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Phenetic Relationship of Lichen on African Wood Trees (*Maesopsis eminii* Engl.) in Tea Plantation of Tangsi Baru Village, Kabawetan District, Kepahiang District

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ABSTRACT
Lichens are a mutually beneficial symbiosis between fungi and algae, they're found from lowlands to highlands. In a-highland Kepahiang Regency, lichens grown on various substrates; one of which is African wood trees (*Maesopsis eminii*. Engl). The study of the lichens diversity and their phenetic relationship aims to determine the diversity of lichens and to determine the phenetic relationship of lichens grown on African wood trees (*Maesopsis eminii*. Engl). Research was carried out in May-October 2020 at the Tea Plantation, Tangsi Baru Village, Kabawetan District, Kepahiang Regency. Sampling was carried out purposively to a height limit of 1.5 m. Sample identification, herbarium preparation, and data analysis were carried out at the Plant Biosystematics Laboratory. Lichens were analyzed based on 53 character statuses, given scores, and converted into matrix data using the MS program. Excel and the UPGMA method (*Unweight Pair Group Method with Arithmetic Average*) program *Numerical Taxonomy System* (NTSYS) version 2.02. It was determined 31 *species of* lichens with 3 types of thallus; 13 species of *crustose* thallus, 12 *species of foliose thallus,* and 6 *species of fruticose thallus*. The lichens relationship phenogram showed a similarity coefficient ranging from 0.54 to 0.98, divided into 2 main groups A and B. Main group A consisted of 22 species*;* 6 species of *fruticose* lichenes, 12 *species of foliose* lichenes and 4 *species of crustose* lichens. Main group B meanwhile, consisted of 9 species of crustose lichens. There were two species of one genus of lichens with a similarity coefficient of 0.98 which shows the similarity of almost all characters, namely *Lecanora helva* and *Lecanora pulicaris*. A distinguishing character is on the *apothecia* margin.

Keywords*: Lichens, phenetic kinship, African Wood*

1. INTRODUCTION

Kinship based on visible morphology is called phenetic kinship, which can be measured by comparing the status of morphological characters as much as possible [1]. [2] introduced the term phenetic to denote kinship relationships between living things based on the number of degrees of equality that exist based on the same morphological characters. The closer the kinship, the more similarities, the less the similarities, the further the kinship is [3].

The symbiosis between fungi and algae that is mutually beneficial is known as *lichens* [4]. Lichens can be found from lowlands to highlands, can be found on various substrates such as trees, man-made properties, rocks, and soil. Based on the thallus varieties lichens are divided into four types; *fruticose lichens, foliose lichens, crustose lichens,* and *squamulose lichens*.

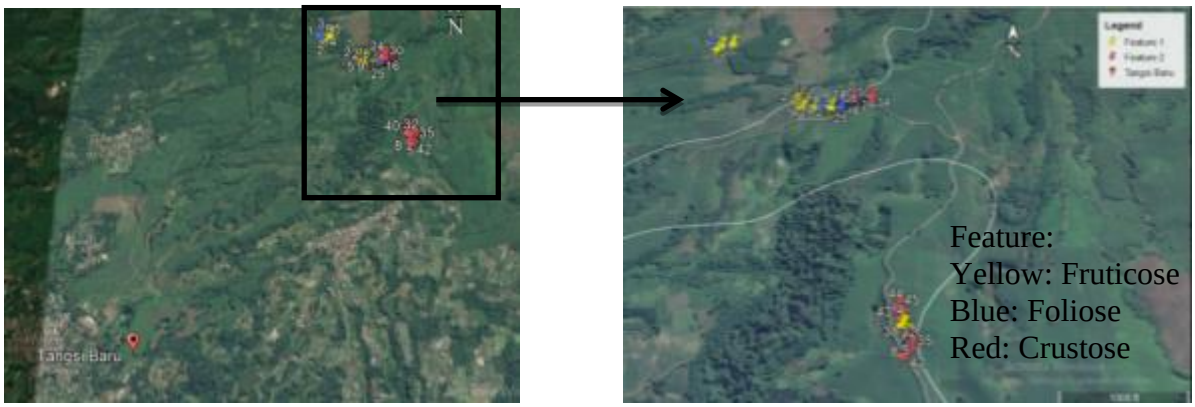

Figure 1. Map of Tangsi Baru Village Tea Garden Kabawetan District Kepahiang Regency (Google Earth)

The fruticose lichens have a bush-like shape, the *foliose* lichens have a sheet-like shape that is notched like a leaf, the *crustose*- type lichens have a crust-like shape and are tightly attached to the substrate surfaces, and the *squamulose lichens* have a shape like overlapping scales [5]. in Tangsi Baru Village, Kabawetan District, Kepahyang Regency Bengkulu Provice, African wood trees (*Maesopsis eminii* Engl.) grown around Tea plantation. There were grown many kinds of lichens with various type of thallii, colour and its morfological characters. Until now, it was still lack of data reported about phenetic relationship on African wood trees in Tangsi Baru Village, Kabawetan District, so a study was conducted on "The Phenetic Relationship of Lichens grown on African Wood Trees (*Maesopsis eminii* Engl.) in Tangsi Baru Village Tea Plantation. Kabawetan District, Kepahiang Regency".

2. MATERIALS AND METHODS

Sampling of lichen (*lichen*) at African wood trees (*Maesopsis eminii* Engl.) was carried out since May-October 2020 in the Tea plantations, Tangsi Desa Baru subdistrict Kabawetan, Kepahiang District. The research method used was *purposive sampling*. The samples obtained were then identified based on their morphological characteristics in the Biosystematics Laboratory of Basic Science FMIPA, Bengkulu University, lichens were identified based on the literature of [1] *The Lichens*, [6] *The Lichens Of British Columbia.*

Lichens are collected, grouped, and analyzed based on about 53 morphological character statuses, given a score, and converted into a data matrix using the MS Excel program. The similarity between groups of matrix data was analyzed using SIMQUAL (*Similarity for qualitative Data*) with a similarity coefficient SM (*Simple Matching*), then the similarity matrix used analysis grouping (Sahn) *Sequential Angglome- rative, Hierarchical and Nested* continued *Clustering* using UPGMA method (*Unweight Pair Group Method with Arithmetic Average*) in the *Numerical Taxonomy System* (NTSYS) version 2.02 [11].

3. RESULTS AND DISCUSSION

From the identification of lichens grown on African wood trees (*Maesopsis eminii* Engl.) In the Tea Plantations of Tangsi Baru Village, Kabawetan District, Kepahiang Regency, 31 *species* of lichens were determined, it was consisted 6 *species of fruticose* lichens, 12 *species of foliose* lichens and 13 *species of crustose* lichens. These lichens were determined as Ascomycota, that grouped in found on African wood trees, is included in *Divisio Ascomycota*, that grouped into 3 *Classes*, 5 Orders, 10 *Families.*

The most common lichens thallus found grown on African wood trees in Tangsi Baru Village Tea Plantation, those are the *crustose* thallus lichens (13 species). Some ideas supported this finding mentioned by researchers. According to [9] *crustose lichens* has tolerance to extreme environmental conditions so that it can adapt quickly to its surrounding environment. [10] adds that *crustose* thallus has a crust-like shape and is tightly attached to the substrate so that it requires less water for growth. This is the reason why thallus *crustose* lichens are found in large numbers at the study site. According to [11] thallus *crustose* lichens grow well at an altitude of 0-3000 masl. The research site has an altitude of 900-1050 masl, this is one of the factors supporting the growth of lichens at the site. This is also supported by research conducted by [12] around the UIN Ar-Raniry campus where the *crustose* type lichens

are most commonly found compared to other thallus types. [13], epiphytic lichens in the forest. Loang Gali tourism, Lenik Ramban Biak, East Lombok, there are 28 species of lichen with 16 *species* of thallus *crustose* and 12 *species* of talus *foliose*.

The least lichens found on African timber trees in the Tangsi Baru Village Tea Plantation are *species* with thallus fruticose; which was only 6 *species* exist. According to [7] *fruticose* lichens thallus is able to grow at an altitude above 700 masl, while the research location has an altitude of 900-1050 masl. Little *fruticose* lichen was found due to the lack of a canopy formed on African timber trees because the trees were planted at a distance of more than 2 meters, so that the light intensity goes directly to the ground. *fruticose* lichen can grow well at low light intensity and air temperature moist ranged 18- 21 ◦C. another factor that causes the least fruticose lichens allegedly due to the arrangement of the talus *fruticose* who cylinder, so the thallus structure attached to the substrates only slightly and is easily detached from its substrates when the wind blows. In this study, there was no found *squamulose. lichen*. This was because the abiotic factors at the research location did not support the growth of lichens with the *squamulose* type. According to [14], *squamulose lichens* are found in environments with high humidity and low temperatures with altitudes above 1600 masl. This is also supported by the research of [15] it was found the *squamulose lichens were* found in environments with a minimum temperature of 14 ◦C and a maximum temperature of 26 ◦C. Whereas at the research location a minimum temperature of 21 ◦C and a maximum temperature of 25 ◦C.

From the results of the phenogram formed, it can be seen that the farthest similarity coefficient is 0.54 and the closest similarity coefficient is 0.98. The similarity coefficient of 0.54 is divided into two main groups, namely group A and group B. Main group A consists of 22 species, 12 species including thallus *foliose, six* species *of fruticose* and four species of thallus *crustose*, main group B consists of nine species with type of thallus *crustose*. Similarity of characters in this group was found *apothecia* cup in several species. At a similarity coefficient of 0.60, the main group A was separated into two groups, namely A1 and A2, the characters that separated this group were differences in the color of thallus, *cilia, apothecia*, and *isidia*.

Group A1 consists of 13 species of lichens, most of the lichens in this group have the *foliose* thallus type, only three species with the *fruticose* thallus type. The similarity of the characters in this group are not contained *prothallus, rhizine*, color *rhizine*, there are no *apothecia*, do not have *labia*, the color of *the labia*, do not have *Perithecia*, and type *photobiont.*

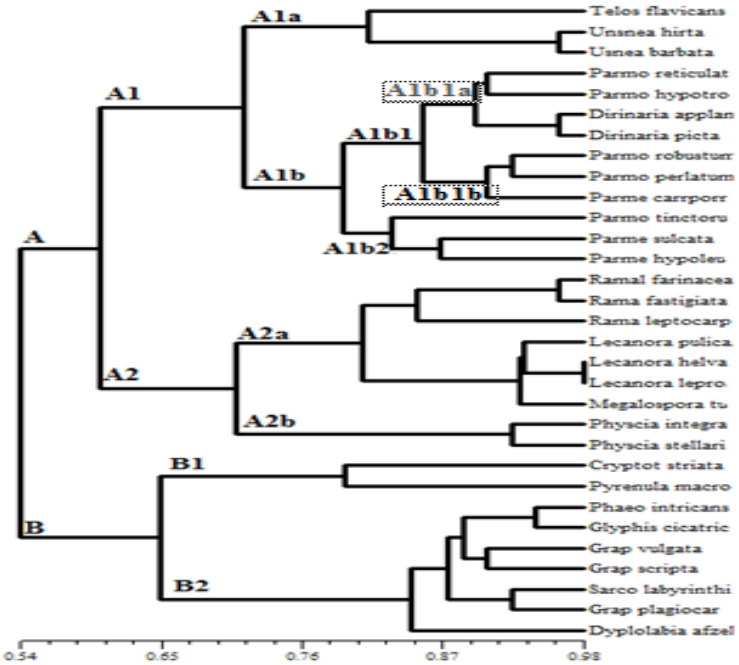

Figure 2. Phenogram of lichens based on the morphological characters

The lichens in group A1 are separated into two groups A1a and A1b at a similarity coefficient of 0.70, the characters that cause group A1 to separate are due to the type of thallus, variations in the thallus, and the type of *rhizine*.

Group A1a consisted of three species, namely *Teloschistes flavicans*, *Usnea hirta* and *Usnea barbata*. This group has similar morphological characters in the type of thallus, variations in the thallus, does not have a lower cortex, does not have a margin of the thallus, does not have a *prothallus*, does not have a *lobe*, has *rhizine* type *umbilicus*, does not have *cilia*, *apothecia*, *apothecia lirellae*, *labia*, *isidia*, and don't have *perithecia*. In this group *Usnea hirta* and *Usnea barbata* are closely related to the similarity coefficient of 0.96, distinguishing characteristics in the species is the color of the thallus above, and the number of *fibrils*.

Group A1b consists of 10 species, namely *Parmotrema reticulatum*, *Parmotrema hypotropum*, *Dirinaria applanata*, *Dirinaria Picta*, *Parmotrema robustum*, *Parmotrema perlatum*, *Parmotrema tinctorum*, *Parmleia carrporrhizans*, *Parmelia sulcata*, and *Parmelia hypoleucina*. The similarities of the characters in this group are the *foliose* thallus type, do not have *prothallus*, have *lobes*, have *lobes*, have *simple* black *rhizine*, do not have plate *apothecia*, do not have *apothecia lirellae*, do not have *labia*, have powder *soredia*, do not have *perithecia* and *fibrils*, *photobiont* type *Trebouxia* is green.

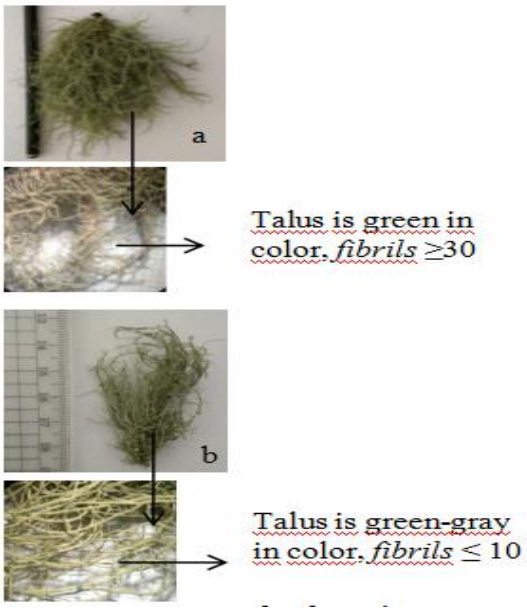

Figure 3. Thallus structures of: a. *Usnea barbata*, b. *Usnea hirta*

At a similarity coefficient of 0.79 the A1b group is divided into two groups A1b1 and A1b2. Group A1b1 contained 7 species, namely, *Parmotrema reticlatum*, *Parmotrema hypotropum*, *Dirinaria applanata*, *Dirinaria picta*, *Parmotrema robustum*, *Parmotrema perlatum*, and *Parmelia carrporrhizans*. The distinguishing characters in this group are the thallus margin, the type of *soredia*, the color and location of the *soredia*. At the similarity coefficient of 0.82, the A1b1 group was separated into two groups, namely the A1b1a group and the A1b1b group. In the A1b1a group *Dirinaria apllanata* and *Dirinaria picta are* included in the *Parmotrema reticulatum* and *Parmotrema hypotropum groups* because they have similar characters in the thallus margins, have *rhizine*, have *cilia*, do not have *prothallus*, *apothecia*, *lirellae*, *labia*, type *soredia*, do not have *isidia*, *perithecia*, *fibrils*, and *photobiont*. In this group the species *Dirinaria picta* and *Dirinaria applanata are* closely related with a similarity coefficient of 0.96, the characters that distinguish *Dirinaria applanata and Dirinaria picta* are thallus color and *soredia* color.

In the group A1b1b *Parmelia carrporrhizans* include both *Parmotrema robustum* and *Parmotrema perlatum* have a similar character on the type of the thallus, the variation of the thallus, the color of the thallus, the color of the cortex below the margin of the thallus, *rhizine*, *Cilia*, do not have *prothallus*, *fibrils*, *apothecia*, and *lirellae*, has same *photobiont* type and color. In group A1b2 there are three species, namely, *Parmotrema tinctorum*, *Parmelia hypoleucina* and *Parmelia sulcata*.

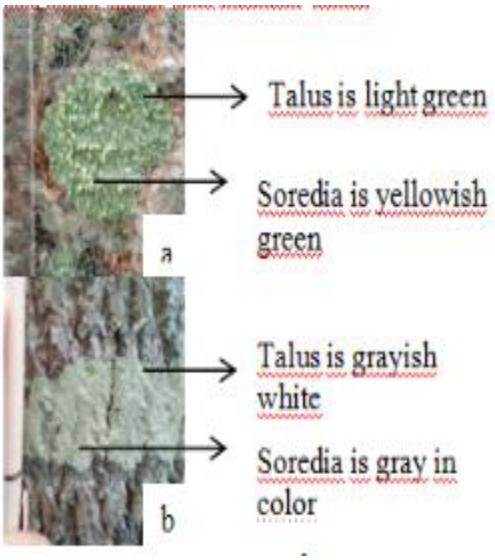

Figure 4. Thallus structures of: a. *Dirinaria applanata*, b. *Dirinaria picta*

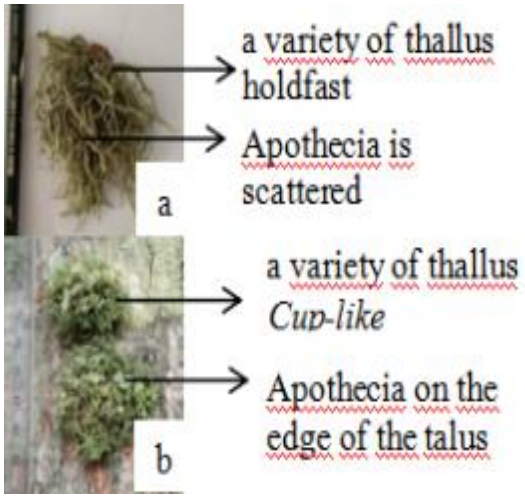

Figure 5. Thallus structures of: a. *Ramalia farinaceae*, b. *Ramalina fastigiate*

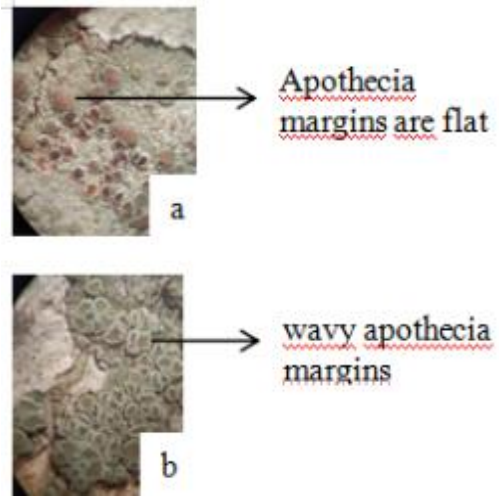

Figure 6. Thallus structures of: a. *Lecanora helva*, b. *Lecanora leprosa*

In the group A1b1b, *Parmotrema tinctorum* belongs to *Parmelia hypoleucina* and *Parmelia sulcata* because it has similar characters in lower cortical color, presence or absence of *rhizine*, color, *rhizine* range, does not have *apothecia, lirellae, perithecia, fibrils, soredia*, has *isidia*, type of *isidia*, and location *isidia*, has the same *photobiont* type and color. At the similarity coefficient of 0.70 the A2 group is divided into two groups, namely the A2a and A2b groups. This group has the same character, has a plate *apothecium*, does not have a *prothallus*, and does not have a *labia*.

The A2a group consists of seven species, namely, *Ramalina farinaceae, Ramalina fastigiata, Ramalina leptocarpha, Lecanora pulicaris, Lecanora helva, Lecanora leprosa*, and *Megalospora tuberculosa*. In the A2a group the species *Ramalina farinaceae* and *Ramalina fastigiata are* closely related with a similarity coefficient of 0.96, the distinguishing characters of these species are variations in the thallus, and the location of the *apothecia*. In this group the species *Lecanora helva* and *Lecanora lepros* were closely related with a similarity coefficient of 0.98, the distinguishing character of these species on the margin of the *apothecia of the* plate.

The A2b group consisted of two species, namely *Physcia integrata* and *Physcia stellaris.* Similarity of characters in this group has *apothecia* plate, does not have *prothallus, lirellae, labia, perithecia,* and *fibrils*. In this group *Physcia integrata, and Physcia stellaris are* closely related with a similarity coefficient of 0.92 distinguishing characters of these species, thallus color, *apothecia* type, and *apothecia* margin.

The main group B consists of nine species, lichens in this group have the type of *crustose* thallus. The similarity of characters in this group is that they do not have lower cortex, do not have *soredia*, have plate *apothecia* and some species have *apothecia lirellae* and *perithecia*. At a similarity coefficient of 0.65, the main group B was divided into two groups, namely groups B1 and B2. The characters that separate this group are the presence of *prothallus, perithecia, apothecia lirellae,* and *labia*. In group B1 there were two species, there are *Cryptothecia striata* and *Pyrenula macrospora.*The characters that distinguish this species are the colors of the thallus, *prothallus*, and *perithecia*. Group B2 consists of seven species, namely, *Phaeographis intricans, Glyphis cicatricosa, Sarcographa labyrinthica, Graphis plagiocarpa, Graphis vulgata. Graphis scripta,* and *Dyplolabia afzelii*. All species *of* group B2 have a *crustose* thallus type, do not have a lower cortex, do not have plate *apothecia*.

The lichens that have the closest kinship value based on their characters are *Lecanora helva* and *Lecanora leprosa*, with a similarity coefficient of 0.98. Then *Usnea hirta* and *Usnea barbata, Dirinaria apllanata* and *Dirinaria picta, Ramalina farinaceae* and *Ramalina fastigiata,* with a similarity coefficient of 0.94. According to [12] analysis of close kinship relationships if the level of character similarity is above 60%. From the analysis of kinship lichens on tree African wood (*Maesopsis eminii* Engl.) lichen has a close kinship between species of the species that is more due to similarity coefficients ranged from 0.54 to 0.98. From the results of the research, it is known that there are 50 species *of lichens* found on African wood trees (*Maesopsis*

eminii Engl.) in the Tangsi Baru Village Tea *Plantation,* including in Divison *Ascomycota,* with three *classes, five orders,* and 10 *families.* Based on the morphological characters, the phenogram of lichens was divided into two main groups A and B with a similarity coefficient ranging from 0.54 to 0.98.

4. CONCLUSION

It was determined 31 species of lichens with 3 types of thallus; 13 species of crustose thallus, 12 species of foliose thallus, and 6 species of fruticose thallus. The lichens relationship phenogram showed a similarity coefficient ranging from 0.54 to 0.98, divided into 2 main groups A and B. Main group A consisted of 22 species; 6 species of fruticose lichenes, 12 species of foliose lichenes and 4 species of crustose lichens. Main group B meanwhile, consisted of 9 species of crustose lichens. There were two species of one genus of lichens with a similarity coefficient of 0.98 which shows the similarity of almost all characters, namely Lecanora helva and Lecanora pulicaris. A distinguishing character is on the *apothecia* margin.

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