19.00 a
135ul EKOFERTILE/plant (**3.8 l/ha**)	9.67 b	13.67 c
155ul EKOFERTILE/plant (**4.3 l/ha**)	13.00 a	16.67 b
4g SOA Liquified/plant (**111.1 kg/ha**) as control	8.50 b	12.67 c
HSD 5%	2.147	2.160

Effects of EKOFERTILE bio-stimulant rates on leaf chlorophyll content of okra

There were significant differences between the treatments for leaf chlorophyll content of okra (Table 3). Plants treated with 3.2 l/ha EKOFERTILE had the highest leaf chlorophyll content from 2 WAP, although not significantly different from the plants treated with 3.8 l/ha EKOFERTILE. The lowest leaf chlorophyll content was produced by the control plants treated with liquified SOA (111.1 kg/ha) (Table 3).

Table 3. Effects of EKOFERTILE bio-stimulant rates on leaf chlorophyll content of okra

Treatment	leaf chlorophyll content (µmol m^{-2}) 2 WAP	leaf chlorophyll content (µmol m^{-2}) 4 WAP	leaf chlorophyll content (µmol m^{-2}) 6 WAP
115ul EKOFERTILE/plant (**3.2 l/ha**)	39.33 a	41.33 a	45.33 a
135ul EKOFERTILE/plant (**3.8 l/ha**)	38.33 ab	40.33 ab	44.33 ab
155ul EKOFERTILE/plant (**4.3 l/ha**)	37.33 bc	39.33 bc	43.33 bc
4g SOA Liquified/plant (**111.1 kg/ha**) as control	36.00 c	38.00 c	42.00 c
HSD 5%	1.354	1.354	1.354

Effects of EKOFERTILE bio-stimulant rates on number of days to 50% flowering, number of fruits, mean fruit weight and fruit yield of okra.

There were significant differences between the treatments for number of days to 50% flowering, number of flowers, number of fruits, fruit weight and fruit yield of okra (Table 4).

Plants treated with 3.2 l/ha EKOFERTILE were significantly the earliest to flower attaining the highest number of flowers, highest number of fruits and the heaviest fruit weight per plant and subsequently greatest fruit yield. Plants treated with 4.3 l/ha EKOFERTILE were the latest to flower. The control plants produced the least number of flowers, the least number of fruits, the smallest fruit weight and the lowest fruit yield (Table 4).

Table 4. Effects of EKOFERTILE bio-stimulant rates on the number of days to flowering, number of fruits, fruit weight and fruit yield of okra

Treatment	Number of days to 50% flowering	Number of flowers	Number of fruits per plant	Fruit weight per plant (kg)	Fruit yield (t/ha)
115ul EKOFERTILE/plant (**3.2 l/ha**)	42.0 c	23.7 a	26.7 a	1.63 a	45.28 a
135ul EKOFERTILE/plant (**3.8 l/ha**)	49.7 b	17.7 bc	16.0 b	1.07 b	29.72 b
155ul EKOFERTILE/plant (**4.3 l/ha**)	53.7 a	19.7 ab	16.0 b	1.10 b	30.55 b
4g SOA Liquified/plant (**111.1 kg/ha**) as control	51.0 b	11.3 c	8.3 b	0.4 c	11.11 c
HSD 5%	1.70	5.41	6.73	0.194	5.389

CONCLUSIONS

- EKOFERTILE bio-stimulant application rate of 3.2 l/ha (115ul/plant) resulted in better vegetative and reproductive growth than the other foliar fertilizer rates and the control. This rate resulted in more flowers, greater fruit numbers and heavier fruit weight/yield.
- Fruit yield from 3.2 l/ha (115ul/plant) EKOFERTILE-treated plants was 307.56 % greater than those from the control (111.1 kg/ha (4g)) plants. Similarly, it was 50.26 % greater than the fruit yield from the mean of the two other EKOFERTILE -treated plants.
- The study has clearly demonstrated that application of 3.2 l/ha (115ul/plant) EKOFERTILE bio-stimulant is best for increased productivity of okra and other vegetables.

Plate 2: Fruiting of EKOFERTILE bio-stimulant-treated okra plants

Plate 3: Harvest from 3.2 l/ha (115ul/plant) EKOFERTILE bio-stimulant-treated plants

Plate 4: Harvest from of 3.8 l/ha (135ul/plant) EKOFERTILE bio-stimulant-treated plants

Plate 5: Harvest from 4.3 l/ha (155ul/plant) EKOFERTILE bio-stimulant-treated plants

Plate 6: Harvest from 111.1 kg/ha (4g/plant) liquified SOA-treated plants