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Short Communication

Influence of seed orientation and depth of sowing on germination and vigour of Anjan (*Hardwickia binata* Roxb)

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ABSTRACT

Influence of seed orientation and depth of sowing on germination, seedling emergence and seedling vigour in Anjan (*Hardwickia binata* Roxb) was investigated. The seeds collected from 20- year old trees were sown in sand filled earthen pots at 1.5, 3.0 and 5.0 cm depths, adopting three orientations of the embryo *viz.*, up right (embryo facing up), horizontal and inverted positions. The experiment was laid out in a completely randomized design. Percentage germination, root and shoot length and dry matter production were measured and the vigour index was calculated. Placing the seeds with the embryo in a horizontal or inverted position at a depth of 1.5 cm and 3.0 cm resulted in early and higher germination, higher root and shoot length, greater dry matter production and vigour index.

Key words: germination, *Hardwickia binata*, seed orientation, seedling vigour, sowing depth.

Hardwickia binata Roxb. belongs to the family Caesalpiniaceae and is a characteristic species of dry deciduous forest. It grows well in dry hot climate with 500 to 1000 mm annual rainfall. It is a good timber species and its green leaves are used as fodder and green manure (Prasad *et al.* 1974); the leaves, pods and bark contain 7, 6 and 9% tannin, respectively. It is propagated through seeds. In general, orientation of seeds and other plant propagules is known to influence the germination and seedling development (Thapliyal 1979). For example maximum germination and better emergence of seeds of *Balanites aegyptica* were achieved in a horizontal position (Elnour and Massimo 1995) while Sal (*Shorea robusta*) seeds placed in an inverted position had the best germination and emergence than in horizontal or upright position (Sharma and Purohit 1980). Germination significantly slowed down when the scar end of teak (*Tectona grandis*) drupes was inverted and sown (Masilamani and Dharmalingam 1998). Depth of sowing is also an important factor affecting seed germination. Too shallow or too deep placement would affect both seed germination and seedling vigour (Singh and Wilson 1974; Masilamani and Dharmalingam 1998). Incorrect position and depth of seeding could delay or suppress seed germination, adding to sowing expenses. Therefore, the present study was conducted to understand the influence of seed orientation (positioning) and depth of sowing on germination and vigour of Anjan (*Hardwickia binata* Roxb).

Hardwickia binata seeds collected from 20 -year old trees of an existing plantation at the Institute of Forest Genetics and Tree Breeding Campus, Coimbatore, Tamil Nadu, India were cleaned. and size-graded, using 16/64" (6.4 mm diameter) round perforated metal sieve. The seeds were sown in sand filled earthen pots (30 cm height and 30 cm upper width) at different depths *viz.* 1.5, 3.0 and 5.0 cm adopting three orientations of the embryo i.e. upright, horizontal and inverted positions. The experiment was laid out in a completely randomized design. For each treatment, 150 seeds were sown with five replications of 30 seeds. The pots were kept in partial shade (chamber covered with nylon mesh) and a germination period of 14 days as recommended by Gupta *et al.* (1975) was adopted. Time taken for seedling emergence was observed daily beginning from the 4th day until the 14th day after sowing. Seed germination (ISTA 1985) was expressed as the percentage of seeds producing normal seedlings.

Fourteen days after sowing, ten seedlings from

each replicate were randomly uprooted and the root and shoot lengths were measured. The seedlings were then oven dried at 85°C for 24 hr and weighed. The vigour index was calculatedas follows (Abdul-baki and Anderson 1973):

Vigour Index = Percentage germination X Total seedling length (cm).

The results were subjected to analysis of variance and tested (t-test) for significant difference (p= 0.05) (Panse and Sukhatme 1967). Percentage values were transformed into arc sine values prior to statistical analysis and the mean values of the experiment were compared using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez 1984).

Hardwickia binata seeds sown with embryo facing horizontally at 1.5 cm depth gave the maximum germination (81%) followed by downward orientation of the embryo at the same depth (65%). Seeds sown at 1.5 cm and 3 cm depths emerged earlier than those sown at 5 cm depth. In general, seeds sown at 1.5 and 3 cm depths with horizontal orientation registered early emergence followed by down ward orientation. As the depth of sowing increased or orientation changed, it took more days for seedling emergence. Similar results have been reported by Mahgoub (1995) in *Balanites aegyptica*, *Sterculia setigera* and *Delonix regia* and by Pyarelal and Karnataka (1993) in *Quercus serrata*. The seeds placed with horizontal orientation at 1.5 and 3.0 cm depths recorded longer root and shoot length of seedlings, and higher dry matter production than those sown at 5.0 cm depth. Vigour index values were much higher when seeds were sown with horizontal orientation at 1.5 cm depth followed by 3.0 cm depth in the same orientation of sowing (Tables 1 & 2).

The seeds placed with embryo in upright position showed deleterious effect on germination and seedling growth. The germination was either delayed or suppressed by upright positioning of seeds suggesting that sowing the seeds with embryo in an upright position results in the exertion of extra energy for germination and this will either delay or cause failure of seedling emergence. The epigeal seeds such as *Hardwickia binata* exert extra energy on hypocotyl elongation. This is related to seed shape and weight as well. This has been shown by Mahgoub (1995) in *Delonix regia* and *Acacia nilotica*. Such reduced germination and seedling growth in seeds placed with embryo end upright position can be explained by Cholodry Went theory as quoted by Thapliyal (1979), who reported that auxin produced or liberated in the root tip accumulates preferentially in the lower half and moves basipetally in to the elongation zone. Bennetclark *et al.* (1959) suggested that the

Table 1. Effect of treatments on germination, days taken for seedling emergence and root length of *Hardwickia binata* at 14 days after sowing

Seed Orientation	Germination %				Days taken for seedling emergence				Root length cm			
	1.5 cm depth	3 cm depth	5 cm depth	Mean	1.5 cm depth	3 cm depth	5 cm depth	Mean	1.5 cm depth	3 cm depth	5 cm depth	Mean
Upward	38^{cd} (38.23)	31^{d} (33.87)	19^{e} (25.79)	29.3 (32.63)	6^{cd}	8^{c}	10^{f}	8.0	8.9^{bc}	8.8^{bc}	9.0^{bc}	8.9
Horizontal	81^{a} (64.01)	61^{b} (51.25)	47^{c} (43.38)	63.0 (52.88)	4^{a}	5^{b}	6^{d}	5.0	15.2^{a}	15.5^{a}	14.0^{a}	14.9
Inverted	65^{b} (54.33)	35^{d} (36.37)	21^{e} (26.34)	40.3 (39.01)	5^{bc}	7^{c}	10^{f}	7.3	12.6^{ab}	7.0^{c}	7.3^{c}	9.0
Mean	61.3 (52.19)	42.3 (40.50)	29.0 (31.84)		5.0	6.7	8.7		12.2	10.4	10.1	

(Figures in paratheses indicate arcsine values)
(Means followed by same letter in a column are not significantly different)

Table 2. Effect of treatments on shoot length, dry matter production and vigour index on *Hardwickia binata* at 14 days after sowing

Seed Orientation	Shoot length cm				Dry matter production mg seedling^{-1}				Vigour index			
	1.5 cm depth	3 cm depth	5 cm depth	Mean	1.5 cm depth	3 cm depth	5 cm depth	Mean	1.5 cm depth	3 cm depth	5 cm depth	Mean
Upward	8.2^{cd}	7.4^{de}	7.6^{de}	7.7	12^{abcd}	8^{e}	11^{bcde}	10.3	647^{d}	508^{d}	420^{d}	525
Horizontal	10.8^{a}	10.3^{ab}	9.6^{abc}	10.2	15^{a}	14^{ab}	13^{abc}	14.0	2112^{a}	1564^{b}	1144^{c}	1607
Inverted	8.8^{bcd}	8.0^{d}	6.2^{e}	7.7	10^{cde}	9^{de}	8^{e}	9.0	1434^{bc}	518^{d}	273^{d}	742
Mean	9.3	8.6	7.8		12.3	10.3	10.7		1264	863	612	

(Means followed by same letter in a column are not significantly different)

inversion of seedling might bring abnormal chemical or physiological changes and the manifestations of these changes are abnormal morphological developments. It may be reasonable to assume that the vigorous seeds produced normal upright seedlings by virtue of their ability to maintain metabolic integrity and sub-cellular coordination even under adverse conditions. The proper directional growth of plumule and radicle would therefore require additional hormones as well as energy for better seedling survival and emergence.

In the present study, at 1.5 cm depth of sowing with horizontal orientation of embryo produced higher germination, and seedling vigour of *H. binata*. Therefore it is recommended to place *Hardwickia binata* seeds at 1.5 to 3.0 cm depth with the embryo facing horizontal or inverted position for early germination with better seedling vigour.

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