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Effect of Orientation of Seed Placement on Seedling Emergence in Some Species of *Calamus*

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ABSTRACT
A study on influence of seed orientation on seed germination of three species of rattans namely, Calamus prasinus, C. stoloniferus and C. thwaitesii made by sowing the seeds at 2 cm depth in vertical (micropyle end upward), horizontal (micropylar end sideward) and in vertical(micropylar end downward) orientations. Maximum germination of 80% in seeds of C. prasinus recorded in inverted position and in other two species it was maximum in vertical orientation. Similarly maximum vigour index also occurred in vertical and inverted orientations. The early seed emergence occurred in different days in all the three rattan species at three orientations.
Keywords: Seed orientation, germination, rattans, *calamus*, seed vigour

INTRODUCTION

Rattan is the most important minor forest product. In India there are four genera and 60 species of rattans of which 43 species are considered as endemic [1-3]. About 22 species are commonly important. They are mainly distributed in three regions viz, the Western Ghats, North-eastern India and the Andaman and Nicobar Islands. All the rattans of Peninsular India belongs to only one genera *Calamus* with a representation of 21 reported species. In the Western Ghats region, where the rattans form an integrated part of the ecosystem, 20 species of *Calamus* have been reported with 18 species, of which 15 are endemic to the Western Ghats [4]. Karnataka has the maximum number of cane species i.e., 13 of which 11 are endemic to the Western Ghats [5].

Now a day there is a great demand for the product of canes worldwide. In order to raise large scale plantation of rattan species, seeds are considered as propagules.

Freshly collected rattan seeds have high moisture content and are sensitive to desiccation. The normal method of propagation of these species was by seeds. The collection of seeds from the dense forests and even it fruiting during monsoon is a very difficult task as they attain into a large lian and reaches to the forest canopy. When the fruits mature and ready to harvest it will start falling, but in the forest floor regeneration is very low. Those fruits fall on the forest floor during heavy monsoon carried away by water current or sometimes decayed due to excess moisture content. Some of the mature fruits of cane species feeded by animals as its pericarp is fragmented [6].

There are a few reports on seed orientation and germination in the forest trees [7-11] but similar reports in rattans were so far not found. So an experimental study was carried out to find a better and suitable orientation of seeds for better germination of three species of *Calamus* viz, *C. prasinus, C. stoloniferus* and *C. thwaitesii* of which *C. prasinus* and *C. stoloniferus* are endemic to the Western Ghats of India. These canes are of great industrial applications.

MATERIALS AND METHODS

Seeds of *C. prasinus, C. stoloniferus* and *C. thwaitesii* were collected from Subramanya forests of Dakshina Kannada and Makut forest of Kodagu districts of Karnataka during June-August months. The fruits were collected in bunches and brought to the laboratory. The outer scaly pericarp is removed by hand and inner sarcotesta is partly removed by rubbing the seeds in water. Complete sarcotesta can be removed by rubbing the seeds gently on coarse wire mesh or coarse sand [12].

For germination studies, usual germination criterion, i.e. seedling emergence and the establishment of a vigorous plant was taken into account. The seeds were sown in pots containing sand. Twenty five seeds of each species were sown in three different orientations viz, vertical, horizontal and inverted with regard to hilum, with a depth of 2 cm. For each orientation three replicates were made. The seeds were watered at regular intervals and the germination was recorded. After three months of seed sowing seedlings of each species and orientation were randomly selected for measuring shoot length and root length for the calculation of vigor index.

Vigor index (VI) was calculated by using the following formula [13]:

VI = Percentage germination X Total seedling length

RESULTS AND DISCUSSION

The seeds of *C. stoloniferus* are small compare to *C. prasinus* and *C. thwaitesii*, sub- spherical, brownish in color. The initiation of germination varied in different species in different seed orientation. In *C. prasinus* in orientation -2 the emergence of radical starts after 32 days of sowing, while in orientation -3 and orientation -1 it was 36 days and 43 days respectively. In *C. stoloniferus* it was 30 days after sowing and in *C. thwaitesii* 58 days of sowing.

Table 1: Seedling measurement as influenced by the orientation of seed placement

Orientation	Shoot length (cm)			Root length (cm)			Vigor index		
	CAPR	CAST	CATH	CAPR	CAST	CATH	CAPR	CAST	CATH
Orientation - 1	23.4	4.3	18.1	18.1	7.7	7.3	2822	720	1143
Orientation - 2	22.4	7.5	18.9	16.4	7.0	7.7	2328	296	931
Orientation - 3	22.78	5.8	18.9	15.6	6.8	6.8	3070	252	1028

CAPR- *C. prasinus* CAST - *C. stoloniferus* CATH - *C. thwaitesii*

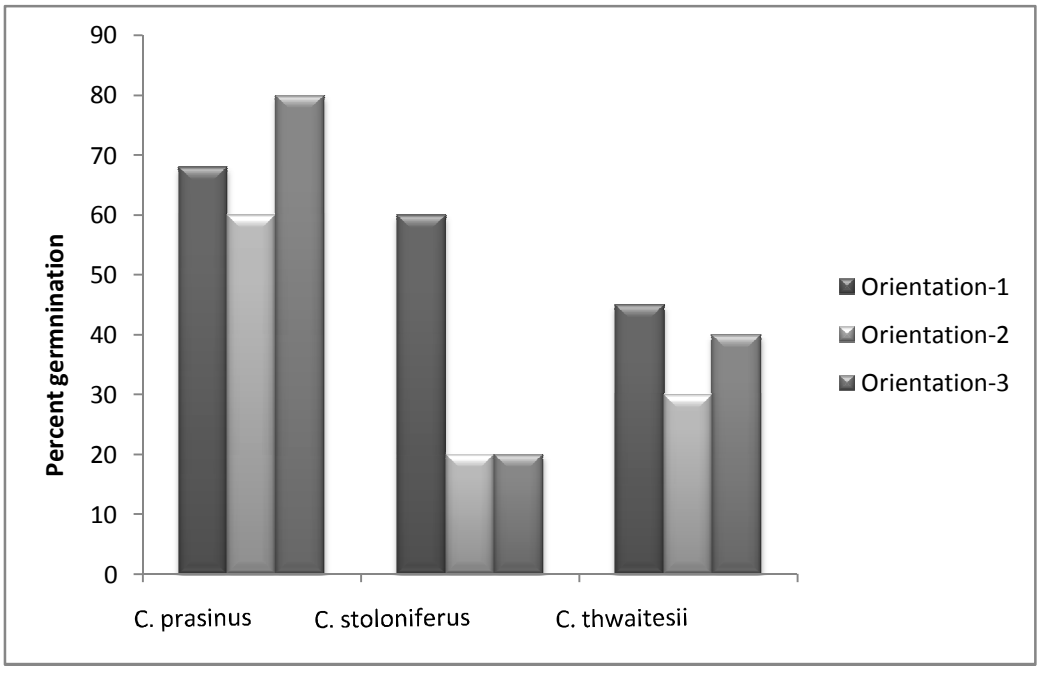

Fig. 1: Percentage germination of seeds of *Calamus* spp. at three different orientations

The rate of germination varied among the three species of rattans with respect to seed orientation (Fig.1). In *C. prasinus* maximum germination of 80% was recorded in seeds sown in inverted position while minimum of 60% in seeds sown in horizontal position. In *C. stoloniferus* and *C. thwaitesii* maximum germination of 60% and 45% were obtained in seeds sown in vertical orientation respectively. The minimum percentage of germination of 20% in both horizontal and inverted positions in *C. stoloniferus* and in *C. thwaitesii* it was 30% in horizontal position. Pandey & Khatoon [11] recorded 80% germination in *Sterculia urens* seeds when sown in vertical position at 2 cm depth and horizontal position at 4 cm depth. On the other hand in forest trees like teak 100% seed germination reported at vertical position, whereas in *Gmelina arborea, Ceiba pentandra* and *Leuceana leucocephala* 100% germination was recorded in horizontal and vertical positions [8, 10] on their studies on the influence of three seed orientation and 1.5, 3.0 and 5.0 cm depth of sowing in anjan (*Hardwickia binata*) seeds, embryo facing horizontal at 1.5 cm depth recorded maximum germination of 81%, followed by 65% in inverted orientation. Seeds sown at 1.5 and 3.0 cm were emerged earlier than at 5.0 cm. Horizontal oriented seeds showed early emergence followed by downward orientation. As other studies quoted here are forest trees in this there will be vigorous seed germination and will commence and complete within month of time.

Bosy & Aarssen [14] reported lower seed germination with inverted orientation compared to other orientations- horizontal and vertical five plants viz *Aster novae-angliae* L., *Cichorium intybus* L., *Daucus carota* L., *Galinsoga ciliata* (Raf) Blake and *Potentilla recta* L. out of eight herbaceous plant species in their studies. However, seeds of *Lycopus unifloris* Michx. and *Erysmium cheiranthoides* L. were not influenced by orientation while seeds of *Sonchus arvensis* L. germinated poorly when burried.

The seedling vigor was calculated in terms of vigor index. In the present study maximum vigor index of 3070 was recorded in *C. prasinus* seeds at inverted orientation, 720 in *C. stoloniferus* at vertical position and 1149 in *C. thwaitesii* also at vertical position (Table 1). So this indicates the best orientation for seedlings in these canes. Similar reports were made in earlier studies by Sahai [9] in *Dalbergia sissoo* and Sharma & Purohit [7] in *Shorea robusta*. In bitter gourd, bottle gourd and ash gourd vertical orientation showed early emergence followed by horizontal orientation [15]. Among the rattans compared in terms of their growth *C. prasinus* registered vigorous root and shoot growth. Similar observations were made by Mahgoub [16] in *Delonix regia* and *Acacia nilotica*. Such reduced germination and seedling growth in seeds placed with embryo end up right explained by Cholodry Went theory as quoted by Thapliyal [17], who reported that auxin produced or liberated in the root tip accumulates preferentially in the lower half and more basipetally into the elongation zone. Bennet Clark et al. [18] suggested that the inversion of seedling might bring abnormal chemical or physical changes and the manifestation of these changes are abnormal morphological developments. The proper directional growth of plumule and radical would be therefore additional hormones as well as energy for better seedling survival and emergence.

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