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Standardization of wedge grafting season on success of custard apple (*Annona squamosa* L.) cv. Balanagar

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Abstract
A field experiment was conducted at the Instructional Farm, Krishi Vigyan Kendra, Raipur university of Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). During the year 2021-22 with a view to study the "Standardization of wedge grafting season on success of custard apple (*Annona squamosa* L.) cv. Balanagar". The custard apple variety of Balanagar was used to grown and treatment was calculated in completely randomized design (CRD). The experiments standardize the season of wedge grafting and determine the shoot growth parameters of custard apple. The wedge method of grafting was done on the selected rootstock for multiplication of custard apple plants. Similar matching thickness of rootstock and scion was selected for grafting for fourteen treatments. The shoot parameters *i.e.*, days taken to sprouting, number of graft sprouted, number of sprouted buds/graft and number of leaves produced per graft were significantly superior in the treatment T_{12} (Wedge grafting on 15th February, 2022). On the basis of above findings, treatment T_{12} (Wedge grafting on 15th February, 2022) stand could be better performance first in position and T_{10} (Wedge grafting on 15th January, 2022) stand in second order of preference. However, treatment T_{11} (Wedge grafting on 30th January, 2022) comes in next in order. Therefore, it may be concluded that treatment T_{12} (Wedge grafting on 15th February, 2022) may be prefer for higher shoot growth in custard apple.

Keywords: Wedge grafting, Balanagar, completely randomized design (CRD), shoot growth, rootstock, scion, sprouting, buds/graft, Annona squamosa

1. Introduction
Custard apple (*Annona squamosa* L.) is an important dry land fruit of India. It belongs to family Annonaceae. The genus includes more than 100 species of which 5 produce edible fruits. Among these, *Annona reticulata* (Bullock's heart, *Ramphal*), *Annona cherimola* (*Hanumanphal*) and *Annona squamosa* L. (Custard apple) are commercially important. Custard apple is cultivated commercially in small scale at different parts of India. However, regular and large scale cultivation of Ram phal and Hanuman phal is not seen. Area under this fruits is particularly found in hilly tracts and forest area of India. Custard apple is most favoured monoecious fruit also known as Sharifa, Sitaphal, Sugar apple and sweetsop in India.
In India, the area under custard apple cultivation is 46 thousand hectares with production of 401 thousand metric tonnes and having productivity of 8.71 metric tonnes (Anon., 2020) [1]. It is commercially grown in India in the states like Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu, Orissa, Assam and some humid parts of Rajasthan. Custard apple is very delicious mostly consumed as table fruit. Custard apple is famous for its flavour and therefore mostly used in Indian desserts, ice cream and drinks in India. Since custard apple is a sweet fruit, it does blend itself well to use for desserts.
In Chhattisgarh, the total area under custard apple is 10064 ha with an annual production of 54802 metric tonnes with productivity of 5.44 metric tonnes (Anon., 2020) [1]. In Chhattisgarh, it is mostly occured in Bastar, Dantewada, Kanker, Rajnandgaon, Kabirdham, Korba, Mahasamund, Bilaspur and Koria district. The phenomenal increase in area is an indication of the acceptability of this fruit by growers for high economic returns.

2. Materials and Methods
The field experiment was conducted at the Instructional Farm, Krishi Vigyan Kendra, Indira Gandhi Krishi Vishwavidyalaya, Raipur university of Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). The Research Farm, Raipur is situated in mid-eastern part of Chhattisgarh at a latitude of 21°16'N, longitude of 81°36'E and at an altitude of 289.56 meters

above the mean sea level. Raipur is characterized as slightly moist and sub-humid zone, where the average annual rainfall received ranges from 1200 to 1400 mm. The month of experiment was from 30th August 2021 to 17th March 2022. The wedge method of grafting was done on the selected rootstock for multiplication of custard apple plants. Similar matching thickness of rootstock and scion was selected for grafting. The grafts prepared in the above manner were irrigated regularly. Sprouts arising from the rootstock were removed regularly. After completion of grafting, the grafted plants were immediately shifted in shade net chamber for proper hardening so that plant may get easily acclimatize in their permanent place after the planting. The observations were recorded at one month intervals up to 120 days after grafting during the course of investigation.

3. Results and Discussion

Data pertaining to shoot growth attributes influenced by various treatments has been given in table 1 and fig 1, 2, 3 and 4.

The minimum days taken to sprouting (10.01) was registered under the treatment T_{12} (Wedge grafting on 15th February, 2022), which was found non-significant differences with the treatments T_{10}, T_{11} and T_{13} having the values of 11.62, 12.58 and 11.13 days respectively. While, the maximum days taken to sprouting (17.85) was recorded under the treatment T_9 (Wedge grafting on 30th December, 2021). Gotur *et al.* (2017) [6] reported that guava plants grafted in August takes minimum time for sprouting might be due to earliness in sprouting also due to favourable internal and external conditions like optimum humidity, moderate temperature and bio-chemical status. These results are also supported by Kulkarni (1990) [12] and Shinde *et al.* (1996) [20] in custard apple.

The highest number of graft sprouted (14.00) was registered under the treatment T_{12} (Wedge grafting on 15th February, 2022), which showed non-significant differences with the treatments T_{10}, T_{11}& T_{13} having respective number of graft sprouted 12.00, 13.00 & 12.00 at 5% level of significance. While, the lowest number of graft sprouted (5.00) was recorded under the treatment T_9 (Wedge grafting on 30th December, 2021). These results corroborates with the findings of Dhutraj *et al.* (2018) [5], who reported that the custard apple plant remain in dormant condition from November to January. At this dormant period sufficient food material is stored in the scion, which helps in better success and higher grafting percentage. The present results are also closely supported by Kulkarni (1990) [12], in custard apple and Mulla *et al.* (2011) [13] in Jamun.

The highest number of sprouted buds/graft (4.85) was registered under the treatment T_{12} (Wedge grafting on 15th February, 2022), which was found statistically at par with the treatments T_{10}, T_{11}& T_{13} and T_1, T_2, T_3& T_4 having the number of sprouted buds/graft of 4.61, 4.73 & 4.78 and 4.43, 4.22, 4.17 & 4.10, respectively. While, the lowest number of sprouted buds/graft (2.73) was recorded under the treatment T_9 (Wedge grafting on 30th December, 2021). This result is in conformity with the finding of Kulkarni (1990) [12], who reported that the grafting done on 15th February and 25th January produced more number of buds in custard apple. Similar results were also reported by Dhutraj *et al.* (2018) [5], who stated that the maximum sprouted buds in custard apple were found in the month of February due to temperature and humidity are enough, which plays an important role for sprouting of buds in the month of February.

Number of leaves per graft was observed significantly maximum at 30 DAG (10.12) in treatment T_{12} (Wedge grafting on 15th February, 2022), which was found non-significant differences with the treatments T_{10}, T_{11} and T_{13} having the number of leaves per graft of 8.73, 9.11 and 9.52, respectively. While, the lowest number of leaves per graft (4.12) was registered under the treatment T_9 (Wedge grafting on 30th December, 2021). At 60 DAG, it is observed that the maximum number of leaves per graft (20.11) was registered under the treatment T_{12} (Wedge grafting on 15th February, 2022), Where as the minimum number of leaves produced per graft (13.05) was recorded under the treatment T_9 (Wedge grafting on 30th December, 2021). At 90 DAG, the superiority of treatment T_{12} (Wedge grafting on 15th February, 2022) recorded highest number of leaves per graft (25.03), While, the lowest number of leaves produced per graft (17.08) was recorded under the treatment T_9 (Wedge grafting on 30th December, 2021). At 120 days after grafting, the data showed that the treatment T_{12} (Wedge grafting on 15th February, 2022) registered the highest number of leaves produced per graft (40.03), the least number of leaves produced per graft (32.05) was seen under the treatment T_9 (Wedge grafting on 30th December, 2021). These results are supported by the findings of Kulkarni (1990) [12] in jamun. Similarly, Pandey and Singh (2001) [16], reported that the sprouting percentage of mango graft was positively correlated with number of leaves per graft. The increase in sprouting percentage also increased the number of leaves per graft. The results of present experiment are similar with the findings of Patil *et al.*(2017) [18] and Dhutraj *et al.* (2018) [5], they stated that the maximum number of leaves (22.01) were produced on 1st February might be due to higher cell activity and early sprouting in custard apple grafts prepared by soft wood grafting.

Table 1: Shoot growth parameter as influenced by season of wedge grafting in custard apple cv. Balanagar

Notations	Treatments	Days taken to sprouting	Number of graft sprouted	Number of sprouted buds/graft
T_1	Wedge grafting on 30th August, 2021	13.17^{bc}	11.00^{efg}	4.43^{cdef}
T_2	Wedge grafting on 15th September, 2021	13.79^{bcd}	10.00^{def}	4.22^{bcdef}
T_3	Wedge grafting on 30th September, 2021	14.03^{bcde}	7.00^{abc}	4.17^{bcdef}
T_4	Wedge grafting on 15th October, 2021	15.20^{cdef}	8.00^{bcd}	4.10^{bcdef}
T_5	Wedge grafting on 30th October, 2021	15.43^{cdef}	6.00^{ab}	3.21^{abc}
T_6	Wedge grafting on 15th November, 2021	16.52^{def}	9.00^{cde}	3.43^{abc}
T_7	Wedge grafting on 30th November, 2021	16.80^{ef}	10.00^{def}	3.53^{abcd}
T_8	Wedge grafting on 15th December, 2021	17.34^{f}	9.00^{cde}	3.75^{abcde}
T_9	Wedge grafting on 30th December, 2021	17.85^{f}	5.00^{a}	2.73^{a}
T_{10}	Wedge grafting on 15th January, 2022	11.62^{ab}	12.00^{fgh}	4.61^{def}
T_{11}	Wedge grafting on 30th January, 2022	12.58^{abc}	13.00^{gh}	4.73^{efg}

T_{12}	Wedge grafting on 15th February, 2022	10.01[a]	14.00[h]	4.85[f]
T_{13}	Wedge grafting on 2nd March, 2022	11.13[ab]	12.00[fgh]	4.78[efg]
T_{14}	Wedge grafting on 17th March, 2022	13.46[bc]	9.00[cde]	2.90[a]
S.Em (±)		1.00	0.86	0.37
C.D. at 5%		2.92	2.50	1.10

Table 1: Conti…

Notations	Treatments	Number of leaves produced per graft			
		30 DAG	60 DAG	90 DAG	120DAG
T_1	Wedge grafting on 30th August, 2021	8.05[defg]	18.03[cdefg]	23.03[def]	36.71[bcdef]
T_2	Wedge grafting on 15th September, 2021	7.45[cdef]	17.51[cdefg]	22.73[def]	36.05[abcdef]
T_3	Wedge grafting on 30th September, 2021	5.22[ab]	14.52[ab]	18.48[abc]	33.07[abc]
T_4	Wedge grafting on 15th October, 2021	7.13[cde]	17.03[bcdef]	22.05[cdef]	35.41[abcde]
T_5	Wedge grafting on 30th October, 2021	5.83[abc]	15.17[abc]	19.07[abcd]	33.61[abcd]
T_6	Wedge grafting on 15th November, 2021	6.11[bc]	15.47[abc]	20.49[abcde]	34.05[abcd]
T_7	Wedge grafting on 30th November, 2021	6.17[bc]	16.08[bcd]	21.03[abcdef]	34.32[abcd]
T_8	Wedge grafting on 15th December, 2021	6.53[bcd]	16.51[bcde]	21.53[bcdef]	35.08[abcde]
T_9	Wedge grafting on 30th December, 2021	4.12[a]	13.05[a]	17.08[a]	32.05[a]
T_{10}	Wedge grafting on 15th January, 2022	8.73[efgh]	18.42[defg]	23.65[ef]	37.31[cdef]
T_{11}	Wedge grafting on 30th January, 2022	9.11[fgh]	19.14[efg]	24.06[ef]	38.05[def]
T_{12}	Wedge grafting on 15th February, 2022	10.12[h]	20.11[g]	25.03[f]	40.03[f]
T_{13}	Wedge grafting on 2nd March, 2022	9.52[gh]	19.53[fg]	24.82[f]	39.11[ef]
T_{14}	Wedge grafting on 17th March, 2022	4.83[ab]	14.13[ab]	17.85[ab]	32.51[ab]
S.Em (±)		0.62	1.02	1.38	1.55
C.D. at 5%		1.82	2.96	4.01	4.51

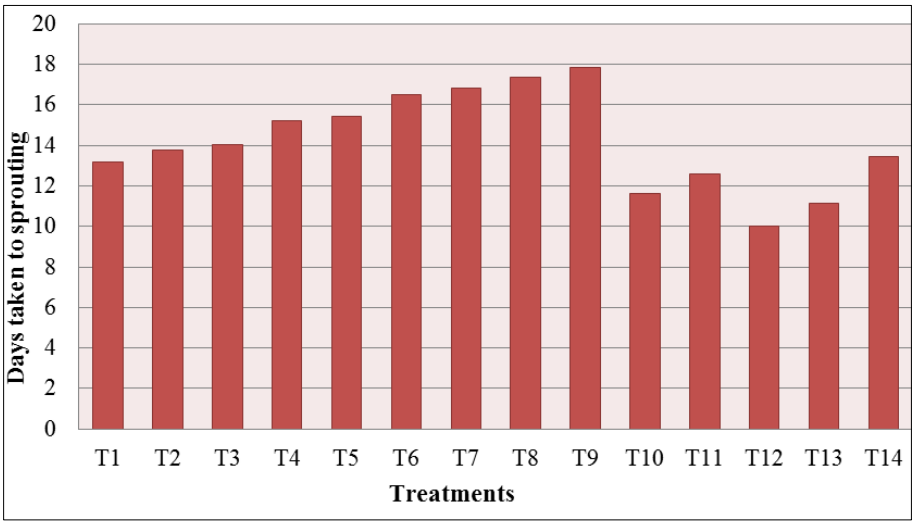

Fig 1: Days taken to sprouting as influenced by season of wedge grafting in custard apple cv. Balanagar

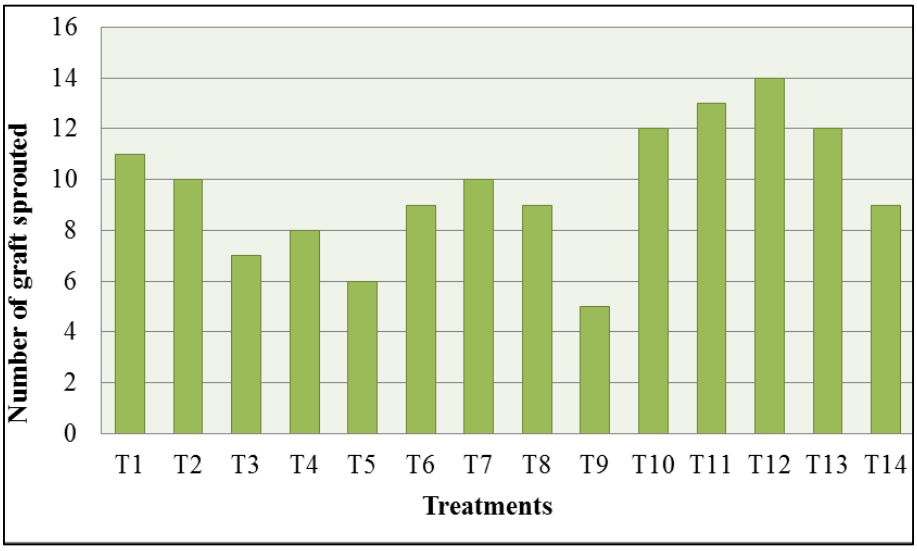

Fig 2: Number of graft sprouted as influenced by season of wedge grafting in custard apple cv. Balanagar at 30 DAG

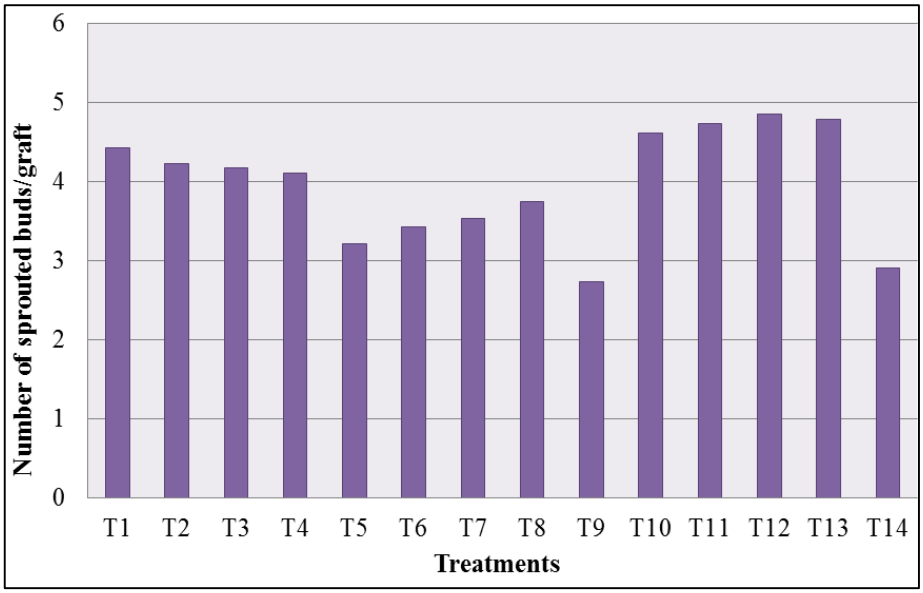

Fig 3: Number of sprouted buds/graftas influenced by season of wedge grafting in custard apple cv. Balanagar at 30 DAG

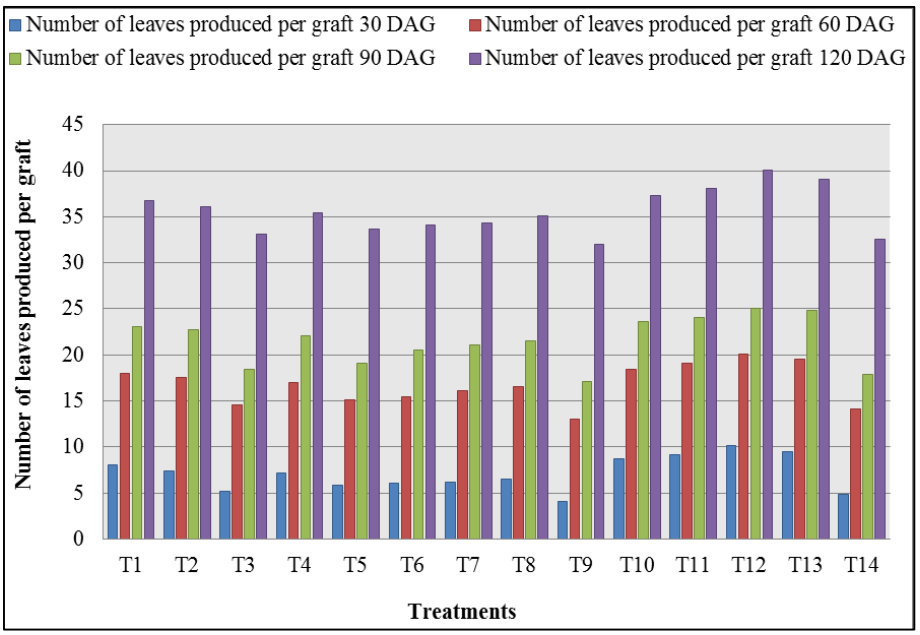

Fig 4: Number of leaves produced per graft as influenced by season of wedge grafting in custard apple cv. Balanagar

4. Conclusion

The shoot parameters *i.e.*, days taken to sprouting, number of graft sprouted, number of sprouted buds/graft and number of leaves produced per graft were significantly superior in the treatment T_{12} (Wedge grafting on 15th February, 2022).

On the basis of above findings, treatment T_{12} (Wedge grafting on 15th February, 2022) stand could be better performance first in position and T_{10} (Wedge grafting on 15th January, 2022) stand in second order of preference. However, treatment T_{11} (Wedge grafting on 30th January, 2022) comes in next in order. Therefore, it may be concluded that treatment T_{12} (Wedge grafting on 15th February, 2022) may be prefer for higher shoot growth in custard apple.

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