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Effect of foliar application of brassinosteroids and salicylic acid on growth, flowering, yield and quality of Cape gooseberry (*Physalis peruviana*)

Ayimtiba Walling, Vijay Bahadur, VM Prasad, Samir E Topno and Anupriya Paul

Abstract
An investigation was carried out during 2020-2021 at Horticulture Research Farm, SHUATS, Prayagraj. This experiment was conducted in Randomized Block Design (RBD) with ten treatments *viz.* T0- Control, T1- Brassinosteroid @ 4 ppm, T2- Brassinosteroid @ 8 ppm, T3- Brassinosteroid @ 12 ppm, T4- Brassinosteroid @ 16 ppm, T5- Salicylic acid @ 50 ppm, T6- Salicylic acid @ 100 ppm, T7- Salicylic acid @ 150 ppm, T8- Salicylic acid @ 200 ppm, T9- Salicylic acid @ 250 ppm, were applied during the research work on Cape gooseberry. Both growth regulator i.e brassinosetriod and salicylic acid were found to be effective in terms of plant growth, flowering, yield and quality of Cape gooseberry. However, Brassinosteroid @ 16ppm proved to be most effective in term of plant height (87.38cm), number of leaves per plant (105.32), number of branches per plant (13.15), leaf area (77.88cm^2), number of buds per plant (133.56), minimum days to flowering (44.07), number of flower per plant (115.56), minimum days to first fruit set (66.32), number of fruits per plant (104.81), fruit weight with and without husk (10.29 and 9.89g), polar diameter with and without husk (4.85 and 3.49 cm), radial diameter with and without husk (4.23 and 3.05 cm), fruit yield (54.96 q ha^{-1}), (11.79^{0}Brix) T.S.S., minimum acidity (0.11%), Ascorbic acid (48.50) and Shelf life (31.31days). From the findings of present study it is concluded that spray of Brassinosteroid @ 16 ppm was found to be the best treatment for better plant growth, yield and quality of Cape gooseberry with maximum benefit cost ratio (3.66). Therefore, application of Brassinosteroid @ 16 ppm will improve yield and fruit quality in Cape gooseberry as a result the growers will be economically benefited.

Keywords: Cape gooseberry, salicylic acid, brassinosteroid, ascorbic acid

Introduction
Cape-gooseberry (*Physalis peruviana* L.), commonly known as Poha, Tepari, Golden berry, Husk berry, being one of the important minor fruit crop, is highly nuturitious with good source of vitamins and minerals. It belongs to genus *Physalis* (Family-Solanaceae) having eighty species, amongst all only three namely; *Physalis peruviana* L; P. *pubescens* L. and *Physalis ixocarpa* Brot. have been recognized as eatable fruit bearing species. The *Physalis peruviana* is considered to be the best with respect to taste, precocity and yield. The edible portion of berry contains 11.5% carbohydrates, 1.8% protein, 0.2% fat, 3.2% fibre, 0.6% mineral matter and 49 mg. ascorbic acid per 100 g. edible portion of fruit (Khan and Gowder, 1955) [5].
Brassinosteroids a new group of polyhydroxyl steroids which have been recognized as a class of phytohormones. It play prominent roles in many developmental processes including the increase of cell elongation, pollen tube growth, flowering, senescence, abscission and maturation Swamy and Rao, (2008). BRs regulate numerous important pomological attributes such as initiation and cessation of flowering, plant canopy architecture, micropropagation, cell division and elongation, vegetative growth, flowering, fruit set, fruit ripening, quality and yield. Besides, Brassinosteroid can improve resistance/tolerance to biotic and abiotic stresses and also enhance post harvest fruit quality.
Salicylic acid (SA), a naturally occurring plant hormone, acts as an important signaling molecule and enhances tolerance of treated plants against biotic stresses (Khan *et al.*, 2012) [2]. Salicylic acid also has a vital role in plant growth, ion uptake, and nutrient transport within the plant.

Materials and Methods
The present investigation entitled, "Effect of foliar application of brassinosteroids and salicylic

on growth, flowering, yield and quality of Cape gooseberry (*Physalis peruviana*)'' was carried out at Horticulture Research Farm, Department of Horticulture, NAI, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the *kharif* season (2020-2021). All the facilities necessary for cultivation, including labour were made available in the department. The experiment was laid out in a Randomized Block Design with ten treatments and three replication *viz*. T0 - Control, T1- Brassinosteroid @ 4 ppm, T2- Brassinosteroid @ 8 ppm, T3- Brassinosteroid @ 12 ppm, T4- Brassinosteroid @ 16 ppm, T5- Salicylic acid @ 50 ppm, T6- Salicylic acid @ 100 ppm, T7- Salicylic acid @ 150 ppm, T8- Salicylic acid @ 200 ppm, T9- Salicylic acid @ 250 ppm, were applied during the research work on Cape gooseberry. The foliar application was done at vegetative growth stage, flowering stage and fruiting stage. Ten healthy fruits were randomly selected from each plant at full maturity stage to record the various developmental parameters of the fruits.

Coarse ratios were recorded on the following parameters:(a) physical characteristics – number/kg of fruit, weight of fresh fruit (g) with and without husk was noted with the help of digital balance, fruit polar and radial diameter (cm) with and without husk was measured with the help of vernier's caliper

(b) Chemical Characteristics -Total soluble solids was noted using hand refractometer. Acidity was estimated by the common-repeated titration method and oxalic acid method for ascorbic acid was followed given by Rangana (1986) [12] method.

Results and Discussion

The results obtained from present investigation have been summarized as below:

A) Growth Parameter

i) **Plant height (cm):** The perusal of the data in (table 1) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm on plant height (cm) of Cape gooseberry as compared to Control (T0). At 25, 50 and 75 DAT, maximum value for plant height (37.80, 51.26 and 87.38 cm) was observed with T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, T5. However minimum plant height (22.21, 35.11 and 57.28cm) with T0 (Control). The data pertaining to plant height of Cape gooseberry indicates that the differences were significant when the CD value was greater than the treatment differences. The maximum value (T4) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T3 at 25, 50 and 75 days after transplanting of Cape gooseberry. The maximum increase in plant height in T4 may be due to cell division and promotion of cell elongation. Similar, results were obtained by khatoon *et al.,* (2020); Varduini *et al.,* (2001) [9] Sridhara *et al.,* (2021) [6].

ii) **Number of leaves per plant:** The perusal of the data in (table 1) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm on number of leaves per plant of Cape gooseberry as compared to Control (T0). At 25, 50 and 75 DAT, maximum value for number of leaves per plant (16.07, 54.18 and 105.32) was observed with T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm, T2 Brassinosteroid @ 8 ppm, T1 Brassinosteroid @ 4 ppm, T9 Salicylic acid @ 250 ppm, T8 Salicylic acid @ 200 ppm, T7 Salicylic acid @ 150 ppm, T6 Salicylic acid @ 100 ppm, T5 Salicylic acid @ 50 ppm. However minimum number of leaves per plant (6.22, 33.69 and 74.16) with T0 (Control). The data pertaining to number of leaves per plant of Cape gooseberry indicates that the differences were significant when the CD value was greater than the treatment differences. The maximum value (T4) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T3 at 25, 50 and 75 days after transplanting of Cape gooseberry. The maximum increase in number of leaves per plant in T4 may be due to cell division and promotion of cell elongation. Similar, results were obtained by khatoon *et al.,* (2020); Varduini *et al.,* (2001) [9]; Sridhara *et al.,* (2021) [6]. Also, Pipattanawong *et al.* (1996) [10] reported that exogenous application of BRs improved the number of leaves, petiole length, total leaf area and number of crowns in strawberry.

iii) **No. of branches:** The perusal of the data in (table 1) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on number of branches per plant of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). At 50 and 75 DAT, maximum value for number of branches per plant (7.32 and 13.15) was observed with T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However minimum number of branches per plant (4.08 and 6.86) with T0 (Control). The data pertaining to number of branches per plant of Cape gooseberry indicates that the differences were significant when the CD value was greater than the treatment differences. The maximum value (T4) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T3 at 50 and 75 days after transplanting of Cape gooseberry. The maximum increase in number of branches per plant in T4 maybe through modulating metabolic pathways and nutrient allocation and/or by interacting with other signaling pathways. It is in accordance with report of Mussig (2005) [7].

iv) **Leaf area (cm^2):** The perusal of the data in (table 1) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on leaf area (cm^2) of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). At 25, 50 and 75 DAT, maximum value for leaf area (28.28, 48.73 and 77.88cm^2) was observed with T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However minimum leaf area (18.84, 33.40 and 52.48 cm^2) with T0 (Control). The data pertaining to leaf area (cm^2) of Cape gooseberry indicates that the differences were significant when the CD value was greater than the treatment differences. The maximum value (T4) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T3 at 25, 50 and 75 days after transplanting of Cape gooseberry. The maximum increase in leaf area (cm^2) in T4 may be due to promotion of cell elongation and increase photosynthetic rate. Similar report were obtained by Vardhini and Rao (2001) [9]; Aiman *et al.* (2014) [11]; and Sridhara *et al.,* (2021) [6]. Also, Pipattanawong *et al*. (1996) [10] reported that exogenous application of BRs improved the number of leaves, petiole length, total leaf area and number of crowns in strawberry.

B) Flowering Parameter

i) **Number of buds per plant:** The perusal of the data in (table 2) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on number of buds per plant of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Maximum number of buds per plant (133.56) was observed with T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However minimum number of buds per plant (85.89) with T0 (Control). The finding of the present investigation showed that maximum number of buds per plant was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The maximum number of buds per plant in T4 may be due to better translocation of nutrients from source to sink. It might also be due to more number of leaves, increase leaf area which accelerates the photosynthesis process produced at all growth stages. Similar, results were obtained by khatoon *et al.,* (2020); Varduini *et al.,* (2001) [9] Sridhara *et al.,* (2021) [6]. It is also reported that number of flowers in strawberry increased by the application of BRs at the foliage Pipattanawong *et al*., (1996) [10].

ii) **Days to first flowering:** The perusal of the data in (table
iii) 2) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on days to first flowering of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Minimum days to first flowering (44.07) was observed with T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However maximum days to first flowering (68.10) with T0 (Control). The finding of the present investigation showed that minimum days to first flowering was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The minimum days to first flowering in T4 may be due to application of brassinosteroid which stimulates higher ethylene production which in turn causes the plant to induce flowering faster. Similar, results were obtained by khatoon *et al.,* (2020); Varduini *et al.,* (2001) [9]; Sridhara *et al.,* (2021) [6].

iv) **Number of flowers per plant:** The perusal of the data in (table 2) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on number of flowers per plant of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Maximum number of flowers per plant (115.56) was observed with T4 Brassinosteroid @16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However minimum number of flowers per plant (73.89) with T0 (Control). The finding of the present investigation showed that maximum number of flowers per plant was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The maximum number of flowers per plant in T4 may be due to better translocation of nutrients from source to sink. It might also be due to more number of leaves, increase leaf area which accelerates the photosynthesis process produced at all growth stages. Similar, results were obtained by khatoon *et al.,* (2020); Varduini *et al.,* (2001) [9]; Sridhara *et al.,* (2021) [6]. It is also reported that number of flowers in strawberry increased by the application of BRs at the foliage Pipattanawong *et al*., (1996) [10].

v) **Days to first fruit set:** The perusal of the data in (table 2) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on days to first fruit set of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Minimum days to first fruit set (66.32) was observed with T4 Brassinosteroid @16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However maximum days to first fruit set (94.43) with T0 (Control). The finding of the present investigation showed that minimum days to first fruit set was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The minimum days to first fruit set in T4 may be due to application of brassinosteroid which stimulates higher ethylene production which in turn causes the plant to induce flowering faster and thereby development of fruit. Similar, results were obtained by Sridhara *et al.,* (2021) [6].

C) Yield Attributes

i) **Number of fruits per plant:** The perusal of the data in (table 3) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on number of fruits per plant of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Maximum number of fruits per plant (104.81) was observed with T4 Brassinosteroid @16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However minimum number of fruits per plant (59.97) with T0 (Control). The finding of the present investigation showed that maximum number of fruits per plant was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The maximum number of fruits per plant in T4 may be due to better translocation of nutrients from source to sink. It might also be due to more number of leaves, increase leaf area which accelerates the photosynthesis process produced at all growth stages. Similar, results were obtained by khatoon *et al.,* (2020); Varduini *et al.,* (2001) [9]; Sridhara *et al.,* (2021) [6].

ii) **Polar and radial diameter with and without husk:** The perusal of the data in (table 3) revealed the significant effect of foliar spray application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on Polar diameter (cm) with and without husk of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Maximum Polar diameter (cm) with and without husk (4.85 and 3.49) was observed with T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However minimum

Polar diameter (cm) with and without husk (3.15 and 2.12) with T0 (Control). The finding of the present investigation showed that maximum Polar diameter (cm) with and without husk was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The maximum Polar diameter (cm) with and without husk in T4 may be due to involvement of brassinosteroid in cell expansion and better uptake of nutrients from source to sink. Similar, finding were obtained by khatoon *et al.,* (2020); Varduini *et al.,* (2001) [9]; (Sridhara *et al.,* 2021) [6]. Maximum radial diameter (cm) with and without husk (4.23 and 3.05) was observed with T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However minimum radial diameter (cm) with and without husk (2.00 and 1.12) with T0 (Control). The finding of the present investigation showed that maximum radial diameter (cm) with and without husk was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The maximum radial diameter (cm) with and without husk in T4 may be due to involvement of brassinosteroid in cell expansion and better uptake of nutrients from source to sink. Similar, results were obtained by khatoon *et al.,* (2020); (Varduini *et al.,* 2001) [9]; (Sridhara *et al.,* 2021) [6].

iii) Fruit weight with and without husk (g): The perusal of the data in (table 3) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on fruit weight (g) with and without husk of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Maximum fruit weight (g) with and without husk (10.29 and 9.89) was observed with T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However minimum fruit weight (g) with and without husk (6.61 and 5.82) with T0 (Control). The finding of the present investigation showed that maximum fruit weight (g) with and without husk was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The maximum fruit weight (g) with and without husk in T4 may be due to involvement of brassinosteroid in cell expansion and better uptake of nutrients from source to sink. Similar, results were obtained by khatoon *et al.,* (2020); Varduini *et al.,* (2001) [9]; Sridhara *et al.,* (2021) [6]

iv) Fruit yield (q ha-1): The perusal of the data in (table 3) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on fruit yield (q ha^{-1}) of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Maximum fruit yield (q ha^{-1}) (54.96) was observed with T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However minimum fruit yield (q ha^{-1}) (25.71) with T0 (Control). The maximum fruit yield (q ha^{-1}) in T4 may be due to the effect of brassinosteroid in improving accumulation of photosynthetic carbon on the sprayed plant. Similar, results were obtained by khatoon *et al.,* (2020); Varduini *et al.,* (2001) [9]; Sridhara *et al.,* (2021) [6].

D) Quality Character

i) Total Soluble Solids (T.S.S.): The perusal of the data in (table 2) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on Soluble Solids (^{0}Brix) of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Maximum Total Soluble Solids (11.79^{0}Brix) was recorded under T4 Brassinosteroid @ 16ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5. However the minimum Total Soluble Solids (8.31^{0}Brix) was recorded with T0 (Control). The finding of the present investigation showed that maximum Total Soluble Solids was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The maximum Total Soluble Solid in T4 may be due to better mobilization of carbohydrates from source to sink. Similar, finding were obtained by khatoon *et al.,* (2020); Varduini *et al.,* (2001) [9]; Sridhara *et al.,* (2021) [6].

ii) Acidity: The perusal of the data in (table 2) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on acidity (%) of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Minimum acidity (0.11%) was recorded under T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5 and then the maximum acidity (0.57%) was recorded with T0 (Control). The finding of the present investigation showed that minimum acidity was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The minimum acidity in T4 may be due to transmute of accumulated organic acid into sugar through metabolic pathways. Similar, reports were obtained by Aiman *et al*., (2014) [11]; Sridhara *et al.,* (2021) [6].

iii) Ascorbic acid: The perusal of the data in (table 2) revealed the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on ascorbic acid of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Maximum Ascorbic acid (48.50) was recorded under T4 Brassinosteroid @ 16ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5 and then the minimum Ascorbic acid (30.08) was recorded with T0 (Control).The finding of the present investigation showed that maximum ascorbic acid was recorded under T4 Brassinosteroid @ 16 ppm followed by T3 Brassinosteroid @ 12 ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The maximum increase in ascorbic acid in T4 may be due to the application of brassinosteroid which reduces the pectin content of a fruit subsequently increasing the ascorbic acid. Similar, finding were obtained by khatoon *et al.,* (2020); Sridhara *et al.,* (2021) [6].

iv) Shelf life: The perusal of the data in (table 2) revealed

the significant effect of foliar application of brassinosteroids @ 4, 8, 12 and 16 ppm and salicylic acid @ 50, 100, 150, 200 and 250 ppm have significant effect on Shelf life (days) of Cape gooseberry (*Physalis peruviana*) as compared to Control (T0). Maximum Shelf life (31.31days) was recorded under T4 Brassinosteroid @ 16 ppm followed by T3, T2, T1, T9, T8, T7, T6, and T5 and then the minimum Shelf life (20.04 days) was recorded with T0 (Control). The finding of the present investigation showed that maximum Shelf life was recorded under T4 Brassinosteroid @ 16ppm followed by T3 Brassinosteroid @ 12ppm was found statistically at par with each other and was significantly superior over rest of the treatment. The maximum shelf life in T4 may be due to regulation of ethylene production with the brassinosteroids application, as ethylene play prime role in fruit ripening and thereby determines the fruit firmness and shelf life; It is in accordance with report of Sridhara *et al*., (2021) [6].

v) **Economics:** Maximum benefit cost ratio was recorded in T4 Brassinosteroid @ 16 ppm (3.66) and the minimum (1.20) was recorded under T0 (Control).

Table 1: Effect of foliar application of brassinosteroids and salicylic acid on growth of Cape gooseberry

Treatments Combination	Plant height(cm)			No. of leaves per plant			Leaf area (cm^2)			No. of branches per plant	
	25 Days	50 Days	75 Days	25 Days	50 Days	75 Days	25 Days	50 Days	75 Days	50 Days	75 Days
T0 Control	22.21	35.11	57.28	6.22	33.69	74.16	18.84	33.40	52.48	4.08	6.86
T1 Brassinosteroid @ 4 ppm	33.47	46.86	81.07	11.92	49.58	98.17	25.66	44.05	71.66	6.36	10.26
T2 Brassinosteroid @ 8 ppm	34.66	47.49	83.41	13.25	50.64	99.18	26.52	45.87	73.11	6.54	11.96
T3 Brassinosteroid @ 12 ppm	35.41	49.65	85.79	15.32	52.82	102.32	27.77	47.11	77.66	6.72	12.82
T4 Brassinosteroid @ 16 ppm	37.80	51.26	87.38	16.07	54.18	105.32	28.28	48.73	77.88	7.32	13.15
T5 Salicylic acid @ 50 ppm	25.37	38.15	69.52	7.48	39.45	82.15	21.70	39.97	63.32	5.41	8.42
T6 Salicylic acid @ 100 ppm	27.44	36.62	74.01	8.96	41.11	84.47	22.74	41.37	64.04	5.62	8.78
T7 Salicylic acid @ 150 ppm	28.81	40.49	76.55	9.86	44.47	87.43	23.77	42.13	65.44	5.87	9.03
T8 Salicylic acid @ 200 ppm	30.67	42.70	77.80	11.02	45.53	90.16	24.34	43.47	67.42	6.15	9.44
T9 Salicylic acid @ 250 ppm	31.00	44.20	80.42	11.74	48.47	92.66	25.02	43.77	68.82	6.33	10.18
F test	S	S	S	S	S	S	S	S	S	S	S
S.Ed(±)	1.601	1.110	1.09	0.807	2.148	2.189	0.25	0.920	0.90	0.33	0.24
CD at 5%	3.363	2.332	2.29	1.696	4.513	4.598	0.53	1.934	1.89	0.69	0.51
CV	6.39	3.14	1.72	8.84	5.72	2.93	1.26	2.62	1.61	6.69	2.93

Table 2: Effect of foliar application of brassinosteroids and salicylic acid on flowering and quality of Cape gooseberry

Treatments Combination	No. of buds per plant	Days to first flowering	No. of flowers per plant	Days to first fruit set	Total Soluble Solids (T.S.S.)	Acidity (%)	Ascorbic Acid	Shelf life (Days)
T0 Control	85.89	68.10	73.89	94.43	8.31	0.57	30.08	20.04
T1 Brassinosteroid @ 4 ppm	112.00	52.31	98.00	75.22	11.35	0.21	42.80	26.92
T2 Brassinosteroid @ 8 ppm	119.02	48.16	103.02	71.38	11.37	0.16	43.91	28.27
T3 Brassinosteroid @ 12 ppm	128.03	45.92	110.91	67.94	11.52	0.14	46.42	30.05
T4 Brassinosteroid @ 16 ppm	133.56	44.07	115.56	66.32	11.79	0.11	48.50	31.31
T5 Salicylic acid @ 50 ppm	101.22	62.92	85.22	85.44	9.38	0.51	33.61	23.62
T6 Salicylic acid @ 100 ppm	105.98	59.48	90.98	82.62	9.59	0.45	35.54	24.19
T7 Salicylic acid @ 150 ppm	108.08	57.73	93.08	79.94	10.41	0.41	36.10	24.51
T8 Salicylic acid @ 200 ppm	108.54	56.85	94.54	78.87	10.64	0.35	38.33	24.59
T9 Salicylic acid @ 250 ppm	110.60	54.24	95.16	76.35	10.75	0.30	40.77	25.47
F test	S	S	S	S	S	S	S	S
S.Ed(±)	2.32	0.89	2.33	0.79	0.170	0.014	1.084	0.61
CD at 5%	4.88	1.86	4.89	1.66	0.358	0.030	2.278	1.29
CV	2.55	1.98	2.97	1.24	1.99	5.453	3.35	2.89

Table 3: Effect of foliar application of brassinosteroids and salicylic acid on yield and Benefit cost ratio of Cape gooseberry

Treatment Combination	No. of fruits per plant	Polar diameter (cm)		Radial diameter (cm)		Fruit weight (g)		Fruit yield (q ha^{-1})	Benefit cost ratio
		With husk	Without husk	With husk	Without husk	With husk	Without husk		
T0 Control	59.97	3.15	2.12	2.00	1.12	6.61	5.82	25.71	1.20
T1 Brassinosteroid @ 4 ppm	87.43	4.19	3.12	3.90	2.68	8.53	7.97	45.91	2.91
T2 Brassinosteroid @ 8 ppm	92.00	4.29	3.25	4.05	2.72	9.57	8.95	48.73	3.15
T3 Brassinosteroid @ 12 ppm	101.01	4.62	3.42	4.11	2.89	10.03	9.73	53.67	3.56
T4 Brassinosteroid @ 16 ppm	104.81	4.85	3.49	4.23	3.05	10.29	9.89	54.96	3.66
T5 Salicylic acid @ 50 ppm	67.85	3.55	2.66	3.07	1.76	7.43	6.99	33.48	1.82
T6 Salicylic acid @ 100 ppm	73.48	3.71	2.81	3.23	1.93	7.76	7.04	36.11	2.00
T7 Salicylic acid @ 150 ppm	77.79	3.77	2.84	3.40	2.11	7.99	7.22	39.27	2.22
T8 Salicylic acid @ 200 ppm	81.60	3.92	2.94	3.41	2.32	8.25	7.87	41.18	2.33
T9 Salicylic acid @ 250 ppm	82.22	4.03	3.03	3.44	2.44	8.36	7.88	45.76	2.66
F test	S	S	S	S	S	S	S	S	
S.Ed(±)	1.61	0.11	0.03	0.06	0.07	0.12	0.08	0.62	
CD at 5%	3.39	0.24	0.07	0.12	0.16	0.26	0.16	1.30	
CV	2.38	3.43	1.40	2.04	3.97	1.80	1.18	1.78	

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Conflict of Interest
As a Corresponding Author, I Ayimtiba Walling, confirm that none of the others have any conflicts of interest associated with this publication.

Conclusion
From the present investigation it is concluded that T4 brassinosteroid @ 16 ppm was found to be the best treatment in respect to plant height, number of leaves, number of branches, leaf area, number of buds, day to first flowering, number of flowers per plant, day to first fruit set, number of fruits per plant, Polar and Radial diameter (cm), fruit weight (g) and fruit yield (q/ha) and quality parameter like T.S.S, acidity, Ascorbic acid and shelf life of Cape gooseberry with a maximum benefit cost ratio of (3.66).

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