Brazilian Journal of Botany 35(4):397-400, 2012

Short communication

Viability and vigor of jamun (*Syzygium cumini*) seeds

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(received: October 30, 2012; accepted: November 07, 2012)

ABSTRACT - (Viability and vigor of jamun (*Syzygium cumini*) seeds). Jamun (*Syzygium cumini* L. Skeels) (Black plum, Damson plum) fruits weigh between 2-5 g at maturity. Fresh seeds represented 20-80% of the total fruit weight; the seed coat and cotyledons contributed 6% and 94% to the total seed weight respectively, while the weight of the embryonic axis was insignificant. Only the embryonic axis stained with Tetrazolium, not the cotyledons. The seeds are polyembryonic with up to four embryos, of which at most three germinate. Decoated seeds germinated faster than coated seeds under nursery conditions, with high significant germination percentages, dry matter production rates and vigor indices. The lack of staining of the cotyledon by tetrazolium was probably due to the presence of an impermeable layer. Decoating seeds for faster germination is recommended.

Key words - decoated seeds, embryo, Myrtaceae, polyembryony, tetrazolium

INTRODUCTION

Jamun (*Syzygium cumini* (L.) Skeels, Myrtaceae) (also known as Jambul, black plum, Damson plum, Duhat plum, Jambolan plum, Portuguese plum, and Malabar plum) is an evergreen tropical tree native to Bangladesh, India, Nepal, Pakistan, Sri Lanka, the Philippines, and Indonesia. Sweet-bitter jamun fruits are excellent sources of iron, calcium, phosphorus, sodium, potassium, vitamin-C and carotene, and have been reported to alleviate heart and liver ailments. Jamun seeds are known to be recalcitrant, chlorotic, multicotyledonous, and have multiple embryos, although there have been very few studies examining their seed anatomy or directed towards improving seed germination and vigor (Swamy et al. 1999, Thoke et al. 2009). The tetrazolium (TZ) test is one of the most reliable techniques used to estimate seed viability and vigor (Hosomi et al. 2011), although every species has its own specific dissection, staining, and TZ evaluation requirements (Enescu 1991). The present investigation was conducted to: 1. assess the fruit:seed and seed: seed coat, cotyledon and embryo ratios; 2. examine the polyembryonic nature of the seeds; 3. elucidate the influence of the seed coat on seed germination and; 4. determine the topographical staining patterns of jamun seeds.

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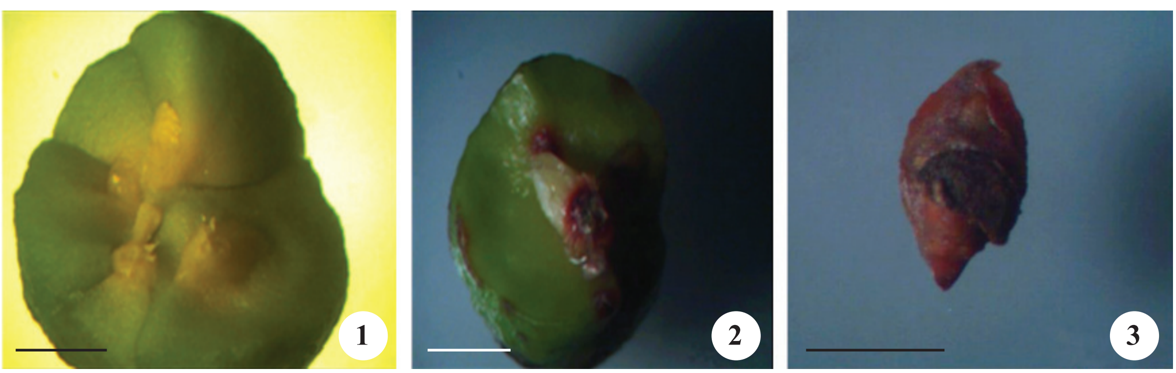
MATERIAL AND METHODS

The following experiments were undertaken in the Department of Seed Science and Technology at the Agricultural College and Research Institute, Madurai, India, using fresh fruits ($n = 120$) collected during their period of natural dispersal (August-September/2012). The collected fruits were divided into three lots for experimental purposes: one lot ($n = 25$ fruits) was weighed and the seeds separated after manual maceration (to remove the fruit pulp) to determine the fruit:seed ratio, after which the seeds were dissected into their various components (seed coats, embryonic axes, and cotyledons) that were subsequently weighed to determine their seed:embryo ratio; the seeds in the second lot ($n = 25$) were cut in half to expose the embryonic axis and cotyledonary furrow and then placed in a 1% TZ solution for 4 hours at 40 °C; the final lot ($n = 70$ seeds) was further divided into two sub-lots (35 seeds each) with and without their seed coats and were surface sterilized with 0.01% mercuric chloride at room temperature and subsequently sown into germination trays (20 × 20 × 4 cm) containing sand to assess their germination percentages and observe their polyembryonic behavior. All experiments were repeated twice to confirm their reproducibility. Germination speed was assessed after 26 days (Maguire 1962) and seedling length and their vigor indices (Abdul-Baki & Anderson 1973) were calculated. The data was statistically analyzed using SAS software and correlation analyses were performed using Microsoft EXCEL®.

RESULTS AND DISCUSSION

The mean values of the 25 fruits of lot 1 showed that the contribution of fresh seed weight to total fruit weight ranged from 20%-80%. Seed coats and cotyledons contributed approximately 6% and 94% to the total seed weight respectively (data not shown); the contribution of the embryos to seed weight was negligible. The jamun seeds (figures 2-3) incubated in a 1% TZ solution for 4 hours at 40 °C showed pink staining only along the embryonic axis; the chlorotic cotyledons remained unstained even though they were viable (figures 2). Similar results were reported in curry leaf seeds (Sivasubramaniam & Selvarani 2012) and may be due to a physical barrier on the cotyledon surface that prevents penetration of the TZ solution.

The maximum number of embryos observed in a jamun seed was four (figure 1), but only three seedlings emerged (figure 6). Polyembryony is a condition in which multiple embryos arise within the embryo sac by budding or by cleavage of the zygotic proembryo or from the synergids and antipodal cells (Maheswari & Sacher 1963). Discrepancies in embryo counts and emerging seedlings due to polyembryony have been reported in *Calophyllum inophyllum* L. (Kumaran et al. 1999, Rajesh et al. 2012), *Syzygium cumini* (Abdul Kadar et al. 2000), *Syzygium mundagom* (Bourd.) Chithra (Jose et al. 2009), and *Murraya koenigii* (L.) Spreng. (Sivasubramaniam & Selvarani 2012) and may be due to the existence of dormant or under-developed embryonic axes. Seeds sown without their seed coats germinated significantly faster (figure 5) than seeds with intact seed coats, but the final germination counts (taken after one month) revealed no significant difference between them, with both conditions showing 100% germination. Highly significant differences were observed, however, in terms of vigor attributes, with seeds without seed coats generating seedling with greater lengths (23.09 cm), dry matter production (0.16 g), and vigor index (16) values – while seeds with intact seed coats had lower seedling length (14.59 cm), dry matter production (0.13 g), and vigor index (13) values. Germination speed, seedling length, dry matter production, and vigor indices among seeds sown without their seed coats increased by 41.79%, 36.81%, 18.75% and 18.75%, respectively, over seeds that retained their seed coats (figure 4). Similar results were reported by Shukla et al. (2008) for decoated *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. seeds. Correlation studies also revealed that germination speed was significantly correlated with root length (0.993), shoot length (0.977), seedling length (0.977), dry matter production (0.984), vigor index 1 (0.976), and the vigor index 2 (0.981) (table 1) of decoated seeds. Swamy et al. (1999) and Thoke et al.



Figures 1-3. 1. Occurence of polyembryony. 2. Tetrazolium staining. 3. Stained embryo. Bar = 100 µm.

Table 1. Correlations between various vigor parameters of jamun seedling. (DMP = dry matter production; VI = vigor index).

	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Seedling length (cm)	DMP (g)	VI 1	VI 2
Speed of germination	1							
Germination (%)	0.202	1						
Root length (cm)	0.933**	0.245	1					
Shoot length (cm)	0.977**	0.223	0.940**	1				
Seedling length (cm)	0.977**	0.231	0.966**	0.996**	1			
DMP (g)	0.984**	0.222	0.948**	0.994**	0.994**	1		
VI 1	0.976**	0.252	0.966**	0.996**	1.000**	0.994**	1	
VI 2	0.981**	0.275	0.949**	0.993**	0.993**	0.998**	0.994**	1

* Significant at 0.05 level; ** Significant at 0.01 level.

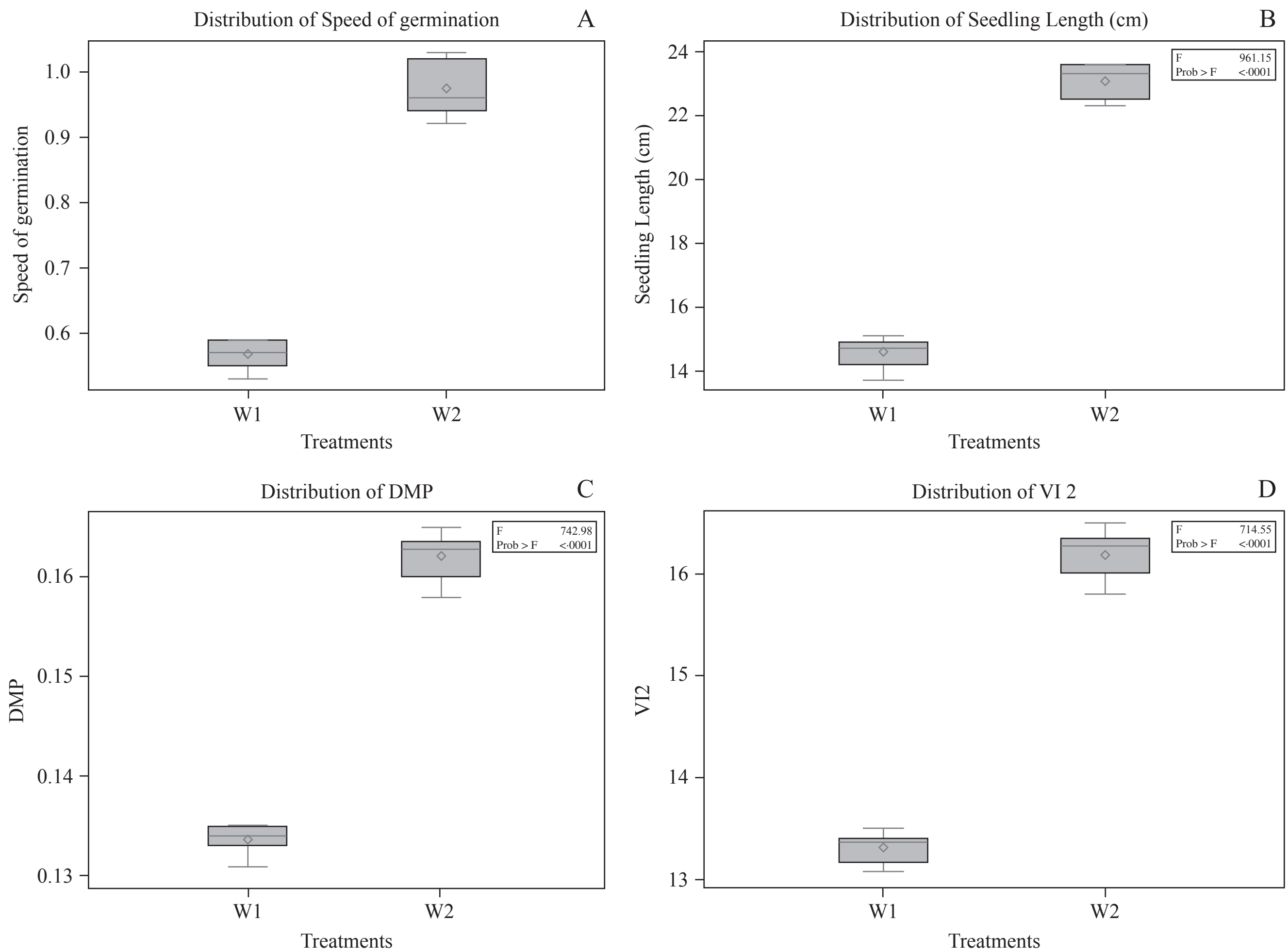


Figure 4. Seed vigour attributes as affected by decoating of jamun seeds. A. Speed of germination. B. Seedling length. C. Dry matter production. D. Vigour index. (W1 = Seeds sown with seed coat; W2 = Seeds sown without seed coat).

Figures 5-6. 5. Speed of germination at 20th days after sowing. 6. Polyembryonic behaviour at 30th days after sowing.

(2009) suggested several treatments (including hot water, gibberellic acid, and the use of bacterial consortia) to improve seed vigor in jamun, and the present study describes a simple technique for decoating jamun seeds prior to sowing to improve early seed emergence that was more effective than the method of Swamy et al. (1999). Our study also demonstrated that jamun seeds have multiple embryos, leading to emergence of up to three seedlings per seed, and that TZ staining was confined to the embryonic axis, with other embryo parts (such as the cotyledons) remaining unstained. Further studies will be necessary to elucidate the observed differences in vigor among polyembryonic seedlings (single, double and triple seedlings) and to compare laboratory Tetrazolium test results with field performances. The simple technique of sowing freshly decoated seeds can be used for raising jamun seedling root stocks for early nursery grafting.

REFERENCES

Abdul Kader S, Bindu KR, Chacko KC. 2000. Polyembryony in *Syzygium cumini* (L.) Skeels and *Vateria indica* L. Indian Forester 126:1353-1356.

Abdul-Baki AA, Anderson JD. 1973. Vigour deterioration of soybean seeds by multiple criteria. Crop Science 13:630-633.

Enescu V. 1991. The tetrazolium test of viability. *In* Tree and shrub seed handbook. (AG Gordon, P Gosling, BSP Wang, eds.). International Seed Testing Association, Zurich.

Gunaga RP, Ganiger RV, Smita DA, Shinde P, Rane AD. 2012. Poly-embryony in *Calophyllum inophyllum* L. Indian Forester 138:305-306.

Hosomi ST, Santos RB, Custodio CC, Seato PT, Marks TR, Machado Neto NB. 2011. Preconditioning *Cattleya* seeds to improve the efficacy of the tetrazolium test for viability. Seed Science and Technology 39: 178-189.

Jose PA, Mohanan N, Hussain A. 2009. Occurrence of twin seedlings in *Humboldtia vahliana* Wight and *Syzygium mundagom* (Bourd.) Chithra – two endemic trees of Southern Western Ghats. Indian Forester 135: 290-292.

Kumaran K, Srimathi P, Jerlin R, Palani M. 1999. Polyembryony in *Calophyllum inophyllum* L. Journal of Non-Timber Forest Products 6:83-84.

Maguire JD. 1962. Speed of germination: aid in selection and evaluation for seedling emergence and vigour. Crop Science 2:176-177.

Maheswari P, Sacher RC. 1963. Polyembryony. *In* Recent advances in the embryology of Angiosperms (P Maheswari, ed.). International Society of Plant Morphologists, New Delhi, p.265-296.

Shukla G, Malla S, Chakravarty S. 2008. Presowing treatments on germination and seedling growth of *Terminalia arjuna* in Terai zone of West Bengal. Seed Research 36:183-186.

Sivasubramaniam K, Selvarani K. 2012. Studies on curry leaf (*Murraya koenigii*) seeds. Current Science 103: 883-885.

Swamy GSK, Patil PB, Athani SI, Prabhushankar DS. 1999. Effect of organic and inorganic substances on germination of Jamun (*Syzygium cumini*) seeds. Advances in Agricultural Research in India 11:89-91.

Thoke S, Patil DR, Swamy GSK, Kanamadi VC. 2011. Response of jamun (*Syzygium cumini* Skeels.) to *Glomus fasciculatum* and bioformulations for germination, graft take and graft survival. Acta Horticulturae 890: 129-134.