IOP Conference Series:
Earth and
Environmental Science

PURPOSE-LED PUBLISHING™

PAPER • **OPEN ACCESS**

Plus tree selection of meranti bukit (*Shorea platyclados*) in Dolok Sibual Buali Nature Reserve, North Sumatra

To cite this article: Ahmad Baiquni Rangkuti *et al* 2025 *IOP Conf. Ser.: Earth Environ. Sci.* **1445** 012102

View the article online for updates and enhancements.

You may also like

- Choosing plus tree of Salagundi (*Roudholia teysmanii*) at Salib Kasih Tourism Area
K S Hartini and B Ompusunggu
- Genetic features of the offspring of Scots pine (*Pinus sylvestrisL.*) trees differing in the abundance of fruiting
Yu I Potasheva, D H Fayzulin and N P Gaevsky
- Morphological characterization of three types of Asam gelugur (*Garcinia atroviridis*) at three altitude in North Sumatra
Sortha Simatupang, Imelda Marpaung, Wasito et al.

This content was downloaded from IP address 217.74.153.144 on 06/10/2026 at 13:31

Plus tree selection of meranti bukit (*Shorea platyclados*) in Dolok Sibual Buali Nature Reserve, North Sumatra

Ahmad Baiquni Rangkuti[1,2*], Kansih Sri Hartini[1] and Samuel Jonathan Siahaan[1]

[1] Faculty of Forestry, Universitas Sumatera Utara, USU 2 Bekala Campus, Deli Serdang 20355, Indonesia
[2] Center of Excellence for Mangrove, Universitas Sumatera Utara, Medan 20155, Indonesia

[*]E-mail: baiqunirangkuti@usu.ac.id

Abstract. Selecting the right seed source or plus tree is one of the most important aspects in breeding activities forest plants, either generatively or vegetatively. Selection of the right plus tree determines the results and process of the next activity. In determining plus trees, several characters are needed that can be used as parameters in assessing the phenotype of a tree. parameters in assessing the phenotype of a tree. Assessment of phenotype characters can also determine the form of growth found in a tree. contained in a tree. The purpose of this research is to determine the candidate *S. platyclados* plus trees found in the Dolok Sibual-Buali Nature Reserve area. Candidate selection method candidate plus tree is done by using the comparison method. Analysis of data analysis carried out is analysis by using a table of values for the observed traits. A total of six *S. platyclados* as candidate trees plus that have been determined. The highest total score was found on candidate number tree candidate number 2 with a total score of the highest total score was found on candidate tree number plus 2 with a total score of 82 and the lowest on candidate tree number plus 6 with a total score of 67, while other candidate plus trees were found in the total score of 68-78. This difference in total score is because the appearance of a tree is influenced by differences in genotypes, differences in the environment where the tree grows, and the interaction between genotype and environment.

1. Introduction

Southeast Asia has a high biodiversity of various families. Dipterocarpaceae is one of the sub-families with a large number of species and a wide distribution. This subfamily has 13 genera, and 9 of them are found in Indonesia, namely Anisoptera, Cotylelobium, Dipterocarpus, Dryobalanops, Hopea, Parashorea, Upuna, Vatica and Shorea. Shorea spp. is one of the largest genus of species and commercial timber producers [1]. One of the Shorea species that has excellent wood quality is *Shorea platyclados*. *S. platyclados*, or known as meranti batu is a tree-habituated plant that can reach 50 m in height with a straight cylindrical trunk, and the diameter of the trunk above the banir reaches up to 180 cm [2].

Content from this work may be used under the terms of the Creative Commons Attribution 4.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

Based on data [3], *S. platyclados* now has a near-threatened status, so plant breeding activities must be carried out to maintain this species. Forest plant breeding research activities are carried out to provide a base population and carry out selection on the breeding population to produce superior seeds in the propagation population. The genetic potential possessed by each seed source in the propagation population will be used as material for the development of forest plantations (production population).

As part of this effort, candidate plus tree assessments are conducted to identify individual trees that have good phenotypic qualities as quality plant material. [4]. The quality of crop yields is inseparable from the seed or seed factor. Quality seeds are seeds that can provide offspring with qualifications that are in accordance with their intended use. One of the good seed sources is plus trees or selected parent trees, which are trees that phenotypically show good growth compared to surrounding trees and are designated as parent trees [5].

2. Methods

2.1 Research area

This research was conducted in September 2023 at Dolok Sibual-Buali Nature Reserve, Bulu Mario Village, Sipirok District and Aek Nabara Village, Marancar District, South Tapanuli Regency, North Sumatra Province. Dolok Sibual-buali Nature Reserve is geographically located at the coordinates 01°0‘- 01°37’ North latitude and 99°11'15‘- 99°17'55’ East longitude. Dolok Sibual-buali nature reserve has an area of 5,000 Ha. The forest of Ca. Dolok Sibual-buali forest is located at an altitude of 750-1,819 metres above sea level. The land slope is mostly steep (21-55%). The soil type is an alluvial soil with medium moisture and a dark brown-black soil colour with a pH between 5-6.5. The maximum temperature is 29 ^{0}C and minimum 18 ^{0}C with humidity between 35-100% [6].

2.2 Data collection

In principle, the comparison tree method compares the properties to be assessed between the comparison tree and the candidate tree. The way of placing the sample unit using systematic sampling in the field with a distance of each plus tree studied 50 meters from 5000 Ha of Dolok Sibual-Buali Nature Reserve is 2 ha. The procedure for selecting plus trees using the comparison tree method is as follows: Survey all trees in the sample plot. Conduct a characteristic assessment of *S. platyclados* [7]. Assessing the health of each tree based on stem straightness, stem roundness, crown condition, and branching angle [8]. Determine the plus tree as much as 1 tree at each location, then determine 5 comparison trees randomly around the plus tree.

2.3 Data analysis

Total tree height can be calculated using the following formula:

$$\text{Total tree height} = \frac{\text{Height of tree trunk plus}}{\text{Average trunk height of comparison trees}} \times 100\% \quad (1)$$

Diameter can be calculated using the following formula:

$$\text{Diameter} = \frac{\text{Diameter of plus tree}}{\text{Average diameter of comparison trees}} \times 100\% \quad (2)$$

Branch Free Height can be calculated using the following formula:

$$\text{Branch free height} = \frac{\text{Branch free height of plus tree}}{\text{Average branch free height of comparison trees}} \times 100\% \quad (3)$$

Canopy width can be calculated using the following formula:

$$\text{Canopy width} = \frac{\text{Tree canopy width plus}}{\text{Average canopy width of comparison trees}} \times 100\% \quad (4)$$

3. Results and discussion

3.1 Survey of plus tree candidates

The results obtained are 6 *S. platyclados* trees that can be used as plus trees in Ca. Dolok Sibual-buali. The 6 plus trees of *S. platyclados* were obtained from 50 plots with a fairly long distance between the trees (more than 50 m) and each of the plus tree candidates was compared with 1-5 comparison trees located around the candidate trees that had traits or characteristics that were not much different from the plus tree candidates. The decrease in the number of *S. platyclados* trees in Dolok Sibual-Buali is due to the fact that many *S. platyclados* trees have been cut down to be used as firewood and also as carpentry wood and many forest functions have been diverted into gardens carried out by the surrounding community and the flowering and fruiting periods are irregular. Meranti generally does not always bear fruit every year but once every 5 years it can bear abundant fruit [9]. Meranti seeds are recalcitran seeds so they cannot be stored for a long time.

The characteristics of the place where it grows and the characteristic characteristics of the fruit make it difficult to germinate in large numbers so that the number of existing populations of *S. platyclados* is small and almost not found at the tiller level. The 6 trees have met various characteristics that have been determined as plus tree candidates. *S. platyclados* is an important economical timber tree in international trade that is used for very high-value buildings, such as furniture manufacturing, high-end interior finishing, flooring, luxury doors, boat decks [10].

3.2 Distribution of tree candidates plus

There were 56 plus tree candidates in different locations and each tree had met the desired characteristics to be used as a plus tree candidate. The candidate tree plus *S. platyclados* was found in sloping ground conditions, and some of them were in flat ground conditions. Then, the distribution of *S. platyclados* plus tree candidates was mapped to make it easier to find the location/position of the plus tree candidates. 6 *S. platyclados* trees were obtained that can be used as plus trees in Dolok Sibual-Buali Nature Reserve. The 6 plus trees of *S. platyclados* were obtained from 50 plots with a considerable distance between trees (more than 50 m) made at the research site and each of the plus tree candidates was compared to 1-5 comparison trees that had traits or characteristics that were not much different from the plus tree candidates.

3.3 Scoring on each tree candidate characteristic plus S. platyclados

Based on the results of the observations that have been made, the plus tree candidates that have been observed in height, diameter, title condition, trunk straightness, natural pruning, trunk roundness and branching angle are weighted.

3.4 Height

After observing the total height of the plus tree candidates in the field, the results obtained from the observation are given a score on each plus tree number. The total height scoring of the plus tree candidates can be seen in Table 1.

Table 1. Total height values of plus tree candidates and average comparison trees of *S. platyclados* in Ca. Dolok Sibual-buali.

No PP	Average height of the comparison tree (m)	Total height of the candidate tree plus (m)	RT	Score
1	20.6	24	11.50	18
2	21.6	28	129.63	20
3	20.8	22	105.77	12
4	22	26	118.18	18
5	21.2	24	113.20	16
6	20.8	22	105.77	12

Based on Table 1, it can be seen that there is a difference in the height of *the plus tree* and also the score value. Where the largest total height *of the plus* tree is found in number 2 with a total tree height of 28 m and the lowest total height *of the plus* tree is found in numbers 3 and 6 with a total tree height of 22 m while in the weighting of the plus tree height score value, there is a *plus* tree height score valueThe lowest is found in numbers 3 and 6, with the score obtained on each of these numbers is 12 with a high percentage difference in each number ranging from 105% - 110% and for the highest score value of the plus tree is found in number 2 with the score obtained on each of these numbers is 20 with a high percentage difference in each of these numbers is ≥121%. Based on the results of the observation of the total high number of plus tree candidates, the highest score is very good to be designated as *a plus* tree candidate. The total height of most trees has a height of over 20 m with a total score of 20. The total height character in most plus tree candidates is more than 20 meters tall with a total score of 20 [11]. There are many factors that affect the size of the height difference between *the plus* tree and the comparison tree, one of the characteristics of *the plus* tree is that it gets full light from the sun and is not in the shade [12].

3.5 Diameter

After the observation of the diameter of the plus tree candidate in the field, the results obtained from the observation were then given a score on each tree number. The scoring of the diameter of *the plus* tree candidate can be seen in Table 2.

Table 2. Values of the diameter of the *plus* tree candidate and the average diameter of the comparative tree *of S. platyclados* in Ca. Dolok Sibual-buali.

No PP	Average Diameter of the comparator tree (cm)	Candidate tree diameter *plus* (cm)	RD	Score
1	38.56	54.14	140.40	30
2	39.68	136.96	345.08	30
3	28.73	38.22	113.04	30
4	46.37	63.67	137.31	30
5	47.45	57.32	120.80	25
6	35.79	44.59	124.57	30

Based on Table 2, it can be seen that there is a difference in the diameter of *the plus* tree and also the score value, where the largest *diameter of the plus* tree candidate is found in number 2 with a tree diameter of 136.96 cm and the lowest diameter *of the plus* tree candidate is found in number 6 with a tree diameter of 44.59 cm while in the weighting of the score value of *the plus* tree diameter candidate There is the lowest plus tree candidate diameter score value found in number 5 with the score obtained on each of these numbers is 25 with a high percentage difference in each of these numbers ranging from 116-120% and for the largest plus tree candidate diameter score value is found in numbers 1, 2, 3, 4 and 6 with the score obtained on each number is 30 with a high percentage difference in each number is ≥121%.

Observation and assessment of the diameter of *S. platyclados* trees showed that the growth properties found in each tree character were generally quite good. The characteristics of tree diameter in most plus tree candidates have a diameter above 0.2 m. or 20 cm with a total score of 30. The larger the percentage difference between the diameter of *the plus tree* candidate and the comparison tree candidate, the greater the score that will be obtained.

3.6 Header condition

After observing the condition of the candidate header *of the plus* tree in the field, the results obtained from the observation were given a score on each plus tree number. The scoring condition of *the plus* tree candidate header can be seen in Table 3.

Table 3. The observation value of the condition of the candidate tree *crown plus S. platyclados* in Ca. Dolok Sibual-buali.

No PP	Header Condition	Score
1	Healthy and balanced	10
2	Healthy and balanced	10
3	Healthy and balanced	10
4	Healthy and balanced	10
5	Healthy and balanced	10
6	Healthy and balanced	10

Based on Table 3, it can be seen that the condition of the crown *of the plus tree candidate* is included in the characteristics of a healthy and balanced one. Trees that experience disturbances in the crown will experience disturbances in their physiological processes so that they can inhibit the growth of the tree. Damage to the crown is generally experienced by old trees. The more damage to the header, the more unhealthy the tree becomes. The threshold value for *the plus* tree candidate in the header condition is 20%. The threshold value for tree damage is at the limit of 20% which means that the branches and leaves are damaged by insect activity and fall off in small amounts. If the damage to the leaf crown is more than 20% then the tree cannot be categorized as *a plus tree candidate*. The health of the tree, as evidenced by the state of the tree canopy, has a considerable influence on the growth of the tree, which in turn affects the quality of the wood and the amount of wood to be produced [13].

3.7 Trunk straightness

After observing the straightness of the trunk of *the plus tree* candidate in the field, the results obtained from the observation were given a score on each plus tree number. The scoring on the straightness of the bar can be seen in Table 4.

Table 4. Observation value of straightness of the trunk of the candidate tree *plus S. platyclados* in Ca. Dolok Sibual-buali.

No PP	Trunk Straightness	Score
1	Straight up to 75 %	7
2	Straight up to 75 %	7
3	Straight up to 75 %	7
4	Straight up to 75 %	7
5	Straight up to 75 %	7
6	Straight up to 50 %	5

Based on Table 4, it can be obtained that the straightness level of the trunk of the candidate tree *plus S. platyclados* ranges from 50-75% with the weighting of the scoring value for the straightness of the trunk reaching 50% in the score of 5 and the straightness of the trunk reaching 75% in the score of 7. Many trees in the forest have poor growth appearance. For example, the stem is bent and not straight. According to the theory of tree genetics, the nature of the bent tree trunk is the dominant influence of genetic factors, so it should not be used for seed mother trees because the offspring produced will be poor in trunk growth. In the results obtained, it can be seen that some of the trees that have been selected to be candidates for plus trees have a straightness of around 75% and others around 50%. The selection of plus tree candidates must have a cylindrical trunk shape length of at least 50% of its height [14].

3.8 Trunk roundness

After observing the roundness of the trunk of the plus tree candidate in the field, the results obtained from the observation were given a score on each plus tree number. The scoring of the roundness of the bars is presented in Table 5.

Table 5. Observation value of the roundness of the trunk of the candidate tree *plus S. platyclados* in Ca. Dolok Sibual-buali.

No PP	Trunk Roundness	Score
1	Round	5
2	Round	5
3	Round	5
4	Round	5
5	Round	5
6	Round	5

Based on Table 5, it can be seen that the roundness level of the candidate tree *plus S. platyclados* on average has a rounded trunk shape for the scoring weighting value of the rounded trunk is given a value of 5. A good roundness of the rod will make it easier in the process of working into wooden logs and is very good for building pole construction considering that one of the functions of *S. platyclados* is for the construction of building poles.

3.9 Branching angle

After observing the branching angle of *the plus* tree candidate in the field, the results obtained from the observation were given a score on each plus tree number. The scoring of the branching angle can be seen in Table 6.

Table 6. Observation of the branching angle of the *candidate tree plus S. platyclados* in Ca. Dolok Sibual-buali.

No PP	Branching Angle	Score
1	50-70º	5
2	>70º	10
3	50-70º	5
4	>70º	10
5	50-70º	5
6	50-70º	5

Based on Table 6, it can be seen that the branching angle value of the candidate tree *plus S. platyclados* ranges from 50-70º with the weighting of the scoring value for the branching angle reaching 50º in a score of 5 and the straightness of the trunk reaching more than 70º in a score of 10. Each tree to be selected as *a plus* tree must have superior traits by having a branching angle value of at least 50º. The branching angle is in the range of 50-70º, then the tendency of the branch's growth direction tends to be upwards and if the branching angle is ≥ 70º, the branch's growth direction tends to be horizontal.

3.10 Total score obtained from all aspects of the characteristics of the plus tree candidate on each plus tree number S. platyclados

Based on the scoring results that have been carried out on each of the characteristics assessed, namely: height, diameter, heading condition, straightness of the trunk, roundness of the trunk and the angle of branching, all of these values are entered into the register table of the results of the assessment of plus trees with the comparison tree method to find out how many trees are suitable as candidates for plus trees. The register of the results of the assessment of the plus tree candidate with the comparison tree method can be seen in table 7.

Table 7. Register the results of the assessment of plus tree candidates with the comparative tree method in the area and outside the Ca. Dolok Sibual-buali area.

No PP	Average tree value checklists		Tree score plus						
	T	D	T	D	P	KLB	KB	SC	Total
1	20,6	38,56	18	30	10	7	5	5	75
2	21,6	39,68	20	30	10	7	5	10	82
3	20,8	28,73	12	30	10	7	5	5	69
4	22	46,37	18	30	10	7	5	10	80
5	21,2	47,45	16	25	10	7	5	5	68
6	20,8	35,79	12	30	10	5	5	5	67

In Table 7, it shows that the number of candidate *trees plus S. platyclados* found in Ca. Dolok Sibual-buali is 6 trees. Of the 6 plus tree candidates , there is a difference in the total score of *the plus tree candidates*. Where the largest total score of the plus tree candidate is found in number 2 with a total score of 82 and the lowest total score *of the plus* tree candidate is found in number 6 with a total score of 67. The *most plus* tree candidates were found on a score of 68-78 which was found in numbers 1, 3, 4 and 5.

Based on the weighting of *the scoring* score that has been carried out, the total scoring score *of the largest plus* tree candidate is the best among other plus tree candidates . However, all plus

tree candidates obtained from *the scoring* results with this comparison tree method can be accepted as plus tree candidates because the total score obtained on each number is above 60. The number of scores from the calculation results carried out for each character of the prospective tree *plus* in each method is at least 60. If the condition of the prospective plus tree *is* good enough that the number of trees that have a minimum score of 60 is quite large, then the minimum score criterion can be increased. The plus tree assignment is canceled even if it has a minimum score of 60 if one of the criteria is worth 0.

In determining the *candidate for the plus* tree, several characters are needed that can be used as parameters in the assessment of the phenotype of a tree. Assessment of tree phenotypic characters can also determine the growth form found in a tree. It is not uncommon to find phenotypic differences between trees in an area. This difference is because the appearance of a tree is influenced by genotypic differences, differences in the environment where it grows and the interaction between genotype and the environment, genetic potential and environmental factors are the cause of variation, while environmental factors are always different between one growing place and another.

Each tree has variations or diversity. Variations between trees can occur due to differences in geographical variation (between provinces), local variations (between growing places), variations between trees in a growing place and variations within trees [15]. Between environmental variation and genetic variation there cannot be a clear line of difference drawn because they affect each other, however, such variation can be changed through silvicultural actions and differences in genetic makeup (can be changed by selection).

Selection is a process of increasing genetic value where individuals with certain traits are preferred to be bred. The traits assessed in this study were the total height of the tree, the diameter of the tree, the title, the straightness of the trunk, the roundness of the trunk and the angle of branching. Plus tree candidates that have been phenotypically selected using a *scoring system* with the comparison tree method can be used as a source of seeds that will later be planted in locations that have been selected as candidates for seed garden areas that have also been selected so that an area suitable as a place for seed gardens can be obtained.

The selection of *the plus tree* itself is subjective depending on its use or business as well as the requirements about the desired quality. For example, for the manufacture of paper, it is necessary to study the fibers and their specific gravity. However, the difference in the purpose of the plus tree business basically all refers to the standard criteria for selecting *the plus* tree as already mentioned. The existence of *plus* trees that are directly related to tree breeding activities in forest development is indispensable in determining the appropriate plant type, the best province of the appropriate plant type and the best individual in the best province.

4. Conclusion

There are 6 *S. plstyclados trees* that are designated as plus tree candidates in the Ca. Dolok Sibual-buali area with the largest total score at number 2 with a score of 82 and the lowest total score *of plus* tree candidates is at number 6 with a score of 67. The *most plus* tree candidates were found on a score of 68-78 which was found in numbers 1, 3, 4 and 5.

Acknowledgment

This research is part of a study entitled "Mother Plant *Shorea platyclados* Micorized Vegetative Breeding Source", which was funded by the USU Talenta Grant No. 142/UN5.2.3.1/PPM/KP-TALENTA/R/2023. Thanks to all those who have helped the success of this research activity.

References

[1] Djarwanto, Damayanti R, Balfas J, Basri E, Jasni, Sulistianingsih I M, Andianto, Martono D, Pari G, Sopandi A, et al. 2017 *Pengelompokan Jenis Kayu Perdagangan Indonesia* (Bogor: FORDA Press)
[2] Cao C P, Gailing O, Iskandar Z, Siregar, Ulfah J and Finkeldey R 2009 *Tree Genetics and Genomes* **5** 408
[3] IUCN *International Union for the Conservation of Nature and Natural Resources.* 2021. IUCN *Red List Threatened Species.* Version 3.1.
[4] Juanda, Muin A and Wulandari R S 2017 *Jurnal Hutan Lestari* **5** 4
[5] Aprianti R R 2006 *Penilaian Kesehatan Pohon Plus Kayu Afrika (Maesopsis eminii Engl.) di Hutan Pendidikan Gunung Walat (HPGW) Sukabumi dengan Metode FHM (Forest Health Monitoring)* (Bogor: Institut Pertanian Bogor)
[6] Balai Besar Konservasi Sumberdaya Alam Sumatera Utara 2011 *Buku InformasiKawasan Konservasi* (Medan: Kementerian Kehutanan)
[7] Hasibuan M, Indriyanto and Riniarti M 2013 *Jurnal Sylva Lestari* **1** 1
[8] Soeparno W 2013 *Metode Penilaian dan Penunjukkan Pohon Plus. Integrated Citarum Water Resources Management Investment Program (ICWRMIP) Citarum Watershed Management and Biodiversity Conservation (CWMBC)* (Bandung: Plantaxia)
[9] Purwaningsih and Kintamani E 2018 *IOP Conference Series: Earth and Environmental Science* **197**
[10] Wardani M and Susilo A 2017 *Evaluasi Eksistensi Shorea platyclados Slooten ex Endert di Hutan Lindung Bukit Daun* Widyariset 3 151-160 Pulan DE dan Buot
[11] Burhannudin S and Abdurrani M 2016 *Jurnal Hutan Lestari* **4** 4
[12] Daniel T W, John A and Frederick S 1992 *Prinsip-prinsip Silvikultur* (Yogyakarta: Gadjah Mada University Press)
[13] Putra I K, Santoso H and Mulyadi R 2017 *Jurnal Kehutanan Tropis* **45** 3
[14] Djamhuri E, Supriyanto I Z, Siregar U, Siregar A, Sukendro S, Wilarso P, Pamungkas and Safei R 2006 *Petunjuk Teknis Seleksi Pohon Induk* (Bogor: IPB Press)
[15] Robiyanti, Muin A and Wulandari R S 2015 *Jurnal Hutan Lestari* **3** 2