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Effect of Scion Dip Treatments and Growing Condition on Physiological Parameter of Mango (*Mangifera indica* L.) Wedge Graft cv. Dashehari

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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 current study was carried out on wedge grafting in Mango (*Mangifera indica* L.) cv. Dashehari during the2022-23 at the Fruit Research Station, Imaliya, Department of Horticulture, JNKVV Jabalpur. This research includes the use of many different plant growth regulators, $ZnSo_4$, and growing conditions. The research was carried out using a statistical design known as Factorial Completely Randomized Design (FCRD).The primary objective of this study is to determine the influence that different scion dip treatments and growing conditions have on the physiological

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characteristics of the plant. According to the findings, among the various treatments, IAA 200 ppm + $ZnSo_4$ 500 ppm under shade net condition was proved superior with respect to maximum chlorophyll content index (27,18.5), leaf area duration (2720.67 cm^2/day, 2,620.67 cm^2/day), leaf area index (8.65,1035) and light transmission ratio (24.05,18.15) at 60 and 120 days after grafting (DAG). It was also noticed that scion dip treatments with IAA 200 ppm in combination with $ZnSo_4$ 500 ppm under the shade net condition were favorable as compared to the open condition.

Keywords: Shade net; chlorophyll content; mango; rootstock; dashehari; condition; wedge grafting.

1. INTRODUCTION

Mango (*Mangifera indica* L.) is an evergreen fruit which grows well in tropical and subtropical climates and it thrives very well from sea level to an altitude of 1400 meters. The mango tree is hardy in nature and it can endure even the temperature as high as 48°C. During flowering and fruit development, high humidity causes reduction in fruit yield. It prefers a warm frost-free climate with a well-drained soil with adequate pH (5.5 -7.5). Winter dry season and temperature ranging from 24-27°C and the annual rainfall is 400-3600 mm (16-142 inches). It does not do well beyond a pH of 7.5. Mango is highly cross-pollinated and heterozygous plant. It is also known as “King of the fruits” [1]. The propagation of mango can be done vegetatively as well as generatively using seeds. Vegetative propagation such as grafting is a technique to maintain true to type of a given variety that enables to transfer of quality parameter from mother to offspring [2]. Grafting is an ancient horticultural technique that is indispensable to modern horticulture as the technique that enables us to exploit the various advantages of grafted trees. The advantages include early flowering in comparison to seedling trees, the size of the trees is generally smaller than seedling trees because they begin to bear fruit earlier [3]. In case of Mango, reproductive shoots per stem were induced in response to the synthetic cytokinin, thidiazuron, during cool, floral inductive conditions but vegetative shoots were initiated when thidiazuron was applied during warm conditions [4].

The chlorophyll content index is applied to calculate the total amount of chlorophyll in plants. The chlorophyll content is relatively accurate indicator of plant health and can be effectively used in nutrient management throughout the season. The amount of leaves in the canopy of the plant is one of the essential ecological characteristics generally quantified by the leaf area index (LAI).Light interception is directly related to the overall dry matter production of a number of crops [5] which is also ideal for fruit trees [6]. Efficient light distribution within the foliage and its interaction with various parts is critical to maximizing photosynthetic activity, flower bud development and colour development [7]. Considering the vital role of physiological factors in growth and development and ultimately survival of grafts, the present investigation is planned and carried out. Grafting is a technique widely utilized to enhance the tolerance against various abiotic and biotic stresses and improve fruit quality and crop production. Postharvest fruit quality of melons grafted on ten pumpkin rootstocks during storage at room temperature (25◦C ± 2◦C) and cold conditions (10◦C± 1◦C). Rootstock helped maintain the post-harvest fruit quality during storage and extended the shelf life [8].

2. MATERIALS AND METHODS

The present investigation was carried out at Fruit Research Station Imaliya, Department of Horticulture, College of Agriculture, JNKVV Jabalpur was laid out in a factorial completely randomized (M.P.) during the period of September 2022 to January 2023.The experiment design with three replications. The experiment was comprised of two factors *i.e.,* factor(A) Scion dip treatment (IAA 100 ppm + $ZnSO_4$ 250 ppm (T_2), IAA 100 ppm + $ZnSO_4$ 500 ppm(T_3), IAA 200 ppm + $ZnSO_4$ 250 ppm(T_4), IAA 200 ppm + $ZnSO_4$ 500 ppm(T_5), BAP 20 ppm + $ZnSO_4$ 250 ppm(T_6), BAP 20 ppm + $ZnSO_4$ 500 ppm(T_7), BAP 40 ppm + $ZnSO_4$ 250 ppm(T_8), BAP 40 ppm + $ZnSO_4$500 ppm(T_9) and no use of PGR – Control(T_1) and factor (B) Growing conditions (Shade net and Open condition) of grafted plants. After scion dip treatment wedge grafting was performed on10 plants grown in poly bags filled with uniform growing media per replication.

The observation on following parameters was recorded using standard methodology.

2.1 Chlorophyll Content Index

Leaf chlorophyll content is measured by using the hand - held chlorophyll meter (SPAD-meter) at 60 and120 days after the grafting.

2.2 Leaf Area Index

The leaf area index is computed by using the leaf area meter at 60 and 120 days after grafting. The formula is given by Watson [9] as the area (A) or the assimilatory surface area over a certain ground area (P).

LAI = A/P

2.3 Leaf Area Duration

The leaf area duration is the measurement of the plants canopy to develop and sustain leaf area. Where LA = leaf area and N = number of days.

LA = LA × N

2.4 Light Transmission Ratio

The light transmission ratio is calculated as the ratio of light intensities at the base of the canopy crown to the total incoming radiation. It was done by using the luxmeter.

LTR = L/L_0 ×100

Where L = Light at the base of the canopy and L_0 = Total incoming solar radiation.

3. RESULTS AND DISCUSSION

3.1 Chlorophyll Content Index at 60 and 120 DAG

The findings presented in the study demonstrated that the application of different treatments had statistically significant effects on the chlorophyll content index at 60 and 120 days of grafting. The scion treated with a combination of 200 ppm IAA and 500 ppm $ZnSO_4$ exhibited the maximum chlorophyll content, with values of 26.00 and 17.65. In contrast, the untreated scion (control) had the lowest chlorophyll content index, with values of 21.25 and 14.00 at 60 and 120 days, respectively. The chlorophyll content index was shown to be significantly influenced by the growth circumstances. The results indicate that the shade net condition yielded higher chlorophyll content indices (24.15 and 16.10) compared to the open condition (22.52 and 14.61) after 60 and 120 days of grafting, respectively. The statistical analysis revealed that the interaction effect was deemed to be statistically significant. The highest levels of chlorophyll content (27.00 and 18.50) were seen in the scion shoot treated with IAA 200 ppm + $ZnSO_4$ 500 ppm under shade net conditions. In contrast, the lowest chlorophyll content index (20.50 and 13.00) was recorded in the untreated scion (control) exposed to open conditions at 60 and 120 DAG, respectively. The potential explanation for the increased quantity and size of leaves, as well as the subsequent rise in chlorophyll content index, in mango grafts might be attributed to their optimal development, vitality, and overall success. The lowest temperature and cold waves resulted in a low chlorophyll content. (similar findings were reported by Mahore [10]) Kumar et al. [11], and Kumar [12].

3.2 Leaf Area Duration (cm^2/ day) at 120 DAG

The data pertaining to Leaf Area Duration may be found in Table 2. These records illustrate the impact of different treatments and growth circumstances on grafted plants. The highest recorded leaf area duration (2,670.67 cm^2/ day) was seen in the scion treated with IAA at a concentration of 200 ppm and $ZnSO_4$ at a concentration of 500 ppm. Conversely, the lowest leaf area duration (2,252.45 cm^2/ day) was observed in the untreated scion, which served as the control group. The leaf area duration is also influenced by the prevailing growth circumstances. The results indicated that the shade net condition (with a maximum value of 2,533.96 cm^2/ day) outperformed the open condition (with a minimum value of 2,393.30 cm^2/ day).

A significant relationship effect was seen between the various treatments and growth conditions. The study observed that the highest leaf area duration (2,720.67 cm^2/ day) was measured when the scion was treated with a combination of 200 ppm IAA and 500 ppm $ZnSO_4$ under shade net conditions. Conversely, the lowest leaf area duration (2,154.80 cm^2/ day) was seen when the scion was left untreated in an open environment.

3.3 Leaf Area Index at 60 and 120 DAG

The leaf area index is greatly influenced by different treatments and growing conditions, shown in the Table. The scion treated with acombination of 200 ppm of IAA and 500 ppm of $ZnSO_4$ exhibited the greatest leaf area index values of 8.07 and 9.92 at 60 and 120 DAG,

Table 1. Effect of IAA, BAP, $ZnSO_4$ and growing conditions on Chlorophyll content Index at 60 and 120 DAG

Scion dip treatments	Chlorophyll content index at 60 DAG			Chlorophyll content index at 120 DAG		
	Shade Net Condition (B_1)	Open Condition (B_2)	Mean	Shade Net Condition (B_1)	Open Condition (B_2)	Mean
Control (T_1)	22.00	20.50	21.25	15.00	13.00	14.00
IAA 100 ppm + $ZnSO_4$ 250 ppm (T_2)	23.75	22.20	22.98	15.55	14.00	14.78
IAA 100 ppm + $ZnSO_4$ 500 ppm (T_3)	24.00	22.50	23.25	15.80	14.30	15.05
IAA 200 ppm + $ZnSO_4$ 250 ppm (T_4)	25.60	24.10	24.85	17.08	16.10	16.59
IAA 200 ppm + $ZnSO_4$ 500 ppm (T_5)	27.00	25.00	26.00	18.50	16.80	17.65
BAP 20 ppm + $ZnSO_4$ 250 ppm (T_6)	22.90	21.00	21.95	15.00	13.20	14.10
BAP 20 ppm + $ZnSO_4$ 500 ppm (T_7)	23.00	21.50	22.25	15.20	13.60	14.40
BAP 40 ppm + $ZnSO_4$ 250 ppm (T_8)	24.20	22.85	23.53	16.08	15.00	15.54
BAP 40 ppm + $ZnSO_4$ 500 ppm (T_9)	24.90	23.00	23.95	16.65	15.45	16.05
Mean	24.15	22.52		16.10	14.61	
	Factor -A	Factor - B	A X B	Factor -A	Factor - B	A X B
SEm±	0.347	0.163	0.490	0.228	0.108	0.323
CD(*P*=.05)	0.994	0.469	NS	0.654	0.308	NS

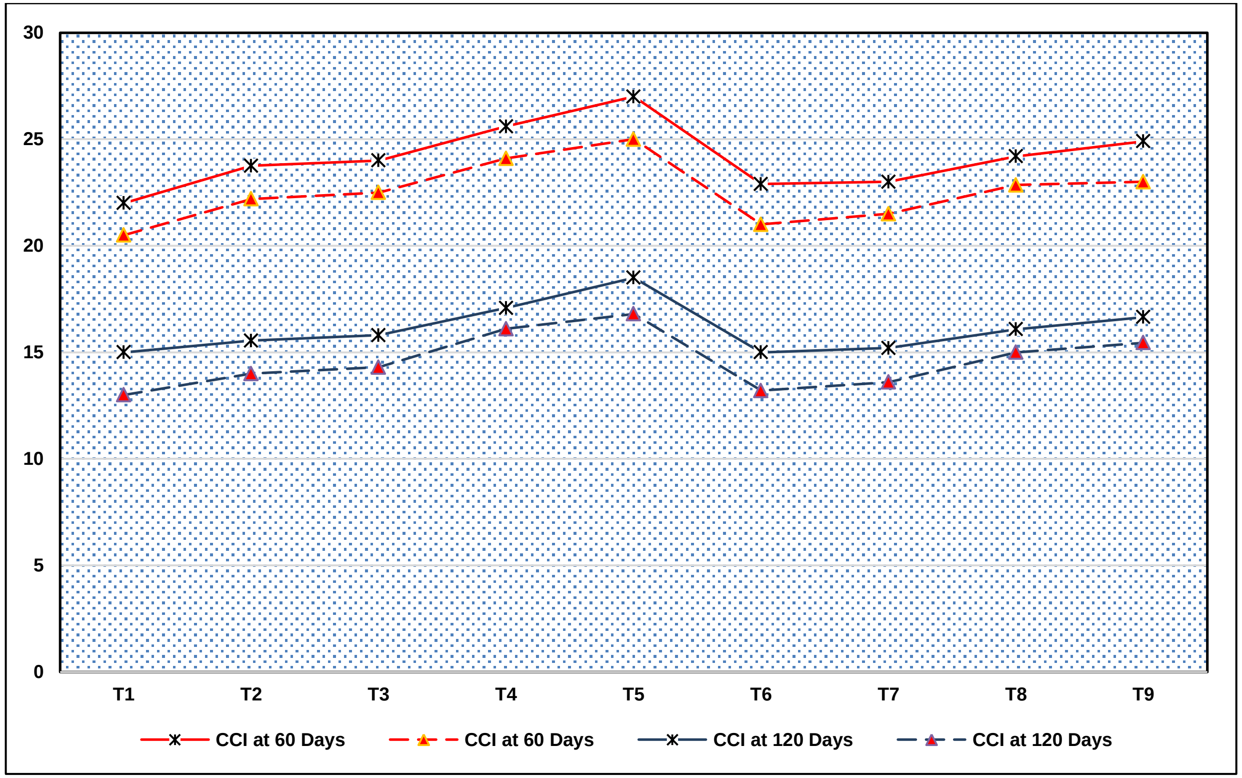

Fig. 1. Effect of IAA, BAP, $ZnSO_4$ and growing conditions on Chlorophyll content index (CCI) at 60 and 120 DAG

Table 2. Effect of IAA, BAP, $ZnSO_4$ and growing conditions on Leaf area duration at 120 DAG

Treatment No.	Scion dip treatments	Leaf area duration at 120 DAG		Mean
		Shade Net Condition (B_1)	Open Condition (B_2)	
T_1	Control	2,350.10	2,154.80	2,252.45
T_2	IAA 100 ppm + $ZnSO_4$ 250 ppm	2,450.25	2,245.10	2,347.68
T_3	IAA 100 ppm + $ZnSO_4$ 500 ppm	2,570.81	2,359.58	2,465.20
T_4	IAA 200 ppm + $ZnSO_4$ 250 ppm	2,650.78	2,550.78	2,600.78
T_5	IAA 200 ppm + $ZnSO_4$ 500 ppm	2,720.67	2,620.67	2,670.67
T_6	BAP 20 ppm + $ZnSO_4$ 250 ppm	2,556.54	2,456.34	2,506.44
T_7	BAP 20 ppm + $ZnSO_4$ 500 ppm	2,422.45	2,312.45	2,367.45
T_8	BAP 40 ppm + $ZnSO_4$ 250 ppm	2,532.81	2,389.66	2,461.24
T_9	BAP 40 ppm + $ZnSO_4$ 500 ppm	2,551.23	2,450.32	2,500.78
	Mean	2,533.96	2,393.30	
		Factor -A	Factor - B	A X B
	SEm±	0.145	0.681	0.04
	CD(*P*=.05)	1.29	1.954	5.8

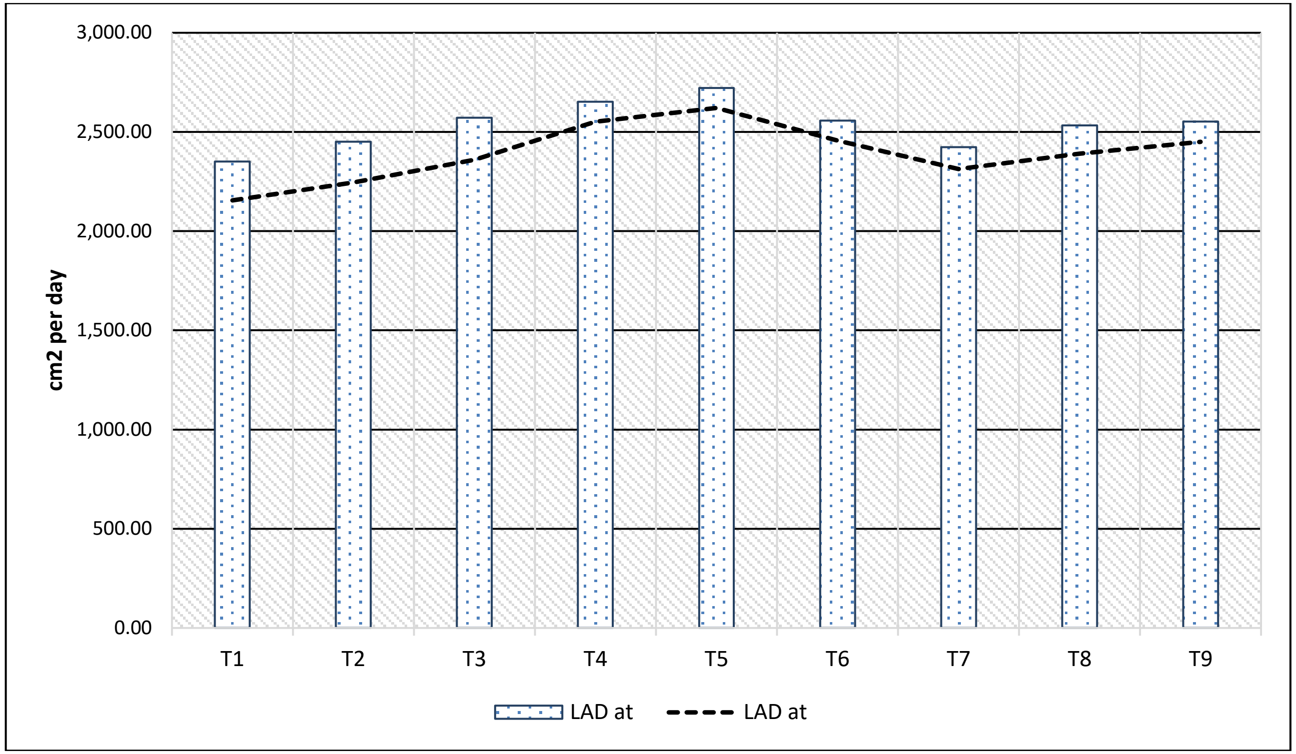

Fig. 2. Effect of IAA, BAP, $ZnSO_4$ and growing conditions on Leaf area duration (LAD) at 60 and 120 DAG

Table 3. Effect of IAA, BAP, $ZnSO_4$ and growing conditions on Leaf area index at 60 and 120 DAG

Scion dip treatments	Leaf area index at 60 DAG			Leaf area index at 120 DAG		
	Shade Net Condition (B_1)	Open Condition (B_2)	Mean	Shade Net Condition (B_1)	Open Condition (B_2)	Mean
Control (T_1)	5.10	4.90	5.00	6.00	5.30	5.65
IAA 100 ppm + $ZnSO_4$ 250 ppm (T_2)	6.02	5.50	5.78	8.00	7.10	7.55
IAA 100 ppm + $ZnSO_4$ 500 ppm (T_3)	6.06	5.65	5.85	8.70	7.40	8.05
IAA 200 ppm + $ZnSO_4$ 250 ppm (T_4)	8.25	7.20	7.72	10.00	9.10	9.55
IAA 200 ppm + $ZnSO_4$ 500 ppm (T_5)	8.65	7.50	8.07	10.35	9.50	9.92
BAP 20 ppm + $ZnSO_4$ 250 ppm (T_6)	5.25	4.90	5.07	8.30	6.30	7.3
BAP 20 ppm + $ZnSO_4$ 500 ppm (T_7)	5.60	5.11	5.35	8.50	6.70	7.6
BAP 40 ppm + $ZnSO_4$ 250 ppm (T_8)	6.75	5.85	6.3	9.50	7.60	8.55
BAP 40 ppm + $ZnSO_4$ 500 ppm (T_9)	7.00	6.14	6.57	9.70	8.80	9.25
Mean	6.52	5.86	-	8.78	7.53	-
	Factor -A	Factor - B	A X B	Factor -A	Factor - B	A X B
SEm±	0.257	0.121	0.363	0.228	0.108	0.323
CD(*P*=.05)	0.737	0.347	NS	0.654	0.308	NS

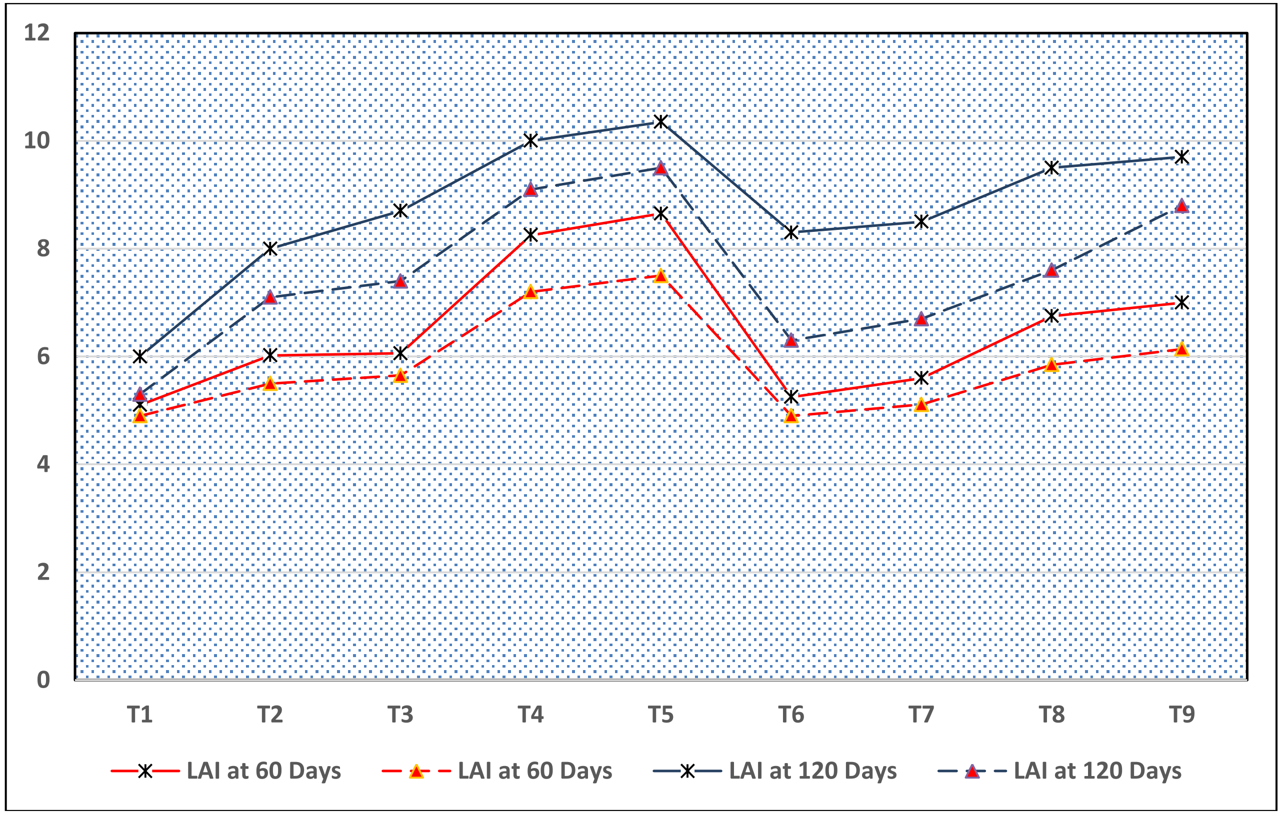

Fig. 3. Effect of IAA, BAP, $ZnSO_4$ and growing conditions on Leaf area index at 60 and 120 DAG

Table 4. Effect of IAA, BAP, $ZnSO_4$ and growing conditions on Light transmissionratio at 60 and 120 DAG

Scion dip treatments	Light transmission ratio at 60 DAG			Light transmission ratio at 120 DAG		
	Shade Net Condition (B_1)	Open Condition (B_2)	Mean	Shade Net Condition (B_1)	Open Condition (B_2)	Mean
Control (T_1)	45.44	80.82	63.13	39.57	60.46	50.02
IAA 100 ppm + $ZnSO_4$ 250 ppm (T_2)	40.82	71.70	56.26	34.99	51.20	43.10
IAA 100 ppm + $ZnSO_4$ 500 ppm (T_3)	38.33	71.30	54.82	33.15	46.61	39.88
IAA 200 ppm + $ZnSO_4$ 250 ppm (T_4)	27.03	68.17	47.60	20.71	43.53	32.12
IAA 200 ppm + $ZnSO_4$ 500 ppm (T_5)	24.05	65.20	44.63	18.15	36.75	27.45
BAP 20 ppm + $ZnSO_4$ 250 ppm (T_6)	45.07	76.02	60.55	29.26	53.50	41.38
BAP 20 ppm + $ZnSO_4$ 500 ppm (T_7)	42.80	74.20	58.50	29.60	50.09	39.85
BAP 40 ppm + $ZnSO_4$ 250 ppm (T_8)	28.70	72.20	50.45	27.79	49.15	38.47
BAP 40 ppm + $ZnSO_4$ 500 ppm (T_9)	28.50	70.90	49.70	25.79	47.08	36.44
Mean	35.64	72.28		28.78	48.71	
	Factor -A	Factor - B	A X B	Factor -A	Factor - B	A X B
SEm±	0.445	0.681	0.04	0.445	0.212	0.636
CD(*P*=.05)	1.29	1.954	5.8	1.29	0.608	1.824

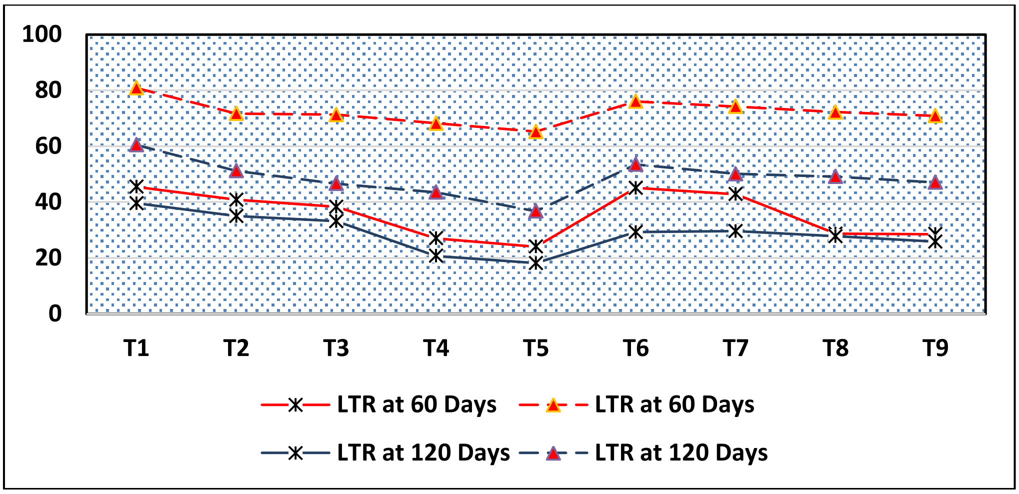

Fig. 4. Effect of IAA, BAP, $ZnSO_4$ and growing conditions on Light transmissionratio (LAR) at 60 and 120 DAG

respectively. In contrast, the untreated scion (control) had the lowest leaf area index values of 5.00 and 5.62 at 60 and 120 days, respectively. The leaf area index was also shown to be highly impacted by growing conditions. The shade netcondition exhibited superior leaf area, with the highest values recorded at 6.52 and 8.78, compared to the open condition which had a minimum leaf area index of 5.86 and 7.53 at 60 and 120 days after grafting respectively.

The statistical analysis revealed that the interaction impact between various treatments and growing condition are non-significant. The results of the study indicate that the highest leaf area index (8.65 and 10.35) was recorded in scions treated with a combination of 200 ppm IAA and 500 ppm of $ZnSO_4$ under shade net conditions. Conversely, the lowest leaf area index (4.90 and 5.30) was observed in untreated scions (control) under open conditions at 60 and 120 days, respectively. These factors have a strong correlation with the development, vitality, and success of mango grafts, resulting in increased leaf quantity and size. The results corroborate the conclusions reported by Mahore [10], Dahiya et al. [13], Kumar et al. [11] and Kumar [12], Rai [14].

3.4 Light Transmission Ratio at 60 and 120 DAG

The data indicates that grafted plants are impacted by various treatments and growing conditions. The scion treated with IAA 200 ppm + $ZnSO_4$ 500 ppm exhibited the lowest light transmission ratio of 44.63 and 27.45, while the untreated scion (control) had the highest light transmission ratio of 63.13 and 50.02 at 60 and 120 DAG respectively. The light transmission ratio is also significantly influenced by the growing conditions. The shade net condition had superior performance in terms of light transmission ratio (35.64 and 28.78) compared to the open condition, which had the greatest light transmission ratio (72.28 and 48.71) at 60 and 120 DAG respectively.

The interaction effect between the different treatments and growing condition was found to be significant. The scion dipped in a solution of IAA 200 ppm + $ZnSO_4$ 500 ppm under shade net conditions exhibited the lowest light transmission ratio of 24.05 and 18.15. Conversely, the untreated scion in open conditions showed the highest light transmission ratio of 80.82 and 60.46. One potential explanation for this phenomenon is the correlation between the greatest number of leaves and the enhanced growth, vitality, and overall success of mango grafts. Mahore [10] and Dahiya et al. [13] have revealed comparable findings, which are also supported by Kumar [12].

4. CONCLUSION

On the basis of the research carried out, it is concluded that the IAA 200 ppm + $ZnSo_4$ 500 ppm under the shade net condition was found superior for all physiological parameters viz. maximum chlorophyll content index (27,18.5), leaf area duration (2720.67 cm^2/day, 2,620.67 cm^2/day), leaf area index (8.65,1035) and light transmission ratio (24.05,18.15) at 60 and 120 days after graftingamong all the treatments when wedge grafting was performedduring last week of September. The chlorophyll content index was greatly affected by the growing condition. In open conditions, it becomes very low due to very low temperatures and cold wave conditions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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