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Effect of different scarification methods on the germination of Petai Belalang (*Leucaena leucocephala*) seed

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The germination of seeds is sometimes impaired by certain physical nature of the seed themselves. The prolong period witnessed in establishing the *Leucaena leucocephala* plants as an immediate forage crop for livestock feed is impaired by delaying germination due to dormancy. An experiment was conducted in a laboratory in September, 2013 to test different methods of scarification of *Leucaena leucocephala* seed to determine the fastest and most effective way of breaking this inherent germination barrier in the seed. A randomized complete block design was used with mechanical scarification, soaking of seeds in hot water, and the control as a treatment, replicated three times. The result reveals that mechanical scarification using sand paper was a better option for breaking dormancy in *Leucaena leucocephala* seeds for use as forage.

Keywords: *Leucaena leucocephala*, scarification, germination, seeds,

INTRODUCTION

Certain crops produce seeds with a characteristic thick wax layer covering the seed coat, thus preventing the easy penetration of moisture into the cotyledons, and hence inhibit germination, a phenomenon called seed dormancy. Seeds of legumes are generally considered to have physical dormancy (Jayasuriya et al., 2013). *Leucaena leucocephala* (Lam.) de Wit (Fabaceae: mimosoideae) is a fast growing tropical legume tree that is native to Mexico and Central America. It has a wide distribution in the tropics and the subtropics (Wei-Seng Ho et al., 2014). It is propagated mainly by seeds. The crop has many economic potentials including high biomass production – 50t ha⁻¹ year⁻¹ (Sanchez et al., 2003), help in recuperating degraded soils (Parrotta et al., 1997), as green fertilization in advanced soil degradation (Balota and Chaves, 2010). It

is equally cultivated for multi-purpose uses, e.g. forage and fodder, fuel, charcoal, and pulp (Lefroy et al., 1992).

Germination and dormancy are key factors in the life cycle of a plant, and reflect important survival strategies in natural populations (Fenner and Thompson, 2005). Seed dormancy refers to a state in which the viable seeds fail to germinate when provided with conditions normally favorable to germination such as adequate moisture, appropriate temperature regimes and light (Schmidt, 2000). Indeed, temperature and precipitation are critical to release of seed dormancy and germination (B. Abudureheman et al., 2014).

In order to overcome this unusual condition of the seed, scarification, a condition of making the seed coat more permeable to moisture is employed. Several methods of

breaking dormancy, such as those applied in this experiment (hot water treatment and scratching with sand paper) have proved successful (Ibianget *et al.*, 2012). However, the number of successful germination is always controlled by several factors, including availability of moisture to the dormant embryo seed (Ghadir *et al.*, 2012). Physical dormancy in seeds can be alleviated under both natural and artificial conditions by the formation of a “water gap” in the impermeable layer of the seed coat, enabling moisture to reach the embryo (Baskin and Baskin, 2003). A lot of work have been reported in breaking dormancy in other crops with heat treatment *Astragalushamosus* (Patane and Gresta, 2006), or to fluctuating temperatures *Trifoliumsubterraneum* (Ghadir *et al.*, 2012). Kimura and Islam (2012) also reported that stimulated temperature regimes can break physical seed dormancy in legumes. Similarly, Asiyire *et al.*, (2008) reported some methods tried by several scientists and researchers with appreciable outcomes, despite the thickness of their seed coat. Studies on breaking dormancy in *Leucaena leucocephala* seed are not adequately reported. The use of forage legume in the pasture has become a technique of growing use by farmers to timely produce quality forage for animals (de Morais *et al.*, 2014). Hence the prolonged duration of time taken to establish this crop causes hindrance to the tropical forage legume establishment. This study, therefore, tends to find the most efficient and fastest ways of germinating Petaibelalang seeds for a better and faster forage legume crop establishment.

METHODOLOGY

The scarification of seeds and subsequent germination test experiments was carried out in September, 2013 at Laboratory “B” of the crop science department, University Putra Malaysia. *Leucaena leucocephala* seeds were selected and sorted out uniform sizes before being scarified using two methods:

Mechanical scarification [T1]

Mechanical scarification involved Scratching of seed using a smooth sand paper. Seeds were placed between two sheets of sand paper measuring 20 cm x 10 cm, holding grip between the left and right palms, gently rubbing against each other until fifteen times, thus changing the colour of the seed coat from dark brown to faint brown. Seeds were then arranged in a plastic through and covered with already sieved fine sand to a depth of 0.5 cm

Hot water treatment [T2]

Soaking of seeds in hot water (seeds immersed in hot water 70 °C for 15 min.) was achieved by boiling 500ml of distilled water using kettle heater and pure into a beaker. Measure temperature of water using portable hand held thermometer till temperature drops to 70°C. Seeds were poured in to the beaker and covered for 15 minutes. Seeds

were drained and arranged at a depth of 0.5 cm in a plastic bowl filled with already sieved fine sand.

Control treatment [T3]

In the control treatment, seed were selected into uniform sizes and arranged into a plastic bowl containing already sieved fine sand at a depth of 0.5 cm.

Each treatment consisting of 50 seeds was then planted at a depth of 0.5 cm in a plastic box (20 cm x 30 cm) filled with 10kg of fine sand, and were made in 8 (eight) groups (Replications), set out in a randomized complete block design (RCBD). Daily watering using tap water was also maintained for a period of 1 (one) week. These treatments were examined on daily basis to monitor the emergence of seedling until after one week of planting. Each seedling is considered as germinated and emerged when the cotyledons appear above the ground surface in the plastic bowl. Total germination in each treatment was converted into percentage using the formula thus:

$$G = X/Y \times 100,$$

Where;

G= Germination

X = Number of seeds that germinated in each box;

Y = Number of seeds planted in each box

100 = Constant for percentage

Data analysis

Data obtained from this experiment was subjected to analysis of variance (ANOVA), using SAS software version 9.2. The means were later separated using the least significant difference (LSD) (Gomez and Gomez, 1984).

RESULT

Three types of seed treatment were reported in Table 1. These are: Sand paper, hot water and control. Different types of treatment give different results based on the germination rates for 7 days (1week) [Figure 1]. Comparison between the three treatment showed that the germination rate of *Leucaena leucocephala* using Sand paper [T1] are significantly higher ($P \leq 0.001$), recording 83.00 as compared to both hot water [T2] with a mean value of 36.50 and control treatment [T3] having least mean value of 9.25 respectively (Table 1). Using sandpaper to rub off the waxy layer of the seeds helps the seeds germinate faster. The removal of the wax layer seems effective using this method, it will allow more moisture to be absorbed (water imbibition), activate the enzyme in the seeds to hydrolyze the starch stored and then growth of the seeds occur. The sand paper treatment seems a much better method in improving seed germination compared to hot water and control treatment.

The emergence of *Leucaena leucocephala* is presented in table 2. Mean squares from analysis of variance

Table 1: Mean squares of ANOVA and Mean values showing germination percentage of *Leuceanaleucecephala* seeds treated with different scarification methods

SOV	Df	Germination
Replication	7	618.26*
Methods	2	11125.16**
Error	14	212.97
Methods		
Sandpaper		83.00 ^a
Hot water		36.50 ^b
Control		9.25 ^c
LSD		15.56

Means with the same letter in a column have no significant difference ($P \leq 0.01$), SOV= Source of Variation

Table 2: Mean squares of ANOVA and Mean values showing days of the emergence of *Leucaena leucocephala* treated with different scarification methods

SOV	Df	Days to Emergence
Replication	7	0.7619 ^{ns}
Methods	2	28.041**
Error	14	0.851
Methods		
Sandpaper		3.7500 ^c
Hot water		6.3750 ^b
Control		7.3750 ^a
LSD		0.9894

Means with the same letter in a column have no significant difference ($P \leq 0.01$), SOV= Source of Variation

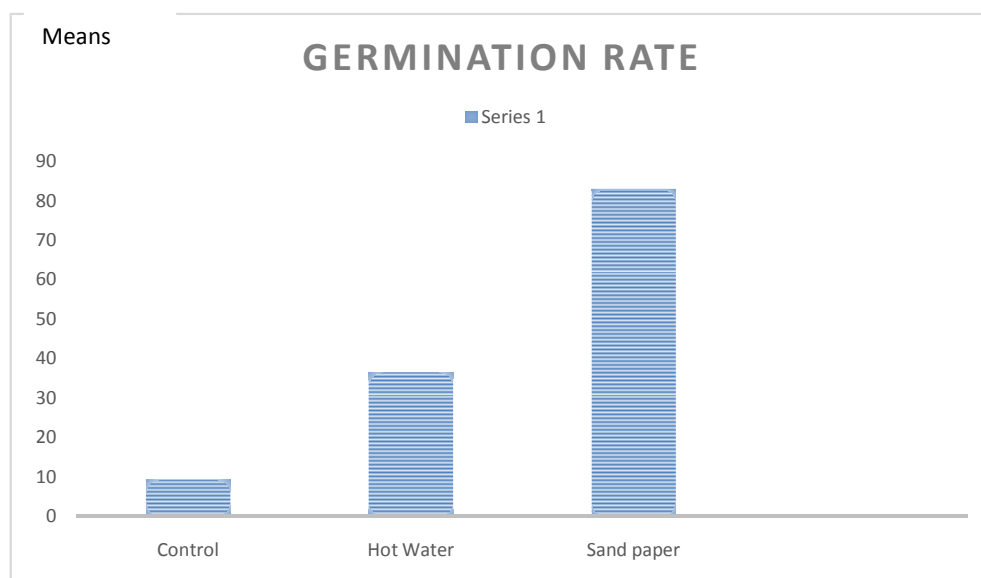


Figure 1: Germination rate of different scarification method using *Leucaena leucocephala* seed.

(ANOVA) shows a significant effect of the different methods of scarification on the emergence of Petaibelalang seeds. The mean values further show that there is a significant ($P > 0.05$) difference between the scarification methods with respect to emergence. Sand paper treatment allowed the emergence in nearly four (4) days while the control had a delayed emergence of up to seven (7) days. However, Hot water treatment gave an intermediate number of days (six) before emergence.

DISCUSSION

The imbibition of water by a dry quiescent seed results to the elongation of radicle of the embryo seed (Asiyire *et al.*, 2008). The seed of *Leuceanaleucecephala* treated with hot water responded fairly to heating (fig 1). This probably was due to the time allowed to soak in hot water. Ghadir *et al.*, (2012) reported that pre heat treatment of seed achieves success in germination only when the duration of heating is proportional to the thickness of the seed coat. Palm kernel seed was allowed to preheat for 1 hour in hot water (Fondom *et al.*, 2010), to achieve good germination (Dewir *et al.*, 2011). This could probably be related to inadequate time of hot water treatment for the Petai Belalang seed coat, thus could not have allowed significant softening of the seed coat to imbibe of moisture. Even though, Kimura and Islam (2012) found hot water scarification not to have shown the effectiveness of hard seed of many *Medicago* species, some even at temperatures of up to 90 °C each. However, for Alfalfa, germination declined at temperatures greater than 80 °C (Kimura and Islam, 2012). Mechanical scarification using sand paper may have removed a significant portion of the thick wax material covering the seed coat. Imbibition of moisture through the remaining thin layer may be responsible for the good germination of the Petaibelalang seed. It was reported that mechanical scarification renders seed germination of *Tetrapleuratetraptera* by up to 90% in 6 days (Asiyire, *et al.*, 2012). This report was also confirmed by the works of Onyekwelu (1990), Lemos Filho *et al.*, (1997) and Lacerna *et al.*, (2004). The inability of the control treatment to yield significant germination is not far from the arguments of researchers that even when germination takes place with such seeds, it is usually delayed by more than 100% days required for a scarified seed to germinate (Ghadir *et al.*, 2012).

Proper seed germination and growth are indispensable for the continued existence of any plant (Fondom *et al.*, 2010) The early response of petaibelalang seed to establishment in four days with sandpaper treatment may be due to severe weakening of the wax covering the seed, which possibly allowed moisture to penetrate the cotyledon. Mechanical and chemical scarification methods are effective in rendering seeds of *Tetrapleuratetraptera* permeable, leading to germination up to 90% after 6 days

(Ibiang *et al.*, 2012). Hard seed coat is resistant to effects of favorable germination conditions, this agrees with the work of Wei-Seng Ho *et al.*, (2014) who noted that the cumulative germination percentage (CGP) was until nine days after planting 95.9% for *L. leucocephala*.

CONCLUSION

The selection of the scarification method to a given seed (based on its characteristic coat) is eminent in any crop establishment practice. Mechanical scarification using sand paper appeared to be the best for *Leuceanaleucecephala* seeds.

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