RESEARCH NOTES
(I)

STORABILITY OF BAMBOO SEEDS : A BRIEF REVIEW

Introduction

Owing to their multifarious uses and predominant role in rural economy, bamboos are an ideal choice for plantations in the sprawling wastelands of India. Bamboo seed is scarce; most species are monocarpic and come to flowering after long intervals of several years. Seed in most flowering years is produced in abundance but becomes difficult to manage due to several factors. International and national research organisations have recommended bamboo as a target species for plantation. It has, however, been realised that lack of regular and plentiful supply of propagation material is a serious constraint for the mass propagation of bamboos. Bamboos can be multiplied vegetatively with ease, but large plantations are difficult to raise and simultaneously the resulting clumps are liable to flower with the parent clump and therefore, the life could be short and uncertain. Seeds play a vital role in artificial regeneration of bamboos owing to the ease with which the saplings can be raised. Propagation through seed is desirable also from the point of view of maintaining genetic diversity in bamboo plantations (Thapliyal *et al*., 1991). The availability of seed, however, is uncertain due to its typical sporadic flowering characteristics. In spite of importance of bamboo seeds, very little work has been done on its physiological behaviour for evolving proper handling techniques to maintain viability in storage. Bamboo seeds appear to be short-lived but factors responsible for rapid deterioration have not been investigated in order to prescribe suitable storage environment. Such studies are essential not only for maintaining viable supply during lean years but also to develop *ex-situ* conservation strategies through seeds which is the easiest and cheapest method. The present paper reviews some important results obtained during storage studies on seeds of different species of bamboo with the objective to understand its storage physiology and possibilities for long term storage.

Seed characteristics

The seed of bamboo is a caryopsis quite similar to grasses. The embryo is minute, embedded at one end of the endosperm. The seed dries up during maturation and the moisture content varies according to species at the time of shedding. The seeds are, however, tolerant to desiccation and can be dried upto 5% moisture content, which is considered safe for storage. The seeds are non-dormant and germinate readily. There are 20,000-30,000 seeds per kg, depending upon the species and the moisture content present in the seeds. A considerable proportion of seeds is empty, which can be separated by winnowing or with the help of seed blowers. There are also seeds with degenerated embryos but these are difficult to separate from the lot. A fresh and cleaned lot is

expected to give more than 75% germination (Rawat and Thapliyal, 2000).

Seed viability and storage

Longevity of bamboo seed varies from species to species but they are generally viable for a few months under ordinary storage conditions. For *Bambusa arundinacea* var. *spinosa, B. tulda* and *Dendrocalamus longispathus* it was found that the fresh seeds germinated better than stored ones and longevity varied between 30 to 65 days (Banik, 1987). Similarly, complete loss of viability within 6 months of storage under ambient conditions has been reported in *D. strictus* (Gupta and Sood, 1976) and *B. tulda* (Thapliyal *et al*., 1991). In the past, it was also possible to preserve the seed viability of a bamboo species (*Phyllostachys* sp.) by storing the seed over calcium chloride (to remove moisture) at room temperature (White, 1947). McClure (1958) reported that *Bambusa bambos* seeds collected in 1945 and stored in unsealed glass jars at room temperature (21-32°C) gave 46% and 0% germination after 160 and 202 days respectively. While the seeds from the same lot stored in sealed glass jars containing calcium chloride, under the same temperature conditions gave 80% and 76% germination respectively after 160 and 202 days.

The various factors that affect seed longevity have been the subject of considerable study in recent years and marked progress has led to the development of efficient practical storage methods. According to Roberts (1973) important factors for efficient storage are type of seed, its pre-storage treatment, stage of maturity, viability and moisture content when stored, the air temperature and humidity of the storage chamber and the extent of infection by fungi and bacteria. However, the most important factors are temperature, humidity and storage containers (Allen, 1957). Moisture content is probably the most important single factor in determining seed longevity, and almost all seeds that remain viable for more than a year can withstand considerable drying without impairing viability. Holmes and Buszewicz (1958) further emphasized that maintenance of constant low moisture content secured by preliminary drying is the most suitable method for prolonged storage of most tree seeds. For tree seeds that can tolerate drying, more research information has been published to demonstrate that effective long-term storage was achieved by combination of low seed moisture content, sealed and air tight containers and sub-freezing temperatures. Temperature, like moisture content, is negatively correlated with seed longevity, the lower the temperature the lower the rate of respiration and thus longer the life span of the seed in the storage (FAO, 1985).

Reduced seed moisture content, low temperature and sealed containers were found to be the best storage conditions for *D. strictus* (Gupta and Sood, 1976), *D. brandisii* (Boonarutee and Somboon, 1989), *B. arundinacea* (Somen and Seethalakshmi, 1989) *B. tulda* (Thapliyal, *et al.*, 1991). Such studies are lacking in other majority of bamboo species. The seeds of *D. strictus* could be stored over silica gel or anhydrous calcium chloride in a desiccator, or at 3-5°C after reduction of moisture content to 8%. Seed lots with 67% germination capacity were stored under these conditions exhibited 51%, 54% and 59% germination, respectively, after

34 months (Gupta and Sood, 1978). Similarly, Banik (1987) reported that it was possible to increase the seed longevity period of *B. tulda* up to 18 months by storing over silica gel in a desiccator. *B. tulda* seeds stored at room temperature with moisture content reduced to 6.6 per cent remained viable for upto one year with 75% germination, whereas seeds with the above moisture content retained high viability at 5 and 15°C but declined rapidly at 30°C (Thapliyal *et al*., 1991).

Though preliminary observations on longevity of seeds of few bamboo species are available, there is no comprehensive account of the behaviour of bamboo seeds under different moisture and temperature regimes. A few species of bamboos are known to produce recalcitrant seeds, which are difficult to store beyond few months. Little information is available regarding the storage behaviour of such seeds, however, it has been reported that the fleshy seeds of *Melocanna baccifera,* stored in a air-conditioned room, retained viability up to 45 days, while it was only 35 days in ambient room conditions, and prolonged further up to 60 days when stored with dry sand in jute bags. The seeds can be transported to long distances in jute bags with dry sand to minimize damage and to retain viability (Banik, 1991).

Conclusion

The most important factors known to affect seed viability in storage are seed moisture content and storage temperature. These two factors at the minimum safe and practical level are responsible for reduction of seed respiration and thereby increasing viability period of seeds. The seeds of all the bamboo species investigated exhibited enhanced longevity after reduction of moister content (around 5%) and storage at low temperature i.e., around 5°C in sealed container. The seeds exhibit orthodox storage physiology and could be stored beyond several years without significant loss in viability. The seeds stored under such conditions are expected to remain viable for decades.

References

Allen, G.S. (1957). Storage behaviour of conifer seed in sealed containers held at 0°F, 32°F and room temperature. *J. For.*, **55**: 278-281.

Banik, R.L. (1987). Seed germination of some bamboo species. *Indian Forester,* **113** (8): 578-586.

Banik, R.L. (1991). Biology and propogation of bamboos of Bangladesh. *Ph.D. Thesis*. University of Dhaka, Dhaka, Bangladesh.

Boonarutee, P. and K. Somboon (1989). Effect of temperature and seed moisture content on the storage of *Dendrocalamus brandisii* seeds. (Turnbull, J.W., ed.). *Tropical Tree Seed Research* : *Proc. International Workshop* held at the Forestry Training Centre, Gympie, Qld, Australia, 21-24 Aug. *ACIAR Proc. No. 28*.

FAO (1985). A Guide to Forest Seed Handling with Special Reference to the Tropics. *FAO Forestry Paper No.20/2,*FAO, Rome.

Gupta, B.N. and O.P. Sood (1976) Storage of *Dendrocalamus strictus* Nees. seed for maintenance of viability and vigour. *Indian Forester*, **104** (10): 688-694.

Holmes, G.D. and G. Buszewicz (1958). The storage of seed of temperate forest tree species. *For. Abstr.,* **19** (3&4).

Maclure, F.A. (1958). Bamboos for the Pacific islands. *South Pacific Commission Quarterly Bulletin,* pp. 1-12.

Rawat, M.M.S. and R.C. Thapliyal (2000). Storage of bamboo seeds – *Bamboos in India : Resources and Technologies. Proc. Workshop-cum-Peer Review on Bamboo*, held at FRI, Dehra Dun.

Roberts, E.H. (1973). Predicting the storage life of seeds. *Seed Sci. & Technol*., **1** : 499-514.

Somen, C.K. and K.K. Seethalakshmi (1989). Effect of different storage conditions on the viability of seeds of *Bambusa arundinacea*. *Seed Sci. & Technol.,* **17** : 355-360.

Thapliyal, R.C., O.P. Sood and M.M.S. Rawat (1991). Effect of moisture content and storage temperature on the viability of *Bambusa tulda* Roxb. seed. *Intl. Tree Crops J.*, **7** : 67-75.

White, D.G. (1947). Propagation of bamboo by branch cutting. *Proc. Am. Society Hort. Sci.*, **50** : 392-394.

Forest Tree Seed Laboratory,
Silviculture Division,
Forest Research Institute,
Dehra Dun (India).

Nawa Bahar
and
V.R.R. Singh*

* Head, Silviculture Division.