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Standardization of Sowing Time of Cape Gooseberry (*Physalis peruviana* L.) for Higher Growth and Yield of Fruits under Sub Tropic of Bihar

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ABSTRACT

An experiment was conducted to explore the possibility of sowing time of Cape-gooseberry with respect to higher growth and yield in sub tropic of Bihar. Two divers genotypes of Cape-gooseberry collected from sub-tropical and temperate regions of country were sown in nursery beds at 15 days interval on 25th August, 10th September, 25th September, 10th October, 25th October, 10th November, 25th November and 10th December and 35 days old seedlings were transplanted in factorial Randomized Block Design replicated thrice. Data recorded on account of various growth and yield attributing traits of both the genotypes influenced significantly due to different date of sowing. The maximum plant height, number of branches/plant, number of fruits/plant, fruit length (mm), fruit diameter (mm), Fruit weight (g), Fruit yield/plant and yield (q/ha) were recorded when seeds were sown on 25th November while, the minimum and maximum days to first flowering were recorded with the sowing on 10th December and 25th August, respectively. Between the genotype, temperate genotype recorded maximum fruit length, fruit diameter, fruit weight while, sub-tropical genotype produced maximum plant height, days taken to first flowering and number of fruits/plant. Amongst the interactions sowing of temperate genotype produced maximum number of branches, fruit length and fruit diameter, fruit weight and fruit yield /ha when sowing was done on 25th November, while plant height, days taken to first flowering and number of fruits/plant was maximum with sub-tropical genotypes at 25th August of sowing. However, the sub-tropical genotype incurred highest net return and B: C ratio when it was sown on 25th August. Thus on the basis of economics it may be concluded that the sowing of sub-tropical Cape gooseberry on 25th August is more economical in respect to higher net return per rupee investment due to consumer acceptability and higher market price.

Keywords Cape-gooseberry, Sowing time, Genotype, Interaction effect, Yield.

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INTRODUCTION

Cape-gooseberry (*Physalis peruviana* L.) traditionally known as Mokai, Tipari, Bhutka, Rashbhari is one of the minor fruit crops of family Solanaceae having 2n= 4x = 48 chromosome number (Tetraploid) (Trevisani *et al*. 2018). It is grown as cash crop in the form of sole crop, intercrop along with perennial fruit orchards and kitchen garden for their cherry size, attractive golden yellow and delicious fruits (Kumar *et al.* 2019). It is cultivated in a wide altitude ranging from mean sea level to 3200 m, with intense solar radiation to humid and cloudy environments (Singh *et al*. 2012). The commercial cultivation of any crop depends on several factors including climatic ones that affect the genetic expression of genotypes. Appropriate planting dates may not only lead to greater yield, but also may contribute to better size as well as vegetable quality. Keeping in view the above facts, the present investigation was formulated to assess the impact of sowing time of Cape-gooseberry genotypes under sub tropic condition of Bihar for their growth, yield and yield attributing traits.

MATERIALS AND METHODS

A field experiment was conducted at experimental field of Nalanda College of Horticulture, Noorsarai, Nalanda, campus of Bihar Agricultural University Sabour, Bhagalpur, Bihar (India) during 2015-16 and 2016-17 to standardize the sowing time of Cape gooseberry for higher growth and yield under sub tropic of Bihar. The experimental site was situated about 10 km away from Nalanda district head quarter and 65 km from Patna city at 25^0.27' latitude and 85^0.45' longitude and 57 meters above the mean sea level. Sixteen treatment combinations comprising of two divers genotypes of Cape gooseberry i.e.,V_1= 'Local Cape gooseberry' collected from sub-tropical and other V_2='Introduced Cape-gooseberry' from temperate region of country and 8 different nursery sowing dates i.e., S_1=25th August, S_2=10th September, S_3=25th September, S_4=10th October, S_5=25th October, S_6=10th November, S_7=25th November and S_8=10th December. Four weeks old seedlings (4-6 leaf stage) were transplanted in the well prepared plots of 3m x 2m size at 60 x 45 cm spacing. The experiment was arranged in factorial Randomized Block Design replicated thrice. Plants were irrigated through watering can just after transplanting to establish the plants in the field. Data were recorded on plant height(cm), number of branches/plant, days taken to opening of first flower, number of fruits/plant, fruit diameter (mm), fruit length (mm), fruit weight (g), fruit yield/ plant (kg) and fruit yield (q/ha) were recorded at appropriate maturity stage in to 4-5 pickings. The recorded data were subjected for statistical analysis as suggested by (Fisher and Yates 1949). Critical difference was also calculated to draw the valid conclusion. The grass return was calculated by multiplying the total fruit yield (q/ha) by price (Rs) of produce prevailing in the market, net return by subtracting the total cost of cultivation (Rs/ha) from total return (Rs/ha), while cost: Benefit ratio was calculated by dividing the grass return (Rs/ha) by total cost of cultivation (Rs/ha).

RESULTS AND DISCUSSION

Data displayed in mean summary (Table 1) revealed that almost all the parameters like plant height, number of fruits/plant, fruit length, fruit diameter, fruit yield/plant and per hectare except number of branches/plant recorded significantly higher values when sowing was done on 25th November (S_7). However, maximum number of branches/plant and days to flowering was observed in 25th August (S_1). The progressive increase in plant height over rest of sowing time may probably be due to congenial environment to survive and early establishment of plant that might have enhanced the photosynthetic activities and increased the plant height. The entire yield attributing traits and yield of crop showed the best response at S_7 (25th November) sowing date. The higher values of entire yield attributing traits and yield at S_7 (25th November) sowing date might be due to the early establishment and increased plant height due to favorable environmental condition that might have assimilated more photosynthates which would be utilised to increase the length and width of fruits. The yield is the resultant of size of fruits, which might have enhanced the fruit yield/ plant and yield/ha. Similar trend has also been reported by Singh *et al.* (2014), Diwedi *et al.* (2015). Table 1 revealed that the response of both the temperate and sub-tropical

Table 1. Effect of sowing time and genotypes on growth and yield of Cape-gooseberry (*Physalis peruviana* L.).

Treatments	Plant height (cm)	Number of branches/ plant	Days to first flowering	Number of fruits/ plant	Fruit length (mm)	Fruit diameter (mm)	Fruit weight (g)	Fruit yield (kg/plant)	Fruit yield (q/ha)
Sowing time									
S_1	73.67	14.67	32.58	40.17	19.15	21.29	8.04	0.32	118.68
S_2	76.63	17.08	30.17	35.08	19.87	20.43	8.24	0.28	103.62
S_3	74.10	14.58	29.92	35.00	19.62	21.10	8.57	0.28	103.51
S_4	74.16	13.25	26.75	34.67	20.15	22.35	9.32	0.30	109.75
S_5	74.18	13.33	23.50	33.50	19.85	23.64	10.68	0.33	127.13
S_6	78.31	14.42	26.42	39.50	21.81	25.13	10.63	0.42	152.01
S_7	86.31	16.50	27.83	41.58	22.92	26.38	11.60	0.51	187.05
S_8	81.03	14.42	23.75	32.67	19.93	24.53	10.83	0.34	123.56
SEm+	**1.565**	0.681	0.972	1.181	0.616	0.459	0.291	0.012	**3.937**
CD (p = 0.05)	**4.54**	1.98	2.82	3.43	1.79	1.33	0.84	0.03	**11.43**
Genotype									
(V_1)	97.92	14.13	39.69	46.15	18.65	21.09	7.36	0.34	125.66
(V_2)	56.68	15.44	15.54	26.90	22.17	25.13	12.12	0.35	130.67
SEm+	**0.782**	0.340	0.486	0.590	0.308	0.230	0.145	0.006	**1.969**
CD (p = 0.05)	**2.27**	0.99	1.41	1.71	0.89	0.67	0.42	NS	**NS**

S_1=25th August, S_2=10th September, S_3=25th September, S_4=10th October,S_5=25th October, S_6=10th November,S_7=25th November, S_8=10th December and local variety (V_1), Introduced variety (V_2).

genotypes varied significantly due to various dates of sowing. The temperate genotype recorded maximum fruit length, fruit diameter and average fruit weight while; sub-tropical genotype produced maximum plant height, days taken to first flowering and number of fruits/plant. The pronounced increase in yield attributing traits and yield in temperate genotypes as compared to sub-tropical one might be only due to more adaptability during cooler month of the sub-tropical region and genetic make-up of genotype

Table 2. Interaction effect of sowing time and genotypes on growth and yield of Cape-gooseberry (*Physalis peruviana* L.).

Treatments	Plant height (cm)	Number of branches/ plant	Days to first flowering	Number of fruits/ plant	Fruit length (mm)	Fruit diameter (mm)	Fruit weight (g)	Fruit yield (kg/plant)	Fruit yield (q/ha)
S_1V_1	109.12	19.00	57.83	62.67	20.88	23.28	7.95	0.50	184.08
S_2V_1	105.22	21.33	51.50	55.67	20.13	22.57	7.79	0.44	160.55
S_3V_1	103.35	14.67	49.83	49.67	18.87	21.98	7.50	0.37	135.73
S_4V_1	96.68	14.33	38.50	46.67	18.87	20.97	7.39	0.35	126.23
S_5V_1	94.57	11.83	33.67	42.83	18.07	20.88	7.33	0.32	115.42
S_6V_1	91.75	11.00	32.00	40.50	17.62	19.67	6.95	0.28	103.17
S_7V_1	91.58	10.83	28.83	35.33	17.37	19.65	6.97	0.25	90.18
S_8V_1	91.08	10.00	25.33	35.83	17.38	19.68	6.94	0.25	89.95
S_1V_2	42.12	10.33	7.33	17.67	17.42	19.30	8.12	0.14	53.28
S_2V_2	44.13	12.83	8.83	14.50	19.60	18.28	8.68	0.13	46.68
S_3V_2	44.85	14.50	10.00	20.33	20.37	20.22	9.64	0.20	71.30
S_4V_2	51.63	12.17	15.00	22.67	21.43	23.73	11.24	0.25	93.27
S_5V_2	53.80	14.83	13.33	24.17	21.63	26.40	14.03	0.34	138.85
S_6V_2	64.87	17.83	20.83	38.50	26.00	30.58	14.32	0.55	200.85
S_7V_2	81.03	22.17	26.83	47.83	28.47	33.10	16.23	0.77	283.92
S_8V_2	70.97	18.83	22.17	29.50	22.47	29.38	14.72	0.43	157.17
SEm+	**2.213**	0.962	1.374	1.670	0.872	0.650	0.411	0.017	**5.568**
CD (p = 0.05)	**6.42**	2.79	3.99	4.85	2.53	1.89	1.19	0.05	**16.16**

S_1=25th August, S_2=10th September, S_3=25th September,S_4=10th October,S_5=25th October, S_6=10th November,S_7=25th November, S_8=10th December and local variety (V_1), Introduced variety (V_2).

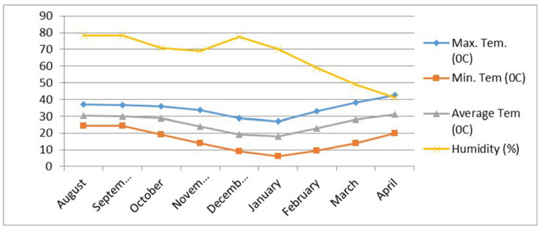

Fig 1. Average monthly temperature and humidity during growing period of Cape-gooseberry (*Physalis peruviana* L).

and vis- versa.

The interaction between genotypes and sowing time significantly influenced all the parameters studied (Table 2). The sub-tropical genotype recorded comparatively higher values of plant height, days taken to first flowering and number of fruits/plant when sowing was done on 25th August (S_1V_1), while minimum values of these parameters were noted under treatment combination of (S_1V_2) i.e., sowing of temperate genotype on 25th August. The progressive increase in the traits at S_1V_1 might be due to proper adoptability and long duration of crop. Temperate Cape gooseberry has not acclimatized to higher temperature during the August-October (Fig.1) that might have restricted vegetative growth phase and early flowering. Similar trend in Cape gooseberry has also been reported by Singh *et al.* (2011).

Interaction effect due to various sowing dates and genotypes had significant impact towards number of primary branches/plant, fruit length, fruit diameter, average fruit weight and fruit yield (kg/plant and q/ha). The temperate genotype interacted more with various sowing time and recorded maximum values of said parameters when sowing was done on 25th November (S_7V_2) (Table 2). It is obvious from the results that the 'Introduced or temperate Cape gooseberry' performed the best when sowing was done during cooler month of November which gradually decreased with either early or delay sowing whereas, the sub-tropical cultivar declined the fruit yield/plant when the sowing was delayed from September to December due to gradual decrease in temperature during these periods and reduction in crop duration, genetic potential and adoptability of crop. The longer crop duration might have intercepted more light energy and helped in more synthesis of photosynthates that ultimately increased the yield components. The progressive improvement in fruit weight under S_7V_2 treatment combination was only due to lesser number of fruits per plant in V_2 that got proper nutrition when sown on 25th November (S_7) and ultimately resulted in higher fruit weight. The potential productivity closely related to the morphological characteristics like branching of the plants (Nikolay and Ani 2016).

Economic feasibility of treatments depends upon the yield, and market price, which varies according to the consumer preference. The sub-tropical genotype had more acceptability as compared to temperate. Data presented in Table 3 clearly indicated that the sub-tropical genotype when sown on 25thAugust (S_1V_1) incurred maximum gross return (4.60 lac/ha), net return (3.03 lac/ha) and B: C ratio (2.93) followed by sowing on 10th September (S_2V_1) even though the yield was maximum in S_7V_2. It was mainly because of high market price of sub-tropical Cape gooseberry due to good quality and more consumer acceptability. Whereas, 'Introduced Cape gooseberry' despite of

Table 3. Economic feasibility of various treatments.

Treatments	Fruit yield (q/ha)	Grass return (Rs /ha) in lac	Net return (Rs/ha) in lac	Benefit-cost ratio
S_1V_1	184.08	4.60	3.03	2.92
S_2V_1	160.55	4.01	2.44	2.55
S_3V_1	135.73	3.39	1.82	2.15
S_4V_1	126.23	3.15	1.58	2.00
S_5V_1	115.42	2.88	1.31	1.83
S_6V_1	103.17	2.57	1.00	1.63
S_7V_1	90.18	2.25	0.68	1.43
S_8V_1	89.95	2.24	0.67	1.42
S_1V_2	53.28	0.80	-0.78	0.50
S_2V_2	46.68	0.70	-0.87	0.44
S_3V_2	71.30	1.06	-0.50	0.67
S_4V_2	93.27	1.39	-0.18	0.88
S_5V_2	138.85	2.08	0.50	1.32
S_6V_2	200.85	3.00	1.42	1.91
S_7V_2	283.92	4.24	2.60	2.70
S_8V_2	157.17	2.35	0.78	1.49

S_1=25th August, S_2=10th September, S_3=25th September, S_4=10th October, S_5=25th October, S_6=10th November, S_7=25th November, S_8=10th December, Local Cape-gooseberry (V_1) and Introduced Cape-gooseberry (V_2).

giving maximum yield incurred lower B: C ratio only because of lesser market price due to poor quality and lesser consumer acceptability.

CONCLUSION

On the basis of above findings it is concluded that the sub-tropical cape gooseberry can be sown successfully on 25th August for higher growth and yield, while temperate genotype can be sown on 25th November in sub-tropical region of Bihar. Despite of lower yield than temperate, sub-tropical cape gooseberry' incurred the highest grass return, net return and B: C ratio when sown on 25th August because of its higher market price due to better quality and consumer preference.

Therefore the sowing of 'Local Cape gooseberry' on 25th August is recommended for commercial cultivation to earn more return per rupee investment. However temperate genotypes can be utilized for improvement of sub-tropical genotypes, processing as well as value addition due to its higher yield potential.

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