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Influence of Fruit Polymorphism on Seed and Seedling Quality Characters of Bael (*Aegle marmelos*) the Endangered Medicinal Tree

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ABSTRACT

Bael identified as endangered medicinal tree is propagated through seeds. Use of quality seed enhance the seedling quality characters and is highly valid in developing nursery management techniques. In perennial crops, quality seeds are obtained by proper selection of fruits. Tree crops produce fruits with physical polymorphism due to developmental and environmental variation. Hence studies were formulated to evaluate the influence of fruit polymorphism on seed quality characters. Fresh bael fruits were collected from five different locations of Coimbatore. The fruits were categorized based on the width into three different groups as large (10-12 cm), medium (8-10 cm) and small (6-8 cm). The large and medium fruits recovered to 32 and 39%, respectively from bulk. Then seeds were extracted and evaluated for seed quality characters along with seeds of bulk fruits. The physiological quality characters measured in germination room revealed that seed germination observed with seeds of large fruits were higher (82%) and were followed by seeds of medium (74%), bulk (68%) and small (60%) fruits. The seedling vigour measured through root (12.5 cm) and shoot length (13.9 cm), drymatter production (613 mg) and vigour index (2164) also exposed the superiority of seeds of large fruits. The measurement of biochemical characters as oil content was more with seeds of medium fruits (42.8%) than other size distributions, while the differences were non significant for seed protein and electrical conductivity. The seeds sown in polybag nursery also expressed that seeds of large fruits produced vigourous seedlings.

Key words: Bael, fruit recovery, seed quality, oil and protein content, nursery

INTRODUCTION

Aegle marmelos (L.) Corr., is a medicinal tree belongs to the family Rutaceae and its various parts are used in Ayurvedic and Siddha medicines to treat a variety of ailments. It is highly habitated to tropical and subtropical climate of India, Burma, Pakistan, Bangladesh, Sri Lanka, Northern Malaya, Java and Philippine (Islam *et al*., 1995). Purohit and Vyas (2005) reported that bael is a medium sized tree having profuse dimorphic branches, greenish white flowers, large and globose fruits. In Tamil Nadu it flowers between May to July and Mazumder *et al*. (2006) revealed that approximately 200-250 kg of fruits could be obtained per tree. The roots are useful for treating diarrhea, dysentery and dyspepsia. The aqueous stem and root bark extracts are used as medicine for malaria, fever, jaundice, cancer, ulcers, urticaria and eczema (Nadakarni, 1954). The fruit and root of the plant have antiamoebic and hypoglycaemic activities (Ponnachan *et al*., 1993).

Goel *et al.* (1997) revealed that crop is rich with the alkaloids aegline, marmesin, marmin and marmelosin. Rana *et al.* (1997) revealed that the seed is rich in luvangetin and pyranocoumarin compounds which has antiulcer activity. The Foundation for Revitalization of Local Health Traditions (FRLHT), Banglore, India listed bael (*Aegle marmelos*) as RET (Rare, Endangered and Threatened) species specifically endangered species. Hence more importance is being given for mass multiplication through afforaststation. The tree is normally propagated through seeds (Nayak and Sen, 1999) and seed requires specific quality characters for its better performance. Quality seeds are obtained through care on selection of seeds from well developed fruits. Hence studies were initiated to evaluate the influence of fruit character, the size on seed quality characters.

MATERIALS AND METHODS

The fruits of bael (*Aegle marmelos*) were collected from Coimbatore district (76°57 E, 11°8 N and 320 MSL) during 2012. Five different trees in five different locations (Saibaba colony, Perur, Karamadai and Ram Nagar) were selected for collection of fruits. The total fruits served as the base material for the study. The fruits were separated based on width as large, medium and small. Fruits with 10-12 cm width were categorized as large fruits, while that of 8-10 cm and 6-8 cm as medium and small fruits respectively. The sorted fruits were recorded for their recovery in each categories based on total weight of fruits (weight of large or medium or small fruits/total weight of fruits×100) and were evaluated for the following characters with 5×5 fruits.

Physical characters of fruit: The fruits of each category were measured for length and diameter and weighed for fruit weight. Then fruits were separated manually into shell (epicarp), pulp and seed and the following parameters were evaluated:

$$\text{Fruit to shell percentage} = \frac{\text{Shell weight}}{\text{Total weight of fruit}} \times 100$$

$$\text{Fruit to pulp percentage} = \frac{\text{Pulp weight}}{\text{Total weight of fruit}} \times 100$$

$$\text{Fruit to seed percentage} = \frac{\text{Seed weight}}{\text{Total weight of fruit}} \times 100$$

Physical characters of seed: In each category of fruits the number of seeds per fruit was counted in five replicates and seed weight per fruit was taken. Hundred seeds of each category of fruits were weighed separately as eight replications (ISTA, 1993) and the mean weight was reported. The seeds were manually separated into seed coat and embryo and the following parameters were observed for all categories of fruits:

$$\text{Seed to seed coat percentage} = \frac{\text{Weight of seed coat}}{\text{Weight of seed}} \times 100$$

$$\text{Seed to embryo percentage} = \frac{\text{Weight of embryo}}{\text{Weight of seed}} \times 100$$

Physiological characters of seed: The seeds of each categories of fruits were evaluated for germination in sand media in a germination room maintained at 25±1°C and 90±3% RH using 100 seeds of four replicates (ISTA, 1993). After the germination period of 23 days, the test was terminated and evaluated and based on normal seedlings the germination was recorded in percentage. On evaluation, ten normal seedlings were randomly selected and measured for their root and shoot length and dry matter production in each of the replications. Using the data the vigour index values were computed as per Abdul-Baki and Anderson (1973).

Biochemical characters of seed: The seeds of each category were also evaluated for electrical conductivity (Presley, 1958) adopting 16 h as soaking duration. The seed oil (Sadasivam and Manickam, 1995) and protein content (Ali-Khan and Young, 1973) were also measured using standard procedures.

Evaluation at nursery: The seeds were also sown in 25 bags for each categories in three replications. The polybags were filled with potting mixture containing Soil: Sand: FYM in 2:1:1 ratio and the seedlings were maintained with regular watering. After 23 days the nursery emergence was observed and reported as percentage to the total seed sown in nursery. After three months of sowing the seedling were evaluated for survival percentage (seedlings survived after 3 months/total number seeds sown×100) and seedling quality characters (root and shoot length, dry matter production and vigour index values) as mentioned earlier.

Statistical analysis: The statistical design adopted for laboratory and nursery experiments were completely randomized block design. The data gathered for each of the above 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. The non significant were indicated as NS in the table.

RESULTS AND DISCUSSION

The results were highly significant for all observed characters except for electrical conductivity and seed protein. On fruit grading, the highest recovery of 39% was obtained with medium fruits and was followed by large (32%) and small (28%) fruits (Table 1). The fruit characters viz., fresh weight (218 g), length (12.1 cm), diameter (23.5 cm), fruit to shell percentage (56.87%), fruit to pulp percentage (33.95%), fruit to seed percentage (9.18%), were higher in large fruits. The fruit

Table 1: Influence of fruit polymorphism on seed and seedling quality characters of Bael (*Aegle marmelos*)

	Fruit characters				Fruit to its component			Seed characters		
Grades (based on width)	Recovery (%)	Fresh weight fruit^{-1} (g)	Length fruit^{-1} (cm)	Diameter fruit^{-1} (cm)	Shell (%)	Pulp (%)	Seed (%)	No. of seeds fruit^{-1} (Nos)	Seed weight fruit^{-1} (g)	100 seed weight (g)
Large (10-12 cm)	32.0	218	12.1	23.500	56.87	33.95	9.18	66.8	20.500	18.810
Medium (8-10 cm)	39.0	150	9.2	20.000	59.45	33.79	6.76	32.0	12.000	15.790
Small (6-8 cm)	28.0	103	7.2	15.900	65.04	29.1	5.86	17.7	6.000	12.870
Bulk	-	148	8.4	19.800	61.33	33.66	5.01	31.2	10.800	13.610
SEd	1.551	0.772	0.733	0.812	0.746	0.738	0.837	0.728	1.275	0.462
CD (p = 0.05)	3.381	1.636	1.554	1.723	1.582	1.565	1.775	1.545	2.703	0.980

characters recorded with medium fruits were higher than bulk but lower than large fruits. The small fruits had the least physical expressions. Similar positive association between fruit size and its physical characters were reported by Palanisamy *et al.* (1994) in sapota.

The seed morphological characters viz., number of seeds fruit^{-1} (66.8), seed weight fruit^{-1} (20.5 g) and 100 seed weight (18.81 g) were also higher in large fruits and was followed by medium, bulk and small fruits. The observations (Fig. 1) on seed to seed coat percentage (23%) and seed to embryo percentage (77%) were higher with seeds of large fruits and exerted a positive association with fruit size. Srimathi (1997) in amla (*Emblica officinalis*) and jamun (*Syzygim cuminii*) and Srimathi *et al.* (1998) in ber (*Zizyphus mauritiana*) also reported that fruit/seed size and seed to embryo percentage are positively related.

The seed quality characters (Table 2) evaluated through germination, root and shoot length and vigour index values were rhythmically coincided with fruit size. Dharmalingam and Vijayakumar (1987) in acid lime and Jerlin and Srimathi (1999) in soap nut (*Sapindus emerginatus*) also reported similar association between fruit and seed size with seedling quality characters. The large fruits recorded higher germination (82%) root length (12.5 cm), shoot length (13.9 cm), drymatter production (613 mg) and vigour index values (2164) than medium, bulk and small fruits. Similar results were also reported by Hoppe *et al.* (1991) in *Melia azadiracta* and by Malarkodi *et al.* (1999) in Punnai. The positive association between the seedlings growth and seed size recovered from the various fruit sizes explained not only by the quantum of reserve nutritional matter accumulated in these type of seed (Ashby, 1936) but also by their higher chemical composition. Ponnuswamy (1993) in neem, Arjunan *et al.* (1994) and Manonmani *et al.* (1996) in

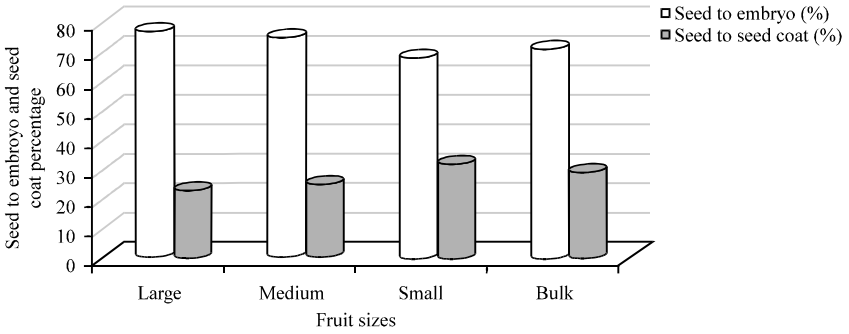

Fig. 1: Influence of seed size variation on its components of Bael (*Aegle marmelos*)

Table 2: Influence of fruit polymorphism on physiological and biochemical characters of Bael (*Aegle marmelos*)

	Physiological characters					Biochemical characters		
Fruit grades (based on width)	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg seedlings^{-10})	Vigour index	Electrical conductivity (dSm)	Oil content (%)	Protein content (%)
Large (10-12 cm)	82 (65.37)	12.500	13.900	613	2164	1.726	31.900	17.27
Medium (8-10 cm)	74 (59.38)	10.500	11.600	553	1554	1.765	42.800	18.74
Small (6-8 cm)	60(50.53)	8.900	10.700	484	1176	1.746	25.400	15.54
Bulk	68 (55.56)	9.400	11.000	512	1462	1.755	33.500	17.61
SEd	(1.087)	0.959	0.760	0.948	0.565	0.121	2.561	1.421
CD (p = 0.05)	(2.305)	2.033	1.611	2.011	1.199	NS	5.430	NS

Table 3: Influence of fruit polymorphism on seedling quality characters of Bael (*Aegle marmelos*) at nursery

	Seedling quality characters after 3 months of nursery period					
Fruit grades (based on width)	Initial nursery emergence (%)	Seedling survival (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg seedlings^{-10})	Vigour index
Large (10-12 cm)	80 (63.43)	80 (63.43)	27.300	21.900	2052	3936
Medium (8-10 cm)	76 (60.66)	76 (60.66)	22.400	18.700	1835	3124
Small (6-8 cm)	62 (51.94)	62 (51.94)	17.500	14.200	1373	1965
Bulk	66 (54.33)	66 (54.33)	21.700	17.200	1683	2567
SEd	(0.601)	(0.601)	1.000	1.795	2.519	2.607
CD (0.05)	(1.275)	(1.275)	2.119	3.806	5.342	5.528

Pongamia pinnata, Kathiravan (2004) in *Jatropha* and also reported that seed size and seed quality characteristics are positively related. The better performance of seeds of large sized fruit might be due the initial capital theory as was expressed through the positive association between fruit size, seed size and the embryo weight. Katsuka (1964) also opined that translocation of reserve from endosperm to embryo proceeds differently in large and small seeds. He expressed that better-filled as larger seeds of *Pinus thunbergii* transformed more nitrogen from the endosperm to the embryo on sowing than the small seeds. However, Siddiqui and Islam (1985) reported a non linear relationship between seed size and seed quality in *Sonneratia aperala*.

The evaluated biochemical characters revealed that the oil content was more in medium fruits (42.8%) and was followed with seeds of large, bulk and small fruits. But the electrical conductivity and the seed protein content expressed a non significant variation for fruit size which might be due to the lesser rate of deterioration accounted by fresh seeds.

The nursery studies conducted with polypots indicated that seeds of bigger fruits produced elite seedling with 80% emergence. It was followed by seeds of medium fruits (76%). The small fruits (62%) performed poorer than bulk (66%) recommending rejection of these fruits in bulk collection (Table 3). These results were also supported by Manonmani *et al.* (1996) working with pungam. Black (1956) and Gross and Werner (1982) also explained the advantage of larger seeds for the early emerge in natural habitate from greater depth of litter vegetation. Seedling quality characters and survival percentage recorded after three months of nursery also revealed a positive association between fruit size and seedling quality characters that extended upto nursery. Hithertoo the small fruits performed poorer than bulk, while the medium fruits better than bulk. Gurunathan *et al.* (2009) on their research with *Jatropha* also reported similar positive association at nursery with fruit size and seedling quality characters.

CONCLUSION

Beal being an underutilized crop, the initial propagation material, the seed should be of higher quality. The above study emphasized the need for size grading of fruits. As the demand for seed is comparatively lesser, as per the study larger fruits selected based on width (10 to 12 cm) could be used for production of elite seedling at nursery, the basic source for raising quality plantations. On stringent selection of best propagative material for raising seed production area, the larger fruits alone should be used for raising effective plantations. But on heavier demand for seeds, both large and medium fruits with the width range of 12-8 cm could be selected for collection of seeds.

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