International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(4): 2033-2036

Received: 04-05-2018
Accepted: 10-06-2018

Ravi Kumar Singh
Department of Horticulture
Naini Agricultural Institute
Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Vijay Bahadur
Department of Horticulture
Naini Agricultural Institute
Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Arun Patidar
Department of Horticulture
Naini Agricultural Institute
Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Correspondence
Ravi Kumar Singh
Department of Horticulture
Naini Agricultural Institute
Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Effect of plant growth regulators on growth, yield and quality of cape goose berry (*Physalis peruviana* L.)

Ravi Kumar Singh, Vijay Bahadur and Arun Patidar

Abstract
The present experiment was carried out during October 2017 to March 2018 in Departmental Research Field of Department of Horticulture, SHUATS, Allahabad. The experiment was conducted in Randomized Block Design (RBD), with nine treatments, replicated thrice. the treatments were T_0 (Control), T_1 (NAA @ 5 ppm), T_2 (NAA @ 10 ppm), T_3 (NAA @ 15 ppm), T_4 (NAA @ 20 ppm), T_5 (GA_3 @ 10 ppm), T_6 (GA_3 @ 15 ppm), T_7 (GA_3 @ 20 ppm) and T_8 (GA_3 @ 25 ppm). From the present investigation it is found that the Treatment T_4 (NAA @ 20 ppm) and T_8 (GA_3 @ 25 ppm) was found best in terms of number of fruits/plant, average fruit weight (g), Polar and Radial Diameter (cm), and yield q/ha. Treatment T_8 (GA_3 @ 25 ppm) was found to be the best treatment in respect quality parameters like TSS, Carotenoid content, Ascorbic acid (mg/100 g), minimum Acidity % of Cape goose berry fruits. The maximum gross return (Rs. 228160), net return (Rs. 161110) and Benefit cost ratio (1:3.4) was also found in T_8 (GA_3 @ 25 ppm) under agro climatic condition of Allahabad.

Keywords: Cape goose berry, plant growth regulators, NAA and GA_3

Introduction
Cape gooseberry is a minor fruit crop of the world and comes under solanaceae family. It is known by different names in different parts of world like golden berry (South Africa and U.K.), giant ground cherry, Peruvian ground cherry and Peruvian cherry (U.S.), poha (Hawaii), jam fruit (India), uvilla (Ecuador) and uchuva (Colombia). It is a quick growing herbaceous crop easily propagated by seeds and cuttings. Cape gooseberry has a wide adaptability to different soil types and climatic conditions. It is basically a warm season crop and requires relatively long season to produce profitable yields. It can be cultivated in tropical, sub tropical and temperate region also.

In India as the climatic and soil conditions Punjab are suitable for this crop, its cultivation can be of great economic potential if adapted on scientific lines. These include chemical sprays particularly of plant growth regulators which influence the growth of plant and its part greatly.

Plant growth regulators are the chemical substances which when applied in small amounts modify the growth of plants usually by stimulating part of natural growth regulatory system. The growth regulators include both growth promoters and retardants which modify the canopy structure and other yield attributes. Among growth regulators, Gibberellic acid plays a vital role in the development of morphological characters of plants and their fruits. The application of gibberllins along auxins (naphthalene acetic acid) are known to influence the seed germination, plant growth, development, flowering and fruit characters.Gibberellic acid delays the senescence of fruits. Naphthalene acetic acidreduces the fruit drop and increases the number of fruits to be set (Alam and Khan, 2002) [1].

Though plant growth regulators have great potential to influence plant growth morphogenesis but its application have to be judiciously planned in terms of optimal concentration, which constitute the major impediments in plant growth regulators applicability. Since very little information is available in the effect of growth regulators on growth and yield of cape gooseberry, the present investigation was aimed to find out suitable growth regulators for increasing the yield potential and also quality in cape gooseberry.

Materials and Methods

The details of the various materials used and methods adopted in laid out the experiment are presented below:

Experimental Site

The area of Allahabad district comes under subtropical belt in the South East of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46 ºC – 48 ºC and seldom falls as low as 4 ºC – 5 ºC. The relative humidity ranged between 20 – 94 percent. The average rainfall in this area is around 1013.4mm annually. However, occasional precipitation is also not uncommon during winter months.

The experiment was carried out at the Departmental Research Field of Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad. The experiment was conducted in Randomized Block Design having 9 treatments with three replications. The allocation of treatments of the individual plots using random number in each replication.

Results and Discussion

The present was carried out during October, 2017 to March, 2018 in Departmental Research Field of Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (U.P.) India. The results of the present investigation, regarding the effect of Plant growth regulators on growth, Yield and Quality of Cape Goose Berry, have been discussed and interpreted in the light of previous research work done in India and abroad.

Growth Parameters

Influence of plant growth regulators, under study on vegetative growth under different treatments is described below.

In respect of Plant height (cm) after 25 days of transplanting the treatment T_1 (NAA @ 5 ppm) recorded maximum plant height (19.83 cm) followed by T_4 (NAA @ 20 ppm) with (18.83 cm). The minimum plant height (13.50 cm) was recorded in treatment T_0 (Control). After 45 days of transplanting the highest plant height (42.17 cm) was observed in T_4 followed by T_3 (38.83 cm). The minimum plant height (28.83 cm) was observed in Control. At 65 days after transplanting significantly the highest plant height (79.83 cm) was found in T_4 followed by T_3 (77.83 cm). The minimum plant height (49.50 cm) was found in Control. Treatment T_4 (NAA@ 20 ppm) was found superior over other treatment combinations The possible reason for increased plant height with the foliar application of NAA may be due to promotion of cell elongation. Increasing concentration of NAA resulted as increased plant height. Similar result was given by Kaur *et al.* (2010) on cape goose berry.

Number of leaves/ Plant At 25 days after transplanting the maximum number of leaves (11.50) was observed in T_2 followed by T_4 (11.50). The minimum number of leaves (8.17) was observed in Control. At 45 days after transplanting the maximum number of leaves (22.17) was recorded in T_8 followed by Control (21.33). The minimum number of leaves (18.67) was recorded in T_1. At 65 days after transplanting significantly the maximum number of leaves (55) was observed in T_7 followed by T_4 (54.83). The minimum number of leaves (33.33) was observed in Control. Similar findings were also reported by Bhosle *et al.* (2002) [3] and Kar *et al.* (1993) [8] on tomato crop.

In terms of Leaf Area (cm^2) at 25 days after transplanting the maximum leaf area (14.33 cm^2) was observed in T_6 followed by T_3 (14.33 cm^2). The minimum leaf area (11 cm^2) was observed in Control. At 45 days after transplanting the maximum leaf area (26.33 cm^2) was recorded in T_8 followed by T_2 (25.33 cm^2). The minimum leaf area (19.67 cm^2) was recorded in T_3. At 65 days after transplanting significantly the maximum leaf area (61 cm^2) was observed in T_8 followed by T_4 (58 cm^2). The minimum leaf area (36 cm^2) was observed in Control. The possible reason for increased leaf area with the foliar application of GA_3 may be due to promotion of cell elongation and higher photosynthetic rate. Similar result was given by Kaur *et al.* (2010) on tomato crop.

Significantly the maximum number of branches (4.00) was observed in T_7 and T_6 followed by T_5 with (3.83) number of branches at 45 days after transplanting. The minimum number of branches (1.5) was observed in Control. At 65 days after transplanting significantly the maximum number of branches (8) was recorded in T_8 followed by T_5 and T_7 with (7.50) number of branches. The minimum number of branches (3.23) was recorded in Control. The maximum number of branches was observed in treatments of GA_3 the possible reason for increased number of branches with the foliar application of GA_3 may be due to anti mitotic action which provided an inhibitory effect on the suppression of the apical growth of main axis. Similar reports were given by Tiwari and Singh (2014) [7, 21] and Prasad *et al* (2013) [12] on tomato crop.

Yield Parameters

Significantly maximum number of fruit/plant was observed in treatment T_4 (NAA @ 20 ppm) followed by treatment T_8 (GA_3 @ 25 ppm) and T_3 (NAA@ 15 ppm) as compared to other treatments. And minimum number of fruits was found in (Control). An increase in fruit number is generally related with total number of flowers and fruit set. Auxin influenced both the number of flowers and percentage of fruit set. Another reason for more number of fruits might be due to the stimulation in anabolic activities and enhanced vegetative growth particularly branching habit. The similar agreement was given by Kaur *et al*. (2010) on Cape goose berry.

The maximum average fruit weight (6.2 g) was observed in treatment T_8 followed by treatment T_6 with (6 g). The minimum average fruit weight (4.4 g) was observed in Control.

The increase in average fruit weight is due to the beneficial effect of GA_3. The similar agreement was given by Kaur *et al*. (2010) on Cape goose berry.

The maximum polar diameter (cm) of fruit (2.4 cm) was observed in treatment T_5 followed by treatment T_4 with (2.30 cm) Polar diameter. The minimum polar diameter of fruit (1.2cm) was observed in Control. Larger size of fruits was due to an increase in cell division and cell elongation and also due to enhanced metabolic activities under the influence of chemical stimuli. It might be due to the enlargement of ovary by hormone application. The quantity of auxin available to the ovary might be the solitary cause of fruit development. Similar reports were given by Bhosle *et al.* (2002) [3] and Kar *et al.* (1993) [8] on tomato crop.

The maximum radial diameter of fruit (2.2 cm) was observed in T_4 followed by T_5 (2.10), T_2 (1.80 cm), T_1 (1.80 cm), T_8 (1.60 cm), T_3 (1.60 cm), T_6 (1.60 cm) and T_7 (1.50 cm). The minimum radial diameter of fruit (1.3 cm) was observed in Control.

The maximum radial diameter (cm) was recorded under treatment T_4 (NAA@ 20 ppm) followed by T_5 (GA_3 @ 10

ppm) and T_2 (NAA@10 ppm) as compared to other treatments. However, it was observed lowest in (Control). Larger radial diameter of fruits was due to an increase in cell division and cell elongation and also due to enhanced metabolic activities under the influence of chemical stimuli. It might be due to the enlargement of ovary by hormone application. The quantity of auxin available to the ovary might be the solitary cause of fruit development. Similar reports were given by Bhosle *et al.* (2002) [3] and Kar *et al.* (1993) [8] on tomato crop.

The maximum yield (57 q/ha) was observed in treatment T_8 (GA_3@25 ppm) followed by treatment T_4 (NAA @ 20 ppm) with (53.88 q/ha) yield. The minimum yield (27.95 q/ha) was observed in Control. Possible reason for maximum yield was due to an increase in number of fruit and average fruit weight and also due to enhanced fruit size under the influence of chemical stimuli. It might be due to the enlargement of ovary by hormone application.

Quality Parameter

The maximum Total Soluble Solid (^{0}Brix) (12.57 ^{0}B) was significantly recorded in treatment T_8 followed by T_6 with (11.67 ^{0}B) TSS. The minimum total soluble solid value (7.10^{0}B) was observed in Control. Similar findings were also reported by Kaur *et al.* (2010) on Cape goose berry.

The maximum carotenoid value (1.65 mg) was significantly noticed in T_8 followed by T_7 (1.51 mg). The minimum carotenoid value (0.99 mg) was noticed in Control. Similar findings were also reported by Kar *et al.* (2003) [8] on Cape goose berry.

Significantly maximum ascorbic acid value (52.97 mg) was recorded in treatment T_8 followed by T_7 with (43.30 mg). The minimum ascorbic acid value (19.53 mg) was recorded in Control. Possible reason for increase in Ascorbic acid content was due to foliar spray of GA_3 which reduced the sugar and pectin level of fruit. Increasing concentration of GA_3 resulted as increased leval of ascorbic acid. Similar report was given by Kaur *et al.* (2010) on Cape goose berry.

Significantly the minimum acidity % (0.11%) was observed in treatment T_8 (GA_3 @ 25 ppm) followed by treatment T_7 (GA_3 @ 20 ppm) with (0.15%) acidity and the maximum acidity % (0.54%) was observed in Treatment T_0 (Control). Since GA_3 affect in chemical parameter of fruit therefore the minimum acidity value was recorded in T_8 (GA_3 @ 25ppm) and T_7 (GA_3 @ 20 ppm). Possible reason might be due to foliar spray of GA_3 which reduced the sugar content of fruit and increased the acidity value of fruit. Similar report was given by Kaur *et al.* (2010) on Cape goose berry.

Econimics

The maximum Gross return (Rs. 228160), Net return (Rs. 161110) and Benefit cost ratio (1:3.4) is recorded in T_8 followed by T_4 (Rs. 215600, Rs. 148530 and 1:3.21) Gross return, Net Return and Benefit Cost Ratio. The minimum Gross return, Net return and Benefit Cost ratio was recorded in Control.

Table 1: Effect of plant growth regulators on Plant height (cm), Number of Leaves/plant, Leaf area (cm^2) and Number of Branches/Plant of Cape Goose Berry

Treatment Symbol	Treatments Combination	Plant height (cm)			Number of leaves/plant			Leaf area (cm^2)			Number of Branches/Plant	
		25 Days	45 Days	65 Days	25 Days	45 Days	65 Days	25 Days	45 Days	65 Days	45 Days	65 Days
T_0	Control (spray of water)	13.50	28.83	49.50	8.17	21.33	33.33	11.00	21.33	36.00	1.50	3.23
T_1	NAA @ 5 ppm	19.83	32.67	63.67	9.00	18.67	39.83	12.67	24.00	39.33	2.83	6.00
T_2	NAA @ 10 ppm	18.67	35.83	73.00	11.50	18.67	50.50	12.67	25.33	40.00	2.67	6.83
T_3	NAA @ 15 ppm	16.17	38.83	77.83	10.50	20.17	48.83	14.33	19.67	47.00	3.00	6.17
T_4	NAA @ 20 ppm	18.83	42.17	79.83	11.50	21.00	54.83	13.67	23.67	58.00	3.67	6.50
T_5	GA_3 @ 10 ppm	15.50	33.67	71.50	9.50	19.67	53.33	12.33	25.00	43.00	3.83	7.50
T_6	GA_3 @ 15 ppm	18.33	33.00	65.00	9.17	19.33	53.33	14.33	23.33	51.00	4.00	6.50
T_7	GA_3 @ 20 ppm	15.50	32.17	71.33	8.83	21.00	55.00	13.67	24.67	49.00	4.00	7.50
T_8	GA_3 @ 25 ppm	17.17	33.67	64.33	9.00	22.17	48.83	14.00	26.33	61.00	3.67	8.00
F-test		NS	NS	S	NS	NS	S	NS	NS	S	S	NS
S.Ed.		3.02	4.01	6.93	1.81	2.53	3.44	1.66	3.15	2.04	0.46	1.07
C.D. at 5%		6.40	8.50	14.70	3.84	5.37	7.29	3.53	6.68	4.33	0.97	2.28

Table 2: Effect of plant growth regulators on No. of Fruits/plant, Avg. Fruit weight (g), Polar and Radical diameter (cm), Yield q/ha, Carotenoid (mg), Ascorbic Acid (mg/100 g), Acidity (%) and Benefit Cost Ratio of Cape Goose Berry

Treatment Symbol	Treatments Combination	No. of fruits/plant	Average of fruit weight (g)	Polar diameter (cm)	Radical diameter (cm)	Yield (q/ha)	TSS (^{o}Brix)	Carotenoid (mg)	Ascorbic Acid (mg/100 g)	Acidity (%)	Benefit Cost Ratio
T_0	Control (spray of water)	65.00	4.40	1.20	1.30	27.95	7.10	0.99	19.53	0.54	1.73
T_1	NAA @ 5 ppm	78.00	5.00	1.80	1.80	39.02	9.70	1.21	23.67	0.36	2.32
T_2	NAA @ 10 ppm	67.00	5.10	2.00	1.80	34.18	8.87	1.13	25.00	0.45	2.03
T_3	NAA @ 15 ppm	85.00	4.80	2.10	1.60	40.82	10.06	1.44	24.10	0.18	2.43
T_4	NAA @ 20 ppm	98.00	5.50	2.30	2.20	53.88	10.50	1.36	38.50	0.25	3.21
T_5	GA_3 @ 10 ppm	68.00	5.90	2.40	2.10	40.14	10.90	1.40	26.89	0.17	2.39
T_6	GA_3 @ 15 ppm	82.00	6.00	1.60	1.60	49.15	11.67	1.28	36.05	0.21	2.933
T_7	GA_3 @ 20 ppm	80.00	5.80	2.00	1.50	46.33	10.00	1.51	43.30	0.15	2.76
T_8	GA_3 @ 25 ppm	92.00	6.20	2.20	1.60	57.03	12.57	1.65	52.97	0.11	3.401
F-test		S	NS	S	S	S	S	S	S	S	
S.Ed.		4.84	0.69	0.15	0.13	0.31	0.71	0.09	2.25	0.02	
C.D. at 5%		10.27	1.45	0.33	0.28	0.65	1.50	0.20	4.78	0.04	

Conclusion

From the present investigation it is concluded that the Treatment T_4 (NAA @ 20 ppm) was found best in terms of growth and yield parameters like, number of fruits/plant, average fruit weight (g), Polar and Radial Diameter (cm), and yield q/ha. Treatment T_8 (GA_3 @ 25 ppm) was found to be the best treatment in respect of quality parameters like TSS, Carotenoid content, Ascorbic acid (mg/100 g), minimum Acidity % of Cape goose berry fruits. The maximum gross return (Rs.228160), net return (Rs.161110) and Benefit cost ratio (1:3.4) was also found in T_8 (GA_3 @ 25 ppm) under agro climatic condition of Allahabad.

References

1. Alam SM, Khan MA. Fruit yield of tomato as affected by NAA spray, Asian Journal of plant Science. 2002; 1:24.
2. Bakrim A, Lamhamdi M, Sayah F, Chibi F. Effects of plant hormones an 20-hydroxyecdysone on tomato (*Lycopersiconesculentum*) seed germination an seedlings growth. African Journal of Biotechnology. 2007; 6:2792-2802.
3. Bhosle AB, Khorbhade SB, Sanap PB, Gorad MJ. Effect of plant hormones on growth and yield of summer tomato. (*Lycopersicon esculentum* Mill.). Orissa Journal of Horticulture. 2002; 30(2):63-65
4. David OW, Wamocha LS, Nagamau K, Sonkko RN. Effect of gibberellicacid on growth and fruit yield of cape goose berry. African Crop Science journal. 2002; 14(4):319 323.
5. Fidelibus M, Vasquez S. Effect of GA3 on grapes University of California.
6. Kaur G, Kaur P, Singh B, Singh S. effect of plant growth regulators on fruit quality of cape goose berry Department Of Horticulture, Faculty Of Agriculture And Forestry, Khalsa College, Amritsar (Punjab). 2013; 9(2):633-635.
7. Tiwari AK, Singh DK. use of plant growth regularors on tomato GB Pantuniversity uttarakhand. 2014; 27(2):38-40.
8. Kar PL, Longkumar M, Sanyal D. Effect of plant growth regulators and their methods of application on growth, flowering and yield in tomato (*Lycopersicon esculentum* Mill) cv. Pusa Early Dwarf. Horticultural Journal. 1993; 6(1):45-49.
9. Kumar A, Biswas TK, Singh N, Lal EP. Effect of gibberelic acid on tomato Department of Biological Sciences Sam Higginbottom Institute of Agriculture and Technology and Sciences Allahabad, Uttar Pradesh, 2014, 28-30.
10. Lakshmanan V, Azhakimanavalan RS, Kumar MV, Jeevanjothi L, Rajagopalan R. Grape yield and quality as influenced by gibberellic acid. South Indian Horticulture. 1992; 40(3):175-178.
11. Meena RS. Effect of GA3 and NAA on growth, yield and quality of tomato (Lycopersiconesculentum Mill.) cv. Pusa Ruby grown under semi-arid conditions. Current Agriculture. 2008; 32(1, 2):83-86.
12. Prasad RN, Singh SK, Yadava RB, Chaurasia SNS. Effect of GA3 and NAA on growth and yield of tomato. *Vegetable Science*. 2013; 40(2):195-197.
13. Pundir JPS, Yadav PK. Note on effect of GA3, NAA and 2,4-D on growth, yield and quality of tomato var. Punjab Chhuhara. Current Agriculture. 2001; 25(1, 2):137-138.
14. Rahman M, Haque A, Mostofa MG. Effect of GA3 on Biochemical attributes and Yield of Summer Tomato. Journal of Bioscience and Agriculture Research. 2015; 03(02):73-78.
15. Rezende BLA, Ayub RA. Gibberellic acid contribution to tomato fruit size. [Portuguese], Biotemas; 2010; 23(4):25-28. 17 ref.
16. Saha P, Das N, Deb P, Suresh CP. Effect of NAA and GA3 on yield and quality of tomato *(Lycopersicon esculentum* Mill.). Environment and Ecology. 2009; 27(3):1048-1050.
17. Saleem BA, Malik AU, Pervez MA, Khan AS, Khan MN. Spring application of growth regulators affects fruit quality of Blood Red sweet orange. Pak. J. Bot. 2008; 40(3):1013-1023.
18. Singh DK, Lal G. Effect of plant bio-regulators on the growth and yield of tomato (*Lycopersicon esculentum* Mill.). Progressive Horticulture. 2001; 33(1):6164.
19. Subbiah BV, Asija GL. A rapid procedure for the determination of available nitrogen in soils. Current Science. 1956; 25:259-260.
20. Sumiati E. Effect of plant growth regulators on flowering and yield of tomatoes in the Lembang Highlands. Bull. Pene. Hortic. 1987; 15(1):134-143.
21. Tiwari AK, Singh DK. use of plant growth regularors on tomato GB Pant university uttarakhand. 2014; 27(2):38-40.
22. Yadav PK, Pundir JPS. Effect of GA3, NAA and 2, 4-D on growth, yield and quality of tomato var. Punjab Chhuhara, Current Agriculture. 2001; 25(1, 2):137-138.