Effect of sulfuric acid treatment on breaking of seed dormancy and germination of Indian doum palm, *Hyphaene dichotoma*, a threatened and endemic palm

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Abstract

Hyphaene dichotoma (White) Furtado belongs to the Arecaceae family of and is a threatened species included in the IUCN red data list. In the present investigation, an attempt was made to germinate seeds of *H. dichotoma*. Successful seed germination was achieved in soil and sand mixture (1:1) when seeds were treated with 10% sulphuric acid for 24 h. This study will be helpful for further investigations on seed germination and conservation of *H. dichotoma* and related species.

Key words: *Hyphaene dichotoma*, seed germination, Indian doum palm, rare plant species.

Introduction

Palms are the third most important plant family with respect to human use; numerous edible products are obtained from palms, including the most familiar date palm fruits, coconut palm nuts and various palm oils. Some little known palm products include palm "cabbage" or "heart of palm", which is the inner white core of shoot apical meristem, tender leaves, which are used as vegetables and salad, immature inflorescences and sap from mature inflorescences (Haynes, McLaughlin 2002).

The genus *Hyphaene* (Arecaceae), commonly known as Doum palms, includes 30 species found in Africa, Medagascar, and Arabia (Oza 1974). *Hyphaene dichotoma* (White) Furtado is the only species found in India. Synonyms of *H. dichotoma* are *H. indica* and *Borassus dichotoma*. Common names are Indian doum palm in English and Rawan tad in Hindi. It is endemic to Daman, Diu, Nagan, Shirgaon, Dahanu, Baroda and Goa (Oza 1974).

H. dichotoma is located mostly in former Portuguese colonies. It is said that Portuguese sailors introduced the palm to India from Africa, as they employed oil rich seeds of this palm as a light source on their ships at night. The fibrous fruit mesocarp and unripe kernel are edible (Haynes, McLaughlin 2002). Fruits are nutritious and are a rich source of calcium, phosphorous and iron (Bonde et al. 1990) and can be used as feed for livestock (Nwosu et al. 2008).

Most of Indian forest palms are severely threatened, mainly due to anthropogenic factors. There has not been much efforts to conserve palms (Kulkarni, Mulani, 2004), but there is an urgent need to conserve the palms that are classified as threatened under the IUCN Red Data list version 2015.2 (Johnson, 1998). Seed germination studies have been made on other related palms like oil palm (Hussey 1958; Rees 1961; Green et al. 2013), and macaw palm (Rodrigues Junior et al. 2013). However, there is only one report available on seed germination of *H. thebaica* (Moussa et al. 1998). Hard, impermeable seed coats of *Hyphaene* species restrict the entry of both water and oxygen and present high physical resistance to growth of the embryo (Moussa et al. 1998). Such seeds often require pretreatments in order to achieve rapid and uniform germination (Moussa et al. 1998). In the present study, a methodology was developed for seed germination of *H. dichotoma* for conservation of this threatened plant species.

Materials and methods

Fruits of *H. dichotoma* (Fig. 1C) were collected from Devka beach, Daman (latitude 20.4489014, longitude 72.8358335. The seed coat of *H. dichotoma* is very hard. Collected fruits (Fig. 1B) were treated with 10% H_2SO_4 for various time intervals (6, 12, 18 and 24 h) to evaluate the time required to break the dormancy of the seeds. Fruits were rinsed thoroughly in running tap water for 20 min to remove traces of H_2SO_4. Then seeds were grown in pots containing a mixture of soil and sand (1:1, 1:3 and 3:1), with each pot having four seeds. Pots were watered with tap water at regular intervals of four days, and maintained in open field

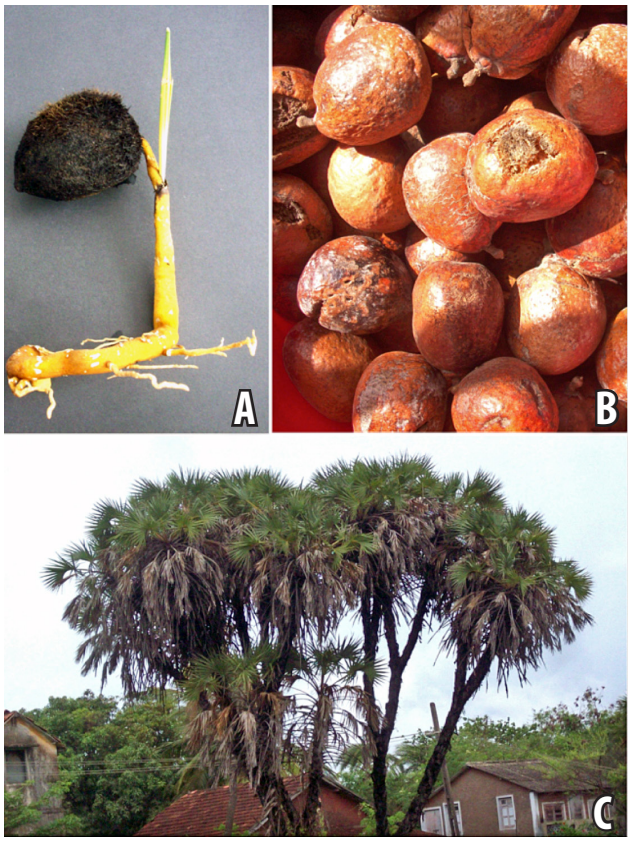

Fig. 1. Germinated seed (A), fruits (B) and tree (C) of *Hyphaene dichotoma*.

conditions in 2011 (November to January, Gujarat, India) during winter. Each treatment had a minimum of four replicates.

The observations were recorded after 45 days. The data were analysed statistically using SPSS-19 version (SPSS Inc., Chicago, USA). The results are expressed mean ±SD of two experiments. The significance of differences among mean values was tested using the Dunacan's multiple range test at 95% confidence interval.

Results and discussion

Seeds were germinated in pots containing soil and sand at 1:1, 1:3 and 3:1 ratio. There was no significant difference in seed germination between the soil/sand ratios. However maximum seed germination (87.50%) was achieved in a soil/sand ratio 1:1, in this substrate about 3.50 ± 0.58 seed germinated (Table 1). The maximum number of germinated seeds (Fig. 1A) was obtained after treatment for 24 h with sulfuric acid and using a mixture of sand and soil at 1:1 ratio.

Seed dormancy is one of the major problems for conservation of rare, threatened, and endangered species (Wochok 1981). Depending on the kind of dormancy, dormancy can be broken by gibberllic acid treatment, stratification, chilling treatment, hot water treatment,

Table 1. Effect of germination substrate and H_2SO_4 treatment on seed germination of *Hyphaene dichotoma*. Means in each column followed by the same letters are not significantly different at $p < 0.05$

Soil (%)	Sand (%)	Time in 10% H_2SO_4 (h)	Number of germinated seeds
100	0	–	1.66 ± 1.15 cd
0	100	–	1.33 ± 0.57 d
50	50	–	2.00 ± 1.00 cd
25	75	–	1.66 ± 1.15 bcd
75	25	–	1.75 ± 0.95 cd
100	0	6	1.50 ± 0.57 cd
100	0	12	1.75 ± 0.95 cd
100	0	18	2.00 ± 0.81 bcd
100	0	24	2.00 ± 0.81 bcd
0	100	6	1.50 ± 0.57 cd
0	100	12	1.75 ± 0.95 cd
0	100	18	2.25 ± 0.50 abcd
0	100	24	2.75 ± 0.95 abcd
50	50	6	1.75 ± 0.95 cd
50	50	12	2.75 ± 1.25 abcd
50	50	18	3.25 ± 0.95 abcd
50	50	24	3.50 ± 0.57 a
25	75	6	1.50 ± 0.57 cd
25	75	12	2.25 ± 0.50 abcd
25	75	18	2.50 ± 0.57 ab
25	75	24	2.50 ± 0.57 abcd
75	25	6	2.00 ± 0.81 bcd
75	25	12	1.75 ± 0.95 cd
75	25	18	2.75 ± 0.95 abcd
75	25	24	3.00 ± 0.81 abc

soaking in water and acid treatment. Presence of a hard seed coat is one of the reasons for dormancy in *H. dichotoma*. To soften the hard seed coat and break the mechanical seed dormancy, it is necessary to treat seeds with acid. In the present investigation best germination was achieved when seeds were treated with 10% sulphuric acid for 24 h and germinated on a soil/sand mixture. Similar effect of sulphuric acid for seed germination has been reported by several research groups (Balouchi, Sanavy 2006; Tanaka-Oda et al. 2009; Northcutt et al. 2012; Purohit et al. 2015).

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