Plant Archives Vol. 25, No. 2, 2025 pp. 1939-1944 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.2.280

IMPACT OF FOLIAR APPLICATION OF GROWTH REGULATORS ON PLANT GROWTH AND YIELD IN CAPE GOOSEBERRY (*PHYSALIS PERUVIANA* L.)

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(Date of Receiving : 17-07-2025; Date of Acceptance : 27-09-2025)

ABSTRACT

The experiment entitled with "Impact of Foliar Application of Growth Regulators on Plant Growth and Yield in Cape Gooseberry (*Physalis peruviana* L.) was carried out at Dr. YSRHU-College of Horticulture, Parvathipuram, Andhra Pradesh during the year 2024-2025. The ten treatments included 2,4-D (10, 15, and 20 ppm), GA_3 (20, 40, and 60 ppm), Ethrel (100, 150, and 200 ppm) and control. The experiment was set up in a randomized block design with three replications. The above growth regulators were imposed at 30, 45 and 60 days after transplanting. The treatment T_6 GA_3 at 60 ppm is the most effective treatment for growth parameters such as plant height, number of leaves and shoot thickness, as well as yield metrics like days to first flowering, number of flowers and fruits per yield, with fewer seeds per fruit. Treatment T_3 2,4-D at 20 ppm is best for increasing the number of branches and fruit set percentage.

***Keywords*:** plant growth regulators, cape gooseberry, growth and yield.

Introduction

Cape gooseberry (*Physalis peruviana* L.), a fast-growing solanaceae fruit, is valued for its nutritional and economic benefits. Its name derives from the Greek word physa, which translates to "bladder" for the calyx and *peruviana* for its Peruvian origin. Cultivated since the 19^{th} century, it is known as Poha, Goldenberry, Rashbhari and winter cherry. The plant grows 50–150 cm tall, sometimes reaching 2 m with support, and bears hermaphroditic, self-pollinating flowers. Fruits, enclosed in a papery calyx, weigh 3.5–10 g and have a sweet-tangy pulp rich in carbohydrates (11.5%), protein (1.8%), vitamins A and C, minerals and pectin (10%), earning it the name "Jam Fruit of India."

This research addresses the use of plant growth regulators (PGRs) in cape gooseberry cultivation. Although PGRs can improve growth, yield and quality, their effectiveness depends on concentration and application methods, yet little research exists for this crop. The long maturation period further increases farmers' risks. Identifying suitable PGRs could promote faster growth, earlier yields and higher productivity, supporting both economic returns and food security.

Materials and Methods

The present investigation was entitled "Impact of foliar application of growth regulators on plant growth and yield in cape gooseberry (*Physalis peruviana* L.) was carried out at Dr. YSRHU- College of Horticulture, Parvathipuram, Parvathipuram Manyam

District of Andhra Pradesh. The location falls under Agro-climatic zone 11, East coast plain and Hills and it was located in the North coast plains of Andhra Pradesh. The geographical location at 18.76^0 N latitude, 83.47^0 E longitude with an average elevation of 120 m (393.7 feet) MSL and received an average annual rainfall of 1529 mm during 2024-2025. The experiment was laid out in RBD (Randomised block design) with three replications. The experiment comprised of ten treatments as 2,4-D (10,15 and 20 ppm), GA_3 (20,40 and 60 ppm), ethrel (100,150 and 200 ppm) and control. The above growth regulators were imposed at 30, 45 and 60 DAT.

From each treatment, five plants per replication were randomly tagged for recording observations. Plant height was measured from the soil surface to the apical tip of the tallest shoot using a measuring scale, while shoot thickness was measured 5 cm above the collar region with a digital vernier callipers. The number of fully expanded leaves per plant and the number of primary branches were counted at 80 days after transplanting. Phenological observations included days to first flowering, counted as the number of calendar days from transplanting to the respective stage. The number of flowers per plant was recorded at peak flowering. Fruit set percentage was calculated by dividing the number of fruits set by the total number of flowers and multiplying by 100. The number of fruits per plant was recorded at harvest, and only marketable fruits harvested at the breaker to ripe stage were considered. Average fruit weight was determined by weighing individual fruits using an electronic balance and fruit yield per plant was calculated by multiplying the average fruit weight by the total number of fruits per plant. The number of seeds per fruit was determined by counting the seeds from a representative sample of fruits and statistically analyzed.

Results and Discussion

The maximum plant height was observed in the treatment T_6, where GA_3 was applied at a concentration of 60 ppm (191.53 cm). This was followed by treatment T_5, which involved GA_3 at 40 ppm (185.11 cm) and the minimum height was recorded in the control treatment T_{10}, which measured (116.03 cm). The application of GA_3 at 60 ppm produced the best results, likely because GA_3 promotes the cell elongation and cell division, especially in the stem internodes, leading to increased longitudinal growth (Taiz *et al*. 2015). These findings are consistent with those of Khan *et al*. (2006) in cape gooseberry and Mishra *et al*. (2021) in tomato. The maximum number of branches per plant was observed in the treatment T_3 2,4-D at 20 ppm, with (30.33 branches per plant) and followed by treatment T_2 2,4-D at 15 ppm with (27.89 branches per plant). In contrast, the minimum number of branches was found in the control treatment T_{10}, which had only (14.07 branches per plant). The positive effects of 2,4-D at 20 ppm may be attributed to its stimulatory action on branching, likely resulting from the interplay between auxin transport/ signalling and other regulators of shoot branching. Typically, auxin produced at the shoot apex suppresses the outgrowth of axillary buds (Lesyer, 2009). These findings are in accordance with Banshidhar *et al*. (2017) in cape gooseberry. The maximum shoot thickness was observed in the treatment T_6, which used GA_3 at 60 ppm (1.94 cm). This was followed by T_5 with GA_3 at 40 ppm (1.91 cm). In contrast, the minimum shoot thickness was recorded in the control group T_{10} at (0.94 cm). The treatment with GA_3 at 60 ppm yielded the best results, likely because GA_3 promotes xylem differentiation in stem and root tissues, reinforcing the internal structure and leading to thicker, more robust shoots. These findings are consistent with those reported by Kaur *et al*. (2016) and are similar to the results obtained by El-Tohamy *et al*. (2023) in their study of cape gooseberry. The highest number of leaves was observed in the treatment T_6, which used GA_3 at a concentration of 60 ppm (785.87 leaves per plant), followed by treatment T_5 with GA_3 at 40 ppm (753.93 leaves per plant). In contrast, the lowest number of leaves was recorded in the T_{10} control treatment (302.67 leaves per plant). The effectiveness of GA_3 at 60 ppm can be attributed to its role in promoting both cell elongation and cell division, which directly contribute to greater leaf expansion and an increased number of leaves per plant (Taiz *et al*.2015). These findings align with the research of Mishra and Singh (2021) in cape gooseberry, Rathod *et al*. (2021) in strawberries and Nitin *et al*. (2023) in grapes.

The minimum days taken to flowering is treatment T_6 GA_3 @60 ppm (39.93 d), followed by treatment T_5 GA_3@40 ppm (43.33 d) and the maximum days taken to 1st flowering was observed in the treatment T_{10} control (81.37 d). GA_3 @60 ppm resulted best it stimulates floral meristem initiation by activating genes related to flowering pathways (e.g., *Leafy* and *soc1*). This results in faster switch-on of the flower bud initiation (Hedden, 2009). The findings are similar to Banshidhar *et al*. (2017) and Izhar *et al*. (2018) in cape gooseberry plants. The highest number of flowers per plant was observed in T_6 GA_3 @60 ppm (75.27), followed by T_5 GA_3 @40 ppm (73.17), while the treatment T_{10} control had the least flowers per plant (54.47). The increased flower production in T_6 GA_3 @60 ppm is attributed to enhanced vegetative growth and greater floral meristem initiation, improving assimilate partitioning to reproductive organs and promoting more floral primordia (Gupta and Chakrabarty, 2013). This aligns with findings by Banshidhar *et al*. (2017), Rathod *et al*. (2021) in strawberry and Madhvendra *et al*. (2022) in cape gooseberry. The more number of fruits produced in the treatment T_5 GA_3 @ 60 ppm (42.11), This was in contrast to the control treatment T_{10}, which produced the lowest average at just 19.11 fruits per plant it might be due to the increased the number of flowering sites, leading to a higher fruit yield per plant. These findings align with studies conducted by Gelmesa *et al*. (2010) in tomato, Narayanlal *et al*. (2013) in guava, Rizwan *et al*. (2014) in sweet orange, Banshidhar *et al*. (2017) in cape gooseberries. The fruit weight was highest in treatment T_6 with GA_3 at 60 ppm, measuring (6.99 g). This was followed by treatment T_5 with GA_3 at 40 ppm, which weighed (6.66 g). Both treatments showed significant differences compared to the control treatment T_{10}, which had the lowest weight (2.72 g). The application of GA_3 at 60 ppm was the most effective, as it induced certain biochemical changes in fruit metabolism, leading to greater accumulation in the fruit and, ultimately, an increase in weight. These findings are in agreement with those of Kaur *et al.* (2016), Ravi *et al*. (2018) and Banshidhar *et al*. (2017) regarding cape gooseberry. The fruit set percentage was reported highest in treatment T_3 *i.e.,* 2,4-D @ 20 ppm (58.30 %), followed by treatment T_2 *i.e.*,2,4 D @15 ppm (56.33 %) and low fruit set percentage was reported in treatment T_{10} control (35.18 %). 2,4-D @ 20 ppm resulted best it might be because 2,4-D promotes fruit retention by reducing fruit drop. The results are in accordance with Kaur *et al*. (2015) in cape gooseberry and Singh *et al*. (2017) in mango. More number of seeds was reported in treatment T_{10} control (155.20), followed by T_7 ethrel @100 ppm (146.60) and fewer seeds was reported in treatment T_6 GA_3 @60 ppm (75.47). Control treatment recorded a higher number of seeds per fruit compared to GA_3 treatments. Although GA_3 promoted flowering, it can sometimes induce parthenocarpic fruit set, leading to seedless or partially seeded fruits (Serrani *et al*. 2007). Excessive vegetative growth stimulated by GA_3 may also divert assimilates away from seed filling, while changes in hormonal balance can reduce pollen viability and fertilization success (Alam *et al*. 2014). Singh and Singh (2013) in brinjal, Pandey and Singh (2011) and Kasim *et al*. (2020) in tomato, similarly reported that GA_3 reduced seed numbers per fruit compared to the control.

Conclusion

The treatment T_6 *i.e.,* GA_3 at 60 ppm is the most effective treatment for growth parameters such as plant height, number of leaves and shoot thickness, as well as yield metrics like days to first flowering and number of flowers and fruits per plant, with fewer seeds per fruit. Treatment T_3 *i.e.*,2,4-D at 20 ppm is best for increasing the number of branches and fruit set percentage.

Table 1 : Effect of foliar sprays of growth regulators on plant height (cm) and number of branches per plant, shoot thickness (cm) and number of leaves in cape gooseberry.

Treatments (T)	Plant height (cm)	No. of branches per plant	Shoot thickness (cm)	No. of leaves per plant
T_1: 2,4 D@ 10ppm	137.53 ^{g}	23.83 ^{c}	1.34^i	331.27 ^{i}
T_2: 2,4 D@ 15ppm	131.85 ^{h}	27.89^b	1.47^h	349.67^h
T_3: 2,4 D@ 20ppm	126.00 ^{i}	30.33 ^{a}	1.59 ^{g}	364.93 ^{g}
T_4: GA_3 @ 20ppm	179.17 ^{c}	19.33^d	1.87 ^{c}	738.67 ^{c}
T_5: GA_3@ 40ppm	185.11^b	20.61 ^{d}	1.91 ^{b}	753.93 ^{b}
T_6: GA_3 @ 60ppm	191.53^a	23.03 ^{c}	1.94 ^{a}	785.87 ^{a}
T_7: Ethrel @100ppm	153.52^f	17.13 ^{e}	1.67^f	557.47 ^{f}
T_8: Ethrel @150ppm	161.28 ^{e}	19.00 ^{d}	1.71 ^{e}	582.97 ^{e}
T_9: Ethrel @200ppm	169.83 ^{d}	18.47 ^{e}	1.75 ^{d}	626.13 ^{d}
T_{10}: Control (water spray)	116.03 ^{j}	14.07 ^{f}	0.94 ^{j}	302.67^j
Mean	155.19	21.37	1.62	539.36
SE m (±)	1.77	0.99	0.006	4.65
CD at 5%	5.25	2.95	0.02	13.81

Table 2 : Effect of foliar sprays of growth regulators on days to 1st flowering, number of flowers per plant, number of fruits per plant, fruit weight (g), fruit yield per plant (g), fruit set percentage (%) and number of seeds per fruit.

Treatments (T)	Days to 1st flowering (d)	No. of flowers per plant	No. of fruits per plant	Fruit weight (g)	Fruit yield per plant (g)	Fruit set percentage (%)	Number of seeds per fruit
T_1: 2,4 D@ 10ppm	74.60^h	60.73^h	30.70^e	2.87^h	101.93^e	53.88^c	121.40^d
T_2: 2,4 D@ 15ppm	70.80^g	61.80^g	31.07^e	3.14^g	97.47^f	56.33^b	115.67^e
T_3: 2,4 D@ 20ppm	62.07^e	66.61^e	35.63^d	3.33^f	102.07^d	58.30^a	104.00^f
T_4: GA_3 @ 20ppm	48.43^c	71.13^c	37.77^c	6.33^c	227.53^c	46.51^f	99.77^f
T_5: GA_3@ 40ppm	43.33^b	73.17^b	40.13^b	6.66^b	249.53^b	49.36^e	91.20^g
T_6: GA_3 @ 60ppm	39.93^a	75.27^a	42.11^a	6.99^a	282.20^a	51.79^d	75.47^h
T_7: Ethrel @100ppm	57.87^d	63.07^f	26.27^g	3.40^f	91.80^f	39.19^h	146.60^b
T_8: Ethrel @150ppm	60.87^e	64.27^f	28.53^f	3.65^e	99.97^e	44.32^g	138.27^c
T_9: Ethrel @200ppm	67.10^f	68.07^d	31.67^e	3.90^d	104.90^d	47.17^f	121.33^d
T_{10}: Control (water spray)	81.37^i	54.47^i	19.11^h	2.72^i	40.07^g	35.18^i	155.20^a
Mean	60.64	65.86	32.29	4.11	139.75	48.20	116.89
SE m (±)	0.92	0.49	0.55	0.05	5.69	0.65	1.91
CD at 5%	2.74	1.45	1.64	0.15	16.91	1.93	5.66

Fig. 1 : Impact of plant growth regulators on Plant height (cm) and No. of branches per plant.

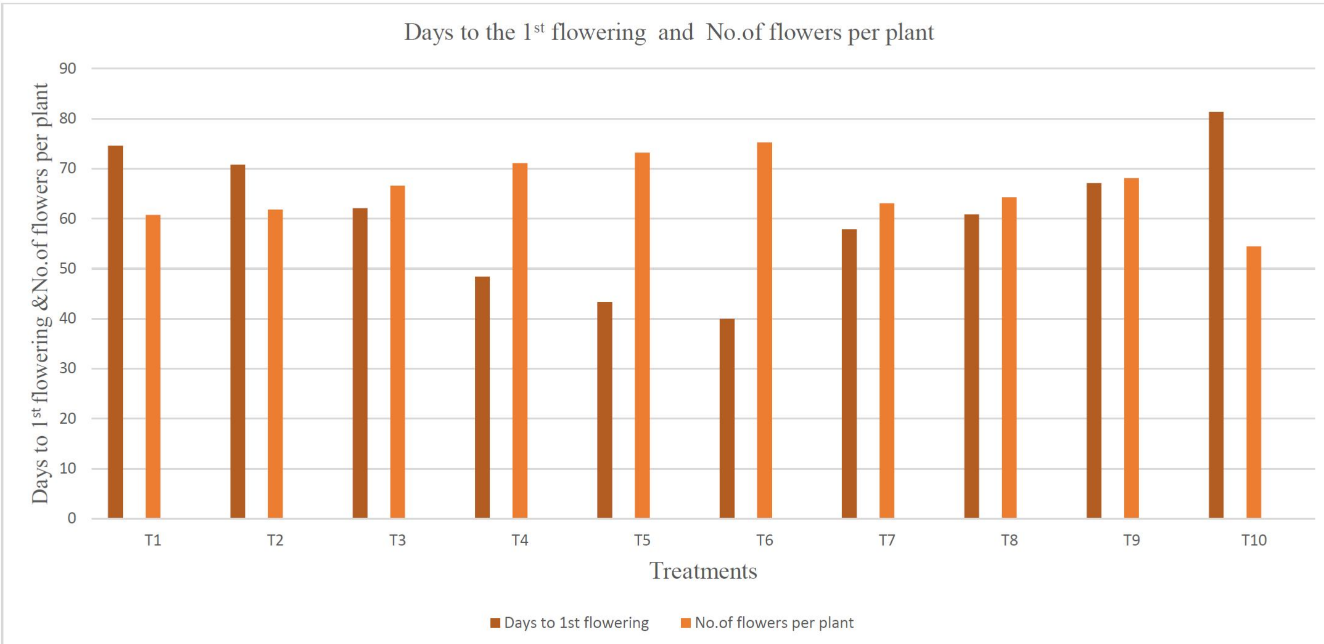

Fig. 2 : Impact of plant growth regulators on Days to 1st flowering and No. of flowers per plant

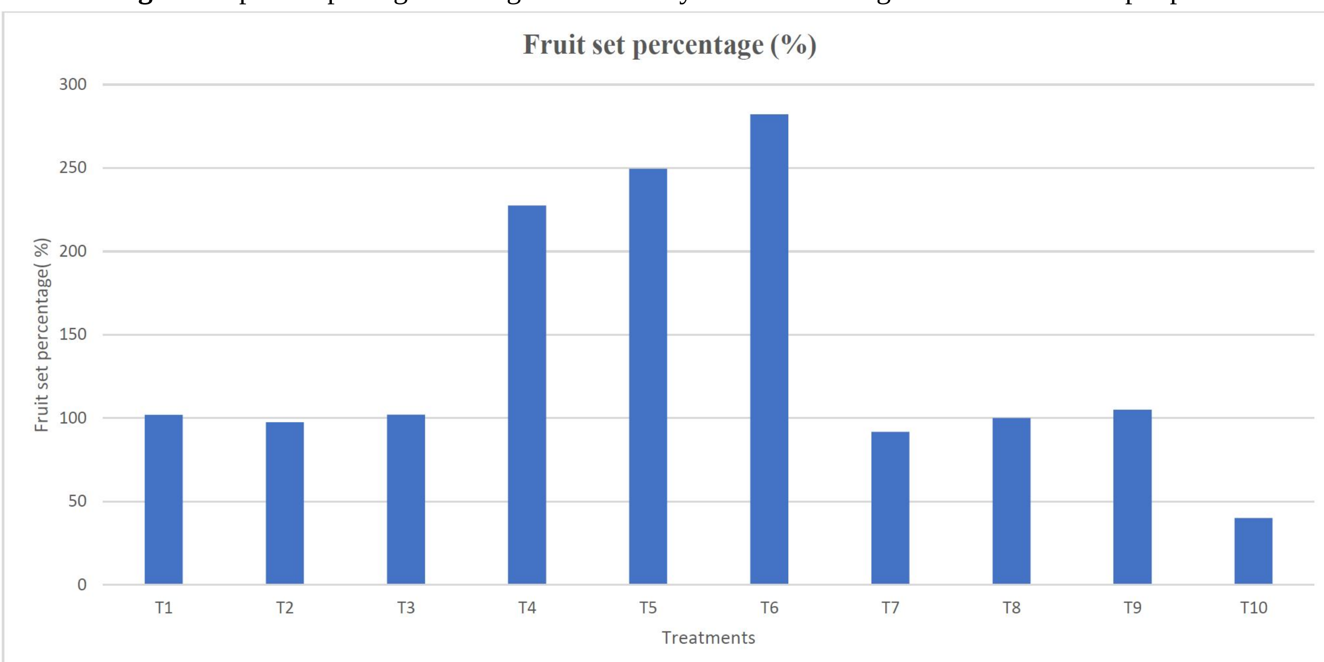

Fig. 3 : Impact of plant growth regulators on fruit set percentage (%)

References

Alam, M.M., Rahman, M. M. and Uddin, M. S. (2014). Effect of GA_3 on growth and yield of tomato (*Lycopersicon esculentum* Mill.). *International Journal of Sustainable Crop Production*. **9**(2), 21–25.

Banshidhar, M. K, Birendra, P, Ajay, K.D. and Izhar, A. (2017). Effect of plant growth regulators and yield parameters in cape gooseberry (*Physalis peruviana* L). *Environment and Ecology*. **35**(2),970-420.

El-Tohamy, W, A, Hayriye, Y, D. and Nazim, S.G. (2023). Impact of gibberellic acid on water status, growth and development of cape gooseberry in newly reclaimed sandy lands within arid regions. *Horticulturae*, **9**(12), 1283.

Gelsema, D, Abebie, B. and Desalengn, L. (2010). Effects of gibberellic acid and 2,4-dichlorophenoxyacetic acid spray on fruit yield and quality of tomato. *Journal of Plant Breeding and Crop Sciences*. **2**(2),316-324.

Gupta, A. and Chakrabarty, S. K. (2013). Gibberellic acid in plant, Still a mystery unresolved. Plant Signalling and Behaviour, **8**(9), e25504.

Hedden, P. (2009). Gibberellin as a factor in floral regulatory networks. *Journal of Experimental Botany*, **60**(7),1979-1989.

Izhar, A., Ashok, K., Banshidhar, M.K. and Anil, K.R. (2018). Effect of different chemicals in enhancing yield of cape gooseberry (*Physalis peruviana* L). *International Journal of Current Microbiology and Applied Sciences*, **7**, 3239-3245.

Kasim, N., Syam, E., Taufik, N., Haring, F., Dermawan, R., Widiayani, N. and Indhari, F. (2020). Response of tomato plant on various concentrations and application frequency of gibberellin. *Earth and environment science*, **486** (10),120-124.

Kaur, G. and Kaur, A.P. (2016). Plant growth and fruit yield attributes of cape gooseberry (*Physalis peruviana* cv. Aligarh) as affected by the use of different growth regulators. *Agricultural Science Digest*, 36(2),138–141.

Leyser, O., Booker, J. and Beveridge, C. (2009). Roles for Auxin, Cytokinin and Strigolactone in regulating shoot branching. *Plant Physiology*, **149**, 1929–1944.

Madhvendra, B.S., Pawan, K., Manoj, K., Dinabandhu, S. and Samik, S. (2022). Optimization of stage of gibberellin spray in cape gooseberry (*Physalis peruviana* L.) for the improvement of yield and fruit quality under subtropical condition. *Emergent Life Sciences Research.* **8**(2), 206-213.

Mishra, A. and Singh, D. (2021). Effect of salicylic acid, 2,4-dichlorophenoxyacetic acid and gibberellic acid on yield and economics of cape gooseberry (*Physalis peruviana* L.). *The Pharma Innovation Journal*, **10**(10), 2543–2546.

Narayanlal, D.R.P. and Verma, L.R. (2013). Effect of plant growth regulators on flowering and fruit growth of guava (*Psidium guajava* L.) cv. Allahabad safeda. *The Asian Journal of Horticulture*, **8**(1), 54-56.

Nitin, P., Saket, M., Vijay, B. and Prasad, V.M. (2023). Effect of PGR on growth and establishment of grapes (*Vitis vinifera* L.) cv. Thompson seedless under Prayagraj agro climatic condition. *International Journal of Plant & Soil Science*, **35**(12),74-80.

Pandey, S. K. and Singh, R. S. (2011). Effect of plant growth regulators on growth, yield and quality of tomato (*Lycopersicon esculentum* Mill.). *Journal of Agriculture Research*, **48**(2),171–177.

Rathod, K.D., Ahlawat, T.R., Kumar, S., Sarkar, M. and Chakraborty, B. (2021). Effect of plant growth regulators on growth, yield and quality of strawberry (Fragaria × ananassa Duch.) cv. Winter Dawn under open field conditions of South Gujarat. *Agricultural Science Digest*, **41**(2),329–333.

Rizwan, U., Sajid, M., Husain, A., Luqman, M., Razaq, M., Nabi, G., Fahad, S. and Rab, A. (2014). Association of gibberellic acid with fruit set and fruit drop of sweet orange. *Journal of Biology*, **4**(2), 2224-3208.

Serrani, J.C., Fos, M., Atares, A. and Garcia, M.J.L. (2007). Effect of gibberellin and auxin on parthenocarpic fruit growth induction in tomato. *Journal of Plant Growth Regulators*, **26**, 211–221.

Singh, D. and Singh, A.K. (2013). Effect of GA_3 and NAA on growth, flowering and fruiting of brinjal (*Solanum melongena* L.). *Asian Journal of Horticulture*. **8**(2), 543–546.

Singh, A., Upadhyay, S. and Upadhyay, R.G. (2017). Effect of Plant Growth Regulators (NAA, 2, 4-D and GA_3) on fruit retention and quality of mango cv. Dasehri. *International Journal of Tropical Agriculture*. **34**(7), 67-74.

Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A. (2015). Plant Physiology and Development. 6th edition. *Sinauer Associates*.