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EFFECT OF DIFFERENT SEED DORMANCY PRETREATMENTS ON *COMBRETUM HARTMANNIANUM* FRUITS

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ABSTRACT

Background Poor or delayed germination is often considered a key factor for low plant productivity. *Combretum hartmannianum* species had very low germination percentages which may affect its regeneration. This study aimed to explore the causes of this poor germination and testing the potentiality of water soaking on germination.

Methodology Experimental treatments comprised of different pretreatments i.e. soaking in water for 24, 48, 72, 96, 120, 144, 168 hours; soaking in hot water for 1, 3 minutes and 24 hours; soaking in sulphuric acid (commercial acid 98%) for 15, 30, 45 and 60 minutes.

Results The results showed that the species had a high rate of empty seeds (17%) and insect damage (30.6%), besides the dormancy problem. Soaking in sulphuric acid for 45 minutes was significantly different from the other treatments. It gave about 25% more germination. The result was found promising to raise the germination percentage of this species. The other treatments including soaking in water 24, 48, 72 days, soaking in acid for 60 minutes and control were significantly different from soaking in acid for 45 minutes.

Conclusion Seed soaking in acid with different times between 45 to 60 minutes was a promising approach for better productivity of *Combretum hartmannianum*.

INTRODUCTION

Seed dormancy refers to a state in which viable seeds fail to germinate when provided with conditions normally favourable to germination (Willan 1985; Sohindji et al. 2020). The purpose of pretreatment is to ensure that seeds will germinate, and that germination is fast and uniform. Pretreatment methods have been developed and described for many species (Hilhorst 2011; Debieu et al. 2013). Yet, dormancy still causes problems of low germination rates for several tropical species, partly because of lack of general knowledge of their seed physiology and variation in dormancy rate (Baskin and Baskin 2020). Methods often have to be adjusted to individual species and seed lots based on experience and experimentation (Schmidt 2000).

Combretum hartmannianum tree is small to medium sized deciduous tree up to 10 m height, found in tall grass savanna zone on clay or loamy soils (Ismail and ElShiekh 2007). It is used mainly for firewood and charcoal, also used as fence posts and the framework of thatches houses. Some parts of the trees are used as perfume by the Nuba (Abtew et al. 2012). The fruits and bark contain tannin. From previous studies at the National Tree Seed Centre stated the poor germination of seeds is an obstacle for plantation of the species (Mohamed 2002). Poor germination was found to be partly due to the combined dormancy, chemical, mechanical and indigenous causes and partly seem to have genetic problems, may be due to crossing hybrid between species which creates hybrid species that are sterile or produce seeds that germinate with difficulty. Hassan et al. (2013) revealed that the different parts of the *C. hartmannianum* contains inhibitors which may significantly reduce the germination percentage, the appearance of the first leaf was delayed and causing abnormal growth of the seedling.

Seed predation takes different forms in plant/herbivore systems. Large seed eaters, like parrots

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may consume and kill entire seeds by eating many of them at a time; insects, like bruchid weevils, complete their development by burrowing into and eating the vital parts of a single seed, each damaged seed yielding one adult weevil. Many insects, such as some tortricid moths whose larvae develop by feeding on seeds inside developing fruit, devour some of the seeds, but only partially damage others. Besides the classification of the *Combretum hartmannianum* species as vulnerable species, all this raise the need to assess the cause of low germination and explore an appropriate pre-treatment that can increase the germination percentage significantly. Accordingly, present study was planned to determine the effect of pre-sowing soaking of *Combretum hartmannianum* fruits in water and sulphuric acid on germination.

MATERIALS AND METHODS

Fruits of *C. hartmannianum* were collected from ElNour Forest, east of Eldamazin city at Blue Nile state, Sudan. Random samples were drawn from the working samples and the following test was applied as described in International Seed Testing Association (ISTA) rules 1993 for each test: seed cutting test to determine viability, number of seeds kg^{-1}, moisture content, purity test and 14 different pre-treatments. Experimental plan consisted of soaking in water for 24, 48, 72, 96, 120, 144, 168 hours; soaking in hot water for 1 and 3 minutes, and 24 hours and washed immediately; soaking in sulfuric acid (commercial acid 98%) for 15, 30, 45 and 60 minutes, stirring with a glass rod during the soaking period. After soaking, the seeds were washed with water for 10 minutes. For each pre-treatment, 100 fruits were used. These fruits were divided into four replicates of 25 fruits each. Fruits were sown immediately after treatment. Fruits were sown in round aluminum dishes filled with moist sand. Dishes were watered daily with a fine shower. Germination was carried out in a controlled germination room at the National Tree Seed Centre – Soba, Sudan at 30^{o}C, light for 12 hours from fluorescent lamps. Germination counts were done at 7 days interval and for a period of 6 weeks. Experiment was conducted in accordance with Completely Randomize Design (CRD) with four replications. The statistical analysis was done by JMP package (Programme improved form SAS Package).

RESULTS AND DISCUSSION

The purity test of *Combretum hartmannianum* fruits showed that their fruits purity were about 81% (Table 1), this test was designed to show the odd material in the collected bulk, besides the seeds of the target species. The moisture content were about 3.9% (Table 1), these percentages are usually a character of seeds of good storability and a higher response to low temperature storage (Schmidt 2000). *C. hartmannianum* also showed a low rate of germination which was associated with high percentage of dead seeds, particularly due to insect infestation. Insect damage reduced seedling growth by 50% compared with undamaged seeds. Since insect damage could drastically reduce germination rates and seedling growth, hence had the potential to limit seed regeneration and dampen rates of spread in populations following reintroduction (Schmidt 2000; Dalgleish et al. 2012). The dead seeds percentage was about 30.6% and the percentage of empty seeds was 17%, consequently there was about 52.4% of sound seeds.

The empty seeds are an indicator of failure of pollination process. There might be a decrease in the pollinators so they failed to fertilize the flowers or the pollen grain production was not sufficient to fertilize all flowers. These two problems could decrease the number of expected seedlings. From the different treatments applied on *Combretum hartmannianum* fruits, the best one was soaking in sulphuric acid for 45 minutes, which was significantly different from the other treatments (Table 2). It gave about 25% more germination, with reference to viability results (Figure 1). *Combretum hartmannianum* had 59% sound fruits, this indicated that the real result of germination was 42%. This result might be promising to raise the germination percentage of this species (Schmidt 2000; Abtew et al. 2012; Dalgleish et al. 2012; Sohindji et al. 2020).

The other treatments including soaking in water 24, 48, 72 days, soaking in acid for 60 minutes and control were significantly different from soaking in acid for 45 minutes, suggesting the soaking in acid for 45-60 minutes may give better. Soaking in water for long time dropped the germination percentage to zero. It may be explained that soaking in water for long time caused rotting of the fruit and seed inside, although it remained solid.

CONCLUSION

Soaking of *Combretum hartmannianum* fruits in sulphuric acid (H_2SO_4) for 45 minutes raised the germination percentage to 25% higher, and proved best for improving the germination.

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Table 1 Seed characteristics of *C. hartmannianum* fruits

Parameters	Unit	Value
Purity	%	81
Number of fruits kg^{-1} (1000)	No.	11.167
Moisture content	%	3.9

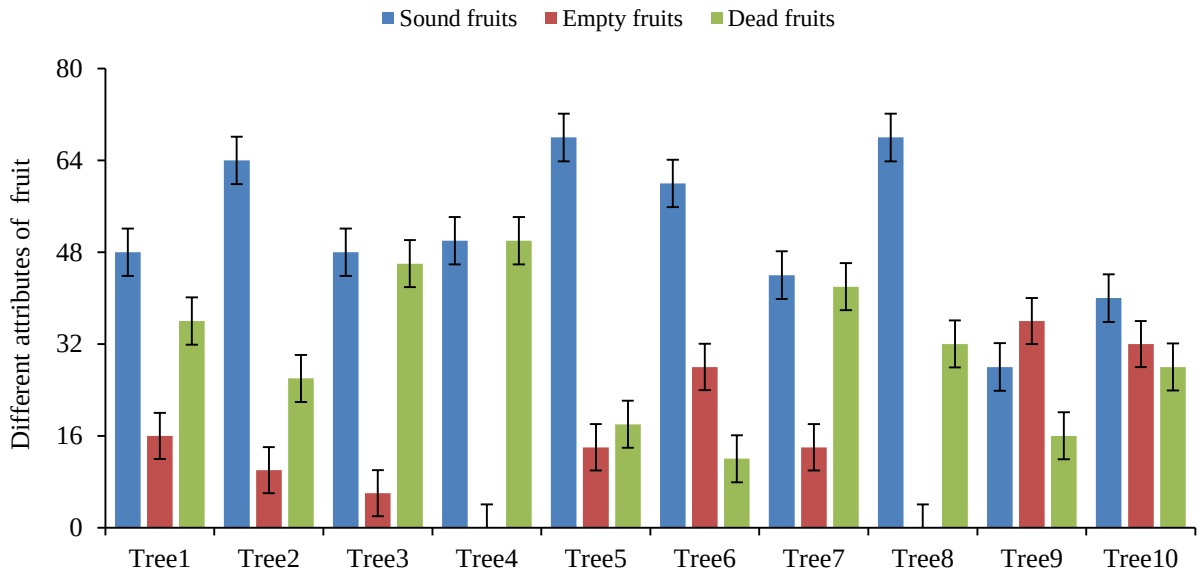

Figure 1 Difference in fruit viability of ten *C. hartmannianum* trees using cutting test method

Table 2 Effect of different treatments on *C. hartmannianum* germination percentage

Treatments	Mean
Control (untreated)	21.1ab
Soaking in water 24 hours	21.13ab
Soaking in water 48 hours	21.7ab
Soaking in water 72 hours	24.4ab
Soaking in water 96 hours	11.5cd
Soaking in water 120 hours	0e
Soaking in water 144 hours	0e
Soaking in water 168 hours	0e
Soaking in boiling water 1 minute	6.7d
Soaking in boiling water 3 minute	13.13c
Soaking in boiled water 24 hours	0e
Soaking in Acid 15 minute	21ab
Soaking in Acid 30 minute	18.4bc
Soaking in Acid 45 minute	25.7a
Soaking in Acid 60 minute	23ab

$p \leq 0.0001$, SE± 2.2, CV = 20

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