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**Maurya Suhashini Jayprakash**
PG Research Scholar, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur, Uttar Pradesh, India

**Rajaneesh Singh**
Professor, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur, Uttar Pradesh, India

**Hari Baksh**
Assistant Professor, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur, Uttar Pradesh, India

**Raj Pandey**
Assistant Professor, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur, Uttar Pradesh, India

**Aman Srivastav**
Assistant Professor, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur, Uttar Pradesh, India

**Corresponding Author:**
**Maurya Suhashini Jayprakash**
PG Research Scholar, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur, Uttar Pradesh, India

# Response of plant growth regulators on growth and yield attributes of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] *cv*. Kashi Ganga

**Maurya Suhashini Jayprakash, Rajaneesh Singh, Hari Baksh, Raj Pandey and Aman Srivastav**

**Abstract**
The bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] *cv.* was the subject of a field study at the Department of Horticulture experimental unit at the Tilak Dhari Post Graduate College in Jaunpur, Uttar Pradesh, in the Zaid season of 2021–2022 to investigate the Response of plant growth regulators on Growth and Yield attributes Kashi Ganga. The experiment was set up using a Randomized Block Design (RBD), with just one variety repeated three times, and ten treatments of various concentrations of the plant growth regulators NAA, Ethrel, and $GA_3$. Kashi Ganga was the variety utilised in this research. (IIVR). Nine foliar applications totalling $T_2$: NAA 150 ppm, $T_3$: NAA 200 ppm, $T_4$: NAA 250 ppm, $T_5$: Ethrel 50 ppm, $T_6$: Ethrel 100 ppm, $T_7$: Ethrel 150 ppm, $T_8$: $GA_3$ 50 ppm, $T_9$: $GA_3$ 100 ppm, and $T_{10}$: $GA_3$ 150 ppm with $T_1$: Control made up this trial. The findings indicate a significant impact of the interactions between various PGRs and spraying stages. With NAA 250 ppm, the maximum vine dimensions (404.64 cm), vine diameter (21.20 mm), internodal length (23.73 cm), number of nodes on the main vine axis (24.53), leaf area (261.83 $cm^2$), number of primary branches (14.27 cm), number of secondary branches (6.15), Node at which first female flower appeared (6.30), days required for appearance of first female flower appeared (49.12) days required for first picking (54.59), maximum sex ratio (6.58/1), Maximum length of fruit (32.52 cm). Maximum fruit diameter (67.27 mm), maximum Number of fruit per vine (7.45), maximum weight of fruit (846.53 g), fruit yield per vine (6.31 kg), Maximum fruit yield per hectare (631.00 q/ha) was observed in treatment $T_7$ Ethrel 150 ppm and maximum number of male flower was observed in treatments $T_{10}$ $GA_3$ 150 ppm.

**Keywords:** Growth, yield, plant growth regulators, bottle gourd

## Introduction
Bottle gourd: [*Lagenaria siceraria* (Mol.) Standl.] *cv.* Kashi ganga is a commonly grown and used vegetable in India. It is economically found growing in Ethiopia, Africa and Central America. It is Diploid crop (2n = 2 x = 22) belonging to cucurbitaceae or gourd family. Bottle gourd is also known as Kalabash or white flower gourd is one of the most important cucurbitaceous vegetable grown in tropical and subtropical parts of the world. It is known by different names such as *Lauki*, *Ghia*, *Doodhi*, *Jatilao*, *Jotilas*, *Bhopla*, *cucuzza* in *Italy*, *Amargo in spain*, *zucca melon in phillippines*, *Oolokwa* in *china* the fruit contain 0.2 percent protein, 2.9 percent carbohydrate, 0.5 percent fat, 0.5 percent mineral matter, 0.044 mg thiamine, 0.023 mg riboflavin, 0.33 g Niacin and 12 mg vitamin C and 0.6 g fiber per 100 g fresh weight (Aykroyd, 1963) [1].

There are numerous therapeutic uses for bottle gourd. The produce cools you down. It has a diuretic and cardiatonic impact. The pulp is effective as a toxic antidote and for treating constipation, cough, and night blindness. The mature dried fruits are used to create musical instruments, tools, and storage receptacles. The fruits can also be cooked like vegetables or used to make preserves, *kheer*, *halwa*, *petha*, and other desserts. *India*, *China*, *Sri Lanka*, *Indonesia*, *Brazil*, *the Philippines*, *Spain*, *Tropical Africa*, *Hong Kong*, and *Malaysia* are among the countries where it is widely grown. Bottle gourd is classified into two categories *viz.* Round-fruited and long-fruited varieties.

Flowering in bottle gourds begins 40–50 days after planting, though cultivar and environmental factors also play a role. On both primary and secondary stems, the staminate flower typically emerged in the axis of nodes before the pistillate. It is an annual creeper that bears tendrils and has a foul odour. The leaves are basic, long, and distichous. Large, unisexual, monoceous flowers with the sexes growing on separate stems.

Both sexes produce single, 7–10 cm-diameter flowers. The inferior ovary is ellipsoid-shaped, 2.5–3 centimetres long, and densely covered in soft, woolly hairs with gland-like tips. Anthesis occurs between 5:00 and 8:00 pm, and the blooms open at night. On the day of anthesis until the following morning, the pollen is still alive.

Bottle gourd fruits can occasionally taste bitter, and this is more common in cool climates and at higher elevations. All cucurbits also generate a small amount of cucurbitacin, which are complex substances with a tetracyclic cucurbitacin structure and are bitter. Fruits from bottle gourds typically contain small amounts of cucurbitains, particularly types B, D, G, and H. The bottle gourd is susceptible to frost and needs a warm climate for growth. Best growth occurs between 25-30 ºC and below 15 ºC is detrimental. The plant can thrive best in a temperature range of 25-30 ºC during the day.

Plant growth regulators are organic compounds that, unlike nutrients, increase, reduce, or modify the physiological processes of plants in minute concentrations. The impact of a growth regulator varies depending on the type of plant, the variety, the stage of development, the chemical concentration, the application technique, and the frequency of application.

NAA is used in chemical fruit thinning, fruit drop prevention, flowering induction, and to enhance fruit size, setting, and yield. By producing the enzymes needed for the production of cell wall and cytoplasmic components, NAA interacts at the gene level. NAA start off blooming uniformly.

Gibberellins are produced in the developing seeds, roots, and juvenile shoot tissues. They are used to induce maleness in dioecious flowers, embolden bolting/flowering in response to long days, embolden flower enlargement, disrupt seed dormancy in some plants that need light for germination, and play a significant role in the development of seedless fruit. Prajapati *et al.* (2015) [6].

The only gaseous hormone that promotes development is ethylene. Ethrel is the liquid version of it. Exogenous ethylene application results in improved flower organ morphogenesis, early flowering, fruiting, and ripening, and eventually increases in crop yield. It boosts reproductive development, increases fruit set, seed germination, causes the creation of female flowers, causes male sterility, and inhibits vegetative growth. The hibernation is ended thanks to ethylene. It speeds up the senescence of flowers and foliage. In comparison to male buds, ethylene played a bigger part in female buds, according to Kooner *et al.* (2000) [5].

## Methods and Materials

A field experiment entitled "Response of plant growth regulators on growth and yield attributes of Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] *cv.* Kashi Ganga" was conducted at experimental Unit, Department of Horticulture, Tilak Dhari Post Graduate college, Jaunpur Uttar Pradesh during *Zaid* season, 2021. The healthy hybrid seed of bottle gourd *cv.* Kashi Ganga were bought from Indian Institute of Vegetable Research (IIVR) Varanasi, Uttar Pradesh. The seeds of bottle gourd were sown in second week of February with spacing of 3.5 x 0.75 meter. The climatic condition of Jaunpur is sub-tropical. Geographically Jaunpur is sub-tropical. Geographically Jaunpur is situated in eastern part of Uttar Pradesh which lies between $25^0$44' North latitude and $82^0$41'. East longitude at an elevation of 83.230 meter above mean sea level. The seeds of bottle gourd were sown 2.5 to 3 cm depth in sandy loam soil having pH 7.2. The experiment was comprised of Nine treatments combination with different plant growth regulators (NAA, Ethel, $GA_3$) and Control (water spray) which is comparised of nine foliar application consisting of $T_2$: NAA @ 150 ppm, $T_3$: NAA @ 200 ppm, $T_4$: Ethrel @ 25 ppm, $T_5$: Ethrel @ 50 ppm, $T_6$: Ethrel @ 100 ppm, $T_7$: Ethrel @ 150 ppm, $T_8$: $GA_3$ @ 50 ppm, $T_9$: @ 100 ppm, $T_{10}$: $GA_3$@ 100 ppm with $T_1$: Control. The experiment laid out in randomized block design (RBD) with three replication. All the treatments were randomized separately in each replications. The required quantity of different plant growth regulators after weighing was dissolved in small quantity of 95% Absolute alcohol separately and stock solutions were prepared for each growth regulators by diluting with distilled water. The solution of required concentration where then prepared by further dilution of the measured volume of stock solution with distilled water. The required quantity of plant growth regulators as per treatment was applied at 2nd and 4th leaf stage of crop. Spray was the done with the help of a compressed air hand sprayer in each plot with equal volume during the morning hours of the day. The control plot was sprayed with distilled water. Statistical analysis of variance was perfomed on the data collected throughout the experiment. The significance of the treatments was determined using the 'F' test at a level of significance of 5%.

## Results and Discussion

### Growth parameters

From the Table 1. The maximum vine length (404.64 cm) vine diameter (21.20 mm), Internodal length (23.73 cm) Number of Nodes on main vine axis (24.53), and leaf area (261.83 $cm^2$) were encountered with $T_4$: NAA 250 ppm. The minimum vine length (280.53 cm), vine diameter (15.41 mm), Internodal length (17.07 cm), Number of nodes on main vine axis (18.19), leaf area (210.75 $cm^2$) were recorded in $T_1$: Control. The Auxin (NAA) is an important plant growth regulator, which stimulates cell division, cell elongation and cell enlargement in apical region of plant resulting in better plant growth. It is due to increase in osmotic pressure and permeability of cytoplasm to water and nutrients and decrease in the cell wall pressure on increase in the cell permeability Pandey and Sinha (1986) [7].

The increased intermodal length and nodes on main vine axis under exogenous application of NAA 250 ppm might be due to stimulatory effect of NAA on vine growth, cell division, cell elongation, cell enlargement Chhonkar and Singh (1959) [3]. These findings are also in conformity with Singh and Randhava (1969) [12] in bottle gourd.

The maximum number of primary branches (14.27 per vine) and maximum number of secondary branches (6.15 per vine) were found and Ethrel 150 ppm ($T_7$) and minimum number of primary branches (6.19 per vine) and minimum number of secondary branches (2.82 per vine) were found under control ($T_1$), respectively. This favourable effect of Ethrel on number of branches per vine and vine length of bottle gourd due to its adverse effect on Auxin, which enfore apical dominance and suppression of lateral buds to sprout. These results are in close conformity with the experiment reported by Kumari *et al.* (2019) [8]. They reported decrease in vine length and increase in number of branches with the application of Ethrel @ 150 ppm in bottle gourd, Chaurasiya *et al.* (2016) [4] who reported reduced in vine length but improved in branches with application of ethrel @ 150 ppm in muskmelon**.**

**Table 1:** Response of plant growth regulators on growth attributes of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] *cv.* Kashi Ganga

| Treatments | Vine length cm | Vine diameter mm | Internal length (cm) | No. of nodes on main vine | Leaf area ($cm^2$) | No. of primary branches | No. of secondary branches |
|---|---|---|---|---|---|---|---|
| Control ($T_1$) | 280.53 | 15.41 | 17.07 | 18.19 | 210.75 | 6.19 | 2.82 |
| NAA 150 ppm ($T_2$) | 368.72 | 19.41 | 22.53 | 22.63 | 239.59 | 7.65 | 3.20 |
| NAA 200 ppm ($T_3$) | 394.21 | 20.47 | 23.40 | 23.69 | 253.12 | 8.20 | 3.41 |
| NAA 250 ppm ($T_4$) | 404.64 | 21.20 | 23.73 | 24.53 | 261.83 | 9.36 | 3.81 |
| Ethrel 50 ppm ($T_5$) | 332.60 | 18.21 | 20.57 | 21.37 | 212.95 | 12.71 | 4.55 |
| Ethrel 100 ppm ($T_6$) | 338.62 | 19.11 | 21.67 | 22.12 | 226.07 | 13.71 | 5.87 |
| Ethrel 150 ppm ($T_7$) | 373.70 | 19.41 | 22.67 | 22.99 | 236.59 | 14.27 | 6.15 |
| $GA_3$ 50 ppm ($T_8$) | 293.38 | 16.48 | 17.95 | 18.26 | 202.64 | 10.56 | 4.08 |
| $GA_3$ 100 ppm ($T_9$) | 307.42 | 17.25 | 18.41 | 19.13 | 212.05 | 11.16 | 4.27 |
| $GA_3$ 150 ppm ($T_{10}$) | 328.39 | 18.06 | 18.84 | 19.33 | 221.87 | 11.84 | 4.34 |
| S.Em+ | 0.40 | 0.01 | 0.02 | 0.02 | 0.21 | 0.02 | 0.01 |
| CD at 5% | 1.20 | 0.05 | 0.07 | 0.06 | 0.63 | 0.08 | 0.03 |

**Yield parameters**

From table 2 the maximum number of fruits (7.45) per vine was observed in treatment $T_7$ Ethrel @ 150 ppm. whereas, the minimum number of fruits (3.82) per vine was found in control ($T_1$). The maximum fruit length (32.52 cm) was observed in $T_7$. Whereas, control recorded minimum fruit length (18.04 cm). Among the application of different combination of plant growth regulators, treatments $T_7$ Ethrel @ 150 ppm has maximum effect on diameter of fruits (67.27 mm). While the minimum diameter of fruits was observed in control $T_1$ (55.32 mm). The beneficial effect of Ethrel on fruit diameter may be explained as that exogenous application of Ethrel increased indigenous levels of Auxins. The enlargement of cells of the fruit by Auxins is diameter leading to the simultaneous increase in fruit diameter. The fruit weight also increased significantly with the application of different combination of plant growth regulators. The treatment$T_7$ proved most effective for increasing average weight of fruit (846.53 g). The minimum average fruit weight was found in $T_8$: $GA_3$ 50 ppm. (507.23 g). The maximum yield of fruits (6.31 kg) per vine was recorded in $T_7$. The minimum fruit yield was observed in $T_1$ (2.48 kg). The maximum fruit yield per hectare (631.00 q/ha) was recorded in treatment $T_7$: Ethrel @ 150 ppm. Minimum fruit yield per hectare (248.70 q/ha) was found in control ($T_1$). This might be due to an increased rate of photosynthetic activity to build-up sufficient good stock, Accelerated transport, efficient utilization of photosynthetic products. Similar result are reported by Kumari *et al.* (2019) [8] in bottle gourd, Ansari *et al.* (2018) [2] in bottle gourd, Mir *et al.* (2019) [9] in cucumber, Soni *et al.* (2016) [11] in bottle gourd, Chaurasiya *et al.* (2016) [4] in muskmelon, Vyas *et al.* (2015) [13] in ridge gourd, Mehadi *et al.* (2012) [10] in round melon and bottle gourd.

**Table 2:** Response of plant growth regulators on yield attributes of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] *cv.* Kashi Ganga.

| Chemical concentration | No. of fruits per vine | Fruits length (cm) | Fruits diameter (mm) | Avenge. Fruit weight (g) | Fruit yield kg/vine | Fruit yield/hectare |
|---|---|---|---|---|---|---|
| Control ($T_1$) | 3.82 | 18.04 | 55.32 | 649.85 | 2.48 | 248.70 |
| NAA 150 ppm ($T_2$) | 6.53 | 28.13 | 64.26 | 763.20 | 4.98 | 498.54 |
| NAA 200 ppm ($T_3$) | 6.25 | 27.13 | 63.02 | 702.99 | 4.39 | 439.49 |
| NAA 250 ppm ($T_4$) | 6.13 | 24.39 | 60.42 | 602.45 | 3.69 | 369.39 |
| Ethrel 50 ppm ($T_5$) | 6.67 | 30.30 | 65.95 | 792.13 | 5.28 | 528.54 |
| Ethrel 100 ppm ($T_6$) | 7.14 | 31.40 | 67.25 | 812.10 | 5.80 | 580.11 |
| Ethrel 150 ppm ($T_7$) | 7.45 | 32.52 | 67.27 | 846.53 | 6.31 | 631.00 |
| $GA_3$ 50 ppm ($T_8$) | 6.39 | 26.44 | 62.32 | 507.23 | 3.24 | 324.22 |
| $GA_3$ 100 ppm ($T_9$) | 5.83 | 25.51 | 61.25 | 681.11 | 3.97 | 397.15 |
| $GA_3$ 150 ppm ($T_{10}$) | 5.59 | 22.46 | 57.69 | 507.23 | 2.83 | 383.56 |
| S.Em+ | 0.01 | 0.04 | 0.03 | 1.18 | 0.02 | 2.60 |
| CD at 5% | 0.02 | 0.13 | 0.11 | 3.54 | 0.07 | 7.19 |

**Conclusion**

On the basis of results obtained from the field experiment following conclusions may be drawn. From the result obtained during the present investigation with different treatment on vegetative growth and yield. It is concluded that application of NAA 250 ppm shows the best effect on vine length, vine diameter, internodal length, number of nodes on main vine axis and leaf area.

The treatment with Ethrel 150 ppm significantly increases the primary and secondary branches per vine, days required for first picking, fruit length, fruit diameter, number of fruits per vine, fruit weight, fruit yield per vine (kg) and fruit yield per hectare (q/ha.).

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