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Short Communication: Effect of growing media on seed germination and seedling growth of *Aganope heptaphylla* (Leguminosae)

R. SUBEKTI PURWANTORO
Center for Plant Conservation (Bogor Botanic Garden), Indonesian Institute of Sciences. Jl. Ir. H. Juanda 13 Bogor 16 122, West Java, Indonesia.
Tel./Fax.: +62-251-832187, email: subekti27@yahoo.com

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Abstract. *Purwantoro RS. 2016. Effect of growing media on seed germination and seedling growth of* Aganope heptaphylla *(Leguminosae). Nusantara Bioscience 8: 150-154*. This study was carried out to explore the effect of growing media on seed germination and seedling growth of *Aganope heptaphylla* (L.) Polhill. The research was conducted in the greenhouse of Bogor Botanic Gardens nursery for two months from July to August in 2015. An experiment was carried out employing a completely randomized design with three treatments and three replications. The treatments were different sowing media: sand, rice husks, and sawdust. Each treatment had 15 seeds placed in plastic trays. The results showed that the germination percentage in the rice husk medium (75.6%) was higher and the peak germination value (0.55) significantly higher (at $p<0.5$) than in the other media. The medium of rice husks was found to be significantly best for the growth of the seedlings; it gave the highest growth in terms of seedling height (40.5 cm), number of roots (46) and the length of roots (11.2 cm).

Keywords: *Aganope heptaphylla*, seed germination, seedling growth, growing media

INTRODUCTION

Aganope heptaphylla (L.) Polhill (syn: *Derris sinuata* [L.] Merr.) is a tropical species from the family Leguminosae. Known as “*belulu*” in Sumatra, its young leaves are eaten as vegetable and used as fodder for cattle (Heyne 1950; Burkill 1966). It is found in Sri Lanka, India, Thailand, Peninsular Malaysia, Indonesia (Sumatra, West Kalimantan), Philippines, Papua New Guinea, and Australia; generally in environments of primary and secondary (dipterocarp) rain forest, or often along rivers, swamps, mangrove forests, seashores, and rocky sea-cliffs, up to 120 m asl. (Sirichamorn et al. 2012).

In Segara Anakan Cilacap, West Java, major logging of mangroves stimulated the growth of *Derris* and *Acanthus* understorey and the logged area became dominated by those two species, with high NDVI density values (Winarso and Purwanto 2014). On the other hand, in Sri Lanka, *A. heptaphylla* is included in the category of critically endangered, possibly extinct species, because it has no distribution records for the last 60 years based on recent comprehensive surveys (MoE 2012). De Walt et al. (2006) categorized *A. heptaphylla* in the Sepilok Forest Reserve, of Sabah, Malaysia as a plant associated with sandstone habitats.

In recent years, there has been an increased interest in the status of mangrove environments and the degradation of mangrove ecosystems in the South-East Asian region (Masagca 2008). Conversion of mangroves to aquaculture or agriculture generally requires total clearance of the vegetation and has thus been a major driver of mangrove destruction. According to van Bochove et al. (2014), "some 38% of global mangrove loss has resulted from clearing for shrimp culture, the single largest driver in South-East Asia. Notable changes in mangrove forest occurred due to overexploitation of the standing forest timber resources and the conversion of forest to agriculture and aquaculture encouraged by land management policies". The impact on natural mangrove forest ecosystems has been large (Van et al. 2015). According to Zewdie and Welka (2015), the degradation of the natural resources in the world is correlated with the increase in human population.

Germination of a seed is the initial, and under some circumstances, critical step in afforestation by natural or artificial means. Seeds of different species and of the same species from different locations exhibit different germination responses. Knowledge of this is essential for understanding plantation programs. Similarly, a species may be found in a wide variety of climatic regions, but the germination behavior may differ according to location (Masoodi et al. 2014).

Aganope heptaphylla has attained important status as an associated mangrove species for all of South-East Asia, but it has received limited research attention from scientists. There is poor information on the relationship between growing media and seed germination and growth of *A. heptaphylla*. The objective of this study was to identify the best medium for *A. heptaphylla* to germinate and grow into a healthy plant.

MATERIALS AND METHODS

Study area

An experiment on the seed germination and seedling growth of *Aganope heptaphylla* (L.) Polhill was carried out in the greenhouse nursery of Bogor Botanic Garden, West Java, Indonesia from 9th July to 1st August 2015.

Design

The experiment consisted of a completely randomized design of three treatments replicated three times. Altogether, there were nine germination trays each receiving fifteen randomly selected seeds of *A. heptaphylla*.

Procedures

The experimental treatments were three different growing media (sand, rice husks, and sawdust) soaked in distilled water for 24 h and then soaked in Dithane-M45 for 5 minutes before being spread in plastic trays (41 x 32.5 x 14.5 cm). Seeds of *A. heptaphylla* were sown in July at a depth of about 0.3 cm in the different media as per assigned treatment. The plastic trays were irrigated immediately after seed sowing. Watering was repeated every day until the final emergence.

Germination study of *A. heptaphylla* in different germination media was conducted in sand, rice husk, and sawdust. Daily observations were made on radicle emergence (Gairola et al. 2011; Mohammed and Elrahman 2015).

Seed germination percentage was calculated using the following formula (Gairola et al. 2011):

Germination % = Number of germinated seeds / Total number of seeds × 100

Germination associate parameters were calculated using the following formulas based on the original analytical methodology of Czabator (1962):

Speed of germination (Gairola et al. 2011; Zewdie and Welka 2015)

Speed of germination= $n_1/d_1 + n_2/d_2 + n_3/d_3 + --- + n_m/d_m$

Where, n = number of germinated seeds, d= number of days, and m = the mth day of counting

Mean germination time (MGT) (Gairola et al. 2011; Zewdie and Welka 2015)

MGT = $n_1 \text{ x } d_1 + n_2 \text{ x } d_2 + n_3 \text{ x } d_3 + --- + n_m \text{ x } d_m$ / Total number of days of counting (i.e. = m)

Where, n= number of germinated seed, d = number of days, and m = the mth day of counting

Mean daily germination (MDG) (Gairola et al. 2011)

MDG = Total number of germinated seeds/ Total number of days of counting

Peak value (PV) (Gairola et al. 2011)

PV = The value for the speed of germination on the day of counting when the speed of germination has reached its maximum.

Germination value (GV) (Gairola et al. 2011):

GV = PV X MDG

Seedling growth parameters

Ten randomly selected seedlings from each treatment were taken from each growing medium treatment to measure root and shoot length, the length, and width of leaves, the number of leaves and roots, and the fresh weight of each seedling. Lengths were measured with a scale expressed in centimeters and fresh weights of seedlings were measured on a three-digit balance, expressed in grams. The measurements and the counts of seedling leaves and roots were recorded 51 days after sowing the seed (Islam et al. 2012; Fetouh and Hassan 2014).

Data analyses

The results were statistically analyzed using MINITAB version 16. Analysis of variance was performed and difference between treatment means was separated by F test at P = 0.05.

RESULTS AND DISCUSSION

The seeds of *A. heptaphylla* sown in various growing media started germinating 3-4 days after the day of sowing and continued for up to 6 days, after which no further germination occurred in any of the treatments (Figure 1). When seed coats become permeable under natural conditions, the imbibition of water usually occurs through a plugged natural opening. However, water may be imbibed by the whole seed coat, depending on the moisture content of the seed (Baskin and Baskin 2001). During imbibition, the seed rapidly swelled and changed size and shape after just 24 h of soaking in water. Sand, rice husks and sawdust have high porosity, which is of benefit in supporting seed germination of *A. heptaphylla*. High porosity in the growing media permits easy oxygen penetration into the seeds after imbibition. The diffusion of adequate oxygen and water from the inert medium promotes respiration in the seed (Hartmann et al. 2002). Germination in non-dormant seeds starts when the dry seeds come into contact with water and ends when the radicle has emerged through all the coats enveloping the embryo (Weitbrecht et al. 2011). According to Abubakar and Muhammad (2013), a completely non-dormant seed has the capacity to germinate over the widest range of normal physical environmental factors possible for the genotype.

Germination study in different growing media

The effects of the three growing media on seed germination are recorded. Germination percentage was a maximum (75.6%) in rice husk followed by sand and sawdust (both 68.9%) but the different was not statistically significant at P<0.05 level. Variation was also recorded in other parameters of germination between the

Figure 1. Pods and seeds of *A. heptaphylla* (left) and seedling development of *A. heptaphylla* (right)

Table 1. Seed germination of *A. heptaphylla* in different growing media

Growing media	Germination percentage	Speed of germination	Mean germination time	Mean daily germination	Germination value
Sand	68.9	0.90	1.96	0.45	0.19
Rice husk	75.6	1.01	1.60	0.49	0.59
Sawdust	68.9	0.87	2.00	0.45	0.14

Note: Means followed by the same letter in each column are no significantly different at 0.05 probability level

Table 2. Growth and development of *A. heptaphylla* seedling in different growing media

Media	Number of leaves	Leaf length (cm)	Leaf width (cm)	Fresh weight of plants (g)
Sand	3.3	7.9	5.7	4.058
Husk	3.4	8.6	6.6	3.485
Sawdust	3.3	8.7	6.6	3.575

Note: Means followed by the same letter in each column are no significantly different at 0.05 probability level

different growing media. The highest peak value was recorded in the rice husk growing medium (0.55) and the lowest peak value was in the sawdust (0.14) (Figure 2). The differences in peak value between the three growing media were statistically significant at P<0.05.

Speed of germination, mean germination time, mean daily germination, and the germination value were all higher in the rice husk medium than in the other two media, but the differences were not statistically significant at P<0.05 (Table 1).

Across the range of measured parameters for seed germination in this experiment, overall germinability was assessed to be better in rice husks than in the other two sowing media, despite the fact that for some parameters the differences did not reach statistical significance. The study suggests that the preferred germination medium for *A. heptaphylla* is rice husks. The porosity of this medium allows imbibition by the seeds and adequate aeration for seeds to germinate quickly. In high daytime temperatures, spraying water on the medium promotes imbibition and seed germination. Rice husk charcoal has good aeration and drainage, but low water holding capacity and therefore seeds do not absorb water optimally for the imbibition process (Rivai et al. 2015). Rice husk growing media contains a high content of silicon and potassium, nutrients which are useful soil amendments (Milla et al. 2013).

Seedling growth in different growing media

Seedling growth in the different germination media treatments of *A. heptaphylla* is recorded. Mean shoot length was highest in rice husks (40.5 cm), significantly greater (at P<0.05 significance level) than in sand (32.6 cm), but not significantly higher than sawdust (38.7 cm) (Figure 3). The mean number of root per seedling was highest in rice husks (46), significantly higher than in sand (35) at P<0.05 significance level, but not significantly higher than in sawdust (41) (Figure 4). Similarly, mean root length in risk husks (11.2 cm) was significantly higher than in sand (8.8 cm) but not significantly higher than in sawdust (10.6 cm). (Figure 5).

There was no statistically significant difference in the mean number of leaves per seedling in the three growing media (Table 2). Similarly, there were no significant differences between treatments in the mean length and width of leaves and in the fresh weight of the seedlings (Table 2).

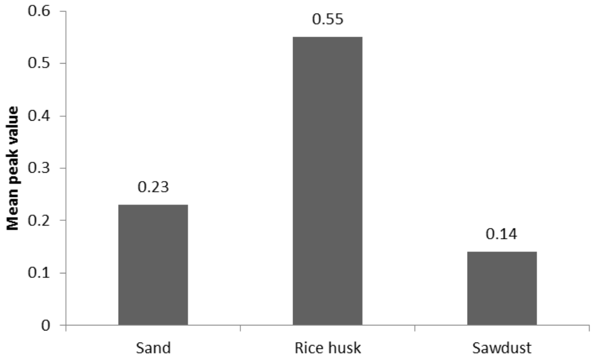

Figure 2. Mean peak value for germination in the three growing media.

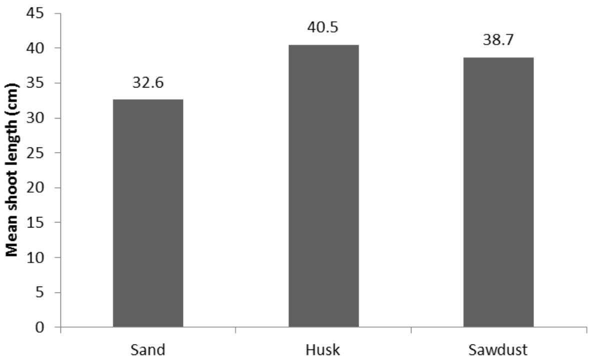

Figure 3. Mean shoot length of seedlings in the three growing media

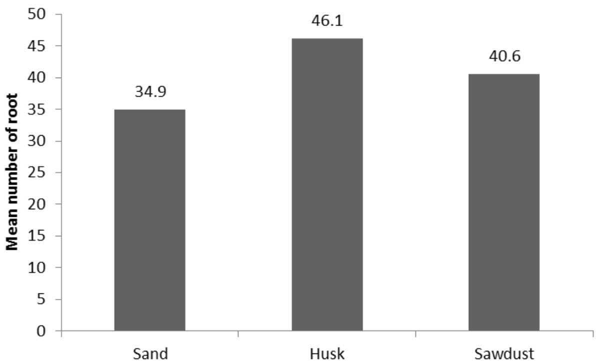

Figure 4. Mean number of roots per seedling in the three growing media

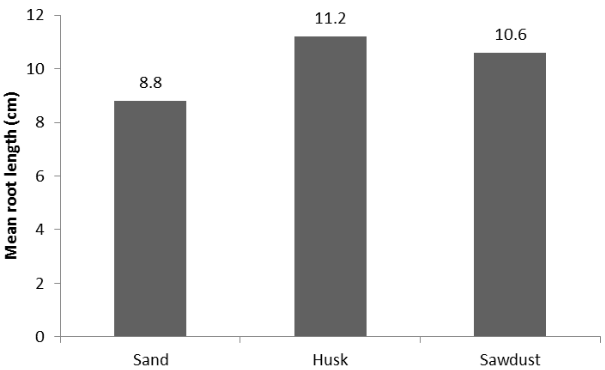

Figure 5. Mean root length of seedlings in the three growing media

Overall, our results show that seed germination and seedling growth of *A. heptaphylla* was better in a rice husk growing medium than in sawdust or sand. There are many studies on the effect of planting media on seed germination in a wide variety of plant species. For example, Kumar (2013) reported that the germination of *Stevia rebaudiana* in a risk husk growing medium reached 57.4%, while Yerima et al. (2015) reported a 78% germination percentage for sunflowers (*Helianthus annuus*) in a rice husk/soil mix. Ndor et al. (2012) reported that sawdust proved to be the best germination medium for *Telfairia occidentalis* compared to other media, and also optimized its growth and vegetative yield.

In our experiment, seedling growth of *A. heptaphylla* was better in a rice husk medium than in sawdust or sand, based on significant increases in three parameters: shoot and root length, and root number. Badar and Qureshi (2014) reported that composted rice husk was effective in increasing the shoot and root length of sunflower seedlings (*Helianthus annuus*). Similar enhancement of shoot and root length in tomatoes, *Lycopersicon esculentum,* has been reported by Lu et al. (2015).

Rice husk contains organic matter and silica. Meena et al. (2014) suggested that silica fertilizer has a double benefit in the soil-plant system: (i) improved silicon nutrition reinforces plant-protective properties against diseases insect attack, and unfavorable climatic conditions. (ii) soil treatments with active silicon substances optimize soil fertility through improved water, physical and chemical soil properties, and the maintenance of nutrients in plant-available forms. Siddiqui and Al-Whaibi (2014) reported that application of $nSiO_2$ improved seed germination percentage, mean germination time, seed germination index, seed vigor index, and seedling fresh weight and dry weight.

The rice husk growing medium is recommended for the germination of seed and the early seedling growth of *A. heptaphylla* on account of the results of this experiment comparing three different growing media. The peak value for germination in the soaked rice husk growing medium was significantly higher than in the soaked sand and sawdust. In the rice husk medium, height, number of roots and root length of *A. heptaphylla* seedlings were significantly greater than in both sand and sawdust.

On the other hand, there was no statistical significance in the differences between media in germination percentage, speed of germination, mean germination time, mean daily germination, germination value of seed and in leaf number, length and width of leaf, and fresh weight of seedlings.

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