Comparing conventional peat swamp versus mound peat swamp on the growth of Pantung (Dyera lowii) plants in peat swamp land

W Wahyudi*
Department of Forestry University of Palangka Raya, Jl. Yos Sudarso Kampus UPR Palangka Raya, 73111, Indonesia

*Corresponding e-mail: wahyudi888@for.upr.ac.id

Abstract. Pantung (Dyera lowii) is one of the indigenous commercial species in Kalimantan which has good adaptability to peat swampland so that it can be used as a rehabilitation plant in degraded peat swampland. The purpose of this study was to determine the effect of mounds on the growth of diameter and height of pantung trees at the age of 10 years. Sampling was carried out randomly on 100 plants, each on a plant planted on conventional peat swampland (L1) and on peat swampland that had been made into mounds (L2). The results showed that at the age of 10 years, the growth of pantung plants grown using mounds was significantly better than without mounds, with a diameter of 25.1 cm and 15.32 cm respectively and height of 11.5 m and 9.44 m respectively. Land that is processed using the mounding technique has good aeration and plant care can be carried out more effectively and efficiently. Its higher location causes the plants not to be waterlogged for a long time, even during the rainy season.

1. Introduction
Pantung plants have a fairly high economic value from wood and sap. Pantung wood has a fairly good quality and can be used for making pencils, carvings, furniture, carpentry wood, and others [1,2,3]. Meanwhile, pantung sap can be used for various uses, including rubber, cable wrapping plastic, handicrafts, and cosmetics as well as being used to give rubber composition easy properties [4,5]. The cultivation of pantung plants has not been widely carried out in Indonesia so that a lot of wood and sap production comes from the peat swamp natural forest [6,3]. This dependence on nature makes the potential of pantung plants, especially in Central Kalimantan, difficult to know and the prospects of this plant in the future are also difficult to predict [7]. Pantung cultivation activities in addition to producing products from pantung wood and pantung sap can also be considered as biodiversity conservation of commercial native species as well as rehabilitation of degraded peat swamp forests and land.

This research on pantung growth is part of several studies that have been carried out by researchers from the Banjarbaru Forestry Research Institute. However, the effect of mounds on the growth of pantung has only been carried out this time. One of the efforts to cultivate pantung plants is in Jabiren Raya District, Pulang Pisau Regency, Central Kalimantan Province. To support the cultivation of pantung plants, research on plants is very much needed, including the manufacture of mounds to reduce flooding so that plant care can run more effectively and efficiently.
The purpose of this study was to determine the effect of mounds on the growth of pantung plants grown on peat swampland. This research was expected to provide information and knowledge about pantung cultivation and its future.

2. Method

2.1 Place and time
The study was conducted in the cultivation area of the pantung (*Dyera lowii*) plant which is located in Jabiren Village, Jabiren Raya District, Pulang Pisau Regency, Central Kalimantan Province. The time required for this research is ± 4 months, starting from January to Mei 2020 including preparation, data processing, and preparation, as well as research results.

Figure 1. The research place
2.2 Research procedure
The research procedures were: (1) Determining research plots areas. The old pantung plants were 10 years old. The same treatments were given for each planted on conventional peat swampland (L1) and mound peat swampland (L2), (2) Determining 100 plant samples at each plant location (L1 and L2) randomly. The mounds are 4 m wide, with a trench width and depth of 2 m and 1 m, respectively, (3) Measuring the diameter (dbh) and height (top height) of the sample plants, (4) Collecting secondary data, and (5) Research data processing.

2.3 Data analysis
To determine the effect of mounds on the peat swampland on the growth of diameter and height of pantung plants, a completely randomized design variance analysis test was carried out with the general model [8]:

\[ Y_{ij} = \bar{y} + t_i + \varepsilon_{ij} \]

Where:
- \( Y_{ij} \) = The value of observations on the i-th treatment: i and repetition: j
- \( \bar{y} \) = Middle value
- \( t_i \) = effect of treatment: i
- \( \varepsilon_{ij} \) = Error in treatment: i and repetition: j

| Table 1. Completely randomized resign |
|--------------------------------------|
| DS  | Df  | Sum of squares (SS) | Mean square (M$S$) | F count | F 5% | F 1% |
| Treatment | T – 1 | SST | SST/DiT | MST/MSE |
| Error | T (E – 1) | SSE | SSE/DiE | - |
| Total | TE – 1 | SSTt | SMS |

Conditions to conclude are as follows:
- a) If \( F_{\text{count}} \geq F_{\text{table}} \), so H1 is accepted. It means that the treatment is significantly different.
- b) If \( F_{\text{count}} < F_{\text{table}} \), so H1 is not accepted. It means that it is not significantly different

3. Results and Discussion
Peat swamp land is always characterized by the presence of stagnant water, either continuously or periodically, especially during the rainy season. Although the pantung plant is a local species, testing plant growth due to flooding is important. Plant growth is strongly influenced by soil factors as a medium for plant growth [9,10]. Inundation of the soil by water disrupts soil aeration so that plant metabolism processes can be disrupted [11]. To reduce the risk of inundation on the growth of pantung plants, land preparation for planting is carried out using the mound technique, which is to create a mound of soil that is higher than the surrounding area as a location for pantung planting, so that when water inundation occurs, the pantung plants do not become flooded. The mounds are made with a width of 4 m, a ditch width of 1 m, and a deep ditch of 60 cm.
Based on the results, the average diameter of a 10-year-old pantung plant planted in conventional peat swamplands and mound peat swampland was 15.32 cm and 25.1 cm, respectively, while the average height was 9.44 and 11.5 m respectively. These data showed the diameter and height growth of pantung plants planted on peat swampland with the mound technique had better results than the diameter and height growth of pantung plants planted on conventional peat swampland (without using mounds). To determine the effect of the mound technique on the growth of diameter of pantung plants on peat swampland in Jabiren Village, variance analysis was carried out as shown in Table 2.

![Mound Diagram](image_url)

**Figure 2.** The mounds are made with a width of 4 m, a ditch width of 1 m, and a deep ditch of 60 cm.

| DS     | Df | Sum of squares (SS) | Mean square (MS) | F count | F table 5% | F table 1% |
|--------|----|---------------------|------------------|---------|------------|------------|
| Treatment | 1  | 3,422.3             | 3,422.3          | 202.02  | 3.89*      | 6.76**     |
| Error   | 199| 3,371.7             | 16.94            | -       | -          | -          |
| Total   | 200|                     |                  |         |            |            |

*= the treatment is significantly different  
**= the treatment is very significantly different

Based on the analysis of variance for diameter (dbh) in Table 2, $F_{\text{count}}$: 202.02 $\geq F_{\text{table}}(\alpha = 0.05$: 3.89 and $F_{\text{table}}(\alpha = 0.01$: 6.76, thus the conclusion is to accept H1, meaning that the treatments are very different real (99%). This means that the planting of pantung using mounds resulted in a significantly higher dbh growth than planting without using mounds. The growth of pantung dbh is better on cultivated land by making mounds because the plants never experience waterlogging, so that air aeration is created and the process of absorption of nutrients from the soil can take place more effectively [10,11].
Table 3. Analysis of variance for pantung plants height on conventional peat swamplands and mound peat swampland

| DS          | Df | Sum of squares (SS) | Mean square (MS) | F count | F table 5 % | F table 1 % |
|-------------|----|---------------------|------------------|---------|-------------|-------------|
| Treatment   | 1  | 167.2               | 167.2            | 58.26   | 3.89*       | 6.76**      |
| Error       | 199| 571.5               | 2.87             | -       | -           | -           |
| Total       | 200| -                   | -                | -       | -           | -           |

* = the treatment is significantly different  
** = the treatment is very significantly different

Based on the analysis of variance for height in Table 3, $F_{\text{count}}: 58.26 \geq F_{\text{table}} (\alpha = 0.05): 3.89$ and $F_{\text{table}} (\alpha = 0.01): 6.76$ thus the conclusion is accept H1, meaning that the treatment is very different real (99%). This means that the planting of pantung using mounds resulted in a significantly higher height growth than planting without using mounds. This statement for height is the same as diameter because both are part of the tree's growth. The growth of pantung height is better on cultivated land by making mounds because the plants never experience waterlogging, so that air aeration is created and the process of absorption of nutrients from the soil can take place more effectively [10,11].

Pantung height growth is better on cultivated land by making mounds because it is influenced by differences in the speed of leaf formation which is very sensitive to the quality of the place to grow [12,13,14]. Land that is treated with the mounds technique has good aeration and its higher location causes the plants not to be waterlogged, even during the rainy season. Without mounds, where plants experience periodic flooding, especially during the rainy season.

The research location of pantung in conventional peat swampland has not been well maintained for more than 2 years. This causes the growth of weeds around the pantung tree which can be a competitor to the pantung tree. The factor of competition with these weeds also causes the growth of pantung plants in conventional peat swampland to be hampered. Several types of weeds that grow around the pantung tree are longleaf grass (*Brachiaria miliformis, Brachiaria mutica, Brachiaria paspaloides*), thin leaf grass (*Crytococcum oxyphyllum*), sharp leaf grass (*Eleusine indica, Cyperus sp*), ripang grass (*Panicum repens*), broadleaf grass (*Erechthites valerianifolia*), karamunting (*Melastoma malabathricum*), and others. Those weeds can be killed and the organic matter that has been produced can be used to increase soil fertility at the location. The addition of organic matter has been conducted and has a significant effect to increase tress growth [9].

![Figure 3. Pantung plants on the conventional peat swampland (left) and on the mound peatland (right)]](image)
The pantung plant cultivated by the community in Jabiren village is native to the peat swamp forest in Central Kalimantan. Cultivation using this species is the right choice because this species has adapted to its habitat. This plant produces wood (HHK) and pantung sap as potential non-timber forest products (NTFP). The sap of pantung has a high value and the demand for this commodity is also high. This latex can be used for various purposes, including as an ingredient for making chewing gum, plastic cable wrapping, handicrafts, and cosmetics and is used to give rubber composition easy squeezing properties [4,5].

Another economic value of pantung is its leaves and skin which can be used as medicinal ingredients to treat inflammation, fever, and pain [15]. While the pantung wood is of good quality and can be used as a drawing table, carving, furniture, pencils, plywood, crates, canoes, shingle, and others, besides that jelutung wood can also be used as a component for making guitars and violins [16].

Given the many benefits of pantung plants, the cultivation of pantung plants is very important. Cultivation of pantung plants in peat swampland should be carried out using a mound technique to avoid the risk of being submerged, especially during the rainy season. The mound technique also makes it easier to carry out maintenance, such as fertilizing, weeding, weeding, and releasing. On land without mounds, fertilization activities are not effective because fertilizers can be carried away by the flow of water that inundates the plants.

4. Conclusion
Pantung plants planted on mound peat swampland have higher growth (diameter and height) than planted on conventional peat swampland. Pantung plants planted on mound peat swampland do not experience waterlogging so that the soil aeration runs well, and the nutrient absorption process runs better. Soil nutrients are not washed away by water flow.

Recommendation
Planting pantung plants in peat swampland should use the mound technique to avoid waterlogging and facilitate maintenance, especially during fertilization. Financial analysis is needed to find out more about the effectiveness of the mound system for the cultivation of important crops.

References
[1] Bahtimi Y 2009 Jelutung (Dyera spp) dan Strategi Pengembangan Dilahan Rawa Kalimantan Selatan Sebagai Penunjang Peningkatan Ekonomi Masyarakat Lokal (Banjarmasin: Universitas Lambung Mangkurat)
[2] Handadari T 2004 Pohon Pantung (Dyera spp) Tanaman Dwiguna yang Konservasionis dan Menghidupi Pusat Informasi Kehutanan : S.504/II/PIK-1/2004, Departemen Kehutanan RI
[3] Tata H L 2012 Jenis-Jenis Hasil Hutan Bukan Kayu Potensial dari Hutan Rawa Gambut di Tanjung Jabung Barat, Jambi (Bogor: ICRAF)
[4] William L 1963 Lactiferous Plant of Economic Importance IV Jelutong (Dyera sp) Economic Botany 17 110-126 (United State: New York Botanical Garden Press).
[5] Tata H L, Bastoni, Sofiyuddin M, Mulyoutami E, Perdana A, Janudianto 2015 Jelutung Rawa: Teknik Budidaya dan Prospek Ekonominya. (Bogor: World Agroforestry Centre (ICRAF) Southeast Asia Regional Program).
[6] Mojiol A R, Wahyudi, Narberty N. 2014. Growth Performance of Three Indigenous Tree Species (Cratoxylum arborescens, Alstonia spathulata, Stemonurus scorpioides) Planted at Burned Area in Klias Peat Swamp Forest, Beaufort, Sabah, Malaysia. Jurnal of Wetlands Environmental Management 2 pp. 66-78. April 2014
[7] Wahyudi 2014. Sustainable Forest Management Policy in Central Kalimantan, Indonesia. International Journal of Science and Research 3 pp 269-274 April 2014
[8] Sudjana 1988 Metoda Statistika (Bandung: Tarsito).
[9] Fisher RF, Binkley 2000 Ecology and Management of Forest Soil Third Edition John Wiley &
[10] Mori T 2001 Rehabilitation of degraded forest in lowland forest Kutai, East Kalimantan-Indonesia In Kobayasi S, Trunbul JW, Toma T, Mori T, Madjid MNNA, editors Rehabilitation of Degraded Tropical Forest Ecosystems (Bogor: CIFOR) Pp 17-26
[11] Sutedjo MM, Kartasapoetra AG 1991 Pengantar Ilmu Tanah (Jakarta: Penerbit Rineka Cipta)
[12] Davis LS, Johnson KN 1987 Forest Management, 3rd ed. McGraw-Hill, NY. 790 p
[13] Nair PKR 1993 An Introduction to Agroforestry, Kluwer Academic Publishers ICRAF Dordrecht-Boston-London 22 385-408.
[14] Nyland RD 1996 Silviculture. Concept and Applications (New York-Toronto: The McGraw-Hill Companies, Inc.)
[15] Wong MTF and Swift RS 2003 Role of Organic Matter in Alleviating Soil Acidity. In: Rengel Z (2003) Ed. Handbook of Soil Acidity Marcel Dekker, Inc: New York.
[16] Yahya S, Hamdan S, Jusoh I, Hasan M 2010 Acoustic properties of selected tropical wood species J.Nondestruct Eval 29 38-42.