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Conservation of endangered medicinal tree bael (*Aegle marmelos*) through seed priming

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In cultivation of medicinal trees, seed germination is a very important problem. Various seed enhancements are being adopted nowadays to improve seedling emergence. Among these seed enhancement, seed priming is an efficient method for increasing of seed vigour and improvement of germination and seedling growth. The laboratory experiment was conducted at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 2012. The present study was conducted to examine the effect of seed priming (3, 6, 9 and 12 h hydro priming) treatment along with control (without any treatment) on seedling quality characters of bael (*Aegle marmelos*). The results showed that the effect of hydro priming was significant on seedling vigour, germination percentage and dry matter production. Mean comparison showed that minimum days to first emergence (12 days) and 50% germination (15 days) and the maximum germination (84%), shoot length (9.7 cm), root length (8.6 cm), dry matter production (303 mg), vigour index 1 (1537), vigour index 2 (722) and vigour index 3 (25452) were achieved by hydro priming of bael seeds for 6 h, but priming after 6 h failed to improve germination. Hence, bael seeds can be hydro primed for 6 h to improve the germiniability.

Key words: Seed priming, germination percentage, seedling vigour and bael.

INTRODUCTION

Aegle marmelos (L.) Corr., is a popular medicinal tree belonging to the family Rutaceae and its various parts are used in Ayurvedic and Siddha medicines to treat a variety of ailments. The tree grows wild in dry forests of hills and plains of tropical and subtropical region of Central and Southern India, Burma, Pakistan, Bangladesh, Sri Lanka, Northern Malaya, and Java Islands (Islam et al., 1995). The tree is commonly known as “Bael tree” and is a medium sized tree having profuse dimorphic branches, alternate, trifoliate and deep green leaves, membranous leaflets, large sweet scented, greenish white flowers, large and globose fruits (Purohit and Vyas, 2005). It flowers from May to July and yields an average of 200 to 250 kg per tree (Mazumder et al., 2006). Almost all parts of the tree are used in preparing herbal medicine (Kala, 2006). The roots are useful for treating diarrhea, dysentery and dyspepsia. The aqueous extracts of the stem and root bark are used to treat malaria, fever, jaundice and skin diseases such as ulcers, urticaria and eczema (Nadkarni, 1954). In pharmacological traits, both the fruit and root showed antiamoebic and hypoglycaemic activities (Ponnachan et al., 1993). The tree is rich in alkaloids, among which aegline, marmesin, marmin and marmelosin are the major ones. The compounds luvangetin and pyranocoumarin, isolated from seeds showed significant antiulcer activity (Goel et al., 1997). Essential oil isolated from the leaf has antifungal activity (Rana et al., 1997). The foundation for revitalization of local health traditions (FRLHT), Banglore, India assessed threat status of bael *(A. marmelos*) tree as rare,

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Table 1. Effect of hydro priming treatments on days to first germination and days to 50% germination in bael (*Aegle marmelos*).

Treatment	Days to 1st emergence	Days to 50% germination
Control	16	18
3 h water soaking	14	16
6 h water soaking	12	15
9 h water soaking	12	15
12 h water soaking	12	14
Mean	13	16
SD	1.660	1.952
CD (P=0.05)	3.538	4.161

endangered and threatened (RET) species, especially endangered species and importance is being given for mass multiplication through various propagation techniques. The tree is normally grown with seeds (Nayak and Sen, 1999). Seed priming, identified as an effective seed invigouration method, has become a common seed treatment to increase the rate and uniformity of emergence and crop establishments. several studies are associated with pre sowing treatments for seed vigour enhancement, the major problem encountered with the commercial application of seed priming is the variability among species, varieties and even seed lots, especially when treating large quantity of seeds. Since different batches of seeds are intrinsically heterogeneous with respect to germination rate, the specific treatment conditions must be optimized for each seed lot. The present study was carried out with the objective to evaluate the physiological changes occurring in bael seeds during hydro priming.

MATERIALS AND METHODS

The fresh fruits were collected from Ramnagar Coimbatore district (76°57 E, 11°8 N and 320 MSL) and the seeds were extracted as wet extraction and were dried under shade for a week to reduce the moisture content to 10%. Hydro priming treatments were imposed in the night, a day prior to setting up the experiment as prescribed by the treatment (that is, soaking for 3, 6, 9 and 12 h) adopting the seed to solution ratio of 1:1. Then, the seeds were dried back to their original moisture content of 10%. The treated seeds along with control were sown as 100 seeds of 4 replicates in sand media prepared as per International Seed Testing Association (ISTA) and were kept in a germination room maintained at 25±2°C and 95±1% relative humidity (RH). During the process of germination, the seeds were observed for days to first germination and based on the germination observations taken on every day germination, the speed of emergence was calculated as per Maguire (1962). After 23 days of germination period, seedlings were evaluated for germination based on normal seedling characters and the results were reported in percentage. Ten randomly selected normal seedlings were measured for the vigour parameters, namely, root length (cm), shoot length (cm) and dry matter production (g). The vigour index was calculated using the following formula and expressed as whole number (Abdul-Baki and Anderson, 1973).

Vigour index I = Germination (%) × Mean length of the seedling (cm)

Vigour index II = Germination (%) × root length (cm)

Vigour index III = Germination (%) × Dry matter production/10 seedling (mg)

The statistical design adopted for laboratory and nursery experiments were Completely Randomized Block Design. The data gathered for the aforementioned parameters were subjected to analysis of variance and tested for significance as per Panse and Sukhatme (1995) and the percentage values were transformed to arcsine values prior to statistical analysis.

RESULTS AND DISCUSSION

Seedling emergence

Effect of seed hydro-priming showed faster emergence and 50% germination in primed seeds than unprimed seeds. Seeds primed for 6 and 9 h resulted in earlier emergence (12 days) than control (without any treatment) seeds (16 days) and 50% germination was observed 15 days after sowing in primed seeds and in control (without any treatment) seeds it was 18 days after sowing (Table 1). Total emergence percentage showed significantly higher emergence in primed seeds than unprimed seeds. Ghassemi et al. (2008) in lentil, Hosseein and Kasra (2011) in basil and Ramesh (2005) in pungam seed reported improved germination rate, root weight compared to unprimed and chemo primed seed treatment. Therefore, optimal yield could be achieved by fast germination and uniform emergence on the nursery. This implies that hydro priming is the key factor to enhance germination, uniform emergence plants and resistance to unfavourable environmental factors that inherit seed germination (light, temperature and water).

Germination percentage

Effect of seed hydro priming on the germination percentage of bael seedlings (Table 2) showed significant ($P<0.05$) effect of seed priming on the germination of bael

Table 2. Effect of hydro priming treatments on germination percentage, root and shoot length and dry matter production in bael (*Aegle marmelos*).

Treatment	Germination (%)	Shoot length (cm)	Root length (cm)	Dry matter production (mg seedlings^{-10})
Control	68 (55.55)	5.3	4.8	187
3hr water soaking	72 (58.05)	8.0	6.0	228
6 hrs water soaking	84 (66.42)	9.7	8.6	303
9hrs water soaking	80 (63.43)	8.0	6.8	241
12hrs water soaking	76 (60.66)	7.6	5.8	204
Mean	76 (60.66)	7.7	6.4	236
SD	3.474	0.870	0.734	3.129
CD (P=0.05)	7.406	1.856	1.564	6.669

Figures in parentheses indicate transformed (arcsine) values

Table 3. Effect of hydro priming treatments on vigour index in bael (*Aegle marmelos*).

Treatment	Vigour index I	Vigour index II	Vigour index III
Control	687	326	12716
3 h water soaking	1008	432	16416
6 h water soaking	1537	722	25452
9 h water soaking	1184	544	19280
12 h water soaking	1018	441	15504
Mean	1087	493	17874
SD	8.607	5.271	57.742
CD (P=0.05)	18.345	11.235	123.075

seeds with seed primed for 6 h which recorded significantly higher germination percentage (84%) than control (68%). This was due to hydration of the seeds during which hydrolytic enzymes were activated in the endosperm converting complex stored food materials into metabolically useful chemicals that resulted in growth of the embryo. Daniel et al. (2009) reported that respiration, radicle protrusion and cell division consistently occurred sooner in primed (radical emergence) seeds as compared to non primed seed when they were imbibed at 25°C. Priming may be helpful in reducing the risk of poor stand establishment under nursery conditions. Priming improved seed performance might be attributable in part to the decreased lipid peroxidation and increased antioxidative activities during seed imbibitions. These results are in accordance with the results of other researchers who reported improvement of germination percentage (Nadjafi et al., 2006). Wang et al. (2003) also reported that, hydro primed seeds showed significant increase in germination performance. The resultant effect of priming depends on the adopted method and duration of treatment. Hydro priming is a simple method of priming treatment. It does not require any special technical equipment owing to the use of distilled water as priming medium. It is probably the cheapest priming method. Similarly, Fujikura et al. (1995) presented hydro priming as a simple and inexpensive method of seed priming.

Seedling growth and vigour index

Effect of hydro priming on the growth of the bael seedlings showed significant effect of hydro priming on the root length, shoot length, dry matter production and vigour index (Tables 2 and 3). Significantly higher root length (8.6 cm) and shoot length (9.7 cm) were recorded in seeds that were primed for 6 h than control seeds. Similarly, dry matter production (303 mg) and vigour index I (1537), vigour index II (722) and vigour index III (25452) that were primed for 6 h were superior to the control. This could be due to hydro priming treatment which speeded up seedling emergence by dissolving the plant hormones as endogenous regulators (ethylene, auxin and cytokinins) before sowing in the soil (Satvir et al., 2002), Similarly, reported by Brocklehurst and Dearman (2008) that seed priming is a pre-sowing strategy for influencing seedling development by modulating pre-germination metabolic activity prior to emergence of the radical and generally enhancing germination rate and plant performance.

Conclusion

Based on the information obtained in this research work, seeds of bael could be hydro primed (soaked in water and dried back to original moisture content) for 6 h, adopting the seed to solution ratio of 1:1 to obtain uniform and successful establishment (emergence, germination percentage, and seedling growth). In order to develop strategies for conservation of this endangered tree, a sound cultivation and in depth approach is required to assess distribution patterns, regeneration status and uses by the indigenous society.

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