Environment and Ecology 42 (3A) : 1113—1117, July—September 2024
Article DOI: https://doi.org/10.60151/envec/XXNK4544
ISSN 0970-0420

Influence of Liquid Plant Growth Promoting Rhizomicrobial Consortia on Graft Success in Mango (*Mangifera indica* L.)

Didgi Pradeepkumar, R. Sridhar, B. S. Shivakumar, M. S. Nandish, M. Ganapathi

Received 23 December 2023, Accepted 23 May 2024, Published on 5 August 2024

ABSTRACT

Mango is the most important and commercially grown fruit crop in India. The area under mango is increasing rapidly but the limited availability of genuine planting material is the most important bottleneck in the expansion of the area. The application of liquid plant growth promoting rhizomicrobial consortia (PGPR) at the nursery stage will enhance the seedling vigour and graft success. Hence, an experiment was conducted at the College of Horticulture, Hiriyur during the academic year 2022–23. The experiment was laid out in Completely Randomized Design with eight treatments and three replications. In this study, liquid PGPRs were applied to the media (soil, sand and FYM @ 3:1:1), the different PGPRs viz., Control- (T_1), *Azotobacter chroococcum* (T_2), *Bacillus megaterium* (T_3), *Frateuria aurantia* (T_4), *Azotobacter chroococcum* + *Bacillus megaterium* (T_5), *Azotobacter chroococcum* + *Frateuria aurantia* (T_6), *Bacillus megaterium* + *Frateuria aurantia* (T_7), *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia* (T_8). Among different treatments, T_8 has showed significantly maximum sprout success (82.22 % and 84.44 % at 30 and 60 days after grafting), survival per cent (84.55 %), sprout length (9.30 cm), sprout girth (4.76 mm), number of leaves (15.37), leaf length (14.08 cm) and leaf breadth (3.29 cm) at 120 days after grafting. Hence, it is concluded that the mango rootstocks treated with *Azotobacter chroococcum, Bacillus megaterium* and *Frateuria aurantia* resulted in better physiological growth and graft success.

Keywords Mango graft, PGPR, *Azotobacter chroococcum, Bacillus megaterium, Frateuria aurantia.*

INTRODUCTION

Mango (*Mangifera indica* L.) is an important tropical fruit and also known as "King of fruits". The

Didgi Pradeepkumar[1], R. Sridhar[2]*, B. S. Shivakumar[3], M. S. Nandish[4], M. Ganapathi[5]

[1]Department of Fruit Science, College of Horticulture, Mudigere-577132, Karnataka, India.

[3]Professor and Head
Department of Fruit Science, College of Horticulture, Mudigere 577132, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga 577201, Karnataka, India

[2]Assistant Professor
Department of Fruit Science, College of Horticulture, Hiriyur, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga 577201, India

[4]Associate Professor
Department of Agricultural Microbiology, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga 571201, India

[5]Assistant Professor
Department of Crop Physiology, College of Agriculture, Shivamogga, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga 577201, India

Email : sridharr@uahs.edu.in
*Corresponding author

area under mango is increasing rapidly but limited availability of genuine planting material is the most important bottleneck in the expansion of area. Therefore, there is a need of production of genuine planting material to increase the area under mango cultivation especially in dry zone of the Karnataka.

Mango is propagated by grafting and the root stock must be prepared in advance for the preparation of grafts in mango. Grafted mango trees blossom and yield fruits in a shorter period of time. Currently, the importance is on sustainable agriculture, which uses less chemical inputs like chemical fertilizers. The use of microbial consortia (*Azotobacter*, phosphorous solubilizing bacteria and potassium solubilizing bacteria) has a better perspective because they are cheaper and eco-friendly. They also help in the production of hormones, vitamins and other growth factors required for plant growth (Pindi and Satyanarayana 2012).

The use of microbial consortia appears to be an emerging option to improve the growth and development as well as cost reduction strategy for production of quality grafted plants of mango. Hence, the present investigation was undertaken to study the influence of liquid plant growth promoting rhizomicrobial consortia on graft success in mango (*Mangifera indica* L.).

MATERIALS AND METHODS

The experiment was carried out at the College of Horticulture, Hiriyur, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, during 2022- 2023. The uniform seedlings (Badami) from the nursery sand beds were transplanted into potting media (soil, sand and FYM @ 3:1:1) in polythene bags of 6×9-inch size. The total of eight treatments were used in this study viz., Media (Control-T_1), Media + *Azotobacter chroococcum* (T_2), Media + *Bacillus megaterium* (T_3), Media + *Frateuria aurantia* (T_4), Media + *Azotobacter chroococcum* + *Bacillus megaterium* (T_5), Media + *Azotobacter chroococcum* + *Frateuria aurantia* (T_6), Media + *Bacillus megaterium* + *Frateuria aurantia* (T_7), Media + *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia* (T_8). Three replications of twenty plants each were maintained to carry out all the parameters. The seedlings were inoculated with liquid PGPR of respective treatment at 4 ml per plant and VAM at 10 g per plant each plant in common to all the treatments. The seedlings were watered daily with adequate quantity of water and weeding was done as and when required.

After 120 days after transplanting softwood grafting was carried out by using scion of Mallika variety during the month of October. Scions from the Mallika were precured and collected on the day of grafting from the mother block unit from the selected trees of twelve years old maintained in the campus. After grafting, the top of the scion was covered with a polytube cap to protect the apical portion of the scion from desiccation. The grafts were watered regularly to maintain moisture content of media. The observation on parameters such as sprout success (%) at 30 and 60 days after grafting (DAG), survival per cent (%), sprout length (cm), sprout girth (mm), number of leaves, leaf length (cm) and leaf breadth (cm) at 120 days after grafting were recorded. The experiment was laid out under Completely Randomized Design (CRD) with three replications. The data collected from the five labelled grafts in each treatment were averaged and significance among different treatments were statistically analyzed.

RESULTS AND DISCUSSION

The evaluation of PGPRs influence on mango graft success and growth parameters were presented in the Table 1. The data on sprout success and survival per cent was significantly influenced by the liquid PGPRs. Among different treatments Media + *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia* (T_8) showed maximum sprout success 82.22 % and 84.44 % at 30 and 60 days after grafting (DAG) respectively and sprout success was on par with T_5 (77.78 %) and T_7 (77.78 %) at 30 DAG, similarly at 60 DAG T_5 and T_7 recorded 84.44 and 84.44 % respectively. Survival per cent recorded at 120 DAG was found maximum with T_8 (84.55 %) which was followed by T_5 (78.85 %) while minimum sprout success (62.22 % and 68.89 %) at 30 and 60 DAG and survival per cent (61.21%) recorded by control (T_1) at 120 DAG.

The maximum sprout success might be due to

Table 1. Effect of liquid plant growth promoting rhizomicrobial consortia on graft success and growth parameters in mango.

	Treatment	Sprout success (%) 30 DAG	Sprout success (%) 60 DAG	Survival per cent (%) 120 DAG	Sprout length (cm) 120 DAG	Sprout girth (mm) 120 DAG	Number of leaves 120 DAG	Leaf length (cm) 120 DAG	Leaf breadth (cm) 120 DAG
T_1	Media (Control)	62.22	68.89	61.21	4.80	3.80	9.73	8.84	2.48
T_2	Media + *Azotobacter chroococcum*	73.33	77.78	68.69	6.12	4.05	11.47	10.63	2.69
T_3	Media + *Bacillus megaterium*	75.56	82.22	64.96	5.87	3.92	10.73	9.04	2.59
T_4	Media + *Frateuria aurantia*	71.11	75.56	64.65	5.40	3.93	10.20	8.83	2.56
T_5	Media + *Azotobacter chroococcum* + *Bacillus megaterium*	77.78	84.44	78.85	8.20	4.38	14.33	13.69	3.10
T_6	Media + *Azotobacter chroococcum* + *Frateuria aurantia*	73.33	80.00	77.91	6.97	4.00	12.87	12.20	2.82
T_7	Media + *Bacillus megaterium* + *Frateuria aurantia*	77.78	84.44	71.15	6.13	3.74	10.77	10.77	2.73
T_8	Media + *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia*	82.22	84.44	84.55	9.30	4.76	15.37	14.08	3.29
	SEm ±	**2.72**	**2.48**	**1.82**	**0.35**	**0.15**	**0.33**	**0.58**	**0.04**
	CD @ 5%	**8.16**	**7.45**	**5.45**	**1.05**	**0.46**	**0.98**	**1.73**	**0.13**

*DAG – Days after grafting.

auxin and/or auxin like plant growth promoting substance produced by PGPR. The hormones of auxin groups can stimulate callus formation (Bonner and Galston 1952). This might also due to role of PGPRs in lowering the level of ethylene and phenol in the plant (Grichko and Glick 2001). Similar results reported by Kose *et al.* (2005) and Sabir (2013) in grape that the application of PGPRs increases the success rate. The maximum survival per cent might be due to the production IAA and cytokinin which plays an important role in xylem formation across the callus bridge between stock and scion. Further, cambial continuity after callusing between graft partners has also an essential role in graft survival rate (Sabir 2011). Sabir (2013) reported that the application of PGPR enhances survival per cent of grafted grape plants. The results are in accordance with the findings of Shankarappa *et al.* (2018) in mango.

The application of PGPR produced maximum sprout length than the control (Table 1). When compared to single inoculations and the untreated control (4.80 cm), the sprout length was significantly higher (9.30 cm) in the Media + *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia* (T_8) treatment at 120 DAG (Fig. 1). This might be due

Fig. 1. Image representing graft survival, growth and establishment of mango grafts at 120 DAG in untreated control (a) and media treated with *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia* (b).

to enhanced nutritional absorption by grafts coupled with cell elongation and proliferation. The production of hormones that promote plant growth, such as auxins (IAA) and gibberellins (GA), which drive cell division and cell expansion stimulates the growth. It agrees with previous result of Shankarappa *et al.* (2018), Poonia *et al.* (2018) in mango seedlings and Zenginbal and Esitken (2016) in mulberry.

The maximum grafts sprout girth (4.76 mm) recorded with Media + *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia* (T_8) whereas, Media + *Azotobacter chroococcum* + *Bacillus megaterium* (T_5) was found on par (4.38 mm) for sprout girth (Table 1). However minimum sprout girth (3.80 mm) recorded by control (T_1). The PGPR's aid with nitrogen fixation, releases hormone that promotes plant development and the conversion of unavailable forms of P and K into forms that were available in media may have contributed to the larger sprout girth. Because of the improved nutrient absorption, the grafts vegetative development was stimulated. These findings are in accordance with the results of Poonia *et al.* (2018) in mango seedlings, Shankarappa *et al.* (2017) in cashew seedlings and Zenginbal and Esitken (2016) in mulberry.

The number of leaves treated with Media + *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia* (T_8) was also significantly greater (15.37) and followed by the (T_5) recorded 14.33. The least number of leaves was observed in control (9.73) as represented in Table 1. The maximum number of leaves in this treatment could be attributed to the more vegetative development results from the increased intake of nitrogen, which is a crucial component of proteins and chlorophyll. Additionally, the microorganisms produced by liquid PGPRs may have produced growth-promoting substances like vitamins, indole acetic acid, gibberellins, and cytokinins, which would have accelerated the differentiation of leaf primordial in the apical growing region and increased leaf production. The similar results reported by Shankarappa *et al.* (2018), Poonia *et al.* (2018) in mango seedlings and Shankarappa *et al.* (2017) in cashew.

The leaf length and breadth were significantly differed with respect to different liquid PGPRs treatment (Table 1). The maximum leaf length (14.08 cm) was recorded with application of Media + *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia* (T_8) and minimum leaf length (8.84 cm) was recorded in control (T_1). The leaf breadth (3.29 cm) was found higher in the treatment *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia* (T_8) and minimum (2.48 cm) was recorded in control (T_1). This might be due to the inoculated seedlings were better able to absorb nutrients compared to uninoculated seedlings. Availability of the ideal nutritional concentrations in media by inoculation of PGPR which improved the vegetative development. These observations are in line with that of Poonia *et al.* (2018) in mango.

The experiment on effect liquid plant growth promoting rhizomicrobial consortia on grafts success showed that the inoculation of liquid PGPRs consortium of Media + *Azotobacter chroococcum* + *Bacillus megaterium* + *Frateuria aurantia* (T_8) along with VAM was effective in getting maximum sprout success (82.22 % and 84.44 % at 30 and 60 DAG), survival per cent (84.55 %), sprout length (9.3 cm), sprout girth (4.76 mm), number of leaves (15.37), leaf length (14.08 cm) and leaf breadth (3.29 cm) at 120 days after grafting. Also, present study revealed that treatments having combined application of the PGPRs found superior in graft success, survival and establishment of grafts in mango, compare to the single application of PGPRs and untreated control.

ACKNOWLEDGMENT

The author is highly thankful to Department of Fruit Science, College of Horticulture, Hiriyur and Department of Fruit Science, College of Horticulture, Mudigere, College of Agriculture, Shivamogga and KSNUAHS, Shivamogga (Karnataka) for providing essential facilities and support during the research experiment.

REFERENCES

Bonner J, Galston AW (1952) Principles of Plant Physiology. W. H. Freeman and Company, San Francisco, pp 499.

Grichko VP, Glick BR (2001) Amelioration of flooding stress by

ACC deaminase-containing plant growth-promoting bacteria. *Plant Physiology and Biochemistry* 39(1): 11-17. https://doi.org/10.1016/S0981-9428(00)01212-2

Kose C, Guleryuz M, Sahin F, Demirtas I (2005) Effects of some plant growth promoting rhizobacteria (PGPR) on graft union of grapevine. *Journal of Sustainable Agriculture* 26(2): 139-147. https://doi.org/10.1300/J064v26n02_10

Pindi PK, Satyanarayana (2012) Liquid microbial consortium- A potential tool for sustainable soil health. *Journal of Biofertilizers and Biopesticides* 3: 124-130.

Poonia KD, Bhatnagar P, Sharma MK, Singh J (2018) Efficacy of biofertilizers on growth and development of mango plants cv Dashehari. *Journal of Pharmacognosy and Phytochemistry* 7(5): 2158-2162.

Sabir A (2011) Comparison of green grafting techniques for success and vegetative development of grafted grape cultivars (*Vitis* spp.). *International Journal of Agriculture and Biology* 13(4): In press.

Sabir A (2013) Improvement of grafting efficiency in hard grafting grape Berlandieri hybrid rootstocks by plant growth-promoting rhizobacteria (PGPR). *Scientia Horticulturae* 164: 24-29. https://doi.org/10.1016/j.scienta.2013.08.035

Shankarappa TH, Mushrif SK, Subramanyam B, Sreenatha A, Maruthi Prasad BN, Aswathanarayana Reddy N (2017) Effect of biofertilizers on growth and establishment of cashew grafts under nursery condition. *International Journal of Current Microbiology and Applied Sciences* 6(8): 1959-1965.

Shankarappa TH, Reddy RN, Subramanyam B, Sreenatha A, Reddy NA (2018) Biofertilizers for growth and establishment of alphonso mango grafts under nursery condition. *International Journal of Current Microbiology and Applied Sciences* 7: 5205-5211.

Zenginbal H, Esitken A (2016) Effects of the application of various substances and grafting methods on the grafting success and growth of black mulberry (*Morus nigra* L.). *Acta Scientiarum Polonorum Hortorum Cultus* 15(4): 99-109.