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Research Article

EFFECT OF PRE-SOWING TREATMENTS ON STONE GERMINATION AND SHOOT GROWTH OF MANGO (*Mangifera indica* L.) SEEDLINGS

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Abstract- A trial was conducted to assess the effect of pre-sowing treatments on stone germination and shoot growth of mango seedlings. Mango stones were soaked for 12 and 24 hours in aqueous solutions of GA_3 (100 and 200 ppm), Beejamruth (2% and 3%) and Thiourea (1% and 2%) and sown in polythene bags. Thiourea at 1% recorded the highest Seedling Vigour Index, shoot length, collar diameter and number of leaves. Soaking mango stones for 24 hours induced early germination, enhanced germination percentage, promoted vigour and increased shoot length, collar diameter and number of leaves. The minimum days taken for germination and the maximum germination percentage was observed in GA_3 at 100 ppm. Evidence generated by this trial highlights the possibility of inducing early germination and producing vigorous rootstocks in mango by dipping stones in aqueous solutions of 100 ppm GA_3 or 1% thiourea for 24 hours prior to sowing.

Keywords- Mango, GA_3, Thiourea, Germination percentage, Shoot length.

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Introduction

Mango (*Mangifera indica* L.) is a subtropical fruit crop, closely associated with the culture and history of the Indian subcontinent. It is widely revered as the 'King of Fruits' and regarded as the 'National Fruit of India'. Mango is commercially propagated by veneer, stone, approach and softwood grafting in different parts of the India. For successful graft union, it is imperative to have healthy, strong and actively growing rootstocks. Mango stones are usually available during the drier parts of the year (April-May) because of which the germination percentage and vigour are very low. The viability of mango stones is also low because stones are recalcitrant in nature. Germination percentage of mango stones is only 12 to 50 per cent when sown within a month of extraction [1].

Pre-sowing treatments with chemicals like gibberellic acid (GA_3), Thiourea and 1-Naphthaleneacetic acid (NAA) have a significant bearing on the time taken for germination, percentage emergence, seedling height, number of leaves and roots in several crop species [2]. Gibberellic acid has been successfully used to improve germination percentage in guava [3] and fig [4]. Several workers have reported that thiourea increases either the germination percentage for instance in papaya [5] or seedling height and girth as in aonla [6]. In recent years, organic formulations like amritpani, panchgavya and beejamruth have also been used to enhance growth and germination in mango stones [7]. Soaking seeds in aqueous solutions of growth chemicals for 12-36 hrs has been found to induce early germination, enhance germination percentage and promote seedling growth in fruit crops like custard apple [8] and karonda [9].

Improving stone germination and enhancing seedling growth are very important for producing healthy rootstocks of mango within a short period of time. An experiment was therefore undertaken to assess the effect of pre-sowing treatments and duration of soaking on germination and growth of mango stones with the twin objectives of increasing germination percentage and producing vigorous rootstocks.

Materials and Methods

The experiment was carried out in the year 2014 at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, which is situated on the coast of Arabian Sea at 20^0-57'N latitude and 72^0-54'E longitude at an altitude of about 10 meters above the mean sea level. The experiment was evaluated in Completely Randomized Design based on factorial concept. Mango stones were procured from Petson Food Industries, Sisodra, district Navsari and washed thoroughly to remove extraneous material adhering to it. Stones were dipped in water and allowed to settle at the bottom of the container. Stones floating on the surface of water were discarded and those which settled at the bottom were used for experimentation. Mango stones thus selected were dipped in aqueous solutions of gibberellic acid (100 and 200 ppm), thiourea (1% and 2%) and beejamrut (2% and 3%) for 12 and 24 hours. The resultant twelve treatment combinations were replicated thrice. Treated mango stones were sown in polythene bags, which were properly filled, labelled with tags and placed in a naturally ventilated polyhouse at proper spacing. Stones were irrigated immediately after sowing in polythene bags. Subsequently, bags were watered as and when required. To protect mango stones and saplings from root rot disease, they were drenched with Copper oxychloride @ 0.02% at monthly intervals. Dimethoate @ 0.03% and Carbendazim @ 0.02% was applied as foliar spray at monthly intervals to control sucking pest and fungal diseases. Observations were recorded for seven different parameters related to germination of mango stones and shoot growth of seedlings. Days taken for 50 per cent sprouting was calculated as to when 50 seedlings out of 100, germinated in each

repetition. Germination percentage was recorded after 40 days of sowing based on the below mentioned formula:

$$\text{Germination percentage} = \frac{\text{Number of stones germinated}}{\text{Number of stones sown}} \times 100$$

The Seedling Vigour Index (SVI) was calculated using the following formula:

$$\text{SVI} = \text{Germination percentage} \times (\text{Shoot length} + \text{Root length})$$

Five mango seedlings were selected at random from each repetition for recording observations related to shoot characters, 90 days after sowing. Shoot length (cm) was measured from the soil surface to the growing tip. Collar diameter (mm) was recorded with the help of vernier callipers at a height of 3 cm from the base of mango seedlings. The total number of leaves per seedling was counted from five selected plants. Leaf area (cm^2) was calculated using a leaf area meter. All parameters except days taken for 50% sprouting were recorded after 90 days of sowing. The experimental data recorded was subjected to statistical analysis as per the method suggested by Panse and Sukhatme [10]. Treatment means were separated using F test values at 5% level of significance.

Results and Discussion

Statistically analyzed results are described and explained under the following subheads.

Effect of pre-sowing treatments

There was a significant impact of pre-sowing treatments on all parameters chosen for this investigation except leaf area [Table-1]. The minimum number of days [26.07] taken for 50% sprouting was recorded when mango stones were soaked in GA_3 100 ppm. GA_3 might have induced early germination by increased hydrolysis of starch and their translocation to growing tips [11]. Similar results were reported by Anjanaw et al. [12] in papaya.

Treating mango stones with GA_3@100 ppm resulted in the maximum germination percentage [66.33%], 40 days after sowing which was at par with GA_3 200 ppm and 1% thiourea. It might be due to the stimulating effect of imbibitions on subsequent seed germination caused by action of GA_3 of seed. Gibberellic acid induces denovo synthesis of proteolytic enzymes like α-Amylase and ribonuclease. Amylases in turn hydrolase starch in the endosperm, providing essential sugars for the initiation of growth processes [13]. GA_3 treatment is also known to overrule the photo dormancy, thermo-dormancy, dormancy imposed by incomplete embryo development, mechanical barriers and presence of germination inhibitors [14]. Similar results in case of GA_3 were reported by Shaban [15] in mango; Padma Lay et al. [16] in papaya and Al-Hawezy [17] in loquat. Higher germination under 1% thiourea can be attributed to strong neutralizing effect of thiourea on inhibitors present in the stone or due to increased cytokinn in activity under thiourea application [18].

Table-1 *Effect of pre-sowing treatments on germination and shoot characters of mango stones*

Treatments	Days taken for 50% sprouting	Germination percentage (%)	Seedling Vigour Index	Shoot length (cm)	Collar diameter (mm)	Number of leaves	Leaf area (cm^2)
Pre-sowing *treatment*s							
S_1 : GA_3 100 ppm	26.07	66.33	5178.94	41.33	9.02	17.90	67.54
S_2 : GA_3 200 ppm	29.17	63.67	4855.89	39.86	8.78	17.48	65.71
S_3 : Beejamruth 2%	37.50	52.67	3337.66	34.43	8.13	13.17	60.50
S_4 : Beejamruth 3%	36.33	55.00	3691.39	36.52	8.51	15.77	64.28
S_5 : Thiourea 1%	31.83	62.33	5286.17	42.77	9.33	18.85	69.85
S_6 : Thiourea 2%	33.83	58.67	4223.28	37.50	8.60	16.82	64.75
S. Em. ±	0.94	1.39	194.88	1.29	0.24	0.48	1.98
CD 5%	2.75	4.09	571.58	3.79	0.70	1.41	NS
Duration of soaking							
D_1 : 12 hrs	35.25	54.72	3772.61	36.80	8.51	15.93	65.39
D_2 : 24 hrs	29.67	64.83	5085.17	40.67	8.95	17.39	65.48
S. Em. ±	0.54	0.80	112.51	0.75	0.14	0.28	1.15
CD 5 %	1.59	2.36	330.00	2.19	0.40	0.81	NS
S x D							
S. Em. ±	1.33	1.97	275.60	1.83	0.34	0.68	2.81
CD 5%	3.89	5.78	NS	NS	NS	1.99	NS
CV%	7.09	5.71	10.78	8.17	6.67	7.07	7.43

Note: Days taken for 50% sprouting was calculated after 40 days of sowing and all other parameters were recorded after 90 days of sowing.

Seedling Vigour Index is a product of germination percentage and seedling length. Higher the seedling vigour index, more vigorous the seedlings are considered to be [19]. In the current trial, maximum SVI [5286.17] was observed when mango stones were treated with 1% Thiourea. It was at par with GA_3 treatments [100 ppm and 200 ppm]. This can be ascribed to the cumulative effect of higher shoot length, root length and germination percentage under 1% Thiourea and GA_3 treatments. These results are in agreement with an earlier report by Patil et al. [20] in citrus.

The highest shoot length [42.77 cm] was noted when mango stones were treated with Thiourea 1% and it was at par with GA_3 100 ppm. This increase in seedlings height with GA_3 treatment may be due to the fact that GA_3 increased osmotic uptake of nutrients, causing cell elongation and thus increasing the shoot length [21].These findings are in conformity with the findings of Harshavardhan and Rajasekhar [22] in jackfruit and Vasantha et al. [23] in tamarind.

Thiourea at 1% induced the maximum collar diameter [9.33 mm] in mango seedlings and was at par with GA_3 treatments [100 and 200 ppm]. This could be due the fact that gibberellic acid promoted cell division and cell elongation in the collar region [24]. Akin results were reported by Al-Hawezy [17] in loquat and Vasantha et al. [23] in tamarind. Thiourea contains sulphur which helps maintain a balance between –SH and –SS groups [25] it can therefore be safely assumed that formation of –SH group was favored and as a result significant improvement was observed in growth of mango seedlings.

The maximum number of leaves [18.85] were recorded when mango stones were treated with thiourea 1%. It was at par with GA_3 at both levels [100 and 200 ppm]. Thiourea is reported to delay leaf ageing and senescence. It enhances the photosynthetic efficiency leading to increased growth of plants. Thiourea application favourably affects both carbohydrate and nitrogen metabolism which in turn enhance plant performance [26]. These observations are supported by the results of Shanu et al. [27]. Higher number of leaves under GA_3 treatments can be attributed to the movement of GA_3 to the shoot apex, which promoted cell division and cell growth apparently leading to increased development of young leaves [28]. This is in line with the results of Anjanaw et al. [12] in papaya.

Although, pre-sowing treatments had a non-significant influence on leaf area, the maximum value [69.85 cm^2] was recorded with 1% Thiourea.

Effect of duration treatment

Duration of soaking had a significant influence on all parameters included in the study except leaf area [Table-1]. Between the two soaking durations, soaking mango stones for 24 hours resulted in higher germination percentage [64.83%], SVI [5085.17], shoot length [40.67], collar diameter [8.95] and number of leaves [17.39]. It also induced early sprouting [29.67 days].

Water participates in many biochemical reactions and serves as a medium for the life processes. In seeds, water is an essential factor in the external environment for the stimulation of germination. The major events occurring during seed germination are water imbibitions, enzyme activation, initiation of embryo growth, rupture of the seed coat and emergence of seedling and finally establishment of the seedling. The 24 hours soaking treatment may have increased these metabolic activities and thereby hastened germination. Similar results were reported by Pandey and Singh [29] in guava.

Table-2 *Interaction effect between pre-sowing treatments and duration of soaking on days taken for 50% sprouting, germination percentage and number of leaves in mango stones*

Duration / Soaking	Days taken for 50% sprouting		Germination percentage (%)		Number of leaves	
	D_1	D_2	D_1	D_2	D_1	D_2
	12 hrs	24 hrs	12 hrs	24 hrs	12 hrs	24 hrs
S_1 : GA_3 100 ppm	31.67	20.48	58.00	74.67	17.47	18.33
S_2 : GA_3 200 ppm	33.45	24.88	57.33	70.00	17.00	17.97
S_3 : Beejamruth 2%	38.49	36.51	51.00	54.33	10.77	15.57
S_4 : Beejamruth 3%	36.92	35.75	52.00	58.00	15.30	16.23
S_5 : Thiourea 1%	35.30	28.37	56.00	68.67	18.43	19.27
S_6 : Thiourea 2%	35.65	32.02	54.00	63.33	16.63	17.00

List of Abbreviations: GA_3- Gibberellic acid, NAA- 1-Naphthaleneacetic acid, SVI- Seedling Vigour Index

Soaking seeds in water at room temperature helps in softening the seed coats, removal of inhibitors, reduces the time required for germination and increases germination percentage [30]. Soaking mango stone for 24 hours may have softened the hard seed coat and leached out some of the water soluble inhibitors resulting in higher germination percentage. These results are in conformity with the findings of Nayak and Sen [31] in bael.

Soaking mango stone for 24 hours may have accelerated the hydrolysis of complex sugar in to simple sugars, which are than utilized in the synthesis of auxins and proteins. It is a well known fact that proteins are utilized in the production of new tissues and that auxins promote growth. This probably explains the higher values recorded for various growth parameters under 24 hours soaking treatment. Similar results were put forth by Maiti et al. [32] in jackfruit.

Interaction effect

The interaction effect between pre-sowing treatments and duration of soaking was found significant with respect to days taken for 50% sprouting, germination percentage and number of leaves [Table-1], [Table-2]. Mango stones treated with GA_3 100 ppm and soaked in water for 24 hours took the minimum days for sprouting (20.48 days) and registered the maximum germination percentage (74.67%). Whereas, 1% Thiourea coupled with 24 hours soaking recorded the maximum number of leaves (19.27).

Conclusion

Based on the present experiment it was found that soaking mango stones in aqueous solution of 100 ppm GA_3 for 24 hours was the best treatment for ensuring early and higher germination. Whereas, soaking mango stones in 1% thiourea for 24 hours proved best with respect to SVI, shoot length, collar diameter and number of leaves. It also recorded significantly higher germination percentage. Depending on availability and resources, nurserymen interested in propagating mango can choose any of the above mentioned treatments for producing early, uniform, healthy and vigorous rootstocks. As this technology is cheap and easy to adopt, it can add to the profitability of the nurserymen.

Conflict of Interest: None declared

References

[1] Gill S.S., Bal J.S. and Sandhu A.S. (1985) *Raising Fruit Nursery*, Kalini Publishers, Ludhiana, 5-11.

[2] Kumar R, Misra K.K., Misra D.S. and Brijwal M. (2012) *Hort. Flora Research Spectrum*, 1(3), 199-207.

[3] Brijwal M. and Kumar R. (2013) *Indian Journal of Agricultural Research*, 47(4), 347-352.

[4] Caliskan O., Mavi K. and Polat A. (2012) *Acta Scientiarum*, 34(3), 293-297.

[5] Anburani A. and Shakila A. (2010) *Acta Horticulturae*, 851, 295-298.

[6] Rashmi Kumari, Sindhu S.S., Sehrawat S.K. and Dudi O.P. (2007) *Haryana Journal of Horticultural Sciences,* 36(1&2), 9-11.

[7] Naguri A. and Tank R.V. (2015) *Bioinfolet,* 12(1), 329-332.

[8] Gharge V.R., Kadam A.S., Patil, V.K., Lakade, S.K. and Dhomake, P.A. (2011) *Green Farming*, 2(5), 550-551.

[9] Nimbalkar S.D., Jadhav Y.S., Adat S.S. and Savvashe A.Y. (2012) *Green Farming,* 3(3), 340-342.

[10] Panse V.G. and Sukhatme P.V. (1967) *Statistical Methods for Agricultural Workers.* ICAR, New Delhi.

[11] Rajamanickam C., Anbu and Balakrishnan, K. (2004) *South Indian Horti*culture, 52(1/6), 324-327.

[12] Anjanaw S.R., Kanpure R.N., Kachouli B.K. and Mandloi D.S. (2013) *Annals of Plant and Soil Research*, 15(1), 31-34.

[13] Copeland L.O. and Mcdonald M.B. (1995) *Principles of Seed Science and Technology*, Chapman and Hall Publications, New York.

[14] Diaz D.H. and Martin G.C. (1971) *Journal of the American Society for Horticultural Science,* 97(5), 651-654.

[15] Shaban A.E.A. (2010) *American-Eurasian Journal of Agricultural and Environmental Sciences*, 7(5), 535-541.

[16] Padma Lay, Basvaraju G.V., Sarika G. and Amrutha N. (2013) *Greener Journal of Biomedical and Health Sciences,* 2(3), 221-225.

[17] Al-Hawezy Shabaq Muhamad Nafea. (2013) *IOSR Journal of Agriculture and Veterinary Science,* 4(5), 03-06.

[18] Gurung N., Swamy G.S.K., Sarkar S.K. and Ubale N.B. (2014) *The Bioscan*, 9(1), 155-157.

[19] Abdul-Baki A. and Anderson J.D. (1973) *Crop Sc*ience, 13, 630-633.

[20] Patil S.R., Sonkamble A.M. and Khobragade H M. (2012) *Green Farming,* 3(6), 690-693.

[21] Shanmugavelu K.G. (1966) *South Indian Horticulture*, 14, 24-25.

[22] Harshavardhan A. and Rajasekhar M. (2012) *Journal of Research ANGRAU*, 40(4), 87-89.

[23] Vasantha P.T., Vijendrakumar R.C., Guruprasad T.R., Mahadevamma M. and Santhosh K. V. (2014) *Plant Archives*, 14(1), 155-160.

[24] Sen S.K., Hore I.K. and Bandhopadhyay A. (1990) *Orissa Journal of Agricultural Research*, 2(3-4), 160-164.

[25] Vora A.B. (1984) *Plant and Soil*, 8, 46-50.

[26] Mathur N., Singh J., Bohra S., Bohra A. and Vyas A. (2006) *World Journal of Agricultural Sciences*, 2(2), 185-187.

[27] Shanu I.S., Naruka P.P., Shaktawat R.P.S. and Verma K.S. (2013) *International Journal of Seed Spice*, 3(1), 20-25.

[28] Salisbury F.B. and Ross C.W. (1988) *Plant Physiology*, CBS Publishers and Distributors, New Delhi, 319-329.
[29] Pandey D. and Singh H.P. (2000) *Annals of Agricultural Research,* 21, 279-281.
[30] Hartman H.T., Kester D.E., Davies, F.T. and Geneve R.L. (1997) *Plant Propagation: Principles and Practices*, Prentice Hall of India, Ltd., New Delhi, 220-221.
[31] Nayak G. and Sen S.K. (1999) *Environment and Ecology*, 17, 786-769.
[32] Maiti C.S., Wangchu L. and Sen S.K. (2003) *Environment and Ecology,* 21, 290-292.