Asian Research Journal of Agriculture

Volume 17, Issue 4, Page 364-371, 2024; Article no.ARJA.124418
ISSN: 2456-561X

Biostimulant: Its Effect on the Growth and Survival of Asexually Propagated Mango Grafts (*Mangifera indica* L.) Cv. Alphonso

Neha H. Karbat. [a*], M.M. Kulkarni. [a++], P. M. Haldankar. [a#], N.V. Dalvi [a†] and N.H. Khobragade [b++]

[a] College of Horticulture, Dr. B.S.K.K.V., Dapoli, Ratnagiri, Maharashtra, India.
[b] Department of Agricultural Chemistry and Soil Science, College of Agriculture, Dr.B.S.K.K.V., Dapoli, Ratnagiri, Maharashtra, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/arja/2024/v17i4535

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/124418

Original Research Article

Received: 26/07/2024
Accepted: 30/09/2024
Published: 02/10/2024

ABSTRACT

The Konkan belt of Maharashtra, India is home to over 400 nurseries producing more than 1 million high quality mango planting materials annually. To enhance the survival rate and growth of mango grafts at the nursery stage, a study was conducted as "Biostimulant: Its Effect on the growth and survival of asexually propagated mango grafts (*Mangifera indica* L.)" Cv. Alphonso during August

[++]Assistant Professor;
[#]Head of Department of Fruit Science;
[†]Associate Professor;
**Corresponding author: E-mail: nehakarbat1@gmail.com;*

Cite as: *Karbat., Neha H., M.M. Kulkarni., P. M. Haldankar., N.V. Dalvi, and N.H. Khobragade. 2024. "Biostimulant: Its Effect on the Growth and Survival of Asexually Propagated Mango Grafts (Mangifera Indica L.) Cv. Alphonso". Asian Research Journal of Agriculture 17 (4):364-71. https://doi.org/10.9734/arja/2024/v17i4535.*

2023 to Aprile 2024 at Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India. The experiment, designed in a factorial randomized block design, tested 26 treatment interactions in which NATCA (10.00 %) + folic acid (0.2 %) combination @ 1ml/L at 60 days interval) performed best in terms of plant growth parameters and also reduced cost of production of mango grafts Cv. Alphonso followed by Chitosan @ 150 ppm at 60 days interval also showed maximum B:C (1.49) and maximum net profit.

Keywords: Mango graft; alphonso; biostimulant; application interval; survival.

1. INTRODUCTION

Mango, botanically known as *Mangifera indica* L. and belonging to Anacardiaceae family, is widely regarded as the King of Fruits [1]. It is extensively cultivated in tropical and subtropical regions of India, which is also home to diverse range of mango varieties. Notably, the Coastal Konkan belt of Maharashtra is recognized as one of India's premier mango-growing regions. India is shift towards high-density mango plantations and has created a surge in demand for premium planting material. Fortunately, the Konkan region is well-equipped to meet this demand, with over 400 nurseries producing more than 1 million high-quality mango plants annually. Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth has played a pivotal role in this success, pioneering the innovative stone grafting technique for mango cultivation. Through its comprehensive training programs, the university has also empowered a skilled workforce to support the expansion of mango cultivation and meet the increasing demand for quality plants.

Biostimulant are increasingly recognized for their beneficial effects on plant growth, enhanced productively and ability to mitigate both biotic and abiotic stresses, leading to their growing importance in agriculture. In Konkan region, previous research focused on nutrient enrichment through media to improve graft growth in nurseries, but investigations on the application of biostimulants and growth regulators in this context were limited. To address this knowledge gap, a study was conducted to evaluate the effect of various biostimulant concentrations, including CPPU, salicylic acid, NATCA (10 %) + folic acid (0.2%) and chitosan applied at monthly and bimonthly intervals on the performance of mango grafts Cv. Alphonso.

Biostimulant offer a cost-effective solution, as they do not increase production costs for grafts. By improving graft survival rates with reduced concentrations or bimonthly applications, nurseryman can potentially increase profits. This may help the nursery operators to hasten the asexual propagation process of mango grafts enhancing survival rates of mango grafts. It is environment friendly and practical to the part of nursery operators and farmers, thereby producing safe and quality planting materials. It also emphasizes the importance of biostimulant which aids in growth and development of mango grafts. Moreover, this can also lead to lower costs of grafts for farmers. Certain wild plants native to the Konkan region such as moringa, custard apple, neem, karnaj and ghaneri etc. exhibit growth-promoting properties in their leaves, which could be explored for future applications.

2. MATERIALS AND METHODS

The experiment was performed at nursery No 10. Department of Fruit Science, College of Horticulture, Dapoli, from August 2023 to April 2024. The experiment was carried out by factorial randomized block design with 26 treatment combination which were replicated by two times. Factor A represents different concentration of biostimulant and factor B represents application interval.

Initially, epicotyl grafted 50 grafts were selected. Application of biostimulant was conducted by spraying from 30 days after grafting up to 6 months after grafting and the observation was recorded at 30 days interval up to 270 days after grafting and in values mentioned in table was at end of the experiment. Observation of all vegetative growth parameter (height, girth, leaf area) recorded at monthly interval, whereas root length, dry root weight of mango graft was noted at the end of experiment. The grafts of plants were handed over for experimentation after 30 days, marking the beginning of the trial. Initially, a small number of grafts were found to

Factor A. Different concentration of biostimulant

T_1 - CPPU@ 15 ppm	T_6 - Salicylic acid@ 500 ppm	T_{11}- Chitosan @125 ppm
T_2 - CPPU@ 20 ppm	T_7 – NATCA (10 %) +folic acid (0.2 %) @ 0.5ml	T_{12} - Chitosan @150 ppm
T_3 - CPPU@ 25 ppm	T_8 - NATCA (10 %) +folic acid (0.2 %) @ 1 ml	T_{13} – Control (without any spray)
T_4 -Salicylic acid@ 100 ppm	T_9 – NATCA (10 %) +folic acid (0.2%) @ 1.5 ml	
T_5 - Salicylic acid@ 250 ppm	T_{10} - Chitosan @100 ppm at 30	

Factor B. Spraying interval

S_1 - Spraying at 30 days interval (DI)	S_2 - Spraying at 60 days interval (DI)

have number of grafts were found to have died by day 30. These were recorded before the application and the survival (%) was determined from the surviving grafts at the end of the 30 days study. Economics was calculated on the basis of cost of production of mango grafts and interval of application of biostimulant. The data after investigation statistically analysed by the method suggested by Panse and Sukhatme [2].

3. RESULTS AND DISCUSSION

At the end of experiment at 270 days after grafting, it was observed that all the growth parameter, survival and B:C was significantly influence by biotimulant and its interval of application.

3.1 Effect of Biostimulant and its Interval of Application on Height of Mango grafts Cv. Alphonso

The data related to effect of biostimulant and its interval of application on height of mango grafts have shown in Table 1. The interaction effect at 270 DAG, on height of mango graft was noted significant and $T_{11}S_1$ (Chitosan @125 at 30 DI) recorded maximum height (45.15 cm) at par with T_8S_2 (NATCA +folic acid@ 1 ml at 60 DI) (43.73 cm) and lowest height (31.38 cm) and (31.75 cm) was noted in $T_{13}S_2$ (Control without any spray) and $T_{13}S_1$ (Control without any spray) treatment.

Monthly application of chitosan at 125 ppm boosted plant growth by stimulating hormones and making minerals more available. Dovel et al. [3] Chitosan application helps to synthesis of auxin which known for its apical dominance which might helped to plant to grow. Bimonthly application of T_8S_2 (NATCA+ folic acid @ 1 ml at 60 DI) also produced similar results to chitosan application. NATCA+ folic acid is also the great source of amino acid, folic acid also helps to synthesis of various growth hormones (GA_3, auxin and cytokinin) Hota et al. [4] which might be helped for increased height grafts. Similar results reported by El-Tanahy et al. [5] in cowpea, noted maximum height (55.01 cm) by the application of chitosan and El-miniawy et al. [6] in strawberry noted maximum height (23.13 cm) and (23.83 cm) during two respective seasons.

3.2 Effect of Biostimulant and its Interval of Application on Girth of Mango Grafts Cv. Alphonso

Data related to girth was given in Table 1. At 270 DAG, the maximum girth (11.66 mm) was reported in T_6S_1 (Salicylic acid@ 500 ppm at 30 DI) at par with $T_{10}S_2$ (Chitosan @100 ppm at

60 DI) (11.64 mm) and $T_{11}S_1$ (11.38 mm) and the lowest girth (8.60 mm) and (8.67 mm) was noted in $T_{13}S_2$ and $T_{13}S_1$ (Control) treatment.

During the investigation period it was observed that at the end T_6S_1 (salicylic acid @500 ppm at 30 DI) showed best results. Salicylic acid plays a key role in plant defence and regulates various physiological processes. It also contributes to the synthesis of growth hormones, including auxin and gibberellin which might be increasing stem diameter through stem elongation. Similar results found by Akram et al. [7] in *Antirrhinum majus* and noted maximum height (91.33 cm) by the application of salicylic acid.

3.3 Effect of Biostimulant and its Interval of Application on leaf area (cm^2) of Mango Grafts Cv. Alphonso

Data despite in Table 1. At 270 DAG, the maximum leaf area (818.57 cm^2) was recorded in $T_{10}S_1$ (Chitosan @100 ppm at 30 DI) followed by treatment T_8S_2 (760.35 cm^2) and minimum leaf area (481.40 cm^2) and (487.72 cm^2) was noted in $T_{13}S_1$ and $T_{13}S_2$ control treatments.

The study found that the biostimulant interaction effect and application interval had a significant impact on the leaf area of mango grafts. Application of chitosan 100 ppm on a monthly basis gave best results followed by NATCA +folic acid on bimonthly basis application also gave significant results in terms of leaf area of mango grafts. Chitosan applied monthly enhanced amino acid and nitrogen production, leading to increased synthesis of auxin and cytokinin hormones. This, in turn, stimulated growth, producing more leaves with increased length, width and expanded leaf area. Similar reported by Abul-magd et al. [8] in *Aglaonema commutatum*) and noted that chitosan application gave maximum leaf area (36.38 cm^2) and Hota et al. [9] in apricot plant noted that NATCA in combination with CPPU or sole increased leaf area of mango grafts.

3.4 Effect of Biostimulant and its Interval of Application on root Length of Mango Grafts Cv. Alphonso

Data related to roots and survival was given in Table 2. All the root observations were recorded at the end of experiment at 270 DAG. Interaction effect of biostimulant and its application interval showed significant effect on root length of mango graft. The maximum root length (18.75 cm) was found in T_8S_2 at par with $T_{10}S_2$ (18.50 cm) and $T_{11}S_1$ (17.55 cm) treatments while, the minimum root length (12.50 cm) and (13.70 cm) was noted in $T_{13}S_1$ and $T_{13}S_2$ control treatment.

Amino acid in NATCA helped to synthesis of hormones like GA and IAA. IAA was well known for its ability to form new roots and promote root growth, which might increase the root length of mango grafts.

3.5 Effect of Biostimulant and its Interval of Application on dry Weight of root of Mango Grafts Cv. Alphonso

The significant result was observed in interaction effect and maximum dry weight (12.92 g) was noted in T_8S_2 treatment at par with T_6S_1 (12.90 g), $T_{10}S_2$ (12.80 g), $T_{11}S_1$ (12.65 g), T_1S_1 (CPPU@ 15 ppm at 30 DI) (12.62 g), T_5S_1 (Salicylic acid@ 250 ppm at 30 DI) (12.60 g) and $T_{12}S_2$ (Chitosan @150 ppm at 60 DI) (12.00) however the minimum dry weight (6.85 g) and (7.05 g) was noted in $T_{13}S_1$ and $T_{13}S_2$ control treatment.

T_8S_2 (NATCA+ folic acid @ 1ml at 60 DI) which gave superior results, even it applied at 60 days interval of application. NATCA acid contained hormones such as IAA and GA, with IAA stimulating root formation and promotes healthy growth of roots which might increase the dry weight of root. Elbohy et al. (2018) in *Zinnia elegans* plant and noted maximum dry weight (8.66 g) and (8.44 g) by the application of salicylic acid mean while Ebrahimpour et al. [10] also reported in pistachio seedling that application salicylic acid increased dry weight of roots up to 5 % to 33 %

3.6 Effect of Biostimulant and its interval of Application on Survival of Mango Grafts of root of Mango Grafts Cv. Alphonso

Maximum survival (86.05 %) of mango grafts was reported in T_6S_1 at par with T_9S_1 (NATCA + folic acid @ 1.5 ml at 30 DI) (85.89 %) while minimum survival (49.32 %) and (51.89 %) was noted in $T_{13}S_1$ and $T_{13}S_2$ control treatment. Salicylic acid increased the grafts union also related grafting stress and aids in recovery and establishment. This all might produce healthy plant growth which might increase survival (%) mango graft. Thorat et al. [11] in mango Cv. Kesar that application of salicylic acid 500 to 1000 mg/L increased the survival percentage of plant by (73.33 %) to (71.67 %).

3.7 Effect of Biostimulant and its Interval of Application on cost of Production (B:C) of Mango Grafts of Root of Mango Grafts Cv. Alphonso

The cost of production application was shown in Table 3. The highest B:C (1.51) was noted in treatment T_8S_2 (NATCA +folic acid @ 1 ml at 60 DI) treatment with 1692.62 Rs net profit followed by $T_{12}S_2$ (Chitosan @ 150 ppm at 60 DI) and reported maximum B:C (1.49) with 1829.60Rs net profit but T_8S_2 treatment required lowest cost of production compared to all the treatment at 30- or 60-days application interval. However, the lowest B:C (1.10) and (1.06) was noted in $T_{13}S_1$ and $T_{13}S_2$ treatment.

Table 1. Effect of biostimulant and its interval of application on height (cm), girth (mm) and leaf area (cm^2) of mango grafts Cv. Alphonso

Treatments	Height (cm) of mango graft at 270 DAG			Girth (mm) of mango graft at 270 DAG			Leaf area (cm2) of mango graft at 270 DAG		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
T1	40.55	36.25	38.40	10.92	10.29	10.61	651.78	572.02	611.90
T2	35.70	36.13	35.92	10.24	9.57	9.90	727.70	530.35	629.03
T3	37.50	33.00	35.25	10.47	9.70	10.09	697.17	578.52	637.85
T4	36.45	35.00	35.73	10.47	9.68	10.07	576.52	612.79	594.66
T5	38.50	38.00	38.25	10.38	10.93	10.65	582.77	656.02	619.40
T6	37.60	37.30	37.45	11.66	11.07	11.36	673.08	735.53	704.31
T7	35.25	39.05	37.15	10.14	10.45	10.29	513.71	687.54	600.62
T8	37.00	43.73	40.37	10.11	10.60	10.35	605.42	760.35	682.89
T9	35.40	37.23	36.32	10.58	10.13	10.35	625.20	697.77	661.48
T10	42.93	39.08	41.01	11.28	11.64	11.46	818.57	683.58	751.08
T11	45.15	35.28	40.22	11.38	10.78	11.08	735.46	552.97	644.22
T12	40.45	35.20	37.83	10.33	10.36	10.34	641.59	599.50	620.55
T13	31.75	31.38	31.56	8.60	8.67	8.64	481.40	487.72	484.56
Mean	38.02	36.66	-	10.50	10.29	-	640.80	627.28	-
-	S. Em±	C.D at 5%	Result	S. Em±	C.D at 5%	Result	S. Em±	C.D at 5%	Result
T	0.29	0.85	SIG	0.06	0.17	SIG	0.30	0.86	SIG
S	0.04	0.13	SIG	0.01	0.03	SIG	0.05	0.13	SIG
T×S	0.58	1.70	SIG	0.12	0.34	SIG	0.59	1.73	SIG

Table 2. Effect of biostimulant and its interval of application on root length (cm), dry weight of root (g) and survival (%) of mango grafts Cv. Alphonso

Treatment	Root length of mango grafts at 270 DAG (cm)			Dry weight of root of mango graft at 270 DAG (g)			Survival (%) of mango grafts at 270 DAG		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
T1	16.85	14.00	15.43	12.62	7.90	10.26	73.63	67.54	70.59
T2	14.10	15.50	14.80	8.00	11.20	9.60	71.82	77.50	74.66
T3	14.20	13.80	14.00	8.10	7.80	7.95	73.91	70.89	72.40
T4	14.80	14.30	14.55	9.20	8.20	8.70	80.00	71.76	75.88
T5	16.40	14.40	15.40	12.60	8.40	10.50	71.88	69.37	70.63
T6	16.15	14.50	15.33	12.90	8.60	10.75	86.05	69.57	77.81
T7	14.90	15.90	15.40	9.20	11.50	10.35	74.00	78.00	76.00
T8	14.60	18.75	16.68	8.90	12.92	10.91	79.35	70.50	74.92
T9	15.10	15.80	15.45	9.40	11.40	10.40	85.89	70.73	78.31
T10	15.30	18.50	16.90	9.60	12.80	11.20	73.00	71.47	72.24
T11	17.55	15.20	16.38	12.65	9.50	11.08	74.02	77.22	75.62
T12	15.40	16.25	15.83	9.98	12.00	10.99	72.62	74.17	73.40
T13	12.50	13.70	13.10	7.05	6.85	6.95	51.89	49.32	50.60
Mean	15.22	15.43	-	10.01	9.93	-	74.47	70.62	-
-	S. Em±	C.D	Result	S. Em±	C.D	Result	S. Em±	C.D at 5%	Result
T	0.24	0.71	SIG	0.19	0.56	SIG	0.97	2.81	SIG
S	0.04	0.11	NS	0.03	0.09	NS	0.15	0.43	SIG
T×S	0.49	1.42	SIG	0.38	1.12	SIG	1.93	5.62	SIG

Table 3. Effect of biostimulant and its interval of application on cost of production (B:C) of mango grafts of root of mango grafts Cv. Alphonso

Sr. No	Treatment	Total number of grafts survived	Total cost (Rs)	Gross return (Rs. 80× survive graft)	Net Profit (Rs)	B:C ratio
1.	T1S1	61	3833.77	4880	1046.23	1.27
2	T2S1	61	3987.31	4880	892.69	1.22
3	T3S1	68	4094.44	5440	1345.56	1.32
4	T4S1	68	3677.12	5440	1763.01	1.47
5	T5S1	64	3624	5120	1496	1.41
6	T6S1	67	3664.35	5360	1695.65	1.46
7	T7S1	58	3544.71	4640	1095.29	1.30
8	T8S1	65	3639.1	5200	1560.9	1.42
9	T9S1	61	3586.82	4880	1293.18	1.36
10	T10S1	62	3597	4960	1363	1.37
11	T11S1	61	3583.67	4880	1296.33	1.36
12	T12S1	60	3570.35	4800	1229.65	1.34
13	T13S1	47	3396.99	3760	363	1.10
14	T1S2	56	3642.22	4480	837.78	1.22
15	T2S2	59	3723.97	4720	996.03	1.26
16	T3S2	56	3725.71	4480	754.29	1.20
17	T4S2	61	3583.72	4880	1296.28	1.36
18	T5S2	59	3583.82	4880	1296.18	1.36
19	T6S2	59	3557.33	4720	1162.67	1.32
20	T7S2	61	3584.18	4880	1295.82	1.36
21	T8S2	62	3267.38	4960	1692.62	**1.51**
22	T9S2	58	3545.24	4640	1094.76	1.30
23	T10S2	58	3545.24	4640	1094.76	1.30
24	T11S2	67	3663.8	5360	1696.2	1.46
25	T12S2	69	3690.34	5520	1829.66	1.49
26	T13S2	45	3370.33	3600	229.67	1.06

4. CONCLUSION

From the present study it can be concluded that application of NATCA (10 %) +folic acid (0.2 %) @ 1 ml/L at 60 days interval for 180 days to mango grafts of Alphonso and obtained superior results in plant growth parameter like (height, girth, root length and dry weight of root) by reducing cost of production with highest B:C (1.51) over all other application of biostimulant at 30- or 60-days interval followed by Chitosan @ 150 ppm at 60 days interval also showed maximum B:C (1.49) and maximum net profit.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Yadav D, Singh SP. Mango: History origin and distribution *Journal of Pharmacognosy and Phytochemistry.* 2017;6(6):1257-1262.
2. Panse VG, Sukhatme PV. Statistical methods for Agricultural Workers. Book ICAR Rev. Ed. 1995;97-156.
3. Doval RR, Torres-Arellanes SP, Tenorio-Barajas AY, Gomez-Sanchez A, Valencia Lazcano, AA. Chitosan: Properties and its application in agriculture in context Elbohy, N.F.S., 2023.
   Attia KE, El-Deen TMN. ncreasing quality of Zinnia elegans plants by foliar spraying with ascorbic and salicylic acids. Middle East J. Agri, 2018;7(4):1786-1797.
4. Hota D, Karna AK, Behera SD, Toppo P. NATCA a potential bio-regulator for fruit production: A review. Bulletin Of Environment, Pharmacology and Life Sciences. 2019;8(1):1-4.
5. El-Tanahy AMM, Mahmoud AR, Abde-Mounty MM, Ali AH. Effect of chitosan doses and nitrogen sources on the growth, yield and seed quality of cowpea. Australian Journal of Basic and Applied Sciences. 2012;6(4):115-121.
6. El-Miniawy SM, Ragab ME, Youssef SM, Metwally AA. Response of strawberry plants to foliar spraying of chitosan. Research Journal of Agriculture and Biological sciences. 2013;9(6):366-372.
7. Akram A, Asghar MA, Younis A, Akbar AF, Talha M, Farooq A, Akhtar G, Shafiqa M, Mushtaq MZ. Foliar application of salicylic acid and its impact on pre- and post-harvest attributes of *Antirrhinum majus* L. Journal of Pure and Applied Agriculture. 2022;7(2):1-11.
8. Abul-magd SS, El-leithy AS, EL-maadawy EI, Heider SM. effect of brassinolide and chitosan on growth and chemical composition of (*Aglaonema commutatum*) plant. Egyptian J. Chemistry. 2023; 66(7):419-427.
9. Hota D, Jain S, Mandal O, Chawla R, Lokesh Anushi, Kalatippi AS, Darshan D. Correlation analysis of horticultural traits of apricot as influenced by Phyto- bio stimulants. Plant Archives. 2024;24(1):380-386.
10. Ebrahimpour E, Panahi B, Talaie A, Tavassolian I. Effect of foliar application of salicylic acid and ascorbic acid on morpho-physiological traits of pistachio seedlings under drought stress. Journal of Nuts. 2020;11(3):213-226.
11. Thorat D, Tandel YN, Thakriya HR. Effect of antitranspirtants on growth and survival of epicotyl grafting of mango (*Mangifera indica* L.) Cv. Kesar. International Journal of Chemical Studied, 2018;6(3):29-31.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/124418