



Performance of Several Superior Local Avocado Varieties in Lampung, Indonesia

Nilia Wardani^{1*}, Rr. Ernawati², Erliana Novitasari³, Dian Meithasari⁴

¹ Research Center for Horticultural, Research Organization for Agriculture and Food, National Research, and Innovation Agency,

² Research Center for Estate Crops, Research Organization for Agriculture and Food, National Research, and Innovation Agency,

³ Research Center for Food Technology and Processing, Research Organization for Agriculture and Food, National Research, and Innovation Agency,

⁴ Research Center for Food Crops, Research Organization for Agriculture and Food, National Research and Innovation Agency

^{1*} nila009@brin.go.id Corresponding author's

Abstrak

Avocado (Persea americana) is one of the fruit commodities with high economic value. Avocados are popular because of their delicious taste and many health benefits. Lampung Province is one of the provinces with the highest avocado production in Indonesia, with various names or varieties. The aim of this study is to identify the potential and introduce the morphological characteristics of five local Lampung avocado varieties that have received registration certificates from PPVTPP (Center for Plant Variety Protection and Agricultural Licensing) in Jakarta as an avocado germplasm source in Indonesia. The five local avocado varieties used are Lumbok, Ratu Puan, Sewu Jadi, Kastani, and Sipit Klawi to obtain qualitative characteristic data on stems, leaves, flowers, fruits, and seed morphology. Meanwhile, quantitative characteristics are mainly for leaf, fruit, and seed size by creating 4 groups as repetitions, each group consisting of 10 units for leaves, 3 units for fruits, and seeds arranged using a randomized block design. The data were analyzed using ANOVA, followed by Duncan's test at a 5% significance level to observe differences between varieties. Based on their qualitative characteristics, the five varieties are almost the same, with only slight differences in the color and shape of the fruit. Meanwhile, based on the quantitative characteristics of fruit value, the Ratu Puan avocado is the best, having the highest edible fruit value at 84.80%, significantly different from the other four varieties. The weight per fruit and the thickness of the Ratu Puan avocado's flesh are not significantly different. The Lumbok avocado from West Lampung has the highest nutritional content of fat (4.41%), carbohydrates (18.99%), and sugar (15.40%) compared to the other avocado varieties.

Keywords: Performance, local avocado, superior, Lampung

1. Introduction

Local varieties are a source of genetic wealth and regional assets that need to be preserved and cultivated as a source of food supply for the local population, with specific advantages that can provide benefits to farmers or society in general. One of the efforts to preserve local varieties is through legal protection, namely by registering varieties that have been registered by the competent authority, including at the PPVTPP (Center for Plant Variety Protection and Agricultural Licensing). Registered documents by the competent authority are one of the requirements for commodities such as fruit to be exported [1]. The management of plant variety registration is based on the mandate of Law No. 29 of 2000 concerning the protection of plant varieties, which states in Article 7 that local varieties belong to the community, which is controlled by the State [2]. According to [3], local varieties are types of plants that grow naturally and are widely cultivated by the community.

Avocado (*Persea americana*) is one of the local genetic resources that has high economic value and is popular among the community because of its delicious taste and

many health benefits. In the range of 2020–2021, avocado production in Indonesia increased by 9.9% from 609,050 thousand tons to 660,296 thousand tons [4]. Lampung Province is one of the largest avocado-producing provinces in Indonesia [5]. Avocado production in Lampung increased from 17,304 thousand tons in 2020 to 24,008 thousand tons in 2021 [6].

The avocado plant is a plant originating in Central America and Mexico. Based on tree species and fruit origin, avocados are divided into three races, namely the Mexican race, the West Indian race, and the Guatemalan race. The West Indian race originates from the lowlands of Central America and South America [7]. According to [8], there are two types of avocado varieties grown in Indonesia, originating from the West Indian race (*Persea americana* Mill) with larger fruit sizes and the Mexican race (*Persea americana drymifolia*) with smaller fruit sizes. Over time, different varieties of avocado have been cultivated in several regions of Indonesia, including Lampung. Differences in varieties planted in various regions will affect the diversity of plant morphology.

Morphological variations due to differences in environmental conditions have been studied, including:

Bambang Lanang (*Michelia champaca*) by [9]; Yam (*Dioscorea alata*, L.) by [10]; Cassava (*Manihot esculenta*, Crantz.) by [11]; and Rambutan (*Nephelium lappaceum*, L.) by [12]. The diversity of avocado plasma nutfah has also been studied by [13]; however, evaluation is still rarely carried out to determine its potential. According to [14], the characteristics information of a plasma nutfah is important as genetic material that carries traits that need to be known for its potential. Morphological characters of various varieties can be evaluated based on qualitative and quantitative characters [15]. For this reason, it is necessary to carry out this research with the aim of knowing the potential as well as introducing the morphological characteristics of five local Lampung avocado varieties that have received registration certificates from the PPVTPP (Center for Plant Variety Protection and Agricultural Licensing) in Jakarta.

2. Materials and Methods

The research was carried out from February 2021 to September 2021 in Lampung. Sampling of five local avocado varieties came from five districts in Lampung Province, namely: West Lampung, East Lampung, Pringsewu, Tanggamus, and South Lampung. The research sample plants are single parent trees (PIT) that have been registered at the PPVTPP and have received a certificate of registration according to the time of application for registration by the Regent where the local avocado variety is located (Table 1).

Table 1. Certified Lampung avocado by the PPVTPP for 2019-2021

Variety	Regency	PIT Location	Certificate number	Certificate date
Lumbok	Lampung Barat	Suka Banjar village, Subdistrict Lumbok Seminung	1273/PVL/2019	26/11/2019
Ratu Puan	Lampung Timur	Giri Mulyo village, Subdistrict Margo Sekampung	1666/PVL/2021	20/04/2021
Sewu Jadi	Pringsewu	Amabarawa village, Subdistrict Ambarawa	1657/PVL/2021	18/02/2021
Kastani	Tanggamus	Kuto Dalam village, Subdistrict Gisting	1377/PVL/2020	10/01/2020
Sipit Klawi	Lampung Selatan	Kelawi village, Subdistrict Bakauheni	1772/PVL/2021	30/11/2021

The equipments used in this study include stationery, a guide for describing avocado plants [16], scissors, a caliper, a clinometer, an Impodio box mini photo studio, a camera, photo pad paper, a ruler, a tape measure, digital scales, and an [17]. The materials used were plant parts (stems, leaves, flowers, fruit, and seeds) from five local avocado varieties in Lampung.

1.1. Data Collection and Analysis Techniques

The data were obtained based on observations of the morphological characteristics of the plants from the time of flowering to fruit harvest. The morphological character aspects that were evaluated included qualitative and quantitative characteristics. Qualitative characters: starting from the shape, age, and height of the observed PIT varieties, also the shape and color of stems, leaves, flowers, fruits, and seeds. While quantitative characteristics are intended for the size of leaves, fruit, and seeds. Each variety was grouped into four groups, by observing the size of the leaves per group, 10 units were measured for leaves and 3 units for fruits and seeds. All groupings were arranged using a randomized block design.

Data analysis, especially for quantitative characters (leaf, fruit, and seed size), was performed with ANOVA [18] and continued with Duncan's test at the 5% level of significance to see differences between the varieties evaluated [19].

3. Results and Discussion

3.1 Qualitative Morphological Characters of Lampung Local Avocados

Table 2 presents the results of observations of the qualitative characteristics of several local avocado varieties that were evaluated. Among the local avocado varieties that were evaluated, they varied slightly, especially for the character of the color of the fruit flesh and the shape of the fruit; this indicated narrow variability [20]. These differences indicate that there are genotypic variations between one individual and another [21]. According to [22], genotypic variation is influenced by differences in the growing environment, resulting in different phenotypic expressions. Different growing environments affect the morphological characteristics of a plasmanuthah [23]. This happened to the five local avocado varieties, each as a single parent tree (PIT), that were evaluated (Table 2). Even though it is still within one species, differences in the parent tree can cause individual diversity [24]. The characterization results show that there are slight differences, especially for the characters of flower color and fruit flesh, because the fruits come from five districts with different environments. According to [25] research, the difference in the growing environment greatly dominates the diversity of growth in height and trunk diameter of the sengan tree. In addition to differences in the growing environment, differences in plant age may also affect the

variation in stem diameter. The local avocado variety Ratu Puan is the oldest (42 years) and has the largest stem diameter (40.70 cm), while the Sewu Jadi avocado variety is the youngest (only 12 years) and has the smallest stem diameter (25.14 cm) (Table 2). [26] research results showed that growth in height and stem diameter in Bisbul plants did not depend on the age of the plants because the plants were grown in the same location with the same maintenance as a collection garden.

Table 2. Qualitative morphological characteristics of several local Lampung avocado varieties registered at PPVTPP Jakarta 2019–2021

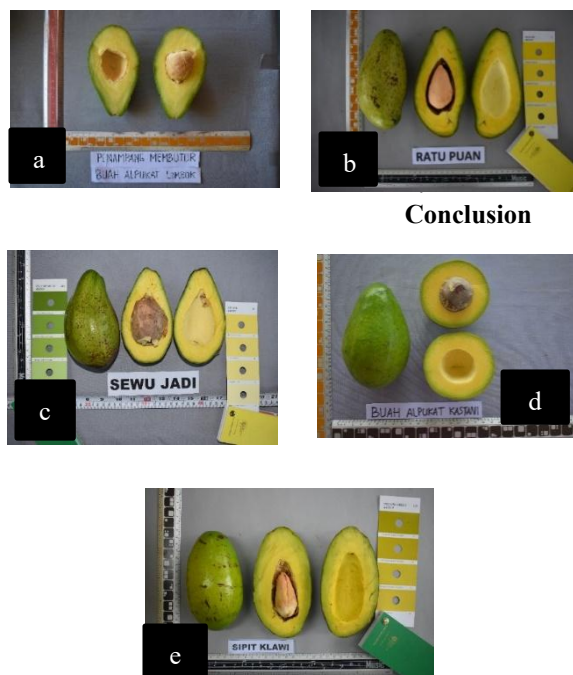
Morphological characteristics	Varieties				
	Lumbok	Ratu Puan	Sewu Jadi	Kastani	Sipit Klawi
TREE					
Age (years)	25	42	12	20	25
Height (m)	8	10	8	8	8
Shape	Circular	Circular	Circular	Circular	Semi Circular
STEM					
Diameter (cm)	34.68	40.70	25.14	36.17	32.77
Color of bark	RHS Brown Group N200B	RHS Black Group 202C	RHS Grayed Group 178B	RHS Brown Group N200B	RHS Grayed Green Group 197B
Shape	Round	Round	Round	Round	Round
LEAF					
Upper leaf color	RHS Green Group 139A	RHS Green Group 147A	RHS Green Group NN137A	RHS Green Group NN137A	RHS Green Group NN137A
Lower leaf color	RHS Green Group 139A	RHS Green Group 138A	RHS Green Group 138A	RHS Green Group NN137A	RHS Yellow Green Group 147B
Leaf shape	Oblong-lanceolate	Oblong	Ovate	Oval	Acute
Leaf apex shape	Acute	Very Acute	Acute	Acute	Acute
FLOWER					
Color	RHS Grayed Yellow Group 160A	RHS Green White Group 157A	RHS Green Yellow Group 1B	RHS Yellow Green Group 145C	RHS Green White Group 157A
Sepals color	RHS Grayed Yellow Group 160A	RHS Green White Group 157A	RHS Yellow Green Group 145B	RHS Yellow Green Group 145C	RHS Green White Group 157A
Petals color	RHS Grayed Yellow Group 160A	RHS Green White Group 157A	RHS Yellow Green Group 2D	RHS Yellow Green Group 145C	RHS Green White Group 157A
Stamen color	RHS Yellow Group 13A	RHS Grayed Yellow Group 160B	RHS Yellow Green Group 150D	RHS Yellow Orange Group 15B	RHS Yellow Orange Group 17C
Pistil color	RHS White Group 155B	RHS Green White Group 157A	RHS Green White Group 157A	RHS Green White Group 157B	RHS Yellow Group 13C
Shape	6-pointed star	6-pointed star	6-pointed star	6-pointed star	5-pointed star
FRUIT					
Fruit skinsurface	Fine	Fine	Fine	Fine	Intermediate
Ripe fruit peel color	RHS Yellow Green Group 146A	RHS Yellow Green Group 144B	RHS Yellow Green Group 144B	RHS Yellow Green Group 144A	RHS Yellow Green Group 151A
Unripe fruit skin color	RHS Yellow Green Group 146A	RHS Yellow Green Group 144B		RHS Green	RHS Green Group 143A

Flesh color	RHS Yellow Group 13B	RHS Yellow Group 7C	RHS Green Group 143A	Group 143A	RHS Yellow Green Group 151C
			RHS Yellow Group 10A	RHS Yellow Group 10B	
Ripe flesh texture	Buttery	Buttery		Buttery	Buttery
Shape	Clavate	Pyriform	Buttery	Obovate	Ellipsoid
SEED			Narrowly obovate		
Color	RHS Yellow Orange Group 22B Broadly	RHS Yellow Orange Group 22C	RHS Yellow Orange Group 22C	RHS Yellow Orange Group 22B Broadly	RHS Grayed Orange Group 164B
Shape	ovate	Ovate	Ovate	Ovate	Ovate

Source: primary data (BPTP Lampung, 2021)

The ripe fruit skin color is the same as the color of the unripe fruit skin of the local avocado varieties Lumbok and Ratu Puan (Table 2). This has the potential to be a fruit ready for export [27]. In accordance with the types of Indonesian avocados [28], based on the results of the characterization of the texture of the fruit flesh of the five local Lampung avocado varieties evaluated, they belong to the butter avocado type with normal fruit shape (Figure 1). According to [29], the normal shape of the avocado greatly influences the attractiveness of consumer preferences.

Figure 1. Fruit shape of five local Lampung avocado varieties: (a) Lumbok; (b) Ratu Puan; (c) Sewu Jadi; (d) Kastani; (e) Sipit Klawi



Conclusion

3.2. Quantitative Morphological Characteristics of Lampung Avocados

Evaluation of the quantitative morphological characteristics of avocados, which is the basis for selecting advantages that have high yield potential, is based on whether they have superior properties, including: uniform fruit, medium-sized oval shape with an average weight of around 500 g or more, good quality fruit flesh tolerant to pests and diseases, not fibrous, with small seeds attached to the seed cavity, and the fruit skin being smooth [1]. Table 3 shows that among the five local avocado varieties evaluated, the Ratu Puan avocado variety has superior fruit character values, with the highest weight per fruit and edible fruit. These results indicate that the Ratu Puan variety has the best and highest potential fruit quantitative characters, followed by the Lumbok and Sewu Jadi varieties (Table 3).

Table 3. The average value of the quantitative morphological characteristics of leaf, fruit, and seed of the Lampung local avocado varieties registered at PPVTPP Jakarta (2019-2021)

Quantitative morphological characteristic	Varieties					CV (%)
	Lumbok	Ratu Puan	Sewu Jadi	Kastani	Sipit Klawi	
LEAF						
Length (cm)	15.65 a	12.65 b	15.10 a	17.27 a	13.20 b	6.0
Width (cm)	7.92 a	5.35 b	8.00 a	7.65 a	7.50 a	7.5
Petiole length (cm)	2.91 b	2.32 c	2.80 b	2.92 b	3.70 a	4.8
FRUIT						
Length (cm)	14.85 b	17.67 a	14.47 b	13.77 b	14.02 b	4.4
Diameter (cm)	7.55 bc	8.05 ab	8.15 bc	7.22 c	8.02 ab	6.0
Weight per fruit (g)	519.0 a	580.25 a	503.50 a	370.50 b	444.75 b	12.5
Flesh thickness (cm)	1.88 a	2.02 a	2.12 a	1.30 b	1.06 b	13.5
Edible fruit (%)	80.16 b	84.80 a	82.86 b	82.00 b	81.36 b	2.3
SEED						
Weight (g)	98.75 a	36.25 c	74.75 b	38.50 c	33.00 c	7.8

Note: Numbers followed by the same letter on the same row not significantly different according to Duncan's test at the 5% level

3.3 Nutritional content of Avocado Flash

The average nutrients content per 100 g of avocado flash varies among several varieties. Variations in nutritional content between varieties are shown in Table 4. The avocado is unique among fruits because it accumulates fats, carbohydrates, and sugars during growth and development. This contrast with the Hass avocado from

America Serikat, which has a very low sugar and carbohydrate content [30].

Table 4. The average nutritional content of the Lampung local avocado some varieties.

Average Nutrition Content Avocado	Varieties and Location				
	Lumbok West Lampung	Ratu Puan East Lampung	Sewu Jadi Pringsewu	Kastani Tanggamus	Sipit Klawi South Lampung
Water Content (%)	74,64	84,79	76,87	82,90	81,05
Ash Content (%)	0,59	1,77	0,89	0,88	0,89
Crude Fiber (%)	4,19	4,92	7,11	3,98	4,70
Protein (%)	0,92	1,58	1,59	1,08	1,38
Fat (%)	4,41	3,84	3,56	2,83	3,87
Carbohydrates (%)	18,99a	5,18	10,01	12,92	8,30
Sugars (%)	15,40	12,20	10,19	13,40	10,19

Source: The results at the Agricultural Product Technology Laboratory of Lampung State Polytechnic (2021).

This suggests that the nutritional content varies depending on where it's grown. As shown in Table 4., Lumbok avocados from west Lampung have the highest nutritional content of fats, carbohydrates, and sugars compared to other avocado varieties from different growing locations. Table 4 shows that the nutritional content of each variety has a high and varied nutritional content. Including the Sewu Jadi avocado variety from Pringsewu which has the highest crude fiber content compared to other varieties. Fiber is a very important nutritional component in a healthy diet because it aids digestion, provides a longer feeling of fullness and reduces the likelihood of overeating [31].

4. Conclusion

The appearance of the morphological characteristics among the five local avocado varieties evaluated showed that there were only slight differences in the qualitative characters, especially for the color of flowers and fruit as well as the shape of the fruit. Meanwhile, based on quantitative morphological characters, fruit value characters are dominant. The Ratu Puan was the best since it has the highest edible fruit value and has high potential for high fruit weight and flesh thickness, not significantly different or as good as the Lumbok and Sewu Jadi varieties. Thus, it is suggested that the three local avocado varieties be submitted as national superior varieties. Avocados have different nutritional content depending on the growing conditions. Lumbok avocados from west Lampung have the highest nutritional content of fats, carbohydrates, and sugars compared to other avocado varieties from different locations.

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