Title of Submitting Paper

Overcoming seed dormancy in the Mazri Palm; a sustainable way for its production at business scale

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ABSTRACT

Introduction

Mazri Palm {(*Nannorrhops ritchieana* (Griff) Aitch.)} is an economic plant species distributed in Pakistan, Afghanistan, Iran and Saudi Arabia. More than 30 products are prepared from its leaves. Seed dormancy for long period is one of the core hurdles in its larger-scale propagation and production.

Materials and Methods

In the current study, we aimed to overcome seed dormancy in Mazri palm via chemical scarification methods. Experimental trials were carried out in the glasshouse of the Botanical Garden, Quaid-i-Azam University Islamabad, Pakistan. We immersed Mazri seeds in 5%, 10% and 15% concentrated sulfuric and nitric acid solutions for 6, 12,18 and 24 hours to break down the exocarp of Mazri seeds. Ten replicates were taken for each treatment using a Completely Randomized Block Design. Germination data were recorded daily.

Results

Seeds treated with 10% sulfuric and 5% Nitric acid for 12 and 18 hours, individually, showed a significant increase in germination. Seeds treated with 15% H_2SO_4 and HNO_3 reported the lowest rate of germination of 30 & 40 % respectively. This means that an increase in acid concentration probably destroys seed embryos that's why very few seeds germinated. We have also observed a direct increase in germination percentage with an increase in temperature and moisture contents.

Conclusion

Based on our experimentations and observations we elucidate that the species has morphophysiological dormancy that can be overcome through chemical scarification techniques followed by suitable environmental conditions to meet our aim of conservation and propagation.

Keywords: germination, morphophysiological dormancy, Sulfuric acid, Nitric acid, embryo

1. INTRODUCTION

Nannorrhops ritchieana is a shrubby palm that is native to Pakistan, Afghanistan, Iran, Oman and Saudi Arabia [1]. In southern Europe and southern and subtropical parts of America, it is grown as ornamental [2]. Usually, the height of this species ranges from 3-5meters. The leaves and stems of this species are an incredible source of mats, baskets, house roofing and many other handicrafts [3;4]. Leaves alone are used to construct and weave ropes, trays, brooms, hats, sandals, storage boxes for grains, prayer mats, baskets [5-6], seeds are used for rosaries [7] and the fruits are an edible and rich source of nutrients. The species is considered an important source of livelihood and income in the region [4].

Road construction and rapid spread in the population are the major threats that collapse its population. The species' long-life cycle is another challenge for its conservation and propagation. It takes around 3-4 years to produce first leaves, second, the individuals take 7-12 years to reach the juvenile stage. The plant takes 23-40 years to reach the reproductive stage and start fruits. Wild populations were mostly represented by older plants whereas juvenile and seedling were very less in number. It shows that in the

coming future it will be very challenging for juveniles and seedlings to cover the gap of old individuals [8].

Seed dormancy is another challenge that collapses and restricts its population from propagation. Palm flora usually exhibits a unique germination process, seed structure and seedling morphology [9] make exploring their germination challenging and interesting [10]. In addition, most palm species depend on sexual propagation and are represented by slow and irregular types of germination [11].
According to Baskin and Baskin [12] palm species have morphophysiological (underdeveloped embryo, hard seed coat and take a long time to germinate) or morphological dormancy (ones that do not have morphophysiological dormancy). The objective of this study is to assess the impact of the application of superacids such as Sulfuric acid (H2SO4) and Nitric Acids (HNO3) on Mazri Palm Seed germination.

2. Materials and Methods

2.1 Seed collection

Nannorrhops ritchieana (Mazri Palm) fruits were collected from wild individuals in Dera Ismail Khan (Fig.1) Fruits were taken to the ecology and conservation Lab Quaid-i-Azam university and stored at room temperature for 25 days. After 25 days the exocarp was removed carefully without triggering harm, so as not to impede seed germination vigor and potential [13] and stored in polythene bags.

Fig.1. An old Mazri Palm from which fruits were collected

2.2 Acid scarification

The germination of Mazri seeds as affected via immersing at different concentrations of HNO3 and H2SO4 (5%, 10% and 15%) and durations (6,12,18,24 hours) were assessed. Each treatment comprised of placing 10 seeds replicates in 50ml flasks with 10ml of HNO3 and H2SO4 solutions. After immersion acid solutions were removed with a syringe and seeds were washed out with tap water. After washing seeds were spread on Whatman filter paper to dry them.

2.3 Experimental Design

Experimental trials were carried out in the glasshouse of the Botanical Garden, Quaid-i-Azam University Islamabad, Pakistan in 2018 (March to October). Ten replicates were taken for each treatment using a Completely Randomized Block Design. Seeds were then grown in plastic bags with a size of 3x6 inches (Fig.4) All pots were irrigated at regular intervals of 2 days and properly maintained.
The observation of germination data was recorded after 40 days on daily basis. Estimation of percentage germination was done following [14].

$$\%\ Germination = \frac{No.of\ Seeds\ Germinated}{Total\ Seeds\ Incubated} x100$$

The germination data were statistically assessed via Microsoft excel.

3. Results and Discussion

3.1 Scarification with Sulfuric acid

Pre-sowing treatments with various concentrations of Nitric acid and Sulfuric acid for different time intervals affect Mazri Palm seed germination. In the case of Sulfuric acid highest number of seeds were germinated in 10% solution immersed for 12 hours. On the other hand, the lowest germination percentage (40%) was observed in control, and seeds were treated with 15% Sulfuric acid

concentration for 12, 18 and 24 hours as shown in Figure (Fig.2).
All these treatments significantly vary from each other. The germination percentage increased up to 10% sulfuric acid concentration and 12 hours immersion time but as concentration increased up to 15% a significant decrease was observed in seed gemination irrespective of immersion time (Fig.2). Results of the current study are in close coherence to the results of [15-18]. These results indicate that the seed coat of Mazri seed creating the problem of impermeability to oxygen and water which delay its germination. This means that an increase in acid concentration probably destroys seed embryos that's why very few seeds germinated in 15% Sulfuric acid concentration.

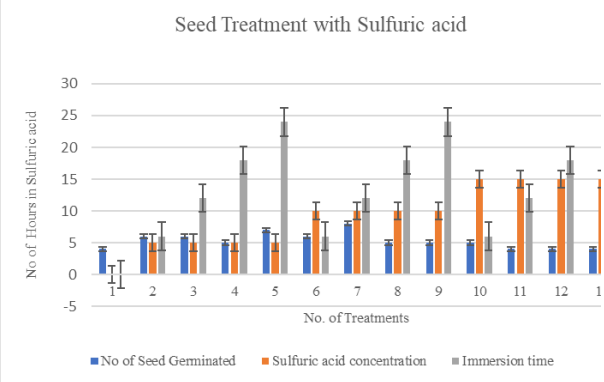

Fig.2. Seed Germination in Sulfuric acid treatment

3.2 Scarification with Nitric acid

Nitric acids are known to assist in dormancy mitigation by breaking the seed coat. Mazri Palm seed germination was significantly affected with various concentrations of Nitric acid. The highest number of seeds (80%) were germinated in 5% nitric acid treatment for 18 hours (Fig.3). The lowest germination (30%) was observed in control followed by seeds treated with 15% nitric acids for different times intervals (Fig.3). The germination percentage increased on 5% concentration and 18 hours immersion time but as concentration increased up to 10 and 15% a significant decrease was observed in seed gemination irrespective of immersion time.

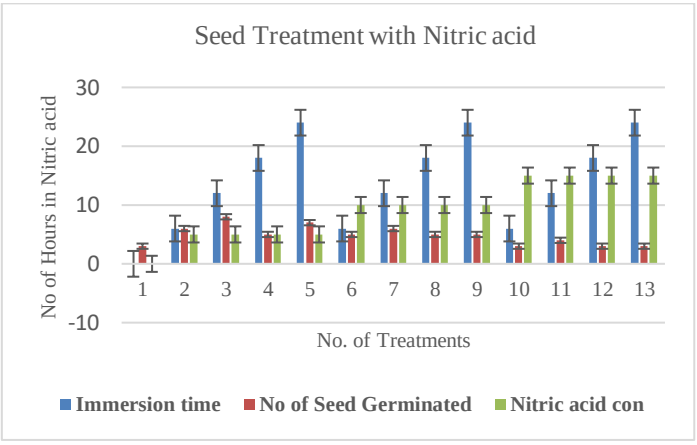

Fig.3. Seed Germination in Nitric acid treatment

As we mentioned in the case of the sulfuric acid hard seed coat of Mazri creating seed dormancy problem due to impermeability to oxygen and water which delay its germination [19;20] According to Yang et al [21], seed germination could be accelerated via mechanical scarification. Using chemicals for scarification purposes significantly increases the rate of germination. Sometimes, scarification leads to inconsistent results [22- 23]

Fig.4. Seed germination in the Glasshouse Botanical Garden Quaid I Azam University

2. CONCLUSION

Our current research indicates that Mazri Palm is an important economic species

facing a lot of problems in which the slow and low rate of seed germination is the prominent one. In order to know the complex puzzle of seed germination in Mazri Palm. We must try to solve this problem and identify suitable and non-laborious methods for seed dormancy alleviation in this economic palm. Our research identified a solution and hence elucidate that the species has morphophysiological dormancy that can be overcome through chemical scarification techniques followed by suitable environmental conditions to meet our aim of conservation and propagation.

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