



Influences of Different Sowing Dates with Application of GA₃ on Germination and Seedling Growth of Cape Gooseberry (*Physalis peruviana* L.) in Subtropical Condition Prayagraj

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation was carried out to find influences of different sowing dates with application of GA₃ on germination and seedling growth of Cape gooseberry (*Physalis peruviana* L.) in subtropical condition Prayagraj. The experiment was conducted in a Complete Randomized Design with three replications during August-March (2022-23) at Horticultural Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences Prayagraj Uttar Pradesh India. The 10 treatments comprised of five dates of sowing i.e., T₁: 20 August 2022 with seed treatment from GA₃ @100ppm, T₂: 20 August without seed treatment from GA₃, T₃: 5 September 2022 with seed treatment from GA₃ @ 100 ppm, T₄: 5 September without seed treatment from GA₃, T₅: 20 September 2022 with seed treatment from GA₃ @100ppm, T₆: 20 September 2022 without seed treatment from GA₃. T₇: 5 October 2022 with seed treatment from GA₃ @100ppm, T₈: 5 October 2022 without seed treatment from GA₃, T₉: 20 October 2022 with seed treatment from GA₃ @100ppm, T₁₀: 20 October 2022 without seed treatment from GA₃. From all the above treatments the highest percentage of germination was recorded from T₇: 93.33% followed by T₈: 90% and T₁₀: 91.66% and vegetative growth of seedling was higher in T₇ followed by T₈ and T₉. All the treatments are sown in nursery through seed propagation after that transplanted in main field level for observe germination parameters and vegetative growth of Cape gooseberry seedling influenced by different sowing dates.

Keywords: Seed treatment; GA3; horticulture; *Physalis peruviana*; yield; germination.

1. INTRODUCTION

Cape Gooseberry (*Physalis peruviana* L.) is an annual fruit crop that is widely grown in many tropical and subtropical regions around the world. The genus *Physalis* (bladder) of the family Solanaceae includes annual and perennial herbs with globular fruits enclosed in inflated calyx that becomes papery on maturity and resembles a Chinese lantern. Various *Physalis* species have been subjected to far too much confusion in literature and commerce. Cape gooseberry is a well-known species that produces superior fruit (*Physalis peruviana* L.). In Hawaii, it is known as Poha or Poha berry, in South Africa as Golden berry, and in India as Rashbhari, Makoi, Tepari, Husk cherry, and Peruvian ground cherry. Cape gooseberry's name is most likely derived from the name "Cape of God Hope" of Southern Africa where it was commercially grown [1-5].

The fruits are yellow-orange berries that are 2 to 3.5 cm in diameter, very juicy, aromatic, and have a distinct bitter-sweet flavor. The small fruits, which resemble tomatoes in shape but have a sweeter taste, better aroma, and a higher pectin content, remain enclosed by the large accrescence epicalyx [6,7]. It can, however, be grown as a perennial crop in some areas with favourable climatic conditions. Fruits are eaten fresh and can be used in the fruit processing industry to make syrup, sauce, recipes,

puddings, chutneys, ice cream, and fruit salads due to their good natural flavor [8-11].

The Cape gooseberry is native to Peru and Chile, but it has been widely introduced into cultivation in other tropical, subtropical, and temperate regions. It is said to thrive wherever tomatoes can be grown, and its nutritional value rivals that of any other major fruit crop. Berry contains 18% protein, 0.2% fat, and 11.5% carbohydrates in the edible portion. It also contains 10 mg of calcium, 60 mg of phosphorus, and 18 mg of iron per 100 gram of fruit pulp, as well as 0.1 mg of thiamine and 1.70 mg of niacin. The ripe fruits are eaten fresh and used to make excellent quality jelly, sauces, and especially jam, for which it is known as the "Jam fruit of India." When dipped in chocolate or other glazes, or pricked and rolled in sugar, the fruits are also appealingly sweet [12-15].

Cape gooseberry is an herbaceous, soft-wooded, erect, veining shrub. Plants have ribbed, often purplish spreading branches on which velvety heart-shaped pointed leaves 6-15 cm long and 4-10 cm wide appear on a regular basis. Yellow pendulous flowers with campanulate hairy corollas with purple to brown spots are born in leaf axils.

The flowers are self-pollinated, but pollination can be improved by gently shaking flowering stems or spraying the plants with water after the

flowers have fallen. The calyx expands, eventually forming a straw-colored husk that is much larger than the fruits it contains. The berry is globosely, smooth, glossy, orange-yellow skin and juicy pulp containing numerous very small yellowish seeds when it is ripe [16-20]. As the fruits ripen, they start to fall to the ground. Fruits are generally harvested manually at regular intervals, which is the most expensive operation in Cape gooseberry production. It is grown as an annual crop in the plains of northern India and as a perennial crop in the hills of southern India. It is successfully grown in states such as Uttar Pradesh, West Bengal, Madhya Pradesh, Haryana, Punjab, the Nillgiri Hills, and other parts of the country. It can be grown successfully up to an elevation of 1200m in North India [21-23]. It grows well up to 1800m in South India. The plant prefers a sunny, frost-free location that is protected from strong winds. It can grow in temperatures as low as 50 degrees Celsius and as high as 350 degrees Celsius; however, temperatures around 210 degrees Celsius are ideal for a good crop.

The dates of sowing and plant population per unit area are critical in achieving optimal plant growth and high yield. According to Bhatnagar and Pandita, the correct sowing time resulted in a higher yield and improved tomato fruit quality [24,25]. The success of any crop depends on a variety of factors, including soil, sowing date, temperature, sunshine hours, and so on.

The Cape gooseberry plant requires full sun, a warm temperature, and protection from frost, among other things. Plants can be grown as annuals in areas where frost or freezing occurs. Cape gooseberry seeds are typically easy to germinate due to their epigeal nature, though germination time may be slightly longer than that of other vegetable seeds. Cape gooseberry seeds should be sprouted in trays with pores that are 80-100mm deep. Germination in the ground is not recommended because conditions are not as easily controlled. Use a well-drained standard potting mix. Before planting the seeds, make sure the potting mix is damp.

Because Cape gooseberry seeds are so small, watering overly dry soil can cause them to dislodge from their position and sink deep into soil cracks. Seeds that sink deeply into soil will not

be able to reach the soil surface once germinated.

Plant seeds in the soil 1/4 inch deep. Cover with soil and carefully water. Overwatering can promote fungal growth, which causes seed rot. Excess water can also bury seeds deep in the soil, preventing them from breaking the surface. When the soil surface begins to dry, apply water. Multiple seeds can be planted in a single starter container, but once seedlings appear, they should be thinned out so that only one plant remains.

The soil should be kept consistently warm, between 75° and 85° Fahrenheit. Cool soils, even if only at night, will significantly delay or inhibit germination. Germination is also inhibited by hot soils above 95 degrees Fahrenheit. Once a few true leaves have formed, the seedling should be gradually moved outside into natural light. Because seedlings should not be exposed to direct, scorching sunlight, plants may need to be hardened off through show sun exposure. Hardening off can be accomplished by using a location with shaded or filtered light, as well as protection from strong winds, rain, or low humidity. The time required for hardening varies, but it can take 5-10 days.

The Cape gooseberry is more acceptable in marginal lands as a mono crop or in mixed cropping with other fruit trees due to its wide adaptability to varying soil conditions without much care [26].

While most of the regions' available normal soils are under cultivation of major crops, some minor crops, such as Cape gooseberry, are critical for their cultivation in marginal lands due to horizontal increases in fruit production, as well as their inclusion in crop diversification for sustainable agriculture. Aside from the crop's genetic potential, the growing environment (i.e. soil conditions, cultural practices) 369 has a significant impact on plant growth and yield. One of the most serious issues is soil salinity, which affects roughly one-third of the world's irrigated land (Mengel et al., 2001). Its global spread is increasing on a regular basis (Schwabe et al., 2006), making it a very serious problem for crop production, with negative effects on germination, plant vigour, and crop yield (Munns and Tester, 2008). In India, salt-affected soils cover approximately 6.73 million ha (Sharma and Gupta, 2010).

One of the considerations for successful crop cultivation under soil salinity conditions is crop selection. Morton [26] claims that cape gooseberry is fairly adaptable to a wide range of soil conditions. According to Miranda et al. (2010), cape gooseberry is commonly grown in Columbia's salt-affected soils. In terms of solanaceous vegetables, which are closely related to cape gooseberry, these crops respond well to applied fertilisers in terms of yield and quality. Furthermore, plant spacing or plant population per unit area may play an important role in optimum plant growth and fruit yield. One of the considerations for successful crop cultivation under soil salinity conditions is crop selection. Morton [26] claims that Cape gooseberry is fairly adaptable to a wide range of soil conditions. According to Miranda et al. (2010), Cape gooseberry is commonly grown in Columbia's salt-affected soils. In terms of solanaceous vegetables, which are closely related to Cape gooseberry, these crops respond well to applied fertilisers in terms of yield and quality. Furthermore, plant spacing or plant population per unit area may play an important role in optimum plant growth and fruit yield.

2. MATERIALS AND METHODS

The present investigation entitled "Influences of different sowing dates with application of GA3 on germination, growth, yield and quality attributes of Cape gooseberry (*Physalis peruviana*) in subtropical condition Prayagraj was done to record the optimum nursery preparation time, germination par T3: 5 September 2022 with seed treatment from GA3 ammeters, vegetative growth parameter, Yield and Quality parameters of Cape gooseberry influenced by different sowing dates with application of GA3 and without GA3. The

details of the materials used and the procedures adopted in the investigation, which was carried out at Horticultural Research Farm (HRF), Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj during the Rabi season of 2022-23.

The experiment was laid out in Complete Randomized Design with three replications. The treatments comprised of 5 dates of sowing comprising 10 treatments, with seed treatment from GA3 @ 100 ppm and without seed treatment i.e. T1 20 August 2022 with seed treatment from GA3 @ 100, T2: 20 August 2022 without seed treatment, T3: 5 September 2022 with seed treatment from GA3 @ 100 ppm, T4: 5 September 2022 without seed treatment, T5: 20 September 2022 with seed treatment from GA3 @ 100 ppm, T6: 20 September 2022 without seed treatment, T7: 5 October 2022 with seed treatment from GA3 @ 100 ppm, T8: 5 October 2022 without seed treatment, T9: 20 November 2022 with seed treatment from GA3 @ 100 ppm, T10 : 20 October 2022 without seed treatment. Sowing media will be the mixture of vermicompost, soil and cocopeat with the ration of 4:4:2 and it will be sterilize in autoclave for killing microbes and then after cooling the media. Portrays was sterilized with ethanol 70% for removing fungal contamination.

Portrays having 2X5 cavities with depth of 85 mm. Portrays was filled with media. Ten number of seeds was sown in each portray in the depth of 1-1.5 cm and it will be immediately irrigated with the help of rose cane after seed sowing and then portrays will kept in shaded area. Optimum

Table 1. Treatment details

Treatments	Sowing date	Application
T1	Second fortnight of August (20August)	With GA3 (100 ppm)
T2	Second fortnight of August (20August)	Without GA3
T3	First fortnight of September (5 September)	With GA3 (100 ppm)
T4	First fortnight of September (5 September)	Without GA3
T5	Second fortnight of September (20 September)	With GA3 (100 ppm)
T6	Second fortnight of September (20 September)	Without GA3
T7	First fortnight of October (5 October)	With GA3 (100 ppm)
T8	First fortnight of October (5 October)	Without GA3
T9	Second fortnight of October (20 October)	With GA3 (100 ppm)
T10	Second fortnight of October (20 October)	Without GA3

moisture will be maintained during the period of seed germination. The seeds of first treatment were sown first fortnight of August 2022. Then after whole treatment seeds were sown in each fortnight intervals. When seedling attains height of 15-20 cm then it will be transplanted in main field with spacing of 60x50cm. Observations will be recorded like germination parameters, vegetative growth parameters of seedling, yield and quality parameters of Cape gooseberry. These all above observations will be recorded at nursery level and main field level.

3. RESULTS

The present studies on the “Influences of different sowing dates with application of GA3 on germination, growth, yield and quality attributes of Cape Gooseberry (*Physalis peruviana*) under subtropical condition Prayagraj” were carried out at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences-Prayagraj, during the year 2022-2023.

The results obtained during the course of study are summarized as under following.

Days taken to seed germination was recorded among all treatments lowest days taken to seed germination was T7 twelve days are taken to 93.33% germination rate followed by T9 91.66% at 12thday, T8 90 % seeds at 12thday seeds are germinated while in T1, T2, T3, T₄, T5, T6, : 80% :73.3%: 60%: 58.33%: 20%: 18.33%: seeds were germinated at 20 days.

Germination percentage was recorded among all treatments the highest germination percentage was found in T7 twelve days at 93.33% germination rate followed by T9 91.66% at 12thday, T8 90% seeds at 12thday seeds are germinated while in T1, T2, T3, T₄, T5, T6, :80% :73.3%: 60%: 58.33%: 20%: 18.33%: seeds were germinated at 20 days.

Hypocotyls length was recorded among all treatments seeds which was treated with GA3 @ 100 ppm for 12 hours showed bigger hypocotyl as per without treated seeds with GA3. T7 showed highest length 1.49 cm followed by T1 and T8.

Appearance of cotyledonary leaves was recorded among all treatment lowest day taken to appearance of cotyledonary leaves was T9: 8 days, followed by T10: 8.08 days, T7: 8.33 days.

While highest days taken to appearance of cotyledonary leaves was T6: 28.16 days followed by T5: 27.66 days.

Appearance of true leaves are recorded among all treatment the lowest day were found in T9 :10 days followed by T10:11 days, T7: 10.58. While higher days are taken by T6: 30.16 followed by T5: 29.66 days.

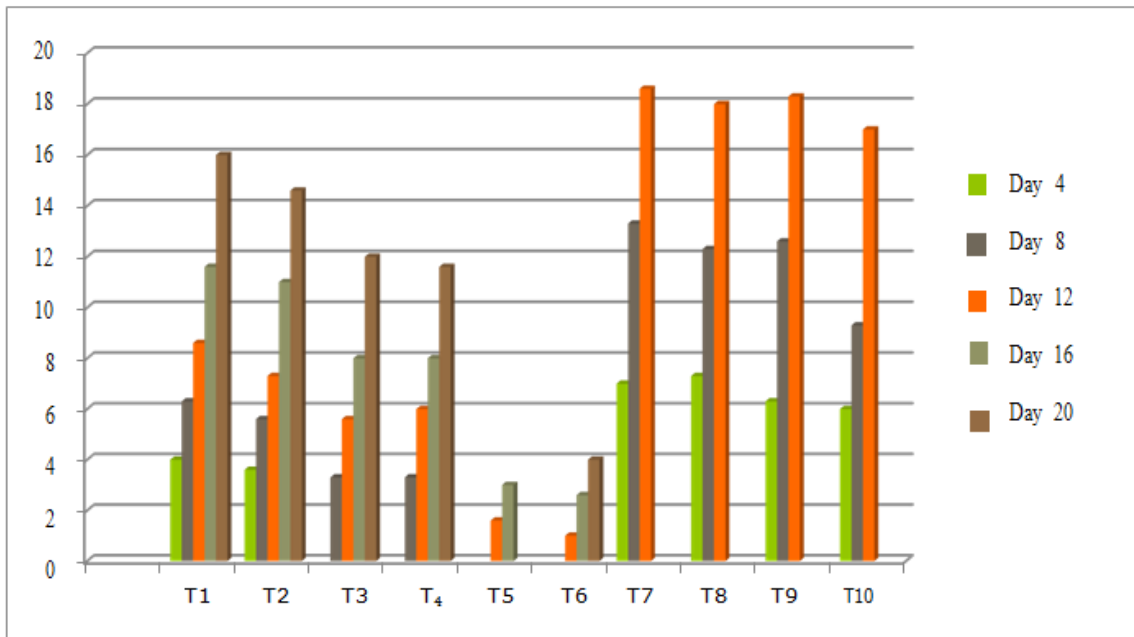
Appearance of plumule among all treatments the lowest days taken to appearance of plumule was T7: 2.83 days followed by T8: 3.25 days, T9 :3.41 days. While highest days taken to plumule initiation were in T6: 16.66 days, T₄: 15.83 days.

Table 2. Days taken to germination and germination percentage

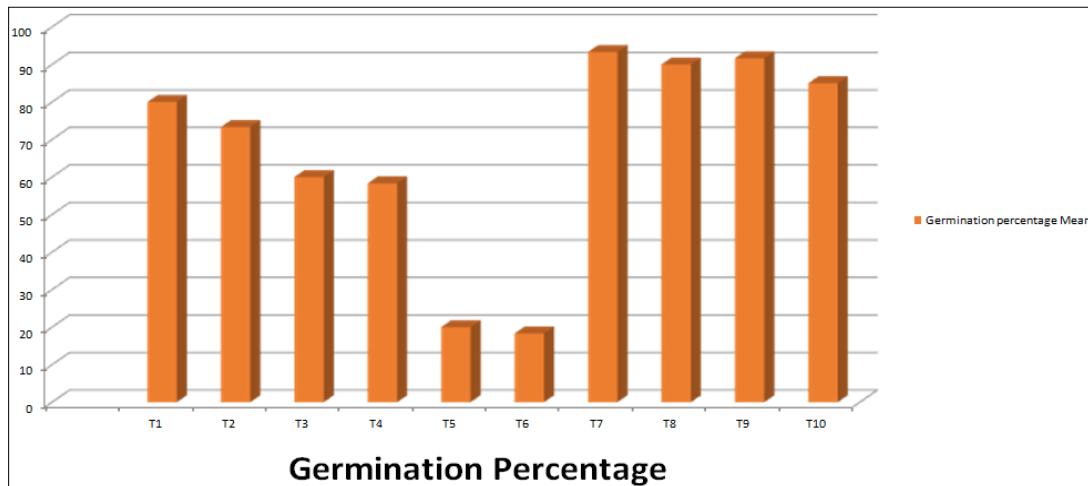
Treatment	Day 4	Day 8	Day 12	Day 16	Day 20	Day 24	Day 28	Total seed sown	% of germination
T1	4	6.3	8.6	11.6	16	-	-	20	80
T2	3.6	5.6	7.3	11	14.6	-	-	20	73.33333
T3	-	3.3	5.6	8	12	-	-	20	60
T ₄	-	3.3	6	8	11.6	-	-	20	58.33
T5	-	-	1.6	3	-	-	-	20	20
T6	-	-	1	2.6	4	-	-	20	18.33
T7	7	13.3	18.6	-	-	-	-	20	93.33
T8	7.3	12.3	18	-	-	-	-	20	90
T9	6.3	12.6	18.3	-	-	-	-	20	91.66
T10	6	9.3	17	-	-	-	-	20	85
F-test	s	s	s	s	S	-	-	-	S
SE(d)	0.89	0.91	0.69	0.61	1.1	-	-	-	1.02
C.V.	31.9	16.96	8.42	16.98	22.44	-	-	-	6.54
CD at 5% level	1.87	1.93	1.46	1.29	2.32	-	-	-	2.09

Table 3. Performance of vegetative growth and survivability of cape gooseberry seedling

Treatment	Length of Hypocotyle (cm)	Days taken to cotyledonary leaves	Days taken to true leaves	Days taken to initiation of plumule	Leaf area @ 30 DAS	No. of Leaves @ 30 DAS	Length of seedling @ 30 DAS	Length of Primary root	Diameter of seedling tender @ 30 DAS	Mean of Survival percentage
T1	1.38	10.5	13.25	5.25	6.05	4.91	4.99	4.483333	5.083333	71.6
T2	0.6	14.5	17.33	7.25	5.466667	4.41	4.5	4.208333	4.725	66.6
T3	1.35	26.08	28.66	14.5	4.491667	3.65	4.241667	3.166667	4.083333	33.3
T4	0.65	26.08	28.41	15.83	4.233333	2.66	3.483333	2.95	3.883333	28.3
T5	1.13	27.66	29.66	16.6	3.1	2.45	3.175	2.508333	2.658333	0
T6	1.4	28.16	30.16	16.6	2.591667	2.16	2.725	2.25	2.083333	0
T7	1.49	8.3	10.58	2.8	30.11667	6.83	22.28333	5.591667	7.466667	93.3
T8	0.7	8.08	10.75	3.25	28.25	6	19.79167	4.358333	6.925	93.3
T9	1.38	8	10	3.41	27.70833	5.5	19.9	4.45	6.7	90
T10	0.6	8.08	11	4.25	25.225	5.16	18.5	4.258333	6.383333	90
F-test	S	S	S	S	S	S	S	S	S	S
SE(d)	0.3	0.99	0.97	0.72	0.94	0.35	0.78	0.26	0.39	0.75
C.V	34.54	7.34	6.27	9.89	8.39	9.87	9.29	8.41	9.77	9.93
CD at 5% level	0.64	2.08	2.04	1.52	1.97	0.74	1.65	0.55	0.83	1.55



Graph 1. Graphical representation of Days taken to germination



Graph 2. Influences of different sowing dates with application of GA₃ on germination of cape gooseberry

Leaf area of among all treatments T7: 30.11 showed highest leaf area followed by T8: 28.25. While lowest leaf was recorded in T6: 2.59, followed by T5 :3.1 cm².

Number of leaves among all treatments T7: 6.83 leaves were showed highest leaves followed by T8: 6 leaves while lowest leaves were recorded in T6: 2.1 followed by T5: 2.45 leaves per plant were recorded.

Length of seedling among all treatments the highest seedling length was observed in T7: 22.28 cm followed by T8: 19.79. While lowest

length was recorded in T6: 2.72cm followed by T5: 3.17 cm were observed.

Diameter of seedling @ 30 DAS among all treatments highest diameter was recorded in T7: 7.4 followed by T8: 6.9 mm while lowest diameter was recorded in T6: 2.08 mm followed by 2.65mm.

Length of primary root was recorded among all treatments the highest primary root length was recorded in T7: 5.59 cm followed by T9: 4.45 cm. While lowest length of seedling was recorded in T6: 2.25 followed by T5: 2.95.

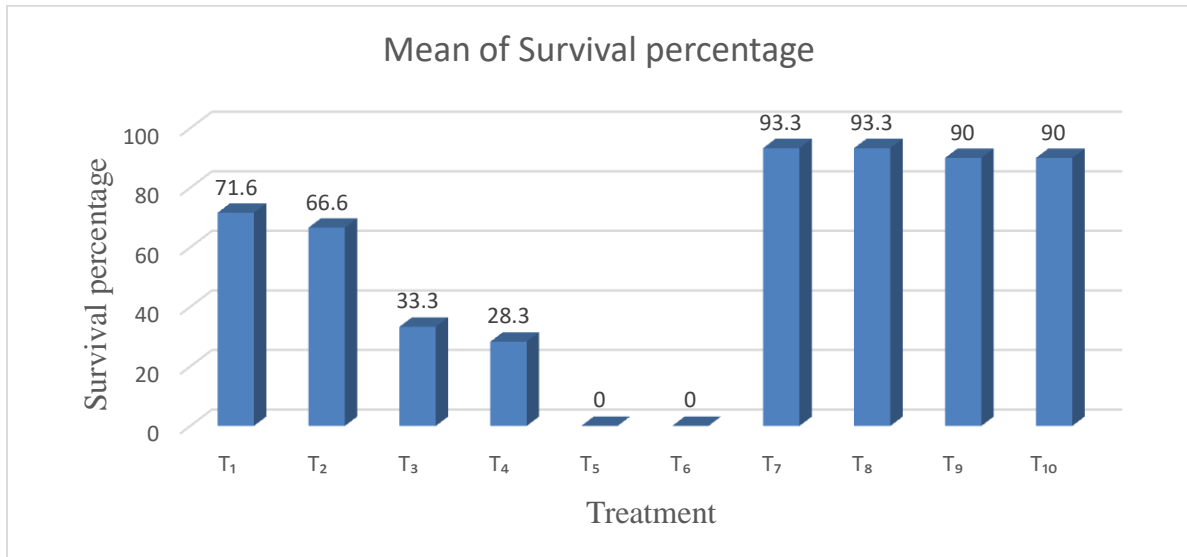


Fig. 1. Graphical representation of survivability of Cape gooseberry

4. DISCUSSION

The present studies on the “Influences of different sowing dates with application of GA₃ on germination and seedling growth of Cape Gooseberry (*Physalis Peruviana*) under subtropical condition Prayagraj” were carried out at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences-Prayagraj, during the year 2022-2023. In this present investigation cape gooseberry seeds were sown in 5 dates with seed treatment from GA₃ and without GA₃ @ 100 ppm concentration. Cape gooseberry sowing was started from 20 August to 20 October at 15 days interval. Temperature and humidity play a vital role in germination of cape gooseberry seeds. In August month temperature was maximum recorded 35^o C and relative humidity was 91 so germination was recorded at 80% but as soon as temperature started decreasing and relative humidity was increasing the rate of germination went on decreasing in the same way till September. In October temperature was 32^o C and relative humidity 92 the germination percentage was recorded 93.33% with seed treatment with GA₃ @ 100 ppm.

5. CONCLUSION

From the present investigation it is concluded that among 5 dates of sowing comprising 10 treatments with seed treatment GA₃ 100 ppm and without seed treatment on the basis of mean performance of all ten treatments comprising 5

dates of sowing from 20 August to 20 October. The highest rate of germination and lowest days taken to germination and also vegetative growth and survivability in main field level was recorded from sowing date 5th October with seed treatment from GA₃ 100 ppm. Sowing time first fortnight of October is suggested for nursery preparation for rapid germination and for good vegetative growth good vegetative growth.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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