Original Research Article

Study of softwood grafting in hibiscus (*Hibiscus spp.*)

1. Check your Statistical Design (RBD), because your trial conducted in nursery area when we use CRD design
2. Mention Factorial information in Abstract, results and table, because you write last line in material method Factorial RBD

Abstract

The study on response of softwood grafting on various types of hibiscus was conducted at College of Horticulture, under Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli Dist. Ratnagiri, Maharashtra. The experiment was laid out in randomized block design with three replications and ten treatments viz, T_1 - DBSKKV H-1, T_2 - DBSKKV H-2, T_3 - DBSKKV H-3, T_4 - DBSKKV H-4, T_5 - DBSKKV H-5, T_6 - DBSKKV H-6, T_7 - DBSKKV H-7, T_8 - DBSKKV H-8, T_9 - DBSKKV H-9, T_{10} - DBSKKV H-10. The recorded parameters were significantly influenced by the response of softwood grafting on hibiscus. The treatment, T_{10} (DBSKKV H-10) demonstrated superior performance in terms of minimum days required for sprouting (8.20) and maximum sprouting percentage (93.20%), survival percentage (91.07%), number of leaves (44.47), girth at graft union (10.63 mm), days required for union of grafting (10.00), plant hight (69.65).

Keywords: Hibiscus, Softwood grafting.

1. Introduction

Hibiscus is a diverse genus of plants that belong to the family Malvaceae. This genus includes several hundred species that are native to warm temperate, subtropical, and tropical regions worldwide. The plants are known for their large, showy flowers and are commonly referred to simply as "hibiscus." They are also known by other names such as rose mallow, hardy hibiscus, rose of Sharon, China rose, Chinese hibiscus, Gurhal, and Jaswand.

Hibiscus plants are valued for their ornamental beauty and are often used in landscaping as shrubs, borders, potted plants, and hedge plants. They are known for their striking flowers, which come in a variety of colours and sizes depending on the species and cultivar. Hibiscus plants are also of interest to researchers and horticulturists for their genetic diversity, which has led to the development of many different cultivars with unique traits. Hibiscus is commonly cultivated in various countries, including India, Hawaii, Fiji, California, and Florida. Hawaii is particularly renowned for its rich collection of hibiscus varieties and is considered a centre for the development of new hibiscus cultivars. There are approximately 300 species of hibiscus found throughout the tropics.

The genus hibiscus includes both annual and perennial herbaceous plants, as well as woody shrubs and small trees. Hibiscus plants are bushy, evergreen shrubs or small trees that typically grow 2.5–5 meters (8–16 feet) tall and 1.5–3 meters (5–10 feet) wide. They have a branched taproot system. The stems of hibiscus plants are aerial, upright, green, tubular, and branched. The leaves are simple and petiolate, arranged in an alternate phyllotaxy. Hibiscus leaves are oval-shaped, with an acute tip and a serrated (saw-like) margin. The venation of hibiscus leaves is unicostate reticulate, meaning the veins are branched or divergent. The surfaces of the leaves can be glossy or velvety, depending on the species. Free adjacent stipules are present on the leaves.

Hibiscus grows finest in complete sun light and have need of adequate temperature and severely high humidity. Hibiscus Favors sandy loam but not heavy soils. Hibiscus prefers neutral to slightly acidic soil with pH level of soil in the middle of 5.5 to 6.5. Hibiscus can be grown throughout the year with satisfactory irrigation and sun light.

2. Materials and Methods

The present investigation was conducted in July 2023 to November 2023, at Nursery no. 4, College of Horticulture Dapoli, under Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra. The experiment was laid out in randomized block design with three replications and ten treatments viz, T_1 - DBSKKV H-1, T_2 - DBSKKV H-2, T_3 - DBSKKV H-3, T_4 - DBSKKV H-4, T_5 - DBSKKV H-5, T_6 - DBSKKV H-6, T_7 - DBSKKV H-7, T_8 - DBSKKV H-8, T_9 - DBSKKV H-9, T_{10} - DBSKKV H-10. Healthy hibiscus seedlings, 25-30 cm in height with 1-2 cm collar thickness and 50% green apical softwood, were selected for the grafting operation. Scion sticks, sourced from disease-free hibiscus plants, were selected based on apical vegetative growth, with 0.5 - 0.7 cm thickness and 2 - 4 months of age. Grafting operation involved making a vertical cut on the rootstock and a corresponding "V" shaped cut on the scion, which was then inserted and tied with a polythene strip in the rootstock. The grafts were covered with polythene bags until sprout initiation. The grafts were managed with proper irrigation, nutrient application, and pest control and intercultural operations such as weeding and irrigation were performed regularly. The observation *viz*. days required for sprouting, sprouting percentage, survival percentage, number of leaves per graft, plant height and girth at graft union were recorded at 30, 60, 90 and 120 days after grafting except days required for sprouting. The data on individual characters underwent analysis of variance, a commonly employed method in Factorial Randomized Block Design, as described by Panse and Sukhatme (1995) [9].

1. Mention number of cutting use in experiment
2. Mention stander length of scion

3. Result and Discussion

3.1 Days required for sprouting

In present investigation, days required for sprouting found to be significant to response of various hibiscus for softwood grafting. The earliest sprouting (8.20 days) was observed in T_{10} (DBSKKV H-1), at par with by T_6 (DBSKKV) at 8.53 days, while the late sprouting (10.33 days) occurred in T_3 (DBSKKV H-3) as shown in table no.1. The variation in sprouting times can be attributed to favourable weather conditions, particularly temperature and humidity, during the grafting period, which likely stimulated cell activity in the scion, leading to earlier sprouting. Similar findings were found, Sonawane *et al.* (2013) [12] achieved the shortest period for sprouting completion in softwood grafting of Carambola, Joshi *et al*. (2014) [5] documented the minimum duration required for sprouting in wedge grafting of guava.

3.2 Sprouting Percentage

In the current investigation, the time required for sprouting was significantly influenced by the response of different hibiscus varieties to softwood grafting. The highest sprouting percentage (93.20%) was recorded in treatment T_{10} (DBSKKV H-10), closely followed by treatments T_1, T_2, T_6 and T_8. The lowest sprouting percentage (68.83%) was observed in treatment T_3 (DBSKKV H-3). These results indicate that softwood grafting significantly impacted sprouting in hibiscus, with various varieties showing favourable responses. The success of the grafts can be largely attributed to the conducive weather conditions, particularly optimal temperatures and humidity levels, during the graft union healing process, as supported by Hartmann and Kester (1968) [4]. These findings closely correspond with those of Nimbalkar *et al*. (2011) [8] noted resulted in more sprouting compared to grafts in the softwood grafting of karonda, Chatse *et al*. (2019) [2], indicating that when propagating Hibiscus (*Hibiscus rosa-sinensis* L.) through softwood grafting across various seasons, the highest percentage of sprouting was observed.

3.3 Survival Percentage

In the present investigation, the survival percentage was significantly influenced by the response of different hibiscus varieties to softwood grafting. The highest survival percentage (91.07%) was observed in treatment

T_{10} (DBSKKV H-10), which was at par with T_1, T_6, T_2 and T_8. The lowest survival percentage (62.20%) was noted in treatment T_3 (DBSKKV H-3). The survival of grafts in hibiscus is influenced by several critical factors. Key among them is the proper alignment of cambium layers and the use of appropriate grafting techniques, such as softwood grafting. The genetic compatibility between rootstock and scion is essential for successful graft union formation. Environmental conditions, particularly optimal temperature and humidity, play a vital role in the healing process, while the season and timing of grafting, ideally during active growth periods, further enhance survival rates. Aftercare, including adequate watering, pest protection, and shading, along with the application of growth regulators like auxins to promote callus formation, also contributes to better graft survival. Additionally, ensuring the graft union is securely tied and selecting healthy, disease-free plant material are crucial for long-term success. Similarly, Shinde *et al.* (2011) [11] recorded maximum survival for softwood grafting in Jamun. Mulla *et al*. (2011) [7] conducted experimental propagation of Jamun using softwood grafting, noted that graft success under open conditions was significantly higher (100%).

3.4 Number of leaves per graft

In the recent investigation, number of leaves was significantly influenced by the response of different hibiscus varieties to softwood grafting. At 120 days, T_{10} exhibited the maximum number of leaves (44.47), which was at par T_6 and T_8, with T_3 again recording the minimum leaves (24.87). The study highlighted that softwood grafting significantly influences leaf production, with success depending on the selection of a healthy, vigorous scion and a compatible rootstock, which together enhance nutrient and water uptake. Favourable environmental conditions, including adequate light, optimal temperatures, and moderate humidity, promote active growth and photosynthesis, while balanced fertilization, particularly nitrogen, supports lush foliage. Consistent soil moisture without overwatering prevents stress and encourages cell elongation and division, resulting in a greater number of leaves, a process further aided by favourable weather conditions during the grafting period, which stimulate cellular activity and early sprouting. This observation is similar with the findings indicating a systematically supported association between softwood grafting, environmental factors, and leaf development by Bodkhe *et al.* (2010) [1].

3.5 Plant Height

In the recent investigation, plant height was significantly influenced by the response of different hibiscus varieties to softwood grafting. At 120 days, T_{10} remained superior at 69.65 cm, while T_4 was the shortest in height (47.10 cm). The increased height in grafted hibiscus plants was primarily due to the compatibility between stock and scion, ensuring efficient nutrient and water transport, and the vigour of the rootstock, which enhanced uptake. Optimal environmental conditions, including appropriate humidity, temperature, and light, further promoted growth by supporting photosynthesis and metabolic processes. Effective watering, fertilization, and pest control were essential in maintaining plant health and preventing stress. These factors collectively contributed to the overall increase in height and vigour of grafted hibiscus plants. A similar trend of increased height in softwood grafts has been observed by Patale (2017) [10] in custard apple, Kudmulwar et al. (2008) [6] reported this tendency in custard apple, Ghojage et al. (2011) [3] found it in jamun.

Table 1. Effect of softwood grafting on days required for sprouting in different types of hibiscus (Hibiscus spp.).

Treatment Details		Days required for sprouting
T_1	DBSKKV H- 1	9.00
T_2	DBSKKV H- 2	9.07
T_3	DBSKKV H- 3	10.33
T_4	DBSKKV H- 4	9.20
T_5	DBSKKV H- 5	9.13
T_6	DBSKKV H- 6	8.53
T_7	DBSKKV H- 7	10.07
T_8	DBSKKV H- 8	9.93
T_9	DBSKKV H- 9	9.60
T_{10}	DBSKKV H- 10	8.20
Result		SIG
S.E m ±		0.12
C.D. (0.05)		0.37

Check CD value

Table no 2. Effect of softwood grafting on sprouting percentage in hibiscus (*Hibiscus spp*).

Treatment Details		Sprouting Percentage
T_1	DBSKKV H- 1	86.63
T_2	DBSKKV H- 2	88.87
T_3	DBSKKV H- 3	68.83
T_4	DBSKKV H- 4	79.93
T_5	DBSKKV H- 5	75.53
T_6	DBSKKV H- 6	88.87
T_7	DBSKKV H- 7	77.77
T_8	DBSKKV H- 8	84.43
T_9	DBSKKV H- 9	82.20
T_{10}	DBSKKV H- 10	93.20
Result		SIG
S.E m ±		3.53
C.D. (0.05)		10.50 Check CD value, not corrected

Table 3. Effect of softwood grafting on survival percentage in hibiscus (*Hibiscus spp*).

Treatment Details		Survival Percentage (%)
T_1	DBSKKV H- 1	84.43
T_2	DBSKKV H- 2	84.43
T_3	DBSKKV H- 3	62.20
T_4	DBSKKV H- 4	75.53
T_5	DBSKKV H- 5	68.87
T_6	DBSKKV H- 6	84.43
T_7	DBSKKV H- 7	73.30
T_8	DBSKKV H- 8	80.00
T_9	DBSKKV H- 9	75.53
T_{10}	DBSKKV H- 10	91.07
Result		SIG
S.E m ±		4.81
C.D. (0.05)		14.29

Table 4. Effect of softwood grafting on number of leaves and plant height at 120 after grafting in hibiscus (*Hibiscus spp*).

Treatment Details		Number of leaves	Plant height
T_1	DBSKKV H- 1	34.60	47.23
T_2	DBSKKV H- 2	30.77	51.76
T_3	DBSKKV H- 3	24.87	48.99
T_4	DBSKKV H- 4	32.87	47.10
T_5	DBSKKV H- 5	28.23	48.17
T_6	DBSKKV H- 6	41.17	52.90
T_7	DBSKKV H- 7	31.30	51.58
T_8	DBSKKV H- 8	40.37	50.37
T_9	DBSKKV H- 9	37.00	50.23
T_{10}	DBSKKV H- 10	44.47	69.65
Result		SIG	SIG
S.E m ±		1.72	2.58
C.D. (0.05)		5.12	7.66

4. Conclusion

According to the above studies on response of various hibiscus on softwood grafting, it may be concluded that genotype DBSKKV H-10 was promising in terms of days required for sprouting, sprouting percentage,

survival percentage, plant height and number of leaves. This result concluded that response of DBSKKV H-10 genotype was found promising as compared to other genotypes through softwood grafting technique under agro-climatic conditions of Konkan region.

Write in conclusion, we can suggest to farmer in Konkan region DBSKKV H-10 genotype was found superior, it's to be recommended for farmer

Disclaimer (Artificial Intelligence)

Author(s) hereby declared that YES generative AI technologies such as Large Language Models (ChatGPT, COPILOYT, etc) have been used during writing or editing of manuscripts.

5. References

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