Radiography Technique for Testing the Quality of Teak (*Tectona grandis* Linn. f.) Seeds

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Abstract

Seed germination remains to be an unsolved problem in teak. Studies made on radiography and seed technological aspects using drupes from India and Thailand disclosed certain important features. Radiography has been standardised for sharp image to read the anatomical potential of seed. Teak drupes from two provenance differed in size and weight within and between seedlots. Radiograms revealed the development of 4, 3, 2 and 1 seed in the tetracarpellary ovary in the order of 1, 5, 19 and 48% with 27% empty drupes. When drupe size decreased the percentage of single-seeded and empty drupes increased correspondingly. Teak drupes possess ontogenic and dormancy problems posing challenge to germination.

সারসংক্ষেপ

সেগুনের বীজের অংকুরোদগম একটি প্রধান সমস্যা। ভারত ও থাইল্যাণ্ড থেকে প্রাপ্ত ফলের এক্স-রে পরীক্ষান্তে কিছু গুরুত্বপূর্ণ তথ্য প্রকাশ পেয়েছে। বীজের গঠনতান্ত্রিক বৈশিষ্ট্য অবলোকনের জন্য ভাল আলোকচিত্র প্রাপ্তির ক্ষেত্রে এক্স-রে পদ্ধতি standardize করা হয়েছে। দু'স্থান থেকে প্রাপ্ত ফলের আকার ও ওজনে পার্থক্য দেখা যায়। এক্স-রেতে ডিম্বাশয়ে ৪, ৩, ২, ১ টি বীজ যথাক্রমে ১, ৫, ১৯ও ৪৮%। ২৭% ফল বীজ শুন্য দেখা যায়। ফল ছোট হলে এক বা শুন্য বীজ প্রাপ্তির হার বেড়ে যায়। সুপ্ততা ও ভ্রুণ বিকাশ সমস্যা বীজের অংকুরোদগমে প্রধান অন্তরায়।

Key words : Seed germination, seed quality, seed testing, teak seed, *Tectona grandis*

Introduction

Teak (*Tectona grandis* Linn.f) is one of the best purpose timbers of the world. The durable nature of the wood associated with highly favourable strength to weight ratio and the antitermite and antifungal properties has made it very advantageous for its versatile use. Teak is a seed propagated tree although vegetative means such as, bud and/or root grafting are possible. However, the latter has little practical feasibility to commensurate with the demand for the planting material every year. Hence seed is the main source for propagation but all hurdles for germination lies with the teak seed.

The commonly known teak 'seed' is a drupe. the hard fruit is irregularly round and consists of (1) the outer thin papery exocarp, (2) the middle thick, felty brown mesocarp and (3) the inner stony, massive and impervious endocarp encircling the tetracarpellary ovary. The true seed inside the cavity is oval in shape, poorly protected by a thin seed coat. The major part of the embryo is contributed by two massive cotyledons, and the embryonic axis is centrally placed with a protruding radicle.

The number of seeds that develop in a fruit may vary from 0-4. The frequency and the proportion are highly fluctuating due to several causes. The wide geographic distribution of the species accounts for considerable variation in the environment, genetic and physiological features (Gupta and Pattanath 1975, Tewari 1992). Gupta and Adarsh Kumar (1976) have studied the extent of seed filling in the fruits from 23 sources adopting the cutting test (a destructive process). The study had brought out the variability in the seed development sequence and to some extent the anatomical potential of seeds. However, the recent approach to such studies is the radiography. Kamara (1973) and Karmara *et al.* (1973) have reported the use of X-ray radiography for increased information accuracy in seed quality testing of teak drupes. This technique is adopted as a routine test for Scots pine in advanced countries like Sweden, Canada, etc. This nondestructive technique can also be extended to teak drupes in teak growing tropical countries for precise information on seed quality and hence an eleborate study was planned.

Materials and methods

Teak fruits from two distinct provenances namely, Topslip of Comibatore district of Tamil Nadu, India and Lampang Province, Thailand were obtained for the study. The former was supplied by the Forestry Department and the latter by the Forest Seed Centre, Denmark. The fruits obtained from Tamil Nadu belonged to the same year collection (1992) and those from Thailand belonged to 1984 but stored under controlled conditions by DANIDA. Not less than 500 fruits from each provenance were used for radiographic studies. The studies were carried out at the Department of Silviculture, Faculty of Forestry, Swedish University of Agricultural Sciences, Umea^{o}, Sweden during 1992. Standardisation of radiography included KV (kilovoltage) and exposure time. Different dosages, namely 15 ,17 and 20 KV with exposure time of 7, 10, 12, 14, 16, 18 and 20 minutes and their combinations were tried. The fruits were placed directly on the wrapper of the film with the pedical end upright.

For assessing the relationship of fruit size and seed development, the fruits were graded using round perforated metal sieves into three size grades, such as large (12 mm dia), medium (11.2 mm dia) and small (9.6 mm dia) in the case of Topslip fruits and an additional category of very small (8.0 mm dia) fruits with Thailand origin. Individual fruit was weighed in each size category and the mean of 400 weights expressed as 100 fruit weight. After exposure the film was processed using the developing and fixing solutions and dried in a drying cabinet. The X-ray film was viewed to assess the anatomic potential of seeds. Individual fruit was scored and then the percentage computed. Cutting test was not done on the same drupes used for X-ray radiography since the drupes were forwarded for germination test.

Results and discussion

The X-ray studies of drupes from the two provenance revealed interesting results. The number of seeds that developed in drupes varied from 0-4 in both the provenance (Plate 1). The average values obtained from the radiograms of about 500 drupes in each seed lot revealed that 4 and 3 seeds per drupe were very low in both the cease as compared to two and one seeded drupes. Even in this the provenance had great influence. The drupes from Tamil Nadu source had higher percentage (1.2 and 8.7) than that of Thailand (0.9 and 0.6) (Table 1).

The two seeded drupes were 16.7 and 21.7% and that of one seeded 54.7 and 42.7% respectively

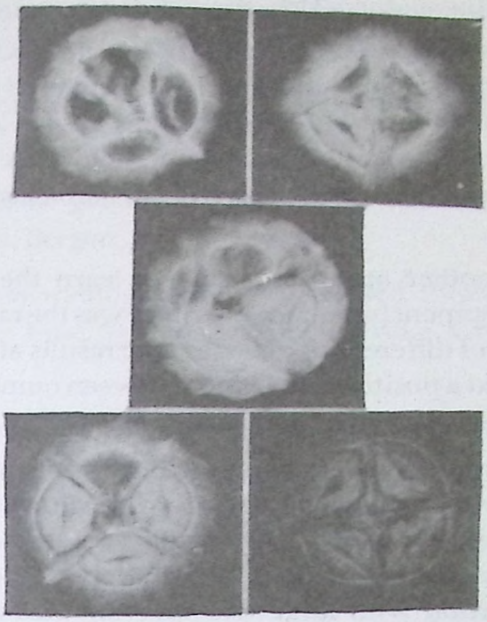

Plate 1. X-ray photographs of teak drupes showing seeds inside.

Table 1. Frequency of seed development in teak drupes.

Number of seeds/fruit	Tamil Nadu (%)	Thailand (%)
Four	1.2	0.9
Three	8.7	0.6
Two	16.7	21.7
One	54.7	42.7
Empty	18.7	34.7

Table 2. Frequency of seed development in relation to drupe size in teak.

Number of seeds/fruit (%)	Large size(%) (12 mm dia.)	Medium size (%) (11.2 mm dia.)	Small size (%) 9.6 mm dia.)	Very small size (%) (8 mm dia.)
Four	1.75	2.0	0.0	0.0
Three	17.20	12.0	2.5	2.5
Two	26.80	21.0	15.5	4.1
One	45.15	48.0	56.4	17.5
Empty	9.10	17.0	25.6	25.9

for Tamil Nadu and Thailand sources. The empty drupes composed of 18.7 and 34.7% respectively in the former and latter sources. The overall mean indicated that about 27% of drupes in seed lot are empty and about 48% contained only one seed and the rest being composed of 2 or more seeds per drupe.

Another approach made to learn the seed development frequency in drupes was the radiography of different size classes. The results at large showed a positive association between number of seeds developed and the drupe size (Table 2).

Only in the large and medium size fruits all the 4 ovules developed into seeds and that too to an extent of about 2%. The 3 and 2 seeded as well as one seeded drupes were almost in equal proportion with large and medium size fruits. Interestingly the large and medium size drupes had also empty carpels to the tune of 9% and 17% respectively. As the drupe size reduced, for example, small and very small, the 3 seeded ones were very low (2.5%), and the 2-seeded up to 15.5% and 4.1% in the two seed lots. However, the one-seeded (56.4 and 17.5) and empty drupes were higher in the above categories. The percentage of empty drupe were 25.6 and 75.9 respectively in the small and very small drupes. Dabral (1979) had reported that teak drupe contains one ovule in each carpel at the early stage and the emptiness develops when the endocarp hardens due to heavy lignification in the locule having ovules in watery stage. However, the emptiness is not related to the size of the locule but the reserve food material accumulated during the past growing season is utilized for seed formation. Site which affects the availability has significant effect on emptiness.

In the technological point of view, the above results very clearly brought out the guidelines for processing of teak drupes prior to sowing in the nursery. The very small and small drupes are mostly empty and / or one seeded whose anatomic potential (AP) is poor (evidence not provided although documented), they can be eliminated by processing using suitable sieves. Selection of drupes on weight basis, for example, drupes weighing more than 55 g / 100, although feasible to eliminate empty drupes and improve the quality of seed material for seedling production, it would not be a practical proposition for large scale adoption. Whereas, drupe processing would be a practical one.

Conclusions

The problems encountered in teak drupe is very complex in nature starting from the phenology and ontogeny which decide the frequency of seed development and an agglomeration of all possible hurdles (dormancy phenomena) for germination. Therefore, solving these problems and evolving suitable technologies for practical adoption will really be a challenging one.

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