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Effect of application of chemicals on qualitative characters of cape-gooseberry

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Abstract
The present study was conducted in the Department of Horticulture (Fruit) at Bihar Agricultural College, Sabour, Bhagalpur (Bihar). This study was done to see the effect of Nitrogen & growth regulators (Gibberellic acid and Ethrel) on the qualitative characters of Cape-gooseberry (Physalis peruviana Linn.). Nitrogen and Two important plant growth substances viz; Ethelene and Gibberellic acid (GA) in different concentrations were utilized for studying their effect on improving the quality of Cape-gooseberry. The experimental plot for the study was statistically laid-out in the field adopting randomized block design with 7 treatments replicated thrice. There were altogether 21 plots with treatments as T1- Urea 1.0%, T2- Urea 1.5%, T3- GA3 20 ppm, T4- GA3 30 ppm, T5- Ethrel 200 ppm, T6- Ethrel 250 ppm and T7- Control (Water spray). The seedlings were transplanted with row to row and plant to plant distance of 60 x 60 cm. Some additional seedlings were also transplanted in each plot for filling the gaps which arouse due to mortality of some seedlings and daily irrigation was provided till establishment. The study revealed that T.S.S. of fruit was found more with all treatments when compared to water spray. Maximum T.S.S. (14.98 °Brix) was recorded with GA3 30 ppm, which was statistically at par with GA3 20 ppm. The minimum fruit acidity (1.112%) was recorded with GA3 30 ppm spray which was statistically at par with Ethrel 250 ppm and Ethrel 200 ppm. Reducing sugar was more with all treatments when compared to water spray. The maximum reducing sugar (4.70%) was recorded with Ethrel 250 ppm which was statistically at par with Ethrel 200 ppm and Urea 1 per cent. Total sugar percentage was found more with all treatments when compared to control. The maximum total sugar percentage (8.62%) was found with Ethrel 200 ppm which was statistically at par with Urea 1 per cent, Ethrel 250 ppm, GA3 30 ppm GA3 20 ppm and Urea 1.5 per cent.

Keywords: Nitrogen, Gibberellic acid, Ethrel, cape-gooseberry and Quality

Introduction
Physalis peruviana, a plant species of the genus *Physalis*, has its origin in the present day region of Chile and Peru. The plant and its fruit are commonly called Cape gooseberry, golden berry or physalis, among numerous regional names. The cape-gooseberry is native to Brazil but long ago became naturalized in the highlands of Peru and Chile and became identified with the region. It was being grown in England in 1774 and was cultivated by early settlers at the Cape of Good Hope before 1807. Soon after introduction to the Cape the plant was carried to Australia where it quickly spread into the wild. Seeds were taken to Hawaii before 1825 and the plant is naturalized on all the islands at medium and somewhat higher altitudes. Only in fairly recent times has the fruit received any attention in the continental U.S. Out of all species, only three species are well known for their fruit values. The recognized eatable fruit bearing species are comprised of Physalis peruviana L; P. pubescens L. and Physalis ixocarpa Brot. Among these, the Physalis peruviana is considered to be the best with respect to taste, precocity and yield (Gupta and Roy, 1980).The plants are frost tender and are killed at temperatures of about 30° F. In much of California the cape gooseberry is best grown as an annual, but will persist for several years in frost-free areas of southern California. Some California growers have grown seedling materials under glass during the fall and winter and set out in early spring to gain the advantage of the longest possible growing season. The plants are easily grown in pots and adapt well to greenhouse culture. It is more commonly known as *Rasbhari* in India which is a small orange berry fruit. They are usually grown in warm regions like South Africa, South America, Central America, India and China. It is one of the important minor fruit and is highly nutritious with good source of vitamins and minerals. The Indian name Rasbhari, Makoi or Tepari resembles to the other crops of the same family Solanaceae to tomato, brinjal, chilli and the potato in its cultural requirements (Khan and Lowder, 1955). In India, Cape gooseberry grown ‘throughout the plains and hills. Recently this crop has assumed much importance and cultivated in large area in South Bihar and in

limited area in Chotanagpur. The yield of this crop is very poor in Bihar due to poor soil nutrients, no definite fertilizer and PGR recommendation, poor technical know-how and poor post-harvest technology. Among these, the application of balanced nutrition is most important without which the quality of fruits could not be enhanced. Thus, the application of nitrogen and use of growth regulators are the prime necessities for obtaining good quality fruits and better performance of the crop. Information regarding the application of nitrogen and growth regulators on quality of cape-gooseberry fruit is still very meager. Therefore, it became imperative to determine optimum dose of nitrogen and to find out the exact strength of PGR for better quality of Cape-gooseberry.

Material and Methods

The present study was done in the Department of Horticulture (Fruit) at Bihar Agricultural College, Sabour, Bhagalpur (Bihar) to study the effect of Nitrogen & growth regulators (Gibberellic acid and Ethrel) on the yield of Cape-gooseberry (Physalis peruviana Linn.). This area is characterized by hot and desiccating summer, moderate rainfall and cool winter, thus the climate is tropical to subtropical of slightly semi-arid nature. January is usually the coldest month when the temperature normally falls as low as 8.1 °C. April and May are the hottest months with an average maximum temperature of 36.0 °C. The soil was sandy loam of good fertility and well drained sub-soil. The pH of the soil was 7.0. It clearly shows that prevailing environmental amplitudes was quite congenial for optimal growth and development under the existing soil for raising cape-gooseberry based cropping system. Seeds were procured from Horticultural garden, Sabour. Raised nursery beds (2 m x 1 m) were prepared. The soil was pulverized well and supplied with sufficient quantities of well rotten compost. Seeds were sown. After sowing, seeds were covered with a fine mixture of soil and leaf mould, lightly pressed and the beds were covered with straw for ensuring maximum germination. The straw was removed after sprouting of seeds. Two important plant growth substances viz; Ethelene and Gibberellic acid (GA) in different concentrations were utilized for studying their effect on yield. A few drops of alcohol were used for dissolving these chemicals in the process of preparing their solutions for spraying.The experimental plot was statistically laid-out in the field adopting randomized block design with 7 treatments replicated thrice. There were altogether 21 plots with treatments as T1 Urea 1.0%, T2 Urea 1.5%, T3 GA3 20 ppm, T4 GA3 30 ppm, T5 Ethrel 200 ppm, T6 Ethrel 250 ppm and T7 Control (Water spray). The seedlings were transplanted with row to row and plant to plant distance of 60 x 60 cm. Some additional seedlings were also transplanted in each plot for filling the gaps which arouse due to mortality of some seedlings and daily irrigation was provided till establishment.

Preparation of plant growth regulators

Aqueous solution of plant growth substances and urea was prepared with required quantity of chemicals in order to apply their different concentrations each time prior to spraying. For GA3 solutions, 20 mg & 30 mg of the chemical was carefully weighed with the help of a sensitive chemical balance. It was dissolved in a small quantity of alcohol and diluted to 1000 ml by adding distilled water with constant stirring in a measuring flask. This gave the stock solution of 20 ppm and 30 ppm GA3. Similarly, the stock solution 200 and 250 ppm of ethrel. Desired concentrations for all the plant growth substances were prepared by further addition of water at k the time of spraying.

Methods and time of application

Aqueous solution of plant growth substances and urea were sprayed with the help of Ganesh Hand Sprayer. First spraying was done on after 30 days of planting. The second and third spraying was done at an interval of 15 days after first and second spraying respectively. The spraying of plant growth substances was done in the afternoon (3 pm) having low light intensity and medium temperature which was free from prolonged effect of days light.

Results and Discussions

1. T.S.S. of fruit (°Brix)

The total soluble solids (TSS) content of fruit in different treatments was estimated by hand refractometer. The data has been furnished in Table-1,

On a scrutiny of the data in table-1, it appears that the application of nitro e GA3 and ethrel on an average was effective in enhancing the TSS of the fruit over control.

Table 1: Total soluble solids (o Brix)

Treatments	Replications			Total	Mean
	I	II	III		
T1	13.50	13.77	13.29	40.56	13.52
T2	13.89	14.15	14.50	42.54	14.18
T3	14.95	14.15	14.55	43.65	14.55
T4	14.90	15.20	14.85	44.94	14.98
T5	13.55	13.95	14.35	41.85	13.95
T6	14.55	13.49	14.05	42.09	14.03
T7	13.35	13.70	12.94	39.99	13.33
Mean	98.69	98.41	98.52	295.62	
C.D at 5%	0.7015			C.V.%= 2.80	

The table reveals that among the different treatments, GA3 30 ppm proved to be the best treatment in increasing the TSS of the fruit. The maximum TSS (14.98 °Brix) was found with treatment T4 (GA3 30 ppm) which was statistically at par with T3 (GA3 20 ppm), However, the minimum TSS was found under Control (T7), which was followed, by T1 (Urea 1.0%), T5 (Ethrel 200 ppm) and T6 (Ethrel 250 ppm). It was observed from the analysis of variance table that treatment differences were significant. The maximum increase in TSS was recorded under GA3 treatment. Similar observation was earlier recorded where higher sugar content in fruits was obtained from plants treated with 10 ppm GA3. Increase TSS content is mostly due to increase in sugar content, which intern depends upon conversion of starch on hydrolysis. The PGR might have accelerated the conversion of starch into simple sugar. Moneruzzaman, K.M. *et al*. (2011) found that the application of GA_3 at 50 ppm increased the total soluble solids content in the fruits by 112

Percent compared with the control treatment. According to Rohit, S. (2014) Urea spray upto 6% recorded significantly higher TSS (20.25^o Brix).

2. Fruit acidity

The percentage of acid content in the fruit was estimated to record the acidity of the fruit. The data has been presented in Table-2, it was evident from the data that acidity of fruits was influenced with the application of plant growth regulators as well as nitrogen.

Table 2: Fruit acidity

Treatments	Replications			Total	Mean
	I	II	III		
T1	1.265	1.295	1.247	3.807	1.269
T2	1.334	1.350	1.375	4.059	1.353
T3	1.245	1.188	1.215	3.648	1.216
T4	1.116	1.105	1.115	3.336	1.112
T5	1.122	1.140	1.170	3.432	1.144
T6	1.150	1.113	1.130	3.393	1.31
T7	1.222	1.251	1.238	3.711	1.237
Mean	8.461	8.488	8.437	104.37	
C.D at 5%	0.0458			C.V.%= 2.13	

On a scrutiny of the data in table-2, it is apparent that the minimum acidity (1.112% was observed under T4 (GA3 250 ppm) which is at par with T6 (Ethrel 250) PPm) and T5 (Ethrel 200 ppm). However, the maximum acidity (1.353%) was found with treatment T2 (Urea 1.5%).

It was observed from the analysis of variance table that treatment differences were highly significant.GA3 (20, pm) and Ethrel were found to decrease the acidity of fruit. Maximum decrease in acidity was caused by GA3 spray. The acids under the influence of chemicals might have either been acid by GA3 or might be used in respiration or both.

3. Reducing sugar

Data with respect to the reducing sugar present in the fruit as influenced by different treatments have been presented in Table-3

Table 3: Reducing sugar in fruit (%)

Treatments	Replications			Total	Mean
	I	II	III		
T1	4.79	4.48	5.07	14.34	4.78
T2	4.43	4.50	4.60	13.53	4.51
T3	4.60	4.46	4.50	13.56	4.52
T4	4.45	4.50	4.61	13.56	4.52
T5	4.85	4.68	4.75	14.28	4.76
T6	4.80	4.90	4.67	14.37	7.79
T7	4.39	4.31	4.38	13.08	4.36
Mean	32.16	32.27	32.29	96.72	
C.D at 5%	0.1726			C.V.%= 2.11	

The table shows that among the treatments, Ethrel 250 ppm proved to be the best treatment in increasing the Reducing sugar. The highest reducing sugar (4.79%) was observed under Ethrel 250 ppm which was at par with T1 (Urea 1.0%) and T5 (Ethrel 200 ppm). Whereas lowest reducing sugar was recorded under treatment T7 (Water spray).Whereas lowest reducing sugar was recorded under treatment T7 (Water spray). It was observed from the analysis of variance table that the treatment differences were highly significant.

4. Total sugar

Total sugar content of the fruit was calculated as influenced by different treatments and has been presented in Table-4

Table 4: Total sugar (Per cent)

Treatments	Replications			Total	Mean
	I	II	III		
T1	8.67	8.59	8.60	25.86	8.62
T2	8.52	8.59	8.67	25.78	8.59
T3	8.68	8.50	8.59	25.77	8.59
T4	8.59	8.67	8.50	25.76	8.59
T5	8.52	8.62	8.71	25.85	8.62
T6	8.68	8.52	8.60	25.80	8.60
T7	8.34	8.41	8.36	25.11	8.37
Mean	59.98	60.05	59.88	179.91	
C.D at 5%	7.8272			C.V.%= 1.03	

A perusal of the data indicated that the maximum total sugar content was observed under T5 (Ethrel 200 ppm) and T1 (Urea 1.0%) which was statistically at par with T6 (Ethrel 250 ppm), T4 (GA3 30 ppm), T3 (GA3 20 ppm) and T2 (Urea 1.5%). Whereas the minimum total sugar content was found under treatment T7 (Water spray). It was observed from the analysis of variance table that the treatment differences were statistically significant.Banerjee, S. and Basu, P. S. (1992) found that both growth regulators GA3 and Ethrel improved the quality of the*Momordica* fruit by increasing the content of total sugar of the fruit.Moneruzzaman, K.M. *et. al*. (2011) found that the application of GA_3 at 50 ppm increased the total sugar content in the fruits by 97 percent compared with the control treatment.

Conclusions

From the above facts could be concluded that the application of optimum dose of nitrogen and two PGRs i.e gibberellic acid and Ethrel may be regarded as the best chemicals for taking maximum T.S.S., minimum acidity. Ethrel 250 ppm was found more effective in increasing the reducing sugar and total sugar in fruits, hence, improving the quality of fruits and ultimately increasing the income of the farmers.

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