



EFFECTS OF PRETREATMENT ON THE GERMINATION RESPONSE OF OLD SEED OF *TETRAPLEURA TETRAPTERA* (SCHUM. AND THONN.) TAUB.

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ABSTRACT: The research was conducted to determine the effect of some pretreatment methods on the germination response of old seeds of *Tetrapleura tetraptera* with the view of selecting effective and environmentally friendly methods of breaking its dormancy. The study was carried out at the screen house of the Nursery of the Department of Forest Resources Management, University of Ibadan. The experimental layout was completely randomized design (CRD), consisting of five treatments replicated four times. The treatments were H₂SO₄, lime juice extract, overnight soaking in water, hot water and control. Percentage germination, germination speed and mean germination time were assessed. Percentage germination, germination speed and mean germination time were found to be significantly affected ($\alpha = 0.05$) by the various pretreatments methods. Seeds treated with concentrated H₂SO₄ at 98% concentration recorded the highest cumulative percentage germination (61%) and mean of germination speed (15.25). Seeds soaked overnight recorded 38% cumulative percentage germination, 9.5 mean germination time and 0.47 mean of germination speed. Seeds treated with lime extract recorded 33% cumulative percentage germination, 8.25 mean germination time and 0.38 mean of germination speed. The control recorded 33% germination, 8.75 mean germination time and 0.37 mean of germination speed. Seeds soaked in hot water failed to germinate. H₂SO₄ has been shown to be very effective in breaking dormancy of *T. tetraptera* seeds in comparison to other pretreatments methods investigated.

Keywords: Percentage germination, Mean germination time, Germination speed

1. INTRODUCTION

Tetrapleura tetraptera (Schum. and Thonn.) Taub. belongs to the family and subfamily of fabaceae and mimosodeae respectively (Atawodi *et al.* 2014). The bole are slender, characterized by very small, low, sharp buttresses. The bark is smooth, very thin and grey-brown in colour. The twigs and young foliage are virtually glabrous or minutely hairy. Leaves are sessile, glabrous or minutely hairy with a common stalk about 15 – 30 cm long, slightly channeled on the upper surface (Orwa *et al.* 2009). The fruits are made up of woody pod with 4 wings, 12 – 23 cm long. Straight or slightly curved shiny purple – brown to black, it has a smell of caramel especially on rotting below the tree

(Katende *et al.* 2000). *T. tetraptera* are highly valued for its medicinal and nutritional benefits apart from other benefits that tree is traditionally known to provide. Studies conducted by many researchers demonstrate the effectiveness and potential of *T. tetraptera* plants in the management and/or control of disease such as kidney disorder and cardiovascular diseases (Ajayi *et al.* 2011), schistosomiasis control (Aladesanmi 2007), antibacterial (Ekwenye and Okorie 2010) and antimicrobial activity (Okoronkwo and Echeme 2012). Some seed refused to germinate (dormant) because of the inhibitory factor of the seed itself (Anglaaere 2005), this kind of dormancy consist of two type; seed coat or external dormancy and internal or endogenous dormancy (Evans and Blazich 2004). Most species of

fabaceae have an impermeable seed coat that imposes a physical exogenous dormancy (Van Assche *et al.* 2013), these includes species in the three subfamilies of caesalpinoideae, mimosoideae and papilionoideae (Baskin and Baskin 1998; Funes and Venier 2006; Choudhury 2009). The seeds of *T. tetraptera* suffered from seed dormancy (Opabode 2011), only a small percentage of the seed of *T. tetraptera* germinate in the field, a lot more remained dormant (Jimoh 2005).

Various pretreatments methods are required in order to overcome seed dormancy. Such pretreatment methods are used to compromise the integrity of the impermeable cover subsequently permitting the imbibitions of water by the embryo. Dormancy breaking is very important when rapid and synchronous germination is required after sowing (Aref 2000). Various methods of breaking seed dormancy exist ranging from physical, mechanical, chemical, water (hot and cold) etc. Their effectiveness varies from species to species as well as time and point of scarification as shown in various research work (Aref 2000; Aliero 2004; Adio *et al.* 2008; Asinwa *et al.* 2008; Gbadebo and Salami 2008; Okunlola *et al.* 2010; Ibiang *et al.* 2012; Soliman and Abbas 2013). For example, seeds of *T. tetraptera* scarification with (H₂SO₄), hydrochloric acid (HCl) and nitric acid (HNO₃) for 15 minutes were reported to have recorded 90, 76.7 and 81% percentage germination respectively six (6) days after sowing (Ibiang *et al.* 2012).

Similarly, Onyekwelu (1990) recorded a 100% germination percentage when the seed of *T. tetraptera* were scarified with sulfuric or nitric acids for 20 minutes. Anglaaere (2005) also recorded a value of 74.3% germination percentage when the seed *T. tetraptera* were soaked in Concentrated H₂SO₄ for 20 minutes. Water was also reported to be effective in breaking dormancy in the seed of *T. tetraptera*, when it was soaked in hot water (80°C) until the temperature drops, 56.7% germination percentage was recorded (Ibiang *et al.* 2012).

However, a 0% germination percentage was reported by Anglaare (2005) when the seeds of *T. tetraptera* were soak in cold water for 24 hours. An increase in the temperature of water to a certain degree has been demonstrated to destroy dormancy in the seeds of some tree species for example; Aref (2000) reported good percentage germination in *Acacia senegal* after boiling the seeds in water and allowing them to cool to room temperature. Lime juice extract has been shown to contain citric acid and ascorbic acid containing 1.38 and 2.86 - 22.80 g/oz respectively (Penniston *et al.* 2011, Rangel *et al.* 2011). Since citric acid and ascorbic acid has been shown to be effective in breaking the dormancy of some seed (Van Haverbeke 1985, Eze and

Ahonsi 1993; Eşen *et al.* 2006; Dolatabadian and Modarres-sanavy 2008) there is the possibility of lime juice also been effective though the quantity required and duration of soaking might pose a challenge.

Useful information with regards to seed attributes, such as quality and vigour has been derived from the assessment of the speed of germination, mean germination time, germination index etc in agricultural crops (Mavi *et al.* 2010; Khan *et al.* 2010) however, this assessment is often neglected with forest tree, very few research that focus on germination conduct such assessment as useful as they appeared to be. Most research focused on germination percentage alone. Thomson' and El-Kassaby (1993) and Soliman and Abbas (2013) performed some of these assessment on forest tree and has been shown to give useful insight into the germination characteristics of the seeds of trees used. Germination percentage alone does not really reflect speed or pattern of germination, whereas germination speed (index) helps in determining seedling vigour. Speed and distribution of germination in germination experiment go beyond the conventional measure of germination percentage; it gives us more insight in assessing how important the various treatments methods are (Al-mudaris 1998). Germination percentage gives us an insight to the percentage of seeds that germinated during the course of the experiment, it does not tell us at what stage of the experiment such seeds germinate. Under field condition the Faster the rate of germination (germination speed) the likely the seedlings are expected to be establish (Schmidt 2000).

Despite the enormous benefits of *T. tetraptera* highlighted, the plants which are mainly in the wild and traditional agroforestry farm (Omokhua and Ukoimah 2008) are becoming low and might go into extinction in no distant future due to overexploitation (Aniedi *et al.* 2013) and slow germination rate in the wild (Jimoh 2005). One of the major reasons for the slow germination rate in the wild is due to the enclosure of the seeds in pods which are hard to decompose or break naturally. Even if the pods decompose, the possession of hard seed coat imposed a physical dormancy on the seeds (Onyekwelu 1990).

Although the effectiveness of H₂SO₄ in breaking seed dormancy in *T. tetraptera* has been established (Onyekwelu 1990; Ibiang *et al.* 2012; Anglaaere 2005) there is however, the need for exploring other means of breaking dormancy of *T. tetraptera* seeds that are accessible, safe and environmentally friendly as well as yielding better germination and vigorous seedlings for easy establishment on the field.

2. MATERIAL AND METHODS

2.1 Study site

The experiment was conducted at the Screen house of the Department of Forest Resources Management, University of Ibadan, lying on approximately latitude 7°28' N and longitude 3°52' E above sea level. The climate is the West African monsoon with dry and wet season. The dry season usually starts from November – March, while the rainy season starts from April to October. Annual rainfall is about 1300 mm while mean annual temperature ranges between a maximum of 34°C and a minimum of 22°C (Akinyele 2010).

2.2 Experimental design and treatments

The experiment was designed and conducted in 2014. Seedpods from previous fruiting season (2013) were collected on the floor of the Botanical Garden of the University of Ibadan. The seed pods were crushed to remove the covering exposing the seeds. Seeds which show no visible sign of disease were collected on which viability test were conducted by floating the seeds in water. The seeds that floated were considered non-viable while the seeds remaining at the bottom were regarded as viable. The viable seeds were collected, air dried and divided into five batches. Seeds from first batch were soaked in 98% concentrated H₂SO₄ for twenty (20) minutes. The second batch of seeds were poured into hot water and allowed to cool to room temperature. Seeds from third batch were soaked overnight in water at room temperature while the fourth batches of seeds were soaked in lime juice extracts for 12 hours. For each treatment, twenty (20) seeds from 120 seeds were randomly selected and sowed into a germination tray of 21 × 8 cm size filled with washed and sterilized river sharp sand. This was replicated four (4) times and laid in completely randomized design (CRD). Seeds were also sowed without pretreatment to serve as control. Seeds were considered to have germinated when the plumule emerges. The germination tray was watered once daily while the experiment lasted. The experiment was terminated when germination stopped for a week for all the treatments.

2.3 Germination indices

1. Germination Percentage: Based on the protrusion of the plumules, the seeds were counted. the following formulae according to

International Seed Testing Association (ISTA) (1999) was used to Percentage germination

Percentage germination is given as

$$\frac{\text{No. of germinated seeds}}{\text{Total number of seeds sown}} \times 100$$

2. Germination Speed (Index): Germination Speed (GS) was also calculated using the Equation of Maguire (1962) given as

$$\frac{\text{Number of seeds germinated}}{\text{Days of first count} + \dots + \text{Number of seeds germinated}} / \text{Days of final count}$$

3. Mean Germination Time (MGT): This was determined using the formulae of Al-mударis (1998), giving as

$$\frac{\sum f \cdot x}{\sum f}$$

Where f = seeds germinated on day x

3. RESULTS AND DISCUSSION

3.1 Results

Analysis of variance carried out on percentage germination, germination speed and mean germination time indicate that the percentage germination, germination speed and mean germination time were significantly influenced by the various pretreatment methods used ($\alpha = 0.05$). The highest cumulative percentage germination (61%) was recorded by seeds treated with H₂SO₄ for 20 minutes followed by seeds soaked in water overnight (24 hrs) with 38%. The control recorded 35% germination, while seeds soaked in lime juice for 12 hours had 33%. Seeds treated with hot water recorded 0% germination (Table 1).

Seeds treated with H₂SO₄ recorded the highest mean germination speed of 2.31 and differed significantly with seeds sowed in Lime extract, overnight soaking, hot water and control. Seeds sowed in Lime extract, overnight soaking and control recorded a mean germination speed of 0.38, 0.47 and 0.37 respectively these did not differed significantly from each other. Seeds soaked in hot water differed significantly from all the treatments recording a 0 germination speed (Table 1). Lime juice extract recorded the highest mean germination time of 29.42 followed by control recording 27.39 while overnight soaking recorded 34.75. H₂SO₄ had 8.07 while 0 was recorded for hot water treatment (Table 1).

Table 1: Mean percentage germination, germination speed and mean germination time for *Tetrapleura tetraptera* subjected to different pretreatments methods

Percentage germination	
H ₂ SO ₄	15.25a ± 1.49
Lime juice	8.25b ± 0.47
Overnight soaking	9.5b ± 0.96
Hot water	0c ± 0
Control	8.75b ± 1.11
Germination speed	
H ₂ SO ₄	2.31a±0.15
Lime juice	0.38b±0.64
Overnight soaking	0.47b±0.92
Hot water	0c±0
Control	0.37b±0.70
Mean germination time	
H ₂ SO ₄	8.07b±0.79
Lime juice	29.42a±1.12
Overnight soaking	24.75a±2.38
Hot water	0c±0
Control	27.39a±2.27

Means carrying the same alphabet did not differ significantly $\alpha = 0.05$ (values presented are Mean±SE)

3.2 Discussion

Scarification of *T. tetraptera* seeds with concentrated H₂SO₄ acid enhanced germination significantly. Therefore it can be regarded to be effective in breaking seed dormancy in *T. tetraptera*. Similar observation was made by Onyekwelu (1990), Anglaare (2005) and Ibiang *et al.*, (2012) from the use of sulphuric acid in breaking the seeds dormancy of *T. tetraptera*. Pretreatment with Lime juice extract though recorded poor result in comparison to other pretreatment methods, it possessed some potential in breaking the seeds dormancy of *T. tetraptera*. Similar result was recorded by Ahani *et al.* (2014) when the seeds of *Elaeagnus rhamnoides* were scarified with lime juice. An increase in duration of soaking in lime juice extracts might possibly result in improves germination. Seeds pretreated with hot water failed to germinate which means it was not effective in breaking dormancy of *T. tetraptera*. This is contrary to many studies which ascertained the efficacy of hot water treatment in breaking dormancy in different plant seeds (Aref 2000, Anglaare 2005, Adio *et al.* 2008, Asinwa *et al.* 2008, Ibiang *et al.* 2012). This contradiction might be attributed to the age of the seed since the seeds used for

this study were seeds that were collected from previous fruiting season (2013) while that used by most of the researchers were fresh seeds. Age is responsible for various physical, physiological and ecological processes such as decay of germination inhibitors and corruption of seed coat (Rees and Long 1993). Decay and corruption of the seeds coat might have set in or start to set in when they were collected thereby possibly reducing the resistance of the seeds coat and making it vulnerable to damage from prolong exposure to heat. Unlike in percentage germination and speed of germination were the higher the value the better the result, for mean germination time, the lower the value the better (Al-Mudaris, 1998). Since germination speed and mean germination time are indications of seeds vigour (Al-mudaris 1998, Adio *et al.* 2008), seeds pretreated with H₂SO₄ acid are considered to be of high vigour than the rest therefore, the likelihood of the seedlings to establish well under field condition. This is followed by overnight soaking, control and lime juice soaking respectively. Similar result was reported by Soliman and Abbas (2013) they recorded faster germination in seeds of *Cassia fistula* subjected to sulphuric acid scarification.

4. CONCLUSION

1. Seeds of *T. tetraptera* was found to exhibit seed coat dormancy
2. Seeds of *T. tetraptera* pretreated with H₂SO₄ perform better in all the germination indices (germination percentage, germination of speed, mean germination time) assessed.
3. Seed treated with hot water treatment failed to germinate possibly because of damage the embryo might have experienced from the heat
4. Seeds pretreated with extracts from lime juice record poor germination percentage

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