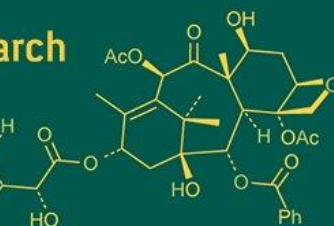
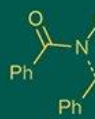


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Effect of PGR's and antioxidant on physiological traits of mango graft var. Dashehari in off season under conditions of Jabalpur, MP

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Abstract

The present investigation entitled "Effect of Plant Growth Regulators and Antioxidant on Physiological Traits of Mango Graft var. Dashehari in off season under condition of Jabalpur, MP." was conducted during 2025-2026 at the Fruit Research Station, Imaliya, Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Jabalpur, Madhya Pradesh. The experiment was conducted in a Completely Randomized Design (CRD) with eleven treatments, three replications and 20 grafts per treatment. The treatments comprised scion dipping with BAP, GA₃ and NAA, alone or in combination with rootstock treatment using ascorbic acid and polycap protection. The observations were recorded for leaf area index, chlorophyll content index, leaf area duration and light transmission ratio (%). The results revealed that the treatments significantly influenced all the studied parameters. Treatment T₅ [Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with BAP @ 20 ppm + Polycap] proved to be the most effective treatment. It recorded maximum Graft Success% at 30 and 60 DAG (78.33 and 76.67%), maximum Leaf Area Index at 60 and 120 DAG (6.88 and 9.05), and highest Chlorophyll Content Index (SPAD value) (37.33 and 58.85) at 60 and 120 DAG. The same treatment also produced the maximum fresh Leaf Area Duration (2534.89 cm² day⁻¹) and minimum Light Transmission Ratio% (62.48% and 32.94%) at 60 and 120 DAG respectively. Thus, the combined application of ascorbic acid, BAP with polycap was found effective in improving graft establishment in mango graft var. Dashehari.

Keywords: Mango, Dashehari, grafting, BAP, GA₃, NAA, Ascorbic acid, Polycap, Graft success, vegetative growth, SPAD value, chlorophyll content index, leaf area index, leaf area duration

1. Introduction

Mango (*Mangifera indica* L.), popularly known as the "King of Fruits," is one of the most important tropical and subtropical fruit crops and has great economic and nutritional significance. Vegetative propagation through grafting is widely used for the production of true-to-type and early-bearing plants; however, successful establishment of grafts depends on rapid graft union formation, bud sprouting, subsequent growth, and survival. Plant growth regulators (PGRs) such as BAP, GA₃, and NAA can influence cell division, cell elongation, callus formation, and vascular differentiation, while antioxidants such as ascorbic acid may reduce oxidative stress and phenolic oxidation at the graft union. These treatments may therefore improve the growth and establishment of mango grafts.

Besides conventional growth parameters, physiological characteristics are important indicators of graft vigour and photosynthetic performance. Graft success (%) reflects the effectiveness of graft union formation and compatibility between rootstock and scion. Leaf Area Index (LAI) indicates the extent of leaf surface available for interception of solar radiation and photosynthesis, whereas Leaf Area Duration (LAD) represents the persistence and functional maintenance of leaf area over time. Light Transmission Ratio (LTR) helps assess the amount of light transmitted through the plant canopy and is associated with canopy development and light interception. Similarly, the Chlorophyll Content Index (CCI) provides an indirect measure of leaf chlorophyll status and photosynthetic potential. The present investigation was therefore undertaken to evaluate the effect of plant growth regulators and antioxidant treatments on graft success, growth, survival, and important physiological traits, including LAI, LAD, LTR and CCI in mango grafts of var. Dashehari.

2. Materials and Methods

The experiment was conducted during 2025-2026 at the Fruit Research Station, Imaliya, Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Jabalpur, Madhya Pradesh, on mango

(*Mangifera indica* L.) var. Dashehari. Grafting was carried out on 26 October 2025. The experiment comprised 11 treatments with three replications and 20 grafts per treatment, giving a total of 660 grafts.

The treatments consisted of plant growth regulators, ascorbic acid and polycap protection, as follows:

Treatments	Treatment combination
T ₁	Control
T ₂	Control + Polycap
T ₃	Scion dipped with BAP @ 20 ppm
T ₄	Rootstock treated with ascorbic acid @ 100 ppm + scion dipped with BAP @ 20 ppm
T ₅	Rootstock treated with ascorbic acid @ 100 ppm + scion dipped with BAP @ 20 ppm + Polycap
T ₆	Scion dipped with GA ₃ @ 20 ppm
T ₇	Rootstock treated with ascorbic acid @ 100 ppm + scion dipped with GA ₃ @ 20 ppm
T ₈	Rootstock treated with ascorbic acid @ 100 ppm + scion dipped with GA ₃ @ 20 ppm + Polycap
T ₉	Scion dipped with NAA @ 20 ppm
T ₁₀	Rootstock treated with ascorbic acid @ 100 ppm + scion dipped with NAA @ 30 ppm
T ₁₁	Rootstock treated with ascorbic acid @ 100 ppm + scion dipped with NAA @ 30 ppm + Polycap

The following parameters were observed and recorded following established standard methods.

2.1 Graft Success%

Graft success percentage was assessed at 30 and 60 days after grafting (DAG). The percentage of successful grafts was calculated using the formula given below.

$$\text{Graft success (\%)} = \frac{\text{Total number of grafts success}}{\text{Total number of grafts prepared}} \times 100$$

2.2 Leaf Area Index

The Leaf Area Index (LAI) was measured at 60 and 120 days after grafting (DAG) with the help of a digital leaf area meter. The LAI was determined following the mathematical principle proposed by Watson (1952) ^[15], which expresses the ratio of the total one-sided leaf (assimilatory) area to the corresponding ground area. The LAI was calculated using the following formula.

$$\text{LAI} = A/P$$

Where,

A = total leaf area

P = allocated ground surface area

2.3 Chlorophyll Content Index

Leaf chlorophyll content index was assessed at 60 and 120 days after grafting (DAG) using a portable, handheld SPAD meter. Measurements were taken from randomly selected grafted plants in each treatment by placing the sensor over the uppermost fully expanded leaf. After the instrument stabilized, the chlorophyll content index displayed on the digital screen was recorded. The recorded observations were then compiled and subjected to statistical analysis.

2.4 Leaf Area Duration

Leaf Area Duration (LAD) represents the extent and persistence of the photosynthetically active leaf area over the crop growth period, thereby indicating the plant's ability to establish and sustain its canopy. As a cumulative measure of leaf area and light interception throughout the season, LAD is closely associated with biomass production and final yield. The mean LAD for the respective growth intervals

was calculated following the method proposed by Watson (1952) ^[15], using the equation given below.

$$\text{Leaf Area Duration} = ((\text{LAI}_1 + \text{LAI}_2))/2 \times (\text{T}_2 - \text{T}_1)$$

Where,

- (LAI₁) = Leaf Area recorded at the first developmental stage
- (LAI₂) = Leaf Area recorded at the second developmental stage
- (T₁) = Sampling time for the initial observation (days)
- (T₂) = Sampling time for the subsequent observation (days)

2.5 Light Transmission Ratio

The Light Transmission Ratio (LTR) was assessed to determine the extent of light penetration within the canopy. It was expressed as the percentage of light intensity reaching the lower portion of the canopy relative to the incident solar radiation. Light intensity was measured using a digital lux meter, and the LTR was calculated using the following formula:

$$\text{LTR(\%)} = \frac{L}{L_0} \times 100$$

Where,

- L = light intensity recorded at the base of the canopy crown (lux)
- L₀ = total incoming solar radiation or ambient light intensity (lux)

3. Results and Discussion

3.1 Graft Success%

Graft success was significantly affected by the different treatments at both 30 and 60 days after grafting (DAG). At 30 DAG, the highest graft success was recorded under T₅, comprising rootstock treatment with Ascorbic acid @ 100 ppm + scion dipping with BAP @ 20 ppm + Polycap, with a success rate of 78.33%. This was followed by T₄ (76.67%), while T₁ (control) recorded the minimum graft success of 48.33%. A similar trend was observed at 60 DAG, where T₅ again recorded the highest graft success (76.67%), followed by T₄ (75.00%), whereas the control recorded the lowest value (46.67%). The treatment differences were statistically

significant, with CD values of 4.08 and 3.18 at 30 and 60 DAG, respectively.

The superior graft success obtained with T₅ may be attributed to the combined action of ascorbic acid, BAP and polycap. Ascorbic acid possibly reduced oxidative damage and browning at the graft union, thereby promoting better healing and cambial union. BAP, being a cytokinin, may have stimulated cell division, callus formation and bud activity, resulting in faster and more effective graft establishment. In addition, polycap likely maintained a favourable humid microenvironment around the scion, reducing moisture loss and desiccation during the critical period of graft union formation. The present findings are in accordance with the observations cited in the thesis, where BAP-based treatments and antioxidant application improved graft establishment, while the use of polycap provided favourable conditions for successful grafting. Similar findings were also reported by Santram and Din (1971) [13], Mathad *et al.* (1991) [9], Alzate *et al.* (2002) [1], Keny *et al.* (2005) [4], Beer *et al.* (2013) [2], Rai *et al.* (2022) [11], Kumar *et al.* (2022) [7] and Nagar *et al.* (2023) [10], Jogaiah and Porika (2023) [3].

3.2 Leaf Area Index and Chlorophyll Content Index

The treatments significantly influenced both leaf area index (LAI) and chlorophyll content at 60 and 120 days after grafting (DAG). T₅ recorded the highest leaf area index (6.88 and 9.05) and chlorophyll content index (37.33 and 58.85 SPAD value) at 60 and 120 DAG, respectively, while the untreated control (T₁) recorded the lowest values. The superior performance of T₅ may be attributed to the combined effects of BAP, ascorbic acid, and polycap, which

promoted cell division, leaf development, photosynthetic activity, and protection against oxidative and water stress. The higher LAI and chlorophyll content under T₅ indicate improved canopy development and photosynthetic efficiency, ultimately supporting better growth of mango grafts. These findings are in agreement with Suryadi *et al.* (2020) [14], Rai *et al.* (2022) [11], Kumar *et al.* (2022) [7], Nagar *et al.* (2023) [10], Jogaiah and Porika (2023) [3], Khan *et al.* (2025) [5], Mathad *et al.* (1991) [9], and Kumari *et al.* (2021) [8].

3.3 Leaf Area Duration (cm² day⁻¹) and Light Transmission Ratio (%)

Leaf area duration (LAD) and light transmission ratio% (LTR) were significantly influenced by the treatments. The maximum LAD (2534.89 cm² day⁻¹) was recorded under T₅, followed by T₄ (2523.44 cm² day⁻¹) and T₃ (2502.41 cm² day⁻¹), while the minimum (2205.43 cm² day⁻¹) was observed in the control (T₁). The higher LAD under T₅ indicates greater canopy development and prolonged maintenance of the photosynthetically active leaf surface, which may have enhanced photosynthate production and supported better graft growth and establishment. In contrast, LTR was minimum under T₅ (62.48% at 60 DAG and 32.94% at 120 DAG) and maximum under T₁ (72.94% and 58.31%, respectively), indicating greater light interception by the denser canopy under T₅. The decline in LTR% with crop age further corresponded with increasing LAI and LAD, reflecting progressive canopy development and improved light utilization. These findings are in close agreement with Rai *et al.* (2022) [11], Kumar *et al.* (2022) [7], and Nagar *et al.* (2023) [10].

Table 1: Effect of PGR's an Antioxidant on Graft Success% in mango graft var. Dashehari

S. No.	Treatments	30 DAG	60 DAG
T ₁	Control	48.33	46.67
T ₂	Control + Polycap	55.00	53.33
T ₃	Scion dipped with BAP @ 20 ppm	75.00	73.33
T ₄	Rootstock treated with Ascorbic acid @ 100 ppm + Scion dipped with BAP @ 20 ppm	76.67	75.00
T ₅	Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with BAP @ 20 ppm + Polycap	78.33	76.67
T ₆	Scion dipped with GA3 @ 20 ppm	61.67	58.33
T ₇	Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with GA3 @ 20 ppm	63.33	60.00
T ₈	Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with GA3 @ 20 ppm + Polycap	63.33	61.67
T ₉	Scion dipped with NAA @ 30 ppm	71.67	66.67
T ₁₀	Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with NAA @ 30 ppm	73.33	70.00
T ₁₁	Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with NAA @ 30 ppm + Polycap	75.00	73.33
	SEm (±)	1.30	1.09
	CD (P = 0.05)	4.08	3.18

Table 2: Effect of PGR's an Antioxidant on Leaf Area Index, Chlorophyll Content Index (SPAD value), Leaf area duration (cm²/day) and Light Transmission Ratio% at 60 and 120 DAG in mango graft var. Dashehari.

S. No.	Treatments	Leaf Area Index		Chlorophyll Content Index (SPAD value)		Leaf area duration (cm ² /day)	Light Transmission Ratio (%)	
		60 DAG	120 DAG	60 DAG	120 DAG		60 DAG	120 DAG
T ₁	Control	4.60	6.59	32.15	35.82	2205.43	72.94	58.31
T ₂	Control + Polycap	4.66	6.70	32.26	37.28	2212.80	67.79	57.09
T ₃	Scion dipped with BAP @ 20 ppm	6.63	8.67	36.69	57.18	2502.41	63.68	33.52
T ₄	Rootstock treated with Ascorbic acid @ 100 ppm + Scion dipped with BAP @ 20 ppm	6.74	8.86	36.84	57.69	2523.44	63.57	33.47
T ₅	Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with BAP @ 20 ppm + Polycap	6.88	9.05	37.33	58.85	2534.89	62.48	32.94
T ₆	Scion dipped with GA3 @ 20 ppm	5.17	7.12	33.11	43.96	2349.39	67.27	56.04
T ₇	Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with GA3 @ 20 ppm	5.21	7.35	33.35	44.33	2354.50	66.86	55.63
T ₈	Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with GA3 @ 20 ppm + Polycap	5.36	7.39	34.07	44.82	2354.81	66.57	55.49
T ₉	Scion dipped with NAA @ 30 ppm	6.22	8.41	35.62	56.26	2455.27	64.77	36.41
T ₁₀	Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with NAA @ 30 ppm	6.38	8.44	35.80	56.84	2465.32	64.01	36.12
T ₁₁	Rootstock treated with Ascorbic acid @ 100 ppm + scion dipped with NAA @ 30 ppm + Polycap	6.53	8.46	36.03	56.96	2339.59	63.97	35.84
	SEm (±)	0.12	0.16	0.63	0.96	35.21	0.98	0.68
	CD (P = 0.05)	0.34	0.47	1.84	2.82	103.25	2.87	2.00

Conclusion

The application of plant growth regulators and antioxidant significantly improved the physiological performance of mango grafts. Treatment T₅ (Ascorbic acid @ 100 ppm + BAP @ 20 ppm + Polycap) recorded the highest graft success (78.33% and 76.67% at 30 and 60 DAG, respectively), leaf area index (6.88 and 9.05), chlorophyll content index (37.33 and 58.85), and leaf area duration (2534.89 cm² day⁻¹) at 60 and 120 DAG. It also recorded the lowest light transmission ratio (62.48% and 32.94%), indicating better canopy development and light interception. Thus, T₅ was the most effective treatment for improving the physiological performance of mango var. Dashehari grafts.

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References

- Alzate A, Royero N, Nuñez V, Cabra J, Tohme J, Mejía-Jiménez A. Optimization of the *in vitro* propagation methodology of selected clones of soursop (*Annona muricata* L.) and evaluation of the compatibility of different scion and rootstock combinations for *in vitro* micrografting. Annual Report CIAT, Project SB-2, Assessing and Utilizing of Agrobiodiversity Through Biotechnology. 2002. p. 318-323.
- Beer K, Yadav AL, Verma A. Effect of grafting time and environment on the graft success of guava (*Psidium guajava* L.) under wedge grafting. Trends in Biosciences. 2013;6(6):770-772.
- Jogaiah S, Porika H. Scion preconditioning and cytokinin treatment improved graft compatibility in Red Globe grape grafted on Dogridge rootstock. Indian Journal of Horticulture. 2023;80(2):165-170.
- Keny MP. Effect of plant growth regulators on stone grafting in mango (*Mangifera indica* L.) cv. Kesar. M.Sc. Thesis. Navsari: Navsari Agricultural University; 2005.
- Khan SQ, Iqbal U, Rehman MU, Mir MM, Mir MA, Parveze MU, *et al.* Anatomical and histological investigation of antioxidants and IBA on graft success in walnut. Applied Fruit Science. 2025;67:54.
- Kukshal R, Rajput V, Bhatia SK. Studies on wedge grafting in guava (*Psidium guajava* L.) under open field conditions. Trends in Biosciences. 2017;10(40):8273-8277.
- Kumar B. Effect of scion dip treatments and timing on growth, vigour and survival of mango grafts under polyhouse. M.Sc. Thesis. Jabalpur: Jawaharlal Nehru Krishi Vishwa Vidyalaya; 2022.
- Kumari M. Effect of defoliation of scion and plant growth regulators on wedge grafting and growth of sapling in guava (*Psidium guajava* L.). Master's Thesis. Kota: Agriculture University, Kota, Department of Horticulture, College of Agriculture, Ummadganj; 2021.
- Mathad JC, Rao MM, Rajanna KM. Influence of regulator on the success of wedge graft of Alphonso mango. South Indian Horticulture. 1991;39(4):231-233.
- Nagar L. Effect of scion dip treatments and growing condition on physiological parameter of mango (*Mangifera indica* L.) wedge graft cv. Dashehari. International Journal of Environment and Climate Change. 2023;13(11):1790-1800.
- Rai HS. Effect of scion dip treatment of IAA, BAP and ZnSO₄ on growth, vigour and survival of wedge grafting in custard apple (*Annona squamosa* L.). M.Sc. Thesis. Jabalpur: Jawaharlal Nehru Krishi Vishwa Vidyalaya; 2022.
- Rao YR, Kaul GL. Effect of kinetin on the success of veneer grafting of guava (*Psidium guajava* L.) in different seasons under Tarai conditions of U.P. Indian Journal of Horticulture. 1977;34(2):137-141.

13. Santram, Din IBC. Improvement on the existing propagation techniques in mango. Annual Report 1970-71. Pantnagar: G.B. Pant University of Agriculture and Technology; 1971.
14. Suryadi R. The effect of ascorbic acid on clove (*Syzygium aromaticum* L.) grafting. IOP Conference Series: Earth and Environmental Science. 2020;418(1):01202.
15. Watson DJ. The physiological basis of variation in yield. In: Norman AG, editor. Advances in Agronomy. Vol. 4. 1952. p. 101-145.