Effect of Land Mounding on Seedling Growth of Gemor (Notaphoebe coriacea, Kosterm.) on Peat Swamp Forest

Purwanto Budi Santosa*, Susy Andriani, Adnan Ardhana, Syaifuddin
Banjarbaru Environment and Forestry Research Development Institute
Jl. A Yani Km 28,7 Landasan Ulin, Banjarbaru, South Kalimantan, Indonesia.
Telp./Fax.: (+62)511 4707872
*Corresponding Author: pur_balitaman@yahoo.com

Abstract. One of potential non-timber forest products (NTFPs) that has become a livelihood for communities around peat swamp forests in Central Kalimantan is gemor (Notaphoebe coriacea). However, the cultivation of this species is lack of information. In the practice of establishing plantations, land preparation is one of the most important factors. This study examined the effects of site preparation treatments (non-mounding and mounding) on the performance of N. coriacea seedlings. The study was carried out in secondary peat swamp forest in Central Kalimantan, Indonesia. N. coriacea planting was carried out by line planting (± 3 meters wide) and the light intensity of ± 50%. Land preparation of non-mounding (P0) was carried out on the surface of peatlands. Mounding land preparation (P1) was done by placing a sack filled with peat, with dimensions of ± 25 cm high, 35 cm wide and 50 cm long. Data was analyzed using t-test. The results showed that the preparation of plant land gave relatively similar growth between mound and non-mound on N. coriacea from generative seedlings.

Keywords : Notaphoebe coriacea, plantation, peat swamp forest.

I. Introduction
One of potential non-timber forest products (NTFPs) that has become a livelihood for communities around peat swamp forests in Central Kalimantan is gemor (Notaphoebe coriacea). About 70 years ago, the community had been endeavored as reported by Panjaitan et al. [1] and Santosa and Harun [2]. Gemor bark is not only used as incense, adhesive/glue and mosquito repellent, but has also potential medicinal benefit [3] and [4].

The gemor harvesting carried out so far by the community by cutting down the tree and taking the bark. The community harvests the gemor stands directly in the forest by cutting down and peeling off the bark which potentially results in scarcity of gemor presence [5]. This is also constrain for the availability of natural regeneration of Gemor. Thus, planting of gemor is required to avoid the extinction of gemor stands in its natural habitat like peat swamp land.

In conducting planting on peatlands, failure often occurs due to environmental conditions that are less favorable for the growth of new plants. Extreme conditions that occur during the rainy season are the tranquility that results in submerged plants. To handle this, environmental manipulation is needed to support plant growth, especially at the beginning of planting. Several studies at other places have shown that land preparation methods can increase plant growth in peat swamp land [8][9]. This study aims to determine the techniques of land preparation in gemor plants in peat swamp land.
2. Material and Methods

2.1. Site description
The study was conducted in the Forest Area with Special Purpose (KHDTK) Tumbang Nusa, Central Kalimantan Province. Geographically, KHDTK Tumbang Nusa is located between 0°8’48” to 3°27’00” South and 113°2’36” to 114°44’00” East. This location is a burnt peat swamp forest area. Location of gemor planting plots is a secondary forest and burnt about 22 years ago, the vegetation composition around the location was generally pioneers such as merapat (Combretucarpus rotundatus) and geronggang (Cratoxylon glaucum). Height of stands around the planting location are about 10—17 m, while canopy width were 3—4 meters. Soil pH was low (about 3.5). Rainfall ranges from 200—3500 mm/year, raining season occurred between October to March and the dry season from June to August. Air temperature ranges from 21°C—23°C, the maximum temperature was 36°C [10].

2.2. Research Methods

2.2.1. Research Design
Mounding land preparation was made from sacks filled with peat, with dimensions of 25 cm high, 35 cm wide and 50 cm long. Seedlings with height between 40.3 cm to 44.2 cm, between 0.7—0.8 cm, and the number of leaves ranging from 8.2 to 8.8 leaves were planted in mound and non-mound plots. Land clearing was done by making a path with a width of 5 meters prior to planting. The experimental units were placed to follow a completely randomized block design with two treatments, namely mounding land preparation (P1) and non-mounding/control (P2). Each treatment consisted of 30 plants and each treatment was replicated 3 times. While spacing between plants was 5 x 3 meters. The plants were maintained for eight month.

2.2.2. Data Analyses
The observations included survival index, plant height, diameter, and number of leaf and were carried out at 5 and 8 months after planting. Collected data from measurement was analyzed with t-test.

3. Results
The survival rate of gemor plants during observation is shown in Figure 1. At age of 8 months, gemor planted on non-mounding treatment had higher survival rate (98%) compared to mounding treatment (90%).

Figure 1: Survival rate performance of gemor planted in degraded peatland of Tumbang Nusa, Central Kalimantan
Both land preparation techniques resulted survival index above 90% which can be classified as good. At the same age (8 month), the survival rate of gemor plant was even better than other tree species of peat swamp (S. balangeran, D. polyphylla, C. bifflorum and C. inophyllum) which was less than 50% as reported by Tata and Pradjadinata [10]. In this study, gemor was planted on secondary forests while Tata and Pradjadinata (2016)[10] planted on degraded land which dominated by shrubs. The plants in current study and study by Tata and Pradjadinata [10] had different survival indexes due to different site conditions and nutrients. Nutrients and pH in secondary peat swamp forests seemed to be better than degraded peatlands dominated by shrubs.

| Treatment | Height (cm) | Diameter (cm) | Number of leaves |
|-----------|-------------|---------------|------------------|
|           | 5 months    | 8 months      | 5 months         | 8 months        | 5 months | 8 months |
| Mounding  | 7.4         | 8.9           | 0.1              | 0.2             | 3.9      | 3.8      |
| Non-mounding | 5.8         | 9.1           | 0.2              | 0.2             | 3.6      | 4.1      |
| P         | 0.513       | 1.00          | 0.658            | 0.513           | 1.00     | 0.828    |

Table 1: Increase of height, diameter and number of leaves of gemor plants from generative seedlings propagation.

Table 1 showed a height increased in between ages of five and eight months. However, the increase in diameter and number of plant leaves were from ages of 5 and 8 months were not clear. In general, there was no statistical different in plant height, diameter, and leaf number of mounding and non-mounding treatments.

Mounding land was supposed to provide a site environment that can support the initial growth of plants. Tata et al. [12] reported that the method of planting in mounds in peat swamps can help the growth of plant roots, especially in areas that have been inundated for longer than 1 week. Furthermore, according to FRDA [13] the mound affected the increase in soil temperature aroundthe rooting zone, increased drainage and aeration in wetlands, reduced disturbance around plants, provided media around rooting area that was rich in organic matter. Heiskanen and Rikala [14] also reported that making mounds for the Picea abies plant had increased concentration of the Nitrogen content in leaves due to increased root growth and/or better N availability resulting from increased concentrations in soil solution. The fact that in this study the site preparation with mounding and non-mounding did not yield a clear difference in the gemor seedling indicated that the site environment of mounding land did not encourage the growth of gemor. It could probably due to the duration of research that was only eight months. Further studies for longer observation periods may be needed to assess the effect of land preparation on the growth of gemor plants.

4. Conclusion
Seedlings growths were found to be similar in both treatments (e.i., mounding land preparation did not produce a clear difference in seedlings growth) in this study.

Acknowledgments
The research was supported by national budget for research (DIPA –APBN) year 2015 of the Banjarbaru Environment and Forestry Research Development Institute. Authors acknowledge Aditia Noor Robby, Sopian Agus, Ariyanto for their assistance during field work.

References
[1] Panjaitan S, Halwany W, Andriani S, Lestari F 2009 Potensi dan Persyaratan Tumbuh Hasil Hutan Bukan Kayu Jenis Gemor (Nothaphoebe coreacea Kosterm.) di Kalimantan. Laporan Hasil Penelitian Dana Bantuan Sosial DIKTI Lingkup Balai Penelitian.
[2] Santosa P.B dan Harun M.K 2013 Strategi budidaya gemor (Nothaphoebe coriacea Kosterm.) untuk agroforestri di lahan gambut. Makalah dipresentasikan pada Seminar Nasional Agroforestri. Universitas Lambung Mangkurat. Banjarbaru.

[3] Suhartono E, Thalib I, Santosa PB 2015. Potensi Kulit Batang Dan Daun Gemor (Nothaphoebe coriacea, Kosterm.) untuk Mencegah Diabetes Melitus; Studi Pendahuluan. Prosiding Seminar Nasional Sewindu BPTHHBK Mataram. Balai Penelitian Teknologi Hasil Hutan Bukan Kayu. Mataram

[4] Arifin YF, Hamidah S, Panjaitan S, Suhartono E 2015. In Vitro anti-Inflammatory activities of red gemor (NothaphoebeefuUmbelliflora). Journal of Medical and Bioengineering. 4 (4): 312-317.

[5] Rostiwiati T, Muhlisi, Adinugroho W.C 2010 Mengenal jenis penghasil kulit kayu Gemor yang hampir punah. Majalah Kehutanan Indonesia. Edisi 1 Tahun 2010. Hal. 33-35.

[6] Santosa P.B 2013 Teknik Persiapan Lahan Tanaman Gemor (Nothaphoebe Coriacea, Kosterm.) Di Lahan Rawa Gambut. Prosiding Seminar Nasional Sewindu BPTHHBK Mataram. Balai Penelitian Teknologi Hasil Hutan Bukan Kayu. Mataram

[7] Shimamura T, Momose K, Kobayashi S 2006 A comparison of sites suitable for the seedling establishment of two co-occurring species, Swintonia glauca and Stemonurus scorpioides, in a tropical peat swamp. Ecological Research 21 (5): 759-767.

[8] Nuyim T 2000 Whole Aspec on Nature and Management of Peat Swamp Forest Thailand. Proceeding of The International Symposium on Tropical Peatland. Hokkaido Universitu and Indonesian Institute of Science. 109-117 pp.

[9] Santosa PB 2012 Pengaruh Persiapan Lahan pada Tanaman Gemor Umur 3 Bulan. Galam 1 (1): 43-48.

[10] Tata HL and Pradjadinata S 2016. Native Species For Degraded Peat Swamp Forest Rehabilitation . Jurnal Silvikultur Tropika. Vol 7. No 3. p. S.80-S82.

[11] Tata HL, Bastoni, Sofiyuddin M, Mulyoutami E, Perdana A dan Janudianto 2015 Jelutung Rawa: Teknik Budidaya dan Prospek Ekonominya. Bogor, Indonesia. World Agroforestry

[12] Forest Resources Development Agreement (FRDA)1989. Mounding for site preparation. Canada

[13] Heiskanen J and Rikala R 2005. Root growth and nutrient uptake of Norway spruce container seedlings planted in mounded boreal forest soil. Forest Ecology and Management. 222: p. 410-417

[14] Barchia, M F 2006 Gambut Agroekosistem dan Transformasi karbon. Gadjahmada Univesity Press. Yogyakarta.

[15] Lo’f M, D Rydberg, Bolte, 2006 Forest Mounding site preparation for forest restoration: Survival and short term growth response in Quercus robur L. seedlings. Ecology and Management 232 :19–25

[16] Heiskanen J., Saksa T., Luoranen J. (2013). Soil preparation method affects outplanting success of Norway spruce container seedlings on till soils susceptible to frost heave. Silva Fennica vol. 47 no. 1 article id 893. 17 p.

[17] Santosa P.B, Yuwati TW, Rachmanadi D 2012. Long Term Effect of Site Preparation on Growth of Balangeran (Shorea balangeran) At Over Burn Peat Swamp Forest, Central Kalimantan. Proceeding INAFOR 2011. Ministry of Forestry