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Effect of Bio Formulations on Germination and Growth of Mango (*Mangifera indica*) Seedling Variety Neelum

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A B S T R A C T

An experiment entitled "Effect of bio formulations on germination and growth of mango (*Mangifera indica* L.) var. Neelum" was conducted at the Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamilnadu during 2019. Mango stones were soaked in different bio formulations of Panchagavya (3, 5 and 8%), Beejamrutha (3, 5 and 8%), Vermiwash (3, 5 and 8%) and Tender coconut water for 24 hours. The result revealed that effect of pre-soaking treatment with Panchakavya 5% was statistically significant on following parameters viz., minimum days taken for germination, maximum germination percentage, maximum height of the rootstock, maximum intermodal length, maximum stem and root girth, maximum number of leaves, leaf area, fresh and dry weight.

***Key words*:** Bio formulations, Germination, Mango, Panchagavya, Vermiwash

Mango (*Mangifera indica* L.) regarded as the "King of Tropical Fruits" is closely linked with the culture and history of India. It is one of the most ancient fruits of India and mention has been made in many ancient old literatures about its cultivation. The genus of mango is reported to have originated from South East Asia with a natural spread in the Indo-Malayan region. Mango is grown in India for the past 4000 years and more than a thousand of varieties grown throughout the country. India ranks first among world's mango producing countries accounting for about 50% of the world's mango production. The fruit is very popular with masses due to its wide range of adaptability, high nutritive value, richness, delicious taste and excellent flavor. In the past two decades, India has witnessed an increase in the area under mango on account of demand for fresh fruits in the domestic as well as international market. However, limited availability of genuine planting material is a major bottleneck in the expansion of area under mango.

As mango is a highly cross-pollinated crop, there is an enormous variation in the seedlings raised even from the fruits of the same tree. Mango stones are usually available during the dried parts of the year (April-May) because of which the germination percentage and vigour are very low. The viability of mango stones is very low because stones are recalcitrant in nature. Germination percentage of mango stones is only 12 to 50 per cent when sown within one month after extraction [7]. When raised by seeds, mango plants are not true to type and lose many of their unique characteristics. Vegetative propagation thus became a necessity in mango to preserve and perpetuate the characteristics of each cultivar. Healthy and good quality planting materials is the foundation of successful fruit industry in the country [21]. Root stocks are always seedlings in origin whether they are zygotic/nucellar. Synchronization and rapid seed emergence are the benefits of bio formulations or organic on germination and seedling growth [17]. The significant enhancement of germination was noticed in different pre-soaking treatments by [16] and [37] in mango. Higher germination percentage of mango stones is the main criterion and strong base for successful grafts. In the recent years, soaking mango stones with organic bio formulations like amritpani, panchakavya and beejamruth have also been used to enhance growth and germination in mango stones [13]. However, there is a variation in the duration of soaking reported and therefore, it was felt prudent to investigate the effect of pre-soaking treatments on the survival and growth of mango (*Mangifera indica* L.) seedling under Chidambaram conditions.

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MATERIALS AND METHODS

The experiment was carried out at the Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu during 2019-2020. The main objective was to determine the effect of pre-soaking treatments on the survival and growth of mango (*Mangifera indica* L.) var Neelum. The experiment was conducted in Completely Randomized Design with eleven treatments replicated thrice. Mango stones were procured from farmer's

field Krishnagiri district, Tamilnadu. 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 settle at the bottom were used for experiment. Mango stones thus selected were dipped in bio formulations of Panchagavya (3, 5 and 8%), Beejamrutha (3, 5 and 8%), Tender coconut water and Vermiwash (3, 5 and 8%) for 24 hours. The treatment details are as:

T_1- Control
T_2- Panchagavya @ 3%
T_3- Panchagavya @ 5%
T_4- Panchagavya @ 8%
T_5- Beejamurth @ 3%
T_6- Beejamurth @ 5%
T_7- Beejamurth @ 8%
T_8- Tender coconut water
T_9- Vermiwash @ 3%
T_{10}- Vermiwash @ 5%
T_{11}- Vermiwash @ 8%

Treated mango stones were sown in polythene bags which are properly filled with potting mixture and placed in a under shade condition. The stones were irrigated immediately after sowing in polythene bags. Five mango seedling were selected at random from each repetition and observations were recorded on number of days taken for germination, germination percentage, height of the seedling, intermodal length, number of leaves per seedling, stem girth, root girth, leaf area of single leaf, total leaf area of the seedling, length of the tap root, number of lateral roots, fresh weight of the seedling, dry weight of the seedling, seedling vigour index- I and seedling vigour index – II at 120 days after sowing. The experiment data were analyzed statistically as per the procedure described by [8]. The AGRES programme was used for the statistical analysis of the data.

RESULTS AND DISCUSSION

Growth characteristics

The data recorded for germination percent is given in (Table 1) There was a significant impact of pre-soaking treatments on days taken for germination was recorded on mango stones soaked in Panchagavya 5% followed by Panchagavya 3% and water soaking. Panchagavya might have induced early germination by increased hydrolysis of starch and their translocation to growing seedlings. Panchagavya fortified seeds and might be due to the action of microorganisms and growth hormones (IAA and GA_3) which are present in the panchagavya [20]. [25] and [18] also reported that Panchagavya possess almost all the major nutrients, micro nutrients and growth hormones enhances the metabolic activity of plants and supports better seed invigoration.

Table 1 Effect of bio formulations on seedling growth character of mango seedling

Treatments	Number of days taken for germination		Germination (%)	GVI	Height of seedling (cm)	No. of leaves	Internodal length (cm)
	Initiation	Completion			120 Days	120 Days	120 Days
T_1: Control	17.47	62.33	56.23	1.26	22.56	11.36	1.52
T_2: Panchakavya (3%)	11.46	42.18	80.96	1.79	35.45	18.85	2.09
T_3: Panchakavya (5%)	10.43	41.67	83.52	1.82	38.98	19.43	2.14
T_4: Panchakavya (8%)	15.67	44.25	61.66	1.49	25.13	14.64	1.57
T_5: Beejamurth (3%)	12.00	44.96	74.26	1.68	34.43	18.72	1.87
T_6: Beejamurth (5%)	14.32	45.32	67.82	1.65	34.36	18.41	1.79
T_7: Beejamurth (8%)	15.33	46.63	63.56	1.62	25.03	14.04	1.62
T_8: Tender coconut water	15.00	53.46	65.56	1.71	27.74	14.58	1.69
T_9: Vermiwash (3%)	14.23	51.96	66.23	1.74	29.24	16.04	1.72
T_{10}: Vermiwash (5%)	16.63	57.00	57.42	1.56	26.43	12.45	1.65
T_{11}: Vermiwash (8%)	16.96	58.62	55.96	1.36	25.43	12.31	1.59
S.Ed	0.20	0.12	1.07	0.0107	0.3511	0.0537	0.0200
CD (P=0.5)	0.41	0.25	2.21	0.0222	0.7268	0.1111	0.0414

The data revealed that almost all the treatments showed significant effect on percentage of germination of seed at 60 DAS over T_1 (control). The maximum germination percentage of seed germination (83.52%) was noted at 60 days after sowing under T_3 (Panchagavya 5%) and followed by T_2 (Panchagavya 3%) whereas the minimum percentage of seeds germination (56.23%) was noted in T_1 (control). These findings may due to panchagavya, which would have triggered the activity of specific enzymes that promoted early germination due to presence of IAA and GA. Beneficial effect of treatment of seeds with panchagavya on germination has also been reported by [18] and [4]. Under pre-sowing condition, the green gram seedlings showed maximum significant germination percentage at 4% concentration of Panchagavya [14] and [36] reported that paddy seeds treated with Panchagavya enhanced the seed germination. These results are in conformity with the findings of [3] in Mango, [15] in Cumin, [23] in pulses, [38] in soya bean, [33] in maize and [28] in rice also reported that Panchagavya has better influence in seed and seedling invigoration.

The data on height of seedling recorded at 120 days after sowing for all treatments showed significant effect on height of seedling over T_1 (control). The maximum seedling height of 38.98 cm was noted T_3 (Panchagavya 5%) at 120 days. The minimum height was recorded under T_1 control. Several studies indicated that plant height can be increased by application of organic regulators. Increase in seedling height has occurred due to cell division and cell elongation, which in turn would have increased the internodal length [1], [2] and [39].

The number of leaves per seedling recorded at 120 days after sowing showed that all the treatment have significant effect on number of leaves over T_1 at 120 DAS. The maximum number of leaves 19.43 was noticed in T_3 (Panchagavya 5%) at 120 days. Above observations are in conformity in [16], [29] and [12] in mango and [22] in Khirni. Hence, it is clear that the pre-soaking treatments had increased the vegetative growth parameters compared to control.

Among all the treatments, T_3 -Panchagavya 5% showed maximum stem girth of 1.95 cm and followed by Panchagavya

3% (1.91 cm) at 120 days which was superior to other treatments including control. The increase in stem girth by application of panchagavya and amrit pani was also reported by earlier workers, [2] and [39] in mango, and [22]. Increase in girth of stem may be possible due to stimulation of cambium and its immediate cell progeny [1]. The above findings are in conformity with the observations reported by [3], [30], [35] and [6].

Table 2 Effect of bio formulations on seedling growth character of mango seedling

Treatments	Stem girth (cm)	Root girth (mm)	Leaf area (cm^2)	Total leaf area (cm^2)	Tap root length (cm)	Fresh weight (g)	Dry weight (g)	Seedling vigour index-I	Seedling vigour index-II
	120 Days	120 Days	120 Days	120 Days	120 Days	120 Days	120 Days		
T_1: Control	1.52	16.03	41.21	659.36	21.09	20.95	8.45	1270.15	475.74
T_2: Panchakavya (3%)	1.91	19.32	51.68	1343.68	27.63	33.45	13.48	2871.37	1091.85
T_3: Panchakavya (5%)	1.95	19.83	53.52	1498.56	29.86	35.91	13.86	3257.12	1158.12
T_4: Panchakavya (8%)	1.61	16.32	46.01	814.83	21.95	29.11	9.2	1553.54	568.74
T_5: Beejamurth (3%)	1.87	19.15	51.43	1234.32	27.26	33.15	12.72	2560.35	945.90
T_6: Beejamurth (5%)	1.82	18.76	50.76	1116.72	26.97	32.92	12.23	2330.76	829.60
T_7: Beejamurth (8%)	1.76	17.69	46.54	930.8	24.52	29.85	9.85	1591.64	626.35
T_8: Tender coconut water	1.65	18.65	47.83	956.6	22.79	30.03	10.32	1822.39	677.97
T_9: Vermiwash (3%)	1.79	18.92	49.31	986.2	23.59	31.42	11.92	1938.24	790.14
T_{10}: Vermiwash (5%)	1.68	16.72	43.82	744.94	21.72	28.97	10.98	1519.53	631.27
T_{11}: Vermiwash (8%)	1.54	16.22	42.58	681.28	21.48	27.59	9.27	1423.96	519.07
S.Ed	0.02	0.06	0.10	11.14	0.11	0.11	0.16	124.69	46.83
CD (P=0.5)	0.03	0.14	0.20	23.07	0.24	0.24	0.33	258.60	97.13

Root characteristics

Different root characteristics viz. length of roots, number of roots, fresh and dry weight of roots, all were significantly differs among various treatments. All value of root characteristics were found maximum by soaking the seeds with panchagavya 5% followed by panchagavya 3% and Beejamurth 3% compared to control in [31] opined panchagavya has beneficial microorganisms like Azospirillum, Azotobacter, phosphobacteria and Lactobacillus, which may be the reason for good root growth. [32], [6], [11] in *Coleus forskohlii* and [34] in (*Solanum nigrum* L). [14] reported that number of lateral roots are maximum in green gram treated with panchagavya.

It was observed by [30] that the plant treated with panchagavya 4% produced the longest tap root (17.83 cm) compared to other treatments. The beneficial effects of panchagavya on plant growth were also reported by [24] in wood apple and [5] in jamun. [19] also reported that effect of different organics on germination and growth of mango stones. [10] studied the suitability of Panchgavya (five products of cow), new organic amendment and its application. Panchgavya was mixed with water to form different concentration and was tested for seed germination, germination index, and root and shoot growth of different seedlings application of Panchgavya can be gain fully used as an alternative supplement in agriculture. Similar findings were also reported by [27], [35], [26], [9].

Fresh weight and dry weight (g)

Fresh weight and dry weight of shoots increased significantly due to various treatments. T_3 (Panchagavya 5%) attained the maximum fresh and dry weight of shoots followed by T_2 (Panchagavya 3%) and (Beejamurth 3%) which were superior to other treatments including control.

This seems to be the effect of mobilization of water and nutrients transported at higher rate which might have promoted more production synthetic product and translocated them to various plant parts which might have resulted in better growth of the seedlings and hence, more fresh weight [1], [37] in mango and [31].

Seedling vigour index is basically the overall performance of seedling. It is calculated as seedling vigour index I (cm) and seedling vigour index II (g) with the help of germination percentage and different growth parameters that are discussed before. It was significantly affected due to various treatments. The seeds soaking in T_3 (Panchakavya 5%) attained the maximum seedling vigour index at 120 DAS followed by T_2 (Panchakavya 3%) which were superior to other treatments including control. The maximum seedling vigour index might be due to enhanced uptake of nitrogen, potassium, water and nutrients and resulted in better root and shoot growth which might have resulted in maximum vigour index [13]. Above observation are in conformity with the findings of [16], [29], [37] in mango and [22] in “khirni’.

CONCLUSION

Based on the findings of present study, it can be concluded that presoaking treatment of Panchagavya 5% was found to be superior over the rest of the other treatments since it recorded significant desirable values for seed germination and seedling growth of mango var. Neelum.

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