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Exploration and Morphological Characterization of Aren (*Arenga pinnata* Merr) Plants in Luhak District, 50 Kota Regency

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Abstract

Aren palm (*Arenga pinnata* Merr) belongs to the palm tribe and high economis Indonesian in the future. The problem that is often encountered in aren palm plants is the low productivity of aren palm plants, this is allegedly because the seeds used are not superior seeds and cultivation techniques that are not yet appropriate. The low production of plants is thought to be due to the low knowledge of the community on the use of superior aren palm planting materials, where the cultivated aren palm is not considered superior properties, including the diversity of aren palm species that grow wildly is still high in one forest land, unclear identity of seeds used by farmers. Exploration is the first step in finding germplasm of aren palm plants that have the expected traits through breeding programs so that it is expected to be one of the solutions for the development of aren palm plants. This research will conducted from May to October 2023 in community-owned aren palm plantations in 50 cities. The purpose of this research is to characterize the morphology of Aren plants in District 50 Kota and to see the level of diversity of aren palm plants in the area. The research method was survey method, with purposive sampling. The data collection technique is to observe the morphological parts of the plant in each sample. The results of the study obtained 4 clusters of palm plants from 3 villages namely Nagari Sungai Kamuyang, Sikabu-kabu and Mungo. Researchers obtained 15 samples of aren palm plants characterized by 19 characters, namely 10 characters have wide variability and 9 characters have narrow variability with a level of diversity ranging from 14% - 47%.

Keywords: Aren, Cluster, Survey, Diversity, Nagari

1. Introduction

Sugar palm (*Arenga pinnata* Merr) belongs to the palm tribe that has many functions including conservation and economic functions, because almost all parts of the aren palm tree can be taken advantage of. Arenga pinnata Merr is well adapted to various agro-climates, ranging from lowlands to 1400 m above sea level (Maliangkay, 2007). Ar palm trees are highly adaptable and suitable for marginal lands, as well as for water and soil conservation purposes (Wulantika, 2019). Aren palm plant is in the same family as coconut, date palm, oil palm and sago palm which are important plants in the tropics (Harjadi, 1986). Almost all parts of this plant can be utilized and have economic value that can be used for human needs (Mulyanie *et al*., 2017). The main product of the aren palm plant is nira, the result of tapping from male flowers which is made into palm sugar as well as soft drinks, vinegar and alcohol. Palm sap contains water (87.66%), sugar (12.04%), protein (0.36%), fat (0.36%), and ash (0.21%) (Lempang *et al*., 2012). Each tree has a different quality of nira with different brix levels, differences in nira quality also result in varying quality of sugar produced (Natawijaya *et al*., 2018). In addition, the aren palm plant can also produce food products such as kolang-kaling from the female fruit, aren flour for food ingredients (Alam and Baco, 2004).

Aren is one type of palm plant that has a very wide distribution in Indonesia, with an area of 62,009 ha, consisting of Sumatra with an area of 15,802 ha, Java 19,757 ha, Bali 587 ha, NTB 1,816 ha, Kalimantan 5,401 ha, Sulawesi 16,951 ha and Maluku 1,696 ha (Directorate General of Plantation, 2009). The spread of palm populations growing wild in nature is a potential local natural resource that is an opportunity if developed (Harahap *et al*., 2019). Currently, some regions are starting to cultivate by doing a good nursery but generally aren palm plants still grow naturally including rare and multipurpose plant species because almost all parts of the plant can be utilized and economically valuable can be used as a source of livelihood for the community. With such potential economic value, it is expected to be developed with the application of proper cultivation techniques and improved product processing so as to provide added economic value to the community (Tenda et al, 2010).

50 Kota is one of the districts in West Sumatra that has the potential to develop palm commodities. The availability of large land and the suitability of environmental conditions are supporting factors for the success of palm cultivation in the regency. Ar palm trees in 50 Kota Regency generally grow wild and have not been widely utilized and conducted good cultivation techniques.

Exploration is the first step in finding germplasm of aren palm plants that have the expected traits through breeding programs so that it is expected to be one of the solutions for the development of aren palm plants in 50 Kota. Characteristic identification aims to obtain information about the characteristics of an individual so that it can be used to distinguish between one individual and another and will be the initial data for those who continue plant breeding techniques in the field of molecular genetics. The more diversity obtained in a place, it will increase the success of obtaining sustainable superior varieties in plant breeding. Characterizing palm trees in 50 Kota Regency is very important to do considering that there is currently no information related to good palm trees that can be used as propagation material. Knowledge or information about the characteristics of palm morphology can be the first step in a plant breeding program.

2. Materials and Methods

Time and Place of Research

The research was conducted in community-owned sugar palm plantations in Nagari Sungai Kamuyang, Nagari Sikabu-Kabu and Nagari Mungo Luhak District, 50 Kota Regency. The research was conducted from May to October 2023.

The method that will be used in this research is a survey method consisting of 2 stages of activity, namely: (1) Exploration and (2) Identification of morphological characteristics.

1. Exploration

At the exploration stage there are several activities that include, secondary data collection, primary data and determination of sampling locations for observation. Secondary data in the form of information on the research location, data on the area, production and productivity of sugar palm plants, and data on the geographical conditions of the research area will be obtained from several literatures and related agencies. Meanwhile, primary data was obtained through interviews using a questionnaire with palm farmers.

After the secondary data and primary data were obtained, then the determination of sampling locations was carried out based on purposive sampling method, namely the determination of sampling with certain considerations or criteria. The criteria of palm trees considered are the age of the plant ≥10 years, has been fruitful or has produced, and plants that can be sampled are plants that are not attacked by pests or diseases. The number of individual palm trees to be sampled was taken 10% of the entire population of palm trees in each selected farm..

2. Identification of Morphological Characteristics

After the exploration was carried out, sampling activities were carried out for each individual palm plant that had been randomly selected in Silago village. The characteristics that will be observed are as follows:

A. Plants

1. Plant Height (m)

Observed directly and measured using a pipe (m) from the base to the end of the main stem.

Stem Circumference (m)

Observed directly and measured using a meter.

2. Stem Surface

Observation is directly observed, the presence or absence of frond marks

3. Stem bark color

Observation of stem bark color is observed directly.

B. Leaves

1. Frond Length (m)

Observation of midrib length is observed directly and measured using rolling meter.

2. Rachis Length (m)

Rachis length observations are observed directly and measured using a meter.

3. Stalk Length (m)

Observation of the length of the midrib is observed directly and measured using a meter.

4. Number of Leaflets

Observation of the number of leaflets is observed directly and then counted.

5. Leaflet Length (cm)

Observation of leaflet length is observed directly and measured using a meter.

6. Leaflet Width (cm)

Observations of leaflet width are observed directly and measured using a rolling meter.

7. Shape of leaf midrib

Observation of the shape of the leaf midrib is observed directly.

8. Leaf Blade Color

Observation of leaf color is observed directly.

C. Fruit

1. Number of fruit bunches per plant

Observation of the number of fruit bunches was observed directly and the number of fruit bunches per plant was counted.

2. Number of fruit strands per bunch

Observation of the number of fruit strands per bunch was directly observed and the number of fruit strands per bunch was counted.

3. Fruit Diameter (mm)

Observations of fruit diameter were measured using a caliper.

4. Weight per Fruit (gr)

Fruit weight observations were weighed using analytical scales.

D. Seeds

1. Seed Diameter (mm)

Observations of seed diameter were measured using a caliper.

2. Number of seeds per fruit (mm)

Observations of the number of seeds per fruit were counted and recorded.

3. Weight per Seed

Observation of seed weight is weighed using analytical scales.

3. Presentation of data

Data obtained from field observations consist of quantitative and qualitative data. Qualitative and quantitative data are displayed in tabular form, so that the table will show a comparison of sample data that has been observed.

3. Results and Discussion

Morphological characterization of palm plants has several observation parameters consisting of qualitative characters and quantitative characters. Qualitative characters are influenced by genetic factors that are more dominant, this is in accordance with the opinion of Martono (2010) which states that qualitative characters are the main characteristics of the plants sampled because qualitative characters are not influenced at all by the environment and can be observed visually. While quantitative characters are very much influenced by the environment so that the results vary. Researchers have conducted exploration and characterization activities of sugar palm plants in Luhak District, 50 Kota Regency and the following is a description of the data obtained in the field.

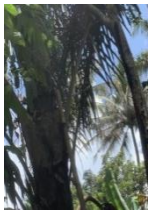
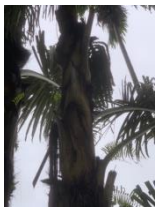
1. Morphology of the sugar palm

Plant morphology was observed directly in the field. Plant morphology was observed based on quantitative traits such as plant height, stem circumference, while qualitative traits such as stem surface and stem bark color.

Table 1. Results of morphological characterization of sugar palm

No	Accession Code	Picture	Description
1	SK1		Plant height 8.5 m, stem circumference 151 cm, stem surface with midrib marks, bark color blackish brown.

2	SK2		Plant height 13.5 m, stem circumference 147 cm, stem surface with midrib marks, bark color blackish brown.
3	SK3		Plant height 16 m, stem circumference 145 cm, stem surface no frond marks, stem bark color grayish brown
4	SK4		Plant height 14 m, trunk circumference 140 cm, trunk surface with midrib marks, bark color blackish brown.
5	SK5		Plant height 20 m, stem circumference 150 cm, stem surface with midrib marks, bark color blackish brown.
6	SKB1		Plant height 7 m, stem circumference 137 cm, stem surface with midrib marks, blackish brown bark color.
7	SKB2		Plant height 10 m, stem circumference 165 cm, stem surface with midrib marks, bark color light brown.

8	SKB3		Plant height 14 m, stem circumference 143 cm, stem surface has frond marks, blackish brown bark color.
9	SKB4		Plant height 8 m, stem circumference 141 cm, stem surface with midrib marks, stem bark color grayish brown.
10	SKB5		Plant height 9 m, stem circumference 120 cm, stem surface with midrib marks, stem bark color grayish brown.
11	MG1		Plant height 14 m, stem circumference 147 cm, stem surface with midrib marks, bark color blackish brown.
12	MG2		Plant height 12 m, stem circumference 142 cm, stem surface with midrib marks, bark color blackish brown.
13	MG3		Plant height 12 m, stem circumference 151 cm, stem surface with midrib marks, bark color blackish brown.
14	MG4		Plant height 10 m, stem circumference 145 cm, stem surface with midrib marks, bark color blackish brown.

15	MG5		Plant height 14 m, stem circumference 130 cm, stem surface with midrib marks, bark color blackish brown.

Observation of plant height, the tallest palm plant was 20 m (SK5) while the lowest palm plant was 7 m (SKB1). Observation of stem circumference, the largest stem circumference was 165 cm (SKB2) while the smallest was 120 cm (SKB5). Observation of the surface of the stem obtained one criterion that is there are traces of fronds, it can be concluded that the dominant stem surface is there are traces of fronds. Observation of stem bark color obtained 3 criteria, namely blackish brown, grayish brown and light brown. according to the reference Sebayang (2016) is Judging from its morphology; Sugar palm grows upright, towering, has round, brownish green stems, the leaves are formed in reset stems with light/dark green pinnate leaves, the flowers consist of male flowers fused in one cob measuring 1-1.2 cm long. The fruit is elliptical with an inward curved tip, 3-5 cm in diameter. Palm seeds are round and when ripe they are black.

Table 2. Leaf morphology of sugar palm

No	Accession Code	Gambar	Description
1	SK1		Frond length 5.5 m, rachis length 0.7 m, petiole length 1.3 m, number of leaflets 142, leaflet length 138.5 cm, leaflet width 6.3 Leaflet shape faceted, Leaflet color green.
2	SK2		Frond length 5 m, rachis length 1.3 m, petiole length 1.5 m, leaflet number 149, leaflet length 114 cm, leaflet width 4.7 Leaflet shape faceted, Leaflet color green.
3	SK3		Frond length 6.5 m, rachis length 1.5 m, petiole length 2 m, number of leaflets 133, leaflet length 141 cm, leaflet width 6 Leaflet shape faceted, Leaflet color brownish green.
4	SK4		Frond length 4.5 m, rachis length 1.5 m, petiole length 0.8 m, leaflet number 130, leaflet length 120 cm, leaflet width 4 Leaflet shape faceted, Leaflet color green.
5	SK5		Frond length 7.5 m, rachis length 2 m, petiole length 1.5 m, number of leaflets 154, leaflet length 165 cm, leaflet width 6.8 Leaflet shape faceted, leaflet color green

6	SKB1		Frond length 5 m, rachis length 1.2 m, petiole length 1.5 m, leaflet number 148, leaflet length 124 cm, leaflet width 4 Leaflet shape faceted, Leaflet color green
7	SKB2		Frond length 5.5 m, rachis length 2.2 m, petiole length 1.5 m, leaflet number 144, leaflet length 133.5 cm, leaflet width 4 Leaflet shape faceted, Leaflet color brownish green.
8	SKB3		Frond length 6 m, rachis length 1.5 m, petiole length 1 m, number of leaflets 128, leaflet length 144 cm, leaflet width 4.4 Leaflet shape faceted, Leaflet color brownish green
9	SKB4		Leaflet length 7 m, rachis length 1 m, petiole length 2 m, number of leaflets 184, leaflet length 167 cm, leaflet width 6.5 Leaflet shape faceted, leaflet color green
10	SKB5		Frond length 5 m, rachis length 1 m, petiole length 1 m, number of leaflets 190, leaflet length 130 cm, leaflet width 5.5 Leaflet shape faceted, Leaflet color brownish green.
11	MG1		Leaflet length 7 m, rachis length 1.4 m, petiole length 1.2 m, number of leaflets 140, leaflet length 169 cm, leaflet width 6 Leaflet shape faceted, Leaflet color green.
12	MG2		Frond length 6 m, rachis length 1.2 m, petiole length 2 m, leaflet number 155, leaflet length 156 cm, leaflet width 6 Leaflet shape faceted, Leaflet color green

13	MG3		Frond length 6.5 m, rachis length 1 m, petiole length 1 m, number of leaflets 132, leaflet length 154 cm, leaflet width 5.5 Leaflet shape faceted, Leaflet color green.
14	MG4		Frond length 5 m, rachis length 1.6 m, petiole length 1 m, number of leaflets 122, leaflet length 133 cm, leaflet width 5 Leaflet shape faceted, Leaflet color green
15	MG5		Frond length 5.5 m, rachis length 2 m, petiole length 1.5 m, leaflet number 177, leaflet length 145 cm, leaflet width 6.4 Leaflet shape faceted, Leaflet color green.

Observation of midrib length, the longest midrib is 7.5 (SK5), while the shortest midrib is 4.5 (SK4). Observation of rachis length, the longest rachis is 2.2 (SKB2), while the shortest rachis is 0.7 (SK1). Observation of petiole, the longest petiole is 2 m (MG2, SKB4 and SK3), while the shortest petiole is 0.8 (SK4). Observation of the number of leaves, the highest number of leaves is 190 (SKB5), while the least is 122 (MG4). Observation of leaflets, the longest leaflet is 169 (MG1), while the shortest is 113 (MG4). Observation of leaf width, the widest leaf is 6.8 m (SK5), while the smallest is 4 (SKB1 and SK3). Observation of the shape of the midrib obtained one criterion, namely faceted, it can be concluded that the dominant shape of the midrib is faceted. Observation of the color of the midrib obtained 22 criteria, which are brownish green and green.

Table 3. Characterization of sugar palm fruit

No	Code	Picture	Description
1	SK1		Number of fruit bunches 1, number of fruit strands 19, fruit diameter 43.2, weight of fruit 51.3
2	SK2		Number of fruit bunches 5, number of fruit strands 29, fruit diameter 52.3, weight of fruit 85.7
3	SK3		Number of fruit bunches 6, number of fruit strands 50, fruit diameter 46.6, weight of fruit 59.9
4	SK4		Number of fruit bunches 3, number of fruit strands 18, fruit diameter 48.9, weight of fruit 71.6

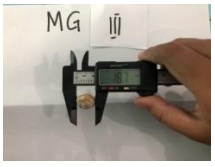
5	SK5		Number of fruit bunches 4, number of fruit strands 32, fruit diameter 51.2, weight of fruit 76.2
6	SKB1		Number of fruit bunches 4, number of fruit strands 38, fruit diameter 33.8, weight of fruit 23.4
7	SKB2		Number of fruit bunches 4, number of fruit strands 32, fruit diameter 51.2, weight of fruit 76.2
8	SKB3		Number of fruit bunches 4, number of fruit strands 41, fruit diameter 39.1, weight of fruit 36.5
9	SKB4		Number of fruit bunches 3, number of fruit strands 20, fruit diameter 33.6, weight of fruit 20.4
10	SKB5		Number of fruit bunches 5, number of fruit strands 13, fruit diameter 41.8, weight of fruit 40.9
11	MG1		Number of fruit bunches 3, number of fruit strands 20, fruit diameter 35.4, weight of fruit 22.6
12	MG2		Number of fruit bunches 1, number of fruit strands 20, fruit diameter 40, weight of fruit 36.4
13	MG3		Number of fruit bunches 5, number of fruit strands 27, fruit diameter 41.8, weight of fruit 42.6
14	MG4		Number of fruit bunches 5, number of fruit strands 30, fruit diameter 41.3, weight of fruit 40.6

15	MG5		Number of fruit bunches 2, number of fruit strands 1, fruit diameter 39.1, weight of fruit 34.9

Observation of the number of fruit bunches, the highest number of fruit bunches is 6 (SK3), while the least number of bunches is 1 (SK1 and MG2). Observation of fruit strands, the most fruit strands is 50 (SK3), while the least fruit strands is 1 (MG5). Observation of fruit diameter, the largest fruit diameter is 52.3 (SK2), while the smallest fruit diameter is 30.4 (SKB2). Observation of fruit weight, the heaviest fruit weight is 85.7 (SK2), while the smallest fruit weight is 14.3 (SKB2).

Table 4. Characterization of sugar palm seeds

No	Code	Picture	Description
1	SK1		Seed diameter 22, number of seeds in a fruit 3, seed weight 6.5 grams
2	SK2		Seed diameter 25.7, number of seeds in a fruit 3, seed weight 11.2 grams
3	SK3		Seed diameter 22.8 Number of seeds in a fruit 3, seed weight 6.2 grams
4	SK4		Seed diameter 23, number of seeds in a fruit 3, seed weight 10.9 grams
5	SK5		Seed diameter 24.1, number of seeds in a fruit 3, seed weight 7.3 grams
6	SKB1		Seed diameter 14.4, number of seeds in a fruit 3, seed weight 1.1 grams

7	SKB2		Seed diameter 3.9, number of seeds in a fruit 3, seed weight 1.1 grams
8	SKB3		Seed diameter 19.7, number of seeds in a fruit 3, seed weight 3.8 grams
9	SKB4		Seed diameter 1.1, number of seeds in a fruit 2, seed weight 1.5 grams
10	SKB5		Seed diameter 16.6, number of seeds in a fruit 3, seed weight 3.9 grams
11	MG1		Seed diameter 11, number of seeds in a fruit 2, seed weight 0.9 grams
12	MG2		Seed diameter 20.7, number of seeds in a fruit 3, seed weight 6.4 grams
13	MG3		Seed diameter 18.2, number of seeds in a fruit 3, seed weight 3.4 grams
14	MG4		Seed diameter 19.4, number of seeds in a fruit 3, seed weight 3.9 grams
15	MG5		Seed diameter 16.3, number of seeds in a fruit 2, seed weight 3 grams

Observation of seed diameter, the largest seed diameter is 25.7 (SK2), while the smallest seed diameter is 1.1 (SKB4). Observation of the number of seeds in a fruit, the highest number of seeds is 3 (SK1, SK2, SK3, SK4, SK5, SKB1, SKB2, SKB3), while the least number of seeds is 2 (SKB4, MG1, MG5). Observation of weight per seed, the heaviest seed is 11.2 (SK2), while the smallest seed weight is 0.9

(MG1). according to the reference Widyawati et al (2010) is sugar palm seeds are classified as hard seeds with a relatively long germination time, which can reach more than three months from fruit ripening. The ripening process of palm fruit can reach more than 24 months after anthesis. The morphological characteristic that can be seen from the ripening process of the palm fruit is the change in skin colour from green to yellow or yellowish.

4. Conclusions

Qualitative observations on the stem of the sugar palm plant that is the color of the stem obtained 3 characters namely blackish brown, light brown, grayish brown. On the observation of the surface of the stem, 1 character is obtained, namely there are traces of midrib, while the quantitative observations of 15 samples obtained very diverse results according to the treatment of the palm plants that were sampled. Qualitative observations on the leaves of sugar palm plants are the shape of the midrib with faceted characters and the color of the midrib of the leaves obtained by 2 characters namely green and brownish green, while quantitative observations are strongly influenced by the environment. Observations on seeds and palm fruit are only qualitative observations whose results vary greatly depending on environmental conditions.

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