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STUDIES ON INFLUENCE BIO-REGULATORS ON YIELD AND QUALITY OF OKRA (*ABELMOSCHUS ESCULENTUS* L.)

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Abstract

Investigation on "Studies on influence of bio-regulators on yield and quality of okra (*Abelmoschus esculentus* (L.)" was carried out in Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamilnadu, during 2015-2016. Okra seeds of cv. Arka Anamika were used in this investigation. The experiment was conducted as a field study in randomized block design with 13 treatments in three replications. The effect of bioregulator treatments *viz*., Seaweed extract @ 50 ppm (T_1), Seaweed extract @ 100 ppm (T_2), Panchakavya @ 3% (T_3), Panchakavya @ 5% (T_4), Brassinosteroid @ 50 ppm (T_5), Brassinosteroid @ 100 ppm (T_6), Gibberllic acid 150 ppm (T_7), Gibberllic acid 300 ppm (T_8), Napthalene acetic acid @ 10 ppm (T_9), Napthalene acetic acid @ 20 ppm (T_{10}), Humic acid @ 3000 ppm (T_{11}), Humic acid @ 1500 ppm (T_{12}) and control (water spray) (T_{13}) were studied on Arka Anamika. The treatments were evaluated based on their effect on yield and quality characters *viz.,* number of fruits per plant, fruit length, fruit girth, single fruit weight, yield plant^{-1}, crude fibre content and ascorbic acid content. In this investigation the bioregulators *viz.,* Brassinosteroids, Humic acid and Seaweed extract are showed significant influence on yield and quality characters of okra. Among them brassinosteroids @ 50 ppm exhibited the highest yield of 18.24t ha^{-1}. It was followed by the humic acid 3000 @ ppm (17.14t ha^{-1}) and the least was control (7.17 t ha^{-1}).Based on the growth, yield, quality and economic analysis of different treatments, brassinosteroids @ 50 ppm (T_5) was selected as the best treatment.

Key words **:** Bio-regulators, Arka Anamika ,Brassinosteroid, crude fibre.

Introduction

Okra (*Abelmoschus esculentus* L.) belongs to the Malvaceae family. It was believed to originate in tropical Africa (Akanbi *et al*., 2010). It is an important vegetable crop in the tropical and subtropical region of the world and it has been used for several purposes. Its tender fruits are used as boiled vegetable into fried slices for cooking. Its stem is used for paper making in paper mills. The flowers are also edible. Okra dried seeds, nutritious matter that can be used to prepare vegetable curds, or roasted and ground to be used as coffee additive or substitute (Kumar *et al*., 2010). Okra leaves are considered good cattle feed, but this is seldom compatible with the primary use of the plant. Okra green fruits are also good source of carbohydrate, protein, fats, vitamins and minerals (Arapitsas, 2008). Moreover, okra mucilage is suitable for medicinal and industrial applications (Akinyele and Temikotan, 2007). It is a semi woody, fibrous herbaceous annual with an indeterminate growth habit. The plants from a deeply penetrating taproot with dense shallow feeder roots reaching out in all direction in the upper 45 cm of the soil.

The area under cultivation of this crop in India is about 4,32,000 hectares and production is about 45,28,000 metric tonnes. The maximum area under this crop lies in Uttar Pradesh, followed by Orissa, Bihar and West Bengal. In Tamil Nadu, the area under cultivation is 7,070 hectares with a production of about 67,140 tonnes and the productivity is about 9.5 t ha^{-1}. Whereas the national productivity is 10.5 t ha^{-1}.Okra has occupied a prominent position among the export oriented vegetables in India because of its high nutritive value, palatability and good post-harvest life. It has an enormous potential as one of the foreign exchange earner crops and accounts for 70 per cent of the export of fresh vegetables. Consumption of young immature okra pods is important as fresh fruits, and it can be consumed in different forms.

Indiscriminate use of chemical fertilizers, pesticides and herbicides has lead to the deterioration of soil health, ground water quality, soil microbial population, atmospheric constituents, quality of the agricultural produce and thereby the health of animals and humans. There, to avoid the above–mentioned problem associated with modern agriculture, emphasis is now laid on the use of bio-regulators. The organic farming practices assure balanced environment and quality food to our people. Organic farming is very much native to India and it is our contribution to the word. Application of organic inputs is economic in the long run as environmental friendly. It is advantageous, since organic manure consist of 30-40 elements in high concentration, unlike chemical fertilizers which contain only 5-6 elements in high concentration. The use of bio-regulators like, brassinosteroids, napthalene acetic acid, gibberlic acid, panchakavya, humic acid and seaweed extract also increase the growth and quality of the produces. The Bio-regulation of growth, yield and quality by externally supplied chemical is one of the most exciting research areas of the recent times. They are effective in several crops to balance the source and sink ratio for increasing the yield (Cheema *et al.,* 1987). Application of plant growth regulators for increasing the yield and quality of many vegetable crops has been emphasized by several workers (Zhukova *et al.*, 1987).

Materials and Methods

The present investigation to study the effect of bio-regulators on yield and quality of okra (*Abemoschus esculentus* L.) was carried out at the field unit of the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu. The Okra, variety "ArkaAnamika" was used in the experimentation .Plants are tall and well branched. Fruits are flush green, tender, long and borne in two flushes. Purple pigment is present on both sides of the petal base. Stem is green with purple shade. Fruits free from spines having 5-6 ridges, delicate aroma. Good keeping and cooking qualities. This variety is resistant to yellow vein mosaic virus, with duration of 130-135 days and a yield potential of 20 t ha^{-1}.The experimental field was laid out in Randomized Block Design with 13 treatments and 3 replications with the spacing of 45×30cm along with the proper cultural operations during Sep-Nov 2015. The main field was brought to a fine tilth with a tractor. Each plot was commonly applied with the respective dose of organic manures like FYM@12.5 tonnes and vermicompost @2.5 tonnes. Plots of 6 m^2 were prepared and ridges and furrows were formed at a spacing of 45 cm and seeds were sown at a spacing of 30 cm. Seeds were sown at the rate of 2 per hill.

For each treatment the required quantity of bioregulators *viz.*, brassinosteroids, gibberlic acid, napthalene acetic acid, panchakavya, humic acid and seaweed extract, were applied 3 times from 2 weeks after sowing and then subsequent sprays at 15 days interval. Other cultural practices like irrigation, weeding and plant protection were adopted as per recommendation .The analysis of variance was done as the procedure given by Panse and Sukhatme, 1978.

Treatment Details

Treatment No	Treatments	Concentration
T_1	Seaweed extract (SWE)	50 ppm
T_2	Seaweed extract (SWE)	100 ppm
T_3	Panchakavya	3 %
T_4	Panchakavya	5%
T_5	Brassinosteroids (BRs)	50 ppm
T_6	Brassinosteroids (BRs)	100 ppm
T_7	Gibberlic acid (GA_3)	150 ppm
T_8	Gibberlic acid (GA_3)	300 ppm
T_9	Napthalene acetic acid (NAA)	10 ppm
T_{10}	Napthalene acetic acid (NAA)	20 ppm
T_{11}	Humic acid (HA)	3000 ppm
T_{12}	Humic acid (HA)	1500 ppm
T_{13}	Control	Water spray

The treatments were imposed as foliar spray on 30^{th} and 60^{th} day during early morning.

Result and Discussion

The number of fruits per plant and single fruit weight, fruit length is the most important factors in determining the yield and these traits were greatly influenced by the application of brassinosteroids along with organic inputs. The maximum values in yield characters were recorded in T_5 which received the application of Brassinosteroids (BRs) @ 50 ppm, which was followed by T_{12} which received the application of Humic acid @ 300 ppm. The minimum was recorded in T_{13} which served as absolute control. The increase in number of fruits per plant and single fruit weight may be due to the partitioning efficiency *viz.,* increased allocation of photosynthates towards the economic part and also due to the hormonal balance in the plant system as suggested by Sharma *et al.*, 1992. Also it was in line with the findings of Nunez *et al.* (1995). The increase in fruit length and fruit weight may be attributed to the increase in the number of cells as well as elongation of individual cells. This might be possible through better translocation of soluble ions under optimum level .The yield was greatly influenced by the application of brassinosteroids @ 50 ppm. Higher yield might be due to improved aeration and water-holding capacity of FYM applied soil and the efficient utilization of nutrients in the FYM applied plants. Anburani (2000) reported that the increase in fruit weight may be due to the accelerated mobility of photosynthates from the source to sink as influenced by the growth hormones, released or synthesized due to the organic sources, as well as K uptake which helped in the mobility of photo assimilates to sink. Organic inputs provided sufficient quantity of carbonaceous material for decomposition by microorganisms and converting them into mineralized organic colloids, besides adding them to soil reserves.

Increase in yield and yield attributing characters with organic manures was due to increased availability of nutrients for longer period and reduced loss of nutrients through leaching (Sinha *et al.,* 1990). Higher yields due to application of vermicompost may be attributed to the high level of nutrients along with growth stimulating substances excreted by earthworms into their cast

The data recorded on crude fibre and ascorbic acid content presented in Table 2. Significant influences were observed among the treatments for this trait. The best was recorded in T_5 which received the application of Brassinosteroids (BRs) @ 50 ppm. This was followed by T_{12} which received the application of Humic acid @ 300 ppm. The highest value in crude fibre and minimum ascorbic acid content was recorded in absolute control (T_{13}).Fruit quality is an important criterion with regard to consumer preference. In the present study, crude fibre content was significantly influenced by the application of bio-regulators and organic inputs. Quality and sustainability of a vegetable for consumption in a crop like okra is judged based on the crude fibre content. The application of brassinosteroids @ 50 ppm along with organic inputs had decreased the crude fibre content to the maximum extent and had increased the ascorbic acid content to the maximum (Srivastava,1994). It may be attributed to the reason that increasing the levels of nitrogen due to its higher availability in FYM caused an increase in the succulence which could have decreased the crude fibre content. Similar report on increased ascorbic acid content with least crude fibre content due to the application of farmyard manure and humic acid was recorded (Vennila and Jayanthi, 2008) in okra. IImprovement in fruit quality due to HA inoculation were reported by Xu *et al.* (1999). This might be due to the immediate availability of nutrients to the crop plants in time due to foliar spray. In the present investigation, it is evident that the better quality attributes in the superior treatment might be due to the combined effect of organic inputs and bioregulators.

Table 1 : Effect of bio-regulators on Number of fruits plant^{-1}, fruit length (cm), fruit girth (cm), single fruit weight (g) and yield per plant (g) in okra

Treatments	Fruit length (cm)	Fruit girth (cm)	Number of fruits plant^{-1}	Single fruit weight (g)	Yield per plant (g)
T_1 - Sea weed extract @50 ppm	15.62	4.97	11.51	12.24	140.89
T_2 - Sea weed extract @100 ppm	18.67	6.58	15.41	15.99	246.26
T_3 - Panchakavya @ 3%ppm	14.87	4.60	10.57	11.33	119.78
T_4- Panchakavya @ 5%ppm	16.92	5.64	13.18	13.85	182.57
T_5 - Brassinosteroid @50 ppm	19.40	6.95	16.35	16.88	257.97
T_6 –Brassinosteroid @100 ppm	18.08	6.26	14.66	15.27	223.14
T_7 - Gibberellic acid @ 150 ppm	17.51	5.96	13.93	14.57	202.96
T_8 - Gibberellic acid @ 300 ppm	14.28	4.28	9.82	10.61	104.95
T_9 - Napthalene acetic acid @ 10 ppm	16.78	5.59	12.99	13.66	140.88
T_{10}- Napthalene acetic acid @ 20 ppm	15.03	4.67	10.78	11.54	124.41
T_{11}- Humic acid @ 1500 ppm	16.19	5.29	12.26	12.96	124.87
T_{12}- Humic acid @ 3000 ppm	18.83	6.65	11.62	12.18	132.15
T_{13}- Control	13.71	3.98	9.23	9.91	82.68
S.Ed.	**0.18**	**0.09**	**0.23**	**0.23**	**8.81**
CD (p = 0.05)	**0.55**	**0.28**	**0.71**	**0.69**	**17.45**

Table 2 : Effect of bio-regulators on crude fibre (%) and ascorbic acid content (mg 100 g^{-1}) in okra

Treatments	Crude fibre (%)	Ascorbic acid (mg 100 g^{-1})
T_1 - Sea weed extract @50 ppm	15.22	13.35
T_2 - Sea weed extract @100 ppm	12.99	13.07
T_3 - Panchakavya @ 3%	15.77	13.00
T_4- Panchakavya @ 5%	14.27	12.74
T_5 - Brassinosteroid @50 ppm	12.44	12.46
T_6 - Brassinosteroid @100 ppm	13.41	12.20
T_7 - Gibberellic acid @ 150 ppm	13.85	12.12
T_8 - Gibberellic acid @ 300 ppm	16.19	11.84
T_9 - Napthalene acetic acid @ 10 ppm	14.36	11.58
T_{10}- Napthalene acetic acid @ 20 ppm	15.66	11.30
T_{11}- Humic acid @ 1500 ppm	14.80	11.23
T_{12}- Humic acid @ 3000 ppm	12.88	10.95
T_{13}- Control	16.63	10.69
S.Ed.	**0.13**	**0.08**
CD (p = 0.05)	**0.40**	**0.24**

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