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Bio-Efficacy of Grace Hume-L and Nitro Bloomer-NB on Lady's Finger (*Abelmoschus esculentus* L.)

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Abstract: The field experiment was conducted during 2013 at Sriniketan and Bahadurpur village of Birbhum district under red and lateritic agro-climatic zone of West Bengal to evaluate the bio-efficacy of Grace Hume-L (based on Humic acid 12% w/w) and Nitro Bloomer-NB (based on Nitro Benzene 35% v/v) for sustainable production of lady's finger (*Abelmoschus esculentus* L.) on two widely cultivated and popular varieties, Arka Anamika and Parbhani Kranti. The experiment was laid out in RBD having seven treatments including one control with three replications. First observation was taken at seven days before first spraying and subsequently upto final harvesting. Ten plants in each replication were randomly selected and tagged for recording growth and yield parameters at 30, 60 and 90 days after sowing. Application of Grace Hume-L at 2 ml/l or Nitro Bloomor-NB at 1.5 ml/l twice (4 and 8 weeks after sowing) proved better for greater production, and yielded 40% more than the control plot irrespective of varieties taken under the study. Farmers may choose these growth regulators for improving crop health and enhancing productivity.
Keywords: Lady's finger, *Abelmoschus esculentus*, Grace Hume-L, Nitro Bloomor-NB, Growth regulator

INTRODUCTION

Lady's finger popularly known as *Bhendi* or *Okra* (*Abelmoschus esculentus* L.), is one of the most important vegetable crops grown throughout the tropical and warm temperate regions of the world [2]. It is considered to be native of India and grown all over the year in almost all states of India including West Bengal. Okra mucilage has medicinal values and it is used as a plasma replacement or blood-volume expander. The mucilage of Okra not only binds cholesterol but also the bile acid carrying toxins discarded into it by the filtering liver. It also has industrial applications. The okra bast fibre contains 67.5% a-cellulose, 15.4% hemicellulose, 7.1% lignin, 3.4% pectic matter, 3.9% fatty and waxy matter and 2.7% aqueous extract. Major constraints for low productivity and poor quality of *bhendi* in India are diseases and insect pest infestation [1] and unwise application of nutrients. Increasing trend of disease and pest infestation in *bhendi* are due to the improper application of nutrients which may imbalance the normal hormonal and growth regulators level, weaken the plant system that ultimately reflected in yield. Therefore, the present investigation was undertaken to study the efficacy of Grace Hume-L (based on Humic acid 12% w/w) and Nitro Bloomer-NB (based on Nitro Benzene 35%) on the growth and yield attributing parameters during the crop growth period.

MATERIALS AND METHODS

General information and treatment details

The field experiment was conducted during 2013 at farmers' fields situated at Sriniketan, Binuria and Bahadurpur of Birbhum district under red and lateritic agro-climatic zone of West Bengal. The soil of the experimental plots was loamy sand in texture with medium to low fertility status and acidic in nature. The experiment was laid out in RBD having seven treatments with three replications. The cultivar Arka Anamika and Parbhani Kranti were taken for the experiment 1 and 2, respectively and each experiment was set up at three different locations to get more perfect result. The seeds were treated with Mancozeb 75% WP @ 3 g/kg and sown during second week of February, 2013 by hand dibbling of two seeds per hill with 5 cm depth. There were 60 number of plants/plot with spacing of 30 cm x 50 cm. Well decompose FYM @ 20 t/ha was incorporated one month prior sowing, while 80:50:50 kg N:P:K per ha was applied as par recommendation. General agronomic practices were done for thinning, weeding and other intercultural operation. The crop was sprayed with Lambda-cyhalothrin 5% EC, Imidacloprid 17.8% SL and Cabendazim 12% + Mancozeb 63% WP to prevent insects and fungi related biotic stresses. A total of 10 harvesting was made at 4days intervals upto 95 days. First observation was taken at seven days before first spraying and subsequently to final harvesting. Ten

plants in each replication were randomly selected and tagged for recording the observations on growth and yield parameters at 30, 60 and 90 days after sowing (DAS). The details of the treatments are presented in Table 1 and 2.

Salient features of the lady's finger variety taken for the experiment

Arka Anamika: Plants are 100cm in height, upright, open and slightly pigmented on stems, petioles and lower leaves. Fruits are dark green with 5 prominent ridges and comparatively less smooth surface. It takes about 50 days (6^{th} node) to first flowering and nearly 55 days to first picking of tender marketable fruits. It is excellent yielder in south but with a lower performance in northern India. It is resistant to yellow vein mosaic, the yield being 125q/ha.

Parbhani Kranti: It has tall, single-stemmed plants with dark green foliage. The leaves are deeply lobed appearing like cut leaves towards plant apex. First flush becomes ready approximately 55 days after sowing. The fruits are smooth, dark green, tender, slender, 5-ridges with long beak. Average green fruit yield varies from 85-90q/ha during spring-summer to 115q/ha in rainy season. Seed yield varies from 5-6q/ha in spring-summer to 10q/ha in rainy season.

Table-1: Treatment details for Experiment No. 1

Treatments	Dose (ml/l)	Application interval
T1 – Grace Hume-L	1.0	1^{st} spraying at 4 weeks, 2^{nd} spraying at 8 weeks after sowing. Spraying done after 4pm.
T2 – Grace Hume-L	1.5	
T3 – Grace Hume-L	2.0	
T4 – Phytonol-MI	0.4	
T5 – Parag	0.4	
T6 – Phytozyme	0.5	
T7 – Control	-	

Table-2:Treatment details for Experiment No. 2

Treatments	Dose (ml/l)	Application interval and time
T1 – Nitro Bloomor-NB	0.5	1^{st} spraying at 4 weeks, 2^{nd} spraying at 8 weeks after sowing. Spraying done after 4pm.
T2 – Nitro Bloomor-NB	1.0	
T3 – Nitro Bloomor-NB	1.5	
T4 – Phytonol-MI	0.4	
T5 – Parag	0.4	
T6 – Phytozyme	0.5	
T7 – Control	-	

Growth Regulators used for the experiment *(Information printed on the container)*

Nitro Bloomor-NB: It is a Biotechnological research based combination product containing highly enriched Nitro Benzene 35% V/V derived from the natural extracts fortified with vitamins, plant hormones, enzymes and naturally available vegetable amino acids. Nitro Bloomor-NB is a growth promoter and flowering stimulant. Manufactured by: Grace Bio-Care Pvt. Ltd., Works: 343-344, G.I.D.C. Estate, Manjusar, Ta: Savli, Dist: Vadodara, Gujrat.

Grace Hume-L: It is a liquid organic growth enhancer containing Humic acid 12% W/W with fulvic acid, natural amino acids and other beneficial ingredients. Manufactured by: Grace Bio-Care Pvt. Ltd., Works: 343-344, G.I.D.C. Estate, Manjusar, Ta: Savli, Dist: Vadodara, Gujrat.

Parag: It is a phytohormone contains GA with its analogues 1000ppm solvents and emulsifiers Q.S. to make 100%. Manufactured by: Agro-Guard Lab (A.G.L.), West Bengal.

Phytozyme: It is a plant growth hormone contains Auxin (derivatives of Carboxylic Acid) A.I. 4.5%, other associate ingredients and antibiotic (Q.S.). Manufactured by: Rajcho Pesticides and Chemicals. North Bondipure, P.O.: Rahara, Dist.: North 24 Parganas, West Bengal.

Observation of growth and yield attributes

Plant height (cm): The plant height was measured from ground level to the tip of the main stem at 30, 60 and 90 DAS. The average height was computed and expressed in centimeters.

Number of leaves per plant: The number of leaves per plant was manually counted at 30, 60 and 90 DAS. The average of 10 plants were computed and expressed in number.

Days to initiation of flowering: The number of days taken to first flowering in each treatment were recorded and expressed as days to first flowering.

Days to 50% flowering: The days taken for 50 per cent of the plants to produce first flower in each plot were

recorded from the date of sowing and expressed as days to 50 per cent flowering.

Fruit length and girth (cm): After the harvest from 10 plants/ plot, twenty fruits were selected at random for recording the length and girth of the fruit. The length of the fruit was measured from the tip of fruit to the point of attachment to the pedicel while the girth was measured at the centre of the fruit. The mean fruit length and girth were computed and expressed in cm.

Yield (q/ha): The marketable fruits were harvested at different intervals and weight of fruits was taken separately for each plot. The mean fruit weight was computed and expressed in q/ha.

Statistical analysis

The mean data was statistically analysed by adopting the appropriate methods outlined by Panse and Sukhatme [3]. The percentage data was transformed, wherever it was applicable, then statistical analysis was made.

RESULTS AND DISCUSSION

Experiment No. 1

Growth attributes

The results showed that growth regulators exerted significant effect on growth attributes such as mean plant height, number of leaves per plant and leaves area per plant of the crop (Okra cv. Arka Anamika) over the control (Table 3). Grace Hume-L@ 2 ml/l proved superior in increasing the different vegetative parameters viz. mean plant height (116.33cm), number of leaves per plant (20), leaves area per plant (28.10cm^2) over the other treatments. The dwarf plant height (80.27 cm), lowest number of leaves per plant (16.19), smallest leaves area per plant (24.17cm^2) was recorded with control. The second best treatment was Grace Hume-L@ 1.5 ml/l in respect of plant height (109.83cm), number of leaves per plant (19.66), leaves area per plant (27.04cm^2) over the control treatment. This increased growth attributes may have important role for increasing crop yield.

Yield attributes

The yield attributing parameters viz. average time period required to flowering in 50 %, number of fruits per plant, length and girth of fruits, fruit weight per plant and fruit yield per hectare were greatly influenced by growth regulators (Table 3). The crop receiving Grace Hume-L@ 2.0 ml/l recorded significantly shortest days (44.5days) for flowering in 50 %, highest number of fruits per plant (20.03), longest length (11.30cm) and girth (5.15cm) of fruits, maximum fruit weight per plant (208.31g) and fruit yield per hectare (138.89q) over control followed by Grace Hume-L@ 1.5 ml/l, Phytonol-MI @ 0.4 ml/l, Grace Hume-L@ 1 ml/l, Phytozyme @ 0.5 ml/l and Parag @ 0.4 ml/l. It has been also observed that the plot treated with Grace Hume-L@ 2ml/l yielded nearly 43% more than the control plot followed by Grace Hume-L@ 1.5 ml/l (aprox. 31%), Phytonol-MI @ 0.4 ml/l (aprox. 26%). However, no significant difference in fruit yield production was recorded among Grace Hume-L@ 1.5 ml/l, 1 ml/l and Phytonol-MI @ 0.4 ml/l while Phytozyme @ 0.5 ml/l and Parag @ 0.4 ml/l were at par to each other. The better yield with Grace Hume-L@ 2.0 ml/l might be due to better vegetative growth of the crop. The crop receiving no growth regulator recorded significantly longest days (47.62 days) for flowering in 50 %, lowest number of fruits per plant (15.40), shortest length (9.17cm) and girth (4.59cm) of fruits, minimum fruit weight per plant (141.68g) and fruit yield per hectare (96.91q) over the treatment of Grace Hume-L@ 2.0 ml/l.

Experiment No. 2

Growth attributes

The results showed that growth regulators had a significant effect on growth parameters such as mean plant height, number of leaves per plant and leaves area per plant of the crop (Okra cv. Parbhani Kranti) over the control (Table 4). The highest mean plant height (97.33cm), maximum number of leaves per plant (18.51) and largest leaves area per plant (25.42cm^2) was obtained from the plant Nitro Bloomor-NB @ 1.5 ml/l over control. The second best treatment was Nitro Bloomor-NB @ 1.0 ml/l followed by Nitro Bloomor-NB @ 0.5 ml/l, phytonol-MI @ 0.4 ml/l, phytozyme @ 0.5 ml/l and parag @ 0.4 ml/l. The dwarf mean plant height (67.33cm), minimum number of leaves per plant (14.73) and smallest leaves area per plant (20.22cm^2) was recorded with control over other treatments that were statistically significant. That might be due to vital role of growth promoters in respect of vegetative growth of the crop.

Yield attributes

The yield attributing parameters viz. average time period required to flowering in 50 %, number of fruits per plant, length and girth of fruits, fruit weight per plant and fruit yield per hectare were influenced by growth regulators (Table 4). The crop receiving Nitro Bloomor-NB @ 1.5 ml/l recorded significantly shortest days (45.5days) for flowering in 50 %, highest number of fruits per plant (21.03), longest length (11.44cm) and girth (4.15cm) of fruits, maximum fruit weight per plant (218.08g) and fruit yield per hectare (138.89q) over control followed by Nitro Bloomor-NB @ 1.0 ml/l, Phytonol-MI @ 0.4 ml/l, Nitro Bloomor-NB @ 0.5 ml/l, Phytozyme @ 0.5 ml/l and Parag @ 0.4 ml/l. However, no significant difference in fruit yield production was recorded among Nitro Bloomor-NB @ 1.0 ml/l, 0.5 ml/l and Phytonol-MI @ 0.4 ml/l while Phytozyme @ 0.5 ml/l and Parag @ 0.4 ml/l were at par to each other. Expectedly, in control plot significantly poor results were observed in respect of days (49.13 days) for flowering in 50 %, number of fruits per plant (16.40), length (9.96cm) and girth (3.38cm) of fruits, fruit weight per plant (139.40g) and fruit yield per

hectare (98.35q). It has been also recorded that the plot treated with Nitro Bloomor-NB @ 1.5 ml/l yielded nearly 41% more than the control plot followed by Nitro Bloomor-NB @ 1.0 ml/l, (aprox. 33%), Phytonol-MI @ 0.4 ml/l (aprox. 30%).

Table-3: Effect of plant growth regulators on growth and yield of okra cv. Arka Anamika (Experiment No. 1)*

Treatments	Dose (ml/l)	Avg. Plant height (cm)	Avg. No. of leaves/ plant	Avg. Leaves area/plant (cm^2)	Avg. Days to 50% flowering	Avg. No. of fruits/plant	Avg. wt. of fruit (g)	Avg. Fruit length (cm)	Avg. Fruit girth (cm)	Avg. Wt. of fruits/plant (g)	Avg. Fruit yield (q/ha)	% yield increase over control
Grace Hume-L	1.0	101.00	18.33	26.18	45.70	17.06	9.80	10.48	4.94	167.19	114.36	18.01
Grace Hume-L	1.5	109.83	19.66	27.04	45.00	18.00	10.30	10.80	5.01	185.40	126.81	30.85
Grace Hume-L	2.0	116.33	20.00	28.10	44.50	20.03	10.40	11.30	5.15	208.31	138.89	43.32
Phytonol-MI	0.4	104.16	18.83	26.77	45.50	17.82	10.00	10.65	4.97	178.20	121.89	25.78
Parag	0.4	94.33	18.00	25.58	46.50	16.50	9.33	10.09	4.91	153.95	105.30	8.66
Phytozyme	0.5	98.33	18.16	26.08	45.80	16.82	9.38	10.36	4.92	157.77	107.92	11.36
Control	-	80.27	16.19	24.17	47.62	15.40	9.20	9.17	4.59	141.68	96.91	-
SEm (±)		1.13	0.46	0.42	0.68	0.21	0.13	0.41	0.09	1.87	2.51	
CD (p=0.05)		3.24	1.39	1.31	2.03	0.68	0.37	1.18	0.23	5.69	7.66	

*Data presented in the table are the average of three different locations.

Table-4: Effect of plant growth regulators on growth and yield of okra cv. Parbhani Kranti (Experiment No. 2)*

Treatments	Dose (ml/l)	Avg. Plant height (cm)	Avg. No. of leaves/ plant	Avg. Leaves area/plant (cm^2)	Avg. Days to 50% flowering	Avg. No. of fruits/plant	Avg. wt. of fruit (g)	Avg. Fruit length (cm)	Avg. Fruit girth (cm)	Avg. Wt. of fruits/plant (g)	Avg. Fruit yield (q/ha)	% yield increase over control
Nitro Bloomor-NB	0.5	85.10	16.71	23.52	46.71	18.06	9.62	10.51	3.94	173.74	118.84	20.83
Nitro Bloomor-NB	1.0	92.83	17.80	24.38	46.02	19.00	10.11	10.92	4.01	192.09	131.39	33.59
Nitro Bloomor-NB	1.5	97.33	18.51	25.42	45.50	21.03	10.37	11.44	4.15	218.08	138.89	41.22
Phytonol-MI	0.4	87.16	16.74	24.12	46.53	18.82	9.97	10.63	3.97	187.64	128.34	30.49
Parag	0.4	74.33	16.50	22.93	47.57	17.50	9.02	10.30	3.91	157.85	107.97	9.78
Phytozyme	0.5	77.33	16.62	23.44	46.85	17.82	9.24	10.45	3.92	164.66	112.63	14.52
Control	-	67.33	14.73	20.22	49.13	16.40	8.50	9.96	3.88	139.40	98.35	-
SEm (±)		1.13	0.48	0.39	0.71	0.21	0.14	0.40	0.09	1.78	2.49	
CD(p=0.05)		3.24	1.47	1.21	2.14	0.68	0.41	1.15	0.23	5.16	7.38	

*Data presented in the table are the average of three different locations.

CONCLUSION

The growth and development of plant is a complex procedure and is depend on genetical factors, environmental factors and endogenous growth substances. It is well understood that genetical factors have a great role in expressing growth and yield attributing characters of a plant under the control of various environmental factors. While, endogenous growth substances like hormones influence the various reactions and metabolism of plants and thus regulate the developmental pattern. On the other hand, external environmental factors viz. light, air, water, temperature etc, which play indispensable role in the development. Hence, enhanced productivity of crop through physiological approaches is achieved by coordinating all the factors in a systematic manner. The effect of various growth regulators on morphological characters like plant height, number of branches, days to flower initiation and 50% flowering etc indicated that these parameters differed significantly due to the application of appropriate growth regulators externally. The success in using these growth regulators depends on several factors such as, the choice of plant growth substances, the purpose for which it is being used, the appropriate concentration and time of application.

In the present investigation it has been observed that Grace Hume-L@ 2 ml/l or Nitro Bloomor-NB @ 1.5 ml/l if applied twice, one at 4 weeks and other at 8 weeks after sowing proved better for greater production. Farmers may use Grace Hume-L (based on Humic acid) and Nitro Bloomor-NB (based on Nitro Benzene 35%) for improved crop health and enhanced productivity. It has been proved that both Grace Hume-L@ 2 ml/l or Nitro Bloomor-NB @ 1.5 ml/l yielded 40% more than control plot irrespective of varieties taken under the study.

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