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The phenotypic appearance of Japanese persimmon (*Diospyros kaki* L.f.) in Karo District, North Sumatra, Indonesia

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Abstract. *Hanafiah DS, Sanggita S, Lubis K. 2018. The phenotypic appearance of Japanese persimmon (Diospyros kaki* L.f.*) in Karo District, North Sumatra, Indonesia. Biodiversitas 19: 559-564.* The farmers in Karo District began to be less interested in cultivating kesemek or Japanese persimmon (*Diospyros kaki* L.f.). Due to the price of this commodity has dropped in the market, the farmers cut down the tree and cultivate more favorable horticultural crops, such as vegetable and citrus cultivation. It is necessary to conduct a study to obtained sufficient information to determine the necessary steps in order to preserve Japanese persimmon plants in Karo District. One first steps was to get information of accession characteristic of Japanese persimmon in Karo District. This research aimed to identify relationships of morphological characteristics among individuals of Japanese persimmon plants. The research was conducted from May until July 2017 at Berastagi, Merdeka, Kabanjahe, and Dolat Rayat sub-districts of Karo District, North Sumatra, Indonesia. The survey method using Japanese persimmon descriptor of *Diospyros kaki* L.f. by the International Union for the Protection of New Varieties (UPOV) with the purposive method for location determination and technique sampling. Thirty-six accessions of Japanese persimmon plants were studied. Based on clustering method of the morphological characteristic, 4 clusters are formed. This difference was canopy form, leaf shape and fruit morphological. Accession 34 from Dolat Rayat Distict has different fruit characters with other accessions.

Keywords: Japanese persimmon, Karo District, morphological characteristic

INTRODUCTION

Diospyros is a large genus comprising more than 500 species, with the majority (~300 species) being distributed in Asia and the Pacific region. Habitus of this genus is shrub or tree which occur in most tropical and subtropical habitats. Several species of *Diospyros*have economic value as edible fruits, such as *D. kaki*, *D. lotus*, and *D. virginiana*. Species with edible fruits are often polyploid, for example, commercial strands of *D. kaki* are hexaploid (2n = 6x, x = 15) (Sugiura 2005; Turner 2014).

Japanese persimmon (*Diospyros kaki* L.f.) believed to have originated in Japan and has been developing in China, Japan, and Korea. This plant was introduced to the Southeast Asia region including Indonesia in early 20th century or around the 1900s (Java and Sumatra), Malaysia and Thailand. Japanese persimmon is an attractive fruit with yellow, orange to deep red skin color, and the intense red of its autumn leaves make it an attractive ornamental. Japanese persimmon is a source of β-carotene, potassium, and vitamin C, and are eaten fresh or dried, raw or cooked (Yonemori et al. 2000; Butt et al. 2015; Yilmaz et al. 2017).

There are 2,000 persimmon fruit cultivars in China, and 800 kinds of persimmon in Japan but which is very important and often used as planting material of fewer than 100 cultivars (Zhang et al.2009). Persimmon fruit can be classified into two general types (categories), which is astringent variety and nonastringent variety. These fruits are unique for accumulating proanthocyanidins also known as condensed tannins, and the fruit astringency is caused by the high content of soluble (Min et al. 2012). The astringent type can't be consumed directly because It contains high tannin and characterized by a rough tasteType of astringent fruit requires treatment of ripening and other treatments (Ishaq and Noch 2006).

The cultivated Japanese persimmon in Indonesia is astringent. The rough taste of fruit is reduced by soaking with $Ca(OH)_2$. The fruit harvested by farmers is not derived from the planting of the seeds carried out by the farmers themselves, but a legacy plant that has existed in the area since the 1900s. The quantity and quality of Japanese persimmon fruit in the market is relatively diverse. There is a tendency of decreased persimmon plant population, due to the farmers prefer to plant more favorable horticultural crops such as vegetable and citrus cultivation (Sebayang 2014).

The center of Japanese persimmon plantation in North Sumatra is Karo District. It is encountered almost in each sub-district of the District. Cultivation center of the Japanese persimmon in Karo District is Simpang IV (3.38 ha), Kabanjahe (0.27 ha) and Berastagi (3.38 ha) (Central Bureau of Statistics 2007). The production of Japanese persimmon fruit in Karo District decreases with time. In 2009, production of the fruit only 13.70 tons in Karo District (Central Bureau of Statistics 2010).

Japanese persimmon is also cultivated in Garut and Ciloto of West Java andMagetan, Malang and Batu of East Java. Based on several differentiated morphological properties, it is known that there is a cultivar of Japanese persimmon plant that developed in Garut, namely “Reundeu cultivar”.

The cultivar is called the "Eureka" cultivar. Morphological characteristics of cultivar Reundeu or Eureka is a medium-large fruit and square, wrinkles around the calyx/ base of fruit, orange peel color, dense and fleshy texture, yellow-orange flesh color, mature fruit is longer then Kapas or Hachiya, slow growing, leaves fall almost simultaneously (Ishaq and Noch 2006; Stein et al. 2013).

The information of a total number of Japanese persimmon cultivars planted by Indonesian farmers has not been reported so far, including farmers in Karo District. It is necessary to conduct a study that examines the diversity of Japanese persimmon plants in the area as basic data to develop the fruit and improve its yield and quality.

MATERIALS AND METHODS

Study area

The research was conducted in sub-district of Berastagi, Kabanjahe, Merdeka, and Dolat Rayat of Karo District, North Sumatra, Indonesia. The study starts from May to July 2017.

Materials and tools

The total sample of Japanese persimmon studied is 36 accessions, i.e.from sub-district of Berastagi of 18 accessions, Dolat Rayat of 6 accessions, Merdeka of 9 accessions, and Kabanjahe of 3 accessions (Table 1). The tool used in this research is camera, gauge, GPS (Global Positioning System), calipers, labels, bamboo stick, ruler, loupe and a questionary form.

Procedure

The research site was sampled purposively in sub-district of Berastagi, Kabanjahe, Merdeka, and Dolat Rayat, Karo District, North Sumatra. The determination of research site and cultivation Japanese persimmon is conducted from the Central Bureau of Statistics and district office. The survey method based on Rew and Pokorny (2006) with field condition adjustment.

Data were collected by simple random sampling, which is a technique for determining the sample by chance.The plants that are found will be identified based on the predefined variables that have been predetermined and documented with a camera. The observation continues if different types of Japanese persimmon were observed and information obtained from the local community.

Based on International Union for the Protection of New Varieties (UPOV) for *D. kaki,* the phenotypic appearance of each accession is observed and noted, such as tree: form of canopy, tree height; one-year-old shoot: length, thickness, length of internode, shape of lenticels, color (sunny side), shape of bud in profile view; Leaf: length,

Table 1. The research location and accession number of Japanese persimmon in Karo District, North Sumatra, Indonesia

Sub-district	Village	Land area (m^2)	Plant age	Accession number
Berastagi	Lau Mulgap I	4000	20 years	A1-A3
	Gundaling I	1000	42 years	A4-A6
	Gundaling II	7000	37 years	A7-A9
	Gurusinga	12000	40 years	A10-A12
	Rumah Berastagi	7000	25 years	A13-A15
	Sempajaya	7000	20 years	A16-A18
Merdeka	Deram	10000	30 years	A19-A21
	Gongsol	1500	32 years	A22-A24
	SadaPerararih	3000	43 years	A25-A27
Kabanjahe	Sumber Mufakat	15000	40 years	A28-A30
Dolat Rayat	Dolat Rayat	7000	40 years	A31-A33
	Kubucolia	6000	20 years	A34-A36

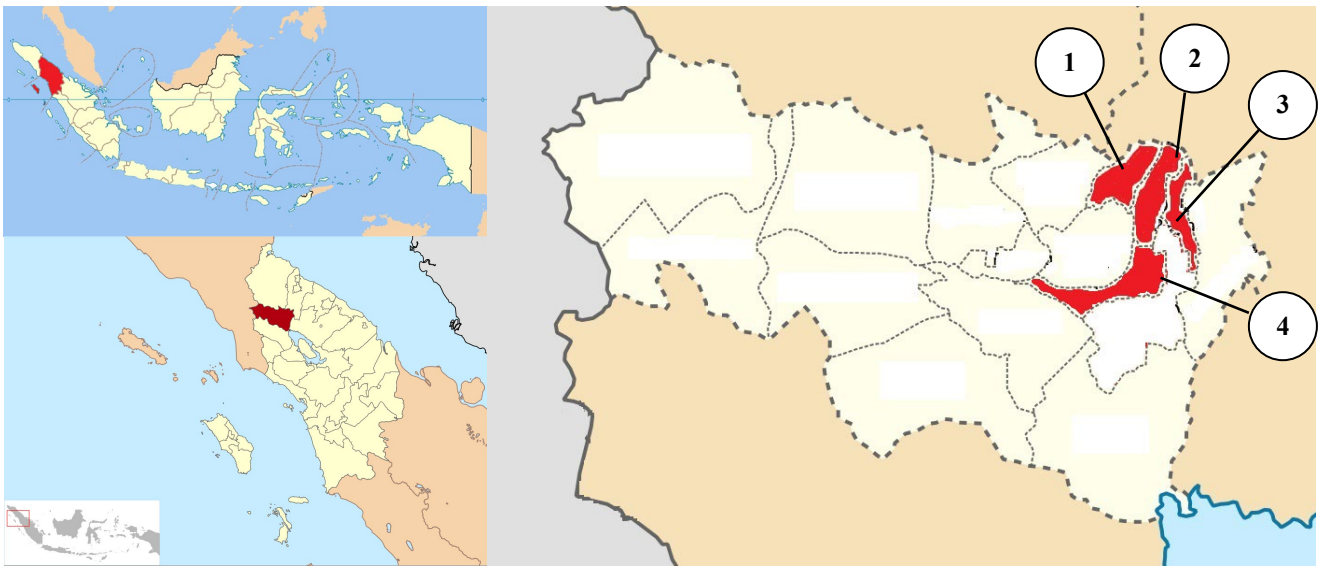

Figure 1. Research sites in Karo District, North Sumatra, Indonesia. 1. Merdeka, 2. Berastagi, 3. Dolat Rayat, and 4. Kabanjahe

width, shape, shape of baseand apex; Fruit: size, general shape in lateral viewand cross section, shape of apex in longitudinal section, grooving at apex, shallow concentric cracking around apex, shallow concentric cracking around apex, cracking of apex, longitudinal grooving, wrinkles at calyx end, calyx attachment, groove at calyx end, calyx size compared with fruit diameter, attitude of calyx, width of sepal, length of stalk, thickness of stalk, color of skin, color of flesh and astrigency.

Data analysis

Data were analyzed by cluster method. Scoring qualitative data based on UPOV guides for Japanese persimmon. Data analysis using SPSS program for cluster analysis.

RESULTS AND DISCUSSION

The Karo District, especially Berastagi Sub-district has sent Japanese persimmon to Singapore as many as 1,500 tons per year in the past. Then, production of persimmon is constrained and decreased due to intense competition with the quality of fruit from other countries. In 2009, the production of persimmon fruit in Karo District was only 13.70 tons per year (Vrheij and Coronel 1992; Central Bureau of Statistics 2010).The production of Japanese persimmon in Karo District decreases with time. There is no packaging at the level of home industry or canning in manufacturer. Now, the fruit supply is only for traditional market. and low price of this commodity making the farmer prefers to plant more favorable horticultural crops such as vegetable and citrus cultivation. There are no farmers cultivated Japanese persimmon as main commodity. (Central Bureau of Statistics 2010; Sebayang 2014).

There were 12 farmers of Japanese persimmon interviewed did not know the seeds came from. However, some farmers mentioned that the persimmon seeds came from Dairi District and not from the official institution (Sanggita 2017).Observations were made on the appearance of canopy forms, one-year-old-shoot color, leaf shape and morphological fruit. There are differences in morphological performances of some accessions (Table 2).

Figure 2 showed the phenotypic appearance differences of canopy form, leaf shape, one-year-old shoots color and fruit morphology of 36 accessions. The morphological characters had the different type of each parameters observation.

The most of Japanese persimmon in Karo District are cultivated as intercropping plants, or a shade tree for the main crops, or planted in the backyard in a small individual. The farmers didn't know the origin of the persimmon plant seeds because it's a plant relic from their parents (Sanggita 2017). This condition was supported by Hidayat et al. (2011) that the difficulty of conservation objectives to be realized is that there is an imbalanced of understanding and experience in society between the context of natural values (ecological and scarcity), the values of benefits (economic) and religious values (religion, sincerity, morality and social culture).

To understand phenotypic appearance relationship among accessions, cluster analysis was run for grouping accession by SPSS program. The phenotypic appearance similarity data of each accession were analyzed and then displayed in a dendrogram (Figure 3).

The four clusters were formed from phenotypic appearance. Accession 34 from Dolat RayatDistricthad a separate cluster different from other accessions. Accession 34 has transverse broad oblong fruit shape, and it provides a distinction with fruit shape on the other accessions. Cluster 3 consists of 8 accessions (accession 9, 13, 15, 18, 21, 27, 31 and 35). These accessions are grouped mainly by canopy form (upright) and fruit shape in lateral view (broad ovate). Cluster 2 consists of 4 accessions (accession 4, 19, 20 and 32). In general, these accessions are grouped by canopy form (spreading) and fruit shape in lateral view (circular).Accessions from cluster 3 and cluster 2 were from Berastagi, Merdeka, and Dolat Rayat Sub-districts. The other accession is grouped into cluster 1. Cluster 1 accessions come from the four sub-districts observed.

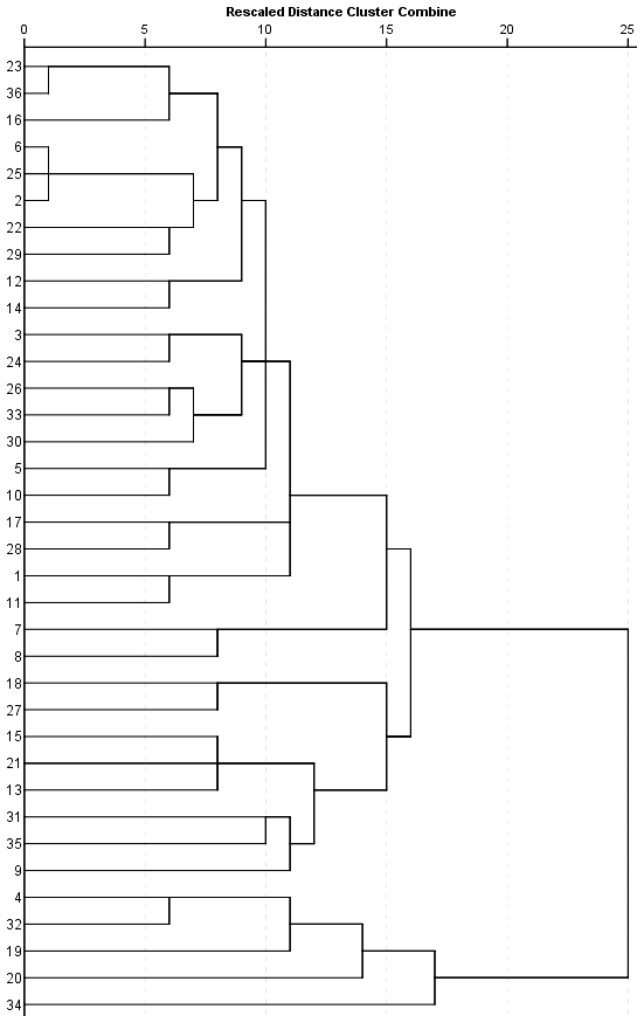

Figure 3. Dendrogram of phenotypic appearance of Japanese persimmon in Karo District, North Sumatra, Indonesia

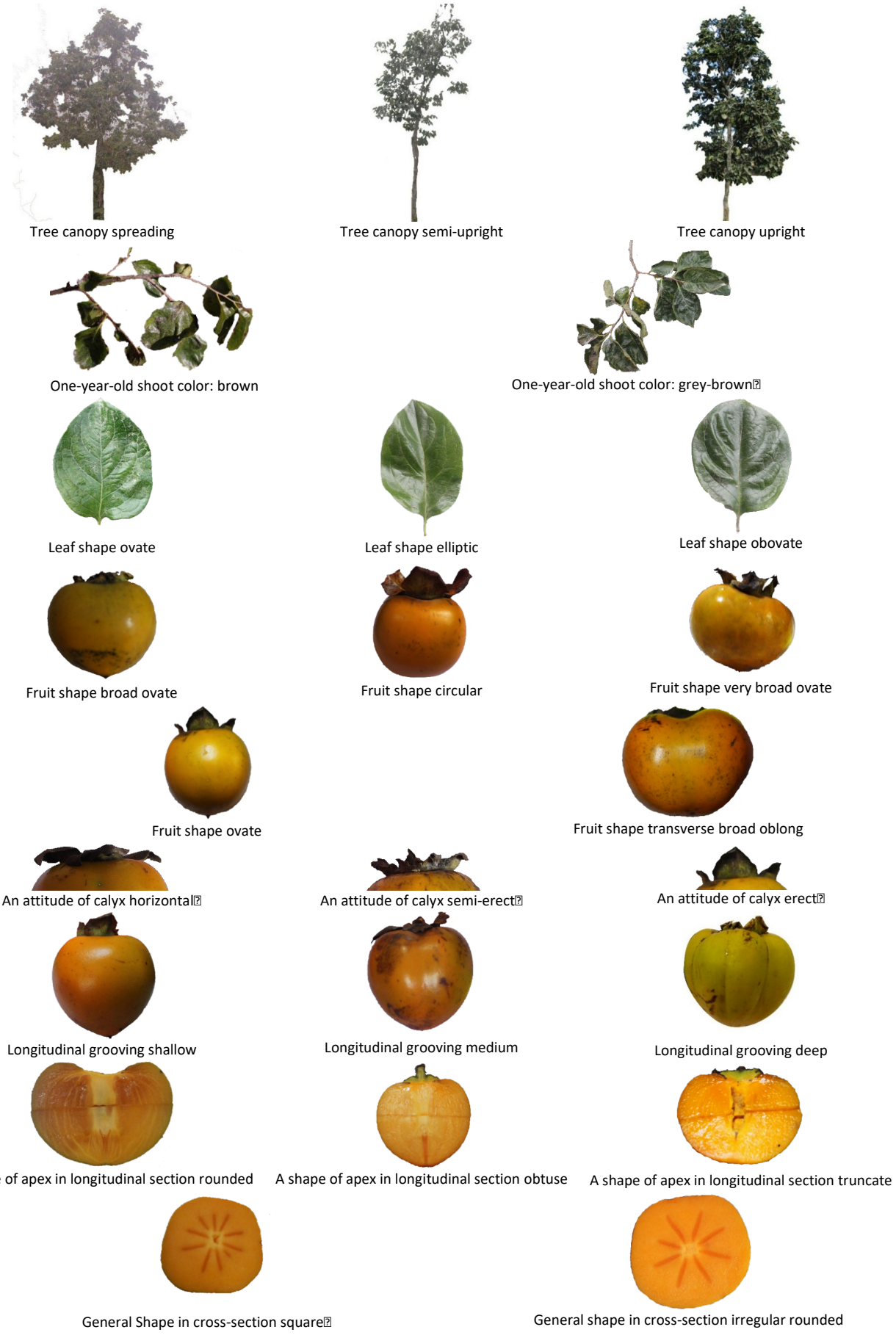

Figure 2. The phenotypic appearance differences in 36 accessions of Japanese persimmon plants in Karo District, North Sumatra, Indonesia

Table 2. Phenotypic appearance of Japanese persimmon accessions studied in four sub-districts of Karo District, North Sumatra, Indonesia

Acces-sion	Phenotypic appearance								
	Tree canopy	One-year-old shoot color (sunny side)	Leaf shape	General shape of fruit in lateral view	Attitude of calyx	Longitudinal grooving of fruit	Shape of fruit apex in longitudinal section	General shape of fruit in cross section	Astringency of fruit
1.	Spreading	Grey brown	Ovate	Broad ovate	Horizontal	Medium	Rounded	Square	Sometimes present
2.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Rounded	Irregular rounded	Always present
3.	Semi-upright	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Obtuse	Square	Sometimes present
4.	Spreading	Grey brown	Ovate	Circular	Semi-erect	Shallow	Truncate	Irregular rounded	Sometimes present
5.	Spreading	Grey brown	Ovate	Very broad ovate	Semi-erect	Shallow	Rounded	Square	Sometimes present
6.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Rounded	Irregular rounded	Always present
7.	Spreading	Brown	Elliptic	Broad ovate	Horizontal	Shallow	Obtuse	Square	Sometimes present
8.	Spreading	Brown	Ovate	Broad ovate	Semi-Erect	Shallow	Obtuse	Square	Sometimes present
9.	Upright	Grey brown	Obovate	Broad ovate	Semi-erect	Shallow	Rounded	Square	Sometimes present
10.	Spreading	Grey brown	Ovate	Very broad ovate	Semi-erect	Shallow	Rounded	Irregular rounded	Sometimes present
11.	Spreading	Grey brown	Ovate	Broad ovate	Horizontal	Shallow	Rounded	Square	Sometimes present
12.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Medium	Rounded	Square	Always present
13.	Upright	Grey brown	Ovate	Broad ovate	Horizontal	Shallow	Rounded	Square	Sometimes present
14.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Rounded	Square	Always present
15.	Upright	Grey brown	Elliptic	Broad ovate	Horizontal	Shallow	Rounded	Irregular rounded	Sometimes present
16.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Rounded	Irregular rounded	Sometimes present
17.	Spreading	Grey brown	Ovate	Ovate	Erect	Shallow	Obtuse	Irregular rounded	Always present
18.	Upright	Brown	Ovate	Broad ovate	Semi-erect□	Shallow	Rounded	Irregular rounded	Sometimes Present
19.	Spreading	Grey brown	Obovate	Circular	Erect	Shallow	Rounded	Irregular rounded	Always present
20.	Spreading	Brown	Ovate	Circular	Erect	Shallow	Rounded	Irregular rounded	Sometimes Present
21.	Upright	Grey brown	Ovate	Broad ovate	Horizontal	Shallow	Obtuse	Irregular rounded	Sometimes present
22.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Obtuse	Irregular rounded	Always present
23.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Obtuse	Irregular rounded	Sometimes present
24.	Semi upright	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Obtuse	Irregular rounded	Sometimes present
25.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Rounded	Irregular rounded	Always present
26.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Obtuse	Square	Sometimes present
27.	Upright	Brown	Ovate	Very broad ovate	Semi-Erect	Shallow	Rounded	Square	Sometimes Present
28.	Spreading	Grey brown	Ovate	Broad ovate	Erect	Shallow	Obtuse	Irregular rounded	Always present
29.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Medium	Obtuse	Irregular rounded	Always present
30.	Spreading	Grey brown	Elliptic	Broad ovate	Semi-erect	Shallow	Obtuse	Square	Sometimes present
31.	Upright	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Obtuse	Square	Always present
32.	Spreading	Grey brown	Ovate	Circular	Semi-erect	Shallow	Rounded	Irregular rounded	Sometimes present
33.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Obtuse	Square	Always present
34.	Spreading	Grey brown	Ovate	Transverse broad oblong	Semi-erect	Medium	Truncate	Square	Sometimes present
35.	Upright	Grey brown	Ovate	Very broad ovate	Semi-erect	Shallow	Rounded	Irregular rounded	Always present
36.	Spreading	Grey brown	Ovate	Broad ovate	Semi-erect	Shallow	Obtuse	Irregular rounded	Sometimes present

The diversity of phenotypic appearance is represented by the qualitative and quantitative characters. It may be caused by many genes or environmental factors of each accession. Maeda et al. (2017) and Yilmaz et al. (2017) explained that the value of plant genetic resources is expressed by its usability and the diversity of plant inbreeding. Characterization studies would allow to point out the variability pattern of observed characters, such as a quantitative characterization of fruit shapes also revealed a clear association between fruit and seed shapes. The most effectiveuse of this quantitative evaluation of fruit shapes involves association tests with quantitative environmental or genetic parameters, including temperatures or gene expression levels. Alif (2008) states that quantitative characters are governed by several genes called dual genes (polygenes). Quantitative characters could not differentiate because their distribution is continuous. These characters are controlled by many genes so they are also called polygenic characters. Each gene unit affects expressing its phenotype. However, the quantitative character is strongly influenced by the environment. This quantitative character can be considered in terms of choosing elders in the breeding field.

Based on the research conducted it is known that in general the persimmon fruit that is found in the form of broad ovate but there is some genotype have another fruit form that is circular, transverse broad oblong, ovate, and very broad oblong. In the fruits form parameters after split mostly irregularly rounded, the shape of the fruit tip widened, the grooves of the fruit in a shallow longitudinal. This is in accordance with Baswarsiati et al. (2006) which states round-shaped Fruit with a border-like edge, the base of the fruit is flat and looks clear petals at the ends.

Accession 34 has a characteristic of broad transverse oblong, and after being split in half square wrinkles at the tip of calyx medium, and orange skin color. These morphological features have supported by Ishaq and Noch (2006), that characteristics of Reundeu or Eureka cultivars have medium-large fruit shape with a square shape, there are wrinkles around the calyx, color orange fruit peel, the texture of the flesh is rather dense and dry, the fruit ripening phase is rather long compared to the cultivar Kapas or Hachiya.

The identification result of 36 accessions in Karo District has a different and special character on some accessions. So it can be used as source in the development of persimmon in the conventional field or as parents origin by combining some of these characters to preserve persimmon crop, and also improve the yield and quality of persimmon fruit.

The success of plant breeding programs to improve the character of a plant is determined by the availability of genetic resources. It is necessary to conduct a study that examines the diversity of Japanese persimmon plants in Karo District as a source of germplasm and information in support of plant breeding programs in North Sumatra, then obtained sufficient information to determine the necessary steps in order to preserve Japanese persimmon plants, improve yield and quality of fruit and developing Japanese persimmon farming.

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