Studies on Effect of Pre-Sowing Stone Treatments on Germination and Seedling Growth of Mango (*Mangifera indica* L.)

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Abstract: *The present investigation entitled "Studies on effect of pre-sowing stone treatments on germination and seedling growth of mango (Mangifera indica L.)" was carried out at Central Nursery Scheme, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during the year 2024-2025.The trial was evaluated in Randomized block design with thirteen treatments replicated thrice. Among the different treatments stone soaking in GA_3 @100 ppm for 12 hours had maximum germination percentage (71.67%), least number of days taken for initiation of germination (11.00 days) and 50% gernmination (17.33 days), seedling growth parameters such as, height of rootstock (33.68 cm), maximum internodal length (6.28 cm), stem diameter (7.06 mm), leaf area (79.51cm2), chlorophyll content (78.18 SPAD unit), seedling vigour index- I (2413.84), seedling vigour index- II (677.25), the maximum number of leaves (13.16) where observed in mango stones dipped in 200 ppm GA_3.*

(***Keywords:*** *Germination, Gibberellic acid, Growth parameters, Mango, Pre-soaking treatments).*

Introduction

Mango (*Mangifera indica.* L) is the most important commercially grown fruit crop of India. "The King of Fruits" and national fruit of India, it is one of the most eulogized and favoured fruits of the Indian subcontinent. It belongs to family Anacardiaceae which has its origin in the Indo-Burma region (Mukherjee, 1958, De Candolle, 1884). All sections of Indian society are attracted to its taste and is considered to be one of the finest fruits for the sake of attractive color, exquisite flavour and appetizing taste. It is being cultivated in India from the last 400 years (Candole, 1984). India has a rich biodiversity and over one thousand vegetative propagated varieties of mango prevail in the country.

Mangoes are classified as recalcitrant seeds, which means their seeds have low viability and are sensitive to environmental conditions, particularly storage. When seeds are not sown immediately after extraction, their germination rate can decline significantly, with a reduction in germination ranging from 12% to 50% (Doijode, 1995). Mango seeds typically take 35 to 40 days to germinate, mainly due to the presence of a thick, stony endocarp that acts as a barrier to the seed's growth (Muralidhara *et al.,* 2016). This study is focused to gather information regarding the effect of pre- sowing stone treatment on mango seed germination and development of seedling.

Materials and methods

The present investigation was carried out at Central Nursery Scheme, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during the month of June 2024-2025. The experiment was laid out in a randomized block design consisting of thirteen different treatments with three replications.

Table.1: Treatment details

Treatment	Stone soaking Treatments
T_1	Control
T_2	Water Soaking for 12 hrs
T_3	KNO_3 @1% for 12 hrs
T_4	GA_3 @100 ppm for 12 hrs
T_5	GA_3 @200 ppm for 12 hrs
T_6	Thiourea @1% for 12 hrs
T_7	Thiourea @2% for 12 hrs
T_8	KH_2PO_4 @ 1% for 12 hrs
T_9	Sucrose @ 1% for 12 hrs
T_{10}	Cow dung slurry for 12 hrs
T_{11}	Cow urine @ 50% for 12 hrs
T_{12}	Vermiwash @ 3% for 24 hrs
T_{13}	Biomix @ 1% for 12 hrs

In this study, the local mango stones were procured from adjoining area of selu, district Parbhani and washed thoroughly to remove extraneous material adhering to it. Healthy stones were selected by dipping it in water, the seeds which floated on water were discarded. Only those seeds,

which settled at bottom were used for sowing under experiment.

Result and Discussion

Germination parameters: Perusal of data presented in Table 1 clearly revealed that different pre-sowing treatments influenced the germination parameters of mango significantly. The germination parameters viz., germination percentage (%), days taken for initiation of germination and days taken for 50% germination.

Germination percentage (%):

Maximum germination percentage (71.67%) was observed in in treatment T_4 which was statistically at par with T_{11} (70.14%) and T_3 (70.08 %). The minimum germination was recorded in T_1 (41.67%) *i.e.* control. GA_3 enhances enzyme activity, particularly α-amylase, which breaks down stored starches into sugars, supplying the energy necessary for embryonic growth and radicle emergence (Bewley *et al.,* 2013). Similar results in the present investigation were in agreement with finding of Muralidhara *et al.* (2015), Reshma and Simi (2019) in mango, Hore and Sen (1985) in bael.

Days taken for initiation of germination:

The minimum days taken for initiation of germination was recorded in T_4 (11.00 days), it was statistically at par with T_{11} (12.00 days). The control treatment T_1: exhibited the longest time (21.33 days). The promotion of mango stone germination by gibberellic acid may be attributed to its antagonistic action against germination-inhibiting compounds (Brain and Hemming, 1958; Wareing *et al.,* 1968). These results are conformity with the findings of Kumar *et al.* (2008a) and Patel *et al.* (2016) in mango.

Days taken for 50% germination:

The minimum number of days to reach 50% germination was observed in T_4 (17.33 days). This was at par with T_{11} (18.00 days). The control treatment (T_1) exhibited the maximum time (27.33 days). Gibberellic acid enhances the synthesis of hydrolytic enzymes such as α-amylase, which breaks down stored starches into simpler sugars, thus making energy readily available for the growing embryo (Bewley *et al.,* 2013). These results are in close proximity with the findings of Singh *et al.* (2023) in custard apple.

Table 2. Germination studies of mango stones influenced by various pre-soaking treatments

Tr. no.	Treatments	Germination percentage (%)	Days taken for initiation of germination	Days taken for 50 % germination
T_1	Control	41.67	21.33	27.33
T_2	Water soaking	46.66	18.00	23.33
T_3	KNO_3 @1%	70.08	12.33	19.33
T_4	GA_3 @100 ppm	71.67	11.00	17.33
T_5	GA_3 @200 ppm	51.62	15.33	22.33
T_6	Thiourea @1%	58.36	14.33	21.66
T_7	Thiourea @2%	50.06	16.00	22.66
T_8	KH_2PO_4 @ 1%	60.00	14.00	20.66
T_9	Sucrose @ 1%	50.13	17.66	23.00
T_{10}	Cow dung slurry	65.26	13.00	19.66
T_{11}	Cow urine @ 50%	70.14	12.00	18.00
T_{12}	Vermiwash @ 3%	51.67	15.00	22.00
T_{13}	Biomix @ 1%	61.73	13.00	20.66
	S.Em. ±	1.13	0.42	0.40
	C.D. at 5 %	3.30	1.23	1.19

Growth parameters:

The data pertaining to the growth parameters of mango as affected by different different pre-sowing treatments is presented in Table 2 and table 3 which showed significant variation among treatments. More height of rootstock was observed in T_4 (33.68 cm). It was statistically at par with T_{11} (32.02 cm) and T_{13} (31.30 cm). The less rootstock height was observed in T_1 (22.29 cm) *i.e.* control. The similar findings were recorded with Kolekar *et al.* (2017) in mango, Vachhani *et al.* (2014) in khirni. The maximum internodal length (6.28 cm) was recorded in T_4. This was at par with T_{11} (5.46 cm), T_{13} (5.38 cm) and T_{10} (4.75 cm). The lowest was observed in T_1 (2.53 cm) Control. Similar findings were recorded by Aközguven and Nikpeyma (1995) in mango. The maximum stem diameter was recorded in T_4 (7.06 mm). which was statistically at par with T_{10} (6.96 mm), T_{13} (6.80 mm), T_{11} (6.77 mm) and T_3 (6.65 mm). The lowest stem diameter was observed in T_1 (5.43 mm). Similar findings were recorded by Muralidhara *et al.* (2015) in mango. The highest number of leaves (13.16) was recorded under T_5. It was at par with T_4 (12.53). The lowest number of leaves (9.31) was noted in T_1. Similar resultss were recorded by Gohil (2009) in papaya, Vachhani *et al.*

(2014) in khirni, Krishnan and Kulasekaran (1984) in wild ber. The maximum leaf area was recorded in T_4 (79.51 cm²). It was at par with T_5- GA_3 @ 200 ppm (74.10 cm²). The least leaf area was observed in T_1 (47.03 cm²). Similar results in the present investigation were in agreement with finding of Anjanawe *et al.* (2013) in papaya. The maximum chlorophyll content (78.18 SPAD units) was recorded in treatment T_4, followed by T_5 with (75.79 SPAD units). The minimum chlorophyll content was recorded in (T_1 – 40.84 SPAD units). These results are conformity with the findings of Choudhary *et al.,* (2018) in papaya. The highest Seedling Vigour Index- I was observed in T_4:GA_3 @ 100 ppm (2413.84), indicating its strong effect on germination and seedling growth. It was at par by T_{11} (2245.88). while T_1-Control, showed the lowest (900.83) Seedling Vigour Index- I. The highest Seedling Vigour Index-II (677.25) was recorded in T_4 (677.25). This was followed by T_{11} (473.20), T_{10} (455.00), T_3 (437.50) and T_{13} (404.26). control (T_1), which recorded the lowest Seedling Vigour Index-II (107.50). Similar resultss were recorded by Muralidhara *et al.* (2015) in mango, Samir *et al.* (2015) in khirni, Yadav *et al.* (2018) in custard apple. The application of GA_3 at 100 ppm significantly boosts the seedling growth of mango by stimulating cell division and elongation, which enhances shoot growth and seedling vigor. It activates metabolism and promotes α-amylase production, converting stored starch into sugars that fuel early growth and elongation (Bewley *et al.,* 2013).

Table 3. Effect of different pre-soaking treatments of stone on height of rootstock, internodal length, stem diameter and number of leaves of mango seedling

Tr. no.	Treatments	Height of rootstock (cm)	Internodal length (cm)	Stem diameter (mm)	Number of leaves
T_1	Control	22.29	2.53	5.43	9.31
T_2	Water soaking	22.83	4.01	6.13	9.47
T_3	KNO_3 @1%	28.20	4.64	6.65	11.79
T_4	GA_3 @100 ppm	33.68	6.28	7.06	12.53
T_5	GA_3 @200 ppm	25.52	4.11	6.40	13.16
T_6	Thiourea @1%	27.48	4.49	6.44	11.03
T_7	Thiourea @2%	25.06	4.07	6.15	10.36
T_8	KH_2PO_4 @ 1%	28.00	4.55	6.46	10.94
T_9	Sucrose @ 1%	24.89	4.04	6.27	10.31
T_{10}	Cow dung slurry	29.29	4.75	6.96	12.06
T_{11}	Cow urine @ 50%	32.02	5.46	6.77	12.23
T_{12}	Vermiwash @ 3%	25.88	4.19	6.43	10.71
T_{13}	Biomix @ 1%	31.30	5.38	6.80	11.77
	S.Em. ±	1.46	0.54	0.19	0.33
	C.D. at 5 %	4.27	1.57	0.57	0.97

Table 4. Effect of different pre-soaking treatments of stone on leaf area, chlorophyll content, seedling vigour index – I and Seedling vigour index- II of mango seedling

Tr. no.	Treatments	Leaf area (cm^2)	chlorophyll content (SPAD)	seedling vigour index – I	Seedling vigour index- II
T_1	Control	47.03	40.84	919.48	107.50
T_2	Water soaking	51.38	60.72	1064.78	178.73
T_3	KNO_3 @1%	66.20	64.16	1911.46	437.50
T_4	GA_3 @100 ppm	79.51	78.18	2413.84	677.25
T_5	GA_3 @200 ppm	74.10	75.79	1317.34	207.20
T_6	Thiourea @1%	66.65	62.95	1603.73	306.00
T_7	Thiourea @2%	55.21	62.84	1254.50	179.80
T_8	KH_2PO_4 @ 1%	58.88	62.84	1680.00	306.00
T_9	Sucrose @ 1%	61.51	63.51	1247.73	178.73
T_{10}	Cow dung slurry	71.07	67.39	1932.14	455.00
T_{11}	Cow urine @ 50%	72.55	74.87	2245.88	473.20
T_{12}	Vermiwash @ 3%	54.53	64.14	1337.21	251.10
T_{13}	Biomix @ 1%	67.96	65.50	1996.56	404.26
	S.Em. ±	3.63	0.79	124.38	27.05
	C.D. at 5 %	10.62	2.31	363.06	78.96

Conlusion

Summarizing the present investigation in the light of obtained results, it may be concluded that among thirteen treatments under study, the treatment T_4 (GA_3 @100 ppm for 12 hrs) showed superior performance in germination parameters like germination percentage (%), days taken for initiation of germination and days taken for 50% germination, whereas the vegetative parameters such as height of rootstock, internodal length, stem diameter, leaf area, chlorophyll content, seedling vigour index- I, seedling vigour index- II.

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