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Effect of different dates of planting and genotypes vegetative growth and yield characters of Cape gooseberry (*Physalis peruviana* L.) under Lucknow conditions

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Abstract
A field experiment was conducted during two consecutive years 2019-20 and 2020-21to find out the suitable planting dates and genotypes to better growth and yield. The experiment was carried at experimental farm of the Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Lucknow. The experiment was laid out in Split plot design with four different planting dates (i.e.15^{th} June, 15^{th} July, 15^{th} August and 15^{th} September). The plant which were planted on 15^{th} June showed better performance on growth parameters *viz*., plant height (99.2cm and 95.3cm), stem diameter (1.3cm) in both years, intermodal distances (5.35cm and 4.9cm), number of leaves per branch (23.6 and 17.4), leaf length (6.0cm and 5.7cm), leaf breadth (4.3cm and 4.1cm) and canopy of plants east-west (45.8cm and 44.3cm), north-south (40.5cm and 39.3cm). However, maximum yield q/ha (47.66q/ha and 46.22q/ha) were obtained in 15^{th} July of planting The data statically revealed that planting dates and genotypes had significant effect on vegetative growth and yield during both the years.

Keywords: Cape gooseberry, dates of planting, genotypes, yield

Introduction

The Cape goose berry (*Physalis peruviana* L.) having consisting of chromosome number 2n=24 is a diploid and also a member of Solanaceae family. There are several different name for this fruit around the world, aguaymanto in Peru, Cape gooseberry in South Africa, Rasbhari, Mokoi, Tepari in India, Poha berry in Hawaii, topotopo in Venezuela, uvilla in Ecuador Morton 1987, [16]. The fruit originates from Andes Mountain of South America, Peru to Chile. The name Cape gooseberry was drive for where its originate Cape of Good “Hope” in South Africa during 19^{th} century. More than 100 species but only few have economic value. While the *Physalis ixocrpa* and *P. pubescence* orientated in Asia and India. It is herbaceous, semi-herbaceous, erected, short- lived hairy plant with heart-shaped leaves, produces flower yellowish with purple blotches and resemble tomato like edible fruits with sweet and sour taste. The fruit are cover with papery husk and hangs down word looks like a Chinese lanterns. Cape goose berry can grow into hemispheric shrub that achieves 1 to1.5 m height without training and bears flower in winter and produces fruit 4 to 10g in weight, 1.25 to 2.50 cm in diameters. The fruit contain inside 100 to 200 small yellowish seeds. Now a day it is successfully grown as perennial tropical and annual in temperate regions of developing countries (Novoa *et al*., 2006) [1]. Worldwide, Columbia is largest producer, exporter, and consumer of Cape gooseberry nearly 162,386 tonnes (FAOSTAT 2013). Moreover, *P. peruviana* L. fruit is nutritious, containing high amounts of antioxidants, vitamins, minerals, and fiber, which have been demonstrated to provide significant health benefits. Fresh fruit can be consumed as eaten raw, salads, cooked dishes, and making delectable jam. Therefore Cape gooseberry used in folk medicine to curing many disease *viz*., anticancer, antimycobacterial, malaria, asthama, hepatitis, dermatitis, diuretic and immunomodulatory (Pietro *et al*., 2000 and Soares *et al*., 2003) [19, 20]. There are no reports on the dates of sowing to cultivate the crop in Uttar Pradesh subtropical agro-climate. Larches (2003), revealed that phenology is the study of recurring phenomena in a plant life history in relation to climate and an evaluating variations throughout the life cycle. In agriculture, phenological investigations are important for determining when to perform crop assignments and the health of plants.

They are also utilized in agricultural meteorological studies to investigate the relationships between crop development and climate has highly visible indicators such as leaves, flowers, and fruit (Rodrigues *et al*., 2013) [9]. Moreover, several factors influence Cape gooseberry cultivation in order to improve fruit quality and yield parameters (Sandoval *et al*., 2018) [10]. The Cape gooseberry completed his phonological phase 254 days with maximum height of 193 cm, stem diameter of 1.16 cm and estimated yield was 300 fruits and production was 151.2 g per plant. The date of sowing the plant population per unit area is vital for optimal plant growth and high yield (Hamma *et al.*, 2012) [8]. The main aim of this study was to find out the suitable dates of planting and genotypes of Cape gooseberry which influenced on the morphological development of the plants and on their productivity under Lucknow condition of Uttar Pradesh.

Materials and Methods

The field experiments were carried out during the two consecutive cropping seasons of June 2019-20 and June 2020-2021 during the *Kharif* season in the Department of Horticulture, SAST, Babasaheb Bhimrao Ambedkar University, Lucknow. The experiment site was situated in a sub-tropical climate and located at 26^0 55'N latitude and 80^0 59'E longitudes at a height of 123 meters above sea level. The research field's soil was sandy clay loam and slightly alkaline soil with a pH 8.2 and low organic matter content (Dwivedi *et al*., 2012) [4]. The experiment consisted of two factors: planting dates and genotypes. Factor A as a main plot and Factor B as a subplot Factor A consisted of four planting dates (15th June, 15th July, 15th August and 15th September) which have been sown in the first week of every month and Factor B denotes genotypes *viz.,* Lucknow, Banaras, CITH CGB Sel. 02, CITH CGB Sel.03 and CITH CGB Sel.05. The experiment was laid out in split pot design and replicated thrice. Land was prepared for Cape gooseberry cultivation by applying the recommended doses of manures and fertilizers. FYM was applied in full doses at a rate of 20 tonnes per hectare (Chattopdhyay, 1996) [21]. Recommended doses of NPK were applied @of 100:80:80: Kg per hectare (Ali Angrej *et al.*, 2016) [11]. During the field preparation, the full dose of P, K, and one-third of N were applied. The remaining portions of nitrogen were applied into two equal parts around the root zone at 60 and 90 days after planting. Forty-five days old seedlings were transplanted into the main field. Irrigation along with other cultural operations including plant protection measures were done as and when required. The phenological studies were done on the widespread presence of several plants developmental phases for each replication of genotypes. The observations were recorded on three randomly selected plants based on vegetative characteristics *viz*., plant height (cm), stem diameter (cm), number of primary branches per plant, internodal distance (cm), leaf length and breadth (cm), canopy of plant east – west (cm) and north - south(cm) and yield (q/ha.) & yield attributes characteristics analyz. Data collected during the investigation of both years were statically analysed at a 5% level of significance by using Panse and Sukhatme's standard procedure (1985).

Results and Discussion

Effect of different dates of planting and genotypes on vegetative growth and yield of Cape-gooseberry

It is obvious from the data given in Table-I clearly revealed that among different planting dates, first planting (99.20 cm and 95.31 cm) dates 15th June gave the highest plant height preceded by second planting dates (97.79cm and 92.50cm) in 15th July. However, minimum was recorded in last planting dates (40.60cm and 37.27cm), respectively which was planted in the 15th September in both years. Furthermore, planting dates were noted as being equally significant to one another. The maximal (1.31cm and 1.25cm) first planting dates as of 15th June and minimal (0.96cm and 0.92cm) fourth planting dates as of 15th September stem diameters were recorded in the both years respectively. All planting dates were depicted as being crucially significant. Second (10.47 and 10.54) planting dates as of 15th July and followed by first (9.33 and 11.13) planting dates on 15th June both had the highest number of primary branches per plant, whereas fourth (7.87 and 8.31) planting dates as of 15th September had the lowest number of primary branches/plant., It is obvious from the table that for two consecutive years first planting dates (as of 15thJune) had seen the maximum canopy spreading (45.82cm and 44.25cm) E-W and N-S (40.52cm and 39.33cm) preceded by second planting (43.90cm and 43.21cm) dates E-W and N-S (39.49cm and 37.43cm). Similarly, the minimum canopy spread direction E-W (21.72cm and 21.09cm) and N-S (18.35cm and 18.07cm) were noted in the last planting dates as of 15th September. Despite the fact that the maximum (5.35cm and 4.94cm) intermodal distance was noted on first planting dates and the minimum (3.97cm and 3.73cm) intermodal distance were measured on the last planting dates in both years. The maximum (23.58 and 17.44) and minimum (13.17and 8.58) numbers of leaves per branch were recorded on the first on 15th June and subsequent in last planting dates as of 15th September respectively in both years. At the first date of planting (as of 15th June) maximum leaf lengths (6.02cm and 5.7cm) as well as breadth (4.29 cm and 4.09 cm) were noted. Although the minimum (2.18cm and 2.82 cm) leaf length and breadth (3.06cm and 1.94cm) were recorded on the last planting dates 15th September in both years. However, yield (q/ha) was highest during the first planting date as of 15th June (40.95 and 39.63) and lowest (10.66 and 10.94) during the last planting date as of 15th September throughout two consecutives cropping years. The planting dates had significantly influenced the vegetative growth parameters. These results conformed the findings of effect on different planting dates and genotypes Hamma *et al*. (2012) [8] an early planting date produced superior results in terms of growth since the crop had more time to finish the vegetative phase. Insufficient vegetative growth under a late sowing date resulted in a decline in LAI, which in turn resulted in a decreased sesame yield potential, according to Boquet *et al*. (1983) [12]. Due to altered day length temperatures and their interaction, most plants respond differently to diverse planting dates (Boote, 1980 and Lee *et al*., 1982) [15, 13].

Interactive effect dates of planting and genotypes on growth and yield attributing characters of Cape gooseberry

It is evident from the data recorded in from Table.1that assessment of the phonological development of Cape gooseberry plants during 2019–20 and 2020–21 at under different planting dates showed that the genotypes had a substantial impact on vegetative growth characteristics under Lucknow region, the maximum plant height (67.76 cm and

65.13 cm), stem diameter (1.17cm and 1.11cm) and intermodal distance (5.43cm and 5.08cm) were observed in both years. Whereas, interactive effect of planting dates on genotypes, minimum plant height (67.58cm and 63.39 cm), stem diameter (0.96cm and 0.92cm) and intermodal distance (4.33cm and 4.04cm) were measured in CITH CGB Sel.05 and CITH CGB Sel.03, respectively during the experimentation. On the other hand, genotype Banaras (8.33 and 8.81) had the lowest number of primary branches per plant and CITH CGB Sel.03 (11.25 and 11.45) had the highest number of primary branches. The CITH CGB Sel.02 had the maximum number of leaves per branch (21.81 and 15.75), while Banaras had the minimal number of leaves (17.45 and 11.54). Although in Banaras, the canopy spread E-W was at its maximum (36.90 cm and 35.67 cm) as well as its minimum E-W (32.95cm and 32.53 cm), while in CITH CGB Sel.03, the canopy spread N-S was at its lowest (28.92cm and 28.07cm). The largest leaf measurements, (5.36 cm and 5.09 cm) in length and (3.8 cm and 3.66cm) in breadth, were found in Banaras. Although, the genotypes CITH CGB Sel.03 and CITH CGB Sel.05 recorded for the minimum leaf length (3.93cm and 3.70cm) and breadth (2.70cm and 2.50cm), respectively, were obtained in both years. While, maximum yield (q/ha) were obtained in CITH CGB Sel. 02 (35.92q and 35.72q) and minimum in Lucknow (22.64q and 22.40q) yield (q/ha) in both years. The difference in yield per plant due to planting time might be due to the differences in growing environment in vegetative growth phase, which was similar to that of Chandler *et al.* (1991). These results are in conformity with the findings of Menzel and Smith (2011) [7] and Rahman *et al.* (2014) [6].

Table 1: Effect of planting dates and genotypes on vegetative growth and yield characteristics of Cape gooseberry

Treatment	Plant height (cm)		Stem diameter (cm)		Primary branches/ plant		Intermodal distance (cm)		Number of leaves/plant		Canopy of Spread East-West (cm)		Canopy of Spread North-South (cm)		Leaf Length (cm)		Leaf Breadth (cm)		Yield (q/ha)	
Planting Date	**2019-20**	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**
15th June	99.2	95.3	1.3	1.3	9.3	11.13	5.35	4.9	23.6	17.4	45.8	44.3	40.5	39.3	6.0	5.7	4.3	4.1	39.63	40.29
15th July	95.8	92.5	1.2	1.1	10.5	10.54	5.13	4.8	23.6	15.1	43.9	43.2	39.5	37.4	5.2	4.9	3.9	3.7	47.66	46.22
15th August	50.7	47.8	1.0	1.0	9.7	9.98	4.85	4.5	17.9	13.3	25.8	25.1	23.1	22.0	3.8	3.6	2.8	2.6	20.74	20.59
15th September	40.6	37.3	0.8	0.7	7.9	8.31	3.97	3.7	13.2	8.6	21.7	21.1	18.4	18.1	2.2	2.8	3.1	1.9	10.94	10.80
S.E.(m)±	0.48	0.44	0.007	0.005	0.21	0.24	0.05	0.05	0.09	0.12	0.12	0.14	0.15	0.16	0.062	0.031	0.05	0.04	0.24	0.36
C.D. (p = 0.05)	1.69	1.55	0.025	0.017	0.74	0.84	0.18	0.18	0.30	0.43	0.42	0.51	0.52	0.56	0.16	0.11	0.22	0.16	0.84	1.29
Genotypes																				
Lucknow	67.8	65.1	1.17	1.11	9	10.11	5.43	5.1	18.0	12.9	33.9	32.8	29.4	28.6	5.0	4.7	3.8	3.6	22.64	22.40
Banaras	76.3	73.6	1.07	1.04	8.33	8.81	5.18	4.8	17.5	11.5	36.9	35.7	32.8	31.6	5.4	5.1	3.9	3.7	25.63	25.05
CITH sel-02	75.8	72.3	1.07	1.00	9.19	10.08	4.66	4.4	21.8	15.8	34.3	33.4	30.7	29.7	4.3	4.0	3.1	2.9	35.92	35.72
CITH sel-03	70.5	66.7	1.04	1.00	11.25	11.45	4.33	4.0	20.7	14.4	33.0	32.5	28.9	28.1	3.9	3.7	2.9	2.7	34.34	34.59
CITH sel-05	67.6	63.4	0.96	0.92	8.92	9.51	4.54	4.2	19.9	13.4	33.6	32.6	30.1	28.1	4.0	3.7	2.7	2.5	30.14	29.61
S.E.(m)±	0.3	0.4	0.007	0.011	0.2	0.15	0.05	0.04	0.13	0.14	0.13	0.19	0.13	0.12	0.06	0.05	0.07	0.06	39.63	40.29
C.D. (p = 0.05)	0.87	1.18	0.02	0.032	0.59	0.42	0.16	0.12	0.36	0.40	0.39	0.55	0.38	0.34	0.18	0.14	0.20	0.16	47.66	46.22
Interaction																				
BXA S.E.(m)±	1.07	0.98	0.016	0.032	0.47	0.53	0.112	0.113	0.191	0.270	0.27	0.32	0.33	0.36	0.138	0.069	0.100	0.099	1.098	0.536
C.D.0.05	1.90	2.51	0.043	0.064	1.24	0.92	0.328	0.265	0.746	0.837	0.80	1.13	0.81	0.74	0.379	0.279	0.410	0.332	2.688	3.028
AXB S.E.(m)±	0.72	0.85	0.014	0.02	0.42	0.35	0.109	0.092	0.240	0.276	0.27	0.37	0.28	0.26	0.128	0.090	0.131	0.108	0.924	1.008
C.D.0.05	2.28	2.61	0.044	0.059	1.28	1.12	0.33	0.284	0.714	0.833	0.80	1.10	0.85	0.82	0.388	0.266	0.390	0.325	2.839	2.954

Conclusion

Based on the results of two years, it can be concluded that on the basis of planting dates and genotype which are statistically significant and influenced the vegetative growth during the period of 15th of June planting. However, the higher yield was obtained with 15th of July. Moreover, irrespective of genotypes CITH CGB Sel.02 gave the better vegetative growth and economical yield of Cape gooseberry. Among, the various genotypes and different planting dates and their combined effect showed that on genotypes CITH CGB Sel.02 seems to be promising in terms of yield and yield attributing characters.

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