Characterization of persimmon (*Diospyros kaki* L.) as biodiversity originated from Indonesia

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Abstract. Persimmon (*Diospyros kaki* L.) belongs to the family Ebenaceae is widely grown in the climate zones range in the world. Persimmon grows well in media rich in organic matter with sufficient water content and generally at an altitude above 1000 masl. It is one type of subtropical fruit plant that is classified as rare in Indonesia. It has the potential to be developed for cultivation. The diversity characteristics of persimmon in each region are represented by the qualitative and quantitative. It may be caused by environmental factors or gene changes. Thus, the lack of environmental factors, plant growth will be disorder and will stop. Temperature is one of the factor affecting photosynthesis and plant metabolism at the cellular level. The difference in the temperatur range can be attributed to variations in latitude, topography, proximity to large bodies of water represented. The research aimed to identify morphological characters of persimmon at Selo District and to determine the level of persimmon diversity based on their morphological characters. The research was conducted in February – May 2020 in Selo Village, Boyolali, Central Java Province. This research used 15 samples of persimmon plant. The observation variable include geographical conditions and plant morphological characteristics (trees, stems, leaves, fruits). The data obtained were presented descriptively. The grouping of elements between samples was carried out by cluster analysis with the UPGMA method using the NTSYS. The results of the cluster analysis were presented in the form of dendogram. The results showed that Selo, persommon had various characters but several observation variables showed uniformity. The persimmon similarity coefficient is 0.66.

1. Introduction

Persimmon (*Diospyros kaki*) belongs to one type of subtropical fruit plant which is classified as rare in Indonesia and has the potential to be developed. In Java, persimmon grows well at an altitude of 800-1500 m above sea level with high rainfall, persimmon plants are rain tolerant to various types of soil. Persimmon is also known as *kaki* fruit, or in English is called Oriental (Chinese/Japanese) persimmon. *Kaki* in Japanese refers to the tannin substance this fruit produces. Aside from being served as a table fruit, persimmons are considered potential as a raw material for sweets or jams [1], [2], [3].
Persimmon fruit development as the potential economical fruit can be carried out by plant breeding and tissue culture. The success of plant breeding programs is largely determined by the availability of various genetic sources of plants and appropriate breeding methods. Exploration belongs to one of the activities that can be carried out to provide genetic sources by utilizing local wisdom in Indonesia [4].

Research on the characteristics of persimmon in each region has not been widely carried out, while the morphological characteristics of persimmon plants in each region are different, resulting in a wide variety of persimmon plants. Until nowadays, the exact number of types of persimmon plants grown by Indonesian farmers remains unknown. Therefore, it is necessary to conduct research that examines the diversity of existing persimmon plants. The collection of diversity information is carried out through activities such as exploration. Exploration provides opportunities for the availability of the desired genetic potential. This activity includes finding information on the existence, collection, characterization, evaluation and descriptions of plants [5]. By doing so, the sufficient information will be obtained to determine the steps needed to conserve persimmon plants, increase the yield and quality of persimmon fruit and develop persimmon farming.

One way to determine the kinship between one species and another is by determining the similarities in their morphological features. The utilization of morphological characters is considered an easy and fast method, since it can be applied directly on the persimmon plant population, and the data obtained can be used as a description of persimmon plants and improvement of properties and plans for persimmon plant development. Morphological characterization has not shown true genetic diversity, because the environment affects plant morphology [6]. The purpose of this study is to determine and study the morphological characters of persimmon in Selo, Boyolali Regency, as well as to determine the diversity of persimmons in the region.

2. Methods
The research was conducted in February – April 2020 at Sepandan Kulon Village, Selo, Boyolali Regency, Central Java. Selo Village was chosen as the research location since persimmons only exist in the highlands or mountains like most areas in Selo, and there were many trees taken care by the local villagers.

The materials used in the study were 15 persimmon plants in Sepandan Kulon, Selo. The 15 trees chosen had certain criteria, namely old, large in size, proven to bear a lot of fruit/productive in every harvest year—that was also based on the initial survey, and recommended by the local people. The tools used in the research were GPS (Global Position System), clinometer, meter, plant descriptor issued by IBPGR (International Board Plant Genetic Resources Institute), stationery, and digital cameras.

This research employed an exploratory method, namely the survey method. The first stage involved site visit (field observation) to obtain information on site conditions and selecting samples to identify the characteristics. Then, the exploration was carried out by recording the required data. Data collection was also carried out through interviews with local communities. The data obtained were then analyzed by applying the descriptive statistics.

Observational data collected were analyzed descriptively. The qualitative data obtained were then converted into quantitative data in the form of scoring. The morphological data derived from the score data on each persimmon plant were then processed for similarity using the Similarity for Qualitative Data (SimQual) similarity matrix method with the DICE similarity coefficient. The next method applied was Sequential Hierarchical and Nested Clustering (SHAN) with the results based on the input matrix data. The analysis of plant samples grouping applied the Unweighted Pair Group Method Arithmetic Average (UPGMA) method. The program used was the Numerical Taxonomy and Multivariate Analysis System (NTSYS) version 2.02i. The results of this analysis were interpreted in the form of a dendrogram so that the morphological diversity of persimmon plants can be shown.
3. Result and discussion

3.1. Plant height
Plant height is a variable that shows the plant’s vegetative growth activity. With the increase in plant height, the plant will experience cell division. Plant growth is influenced by several factors, such as the environment, physiological conditions and plant genetics. The measurement results of persimmon plant height showed differences between plants.

| Sample | Height (m) | Score |
|--------|------------|-------|
| K1     | 13.49      | 5     |
| K2     | 13.89      | 5     |
| K3     | 9.96       | 4     |
| K4     | 11.87      | 4     |
| K5     | 10.57      | 4     |
| K6     | 10.48      | 4     |
| K7     | 13.48      | 5     |
| K8     | 9.96       | 4     |
| K9     | 9.11       | 4     |
| K10    | 10.90      | 4     |
| K11    | 11.92      | 4     |
| K12    | 12.31      | 5     |
| K13    | 13.49      | 5     |
| K14    | 14.84      | 5     |
| K15    | 10.48      | 4     |

Source: Observation results.

3.2. Canopy Shapes
The various forms of headers are round, oval, freely spreading, rectangular, column and vertical [7]. Table 2 shows the diversity of persimmon canopy shapes. The shape of the persimmon canopy in Selo Village was not too diverse, divided into irregular and semicircular. The irregular canopy referred to the rounded shape [8].

| Sample | Canopy shape   | Score |
|--------|----------------|-------|
| K1     | Irregular      | 5     |
| K2     | Irregular      | 5     |
| K3     | Irregular      | 5     |
| K4     | Semi Circular  | 4     |
| K5     | Irregular      | 5     |
| K6     | Semi Circular  | 4     |
| K7     | Semi Circular  | 4     |
| K8     | Irregular      | 5     |
| K9     | Irregular      | 5     |
| K10    | Irregular      | 5     |
| K11    | Irregular      | 5     |
| K12    | Irregular      | 5     |
| K13    | Irregular      | 5     |
| K14    | Irregular      | 5     |
| K15    | Semi Circular  | 4     |

Source: Observation results.
3.3. **Plant diameter**

Persimmons belong to dicotyledons, so the older the plant’s, the larger the circumference will be. The addition of tree circumference in dicotyledons, especially persimmon, is due to the activity of cambium cell division.

| Sample | Plant Diameter (cm) | Score |
|--------|---------------------|-------|
| K1     | 78                  | 5     |
| K2     | 79                  | 5     |
| K3     | 70                  | 5     |
| K4     | 53                  | 4     |
| K5     | 61                  | 4     |
| K6     | 62                  | 4     |
| K7     | 87                  | 5     |
| K8     | 59                  | 4     |
| K9     | 70                  | 5     |
| K10    | 71                  | 5     |
| K11    | 69                  | 4     |
| K12    | 55                  | 4     |
| K13    | 63                  | 4     |
| K14    | 72                  | 5     |
| K15    | 67                  | 4     |

Source: Observation results

3.4. **Leaf morphology**

The leaf morphology consists of 4 qualitative and 2 quantitative characters. Qualitative characters consist of young leaf color, old leaf color, leaf shape, leaf base shape. The variation in qualitative characters was very small, only in the variables of young leaf color and leaf shape. The leaf margins, the top and bottom surfaces of the leaves, the shape of the tips and the base of the leaves have uniform characters. These variables are phenotypic traits that are difficult to influence by the environment.

3.5. **Fruit morphology**

The observations results of the morphological characters of persimmon fruit showed that the diversity was small. The shape of the persimmon is round to round sideways. The flesh is orange for the old, while the young ones are yellowish orange, but are already ripe, while the unripe fruits are green. The texture of the pulp is soft and soft, fibrous and not gritty. The taste of the flesh is sweet and spicy due to the tannin contents, but the harsh taste will disappear when the fruit is soaked in lime water.

Plant yield observation data were obtained from direct interviews with persimmon plant owners. These data presented the range of persimmon yields from previous years. The owner was not sure how much the harvest was, but the owner remembered that the yield range was approximately 2 quintals. From the observations, it can be seen that the color of the persimmon rind in all samples had the same color. The skin color of the persimmon is orange when the fruit is ripe. As for the raw or half ripe fruit, the colors are green and yellow. The fruit is round with a border, the base of the fruit is flat and there is a clear petal at the end [9]. The color of the young fruit is yellowish green and when it is ripe it turns to orange red to bright red.

3.6. **Total dissolved sugar solids**

The results of the identification of total sugar solids in were 23.0 - 26.0 °Brix. The optimal sugar content is at the ripeness level of 5-6 then slowly decreases as the level of maturity leads to decay [10]. The range of sugar content in persimmons is 24.0-27.5 °Brix. The addition of ethanol can eliminate the astringency properties within 2 days which is marked by a change in the color of the persimmon rind and the fruit’s volatile content within a day after spraying. The higher the total value of dissolved
solids in the fruit, the sweeter the fruit taste. Persimmons have a sweet and spicy taste. The stinging taste can be removed by soaking persimmons in lime water.

3.7 Persimmon tannin content
The results of the identification of tannin levels were 3.47 mg/100 g, with the acid content of 0.06-0.09%. Tannin content can be removed by soaking the fruit in a solution of lime water. As suggested by the farmer during the interview, persimmon fruit needs to be soaked in lime (lime) water for about 3 days to get rid of the tangy taste of the fruit. Most of the soaking in the collector’s place lasted almost a week. Then the fruit is dried in the sun to dry. When the fruit is dry it will usually look like there is a sprinkling of white powder on the peel, which is limestone powder that has dried up.

3.8 Diversity and grouping analysis
Morphological characters refer to phenotypic traits that can be influenced by genotype and environmental factors [11]. Propose that if a character has high enough genetic diversity, then the diversity of characters between individuals in the population will be high too so that it will be easier to get the desired traits during selection [12]. Therefore, genetic diversity information is needed to obtain the expected new varieties. Selection will be more effective if the characters that are the target of selection have high diversity [13].

Figure 1. Persimmon Dendogram Graph in Selo Village, Selo District, Boyolali Regency.

The picture above shows the dendrogram for persimmon grouping in Selo Village, Selo District, Boyolali Regency which consisted of 15 samples. The persimmon similarity coefficient was high, up to 0.66. The level of similarity is considered low if it is less than 0.6. The lower the similarity coefficient, the higher the variety will be [14]. The diversity level of persimmons in Selo Village was 0.44. The results of the dendrogram show that persimmon in Selo Village is divided into 4 groups.
Group (A) consists of K1, K2, K7, K12, K13, K14; group (B) consists of K4, K6, K10, K15; group (C) consists of K3, K8, K9; and group (D) consists of one sample, namely K5. The fewer dendrogram branches that have to pass from one sample to another, the higher the similarity. Conversely, the more branches of the dendrogram that must be passed from one sample to another, shows that the similarities are small.

Morphological properties can be employed to identify and describe the kinship between two individuals or populations that can be measured based on the similarity of a number of characters [15]. Diversity that occurs naturally is the result of adaptation or self-adjustment of each individual to the environment [16]. Environmental factors also influence the visible character (phenotype) of an individual besides being determined by genetic factors (genotype).

4. Conclusion
Based on the research carried out, it can be drawn some conclusions: Persimmons in Selo have oblate and spheroid fruit shape, soft flesh texture, large fruit sizes ranging from 77-105 g/fruit, fruit sugar content of 23-26 °Brix, acid content of 0.06-0.09%, tannin content of 3.47 mg/100 g. Research environmental conditions with high rainfall also affect the content of persimmons. The ripe fruits are orange colored. When fully ripe, the fruit is reddish orange in color. It tastes sweet, with a shelf life of more than 14 days, with the productivity of 1-2 quintals/tree/year, bearing fruit only once a year. The level of persimmon morphological diversity based on all observed variables was 0.44. This diversity is because the persimmons cultivated in Selo Village were gained from previous farmers, where it can be assumed that the persimmons planted in this area have mother plants with the same characters. This results in persimmons having little variety.

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