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Influence of Seed Pelleting on Physiological Seed Quality Improvement in Bael (*Aegle marmelos* (L.) Corr.) the Endangered Medicinal Tree

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Authors' contributions

This research was carried out in full support of both the authors. Both the authors designed the study, wrote the protocols with interpretations of the results, statistical analyses and wrote the first draft of the manuscript, performed the statistical analysis and managed the analyses of the study. Author PS proof read and corrected the draft. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: Bael is an endangered medicinal tree with multipurpose utility propagated through seeds. Hence attempts were to improve the vigour of the seed through seed pelleting with ecofriently organic products.
Study Design: A Factorial completely randomized design (FCRD) for laboratory experiments and RBD for nursery studies with five replication with five replications.
Place and Duration of Study: The laboratory and nursery experiment was conducted at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 2012-13.
Methodology: The seeds were pelleted with botanical leaf powders *viz.,* karisilanganni (*Eclipta prostrate*), avaram (*Cassia auriculata*), arappu (*Albizia amara*), neem (*Azadirachta indica*),

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biofertilizers *viz.*, azophos, phosphobacteria and biocontrol agents *viz., Trichoderma viride* and *Pseudomonas fluorescens* along with unpelleted seeds.
Results: The results showed that among the treatments arappu pelleting enhanced the germination (76%) and seedling quality characters *viz*., root length (13.0 cm), shoot length (9.9 cm), dry matter production (318 mg) and vigour index (1740) compared to control followed by neem and phosphobacteria pelleting. The treatment scored as best also performed better at polypot nursery.
Conclusion: Our data show that arappu pelleting enhanced seed quality compared to control

Keywords: Seed pelleting; arappu (Albizia amara); germination; vigour index.

1. INTRODUCTION

Bael (*Aegle marmelos*) is important tree exploited heavily for various plant parts to treat a number of neural, broncheal, gastro intestinal, cardiac and uro disorders and agricultural uses [1]. Seed management techniques are not only employed to invigourate the seed but also for modifying the physical and biochemical characteristics of seed. In addition it is also employed to add needy substance to the individual seed so that the seeds get invigourative effect on absorption of such materials, at initial watering by enriching the rhizosphere region of each and every seed as nutritive without physiological modification of seed but by simple physical alterations of the seed. Seed pelleting is one such physical treatment given to seed to invigourate the seedling vigour. Some of the common benefits of pelleting are uniformity in seed size, precision planting, better production, uniform stands with reduced seed rate, more insect and disease resistance, better performance under stress conditions and associated nourishment to the seedlings [2-6]. In view of poor germination and microbiotic nature (short lived) for this crop, attempt was made with bael seed to increase the planting value of the seed through pelleting.

2. MATERIALS AND METHODS

The uniformly graded seeds collected from Ramnagar, Coimbatore district, India were pelleted individually using botanical leaf powders *viz.,* karisilanganni (*Eclipta prostrata*), avaram (*Cassia auriculata*), arappu (*Albizia amara*) and neem (*Azadirachta indica*) @ 250 g kg^{-1} of seed as filler material and biofertilizers *viz.,* azophos, phosphobacteria @ 100 g kg^{-1} of seed and biocontrol agents *viz., Trichoderma viride* and *Pseudomonas fluorescens* @ 25 g kg^{-1} of seed as filler material using 10 percent wheat flour @ 150 - 200 ml kg^{-1} of seed as the common adhesive. The laboratory and nursery experiment was conducted at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 2012-13. The pelleted seeds were dried under shade for two days and were evaluated for seed quality characters where speed of germination [7] using the following formula for each of the seed sources and the mean expressed as whole number.

$$\text{Speed of germination} = \frac{X_1}{Y_1} + \frac{X_2 - X_1}{Y_2} + \ldots\ldots\ldots + \frac{X_n - X_{n-1}}{Y_n}$$

X_1- Number of seeds germinated at first day; X_2- Number of seeds germinated at second day; X_n- Number of seeds germinated on n^{th} day; Y_1- Number of days from sowing to first count; Y_2- Number of days from sowing to second count; Y_n- Number of days from sowing to n^{th} count), germination percentage was calculated adopting the following formula.

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Total number of seeds placed for germination}} \times 100$$

2.1 Root Length

The length between the collar region to the tip of primary root were measured using measuring scale and the mean expressed as root length in centimeter.

2.2 Shoot Length

The shoot length from the collar region to the tip of the true leaves and the mean expressed as shoot length in centimeter.

2.3 Dry Matter Production

Ten normal seedlings used for linear measurements of root and shoot length were dried at first in shade and then in a hot air oven maintained at 85±2°C for 48 h then cooled in desiccators containing calcium carbonate,

weighed and expressed as dry matter production 10 seedling^{-1} in milligram.

2.4 Vigour Index

Computed adopting the following formula [8] and the mean expressed as vigour index in whole number, Vigour index = Germination (%) x total seedling length (cm)

2.5 Nursery Performance

The seeds of best treatment along with control seeds were sown in 50 bags of three replications each (comprising of 150 bags/ treatment). The polybags were filled with potting mixture containing Soil: Sand: FYM in 2:1:1 ratio and the seedlings were maintained in the nursery with required management practices. After 30 days after sowing the nursery emergence was observed based on number of seed put forth as in the nursery and was reported as percentage to the total seed sown in nursery. After three months of sowing, the seedlings were evaluated for survival percentage (surviving seedlings after three months / total number of seeds sown X100) and seedling quality characters *viz*., root and shoot length, dry matter production and vigour index values) were calculated as mentioned earlier.

2.6 Statistical Analysis

The data obtained from different experiments were analysed for 'F' test of significance following the methods [9] adopting FCRD for laboratory experiments and RBD for nursery studies with five replication. Wherever necessary, the percent values were transformed to angular (Arc-sine) values before analysis. The critical differences (CD) were calculated at 5 percent probability level.

3. RESULTS AND DISCUSSION

Seed pelleting is a mechanism of applying required substances on the seed in such a way that they influence and the seed-soil interface [10]. It is the process of enclosing seed into a small quantity of filler material for singling the seeds, the most essential phases of precision planting in modern agriculture in addition to their action as a natural water holding media fortified with nutrients to the young seedlings. Thus, seed pelleting provides a package of effective quantities of materials in such a way that they can influence the micro-environment of each seed and thereby the treatment of remaining bulk of the soil is not essential as practiced through broadcasting or soil application. By this farmers can save the inputs required and the associated costs of applying them. Some of the common benefits of pelleting are uniformity in size, easier planting, uniform stands, reduced seed rate, more resistance to insect and disease, stress tolerance and nourishment to the seedlings.

In pelleting, using adhesive the seeds are stamped and are filled with filler material and rolled for uniformity. The success of pelleting depends on the selection of filler material. Researchers exposed the extended selection of filler material as leaf powder [11], biofertilizer and biocontrol agents [12], inorganic nutrients [13], vermicompost [14] and combination of all these. In development of the ecofriendly production techniques for organic farming, use of organic bio fertilizers and leaf powders are widely recommended. The researchers pointed out that inoculation of bio fertilizers stimulate the growth [15] and enhance the uptake of N [16], P [17], K [18] and other micronutrients [19] and thereby increased the survival rate of planted seedling.

The speed of emergence was late in all the pelleting treatments due to physical hardiness that persist with pelleted seed while enclosing the seed in filler materials compared to control. Similar late emergence was also indicated by several researchers [20-22] in different crops. The results revealed that among the treatments, seeds pelleted with arappu followed by neem and phosphobacteria enhanced the germination and seedling quality characters though pelleting delayed germination compared to control The better performance of these treatment in comparison with control seeds was follows (Table 1).

The other filler materials also improved seed germination, as 10 percent by karisilanganni, 8 percent by avaram, 12 percent by azophos and *Trichoderma viride* and 6 percent by *Pseudomonas fluorescens* compared to control, as indicated in (Fig. 1). Not only the seed germination but also seedling quality characters were improved by the pelleting treatments, in which the root length was the highest in arappu (13 cm) and was followed by neem (12.8 cm). Similarly the shoot length was also the highest in arappu (9.9 cm) and was followed by neem (9.7 cm). The dry matter production recorded by the pelleting treatments were in the order of arappu (318 mg), neem (312 mg), phosphobacteria (304

mg), *Trichoderma viride* (301 mg), Karisilanganni (293 mg), avaram (278 mg), *Pseudomonas fluorescens* (274 mg) , azophos (274 mg) and control (220 mg), the order of performance by the pelleting techniques observed for vigour index were also the same recording values as 1740, 1539, 1379, 1278, 1234, 1094, 1023, 1006 and 790 respectively (Fig. 2).

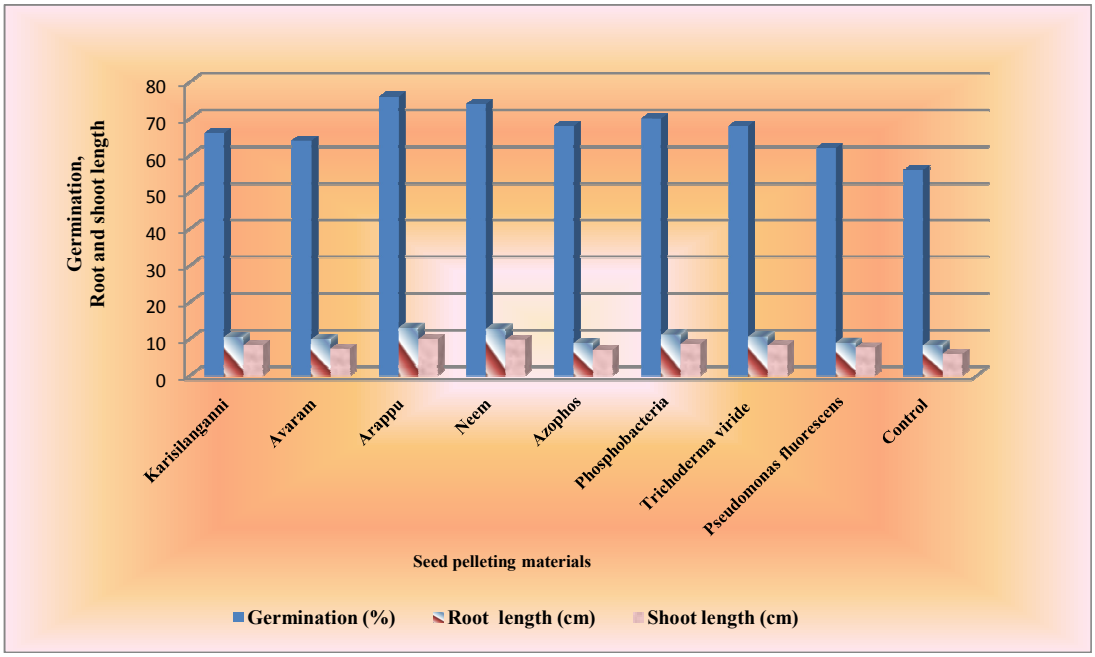

Fig. 1. Influence of pelleting on seed and seedling quality characters (Germination (%), root length (cm) and shoot length (cm))

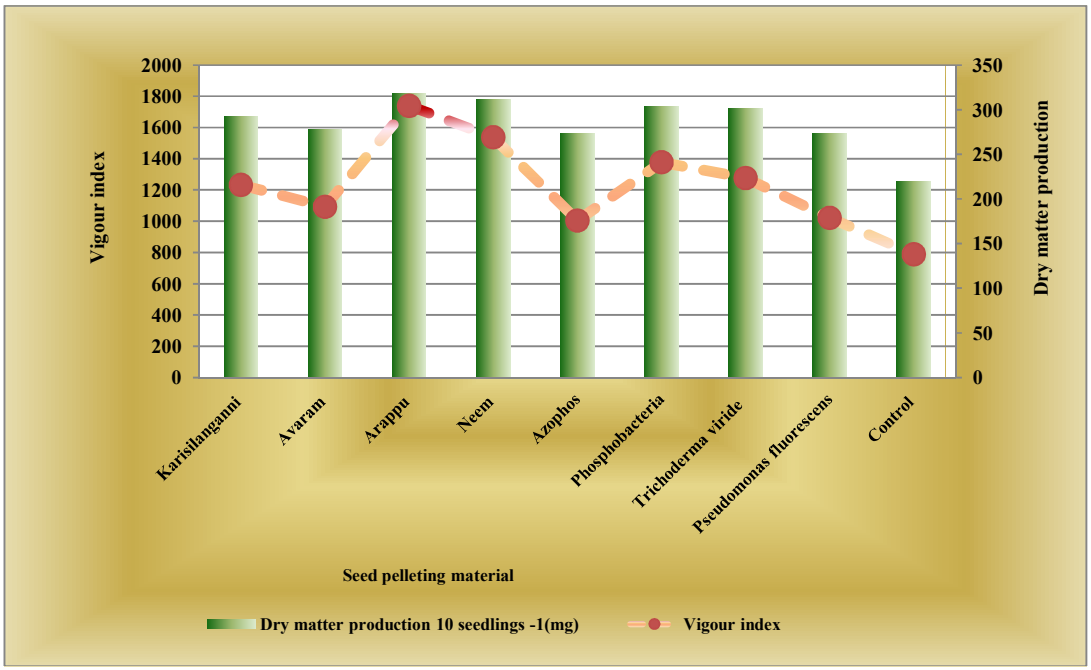

Fig. 2. Influence of pelleting on seed and seedling quality characters (dry matter production-1 (mg) and vigour index)

Table 1. Comparison of best treatments with unpelleted seed

Seed pelleting treatment	Increase over unpelleted seed (%)					
	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production 10 seedlings^{-1} (mg)	Vigour index
Arappu	(-) 0.3	20	59	68	45	120
Neem	(-) 0.4	18	56	64	42	95
Phosphobacteria	(-) 0.7	14	35	46	38	75

This germination improvement by leaf powder, karisilanganni (*Eclipta prostrate*), avaram (*Cassia auriculata*), arappu (*Albizia amara*), neem (*Azadirachta indica*), might be due to its action as a wick in absorbing, regulating and correcting the soil moisture and the improvement in seed soil relationship [13]. Botanical leaf powders like arappu are said to contain gibberellins like substances in addition to saponins and micronutrients, the zinc which have synergistically activated to form the IAA [4]. In addition to the above reason the chlorophyll molecules of arappu, neem, karisilanganni and avaram leaf powders might have synergistic action with amino acids and humic acid present in the soil rhizosphere that might have acted as a chelating agent [3] and activated the growth and development of botanical leaf powder pelleted seeds into robust seedling at field emergence. He also expressed that the energy of the seed recorded through the seedling vigour parameters also highlighted that *Azadirachta indica* leaf powder followed by *Pongamia pinnata* and *Albizia amara* leaf powder pelleting served better than control and other filler materials used for pelleting. Seed pelleting with *Albizia amara* enhanced the seedling quality characters and helps in improving the germination of seeds under stress condition such as soil salinity [23].

The present study also highlighted the beneficial influence of user friendly and environmental safe leaf pelleting techniques in improving the vigour of the seed and among them the performance was best with *Albizia amara* which was also supported by Praveena [24 and 25]. Pelleting with biofertilizers specific to crop has been adopted as a routine presowing seed treatment in agricultural crops [26]. In silvicultural species, seeds pelleted with phosphobacterium produced vigourous seedling with more collar diameter at 90 days after sowing in *Azadirachta indica* [27], the cause for invigouration by addition of phosphobacteria as activation of growth hormones *viz*., IAA and gibberellins, which stimulates root growth by greater uptake of plant nutrients [28].

In *Jatropha curcas*, the results of the nursery study revealed that seed pelleting with *Azospirillum* @ 100 g kg^{-1} of seed followed by pungam leaf powder @ 300 g kg^{-1} seed maximized the nursery emergence and seedling vigour (29). In *Aegle marmelos* also on using various filler materials (neem leaf powder @ 200 g kg^{-1} of seed and phosopho-bacterium*, Azospirllium,* Azophos and Azotobacter @ 50 g kg^{-1} of seed) also expressed that seed pelleting with *Azospirillum* @ 50 g kg^{-1} of seed performed better both at laboratory and in nursery and was followed by pelleting with *Azadirachta indica* leaf powder @ 200 g kg^{-1} of seed [30]. Seed pelleted with biofertilizers also improved to seed germination and growth characters up to 3 months of nursery period in tamarind as reported [22]. In line with all these researches, the present study also highlighted that seed pelleting irrespective of pelleting material was beneficial and all had improved the vigour of seedlings under the germination room condition. In addition, while sowing the pelleted seed in sand it had provided good anchoring in addition to the nutrients to growing seed and there by improved the seed germination and vigour attributes.

To evaluate the efficacy of the selected treatment at nursery the seeds pelleted with arappu were sown in polypot nursery and were evaluated their seed and seedling quality characters. These results also expressed that seed pelleted with arappu performed better (Table 2) and could be recommended as the seed management technique to improve the production seedlings mass at nursery.

Table 2. Influence of seed pelleting on seed and seedling quality characters in bael (*Aegle marmelos*) at nursery

Seedling quality characters after 180 days	Arappu	Control	SEd	CD(P=0.05)
Seedling survival (%)	78 (62.02)	62 (51.94)	(0.399)	(0.856)
Root length (cm)	20.6	9.6	0.251	0.540
Shoot length (cm)	19.4	16.5	0.113	0.243
Dry matter production 10 seedlings^{-1} (mg)	1214	793	10.180	21.837
Vigour index	3120	1618	25.628	54.974

Figures in parentheses indicate arc sine transformed values

4. CONCLUSION

In the present study seed pelleting with arappu or neem leaf powder @ 250 g kg^{-1} of seed or phosphobacteria @ 100 g kg^{-1} of seed using wheat flour 10 percent as adhesive @ 150 -200 ml kg^{-1}of seed enhanced the seed germination and seedling vigour.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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