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RESPONSE OF OKRA (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH TO DIFFERENT ORGANIC FERTILIZERS

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ABSTRACT

The present research trial was carried out in the experimental area of Crop Diseases Research Institute (CDRI) Karachi, Pakistan during crop season of the year 2013. The experiment was laid out in accordance to randomized complete block design (RCBD) replicated thrice. Okra generally called as "lady finger" is mainly cultivated as vegetable crop in plain areas of the country. In the present study, we investigated the effect of three different organic fertilizers (Green Sun, Biophosphate, Nitrophos). Humic acid was also added @ 4 Kg ha^{-1} along with each treatment. Application of Green Sun @ 150 Kg ha^{-1} significantly affected plant height, number of leaves per plant, days to flowering. Whereas, Nitrophos applied at the same ratio significantly increased fruit length. Green Sun, Biophosphate and Nitrophous significantly affected capsule circumference, number of capsules per plant, capsules weight and total capsule weight per plant verses control, whereas all the three treatments had non-significant effect in comparison with each other.

Key-words: Okra, organic fertilizers, micronutrients, humic acid.

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) is one of the most extensively cultivated and commonly used specie of Malvaceae family (Bayer and Kubitzki, 2003; Naveed *et al*., 2009). Being a tropical to subtropical flowering plant, commonly found from Africa to Asia, in southern Europe, the Mediterranean and all the America (Oyelade *et al*., 2003; Andras *et al*., 2005). Okra generally called as "ladyfinger" is mainly cultivated as short duration crop for its young capsules that are used either as fried or boiled dish or may be used to enhance the value of stews, soups and salads (Kashif *et al*., 2008). In Pakistan, Due to high return or profit, it is widely cultivated all over the country.

To sustain soil output or efficiency is a chief limitation of humid and sub-humid areas. It has been observed that crops are cultivated in fertile lands for some period in absence of any fertilizers.

Soil productivity maintenance is a major constraint of tropical and subtropical areas. Crop cultivation is usually performed between fields to utilize only fertile soils for some years without use of fertilizers. But this practice usually fails to fulfil the demand of rising population of the World (Akande *et al*., 2010).

Tropical and subtropical agricultural fields are affected severely due to sub-optimal soil fertility and its transfer, resulting in depletion of the nutrient concentration and alteration in soil fauna and flora population (Economic Commission for Africa, 2001). Use of chemical enricher can expand plant yield and soil reaction, whole nutrient concentration, and accessibility of nutrients, but is not used as much because of shortage, high rate, and nutrient imbalance in soil solution. Most of the chemical enrichers applied in traditional agriculture chiefly contain nitrogen, phosphorus and potassium and these deplete the available micro nutrients from the soil and affect the soil fauna and flora and human essential nutrients usage (Reijntes *et al*., 1992). Addition of chemical enrichers in surplus quantities favours abrupt incidences of insect pests and diseases as well as helps to abolish microbes' population in soil.

Addition of carbon based sources with the purpose to sustain and enhance concentration of essential nutrients in soil has always been supported (Alam and Shah, 2003; Saleem *et al*., 2016; Smil, 2000). Organic manures may be explained as the product obtained from unprocessed living origin such as plant or animal. The final produce is changed in a worse decaying material due to microbes or mixing of adequate quantities of essential nutrients in order to increase the fertility of soil. Generally, these materials may have macro necessary nutrients i.e. nitrogen, phosphorus and potassium @ 5% at least.

As in their original form, waste organic materials contain a wide range of plant nutrient concentrations that tends difficult to handle them in field condition. It is therefore only reasonable and for the user's benefit that such

waste organic material should be processed and converted into standard nutrient sources, and is favoured by large number of commercial farmers as compared to the product without process (FAO, 2006).

Driving agriculture on sustainable basis, it is imperative not to harm natural resources by utilizing the conventional land farming information in a way to secure the environment (Ramprasad *et al*., 2009). Keeping in view the above-mentioned scenario present field study was initiated to investigate the effect of three different organic fertilizers containing micronutrients along with humic acid on yield and yield contributing parameters of okra. Most of the vegetable growers in Pakistan use waste organic materials as source of plant nutrients due to non availability of commercial organic fertilizers. The core objective of current investigations was to assess the potential of different commercial organic fertilizers for future use in okra plantation.

MATERIALS AND METHODS

Study site

The present research was carried out in the experimental area of the Crop Diseases Research Institute of Pakistan Agricultural Research Council, Karachi, Pakistan during the year 2013.

Experimental design

The experiment was laid out in the randomized complete block design (RCBD) using three different organic fertilizers (Green Plus, Biophosphate and Nitrophos) as treatments along with WOW humic acid as given in Table a and each treatment was replicated thrice along with control.

Materials used

The seeds of hybrid Indian okra (*A. esculentus*) variety "Rana Kirshna F_1 hybrid" were sown through dibbling method on already well prepared ridges on 30 April 2013, with row to row and plant to plant distances of 60 cm and 23 cm, respectively. Three to four seeds were planted in one hill. Prior to sowing seeds were soaked in plain water for 4-5 hours to break seed dormancy and facilitate germination. Seeds were sown in each spot to acquire adequate germination. After completion of germination (thinning was carried out after 8-10 days to maintain proper plant population, (2 seedlings / hill). Hoeing, weeding and other culture practices were also carried out simultaneously in all the replications. The organic fertilizers (Green Plus, Biophosphate and Nitrophos) were added at the rate of 150 Kg ha^{-1} along with WOW humic acid @ 4 Kg ha^{-1}. WOW humic acid was added equally @ 4 kg ha^{-1} along with each treatment. None of the organic fertilizer was added in control plots. All the organic fertilizers were applied in three separate doses; at the time of sowing, at flowering and after first picking (Table 1). Field was irrigated after every 2nd day until germination completed and two to three days' intervals thereafter. Picking was done on alternate days during first month, later on after interval of two days. After 16 numbers of pickings, the data collection was completed.

Morphological parameters

The parameters studied during this course of study included: days to flowering, plant height (cm), number of leaves $plant^{-1}$, leaf length (cm), leaf length was measured in centimetres excluding petiole, leaf width (cm), capsule length (cm), capsule circumference (cm), number of capsules $plant^{-1}$, average weight of single capsule (g), total capsule weight $plant^{-1}$ (g), total yield of capsules (t ha^{-1}).

Data analysis

The data obtained were subjected to analysis of variance technique (Steel *et al*., 1997) while Least Significant Difference (LSD) test was used to check the difference among the treatments.

RESULTS

Data regarding plant growth are presented in Table 2. Maximum plant height (84.45 cm) was observed from plots treated with Green Sun versus rest of the treatments including control, whereas Biophosphate and Nitrophos showed non-significant differences in compression with rest of the treatments. Application of Green sun also produced more number of leaves per plant (18.5) vs. rest of the treatments and control. The plots treated with Biophosphate and Nitrophos showed non- significant differences - comparatively less number of leaves $plant^{-1}$ (15 and 15.8) respectively. Non- significant differences were shown for leaf length (cm) and leaf width (cm) regarding all the parameters including control, treatment wise leaf length remains as T_1 (18.8 cm), T_2 (17.4 cm), T_3 (17.5 cm) and control (18.5 cm) respectively. The value for leaf width (cm) under different treatments remained as maximum

for Green Sun (25 cm), Biophosphate (19.25 cm), Nitrophos (21.65 cm) and control (19 cm). The plants grown under control plots showed maximum days to flowering (47.6) and T_1 (Green Sun) took minimum days to flowering (31.9). The value for days to flowering under T_2 (Biophosphate) and T_3 (Nitrophos) remained (37.3) and (36.4) respectively. The plots treated with T_3 (Nitrophos) gave maximum fruit length (13.52 cm) followed by T_1 (Green Sun) that produced fruit length of 11.13 cm, T_2 (Biophosphate) produced fruit length of (10.81 cm) and under T_4 (Control) value for fruit length remained 9.75 cm.

Table 1. Shows the treatment description, major ingredients, micronutrients and their form.

S. No.	Treatment Description	Major Ingredients	Micronutrients	Form
T_1	Green Sun	NPK (15:15:15)	Iron, Zinc, Boron	Pellets
T_2	Biophosphate	NPK (15:45:20)	Zinc, Manganese, Iron, Boron	Granular
T_3	Nitrophos	NPK (15:30:18.75)	Iron, Zinc, Boron, Copper	Granular
T_4	Control	None of organic fertilizer or WOW humic acid was added under control conditions.		
Humic Acid: Added @ 4Kg ha^{-1} into all the treatments in granular form.				

Table 2. Effect of Green Sun, Biophosphate, and Nitrophous on plant height, number of leaves per plant, leaf length, leaf width, days to flowering and capsule length of Okra.

Treatments	Plant height (cm)	Number of leaves $plant^{-1}$	Leaf length (cm)	Leaf width (cm)	Days to flowering	Capsule length (cm)
Green Sun	86.45 ± 3.75a	18.5 ± 0.86a	18.8 ± 0.81a	22.58 ± 1.47a	31.9 ± 0.63c	11.13 ± 0.83b
Biophosphate	84.00 ± 3.92ab	15.00 ± 1.15 ab	17.4 ± 0.61a	19.25 ± 1.03ab	37.3 ± 0.87b	10.18 ± 5.8b
Nitrophos	74.85 ± 3.66ab	15.8 ± 1.17a b	17.5 ± 0.72a	21.65 ± 1.25a	36.4 ± 0.60b	13.52 ± 0.77a
Control	70.00 ± 3.49b	11.6 ± 1.08b	18.5 ± 0.64a	19.00 ± 0.64ab	47.6 ± 0.84a	9.75 ± 0.57b
LSD ($p<0.05$)	15.10	5.18	3.70	1.09	2.69	2.19

Statistical significance determined by analysis of variance. Numbers followed by the same letters in the same column are not significantly ($p<0.05$) different, according to Duncan's Multiple Range Test. *Mean ± Standard Error. LSD (Least Significant Difference).

The data depicted in Table 3 shows that all the three treatments had significantly increased Capsule circumference (cm) compared to control. Similarly, number of Capsules per plant had significantly increased. None of the treatments had significant effect on number of capsules per plant when compared with each other. The largest capsule weight (7.21g) was harvested from the plots treated with Biophosphate and lowest (5.56 g) under control conditions. All the treatments except control gave significant increase on total capsule weight per plant (g), but with non-significant effect among themselves.

Table 3. Effect of Green Sun, Biophosphate, and Nitrophos on capsule circumference, number of capsules per plant, capsule weight and total capsule weight per plant of Okra.

Treatments	Capsule circumference (cm)	Number of capsule plant^{-1}	Capsule weight (g)	Total capsule weight plant^{-1} (g)	Yield (t ha^{-1})
Green Sun	5.78 ± 0.16a	16.2 ± 1.74a	6.65 ± 0.42ab	93.75 ± 14.29a	6.20 ± 0.63a
Biophosphate	5.27 ± 0.12a	11.99 ± 1.57a	7.21 ± 0.50a	90.75 ± 9.50a	5.62 ± 0.88a
Nitrophous	5.42 ± 0.23a	11.5 ± 1.17a	5.16 ± 0.31b	77.05 ± 6.54a	4.89 ± 0.52a
Control	3.31 ± 0.17b	5.2 ± 0.43b	5.56 ± 0.40ab	25.1 ± 3.38b	1.81 ± 0.23b
LSD ($p<0.05$)	0.50	4.74	1.70	35.10	1.30

Statistical significance determined by analysis of variance. Numbers followed by the same letters in the same column are not significantly ($p<0.05$) different, according to Duncan's Multiple Range Test. LSD (Least Significant Difference).

DISCUSSION

Addition of organic fertilizers positively affected plant height of okra plants during the study period as compared to the control where no fertilizer was added. This might be due to the decomposition of organic fertilizers and release of essential nutrients that supported the vegetative growth of okra plants. The maximum plant height recorded from plants that received Green Sun than other organic fertilizers indicates the presence of readily available nutrients to the roots of plants that helped to enhance the morphological characters (Ajari *et al*., 2003).

The increase in number of leaves plant^{-1} is due to the application of organic fertilizers suggests their application during initial vegetative growth period. Presence of sufficient amount of nitrogen enables the plants to gain maximum plant growth. These findings are supported with the views of Tiamiyi *et al*., (2012) who reported positive effect of organic manures on the vegetative growth of plants due to higher content of nitrogen and its absorption.

Application of organic manures in soils has positive effect on their physical, chemical and biological properties (Premsekhar and Rajashree, 2009). An increase in yield parameters of okra could be attributed to the availability of nutrients in soil solution due to improved nutrient concentrations and sufficient soil moisture status. Fagawalawa and Yahaya (2016) were of views that use of organic fertilizers increases the fertility status of soil and increased the crop yield.

CONCLUSION

Application of Green Sun @ 150 Kg ha^{-1} plus Humic acid @ 4 Kg ha^{-1} significantly affected plant height, no of leaves per plant and days to flowering. Addition of Nitrophos plus Humic acid @ 150 and 4 Kg ha^{-1} significantly influenced capsule length (cm). All the three treatments (Green Sun, Biophosphate and Nitrophos) showed significant responses with respect to capsule circumference (cm), no of capsules per plant, capsules weight per plant (g) and total capsule weight per plant (g) verses control, whereas the effect among themselves remained non-significant. Addition of Biophosphate and Nitrophos almost showed similar response for plant height (cm), and number of leaves plant^{-1}. By considering leaf length (cm) and leaf width (cm) all the treatments remained non-significant including the control.

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