The evaluation of soil chemistry and soil physic on understudied of camphor trees (*Dryobalanops aromatica* Colebr)

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Abstract. The Study of chemical characteristics and soil physics under tree stands Camphor (*Dryobalanops aromatica* Colebr) aims to evaluate the chemical and physical properties of the soil in influencing the growth and production of trees Camphor (*Dryobalanops aromatica* Colebr). This research was conducted at the Research and Technology Laboratory Faculty of Agriculture University of North Sumatera. The research was conducted from November 2017 to March 2018. The research used a survey method with sampling based on purposive sampling that is taking soil samples. The results showed that the characteristics of the land under lime stands varied considerably, is cation exchange capacity (low and very low), C- organic (low, medium, and high), soil texture (sandy clay and sand clay), pH (very acid), and Ca-total (very low). The result of regression analysis showed that the real soil organic matter is directly proportional to the height and diameter of the lime tree trunk, while the real soil pH is inversely proportional to the height and diameter of tree trunks and the real exchange rates are directly proportional to plant height but not significant to the diameter of the stem.

1. Introduction

*Dryobalanops aromatica* Colebr. is a type of plant group *Dipterocarpaceae* which has several advantages because of a tree trunk can be generated various high-value commodities such as camphor, balm, resin, essential oil, and wood. In addition, the existence of limestone at this time according to the International Union for the Conservation of Nature and Natural Resources (IUCN) Relist is included in Critically Endangered or critical conservation status. This status is the highest level of vulnerability before extinction status. Assuming from both of these reasons, it is mentioned that the meaningful writing as a brief review of the golden age of lime plants is expected to be able to generate and motivate the community to contribute to preserving it [9]. Limestone habitats are common in mixed *Dipterocarpaceae* jungles up to 300 meters above sea level, on hillsides, and in textured mountains of sandy soils. The spread of this rare plant ranging from peninsular Malaysia, Sumatra, to Borneo (Sarawak, Brunei, Sabah and East Kalimantan).

Some areas in Indonesia which include limestone dispersal areas among them in the western region of Singkil, Christmas river, between Sibolga and Padang Sidempuan to Aerbangis and in the east ranging from the south river Rokan to the north of Batanghari. To the east can be found in the Riau archipelago including Bengkalis and Malacca, to the west on Morsala island, but this tree is not found on the islands...
of Simalur, Nias, and Batu islands [5]. Land surveys are means or methods for evaluating land to obtain data directly from the field. Survey of soil according to work is a collection of chemical, physical and biological data in the field as well as in the laboratory for the purpose of the land and special land estimation [1]. [11] mentioned that soil ability as a plant habitat that produces harvested material is determined by fertility level or as an alternative production capacity or productivity. Similarly, according to [8], soil fertility is the ability of soil to be able to provide nutrients in sufficient quantities for growth and crop yield.

The number of people who do not know the benefits of lime trees so that the number of trees began to be threatened, this is what makes the author interested in reviewing the inventory and limestone land characteristics

Dryobalanops aromatica Colebr, Garonggang village Pardomuan village, West Angkola district, South Tapanuli district, Sumatra province North. Through the characteristics of the land can be seen the efforts to be done in increasing the potential land to obtain growth and conservation of limestone

Dryobalanops aromatica Colebr. in the village Garonggang Pardomuan village, West district West Angkola, South Tapanuli district, North Sumatra province. The objective of the study was to identify the limestone land characteristics of

Dryobalanops aromatica Colebr in Garonggang village, Pardomuan village, West Angkola district, South Tapanuli district, North Sumatera province

2. Materials and Methods

This research was conducted in Garonggang Village, Pardomuan Village, South Angkola District, South Tapanuli Regency with a height of 636 to 820 meters above sea level. Soil analysis was conducted at the Research and Technology Laboratory of FP USU, Soil Fertility Laboratory, Faculty of Agriculture, University of North Sumatra Medan. Analytical Laboratory PT. Socfindo, Medan. The study was conducted from November to February 2018.

The materials used in this study were limestone (Dryobalanops aromatica Colebr) or camphor or lime tree in Pardomuan Village, South Angkola District, South Tapanuli Regency, secondary data of research location, soil samples taken from research area, plastic bag, plastic clear and rubber bands as a container of soil samples, label paper to name the samples as well as the chemicals used for the analysis in the laboratory.

This research is descriptive by using survey method. Sampling technique based on the Stratified Random Sampling method. The sampling of soil sample points is done randomly. Characteristics of land used as parameters in the inventory of this research are texture (sand fraction, clay fraction, and dust fraction), Cation exchange capacity, saturation base (K + exchange, Na + exchange, Ca2 + exchange, Mg2 + exchange), Ca2 + total, pH, C-organic, Organic materials as well as tree height and tree trunk diameter

3. Results and Discussion

The results of the inventory of limestone soil characteristics (Dryobalanops aromatica) can be seen from the characteristics of trees (tree height and tree trunk diameter), Climate Characteristics (Rainfall and Air Temperature) soil characteristics (pH, C-Organic, organic matter, soil texture, base (KB), cation exchange capacity (CEC), exchange base ions (K + Na + Ca2 + Mg2+).

3.1. Characteristics of trees (tree height (m) and tree trunk diameter (cm)

The lime tree is a tree that is quite large with a tree trunk erect straight, straight, round, with a brown stem skin and like scales. According to [9] that the trunk of the lime tree is upright, straight, resin, has a single leaf, shifting, glossy surface, flat leaf edge, leaf replica pinnate tightly, if the leaves are wrung will produce a fragrant aroma.

In the inventory result of lime tree characteristic, it is found that the highest data on tree height is 19.40 m with stem diameter 25.11 cm, and the lowest tree height is 12.14 m with stem diameter 15.85 cm. This can be affected by the age of the tree. Genetic factors, as well as tree interactions to the environment. [4] states that trees can have different growths and stem sizes as a result of the interaction of genetic and environmental factors. [10] states that pH is a soil parameter strongly controlled by the
The electrochemical properties of soil colloids. This term refers to the acidity and alkalinity of the soil, which is determined by the degree of hydrogen ions in the soil solution. The pH value can affect the supply of nutrients for the plant.

Table 1. Characteristic of lime tree (Dryobalanops aromatica) at Garonggang village, South Angkola district

| Sample Position | High (m) | Roving stems (cm) | Diameter stems (cm) |
|-----------------|----------|-------------------|---------------------|
| LU BT           |          |                   |                     |
| 1° 16' 58"     | 99° 6' 21" | 13.68             | 55.4                |
| 1° 16' 8"      | 99° 5' 36" | 18.49             | 76.3                |
| 1° 16' 9"      | 99° 5' 36" | 12.14             | 49.8                |
| 1° 16' 11"     | 99° 5' 35" | 19.40             | 78.9                |
| 1° 16' 9"      | 99° 5' 30" | 16.32             | 66.7                |
| 1° 15' 30"     | 99° 5' 56" | 15.05             | 62.3                |
| 1° 15' 35"     | 99° 5' 46" | 19.09             | 78.1                |

3.2. Soil characteristics (pH)

From the results of the research that has been done is known that the pH parameter (Table 2) has a value that is not much different, the highest pH value 4.09 and lowest 3.18, with criteria very sour. This indicates that the H⁺ ion is higher than OH⁻ [7].

Table 2. Characteristics of soil (soil pH)

| Sample Position | pH  | Category | C-Organic (%) | Category * |
|-----------------|-----|----------|---------------|------------|
| LU BT           |     |          |               |            |
| 1° 16’ 58”     | 4.09| Very sour* | 1.02          | Low        |
| 1° 16’ 8”      | 3.58| Very sour* | 1.66          | Medium     |
| 1° 16’ 9”      | 3.75| Very sour* | 1.32          | Medium     |
| 1° 16’ 11”     | 3.34| Very sour* | 1.88          | High       |
| 1° 16’ 9”      | 3.31| Very sour* | 1.55          | Medium     |
| 1° 15’ 30”     | 3.88| Very sour* | 1.53          | Medium     |
| 1° 15’ 35”     | 3.18| Very sour* | 1.76          | High       |

Note: *Based on [3]

3.3. Characteristics of soil (C-organic)

In (Table 2) the organic material parameters of the research that has been done is known that the parameter of organic material has various value, and included in the category of low, medium and high. Organic material in the low category is 1.76%, while in the range of 2.28% -2.86% and in the high category has a range of values 3.03% -3.24%. According to [11] the content of organic matter on each horizon is an indication of the magnitude of accumulation of organic materials in different circumstances. The content of organic matter is found indirectly organic matter = C-organic x 1,724. If the amount of C-organic in the soil can be known then the soil organic matter content can also be calculated. The content of organic matter is one indicator of soil fertility level.

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3.4. Soil characteristics (soil texture sand, dust, and clay fractions)

From the results of the research that has been done (Table 3) it is known that the soil texture parameters consisting of clay fraction, dust and sand have varied nicely. At a fraction of dust, the highest value is 21.01 and the lowest is 3.54. On clay fraction the highest value is 14.00 and the lowest value is 9.98. At the sand fraction the highest value is 85.86 and the lowest is 64.99. With texture class that is Sandy Clay and Sand is clay, and sand is enough to dominate.

Any distribution fraction may affect soil texture which is an important factor capable of influencing the physical, chemical and biological properties of the soil. This is in accordance with [6] which states that the particle size distribution is a major physical factor that affects the physical, chemical and biological properties of the soil.

| Sample position | Sand fraction | Clay fraction | Texture        |
|-----------------|---------------|---------------|----------------|
| LU 1° 16' 58" 99° 6' 21" | 64.99         | 21.01         | 14.00          | Sandy clay |
| BT 1° 16' 11" 99° 5' 36" | 71.85         | 18.17         | 9.98           | Sandy clay |
| LU 1° 16' 9" 99° 5' 36" | 68.43         | 19.69         | 11.87          | Sandy clay |
| BT 1° 16' 11" 99° 5' 35" | 85.86         | 5.04          | 10.60          | Sandy clay |
| LU 1° 16' 9" 99° 5' 30" | 73.01         | 14.00         | 10.44          | Sandy clay |
| BT 1° 15' 30" 99° 5' 56" | 67.77         | 13.22         | 13.22          | Sandy clay |
| LU 1° 15' 35" 99° 5' 46" | 72.18         | 17.39         | 10.43          | Sandy clay |

From the results of the research (Table 4) it is known that K + belongs to the low category with the highest value of 0.16 me / 100 g of soil and the lowest value of 0.10 me / 100 g of soil. In Na + there is a very high category that is 1.06 me / 100 g of soil. At Ca2 + and Mg2 + (Table 5) all samples in very low category with highest Ca2 + and Mg2 + sequential values were 0.20 me / 100 g of soil, 0.21 me / 100 g of soil and lowest value 0.09 me / 100 g of soil, 0.13 me / 100 g of soil. According to [14] cations are positively charged ions such as Ca2 +, Mg2 +, K +, Na +, and so on. In the soil these cations are dissolved in groundwater or absorbed by the soil colloids. The number of cations (in mill equivalents) that can be absorbed by the soil per unit of soil weight (usually per 100g) is called the cation exchange capacity (CEC).

| Sample position | K+ | Category | Na+ | Category |
|-----------------|----|----------|-----|----------|
| LU 1° 16' 58" 99° 6' 21" | 0.11 | Low*     | 0.86 | High*    |
| BT 1° 16' 11" 99° 5' 36" | 0.16 | Low*     | 0.87 | High*    |
| LU 1° 16' 9" 99° 5' 36" | 0.15 | Low*     | 0.84 | High*    |
| BT 1° 16' 9" 99° 5' 30" | 0.10 | Low*     | 1.06 | Very high* |
| LU 1° 15' 30" 99° 5' 56" | 0.12 | Low*     | 0.91 | High*    |
| BT 1° 15' 35" 99° 5' 46" | 0.15 | Low*     | 0.94 | High*    |

Note: *Based on [3]

From the results of the research that has been done (Table 5) it is known that the parameters of Ca-total has the highest value of 65.73 ppm and the lowest is 24.63 ppm. All categories are low. In the cation exchange capacity parameter (CEC) has the highest value of 10.97 me / 100 g of soil and the lowest value of 1.69 me / 100 g of soil, with the varied categories is low and very low. The basic
Saturation parameter has the highest value is 90.34% and the lowest is 12.5%, with a varied category that is very low and very high.

Table 5. Basic exchange ions (Ca2+ and Mg2+) (me / 100g of soil) and Ca total (ppm)

| Sample Position | LU  | BT  | Ca2+ | Mg2+ | Category | Ca-total | Category |
|-----------------|-----|-----|------|------|----------|----------|----------|
| 1° 16' 58"      | 99° 6' 21" | 0.13 | 0.16 | Very low | 24.63 | Low** |
| 1° 16' 8"       | 99° 5' 36" | 0.09 | 0.18 | Very low | 31.54 | Low** |
| 1° 16' 9"       | 99° 5' 36" | 0.17 | 0.21 | Very low | 26.76 | Low** |
| 1° 16' 11"      | 99° 5' 35" | 0.20 | 0.17 | Very low | 65.73 | Low** |
| 1° 16' 9"       | 99° 5' 30" | 0.18 | 0.13 | Very low | 27.02 | Low** |
| 1° 15' 30"      | 99° 5' 56" | 0.16 | 0.18 | Very low | 25.45 | Low** |
| 1° 15' 35"      | 99° 5' 46" | 0.19 | 0.19 | Very low | 39.72 | Low** |

Note:  
** Based on [3]

In soils with relatively low CEC values, the process of nutrient uptake by the soil colloids is not relative, and consequently these nutrients will be easily washed and lost with the movement of water in the soil (infiltration, percolation), and in turn nutrients are not available for plants. CEC value of soil is very diverse and depends on the nature and characteristics of the soil itself and the high value of CEC can be caused by the high content of soil organic matter partly due to physical activity in the soil body, cation exchange capacity (CEC) is a chemical property that is very closely related to soil fertility [2].

The relationship between tree characteristics and soil characteristics in the research that has been done, it is known that the relationship between tree characteristics and soil characteristics on certain parameters. From the results of simple linear regression table can be known at each parameter found that there are three parameters that have a significant influence on plant height, namely pH, and C-organic which has significant value in the sequence is 0.049 and 0.012.

Table 6. Cation exchange capacity (CEC) and basic saturation (KB)

| Sample Position | LU  | BT  | CEC  | Category | KB (%) | Category |
|-----------------|-----|-----|------|----------|--------|----------|
| 1° 16' 58"      | 99° 6' 21" | 8.99** | Low*  | 13.99 | Very Low* |
| 1° 16' 8"       | 99° 5' 36" | 9.52** | Low*  | 13.55 | Very Low* |
| 1° 16' 9"       | 99° 5' 36" | 10.97** | Low*  | 12.50 | Very Low* |
| 1° 16' 11"      | 99° 5' 35" | 1.69** | Very Low*  | 90.34 | Very High* |
| 1° 16' 9"       | 99° 5' 30" | 8.45** | Low*  | 14.46 | Very Low* |
| 1° 15' 30"      | 99° 5' 56" | 9.68** | Low*  | 14.15 | Very Low* |
| 1° 15' 35"      | 99° 5' 46" | 10.01** | Low*  | 14.60 | Very Low* |

Note:  
* Based on [3]  
** me /100 g soil.

Table 7, the significance of 0.049 and 0.012 are greater than 0.05. So on the basis of such comparisons, the pH, C-organic and organic materials have a significant effect on plant height. In soil
pH parameters (Table 7) can be known to have linear model \( Y = 39.294 - 6.403X \) with the value of the coefficient of determination \( (R^2) \) of 0.573 or 57.3%. From the linear model that can be interpreted that the value of plant height is inversely proportional to soil pH. In the C-organic parameter in the simple regression test the linear model was \( Y = 3.305 + 8.490X \) (Table 7) with the coefficient of determination \( (R^2) \) of 0.748 or 74.8%. From the linear model formed can be interpreted that the value of plant height is directly proportional to C-organic on the soil.

In soil pH parameters (Table 8) has linear model \( Y = 51.096 - 8.311X \) with a coefficient of determination \( (R^2) \) of 0.567 or 56.7%. From the linear model formed can be interpreted that the diameter of plant stem is inversely proportional to soil ph. In parameter C-organic linear model that formed is \( Y = 4.133 + 11.182X \) and \( Y = 4.140 + 6.484X \) with coefficient of determination \( (R^2) \) of 0.763 or 76.3%. From the linear model formed can be interpreted that the value of plant stem diameter is directly proportional to C-Organic on the soil. In the multiple regression (Table 7) it is known that the exchange ion has a significance of 0.039 which is greater than 0.05. So on the basis of such comparison, the exchange-based ions have a significant effect on the height of the plant. And it is assumed that interactions between exchangeable ions are observed. The value of the determination coefficient \( (R^2) \) formed is 0.980 or 98%, it can be said that the exchange metals can simultaneously affect the height of the plant. The significant effect on plant height, is K +, Na +, Ca2 +, and Mg2 +.

**Table 7.** Simple linear regression of soil characteristics against high lime trees (*Dryobalanops aromatica*)

| Parameters | Linear regression model | \( R^2 \) | Sig | Conclusion (\( \alpha=0.05 \)) |
|------------|-------------------------|---------|-----|-------------------------------|
| pH         | \( Y = 39.294 - 6.403X \) | 0.573   | 57.3% | 0.049 *                       |
| C-Organic  | \( Y = 3.305 + 8.490X \) | 0.748   | 74.8% | 0.012 *                       |
| KB         | \( Y = 15.160 + 0.46X \)  | 0.224   | 22.4% | 0.284 ns                      |
| CEC        | \( Y = 18.905 - 0.307X \) | 0.113   | 11.3% | 0.461 ns                      |
| K+         | \( Y = 19.982 - 28.586X \)| 0.059   | 5.9%  | 0.598 ns                      |
| Ca2+       | \( Y = 9.896 + 40.069X \) | 0.295   | 29.5% | 0.208 ns                      |
| Mg2+       | \( Y = 8.402 + 45.355X \) | 0.162   | 16.2% | 0.371 ns                      |
| Na+        | \( Y = 1.984 + 15.914X \) | 0.210   | 21%   | 0.300 ns                      |
| Ca-Tot     | \( Y = 11.723 + 0.133X \) | 0.484   | 48.4% | 0.083 ns                      |

**Table 8.** Simple linear regression of soil characteristics against lime tree trunk diameter (*Dryobalanops aromatica*)

| Parameters | Linear regression model | \( R^2 \) | Sig | Conclusion (\( \alpha=0.05 \)) |
|------------|-------------------------|---------|-----|-------------------------------|
| pH         | \( Y = 51.096 - 8.311X \) | 0.567   | 56.70% | 0.05 *                       |
| C-Organic  | \( Y = 4.133 + 11.182X \) | 0.763   | 76.30% | 0.01 *                       |
| KB         | \( Y = 19.761 + 0.06X \)  | 0.224   | 22.40% | 0.283 ns                      |
| CEC        | \( Y = 26.352 - 0.601X \) | 0.255   | 25.50% | 0.248 ns                      |
| K+         | \( Y = 18.854 + 18.701X \)| 0.015   | 1.50%  | 0.794 ns                      |
| Ca2+       | \( Y = 19.362 + 11.852X \)| 0.015   | 1.50%  | 0.792 ns                      |
| Mg2+       | \( Y = 25.476 - 24.197X \)| 0.027   | 2.70%  | 0.724 ns                      |
| Na+        | \( Y = -4.208 + 28.296X \)| 0.391   | 39.10% | 0.133 ns                      |
| Ca-Tot     | \( Y = 15.442 + 0.169X \) | 0.458   | 45.80% | 0.095 ns                      |

4. Conclusions

Characteristics of land under lime stand (*D. aromatica*) varies considerably pH (very acid), Ca-total (very low), basic saturation (very low), cation exchange capacity (low) and C- organic (medium). There is a significant relationship directly between the soil organic matter against the height and diameter of the lime tree trunk (*D. aromatica*). There is a significant correlation between pH to height and diameter.
of camphor tree trunk (*D. aromatica*). The exchange base ions (K+, Na+, Ca2+, Mg2+) have a significant relationship to plant height but not to plant stem diameter.

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