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Impact of different PGR on seed germination of dragon fruit (*Hylocereus undatus*) under Chhattisgarh plain

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Abstract
The current study entitled "Influence of different PGR on seed germination and shoot growth of dragon fruit (*Hylocereus undatus*)" was carried out at the Research cum Instructional Farm of Department of Fruit Science, Pt. K.L.S. College of Horticulture and Research Station, Rajnandgaon (C.G.). during the Rabi season of 2022-23 in completely randomized design and replicated thrice with a total of 10 treatments *viz*., T_0: distilled water control, T_1: GA3 @ 50 ppm, T_2: GA3 @ 100 ppm, T_3: GA3 @ 150 ppm, T_4: NAA @ 50 ppm, T_5: NAA @ 100 ppm, T_6: NAA @ 150 ppm, T_7: IBA @ 50 ppm, T_8: IBA @ 100 ppm, T_9: IBA @ 150 ppm. The growth attributing characters of the following dragon fruit were observed to be the maximum among the different treatments. The days to 50 per cent germination were significantly the earliest in T_9 (3.67); germination percentage were the maximum in T_9 (97.78); vigour index-I, vigour index-II, survival percentage, were the maximum in T_9 (23.09 cm, 141.03 g, 96.67 %,); T_8 and T_9 both recorded the maximum among all the other treatments. In the observation referred survival percentage (%) treatment T_9 gave the maximum survivability out of all the treatments and proved to be superior to others.

Keywords: Dragon fruit, benefit cost ratio, germination, survival percentage, maximum

1. Introduction
Dragon fruit [*Hylocereus undatus*] is popular in South East Asia. It is an edible vine cactus species belonging to the family Cactaceae which has received worldwide recognition first as an ornamental plant and then as a fruit crop. It is commonly called as Pitaya. It is known by synonyms such as "Strawberry pear" and "Red pithaya". It is one of the newly introduced exotic fruit crop in India. It's botanical name, *Hylocereus*, refers to both of its adaptation to habitat (hulos means "forest" in Greek) and the way in which it resist the drought situation (the wax or cereus covering the stems). In India, dragon fruit was introduced during the late 1990s. Thereafter, area under its cultivation was gradually increased from 4 to 400 ha in different states during 2005–2017. According to recent estimates, India's dragon fruit production increased drastically to more than 12,000 MT over an area of 3,000–4,000 ha in 2020. Out of total 3,085 ha, more than 80% area (2,468 ha) is under new cultivation with less than 18 months old plantation. Further, average productivity of these areas is ranging from
1.5 to 3.1 MT/ha. While remaining 20% cultivation area (617 ha) is already well established and attained its full maturity level with average productivity of 8–13.5 MT/ha. Indian farmers, who follows good cultivation practices under drip irrigation, can get up to 4.5 tons of fruit per ha in the first year after planting, up to 7.5–10 tones/ha in the second years and 16– 24 tones/ha on third year onwards. This fruit is new to Chhattisgarh and is cultivated in some parts of Durg, Raigarh district (Kotra, Kharsia), Raipur and Rajnandgaon district. As hot climate and low rainfall is suitable for its cultivation so its area and production will increase in Chhattisgarh in future. Area production of dragon fruit in world, India and Chhattisgarh respectively are 1,12,264 ha, 21,00,777 MT (ICAR-NIASM Maharashtra) 3,085 ha 12,000 MT in 2020 (data collected by ICAR-NIASM Maharashtra) and 152 ha 612 MT. {Directorate of Horticulture & farm forestry Raipur (C.G.) 2018-19}.

2. Materials and Methods

The present study, titled **"**Influence of different PGR on seed germination and shoot growth of dragon fruit *(Hylocereus undatus)*". Was conducted in the year 2022–2023, under Shade net of Horticultural Cum Instructional Farm, Department of Fruit Science, Pt. llege of Horticulture and Research Station, Rajnandgaon (C.G.). The chapter covers the specifics of the experimental study and various approaches or methodologies used during the course of the research.

1. **Experimental Site:** The experiment was carried out in Shade net at Horticulture Research cum Instructional Farm, Department of Fruit Science, Pt. K.L.S. College of Horticulture and Research Station, Pendri, Rajnandgaon (C.G.). Geographical situation The geographic coordinates of Chhattisgarh are 17° 14'N - 24° 45'N latitude and 79° 30'E - 84° 15'E longitude. On the banks of the Shivnath River, Rajnandgaon is situated at a height of 307 metres above mean sea level and at coordinates 21° 06' N and 81° 02' E.
2. **Climate and weather condition:** Rajnandgaon is located in India's central region. Rajnandgaon experiences a tropical, wet and dry climate. The temperature in Rajnandgaon is moderate and tolerable throughout the year, but from March to June, during the summer months as its extremely hot. In the summer, the temperature can reach as high as 45 to 50°C. The region receives 1200 mm of rain on average each year, which is typically dispersed from the middle of June through early October. In the month of October, the winter season begins. Rajnandgaon is located in India's central region. Rajnandgaon experiences a tropical, wet and dry climate. In the summer, the temperature can reach as high as 45 to 50 °C. The region receives 120 June through early October. In the month of October, the winter season begins.

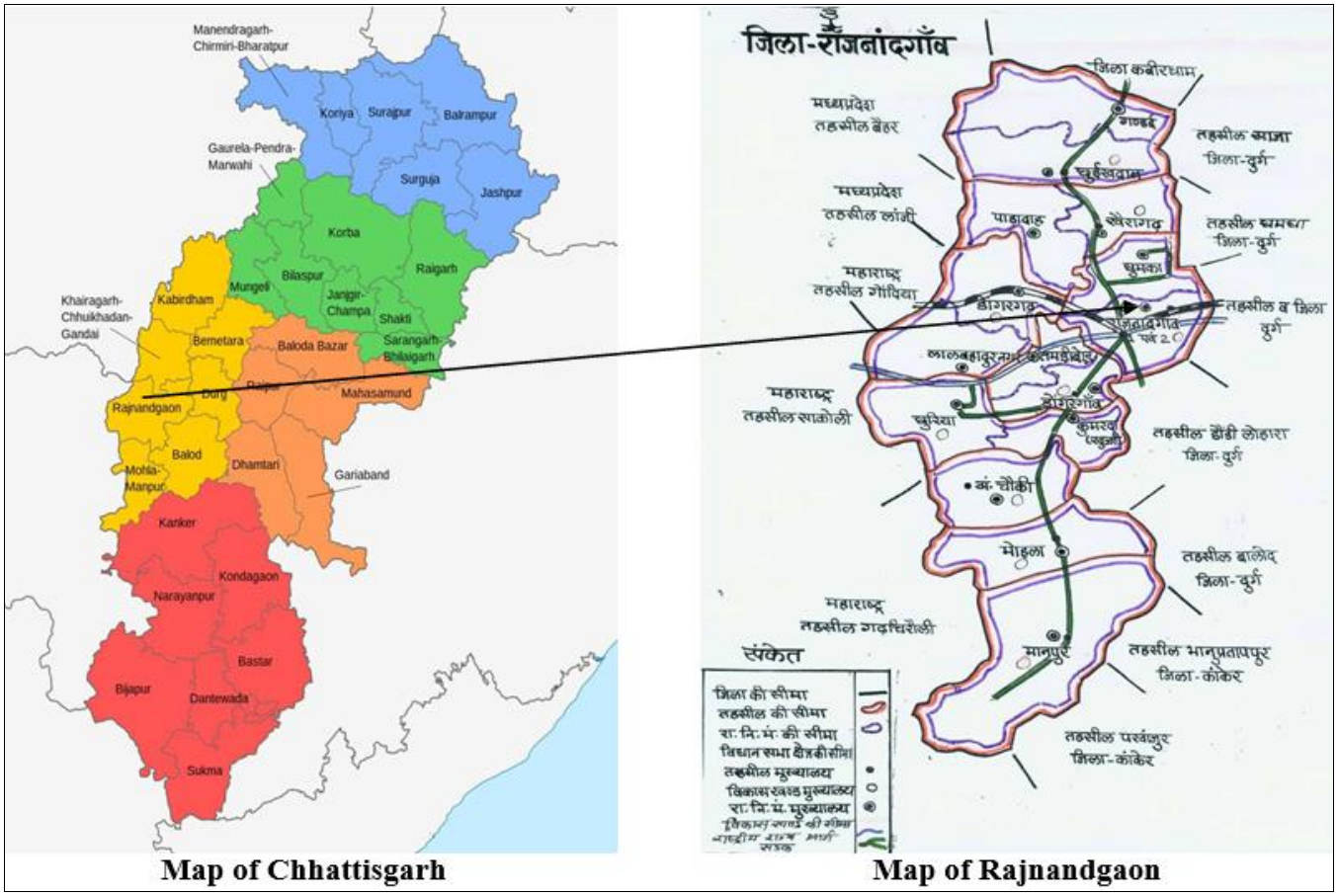

Fig 1: The Location Map of Study Site

c. The experimental materials

- **Gibberellic acid (GA3):** To prepared desired quantity of GA3 i.e. 50, 100 and 150 ppm solution, 50, 100 and 150 mg GA3 powder was weighted and dissolved in 95 % absolute alcohol than volume of 1 liter was made by adding distilled water.
- **Napthalene acetic acid (NAA):** To prepared desired quantity of NAA i.e. is 50, 100 and 150 ppm solution, 50, 100 and 150 mg NAA powder was weighted and dissolved in ethanol just sufficient to dissolve the NAA powder than the solution was made by adding 1 liter of distilled water.
- **Indole Butyric acid (IBA):** To prepared desired quantity of IBA i.e. is 50, 100 and 150 ppm solution, 50, 100 and 150 mg IBA powder was weighted and dissolved in methanol just sufficient to dissolve the IBA powder than the solution was made by adding 1 liter of distilled water.
- **Breaking seed dormancy:** Place the seed on a petridish covered with wet filter paper. Each treatments were repeated 3 times, 30 seed each times. Then germinated seed was transferred in pro-trays.
- **Data collection:** No. of days required for germination (DAS), No. of days required for 50 per cent germination, Germination percentage (%), Vigour Index-I (cm), Vigour Index-II (g), Survival percentage. The ANOVA were carried out by statistical analysis as per the procedure laid down by Gomez and Gomez. The variance ratio (F-value) was used to test the significance of the treatment effect. Appropriate standard errors and critical difference at 5%

probability level was used to test the statistical significance of the results. The following Analysis of variance (ANOVA) table was prepared for each character recorded. The statistical analysis was carried out for each observed character by using MS-Excel and OPSTAT.

Table 1: Treatment details

Treatments	Concentrations of PGR
T_0	Control (Distilled water)
T_1	GA3 @ 50 ppm
T_2	GA3 @ 100 ppm
T_3	GA3 @ 150 ppm
T_4	NAA @ 50 ppm
T_5	NAA @ 100 ppm
T_6	NAA @ 150 ppm
T_7	IBA @ 50 ppm
T_8	IBA @ 100 ppm
T_9	IBA @150 ppm

3. Results and Discussion

3.1 No. of days required for germination

Days to germination is determined by seed genetic composition, morphological features and environmental factors. Less number of days to 50% germination is desirable to obtain early maturity of the crop. The minimum number of days to germination was observed in IBA @ 150 ppm T_9 (3.12 days) suggesting the superiority of the varieties for the given trait among all the other treatments whereas, the maximum number of days to germination was observed in T_0 control distilled water (5.33 days). Distilled water has shown a significant effect on the no. of days required for germination. The no. of days required for germination was under treatment T_0 (5.33) with Control (Distilled water). This could be attributed to the activation of specific hydrolytic enzymes such as α- amylase, which acted upon the reserve food materials stored in seeds at the time of seed development into glucose molecules there by increased the respiratory activity and promote the early seed germination. The results are in agreement with Ahmad (2006) [1].

3.2 No. of days required for 50 per cent germination

Days to 50% germination is determined by seed genetic composition, morphological features and environmental factors. Less number of days to 50% germination is desirable to obtain early maturity of the crop. The minimum number of days to 50% germination was observed in IBA @ 150 ppm T_9 (3.67 days) suggesting the superiority of the varieties for the given trait among all the other treatments whereas, the maximum number of days to 50% germination was observed in T_0 control distilled water (5.67 days). Distilled water has shown a significant effect on the no. of days required for 50 per cent germination. The no. of days required for 50 per cent germination was under treatment T_0 (5.67) with Control (Distilled water). This might be due to rapid hydrolysis of reserve food material stored in the seeds by the action of hydrolytic enzymes activated by endogenous growth promoting substances. The results are in agreement with Ahmad (2006) [1].

3.3 Germination percentage (%)

Germination percentage (%) is determined by seed genetic composition, morphological features and environmental factors. Less number of days to 50% germination is desirable to obtain early maturity of the crop. The perusal of data revealed that there was significant difference in the the maximum germination percentage (%) was observed in IBA @ 150 ppm T_9 recorded the maximum germination percentage (%) (97.78) which was followed by T_8 IBA @ 100 ppm (93.33) and T_7 IBA @ 50 ppm (90.00). While, the minimum germination percentage (%) was observed in T_0 control Distilled water (76.67). This might be due to rapid hydrolysis of reserve food material stored in the seeds by the action of hydrolytic enzymes activated by endogenous growth promoting substances. This could be attributed to the activation of specific hydrolytic enzymes such as α-amylase, which acted upon the reserve food materials stored in seeds at the time of seed development into glucose molecules there by increased the respiratory activity and promote the early seed germination Ahmad (2006) [1]. also reported similar findings for germination percentage in dragon fruit.

Table 2: Impact of Different Concentrations of Ga3, Naa And Iba On No. of Days Required Germination, No. Of Days Required For 50 Per Cent Germination, Germination Percentage (%).

No. of days required germination		No. of days required for 50 per cent germination	Germination percentage (%)
Treatment	Mean	Mean	Mean
Control (Distilled water)	5.33	5.67	76.67
GA3 @ 50 ppm	4.00	4.00	86.78
GA3 @ 100 ppm	4.12	4.00	85.56
GA3 @ 150 ppm	4.03	4.00	88.89
NAA @ 50 ppm	5.28	5.33	82.22
NAA @ 100 ppm	5.20	5.33	84.44
NAA @ 150 ppm	4.90	5.00	85.56
IBA @ 50 ppm	4.20	4.00	90.00
IBA @ 100 ppm	4.00	4.00	93.33
IBA @ 150 ppm	3.12	3.67	97.78
C.D.	0.63	0.63	4.39
SE(m)	0.21	0.21	1.48
C.V.	8.11	8.11	2.94

3.4 The observations of vigour index-I

Vigour index-I is determined by seed genetic composition, morphological features and environmental factors. The perusal of data revealed that there was significant difference in the maximum vigour index-I was observed in IBA @ 150 ppm T_9 recorded the maximum vigour index-I (23.09) which was followed by T_8 IBA @ 100 ppm (19.91) and T_7 IBA @ 50 ppm (18.44). While, the minimum vigour index-I was observed in T_0 control (10.69). These research findings were in accordance to those obtained by UA Raut *et al.* (2022) [6] in dragon fruit.

3.5 Vigour index II (g)

Vigour index II (g) is determined by seed genetic composition, morphological features and environmental factors. The perusal of data revealed that there was significant difference in the maximum vigour index II (g) was observed in IBA @ 150 ppm

T_9 recorded the maximum vigour index II (g) (141.03) which was statistically at par with T_8 IBA @ 100 ppm (128.77) and followed by T_7 IBA @ 50 ppm (103.90). While, the minimum vigour index II (g) was observed in T_0 control (62.12). SISWA Panjang Hernosa *et al.* (2022) [5] observed quite similar results in dragon fruit.

3.6 Survival % at 120 das

Survival % at 120 DAS is determined by seed genetic composition, morphological features and environmental factors. The perusal of data revealed that there was significant difference in the maximum survival % at 120 DAS was observed in IBA @ 150 ppm T_9 recorded the maximum survival % at 120 DAS (96.67) which was followed by T_8 IBA @ 100 ppm (88.33) and T_7 IBA @ 50 ppm (88.32). While, the minimum survival % at 120 DAS was observed in T_0 control (58.33). These research findings were in accordance to those obtained by UA Raut *et al.* (2022) [6] in dragon fruit.

Table 3: Impact of different concentrations of GA3, NAA and IBA on vigour index-I, vigour index II (g), SURVIVAL % AT 120 Das, Root Length (CM)

vigour index-I		vigour index II (g)	Survival % AT 120 DAS
Treatment	**Mean**	**Mean**	**Mean**
Control (Distilled water)	10.69	62.12	58.33
GA3 @ 50 ppm	11.74	71.59	81.67
GA3 @ 100 ppm	12.45	70.06	85.00
GA3 @ 150 ppm	13.99	74.55	80.00
NAA @ 50 ppm	14.57	79.68	65.00
NAA @ 100 ppm	14.77	82.83	65.00
NAA @ 150 ppm	16.14	90.21	68.33
IBA @ 50 ppm	18.44	103.89	88.32
IBA @ 100 ppm	19.91	128.77	88.33
IBA @ 150 ppm	23.09	141.03	96.67
C.D.	2.09	14.15	11.51
SE(m)	0.70	4.76	3.87
C.V.	7.81	9.12	8.64

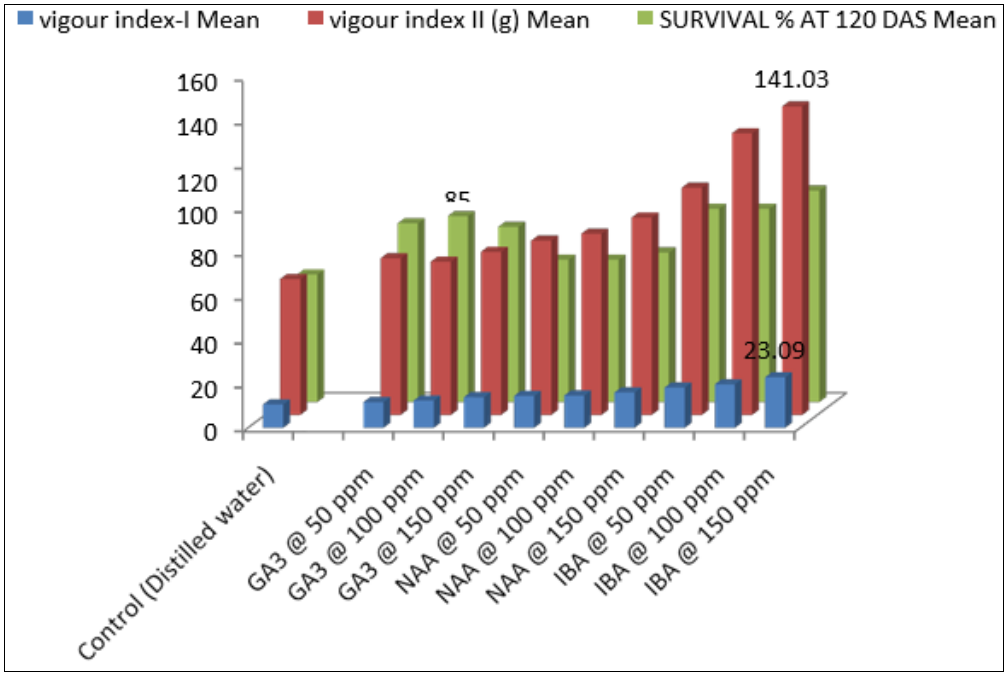

Fig 2: Graphical representation of impact of different concentrations of GA3, NAA and IBA on vigour index-I, vigour index II (g), SURVIVAL % AT 120 DAS, root Length (CM)

4. Conclusion

It can be concluded that in case of germination parameters *viz*., No. of days required for germination, No. of days required for 50 per cent germination and germination percentage (%) were the maximum in T_9 was found to be best for all the three germination parameters and significantly took lesser time for germination, least span of time for 50 per cent germination and for maximum germination percentage (%).In case of seedling growth parameters, it was recorded that T_9 was significantly superior and gave the best results over rest of the treatments and the parameters included vigour index-I, vigour index-II, survival percentage,. In the observation referred survival percentage (%) treatment T_9 gave the maximum survivability out of all the treatments and proved to be superior to others.

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