



P-ISSN: 2349-8528

E-ISSN: 2321-4902

[www.chemijournal.com](http://www.chemijournal.com)

IJCS 2020; 8(4): 1573-1575

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Received: 16-05-2020

Accepted: 20-06-2020

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## Effects of different plant growth regulators on plant growth, yield and fruit quality of Bitter gourd (*Momordica charantia* L.) cv. Kashi Mayuri

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i4o.9836>

**Abstract**

A field experiment was conducted to study the effect of plant growth regulators on plant growth, yield and fruit quality of bitter gourd (*Momordica Charantia* L.) cv. Kashi Mayuri in a Randomized Block Design with three replications at Horticulture Research Farm, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India during kharif, 2018-2019. The experiment consists of 13 treatments which includes 4 plant growth regulators at 3 different concentrations. The treatments include NAA (at 50, 75, 100 ppm), GA<sub>3</sub> (at 15, 20, 25 ppm), CCC (at 100, 150, 200 ppm), Ethrel (at 100, 150, 200 ppm) and control (pure water) that were applied at 2 leaf stage of plant. The study revealed that GA<sub>3</sub>@25 ppm (T<sub>6</sub>) recorded maximum plant height (168.54, 288.41 and 360.41cm), number of leaves per plant (80.67, 128.58 and 238.51) at 30, 60 and 90 DAT and minimum plant growth was recorded in control (pure water). In terms of yield, number of fruits per plant (g), fruits yield per plant (kg), fruits yield per hectare (t ha<sup>-1</sup>) was recorded maximum in GA<sub>3</sub> @25 ppm (T<sub>6</sub>) followed by GA<sub>3</sub> @ 20 ppm (T<sub>5</sub>) and GA<sub>3</sub> @ 15 ppm (T<sub>4</sub>). Similarly, fruit quality parameters like diameter of fruits (10.64 cm) and length of fruits (15.89 cm) total soluble solids (4.31 °Brix), Ascorbic acid content (1.90 mg/100g) was found to be maximum in GA<sub>3</sub> @25 ppm.

**Keywords:** Bitter gourd, plant growth regulators, GA<sub>3</sub>, yield, fruit quality

**Introduction**

Bitter gourd (*Momordica charantia* L.) is one of the most important cucurbit vegetable belonging to the family cucurbitaceae. It is native of Indo-Burma region. It is cultivated round the year in India for its tender fruits, which is consumed as vegetable. Bitter gourd (2n=22) also known as balsom pear, karela, or bitter melon is a fast growing tropical vegetable crop. The crop is extensively cultivated in China, Japan, India, Malaysia, South East Asia, tropical Africa and South and North America. In India, it is cultivated in an area of 10.25Mha with a production of 184.39 Mt in 2017-18 [NHB database, 2019]

Globally PGRs have been used widely in crop production as it has significant positive effect on crop production. PGRs are being used to enhance the yield (Nickell, 1982) [7]. In addition, they can enhance the fruit set and also seed yield. The application of plant growth regulators has been found to be effective in initiating higher percentage of female flowers and there by modifying the sex ratio and ultimately resulting in more fruiting in cucurbits. A relationship between growth substances and sex expression probably exists in these plants. During the flowering period, a high auxin level in the vicinity of differentiating primordium and staminate organs by a low level favours the formation of pistillate organs (Heslop Harrison, 1957) [4].

Use of plant growth regulators (PGRs) may be a useful alternative to induce more number of female flowers. It was reported that exogenous application of NAA, Ethrel, GA<sub>3</sub>, growth retardant (MH) may shift the sex expression in cucurbits towards femaleness, increasing the number of pistillate flowers, number of fruits/plant and individual fruit weight as well as yield (Jadav *et al.*, 2010 and Mia *et al.*, 2014) [5, 6].

**Materials and Methods**

The experiment was carried out at the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture,

Technology and Sciences, Allahabad. The experiment was conducted in Randomized Block Design with 13 treatments that includes 4 plant growth regulators of 3 different concentrations with 3 replications. The treatments are NAA (at 50, 75, 100 ppm), GA<sub>3</sub> (at 15, 20, 25 ppm), CCC (at 100, 150, 200 ppm), Ethrel (at 100, 150, 200 ppm) and control (pure water) that were applied at 2 leaf stage of plant.

Prayagraj is situated at an elevation of 78 meters above sea level at 25.87 degree North latitude and 81.15 degree E longitude. The experiment was conducted on the cultivar Kashi Mayuri. The spacing between row to row is 1m and plant to plant is 50cm. Bund size of plot is 0.30 m. One main irrigation channel of 1 m width and two sub-irrigation channels of 50 cm each were prepared in the experimental field to meet out the irrigation requirement. A common dose of farm yard manure 10 tonnes per hectare was applied to experimental land area uniformly in last ploughing and incorporated into the soil. Nitrogen (90 Kg per ha) was applied in three splits viz., half as a basal dose and remaining half in two equal splits at 45 and 60 days after sowing as a top dressing in each plot. Phosphate (25 kg per ha) and potash (50 kg per ha) fertilizers were applied along with the basal dose of nitrogen in each plot. Nitrogen, Phosphorus and Potash were applied in the form of Urea, Single Super Phosphate and Muriate of Potash respectively.

## Results and Discussion

### Growth parameters

The maximum plant height (168.54, 288.41 and 360.41cm) at 30, 60 and 90DAT was recorded in (T<sub>6</sub>) GA<sub>3</sub> @ 25 ppm followed by (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm and (T<sub>5</sub>)GA<sub>3</sub> @ 20 ppm respectively as depicted in table 1. This could be attributed to the stimulatory effect of the plant growth regulators on cell division and cell enlargement, which lead to enhanced leaf area and hence influenced the growth and development (Geeta *et al.*, 2010<sup>[3]</sup> and Ajay *et al.*, 2018<sup>[1]</sup>).

The maximum number of leaves (80.67, 128.58 and 238.51) at 30, 60 and 90DAT was recorded in (T<sub>6</sub>) GA<sub>3</sub> @ 25 ppm followed by (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm and (T<sub>5</sub>)GA<sub>3</sub> @ 20 ppm respectively. Whereas, the minimum number of leaves per plant (58.64, 82.68 and 130.40) at 30, 60 and 90 DAT was found in (T<sub>0</sub>) Control (pure water).

### Flowering parameters

The minimum days to first female flower emergence (26.83 days) per plant was recorded in (T<sub>6</sub>) GA<sub>3</sub> @ 25 ppm followed by (T<sub>5</sub>)GA<sub>3</sub> @ 20 ppm (27.17 days) and (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm (27.41 days) respectively. Whereas, the maximum days to first female flower emergence (36.88 days) was recorded in (T<sub>0</sub>)Control (pure water). The minimum days to first male flower emergence (37.23 days) per plant was recorded (T<sub>6</sub>) GA<sub>3</sub> @ 25 ppm followed by (T<sub>5</sub>) GA<sub>3</sub> @ 20 ppm (38.58 days)

and (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm (38.17 days) respectively. Whereas, the maximum days to first male flower emergence (43.66 days) was recorded in (T<sub>0</sub>) Control (pure water). These results indicated that application of Ethrel delayed flowering in bitter gourd. Application of GA<sub>3</sub> stimulated the number of both pistillate and staminate flowers.

### Yield parameters

The maximum number of fruits/plant (38.50) per plant was recorded in (T<sub>6</sub>) GA<sub>3</sub> @ 25 followed by (T<sub>5</sub>) GA<sub>3</sub> @ 20 ppm (36.44) and (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm (35.62) respectively. Whereas, the minimum Number of fruits/plant (26.10) was recorded in (T<sub>0</sub>) Control (pure water) as shown in table 2.

The maximum Fruits yield /plant (kg) (3.29) per plant was recorded in (T<sub>6</sub>) GA<sub>3</sub> @ 25 followed (T<sub>5</sub>) GA<sub>3</sub> @ 20 ppm (2.97) and (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm (2.84) respectively. Whereas, the minimum Fruits yield /plant (kg) (1.45) was recorded in (T<sub>0</sub>) Control (pure water).

The maximum Fruits yield (t ha<sup>-1</sup>) (65.89) per plant was recorded in (T<sub>6</sub>) GA<sub>3</sub> @ 25 ppm followed by (T<sub>5</sub>) GA<sub>3</sub> @ 20 ppm (59.49) and (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm (56.89) respectively. Whereas, the minimum Fruits yield (t ha<sup>-1</sup>) (28.97) was recorded in (T<sub>0</sub>) Control (pure water) as shown in table 3. The increase in fruit yield by GA<sub>3</sub> is probably due to an increase in metabolism and accumulation of carbohydrates, auxin directed mobilization of metabolites from source to sink Geeta *et al.*, (2010)<sup>[3]</sup>.

### Fruit quality parameters

The maximum diameter of fruits (10.64cm) per plant was recorded in (T<sub>6</sub>) GA<sub>3</sub> @ 25 ppm followed by (T<sub>5</sub>) GA<sub>3</sub> @ 20 ppm (9.82cm) and (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm (9.67cm) respectively. Whereas, the minimum Diameter of fruits (7.63cm) was recorded in (T<sub>0</sub>) Control (pure water). These findings are confirmity with the reports of in bottle gourd.

The maximum Length of fruits (15.89cm) per plant was recorded in (T<sub>6</sub>) GA<sub>3</sub> @ 25 ppm followed by (T<sub>5</sub>) GA<sub>3</sub> @ 20 ppm (15.48cm) and (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm (14.67cm) respectively. Whereas, the minimum Length of fruits (11.5cm) was recorded in (T<sub>0</sub>) Control (pure water). These findings are confirmity with the reports of in bottle gourd.

The maximum Total Soluble Solids (<sup>0</sup>Brix) (4.31) per plant was recorded in (T<sub>6</sub>) GA<sub>3</sub> @ 25 ppm followed by (T<sub>5</sub>) GA<sub>3</sub> @ 20 ppm (4.08) and (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm (3.81) respectively. Whereas, the minimum Total Soluble Solids (<sup>0</sup>Brix) (2.33) was recorded in (T<sub>0</sub>) Control (pure water)

The maximum Ascorbic acid content (mg/100g of fruit pulp) (1.90) per plant was recorded in T<sub>6</sub> GA<sub>3</sub> @ 25 ppm followed by (T<sub>5</sub>) GA<sub>3</sub> @ 20 ppm (1.85) and (T<sub>4</sub>)GA<sub>3</sub> @ 15 ppm (1.76) respectively. Whereas, the minimum Ascorbic acid content (mg/100g of fruit pulp) (1.42) was recorded in (T<sub>0</sub>) Control (pure water).

**Table 1:** Effect of different plant growth regulator on plant height (cm) of Bitter gourd (*Momordica charantia* L.) cv. Kashi Mayuri

Treatmentsymbols	Treatment combination	Plant height (cm)		
		30 DAT	60 DAT	90 DAT
T0	Control (pure water)	133.64	205.64	291.52
T1	NAA @ 50 ppm	138.64	215.65	288.52
T2	NAA @ 75 ppm	141.50	220.56	275.66
T3	NAA@100 ppm	145.97	218.70	283.55
T4	GA <sub>3</sub> @ 15 ppm	159.58	282.66	348.65
T5	GA <sub>3</sub> @ 20 ppm	162.48	285.64	355.53
T6	GA <sub>3</sub> @ 25 ppm	168.54	288.41	360.41
T7	Ethrel @ 100 ppm	138.50	225.71	296.54
T8	Ethrel @ 150 ppm	141.86	230.17	308.58

T9	Ethrel @ 200 ppm	144.73	228.57	315.65
T10	CCC @ 100 ppm	140.56	268.60	338.56
T11	CCC @ 150 ppm	154.61	275.48	341.53
T12	CCC @ 200 ppm	158.47	276.86	337.67
F-test		S	S	S
C.D at 0.5%		0.248	0.187	0.129
S.Ed. (+)		0.120	0.091	0.062

**Table 2:** Effect of different plant growth regulator on Number of fruits/plants of Bitter gourd (*Momordica charantia* L.) cv. Kashi Mayuri

Treatmentsymbols	Treatment combination	Number of fruits/plant
T0	Control (pure water)	26.10
T1	NAA @ 50 ppm	28.93
T2	NAA @ 75 ppm	28.73
T3	NAA @ 100 ppm	30.23
T4	GA <sub>3</sub> @ 15 ppm	35.62
T5	GA <sub>3</sub> @ 20 ppm	36.44
T6	GA <sub>3</sub> @ 25 ppm	38.50
T7	Ethrel @ 100 ppm	30.43
T8	Ethrel @ 150 ppm	29.53
T9	Ethrel @ 200 ppm	31.48
T10	CCC @ 100 ppm	32.45
T11	CCC @ 150 ppm	33.49
T12	CCC @ 200 ppm	34.56
F-test		S
C.D at 0.5%		0.362
S.Ed.(+)		0.175

**Table 3:** Effect of different plant growth regulator on Fruits yield (t ha<sup>-1</sup>) of Bitter gourd (*Momordica charantia* L.) cv. Kashi Mayuri

Treatmentsymbols	Treatment combination	Fruits yield (t ha <sup>-1</sup> )
T0	Control (pure water)	28.97
T1	NAA @ 50 ppm	36.15
T2	NAA @ 75 ppm	37.10
T3	NAA @ 100 ppm	40.88
T4	GA <sub>3</sub> @ 15 ppm	56.89
T5	GA <sub>3</sub> @ 20 ppm	59.49
T6	GA <sub>3</sub> @ 25 ppm	65.89
T7	Ethrel @ 100 ppm	41.78
T8	Ethrel @ 150 ppm	41.04
T9	Ethrel @ 200 ppm	39.98
T10	CCC @ 100 ppm	51.09
T11	CCC @ 150 ppm	48.61
T12	CCC @ 200 ppm	50.91
F-test		S
C.D at 0.5%		0.669
S.Ed.(+)		0.324

## Conclusion

Based upon the results obtained, it can be concluded that T<sub>6</sub> treatment (GA<sub>3</sub> @ 25 ppm) is found to be beneficial with respect to plant growth, flowering, yield and fruit quality of bitter gourd cv. Kashi mayuri. Plant height, number of leaves per plant, number of branches per plant, number of fruits per plant, fruit yield per plant and hectare, fruit diameter, length of the fruit, ascorbic acid, total soluble sugars was found to be maximum in T<sub>6</sub> (GA<sub>3</sub> @ 25 ppm). Further, days to first male flower emergence, days to first female flower emergence was recorded in T<sub>6</sub> (GA<sub>3</sub> @ 25 ppm). Hence, T<sub>6</sub> (GA<sub>3</sub> @ 25 ppm) is considered as best treatment among different treatments of plant growth regulators followed by T<sub>5</sub> (GA<sub>3</sub> @ 20 ppm) and T<sub>4</sub> (GA<sub>3</sub> @ 15 ppm) for higher and quality yields in Bitter gourd cv. Kashi mayuri.

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