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Longevity of rattan (*Calamus longisetus* Griff.) seeds

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Abstract: Storage conditions have significant impact on the seed longevity of rattans. Fruits of *Calamus longisetus* from the Palmetum of Kerala Forest Research Institute were used to assess seed longevity. Since seeds are valuable resources for propagation and conservation, it becomes a necessity to sustain their viability for a long period. After processing, fresh seeds were sown in vermiculite to understand germination pattern. Remaining seeds were stored under following conditions to study their longevity: 1) seeds in single polythene bag kept at ambient condition (T_0); 2) single polythene bag kept in sacks filled with saw-dust at 4°C (T_1); 3) double polythene bag kept in sacks filled with saw-dust at 4°C (T_2); 4) cotton bag kept in sacks filled with saw-dust at 4°C (T_3). Fresh seeds had 57.5% germination. Seed viability under T_1 and T_2 conditions maintained up to 8 months with 71.5, 69.5% germination, respectively as against T_0 where the viability maintained only up to 2 months with 49.5% germination. Under T_3 condition, viability was only up to 6 months with 50% germination. Variation in viability under different conditions was highly significant ($p \leq 0.01$). The study concluded that polythene bag with 0.05 mm thickness is the best container for storing rattan seeds. The media for storing the seeds in polythene bags is saw-dust and the optimum temperature for the storage is 4°C. Seed longevity could be extended for about 8 months; hence, seeds can be collected as much as possible to use for establishing plantations or shipping them to other places.

Keywords: *Calamus longisetus*, germination, seed longevity, storage, viability

INTRODUCTION

Rattans are climbing palms with flexible stems belonging to the family Arecaceae, which are widely exploited for furniture and handicraft manufacture. They constitute one of the major non-wood forest produce, which provide livelihood for tribal and rural people and provide raw material for industries in various parts of the world. About 600 species under 13 genera of rattans are distributed in tropical and sub-tropical belt, mainly in the Asia-pacific region and tropical Africa with maximum species diversity in south-east Asia. In India, there are about 61 species under four genera, *Calamus*, *Daemonorops*, *Korthalsia* and *Plectocomia* distributed in Western Ghats of peninsular India, sub Himalayan hills and valleys of eastern and north-eastern India and the Andaman and Nicobar Islands. *Calamus* is the only genus with 21

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species occurring in the Western Ghats of peninsular India (Renuka, 2003; Renuka *et al.,* 2010).

Kerala Forest Research Institute had established a Palmetum at Peechi, Thrissur during 2002 as part of conservation and propagation of the endangered and other important rattan species (Renuka, 2008). One of the rattan species planted was *Calamus longisetus* Griff., a clustering and large diameter rattan fairly common in India (South Andamans), Bangladesh, Myanmar, Thailand and Malay Peninsula (Renuka, 1995). It comes under the vulnerable category (Renuka, 2001). This species is a very strong cane and used in furniture industry and basket making (Bhat *et al*., 1996). Indigenous people of the Andaman Islands use the leaves for thatching and the fruits are edible. Seeds of the species were collected from the natural forests at Wumburlygung, South Andamans and one-year-old seedlings were planted in the Palmetum during 2002. Flowering was initiated at the age of four years. It flowers during November-December and fruits mature during April-May (Renuka, 2008).

Like other rattan species, *C. longisetus* also has several advantages as a plantation crop. Trees growing in rattan plantations serve as support for climbing palm thereby conserve the forest cover (Reddy, 2010). For large-scale cultivation a thorough understanding about the propagation method is inevitable. Being monocots, it is obvious that conventional vegetative propagation techniques do not offer much potential for large-scale propagation of rattans (Renuka *et al.,* 2010). It has been widely assumed that rattan seeds are recalcitrant, but very little experimentation has been done. Since *C. longisetus* comes under recalcitrant group and the seeds have short viability, which means its propagation depends on assured and regular availability of seeds and seedling production in nursery immediately after fruit maturation. Moreover, seeds are a valuable resource for the propagation and conservation of germplasm. So it becomes a necessity to sustain the viability of seeds for raising seedlings at the required time. A long period of storage is also necessary due to large quantity of fruits being available at the time of harvesting. Hence this study was undertaken to study the longevity of seeds of this rattan species.

MATERIALS AND METHODS

Fruits of eight-year-old *C. longisetus* were collected during May, 2010 from the Palmetum of Kerala Forest Research Institute, Peechi, Thrissur (10^{o}530' N & 76^{o}347' E) during the month of May (Fig. 1). The fruits were de-pulped (removal of pericarp and sarcotesta) after soaking in water for 48 hours, by rubbing them with hands and the seeds were cleaned by repeated washing in water (Fig. 2). Figure 3 is the dissected seed showing the embryo and its position. A number of techniques have been developed to remove pericarp and sarcotesta such as beating or stepping on seeds, rubbing seeds between gunny sacks, using mortar and pestle, etc. (Evans and Sengdala, 2003; Burnette and Morikawa, 2007). Removal of fruit scales (pericarp) and fleshy sarcotesta, before

Figure 1. *C. longisetus* - fruits

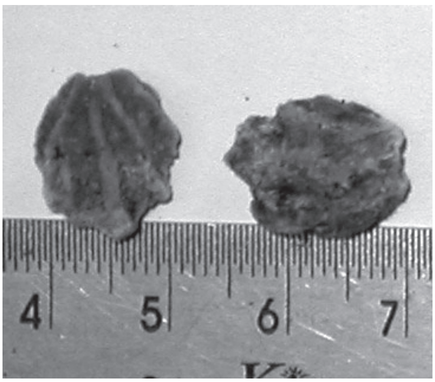

Figure 2. *C. longisetus* - seeds

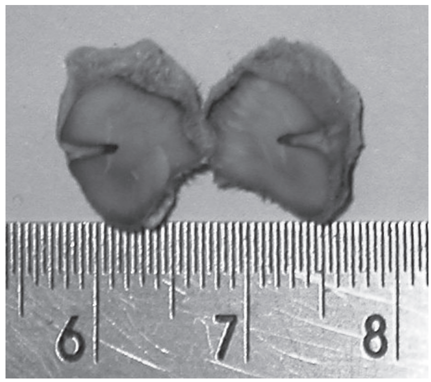

Figure 3. *C. longisetus* – dissected seed

seeds are sown is the standard practice, which helps to increase germination rate in most of the rattan species (Bora *et al*., 2001; Evans and Sengdala, 2003).

Moisture content (MC%) of fresh seeds was determined by conventional oven dry method (ISTA, 2004). Viability of fresh seeds was assessed by germination test. The de-pulped seeds were subjected for assessing their longevity. The following treatments were applied to standardize container and conditions of storage:

T_0 : Control - seeds in single polythene bag (0.05 mm thickness) kept at ambient condition.

T_1 : Seeds in single polythene bag (0.05 mm thickness) kept in sacks filled with saw dust at 4° C cold storage.

T_2 : Seeds in double polythene bag (0.05 mm thickness each) kept in sacks filled with saw dust at 4° C cold storage.

T_3 : Seeds in cotton cloth bag kept in sacks filled with saw dust at 4°C cold storage.

Saw dust was used to regulate moisture content of the seeds.

Viability of stored seeds was tested at two months interval. Daily observations were recorded in germination sheets.

RESULTS AND DISCUSSION

The result of longevity study of *C. longisetus* seeds is given in Table 1. The processed fresh seeds had 57.5% germination and the moisture content (MC%) of the fresh seeds was 14.53%. According to Jacob *et al*. (2010), MC% of *Calamus* seeds varies from 19 to 34 per cent. Generally, rattan seeds have high seed moisture content at the time of dissemination; however, even within a genus, species can differ in their storage behavior (Hong *et al*., 1997). Sumantakul *et al*. (1997) found more or less a similar result (61%) when the seeds of *C. longisetus* sown in vermiculite media. Seed germination commenced 29 days after sowing (DAS) and continued up to 60 DAS.

Table 1. Mean (± SE) seed germination (%) of *C. longisetus* under various treatments

Treatment	Storage interval				
	2 months	4 months	6 months	8 months	10 months
T_0	49.50 ± 3.79	0	0	0	0
T_1	82.00 ± 7.83	88.00 ± 8.66	82.00 ± 8.09	71.50 ± 5.26	6.00 ± 3.27
T_2	82.50 ± 3.42	86.50 ± 7.19	81.00 ± 7.10	69.50 ± 6.23	3.00 ± 2.58
T_3	68.00 ± 4.00	51.50 ± 4.57	50.00 ± 4.11	1.00 ± 0.01	0

NB: T_0 = seeds in single polythene bag (control), T_1= seeds in single polythene bag, T_2 = seeds in double polythene bag, T_3 = seeds in cotton bag

However, period of good seed germination was from 32 to 42 DAS and the maximum germination (10.75%) was at 32 DAS (Fig. 4). Earlier study on *C. manan* reported germination rates of 80 and 67%, respectively for complete and partially removed sarcotesta (Ahmad and Aminah, 1985). However, they cautioned about possible

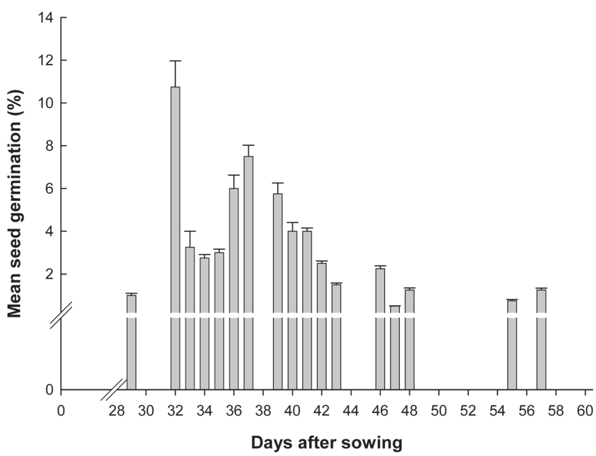

Figure 4. Germination pattern of *C. longisetus* seeds

damage to the embryo during the sarcotesta cleaning process. Mori *et al*. (1980) found 90-100% germination when sarcotesta of *C. manan* completely removed. Other studies on C. *merrilli* and C. *ornatus* var. *philippinensis* showed 78 and 87% germination when hilar cover was removed while processing the seeds (Bagaloyos, 1988). Though the hilar cover removal technique gave encouraging results, it cannot be practiced on a commercial scale for large quantities of seeds since it is a very tedious process. However, Sumantakul (l989) has reported a low germination rate of 16% for *C. latifolius* when the pericarp and sarcotesta were removed completely. According to Dwiprabowo *et al*. (1998), rattan fruits maintained viability only for <10 days after harvest. They also suggested the removal of the scales and flesh before sowing as a pre-treatment measure.

According to Ahmad and Aminah (1985), the low germination rate is probably due to damage of embryos during the cleaning process. Sumantakul (1989) also reported that for *C. latifolius*, seed seasoning at 40°C for 24-48 hours gave a significantly higher germination rate of about 70% than in control. Timing of seed collection is also important since the immature seeds show low rate of germination; when the seeds mature, their scales can be separated easily and the inner seed coat will be dark in colour (Dransfield, 1998; Burnette and Morikawa, 2007). Generalao (1977) reported that viability of rattan seeds was related to moisture content and dry storage methods were not effective. Renuka (2003) reported that viability of the seeds of *C. pseudotenuis*, *C. thwaitesii*, *C. hookerianus* and *C. rotang* was maintained only up to 8, 10, 12 and 13 days, respectively after collection, and the correlation between moisture content and viability indicated that the seeds are recalcitrant. Sulekha (2004) conducted detailed embryological studies on *C. thwaitesii* and *C. hookerianus* and reported that the seeds are recalcitrant.

In the stored seeds, T_0 (control) showed viable only up to two months with 49.5% germination (13.05% MC). T_1 had a reduction in germination from 82% (14% MC) after two months to 6% (11% MC) after 10 months of storage. T_2 showed a germination of 82.5% (15.05% MC) after two months and it was reduced to 3% (13.77% MC) after 10 months of storage. The highest germination was observed in T_1 and T_2 after four months of storage (88, 86.5% respectively); and it was higher than the germination of fresh seeds. T_3 showed a germination of 68% (18.08% MC) after two months of storage and it was reduced to 1% (11.58% MC) after six months. While comparing the seed viability under different storage conditions, T_1 and T_2 maintained a germination of 71.5 and 69.5% after eight months and it was in fact higher than the germination of fresh seeds. However, the seeds in T_3 treatment were viable only up to six months with 50% germination and thereafter lost its viability. The germination data was statistically analyzed by ANOVA which showed the germination among the different storage conditions are highly significant (Table 2).

According to Mori (1980), rattan fruits can be stored in closed plastic bags for one

Table 2. ANOVA-table: treatments source of variation in germination of *C. longisetus*

Source of variation	df	2 months MSS	2 months F	4 months MSS	4 months F	6 months MSS	6 months F	8 months MSS	8 months F	10 months MSS	10 months F
Treatments	3	964.67	37.34**	6812.67	38.89**	5923.67	63.24**	6536.67	263.22**	33.00	7.61**
Error	12	25.833		175.167		93.667		24.833		4.333	
Total	15										

*NB: ** = significant at $p \leq 0.01$, df = degrees of freedom, MSS = Mean sum of squares, F = F-value*

month at room temperature and up to 3 months at temperature between 10°C and 14°C. They found the fruits of *C. manan* stored in closed plastic bags maintained high rate of germination (81%) after one month under room temperature (21-28°C). In another study, it was found that seeds of *C. manan* and *C. caesius* stored in closed bags at room temperature maintained more than 50% viability up to six months (Ahmad and Aminah, 1985). It is reported that the rattan fruits/seeds stored in closed polythene bags under room temperature or seeds in airtight polythene bags kept in refrigerator at 5°C remain viable for 2-3 months (Renuka, 2003; Sulekha, 2004; Renuka and Rugmini, 2007).

In the present study, seeds of *C. longisetus* in 4°C cold storage showed a relatively very high germination rate after an interval of four months and indicated after-ripening during the storage. Observations on the storage of C. *longisetus* seeds showed that seeds stored in single/double polythene bags at 4°C storage retained viability up to eight months. The study revealed that the optimum storage condition for *C. longisetus* is 4°C in single polythene bag (0.05 mm thickness). Since the seed physiology of rattans is similar, this method of storage will be suitable for other species as well. A more or less similar result was reported by Burnette and Morikawa (2007), where the seeds of *C. wailing* maintained viability for seven months by storing seeds in breathable plastic screen and in sealed plastic tub over water at room temperature. However, they noticed 75% of the seeds were pre-sprouted during storage.

CONCLUSIONS

Storage conditions have significant impact on seed longevity of the rattan, *Calamus longisetus*. The optimum storage condition for getting maximum seed longevity was that of the seeds in single polythene bag (0.05 mm thickness) kept in sacks filled with saw dust under 4°C cold storage. This storage condition could extend the viability of seeds up to eight months with a mean germination of 71.50%. Similarly, seeds in double polythene bag kept in sacks filled with saw dust under 4°C cold storage maintained viability up to eight months with 69.50% germination. Whereas, seeds in cotton cloth bag kept in sacks filled with saw dust under 4°C cold storage maintained viability only up to six months. However, it is to be noted that longevity of the seeds kept in single polythene bag at room temperature was only for two months as reported in many other studies.

The study concluded that polythene bags with 0.05mm thickness is the best container for storing rattan seeds and the media for storing the seeds in polythene bags is saw dust, which prevents loss of seed moisture and the optimum temperature for the storage is 4°C. The seeds of *C. longisetus* can retain their viability for about eight months and hence the local people can collect as much seeds as possible and use for establishing rattan plantation for any purpose or shipping the seeds wherever it is possible.

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