

Improvement of yield and fruit quality attributes through organic and inorganic fertilizers in cape-gooseberry (*Physalis peruviana* L.) cv. Aligarh

Abstract

An investigation was undertaken during 2015-16 in the trial field of Department of Horticulture, Khalsa College, Amritsar (Punjab) to study the effect of integrated nutrient management on the yield and quality of fruits in Cape gooseberry cv. 'Aligarh'. Treatments consisted of application of inorganic fertilizers alone and in combination with bio fertilizers and FYM. The experiment was laid out in Randomized Block Design with seven treatments replicated four times. Results of the study revealed that the seedlings treated with 75% NPK + 1.25 t/acre FYM proved to be the best in terms of plant height, shoot length, juice percentage, while maximum yield was recorded with the treatment of 50% NPK + 0.7t/a FYM+ bio fertilizers.

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Amarjeet Kaur, Maninder Singh

Department of Horticulture, Agriculture and Forestry, Khalsa College, India

Correspondence: Amarjeet Kaur, Department of Horticulture, Agriculture and Forestry, Khalsa College, Amritsar- 143001, India, Email dr.amarjitkaur30@gmail.com**Received:** January 26, 2017 | **Published:** February 07, 2019

Introduction

Cape gooseberry (*Physalis peruviana* L.) is an important tropical fruit crop under minor fruit category of India. It is known by different names like golden berry (South Africa and UK), giant ground cherry, peruvian golden cherry (US), poha (Hawaii), jam fruit (India) and uchuva (Colombia). It belongs to family Solanaceae¹ and it is a potential underutilized fruit crop which is grown as perennial in tropics and as an annual in temperate and subtropical regions of the world (Morton 1987). It is native to tropical highlands in Peru and Chile in South America. The name of cape gooseberry was derived from Cape of Good Hope in South Africa,² where it is commercially grown. It is widely grown in Australia, New Zealand, United States, Mexico, India, Sri Lanka, United Kingdom, China, South Africa, Kenya, Egypt, Caribbean, California and Hawaii. In China, India and Malaya, it is commonly grown but on a lesser scale. In spite of numerous beneficial aspects of Cape gooseberry it is restricted to limited area in our country. Thus there is a great scope to increase production and productivity of Cape gooseberry. For getting higher yields and quality produce, soil health is a critical factor. In recent days, consumers are becoming more and more health conscious and are ready to pay more prices for organically grown quality fruits, due to its taste, appearance, more shelf life and richness in nutritive parameters. Bio fertilizers are natural fertilizers containing carried based micro-organisms which help to enhance productivity by biological nitrogen fixation, producing vitamins and other growth factor required for plant growth.³ The growers also have realized the importance of the same as the cost of chemical fertilizers is increasing day by day. Hence, keeping these views in mind and to know if the quantum of inorganic fertilizers can be substituted with organic manures and/or bio fertilizers, without reducing the yield and deteriorating the quality of fruits.⁴ Therefore, chemical fertilizers must be integrated with organic fertilizers such as FYM and bio fertilizers. Hence, the present investigation was carried out to study the integrated effect of chemical fertilizers in combination with organic manures and bio fertilizers on growth and quality parameters of Cape gooseberry.

Materials and methods

The present investigation was carried out at an experimental

orchard and laboratory of Department of Horticulture, Khalsa College, Amritsar during 2015-16. For raising a nursery, seeds of Cape gooseberry genotype 'Aligarh' were sown on 15 June 2015 in raised nursery beds measuring 1m x 1m. Seedlings were transplanted a month after sowing i.e., in mid July (when these attained a height of 20cm) in well-prepared field beds measuring 4m x 2m. Plant-to-plant and row-to-row spacing was 1m x 1m. The experiment was laid out in Randomized Block Design. The experiment consisted of 7 treatments with 4 replications. FYM was applied according to the treatments 20 days before transplanting. Nitrogen was applied in the form of urea and phosphorous in the form of SSP before transplanting. There was no need of applying potash according to soil test report. Non-symbiotic bio fertilizers (*Azotobacter*, *Azospirillum*), well known for their broad spectrum utility in various crops, were used in the experiment. These were applied @ 10g/plant by mixing with 1kg FYM during the time of transplanting. Effect of different combinations of biological and chemical fertilizers on crop was recorded in terms of plant height, shoot number, shoot length, stem girth, leaf area, apparent fruit maturity, Organoleptic rating, juice percentage and yield/plant from randomly selected plants from each replication.

Treatment details

T₁-100% NPKT₂-75% NPK + 1.25t/acre FYMT₃- 50% NPK + 0.70t/acre FYM + bio fertilizers (*Azotobacter* and *Azospirillum* @10g/plant)T₄- 1.0t/acre FYM + bio fertilizers (*Azotobacter* and *Azospirillum* @10g/plant)T₅- 2.0t/acre FYMT₆- Bio fertilizers (*Azotobacter* and *Azospirillum* @10g/plant)T₇- Control (No fertilizers)

Results and discussion

The data with regard to plant height as influenced by organic and inorganic fertilizers indicated that the maximum plant height

(127.5cm) was recorded in T₂ treatment(NPK 75% + 1.25 t/acre FYM) followed by T₄, T₃ and T₅ which recorded 127.00cm, 126.50cm, 124.02 cm respectively. The height of plants under control was recorded to be minimum (102.75cm). It is evident that the difference among treatments was not significant. The maximum plant height in T₂ might be due to the synergic effect of organic manures along with inorganic fertilizers. Similar findings were also reported by Sahu⁵ in guava, Pal et al (2015) in tomato. The minimum plant height in control might be due to non application of nutrients and ultimately due to the supply of insufficient quantity of nutrients needed for the growth of the plant as also reported by Garg & Singh⁶ in cape gooseberry. Addition of bio fertilizers (*Azotobacter* and *Azospirillum*) might have helpful in nitrogen fixation and quicker source for plant absorption. Sepat et al.,⁴ in tomato also reported positive effect of combination of organic fertilizers and farmyard manure on plant height in tomato. The greatest plant height had also been reported with the addition of FYM by Khan and Begum (2007)⁷ in acid lime. The maximum number of shoots (6.75) per plant were obtained in treatment T₂ followed by (6.25), (6.24) and (6.00) in T₅, T₄ and T₃. This increase might be due to the availability of major as well as minor nutrient elements at optimum proportion in the soil and assimilation of food material within the plant.⁸ Mohankumar & Gowda⁹ found that the number of branches were highest in the treatment of 150% recommended FYM in brinjal plants due to steady and adequate supply of nutrients from FYM alone or with mixture of FYM and NPK. The minimum number of shoots (5.00) per plant was reported under control T₇. These results are also in agreement with the findings of Pal et al (2015) in tomato.

It is evident from the data that maximum average shoot length (92.28cm) was found in treatment T₂ followed by T₅ (83.67 cm), T₄ (82.96 cm), T₁ (80.74cm). The maximum length of shoots could be attributed to the easily availability of required quantity of nutrients and improved soil conditions due to the addition of FYM for releasing the different macro and micro nutrients at proper stage required for plant growth which might have manifested in enhancing the growth in terms of shoot length. The lower values of these traits (73.58cm) in control treatment (T₇) could be attributed to non-availability of required quantum of nutrients.⁸ Similar findings were also reported by Sahu⁴ in guava. The perusal of data regarding stem girth indicated that the maximum stem girth (2.96cm) was obtained in plants treated with T₂ followed by T₄, T₃ and T₁ with stem girth of 2.47cm, 2.34 cm and 2.31cm respectively. These results do not differ significantly from each other. The minimum stem girth (2.02cm) was found under control T₇. The maximum stem girth (2.69cm) might be due to the increase in shoot length and number of leaves which might have resulted to the production of more quantum of carbohydrates and subsequently their translocations towards the stem. While, the minimum values of stem girth in control might be due to the poor availability of nutrients required for better plant growth. These findings are well supported with the findings of Dutta et al.,¹⁰ in papaya and Sahu⁴ in guava plants,

respectively. The maximum leaf area (0.358m²) was found under T₃ followed by T₁ with leaf area of 0.277m². Treatment under control had minimum leaf area (0.229m²) followed by T₆ which have leaf area of 0.250m². All these results do not show significant difference among them. Increase in leaf area by combined application of inorganic fertilizers with FYM might be due to the easily availability of required quantity of nutrients and improved soil conditions which promoted the vegetative growth and also the leaf area. It can be inferred that bio fertilizers, along with NPK and FYM, helps proliferation of roots which, ultimately, resulted in sturdy and healthy plants showing resistance to biotic and abiotic stresses. Moreover, this also promoted better nutrient uptake and carbohydrate accumulation in leaves, resulting in healthy leaf growth. These results are in accordance with the findings of Sandhu & Gill¹¹ in capegooseberry. The minimum days (100.75) for apparent fruit maturity were found in T₃ followed by T₆ with (103.00), T₅ with (104.25) and T₂ with (104.75) days respectively. These treatments were found to be at par with each other. This might be due to the elaboration of small quantities of growth promoting substances like GA, IAA, cytokinins, Vitamin B, etc or by *Azotobacter*; which, along with NPK and FYM might have improved the physiology of plants causing a shift from the vegetative to the reproductive phase. These results are in accordance with the findings of Sandhu & Gill¹¹ in capegooseberry. Maximum Organoleptic scores 9.12 and 9.07 were awarded to the fruits from the plants under T₃ and T₁ respectively. Both of these treatments were found to be at par with each other. It was also observed that the fruits from treatments T₂, T₄ and T₆ scored 8.50, 7.75 and 7.62 organoleptic ratings, respectively, which differ significantly. Fruits yielded from control got minimum 7.00 Organoleptic scores. Results of the study revealed that the combined application of organic and inorganic fertilizers enhanced the fruit quality of capegooseberry. Plants treated with 50% NPK + 0.7 t/acre FYM + bio fertilizers produced fruits of better quality with high organoleptic characters. Results of these findings are confirmed by Umar et al.,¹² in strawberry. Maximum percentage of juice (74.05%) was found in fruit of plants treated with T₃ followed by T₁, T₂ and T₄ with 73.40, 73.36 and 72.56 per cent juice, respectively. All of these results were found to be at par with each other. Minimum juice percentage (68.31%) was found in the treatment under control (T₇) (Table 1) (Table 2). It was noted that plants treated with T₃ registered maximum fruit yield (1.30kg), it was followed by T₁, T₂ treatments with fruit yield of 1.04kg and 0.94 kg per plant respectively. T₃ differ significantly from all other treatments. Minimum yield (0.72kg) was found in the treatment under control which is found to be at par with T₆ with yield of 0.76kg. Increase in yield due to application of organic manures, fertilizers and bio fertilizers together was might be responsible for synthesis of plant growth hormone, development of root system and therefore high nutrient utilization by crop plants. Similar findings have been reported by Sepat et al.,⁸ and Singh and Singh¹³ in tomato.

Table 1 Effect of integrated management on vegetative characteristics of Cape gooseberry

Treatments	Plant height (cm)	Shoot number/ plant	Average shoot length (cm)	Stem girth (cm)	Leaf area (sq.m)
T1- 100% NPK	126.75	5.5	80.74	2.49	0.277
T2- 75%NPK+1.25t/a FYM	127.65	7.5	93.87	2.78	0.262
T3-50%NPK+ 0.7t/a FYM+ bio fertilizers	127	5.75	81.91	2.6	0.358
T4 – 1t/a FYM+ bio fertilizers	127.4	6	82.24	2.6	0.255

Table Continued...

	Plant height (cm)	Shoot number/plant	Average shoot length (cm)	Stem girth (cm)	Leaf area (sq.m)
T5 – 2t/ a FYM	119.5	5	74.78	2.44	0.251
T6 - bio fertilizers	112.87	4.25	73.66	2.37	0.25
T7 – Control	108	3.75	73.62	2.08	0.229
MEAN	121.14	5.39	80.12	2.48	0.26
CD at 5% level	14.4	2.18	12.09	0.28	0.13

Table 2 Effect of integrated management on fruit characteristics of Cape gooseberry

Treatments	Fruit maturity(days)	Juice Percentage (%)	Organoleptic rating	Yield/plant (kg)
T1- 100% NPK	105.5	73.4	9.07	1.04
T2- 75%NPF+1.25t/a FYM	104.75	73.36	8.5	0.94
T3-50%NPK+ 0.7t/a FYM+ bio fertilizers	100.75	74.05	9.12	1.3
T4 – 1t/a FYM+ bio fertilizers	104.74	72.56	7.75	1.01
T5 – 2t/ a FYM	104.25	71.05	7.62	0.77
T6 - bio fertilizers	103	70.98	7.61	0.76
T7 – Control	107.25	68.31	7	0.72
MEAN	104.32	71.95	8.1	0.936
CD at 5% level	1.72	2.81	1.1	0.54

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None.

Conflicts of interest

The authors declared there is no conflict of interest.

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