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Effect of dates of transplanting and crop geometries on growth, yield and quality of cape gooseberry

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ABSTRACT

The present investigation consisting of 3 dates of transplanting (15th September, 30th September and 15th October) and 2 crop geometries (90 cm × 60 cm, 60 cm × 60 cm) was laid out in split plot design with three replications. The results revealed that the different dates of transplanting and crop geometries significantly influenced the growth, yield and quality of cape gooseberry. Significantly maximum (90.24 cm E-W and 88.85 cm N-S) plant spread, leaf perimeter (34.28 cm), leaf length (11.55 cm), leaf breadth (10.25 cm), number of picking per plant (5.38), fruit set (87.09 per cent), number of fruits per plant (82.34), fruit yield per plant (1038.43 g), estimated yield (255.99 q/ha), TSS (12.50ºB), TSS/Acid ratio (50.19), total sugars (6.34 per cent), juice content (60.11 %), vitamin-C (29.84 mg/100g), carotene content (1.63 mg/100g), vertical fruit diameter (22.91 mm) and horizontal fruit diameter (22.27 mm), highest fruit weight (10.88 g), sensory score (6.87), minimum days taken to first harvest (116.49 days), duration of harvesting (31.19 days) and the lowest titratable acidity (0.26 %) were observed when transplanting of cape gooseberry was done on 30th September at 90 cm × 60 cm spacing (D_2S_1).

Key words: *Physalis Peruvian*, vegetative growth, production attributes, quality attributes.

INTRODUCTION

Cape gooseberry (*Physalis peruviana* L.) is an important annual herbaceous, tropical fruit crop of India, which is native to South America (Klinac, 6). The word Cape gooseberry is most probably derived from the name of “Cape of God” of South Africa where it was commercially cultivated. Cape gooseberry reaches in nature 2 to 3 feet in height under favourable growing conditions. The fruit is a berry with smooth, waxy, orange yellow skin (Legge, 8).

Cape gooseberry has high significance for diversification of fruit bowl in the market. It is usually cultivated as a short cycle (3-4 months), annual crop but in absence of frost it can be perennial. In the region of origin, it is grown in a wide altitude range from sea level to 3200 m, with an intense solar radiation to humid and cloudy environment (Singh *et al*. 16).

Successful cultivation of any crop depends upon several factors viz. date of sowing, plant spacing and other cultivation practices. Planting time and plant geometry are of prime importance. Optimum plant spacing ensures proper growth and development of plants resulting in maximum yield and economic use of land. There is a wide range of planting time which may influence the yield due to varying climatic conditions at different stages of crop growth. The variations in planting time may also favour the plant vigour and spread which further control the yield and thus the crop requires variable spacing. Yield of cape gooseberry has been reported to be dependent on the number of plants accommodated per unit area. However, there are no reports regarding optimum sowing date and spacing for the successful cultivation of cape gooseberry, especially under the agro-climatic conditions of Rajasthan. The dates of sowing and plant population per unit area play decisive role with regard to optimum growth of plant and high yield (Bhatnagar and Pandita, 1).

Considering the above facts, the present experiment was undertaken to find out the suitable planting time and optimum plant spacing for obtaining maximum fruit yield and quality of cape gooseberry.

MATERIALS AND METHODS

The present experiment was conducted at the Farm, College of Horticulture and Forestry, Jhalrapatan City, Jhalawar during the year 2015-2016. The region received 123 mm maximum rainfall and temperature prevails between 25-35ºC. In order to assess the physico-chemical properties of the soil at the experimental site, the soil samples were drawn randomly from different spots in the field at a depth of 0-30 cm before the commencement of the experiment. The experimental material consisted of seeds of cape gooseberry. Seeds were sown in the pro-tray (9 cm × 7 cm size). The treatment

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consisted of 3 dates of planting 15th September, 30th September, 15th October and 2 crop geometries 90 cm × 60 cm, 60 cm × 60 cm. There were six treatment combinations each replicated thrice in split plot design. For recording growth parameters five plants were tagged in each replication. Plant height (cm) was measured with the help of measuring scale. Plant spread (cm) was recorded with the help of a meter scale. Chlorophyll content of leaves (mg/g) was measured as per method as suggested by Sadasivam and Manickam (15). Leaf perimeter (cm) was measured with the help of thread in centimeters. Leaf shape was observed on visual basis and expressed as ovate and cordate (Fig. 5.). Leaf length and leaf breadth was measured by vernier caliper. Days taken to fruit set was recorded when the swelling of ovary took place and attained the size equal to fly head.

Days taken to first harvest was observed by counting average number of days taken from planting date to harvesting of fruits. Duration of harvesting was recorded as number of days taken to first harvesting to the last harvesting. Fruit set (%) was recorded by number of fruits set divided by total number of flowers appeared on tagged shoots multiplied by 100. The number of times the fruits harvested was taken as number of picking. The yield of all the harvest obtained from selected plant formed fruit yield per plant. Estimated yield (q/ha) was calculated on the basis of fruit yield obtained from a unit plot area by dividing fruit yield per plot (kg) by area of plot (m^2) multiplied by 10000. Total Soluble Solids (°Brix) was recorded by hand refractometer. Titratable acidity (per cent) was determined by titrating the juice against standard alkali solution (0.1N NaOH). TSS: Acid ratio was calculated by dividing the value of total soluble solids content by acid content (per cent). Reducing sugars and total sugars were estimated by Lane and Eynon (7) copper titration method. Fruit weight (g) was calculated by dividing the weight of fruits with number of fruits weighed. Fruit diameter was measured by Vernier caliper. Juice (per cent) was calculated on the basis of total weight of fruit and the juice weight. Carotene (mg/100g) was measured with the UV-VIS spectrophotometer. Sensory scoring was done with help of Hiddonic scale out of 10.0. Vitamin C (mg/100g fruit) was calculated with help of formula:

Ascorbic acid (mg/100g pulp):

Titre × Dye factor × Volume made up × 100/ Aliquot × Vol. of solution taken for estimation

The mean values of the characters were used for statistical analysis following the method of analysis of variance for spilt plot design as per method as suggested by Panse and Sukhatme (11).

RESULTS AND DISCUSSION

The vegetative growth of cape gooseberry (Table 1) under different transplanting date and spacing revealed maximum plant height (90.06 cm) in 30th September with 60 cm × 60 cm spacing (D_2S_2). Maximum (E-W) (90.24 cm) and (N-S) (88.85 cm) plant spread and leaf perimeter (34.28 cm) was observed in 30th September with 90 cm × 60 cm spacing (D_2S_1). Highest chlorophyll content of leaves (2.64 mg/g) was noted in 15th October with 60 cm × 60 cm spacing (D_3S_2). Maximum leaf length (11.55 cm) and leaf breadth (10.25 cm) was found in 30th September with 90 cm × 60 cm spacing (D_2S_1). More height in the plant at closer spacing 60 cm × 60 cm might be due to competitive growth behaviour of plant over other plants to get more and more sunlight. It is well proven fact that the plant planted closer become lanky and grows upward to trap maximum solar radiation. In wider spacing 90 cm × 60 cm most of the growth attributes were found better. With increase in spacing there had been more vegetative growth. These results are in agreement with Manchanda and Singh (10), Faiza *et al.,* (3), Pawar and Karale (12) and Mallik *et al*. (9).

Data showed that the production attributes influenced significant with different transplanting dates and spacing (Table 2, 3 and Fig. 1, 2, 3). The minimum number of days taken to first flower initiation (47.82 days), and days taken to fruit set (56.81 days) was taken by 30th September with 60 cm × 60 cm spacing (D_2S_2). The minimum days taken to first harvest (116.49 days) and duration of harvesting (31.19 days) was noted in 30th September with 90 cm × 60 cm (D_2S_1) spacing. The maximum number of picking per plant (5.38), fruit set (87.09 per cent), number of fruits per plant (82.34) and fruit yield per plant (1038.43) were noted in 30th September with 90 cm × 60 cm spacing (D_2S_1). Maximum estimated yield (255.99 q/ha) was noted in 30th September with 90 cm × 60 cm spacing (D_2S_1). Highest marketable yield in 90 cm × 60 cm spacing with 30th September transplanting might be due to better availability of nutrients, light, soil moisture and favourable growing condition (Temperature (27º C) and relative humidity (55.14 %), less day night fluctuation in temperature); 30th September planting had maximum yield, perhaps due to better carbon assimilation process. Plant of September planting received shorter and cooler condition at flowering and fruit development stages. On the contrary, plant planted on other transplanting dates got extreme cold condition at growth stages which might led low yield. These results are in consonance to the finding as reported by Peyvast *et al.,* (13) who reported that the earliest planting

Table 1. Interaction effect of date of transplanting and spacing on growth parameters of cape gooseberry.

Treatment	Plant height Spacing		Plant spread (E-W)		Plant spread (N-S)		Chlorophyll content (mg/g)		Leaf perimeter (cm)		Leaf length (cm)		Leaf breadth (cm)		Days taken to first flower initiation	
Transplanting dates	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
D_1	80.55	82.74	87.92	83.26	87.95	83.56	2.61	2.60	33.42	33.29	11.83	11.81	9.24	9.23	49.59	49.40
D_2	88.53	90.06	90.24	85.83	88.85	84.93	2.63	2.62	34.28	34.06	12.55	12.53	10.25	10.24	48.32	47.82
D_3	77.44	78.50	84.20	80.11	86.43	82.42	2.60	2.64	32.47	32.32	11.05	11.03	8.54	8.53	51.44	50.81
CD (0.05)	4.55		2.48		1.85		0.11		1.57		0.67		0.66		2.15	

D_1- Transplanting on 15th September, D_2- Transplanting on 30th September, D_3- Transplanting on 15th October, S_1- Crop spacing 90 × 60 cm, S_2- Crop spacing 60 × 60 cm

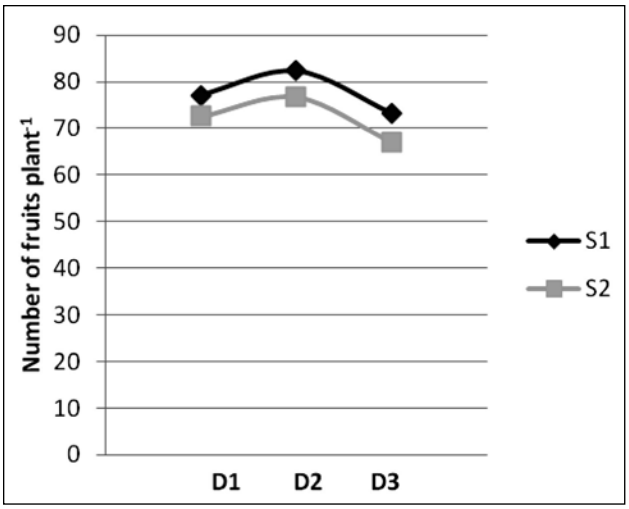

Fig. 1. Number of fruits plant^{-1}

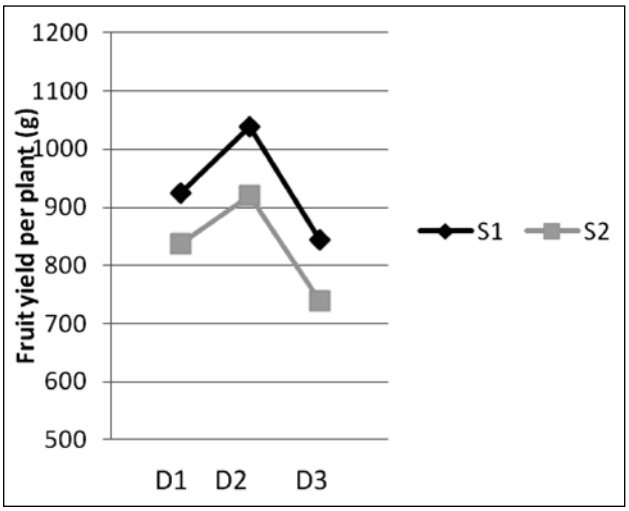

Fig. 2. Fruit yield per plant (g)

resulted in a significantly higher total fruit yield as compared to the later planting date in tomato. Similar results have been reported by Hossian *et al.,* (5) in tomato. However with the later date of planting (30th October) the growing temperature under which the plant remained exposed being cooler perhaps made the plant unable to complete appropriate vegetative growth and that might be responsible for less yield. The difference in yield per plant due to planting time might be due to difference in growing environment and in vegetative growing phase of strawberry (Chandler *et al.,* 2).

The different transplanting dates and spacing (Table 2, 3 and Fig. 4) had significant effect on different quality attributes. The maximum TSS (12.50º B), lowest titratable acidity (0.26 %), maximum TSS/

Table 2. Interaction effect of date of transplanting and spacing on production attributes of cape gooseberry.

Treatment	Days taken to fruit set		Days taken to first harvest		Duration of harvesting		Fruit set (%)		Number of picking		Vertical fruit diameter (mm)		Horizontal fruit diameter (mm)	
Transplanting dates	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
D_1	58.77	58.77	118.90	119.79	34.17	35.13	86.08	85.01	4.90	4.31	21.84	20.99	21.62	20.60
D_2	56.93	56.93	116.49	117.12	31.19	32.23	87.09	86.44	5.38	4.72	22.91	21.80	22.27	21.65
D_3	60.29	60.29	120.21	121.22	36.21	36.84	83.82	82.46	4.01	3.52	21.56	20.62	20.80	20.10
CD (0.05)	2.49		2.20		2.06		2.42		0.43		0.97		1.00	

Table 3. Interaction effect of date of transplanting and spacing on quality attributes of cape gooseberry.

Treatment	Juice (%)		Total Soluble Solids (ºB)		Titratable acidity (%)		TSS/Acid ratio		Total sugar (%)		Vitamin- C (mg/100g)		Carotene (mg/100g)		Sensory score	
Transplanting dates	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
D_1	58.37	58.24	11.69	11.79	0.28	0.29	44.44	42.75	6.17	6.09	29.14	29.07	1.61	1.60	6.61	6.38
D_2	60.11	59.79	12.50	12.42	0.26	0.28	50.19	48.04	6.34	6.18	29.84	29.78	1.63	1.62	6.87	6.80
D_3	57.22	57.00	11.68	11.59	0.29	0.29	41.91	40.32	6.16	6.10	28.76	28.62	1.58	1.57	6.41	6.38
CD (0.05)	2.69		0.62		0.01		2.94		0.25		1.18		0.06		0.28	

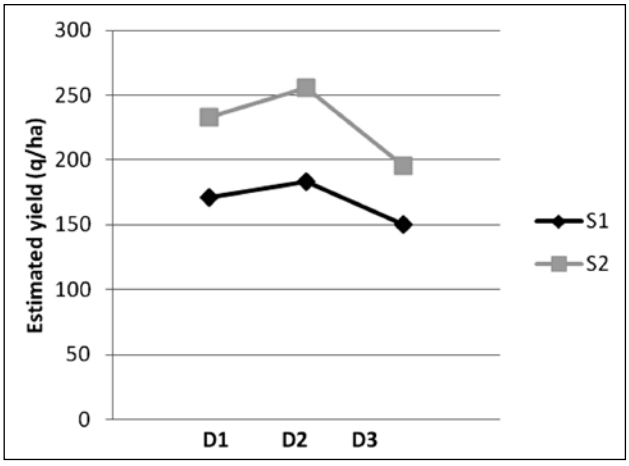

Fig. 3. Estimated yield (q/ha)

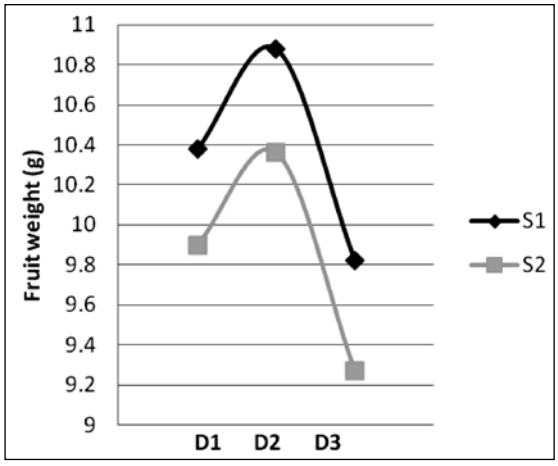

Fig. 4. Fruit weight (g)

Acid ratio (50.19), maximum total sugar (6.34 per cent), maximum juice per cent (60.11 %), maximum vitamin-C (29.84 mg/100g), maximum carotene content (1.63 mg/100g), maximum vertical fruit diameter (22.91 mm) and horizontal fruit diameter (22.27 mm) and highest fruit weight (10.88 g) and sensory score (6.87) were recorded under 30th September with 90 cm × 60 cm spacing (D_2S_1). Better quality parameter (TSS, acidity, juice, carotene, vitamin-C, total sugar, sensory score, weight of fruit) in 90 cm × 60 cm spacing with 30th September planting may be explained in the light of the fact that the early planting might had more exposure to favourable environmental condition, availability of ample growing days perhaps allowing better development of quality parameter are reported by (Rahman *et al.,* 14). Further at wider spacing (90 cm × 60 cm), there might have been less competition for nutrient, favouring accumulation of more carbohydrates, more protein synthesis which might be attributed to better quality

parameter. The obtained results are in conformity to the finding as quoted by Gupta *et al.,* (4) in tomato. From the results of present investigation it can be concluded that transplanting on 30th September with 90 cm × 60 cm spacing (D_2S_1) may be adapted to better growth and higher yield with insignificant quality

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