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The morphological character variation analysis of *Schizostachyum lima* (Blanco) Merr in Central Lombok Regency

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Abstract. The small diameter size with thin wall thickness is the unique character of *S. lima*, so it is appropriate to be used as raw material for environmentally friendly bamboo straws. This environmentally friendly bamboo straw has become one of the mainstay export commodities from Lombok Island. This research aimed at determining the diversity of *S.lima* in Central Lombok Regency through morphological characteristics and analyzing the phenetic relationship. The research was conducted from November 2020 to June 2021 in Central Lombok Regency. Determination of sampling locations based on literature and the community, especially bamboo craftsmen and *S.lima* collectors. There are 45 phenetic characters used in this research, consisting of qualitative data and quantitative data. Data analysis was used the NTSYS PC version 2.11a to analyze phenetic relationships. The phenogram was analyzed and subsequently used to develop descriptions of each *S.lima* which was found in the Central Lombok Regency. As a result, most of *S.lima* was found growing in community plantations with variations in the soil texture. The results of the cluster analysis resulted in 2 large groups, the first group consisting of 21 locations *S.lima* was found, and the second group only consisted of 1 location, namely Lantan. The level of similarity between the first group and the second group 2 was only 40%. Another group consisting of 21 locations showed a varying degree of similarity from one location to another (52%-93%). There are 6 locations that have the highest level of similarity (93%), namely, between Jurit and Presak bat, Bebante with Mekar Damai and Montong Terep, and Gunung Ise. The results of this study indicate that *S.lima* found in all locations in Central Lombok did not show significant variation when the growth factor was optimal. Further research by molecular approach is needed to determine the genetic variation of *S. lima* in Central Lombok Regency.

1. Introduction

Schizostachyum lima, a species of the family Poaceae, a subfamily of Bambusoideae, is native to the Philippines, Borneo, Sulawesi, the Moluccas, New Guinea, and the Solomon Islands [1]. *Schizostachyum lima* is also found growing wild throughout the Lesser Sunda Islands, including the



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Island of Lombok [2]. This type of bamboo could grow well in the dry and humid areas, lowlands to highlands up to 500 m asl in Kopang, Central Lombok [3,4].

Central Lombok has been the center for bamboo crafts for ages, such as those in Karang Sidemen village, Bujak village, and Kabul village. Various bamboo handicraft products such as building materials, household appliances, gazebos, and so on [5]. Bamboo craftsmen from Karang Sidemen village specializing in making bamboo handicraft products made from *S.lima*.

The small diameter size with the thin wall thickness is the unique character of *S. lima*, so it is appropriate to be used as raw material for environmentally friendly bamboo straws. This environmentally friendly bamboo straw has become one of the mainstay export commodities from Lombok Island. Some countries that have imported bamboo straws from Lombok such as; Belgium, Singapore, Netherlands, Switzerland, Germany, UK, Australia, South Africa, Hong Kong, Norway, Denmark and Portugal. The demand for bamboo straws from 2017 to 2019 has increased from 5000 straws to 114,772 straws [6].

Nowadays, efforts to develop *S.lima*, such as assembling superior varieties as raw materials for environmentally friendly bamboo straws with the best quality, have never been carried out. Therefore, it is necessary to explore the *S.lima* germplasm on Central Lombok Regency. This research aimed at determining the diversity of Central Lombok Regency *S.lima* through morphological characteristics and analyzing the phenetic relationship.

2. Method

The research was conducted from November 2020 - June 2021 in Central Lombok Regency, particularly in Subdistrict Praya (Lendang kondak), Southwest Praya (Batu Jangkih, Pampang, Kending Sampi, Panggongan and Kangas Lauk), Pujut (Tunak), Kopang (Jurit, Karang Lebah, Lendang Tampil, Gunung Tengak, Besun and Bebante), Barebali (Lendang dode, Gunung Ise, Tojak, Montong Terep and Mekar Damai), North Batukliang (Karang Sideman, Bujak, Lantan and Presak Bat). Determination of sampling locations was based on literature and the community, especially bamboo craftsmen and collectors. Samples of *S.lima* found in the study areas were collected [7], habitat types were recorded and soil samples were taken to analyze the soil texture. Data recorded consisted of collector name, collection number, location, and habitat. One individual of each *S.lima* was collected for developing herbarium. The specimens obtained are sprayed using 70 % alcohol, then set between the sheets of newspaper and inserted into a bag to bake for at least three days at 50 °C. After dry specimens are attached to the paper, labeled then ready to be identified and saved. Collected specimens are identified using descriptors [8–10]. Identification of *S.lima* was analyzed at the Laboratory of Ecology and Biosystematics Plant, State University of Mataram. Morphological characterization used as many as 45 characteristics. The morphological characteristics included habitus, young shoots, culms, branches, Culm-sheaths, auricles, ligules, blades, leaves, leaves-blades other morphological characteristics soils analysis will be carried out in Balai Pengkajian Teknologi Pertanian (BPTP) West Nusa Tenggara.

The next stage of this research was analyzed using the NTSYS pc version 2.11a program. This program can be used to analyze phenetic relationships. The program results are in the form of a phenogram. The phenogram was analyzed and subsequently used to develop descriptions of each *S.lima* found in the Central Lombok Regency.

3. Result and discussion

3.1. Ecological data of *S.lima*

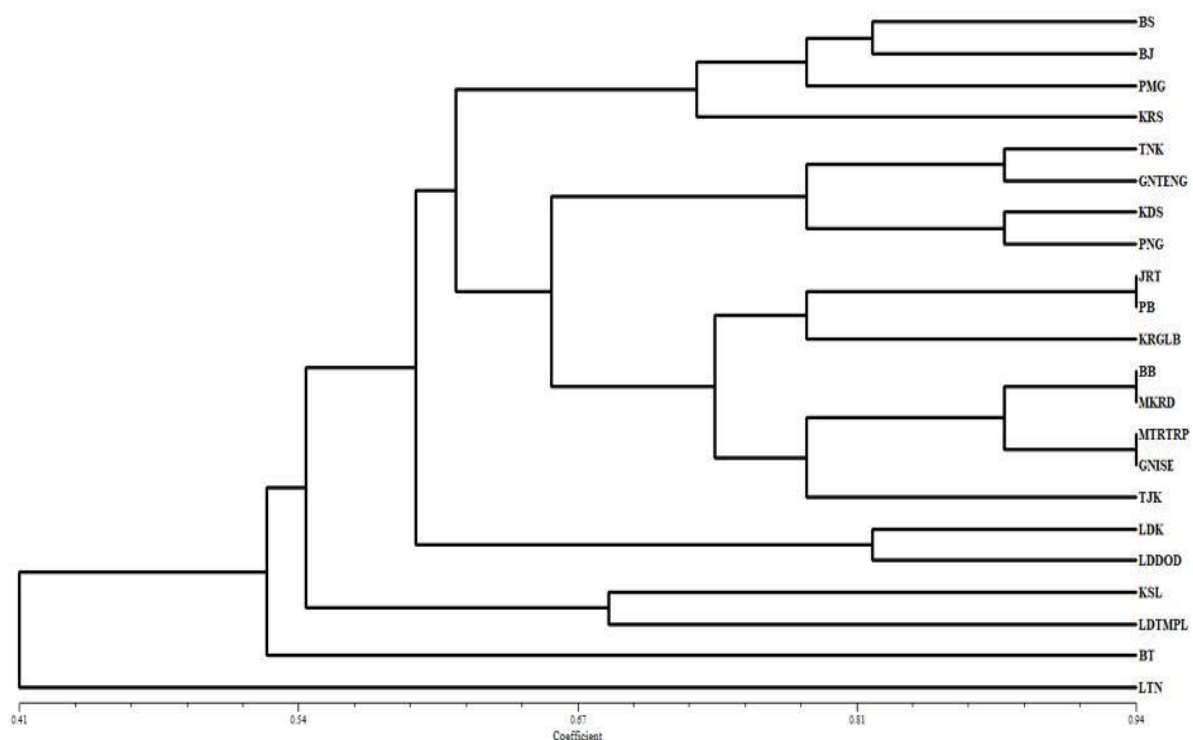
Most of *S.lima*, which was found growing in community plantations with variations in soil texture, were presented in Table 1 below. *S.lima* Grows from an altitude of 108 to 554 above sea level; temperature ranges from 25.8 to 28.3 with humidity 52.8% to 88.50%. Previous research found that *S.lima* grows in the lowland tropics up to m up to 500 m asl in Kopang, Central Lombok [4].

Table 1. Ecological Data.

Area	Habitat	Soil texture
Gunung Ise	Community garden	Sandy loam
Lantan	Community garden	Sandy
Lendang Dode	Community garden	Sandy -clay -loam
Presak bat	Village roadside	Sandy-silt-loam
Lendang Kondak	Riverbank	Clay loam
Gunung tengah	Community garden	Sandy-clay -loam
Bujak	Home yard	Sandy-clay -loam
Tunak	Ricefield	Clay-loam
Batu jangkih	Community garden	Loam
Besun	Community garden	Sandy-clay -loam
Karang Lebah	Community garden	Sandy loam
Lendang tampel	Community garden	Sandy loam
Tojak	Community garden	Sandy loam
Mekar damai	Community garden	Sandy loam
Montong terep	Community garden	Loam
Jurit	Community garden	Sandy loam
Pampang	Community garden	Sandy clay
Karang Sidemen	Community forest	Sandy loam
Kending sampi	Community garden	Sandy loam
Panggongan	Community garden	Loam
Kangas lauk	Community garden	Sandy loam
Bebante	Village roadside	Sandy loam

3.2. Cluster analysis of *S.lima* in Central Lombok Regency

So far, bamboo is mostly propagated through its vegetative organs, including *S.lima*. Bamboo has a very long juvenile phase (decades of years), similar to woody plants, only flowers once and dies after seed production (monocarpy) [11,12]. Most of the people took the vegetative organs of *S.lima* from the same place and then planted them on their respective lands. Reality propagation of plants through vegetative organs will not increase genetic variation in plants [13]. This condition can be seen from all qualitative data on the morphological characters of *S.lima* in the observations obtained have similarities in all research locations. There are 45 phenetic characters used in this research, consisting of qualitative data and quantitative data which will later form an analysis cluster, Figure 1.



Data description:

BS= Besun; BJ= Bujak; PMG= Pampang; KRS=Karang sedimen; TNK=Tunak; GNTNG=Gunung Tengah; PNG= Panggongan; JRT= Jurit; PB=Bebante; MKRD= Mekar Damai; MTRTRP= Montong Terep; GNISE= Gunung Ise; TJK= Tojak; LDK = Lendang Kondak; LDDOD= Lendang Dode; KSL=Kangas Lauk; LDTML= Lendang Tampil; BT=Batu Jangkih; LTN= Lantan

Figure 1. Cluster analysis *S. lima* in Center Lombok Regency.

The results of the cluster analysis resulted in 2 large groups, the first group consisting of 21 locations *S. lima* was found, and the second group only consisted of 1 location, namely Lantan. The level of similarity between the first group and the second group 2 was only 40%. The similarity of morphological characters (synapomorphy) of *S. lima* Lantan with *S. lima* found in 21 other locations was seen in 37 morphological characters and differed in 8 morphological characters (autapomorphy). The difference can be seen in the culm color, the length between segments, size of culm diameter, leaf color, length and width of the middle leaf, and the length of the terminal leaf, Figure 2.

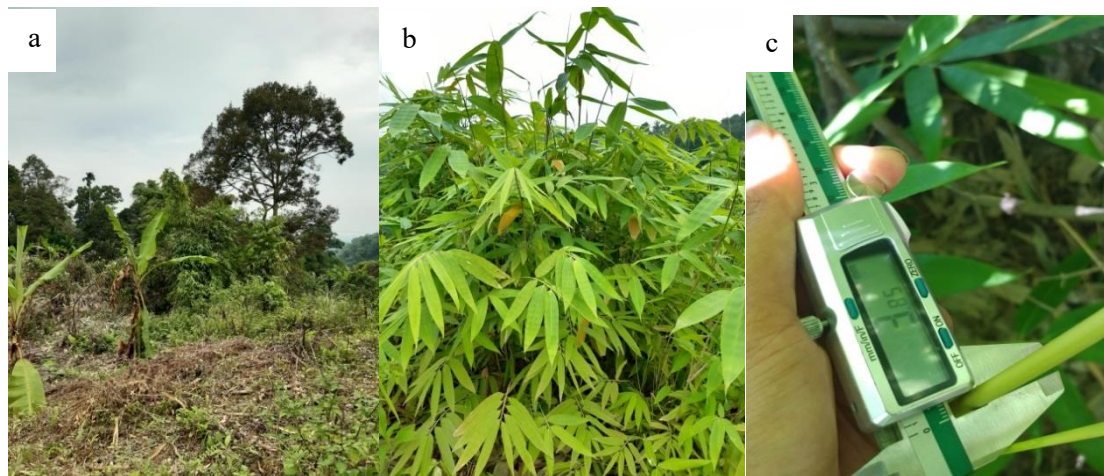


Figure 2. *S.lima* in Lantan Villages (a) Habitat; (b) Clump; (3) Diameter Clump.

S. lima, which is grown in Lantan Village, both qualitative and quantitative data looks different, especially in its stunted habitus and smaller diameter culm. The color and leaves also look yellowish green. When viewed from the soil texture owned, Lantan village has a sandy soil texture. The only habitat location for *S.lima* found with a sandy texture is in Central Lombok Regency. Sandy soil has properties that easily pass water, low organic matter content, and high soil temperature, so that such conditions are not favorable for plant growth [14]. In addition, according to information from the garden owner, the *S.lima* bamboo clump is a bamboo clump that was previously tried to be destroyed by burning and then grows back. Ecologically land fires can reduce the quantity and quality of biological natural resources. Land fire is a dangerous land destroying factor because it causes damage to biotic and abiotic components. Biotic damage in the form of loss of natural vegetation structure, destruction of wildlife habitat, death of soil flora and fauna and soil microorganisms. Abiotic damage in the form of loss of organic matter, damage to the function of the water system (hydrological), the emergence of runoff and erosion, decreased carbon uptake [15–18].

In the cluster analysis above (figure 1), it can also be seen that another group consisting of 21 locations showed a varying degree of similarity from one location to another (52%-93%). There are 6 locations that have the highest level of similarity (93%), namely, between Jurit and Presak bat, Bebante with Mekar Damai and Montong Terep, and Mount Ise. The similarity of morphological characters was seen in 44 morphological characters, and each only differed in 1 morphological character (length of midrib, width of terminal leaf, and width of middle leaf). Growth factors and ecological factors that are almost homogeneous greatly affect the formation of homogeneous morphological characters, Figure 3.

The difference on the soil texture also indirectly affects the formation of the *S. lima* cluster in Central Lombok Regency. It can be seen that found growing in 21 locations had growth that was not much different from one another. Meanwhile, *S. lima* which growth in Lantan Village had Sandy soil texture, the only habitat in Central Lombok Regency so that Lantan Village forms their own cluster. A Sundry soil texture has the ability to hold ground water and provide nutrients especially for low plants that it is very influential on the plant growth and development. This condition can be seen from the morphological characters of *S. lima* growing in Lantan Villages which are very different from other locations.



Figure 3. *S. lima* at a different location (a) Gunung Ise; (b) Panggongan; (c) Pampang; (d) Montong Terep.

4. Conclusions

Most of *S. lima* was found growing in community plantations with variations in the soil texture. The results of the cluster analysis resulted in 2 large groups, the first group consisting of 21 locations *S. lima* was found and the second group only consisted of 1 location, namely Lantan. The level of similarity between the first group and the second group 2 was only 40%. Another group consisting of 21 locations showed a varying degree of similarity from one location to another (52%-93%). There are 6 locations that have the highest level of similarity (93%), namely between Jurit and Presak bat, Bebante with Mekar Damai and Montong terep, and Gunung Ise. The results of this study indicate that *S. lima* found in all locations in Central Lombok did not show significant variation except for *S. lima* who grew up in Lantan Village.

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