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Effects of different hot water pre-germination treatment and germination media on the germination of Falcata (*Falcataria moluccana*, (Miq.) Barneby and J.W. Grimes)

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Abstract

Since hot water treatment is the most common pre-germination treatment for falcata seeds. The ideal soaking time in hot water (100°C) to break dormancy of falcata seeds and the effective germination media that can enhanced germination were investigated. The germination of seeds soaked in different length of time *viz*., 5 secs, 15 secs and 30 secs were compared. The germination media used in this study were direct potting (70% soil, 20% sand, 10%vermi cast), cloth, and tissue paper, pure sand and pure soil. All seeds treated with hot water were soaked overnight in tap water before transferring the seeds to the different germination media. Higher germination percentage (66%) was observed in 30 second soaking in hot water. The use of cloth resulted in significantly higher germination percentage as compared to other germination media. It is recommended in this study to use 30-second soaking in hot water plus overnight soaking in tap water as pre-germination treatment and the use of cloth as germination media.

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Introduction

Fast growing exotic *Falcataria moluccana* (Miq.) Barneby& J. W. Grimes, Fabaceae (Mimosoidea), commonly called falcata is one of the most common species found in the upland farms in the Philippines (Santos *et al.* 2010). It has been cultivated in the Philippines since 1970 for pulp and paper (FMB, 2009). Furthermore, falcata can be used to produce high value-added wood products (Nemoto, 2002). The preference of falcata can also be attributed to its ability to grow in variety of soils (Krisnawati *et al.* 2011) and the wood properties which favors efficient transport and loading (Varis, 2011). Farmers also favor falcata as it can be used as intercropped (Nissen *et al.* 2001).

As early as 1988, Anino (1991) observed the occurrence of a very damaging gall rust disease and has affected the falcata plantation in the country since. The disease is caused by *Uromycladium falcatarium* (Doungsa-ard *et al.* 2015). The disease is characterized by formation of galls on foliage and branches which resulted to massive defoliation of the tree crowns and sometimes death depending on the severity (Old and Cristovao 2003) affecting all growth stages from seedlings to mature trees (Rahayu *et al.* 2010). Aside from cutting and burning of infected plant parts as control method (Anino 1994), planting below 300m asl is recommended by Lacandula *et al.* (2017). The use of GIS software was also employed to determined suitable sites for falcata plantation (Paquit and Rojo, 2018).

Albeit the presence of gall rust disease, farmers are still growing falcata. Recently, 63% of the total log production in the country is from falcata mostly produced in Region 13 (PFS 2018). Due to the demand for planting stocks, plenty of nursery operators are growing and selling falcata seedlings. This nursery can be observed in highways in the province of Bukidnon (Region X), Misamis Oriental (Region X) and in Caraga region (Region XIII). Different farmers have their own pre-germination treatment to hasten seed germination. The work of Sajeevukumar *et al.* (1995) recommended the use of physical scarification followed by soaking in flowing water for 24 hours. In contrast Soerianegera and Lemmens, (1993) recommended soaking in boiling water for 1-3 minutes followed by washing and then 15 minutes soaking in cold water.Parrotta (1990) recommended dipping in boiling water, then allowed it to cool at room temperature followed by 24 hour soaking in water. All mentioned studies claimed higher percentage of germination. However, to properly provide protocol for falcata farmers, effective germination media must also be investigated. Since hot water (boiling) pre-germination treatment is also commonly used in the country for falcata, the effective soaking time in hot water and the germination media were investigated in this study.

Materials and methods

The study was undertaken at the forest nursery in Central Mindanao University (CMU), Musuan, Maramag, Bukidnon, Philippines. The said nursery is owned and managed by CMU mainly to supply the seedling requirement of the tree plantation of the university.

Collection and preparation of planting materials

The seeds were purchased from a faculty in CMU who previously conducted research projects in Falcata. About 2 grams consisting of approximately 10,000 pieces of falcata seedswere purchased.

Pre-germination treatment

Hot water pre-germination treatment at varying soaking time was the only pre-germination treatment tested in this study. The soaking time as treatment includes 5 secs, 15 secs and 30 secs. A total of 1,500 seeds were subjected in each treatment. All of the seeds were soaked overnight in tap water after hot water treatment.

Germination media

After pre-germination treatment, the treated seeds were transferred to different germination media ie., direct potting, clothes, tissue, soil, and sand. For direct potting, a polyethylene bag (2x4x6) with

potting media (70%soil, 20% sand and 10% vermicast) was prepared. For cloth and tissue, 9 wide plastic containers were prepared where the cloth and tissue were placed. For soil media, garden soil from the nursery were placed on the 9 plastics trays with drainage, the tray was placed with a single sheet of paper in the base to keep the soil from pouring out through the drainage holes. Sand was also prepared similar with the soil only that it was sterilized first and applied with fungicide. The seeds were then broadcasted in the different media. The set-up was replicated thrice. Regular watering was conducted in all set-up.

Transplanting

Except for direct potting, atleast 10 of those that germinated in every germination media were transplanted to potting media describe above.

The pots were regularly watered and weeds was regularly removed.

Data collection

Percent germination was determined using the formula:

$$\%\ \text{germination} = \frac{\text{No. of seeds germinating in every treatment}}{\text{Total no. of seeds in every treatment}} x\ 100$$

For growth performance the following parameters were measured:

Height growth (cm): The measurement was done by measuring the seedling from the basal portion to the shoot tip. The data were collected every week. Initial measurement was taken during transplanting and final measurement after 3 months. Diameter growth (cm): The diameter of seedling was taken after 10 days onwards from transplanting with the use of Digital Caliper expressed in centimeters. Data were obtained every week.

Percent survival: This was determined upon the termination of the study. This parameter were computed using the formula:

$$\%\text{Survival} = \frac{\text{No. of seedlings survived per treatment}}{\text{Total no. of seedlings planted per treatment}} x\ 100$$

Data analysis

The data were analyzed using the analysis of Variance (ANOVA) through Statistical Tool for Agricultural Research (STAR) software, and the differences among the treatment means was determined using Tukey's W-Procedure or Honest Significant Difference (HSD).

Results and discussion

Highest percent germination was observed in seeds soaked for 30secs in hot water (66.42%) (Fig. 1).

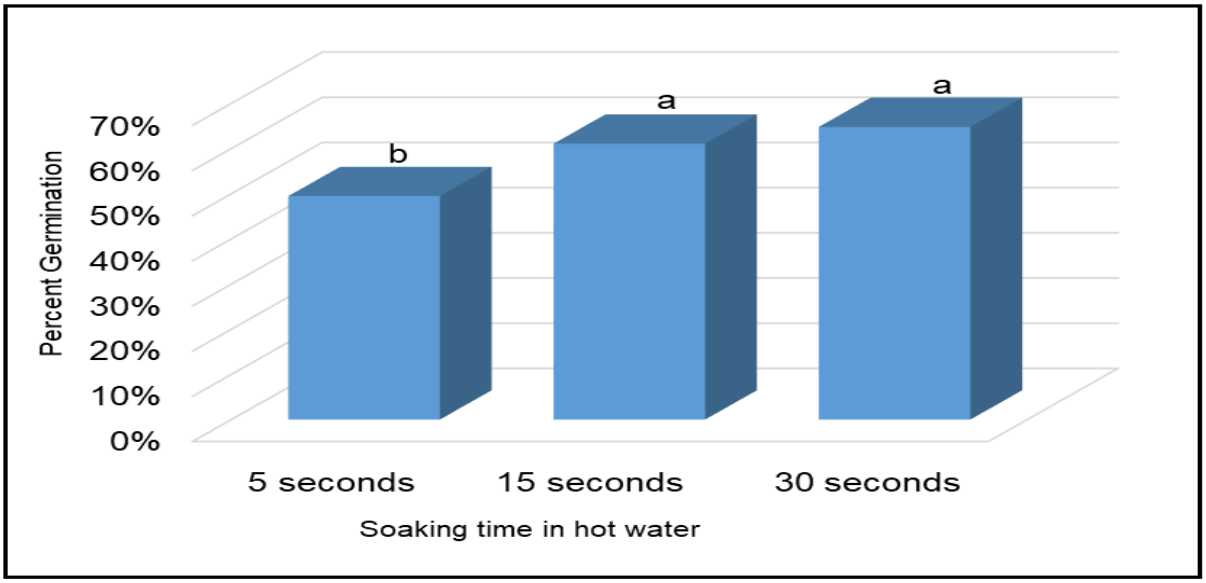

Fig. 1. Mean percent germination in different pretreatment of seeds. Mean numbers with the same letters are not significantly different from each other.

A shorter period of soaking time (5 seconds) in hot water resulted to significantly lower germination percentage. Similar observation although different but also fast growing tropical species were observed by Sharma *et al.* (2008). The result showed that hot (100°C) water treatment can effectively break dormancy of falcata seeds. Further, McDonell *et al.* (2012) stressed that dipping seeds in hot water effectively reduced contaminants compared to dipping seeds in room temperature water. The length of soaking time in hot water also positively influence germination although the optimum length of soaking time for falcata seeds is not determined in this study.

The work of Soliman and Abbas (2013) showed that increasing length of soaking time up to 6mins enhanced germination of *Cassia fistula*. Presence of water soluble inhibitors in the seed-coat of falcata as described in Sajeevukumar *et al.* (1995) may have been overcome by increasing soaking time in hot water. The germination percentage in this study is lower compared to those mentioned studies, this could be attributed to the storage of seeds.

The viability could have been affected, as discussed in the methods, the seeds were only purchased and date of collection was uncertain.

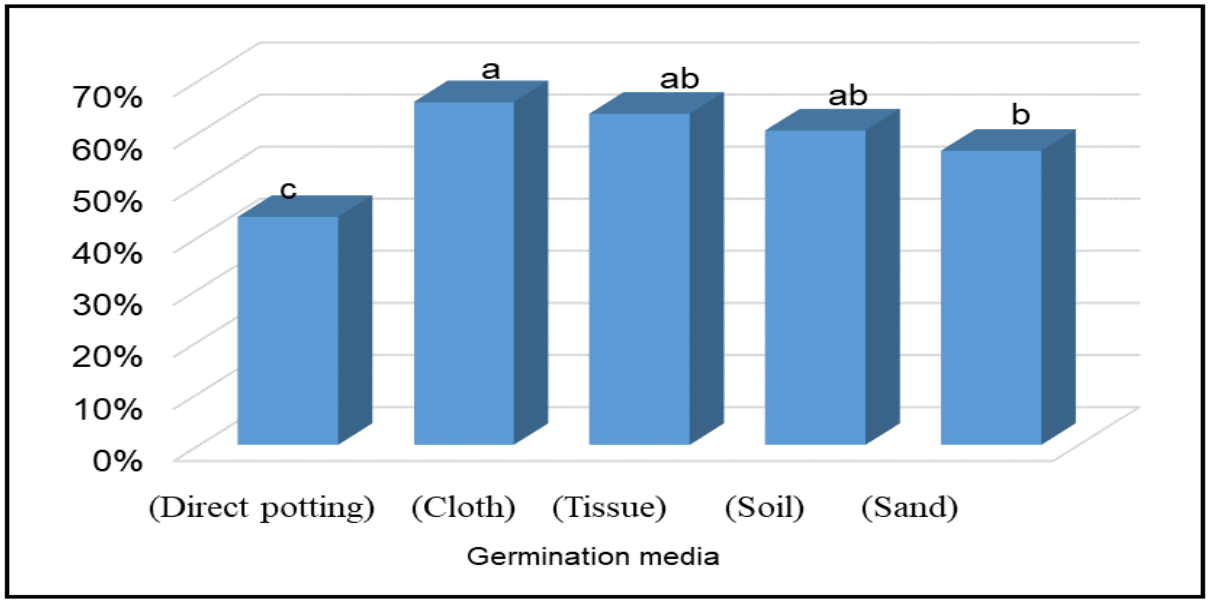

Fig. 2. Mean percent germination in different germination media. Mean numbers with the same lettersare not significantly different from each other.

Different germination media has significant effect on germination of falcata (Fig. 2). Highest percentage germination with an average of 67% was observed in cloth germination media, followed by tissue with an average of 63.56%.

While the lowest percent germination was observed in sand with an average of 56.44%. These show that the germination media has influence on the germination capacity of the seeds. Low germination percentage using sand as germination medium was also observed by Gairola *et al.* (2011) and Omokhua *et al.* (2015). While high germination percentage using cloth and paper was observed by Mamiro *et al.* (2015). Use of paper as germination medium was also recommended by FAO (2018).

The higher moisture that can be retained in cloth and tissue paper may have been the factor to enhance germination of falcata seeds.Shaban, (2013) argued that water is the basic requirement for seed germination as it is essential for enzyme activation, breakdown, translocation, and use of reserve storage material. According to Naidu and Mastan (2001), during the growth of seeds embryo or germination on seeds, the imbibitions of water help to enlarge the embryo which leads to increase in fresh weight of seed. Since falcata seeds have thick impermeable

seedcoat resulting to slow imbibition (Sniezkoand Gwaze 1987 as cited by Sajeevukumar *et al.* 1995) makes the cloth and tissue paper effective as germination media because it can retain more moisture compared to other media in this study.

Early emergence was also observed in cloth and tissue germination media. Two days after seed soaking radicles already emerges and are ready for transplanting in potting medium. Other media such soil and sand took 9 days for falcata seeds to germinate. Direct potting or sowing although regarded as is fast, easy, and economical because it minimizes seed handling and labor (Luna *et al.* 2009), resulted in significantly lower germination percentage.

This observation may contradict to the statement of Munjuga *et al.* (2013) that the best kind of germination medium is sand or light soil germination of seeds will be faster due to aeration although we agree that seedlings can be easily pulled out during uprooting with less damage to the roots.

Conclusion

The effective length of soaking time in hot water as pre-germination treatment to break dormancy of falcata seeds is 30 seconds followed by overnight soaking in tap water. Wet cloth as germination medium further enhance germination as it resulted in significantly higher germination percentage compared to other media.

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