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Effect of plant growth regulators on growth and yield attributes of sponge gourd (*Luffa cylindrical* L.) cv. Kashi Shreya

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Abstract
The field experiment was conducted at Experimental Unit, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur (U. P.) during the Zaid season of 2021-2022 to study of effect of plant growth regulators on growth and yield attributes of sponge gourd (*Luffa cylindrical* L.). The seed of sponge gourd were sown in the second week of February at the spacing of 3m x 75 cm. The experiment was laid out in Randomized Block Design with 10 treatments and 3 replications. The experiment was intended to study the effect of three plant growth regulator (PGR) *viz.*, gibberellic acid (GA_3), Naphthalene acetic acid (NAA) and Ethrel for growth, flowering and yield attributes of sponge gourd. The application of Ethrel @ 250 ppm was found beneficial for of fruit length (26.61 cm), fruit diameter (3.72 cm), average fruit weight (160.66 g), yield per plant (5.27 Kg), per plot (63.32 Kg) and yield per hectare(200.65 q), number of branches per plant (13.05) and number of node where first female flower appeared (24.37). Whereas application of GA_3 @ 200 ppm influenced the main vine length (558.72 cm) at harvesting, however maximum days taken to first opening of male flower (54.83), days taken to first opening of female flower (58.83), days taken to first fruit set (62.83), days to first harvest (76.18) was obtained in control (application of distilled water).

Keywords: Plant growth regulator, growth, flowering and yield attributes

Introduction
The sponge gourd (*Luffa cylindrica* (Linn.) M. Roem) is one of the important cucurbitaceous crops, grown extensively throughout in India. In India, the total area under gourds cultivation is about 3.5 million hectares and production are about 33.5 million tons (Anon., 1999) [1]. In India total area covered under vegetable crop is about 10.35 million hectares with the production 191.77 million metric tons (N.H.B. 2019-2020). *Luffa cylindrica* M. Roem. (2n=26) synonym *L. aegyptiaca* Mill. Sponge gourd, towel gourd, smooth loofah, vegetable sponge, dish cloth gourd is an annual, monoecious climber. It has long been cultivated in South and south-east Asia. The fruit is 20-50 cm long and almost cylindrical in shape. In south, southeast, and East Asia, the tender fruits are eaten fresh or more commonly cooked and consumed as a vegetable. Sometimes, the tender leaves and growing shoots are also used as a pot herb.

The tender fruits are used as vegetable or as cooked vegetables. Besides it is using vegetable, this gourd is utilized for various purposes. The fibers obtained from the mature dry fruits are used in industry for filters of various sorts. Sometimes the dry fruits which have good storage capacity are used for ornamental purposes. The sponge has a variety of commercial purposes including personal hygiene products, household cleaning products, steam engine filters, craft items, insulation, padding for saddles, and immobilization agents in biotechnology. Demand for luffa sponge products in the United States is increasing. Currently, most sponges are imported from tropical and sub-tropical countries such as Taiwan, Korea, El Salvador, Guatemala, and Colombia. Luffa buyers import luffa as raw pieces ranging from 8 to 40 cm in length and 5 to 12 cm in diameter.

Sponge guard fruit is easily digestible and increase the appetite when consumed. It is said to be useful for the patients of malaria. According to Gopalan *et al.*, (1982) [2], the nutritive value of sponge gourd (Per 100 g edible portion) is Moisture 93.2 g, Protein 01.2 g, Fat 00.2 g, Minerals 00.5 g, Fiber 02.0 g, Carbohydrate 02.9 g, Energy 18.0 k.cal, Calcium 36.0 mg, Phosphorus 19.0 mg, Iron 01.1 mg, Carotene 120.0 mg, Thiamine 0.02 mg, Riboflavin

0.06 mg, Niacin 0.4 mg.

Cucurbits belongs to the family Cucurbitaceae which comprises of 120 genera and 825 species, available in the world Jeffery, 1980, out of them 36 genera and 100 species are found in India. In this family approximately 38 species are economically important and its cultivation is done largely from tropical to temperate zones. Nearly 8 species are still persisting in forest under the custody of tribal which greatly needs acclimatization. During recent year cucurbits production and consumption has increased rapidly because of high tonnage and good market value.

Among the cucurbits major emphasis are being given to support minor cucurbitaceous crop like sponge gourd, ridge gourd, bottle gourd, cucumber, spine gourd, sweet gourd, satputia *etc.* because all these prized vegetables are growing well in the land which is not suitable for major vegetables. Cucurbitaceous vegetables crop cultivated throughout the country. The plant is well adapted to a wide range of environmental condition. The area and production of cucurbits in the world is about 8.5 million hectare and 179.09 million tons, respectively. China is leading country in the world producing 113.87 mt. of cucurbits from an area of 4.3 million hectare and the productivity being 26.00 tons per hectare, whereas, in India area, production and productivity of cucurbits is 0.43 million hectare, 4.52 million tons and 10.52 tons per hectare respectively. Area and production of gourd {bottle, ridge, bitter, snake, wax and smooth gourd *etc.*} in the country was 0.36 million hectares with an annual production 3.5 million tones.

Plant Growth Regulators are the chemicals which influences the plant growth when applied in very minute quantity. There are many reports which indicate that application of growth regulators enhanced plant growth and crop yield. Exogenous application of plant growth regulators improved the yield production and fruit quality of horticulture crops. Some horticulture crop production was increased by application of different growth regulators. There are five major classes of plant hormones and each one of them has multiple effects on plant growth and development.

Materials and Methods

The experiment was conducted at Experimental Unit, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur (U.P). Jaunpur is situated in eastern part of Uttar Pradesh, which lies between 25°N 44'0" North latitude and 82°N 41'0" East longitude at an elevation of 83.230 meter above mean sea level) during the Zaid season of 2021-2022 to study of effect of plant growth regulators on growth and yield attributes of sponge gourd (*Luffa cylindrical* L.). The seed of sponge gourd were sown in the second week of February with a spacing of 3m x 75 cm. The climatic condition of Jaunpur is sub- tropical with three distinct seasons *i.e.*, winter, summer and rainy. During the winter season (December-January) temperature falls, 5 °C even low, while in summer season (May- June) it reaches as high as 45 °C. Occasional spell of frost and precipitation may occur during winter. Most of the rainfall is received in the middle of July to end of September after which the intensity of rainfall decreases. The main annual rainfall is about 850-1100 mm. Soil of the field was well drained sandy-loam in nature with rich in organic matter and with good fertility status.

The experimental material consisted of Kashi Shreya cultivar of sponge gourd, which is released from Indian Institute of Vegetable Research, Varanasi (IIVR). The experiment was laid out in Randomized Block Design with three replication and ten treatments. Three PGRs *viz.*, GA_3 (Gibberellic acid), NAA (Naphthalene acetic acid) and Ethrel (2-chloroethyl phosphoric acid) were used for study. The treatments *viz.*, T_1 (Control), T_2 (NAA 100%), T_3 (NAA 150%), T_4 (NAA 200%), T_5 (GA_3 100%), T_6 (GA_3 150%), T_7 (GA_3 200%), T_8 (Ethrel 150%), T_9 (Ethrel 200%), T_{10} (Ethrel 250%) The seed of sponge gourd were sown 3 to 4 seeds per pit, applied 20 ton/ha compost, 120 kg/ha N, 60 kg/ha P and 60 kg/ha K. Recommended package of practices was followed to raise the normal crop. Data were recorded on 15 important characters related to growth, flowering and yield attributes during the course of investigation which were subjected to statistical analysis using suitable technique of different attributes.

Result and Discussion

The observations on vegetative growth and yield parameter of sponge gourd were analysed statistically and presented in this chapter. Each chapter of sponge gourd were described in light of data presented in tables.

Table 1: Effect of plant growth regulators on growth and flowering characters of sponge gourd *cv.* Kashi Shreya

Treatments	Vine Length	Branches/ Plants	First opening of male Flower	First opening of female Flower	Node on which first male flower appeared	Node on which first male flower appeared	Days taken to first fruit set
T_1	485.51	8.42	54.83	58.83	16.30	16.83	62.83
T_2	488.06	8.85	52.58	55.58	15.47	17.05	59.58
T_3	498.53	9.16	50.58	51.58	14.78	19.08	55.58
T_4	527.13	10.04	47.33	51.33	13.83	22.81	55.33
T_5	530.54	9.64	48.33	56.83	14.52	17.58	60.83
T_6	541.65	10.64	46.58	56.58	13.39	21.33	60.58
T_7	558.72	11.87	45.33	54.58	13.04	18.33	58.58
T_8	484.91	11.18	52.83	52.33	15.87	20.83	56.33
T_9	264.58	12.44	51.58	50.58	15.04	23.81	54.58
T_{10}	507.79	13.05	47.58	49.33	14.24	24.37	53.33
SEm±	1.268	0.003	0.009	0.009	0.003	0.14	0.009
CD at 5%	3.797	0.009	0.027	0.027	0.010	0.42	0.028

Table 2: Effect of plant growth regulators on yield attributes of sponge gourd *cv*. Kashi Shreya

Treatments	First harvesting (Days)	Fruit length (cm)	Fruit diameter (cm)	Average fruit weight (g)	Average fruit girth (cm)	Yield/plant (Kg)	Yield/Plot (Kg)	Yield/ha (q)
T_1	76.18	16.86	3.11	99.20	11.50	4.07	48.88	155.18
T_2	74.71	20.85	3.37	129.15	13.24	4.19	50.32	159.76
T_3	70.50	22.38	3.47	116.08	14.23	4.72	56.68	179.95
T_4	70.33	24.63	3.59	149.30	14.73	4.88	58.60	186.04
T_5	75.83	19.61	3.18	122.70	12.07	4.34	52.16	165.60
T_6	75.58	20.66	3.30	104.73	12.47	4.84	58.12	184.52
T_7	73.58	20.61	3.25	135.51	12.48	4.49	53.92	170.85
T_8	71.33	21.61	3.42	109.40	14.73	4.73	56.80	180.33
T_9	69.58	23.16	3.52	142.38	14.76	5.15	61.88	196.46
T_{10}	68.33	26.61	3.72	160.66	15.24	5.27	63.32	200.65
Sem ±	0.283	0.015	0.008	0.011	0.014	0.038	0.459	1.416
CD at 5%	0.849	0.045	0.023	0.034	0.043	0.115	1.370	4.241

Maximum vine length was obtained by PGR application at harvesting stage (558.72 cm) was observed with GA_3 @ 200 ppm being significantly superior, number of branches per plant was significantly increased by PGR application and Ethrel @ 250 ppm was found most effective (13.05), Maximum days taken to first opening of female flowers (58.83) were found in control. This might be due to Gibberellins hastening the early production of male flower and Ethrel application leads to decreased endogenous Gibberellins. But in days taken to first opening of male flower is significantly affected with GA_3. So earliest opening of male flowers (45.33) with GA_3 @ 200 ppm. Whereas maximum days to taken opening of first male flower (54.83) was found in control. Maximum node numbers of male flower (16.30) with control and maximum node numbers of female flower (24.37) with Ethrel @ 250 ppm. Maximum days taken to first set (62.83) in control and minimum days taken to first fruit set (53.33) in Ethrel @ 250 ppm. Similar results are found by Chaurasiya *et al.* (2016) [3] reported maximum vine length with spraying of GA_3 @ 60ppm in muskmelon, Kadi *et al.*, (2018) [4] reported maximum vine length with spraying of GA_3 @ 100 ppm in cucumber and Dalai *et al.*, (2015) [7] and Kumari *et al.*, (2019) [5] reported maximum vine length with the application of GA_3 @100 ppm in bottle gourd.

Maximum Days taken to first harvesting were increased significantly by PGR application, days taken to first fruit harvest (76.18) was observed in control, whereas minimum days to taken for first fruit harvest (68.33) was recorded with treatment Ethrel @ 250 ppm. This may be due to Ethrel application leads to decreased endogenous Gibberellins which hastens the early induction of female flowers and then early opening of female flower that ultimately require lower days for first fruit harvest. The similar results are reported by Chaurasiya *et al.* (2016) [3] in muskmelon and Kumari *et al.*, (2019) [5] in bottle gourd. The maximum length of fruit (26.61) was recorded in treatment Ethrel @ 250 ppm followed by NAA @ 200 ppm (24.63) and Ethrel @ 200 ppm (23.16), Whereas the minimum fruit length (16.86 cm) was observed in treatment *i.e.*, control (T_1). Among the application of different combination of plant growth regulators, Ethrel @ 250 ppm had maximum effect on diameter of fruits (3.72 cm), while the minimum diameter of fruits was observed in control (3.11). The beneficial effect of Ethrel on fruit diameter may be explained as that exogenous application of Ethrel increased endogenous levels of Auxins. The enlargement of cells of the fruit by Auxins is diametric leading to the simultaneous increase in fruit diameter. The treatment Ethrel @ 250 ppm proved most effective for increasing average weight of fruit (160.66 g), whereas minimum average fruit weight was found in control (99.20 g). The maximum mean fruit girth (15.24 cm) was observed with treatment Ethrel @ 250 ppm followed by Ethrel @ 200 ppm (14.76), Ethrel @ 150 ppm (14.73) and NAA @ 200 (14.73), whereas minimum fruit girth (11.50 cm) was recorded under control. The maximum yield of fruits (5.27 kg) per plant was recorded in Ethrel @ 250 ppm, whereas the minimum fruit yield was observed in control (4.07 kg), which might be due to an increased rate of photosynthetic activity to build-up sufficient food stock, accelerated transport, efficient utilization of photosynthetic products.

The fruit yield/ plot was significantly influenced by the various plant growth regulators treatments. The maximum fruit yield/ plot (63.32 kg) was recorded under the treatment Ethrel @ 250 ppm followed by Ethrel @ 200 ppm (61.88) and NAA @ 200 ppm (58.60), while the minimum fruit yield/ plot (48.88 kg plot) was observed under control. The fruit yield/ ha data revealed that the effect of plant growth regulators significantly increased the fruit yield and mean maximum fruit yield was observed (200.65 q/ha) under the treatment Ethrel @ 250 ppm followed by Ethrel@ 200 ppm (196.46) and NAA @ 200 ppm (186.04), while the minimum fruit yield/ ha (155.18) was observed under control. Similar results are reported by Kumari *et al.* (2019) [5] and Ansari *et al.*, (2018) [6] in bottle gourd.

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