Available Online at http://www.journalajst.com

ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol. 12, Issue, 09, pp. 11827-11830, September, 2021

RESEARCH ARTICLE

PHYSIOLOGY CHARACTERISTICS AND STORAGE OF HOPEA ODORATA SEEDS

***Nguyen Thi Hai Hong, Nguyen Thai Minh Han, Dang Phuoc Dai Phung Van Khang Khangand Kieu Tuan Dat**

Department of Plant Breeding and Biotechnology, Forest Science Institute of South Vietnam, Vietnam

ARTICLE INFO

Article History:
Received 24th June, 2021
Received in revised form
24th July, 2021
Accepted 21st August, 2021
Published online 30th September, 2021

Key words:
Hopea Odorata,
Seed Physiology,
Seed Storage, Germination.

ABSTRACT

Hopea odorata is a large tree species with high economic value that prevails in tropical evergreen rainforests. This is one of few large-timber indigenous species named on the Vietnamese list of major species forafforestation in Vietnam. However, its fruiting occurs very erratically. Seeds are typical tropical recalcitrant and have rapid loss of viability. Thus, study on physiology characteristics and storage of *Hopea odorata* seeds is essential to have sufficient knowledge for propagation, biodiversity conservation and plantation development. The results showed that the average number of fruits per kilogram were 3093 and mean seed fresh weight at collection was 0.32gram. Moisture contentof fresh seeds was 51% and the germination rate was 96.5%. Seed germination started onthe 1st day, reached the highest rate on 2nd dayand endedon 14th day. *S*eed germination rate reduced significantly from 96.5 to 85% when moisture contentwas reduced respectivelyfrom 51to 35% and dropped to 0% at moisture content of 8%. Critical moisture content of *Hopea odorata* seeds was 35%. The highest germinate ratewas at room temperature(27–32°C). Seed viability could maintain till 150 days at storage temperature of10°C.

Citation: ***Nguyen Thi Hai Hong, Nguyen Thai Minh Han, Dang Phuoc Dai Phung Van Khang Khangand Kieu Tuan Dat,*** **2021.** "Physiology characteristics and storage of hopea odorata seeds", *Asian Journal of Science and Technology*, 12, (09), 11827-11830.

Copyright © 2021, Nguyen Thi Hai Hong et al. *This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

INTRODUCTION

Understanding of seed biology of most tropical tree species is today limited. Lack of information of seed handling and storage is a constraint for seed propagation of many important species (Thomsen, 2000). A major hindrance has been an adequate supply of high-quality seeds of indigenous species for seedling production (Ellis *et al,* 2007). Plantation development of indigenous species has been strongly advocated for the purpose of biodiversity conservation and environmental protection (Nghia, 2003) and plays an important role in the current program of restructuring the forestry sector in Vietnam. Low germination rate of seeds is often due to insufficient knowledge of physiological characteristics, harvest techniques, storage, dormancy, and germinationof seeds. Moisture content and temperature are two of the main factors concerning seed storage (Thomsen, 2000; Rindyastuti and Siahaan, 2019). In addition, seed storage, whether for a limited or prolonged period, is an integral part of plantation development strategy (Ellis *et al,* 2007). Therefore, it is important to know the critical and optimal moisture contents and temperatures for each species. *Hopea odorata* is a large tree species with high economic value, belongs to Dipterocarpaceae family, which make up the major component of the South East Asian tropical rainforests.This species is globally assessed as Vulnerable (A2cd) due to a 30–50% population reduction in the last three generations (+300 years) and decline is ongoing(Ly *et al,*2017). In Vietnam, *Hopea odorata* is one of the few large-timber native species named on the Vietnamese list of main forest species (MARD, 2018). It has been widely planted, especially as a roadside tree because it is fast growth, tall, straight, clear bole; produces a valuable timber (very durable and strong) and resin to make paint and varnish (Nghia, 2005). However, its fruiting occursvery erratically(Hoque *et al,*2020). Seeds aretypical tropical recalcitrant,rapid loss ofviability (Ellis *et al,* 2007; Thomsen, 2000). These are a major constraint in afforestation. The objectives of this study wereto investigate physiological characteristics of *Hopea odorata* seeds, effects of moisture contents, germination temperature, storage temperature and duration on viability ofseeds to provide sufficient knowledge for propagation, biodiversity conservation and reforestation.

Corresponding author:** ***Nguyen Thi Hai Hong,
Department of Plant Breeding and Biotechnology, Forest Science Institute of South Vietnam, Vietnam.

MATERIALS AND METHODS

Plant material: Mature fruits of *Hopea odorata* were collected from the plus trees at Dinh Quan district, Dong Nai province. The wings were removed manually soon after harvesting.

Small, immature fruits and fruits infested by insects or diseases were discarded.

Methods: Thefruits were weighted, their size was measured, meanseed fresh weight,meanseed number per kilogram and per litrewere determined. A sample of 200 fresh seeds was divided into four seed lots and tested for ability to germinate.Moisture content of samples of 10 seedsweredetermined by the low constant temperature oven method, 103°C for 17 hours (ISTA, 2005) and calculated on the fresh weight basis. To examine influence of germination temperature, 800 seeds were divided equally into four seed lots, treated and sown. Each seed lot was then placed at the room temperatue (27 – 32°C) andincubators controled at temperature levels of 20, 10 and 2°C. For testing desiccation tolerance, i.e. the relation between ability to germinate and moisture content during rapid enforced desiccation was conducted according to Thomsen's method (2000). Seeds determined initial moisture enforce desiccation was determined by drying seeds over newly regenerated silica gel at room temperature to reduce moisture content from 51% to45, 40, 30, 35, 25, 15 and 8%. The dried seeds to each moisture content were sealed in a laminated aluminium foil packet. Then, viability of each samples were examined. The effect of storage temperature andduration of seedswas investigated. Seeds dried by silica gel to reduce their moisture content in 35 % were sealed in laminated aluminium foil packets and then stored at the different temperatures (room temperature, 20, 10and 2°C) for 10, 30, 60, 90, 120 and 180 days. The ability to germinate of seeds were observed. Seed germination test was conducted in blotting paper saturated with deionized water, four replicates of 50 seeds each, at room temperatures or at alternating for specified tests, untill all seeds had either germinated or rotted. Seeds were treated by sinking in warm water (30 – 35 °C) in 4 hours before sowing. The samples were watered, and germination was then recorded every two days. The experiments were followed as complete randomized block design with fourreplicates and 50 seeds were used in each replication. The chi-square test was used to compare germination rates between treatments in the same experiment at significance level of 95% ($P \leq 0,05$). R program was used to analyze data.

RESULTSAND DISCUSSION

The results of this study showed that mean seed fresh weight at collection was 0.32 gram (0.25 - 0.44 gram), mean seed number per kilogram and per litre were 3,093 (2,273 – 4,065 seeds) and 1808 (1,250 – 2,500 seeds), respectively. Moisture content of fresh seeds was 51% (48.7 – 53.3%). These results were close to the previous studies of the same species (Nghia, 2005; Ellis *et al,*2007; Corbineau *et al,* 1986). Actually, the study of Nghia (2005) reported that the number of *Hopea odorata*fresh seeds per kilogram ranged from 2,500 to 3,000. Theseed had an average weight of 0.27 g, moisture content at maturity, shedding, or receipt was determined to be 54% (Ellis *et al,*2007), 49.5% as seeds collected in Thailand (Corbineau *et al,* 1986) and 48.5% in Malaysia (Jayanthi and Krishnapillay, 1986).

Germination of freshly harvested seeds: Fresh seeds had no dormancy. Germination of seeds began after sowing one day and ended after 14 days (Figure 1). The highest germination rate reached on the second day.

The average germination rate of the experimental seed lots was 96.5%. However, the germination rate of *H. odorata* seeds ranged from 40 to 90% (Nghia, 2005).

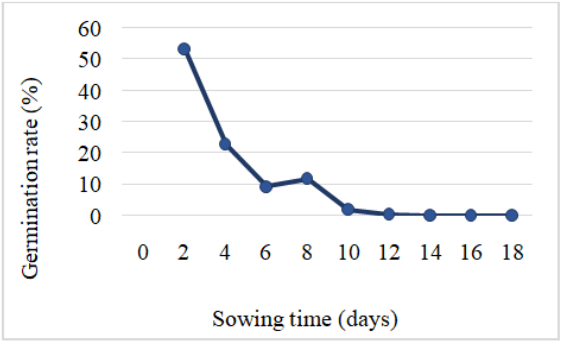

Figure 1. Germination rate of fresh seeds at collection

Beside, Ellis *et al,* (2007) indicated that the first and last seeds germinated in their test were on the 7th and 28th days. The similar results to this study were also reported that the fresh seeds after harvesting had high germination rates of between 93% and 100% (Hoque*et al,* 2020; Corbineau and Coome, 1989; Jayanthi and Krishnapillay, 1986).

Effects of germination temperature: The results of the study showed the effect of germination temperature on viability of *H. odorata* seedswas statistically significant (**Figure 2**). The highest germination rate of seeds reached 96.7% at room temperature and was not significantly different from theseof 93.3% at 20°C. When the temperature dropped to 10°C, the seed germination rate decreased significantly by 32.2% and no germination was observed at 2°C. The reported study on the same species showed that *H. odorata* seeds were able to germinate at relatively low temperature (5°C) (Corbineau and Côme, 1989). However, Thomsen (2000) indicated that *H. odorata* seeds couldnot withstand temperatures below 15°C.

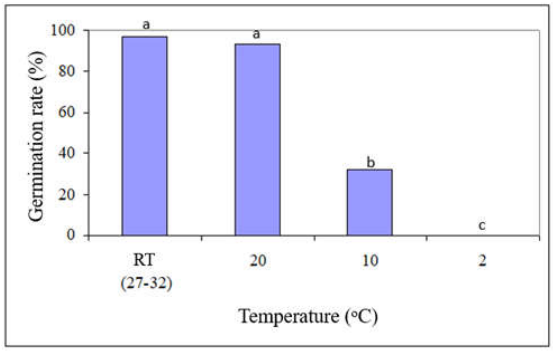

Figure 2. Effect of germination temperature on viability of *H. odorata* seeds.Different letters indicate significant differences at 95 % confidence level ($P_{value} \leq 0.05$)

Effects of desiccation (or seed moisture content)

There were very significant effects of moisture content on germination rate of *H. odorata* seeds ($P < 0.001$) (**Figure 3**). The seed viability declined significantly from 96.5 to 85, 40.5 and 16% as moisture content were reduced from 51, 35, 25 to 15%, respectively. Critical moisture content to *H. odorata* seeds was 35 %.

This result are close to the experimental results of Ellis *et al*, (2007) (38%) and Corbineau and Côme (1989) (33%). No germination of seeds at 8 % moisture content in this study was comparable to these at 10% seed moisture content (Ellis *et al,* 2007). Corbineau and Côme (1989) stated that the seeds would die when dried to 15%. Meanwhile, Jayanthi and Krishnapillay (1986) determined that germination rate of *H. odorata* seeds collected in Malaysia decreased slightly when dried to 42.5 and 31.4% and seeds no longer germinated asmoisture content was 22.9%. These results could be explained that the volume of the seed was reduced when a seed was dried and this resulted in mechanical stress. Thomsen (2000) gave a hypothesis which a relationship between desiccation sensitivity and vacuolation and insoluble reserve accumulation might exist.

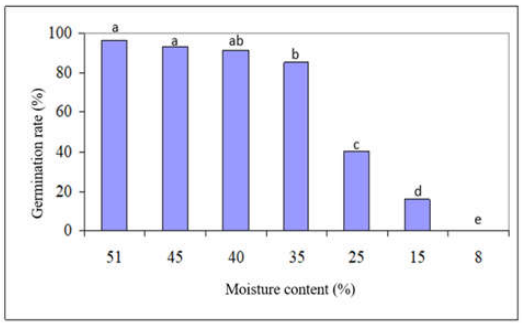

Figure 3. Effects of moisture content on viability of *H. odorata* seeds.Different letters indicate significant differences at 95 % confidence level ($P_{value} \leq 0.05$).

Effects of storage temperature and duration: Effects of storage moisture, temperatureand time on seed viability have been investigated and reported for many crops and wild plant species but it is more difficult to recalcitrant seeds. For *H. odorata,* these research findings have already shown that seed longevity was significantly extended by reducing storage temperature.At the starting time of experiment, moisture content and germination rate of seeds were 35and 85 %, respectively. The highest germination ratesof seeds gained 46.4and 43.8% after storing 30 days at 10 and 2°C, respectively. Viability of seeds lost completely after storing 30 days at room temperature and 20°C. At the storage temperature of 10°C, seed longevitywas extended till 150 days (Figure 4).

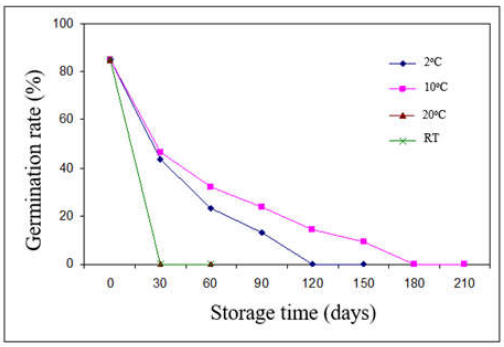

Figure 4. Effects of storage time on germination rate.

According to Nghia (2005), seeds *H. odorata* with moisture content of 32 – 34% were stored in sealed polyethylene bags at 5 – 10°C in the refrigerator for 3 – 4 months. Joker (2000) reported that germination rate decreased to 50% after 16 weeks of storage, only a few viable seeds remained at 20 weeks and suggested that seeds should be lightly dried to about 40% moisture content and stored at 15°C in sealed plastic bags for more than one month. In addition, harvested seeds without desiccation, stored in a refrigerator (0 – 4°C) were able to germinate (10%) after 27 days while other conservation methods could only maintain the viability of seeds up to 18 days (Hoque *et al,* 2020). These study results on storage of *H. odorata* seeds indicated that drying seeds to suitable moisture content (~ 35%) and storing in low temperature (~ 10°C) were able to prolong the viability of the seeds.

CONCLUSIONS

Seeds of *H. odorata* were recalcitrant and sensitive to desiccation. Moisture content and germination rate of fresh seeds were 51% and 96.5%, respectively. Seeds started to germinate after one day of sowing, reached the highest germination rate on the 2nd day and lost viabilityonthe 14th day. Viability of seeds decreased significantlyfrom 96.5 to 85%in case ofreduction in moisture contentfrom 51to 35% and lost absolutely at moisture content of 8%. Critical moisture content of *H. odorata* seeds was 35%. The highest germination rate at room temperature was 96.7%, different significantly from these of 32.2%at 10°C and seeds were unable to germinate at 2°C. The storage temperature of 10°C maintainedviability of seeds up to 150 days.

ACKNOWLEDGMENTS

This research was a part of the project “Breeding selection, propagation and plantation technique of *Diperocarpus alatus* and *Hopea odorata*” funded fromthe Vietnamese Ministry of Agriculture and Rural Development.

REFERENCES

Corbineau, F., and Côme, D. 1986. Experiments on germination and storage of the seeds of two dipterocarps: *Shorea roxburghii* and *Hopea odorata*. Malaysian Forester, 49(3-4). pp.371-381.

Corbineau, F., and Côme, D. 1989. Germination and storage of recalcitrant seeds of some tropical forest tree species. In Annales des Sciences Forestieres (Vol. 46, No. Supplement, pp. 89s-91s). EDP Sciences.

Ellis, R.H., Mai-Hong, T., Hong, T.D., Tan, T.T., Xuan-Chuong, N.D., Hung, L.Q., Ngoc-Tam, B. and Le-Tam, V.T. 2007. Seed Sci. & Technol., 35, 460-476.

Hoque, M.M.U., Alam, Z., Mariam, H., Rahman, M.A., and Hossain, M.T. 2020. Influence of Storage Condition and Duration on Germination of Telsur (*Hopea odorata* Roxb.) Seed. IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT). 13(2). (2020): pp 06-09.

International Seed Testing Association 2005. International rules for seed testing. Edition 2005. The International Seed Testing Association (ISTA). CH-Switzerland.

Jayanthi N., Krishnapillay, B. D. 1986. Handling and storage of *Hopea odorata* seeds. In Comparative storage biology of tropical tree seeds. Ed. Sacandé, M., Jorker, D., Dulloo, M. E., Thomsen, K. A. International Plant Genetic Resources Institute (IPGRI).

Joker D. 2000. Seed Leaflet No. 49 November 2000, *Hopea odorata* Roxb. Danida Forest Seed Centre.

Ly, V., Newman, M.F., Khou, E., Barstow, M., Hoang, V.S., Nanthavong, K. & Pooma, R. 2017. Hopea odorata. The IUCN Red List of Threatened Species 2017: e.T32305A2813234.https://dx.doi.org/10.2305/IUCN.UK .2017-3.RLTS.T32305A2813234.en.

Ministry of Agriculture and Rural Development, 2018. List of major species for afforestation. In Circular No. 30/2018/TT-BNNPTNT dated November 16, 2018.

Nghia, N.H. 2003. Conservation of forest genetic resources in Vietnam. XII World Forestry Congress 2003, Quebec, Canada. http://www.fao.org/ DOCREP/ ARTICLE/WFC/ XII/oo40-B3.HTM.

Nghia, N.H. 2005. Dipterocarps of Vietnam. Publishing House of Agriculture, 100 papers.

Rindyastuti, R. and Siahaan, F.A. 2019. Seed storage importance and behaviour of a vulnerable species Angsana (Pterocarpus indicus Willd.). Journal of Biological Research, 24(2). 63-70.

Thomsen, K. 2000. Handling of desiccation and temperature sensitive tree seeds. Danida Forest Seed Centre.

****