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Diversity of Morphologically Vegetative Characters of Kepel (*Stelechocarpus burahol*): Study in Yogyakarta Palace Region, Indonesia

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Abstract*— Kepel or *Stelechocarpus burahol* is a plant member of the *Annonaceae* family that is very useful as herbal medicines and natural deodorant for the Javanese palace's monarch. Kepel is an endemic Javanese plant that is currently very rare and endangered, so preservation and conservation are essential. The study aims to characterize vegetative morphology and determine the clustering of Kepel in Yogyakarta Palace Region as the first step for Kepel conservation. The study was carried out by a survey method using purposive sampling in 14 regions in Yogyakarta Palace Region. The plant used as an accession was healthy, grows normally, and has produced fruits. The variable observation of the canopy, stem, and leaf refers to the *Annonaceae* family's description based on Bioversity International. Data analysis is performed using cluster analysis based on the coefficient of similarity. The results showed that 46 *kepels* in Yogyakarta Palace Region had a high diversity based on the analysis of similarities in 16 variables with a similarity coefficient of 0.5-0.91. Analysis of cluster described that there are two clusters with a coefficient similarity of 0.5. Cluster A has 40 accessions (87%); cluster B has six accessions (13%). Leaf shape, leaf size, and stem color have an essential role in clustering the Kepel in Yogyakarta Palace Region. Cluster A relatively has a smaller leaf than the leaf of cluster B. The leaf blade shape of cluster A is elliptic to lanceolate, and the stem colors are beige-green and grey. Cluster B has an elliptical to ovate leaf blade shape, and the stem color is light brown, brown, and reddish-brown. This research data can enrich Kepel germplasm information, which is very useful as basic data for the conservation, development, and breeding of Kepel plants.

***Keywords*— Diversity; *Kepel*; morphology characterization; Yogyakarta Palace Region; cluster analysis; vegetative characters.**

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I. INTRODUCTION

Indonesia is one of the countries that belong to megadiversity with very high biodiversity, but only 25% are known, utilized, and cultivated. Some of them are rare and almost extinct plants. Indonesia is one of the world's countries with very high biodiversity with very unique and abundant biodiversity [1]. The biodiversity of the Indonesian archipelago contains very high levels of indigenous species that are seriously threatened by the loss of their habitat [2]. One of the rare plants that are very useful and have a high potential to develop and preserve is *Kepel*, often called *burahol. Kepel* (*Stelechocarpus burahol*) is an Indonesian endemic plant also found in Malaysia, the Philippines, and Thailand. Kepel is native to Indonesia, which also grows in Southeast Asia to the Solomon Islands. In Indonesia, *Kepels* are distributed in Sumatra, Java, Kalimantan, Bali, and Sulawesi [3]. *Kepel* is a tropical plant that grows in its natural habitat, tropical and humid secondary forests in Java, and is found growing from 0 meters to an altitude of 800 meters above sea level [3]. In Kulon Progo, Yogyakarta, Indonesia, the *Kepel* can grow and bear fruit up to 900 m above sea level [4]. *Kepel* is unique and exotic; the fruit of the *kepel* attach to the main trunk, not in the branches like general fruit plants. When fruitful, the fruit is abundant attached to the main stem's tubercles surface from the base until close to the top (Fig. 1.). The canopy shape is pyramidal shaped with 1-3 main branches. The leaves are simple, thinly, smooth, shaped elliptically-oblong to ovate-lanceolate, and dark green color [5]. In Java island, especially in the Yogyakarta region, *kepel* is generally planted around the palace, and traditionally the fruit is often used by the royal family as a deodorant to scent the body. Consumption of the fruit *kepel* can make a smell of fragrant sweat, eliminate bad breath, and prevent urine and

dirt from the stinging smell and smell fragrant [6]. Consumption of *kepel* fruit also can reduce lousy breath odor [7]. The ethyl acetate content in this fruit has antimicrobial activity and inhibits the development of oral bacteria *P. gingivalis* and *F. nulceatum* [8], [9]. Furthermore, *kepel* fruit extract could reduce bad breath in the mouth (halitosis), while phenolic and flavonoids compounds can function as antioxidants [10], [11].

Fig. 1 *Kepel* (*Stelechocarpus burahol*) trees. A: the canopy *kepel* is pyramidal and vegetative stage; B: Fruit of the *kepel* sticking and fulfilling tree trunks

Although *kepel* has many utilities, this tree is a rare plant and difficult to find. This tree is presently registered in the "List of Rare Plant" and belongs to the Conservation Dependent (CD) category [12]. The scarcity of *kepel* means that the viability of this tree is challenging to track down because it is rare, and it is urgent to do conservation expeditiously so that it does not become vulnerable or even extinct. Moreover, the information and the research about the *kepel* are very limited and rarely done. Most of the previous Kepel studies were research on the benefits and uses of Kepel fruit as herbal medicine [7], [8], [10]. Research on the diversity of *kepel* plant morphology is very rarely carried out, especially diversity in the Special Region of Yogyakarta. Therefore, the conservation and study of *kepel* need to be done so that this tree is preserved. Identification and characterization are the first stages of conservation as a basis for acquiring information about germplasm diversity [13]. This research aims to identify the diversity of *kepel* based on the vegetative character in The Yogyakarta Palace Region. This research data can enrich *kepel* germplasm information, which is very useful as basis data for the conservation, development, and breeding of *kepel* plant.

II. Materials and Method

This research was conducted using the survey method [14] in Yogyakarta Palace Region, Java Island, Indonesia. Surveys of *kepel* have been done in 14 districts of The Yogyakarta Palace Region, including Keraton, Pakualaman, and Kotagede district, for six months in 2019. Selection of the *kepel* as an accession plant using the purposive sampling method [15], [16]. *Kepel* that had been fruitful (age more than ten years), grows normal, healthy, and is not affected by pest disease were used as accession. [4]. Vegetative character data collection was carried out by direct data collection through observation. Measurements of the vegetative character include the stems, canopies, and foliage. The morphological observation variable of the *kepel* was characterized using 16 characters based on a description for the *Annonaceae* plant (A*nnona cherimolla*) of international biodiversity, the International Plant Genetic Resources Institute (IPGRI) [17].

The Observation variables include the following: Canopy shape, stem color, tree age, tree height, canopy diameter, number of primary branches, stem perimeter, and number of tubercles) and a leaf blade shape, leaf base shape, leaf apex shape, leaf color, leaf margin, leaf length, leaf width, and petiole length). The interview was also carried with the owners about the age range and history of the origin of the *kepel* in the house yard or office yard. Data retrieval in the form of latitude, longitude, and altitude are also done to describe the distribution of accessions in The Yogyakarta Palace Region. The observation Data of *kepel* vegetative character in The Yogyakarta Palace Region is then presented in the form of scoring, then analyzed to assess the matrix of similarities using SIMQUAL procedure (similarity to qualitative data) [18]. The grouping of matrix data (cluster analysis) and the production of a dendrogram is conducted with an unweighted PAIR-Group method of Arithmetic Average (UPGMA) using a numeric taxonomy program and NTSYS multivariate system version 2.02i [19]–[21].

III. Results and Discussion

A. Distribution of Kepel in Yogyakarta Palace Region

The distribution of the *kepel* in The Yogyakarta Palace Region is spread over 13 districts of 14 districts, and there is no *kepel* in the Mergangsan district. The number of accessions in each area in The Yogyakarta Palace Region is Keraton (5 accessions), Mantrijeron (5 accessions), Gedongtengen (2 accessions), Jetis (4 accessions), Gondomanan (5 accessions), Gondokusuman (3 accessions), Wirobrajan (4 accessions), Guns (2 accessions), Tegalrejo (3 accessions), Danurejan (3 accessions), Pakualaman (2 accessions), Kotagede (3 accessions), Umbulharjo (5 accessions), and Mergangsan (0 accessions). Based on the distribution map of the *kepel* in The Yogyakarta Palace Region, it is selectable that the spreading of *kepel* distributes in almost the entire region. However, the plant population is found around the palace building and historical site, including in the fortress of the Palace of Ngayogyakarta, Pakualaman palace, Jogokaryan mosque, and Kotagede (Figure 2.). As additional information, most of the *kepel* in The Yogyakarta Palace Region grows in the home yard, garden, office yard, and orchards. In the same condition in Kulon Progo, almost all *kepel*s are grown and planted in the backyard, yard, garden, or office yard [4].

The Yogyakarta Palace Region is located in the center of Special Regions of Yogyakarta Province, with a height of 110-115 m above sea level. The Yogyakarta Palace Region lies between 110°24'19"-110°28'53" East longitudes and 7°15'24"-7°49'26" south latitudes with an average height of 114 m above sea level [22]. It has a tropical and humid climate that is suitable for the growth of *kepel*. Nevertheless, the *kepel*s in The Yogyakarta Palace Region are rare and difficult to find. Based on the survey that has been done for

six months, there are only 46 *trees* in The Yogyakarta Palace Region.

Based on an interview with the owner and the community, it is known that the scarcity *kepel* is caused by community reluctance to plant. Influencing factors are: (1) *kepel* need more than eight years to produce fruits, (2) the fruit has low economic value, (3) fruit flesh is scrimpy with several big seeds (4) there is no innovation for post-harvest processing so that the fruit maturation is left rot and turned into garbage, and (5) assumption in the community that only the palace can plant the *kepel*. Moreover, many old-age *kepel*s are cut down. There is an assumption about a mystical nuance around the location of the tree (haunted). *Kepel* has not been widely cultivated until now [23]. One of the lacks of public attention to this plant is the lack of economic attractiveness or benefits of *kepel*. The economic value is low because *kepel* fruit has a large seed size compared to the overall fruit size, which is around 49%, while the edible portion of the fruit is only about 27% [23]; [24].

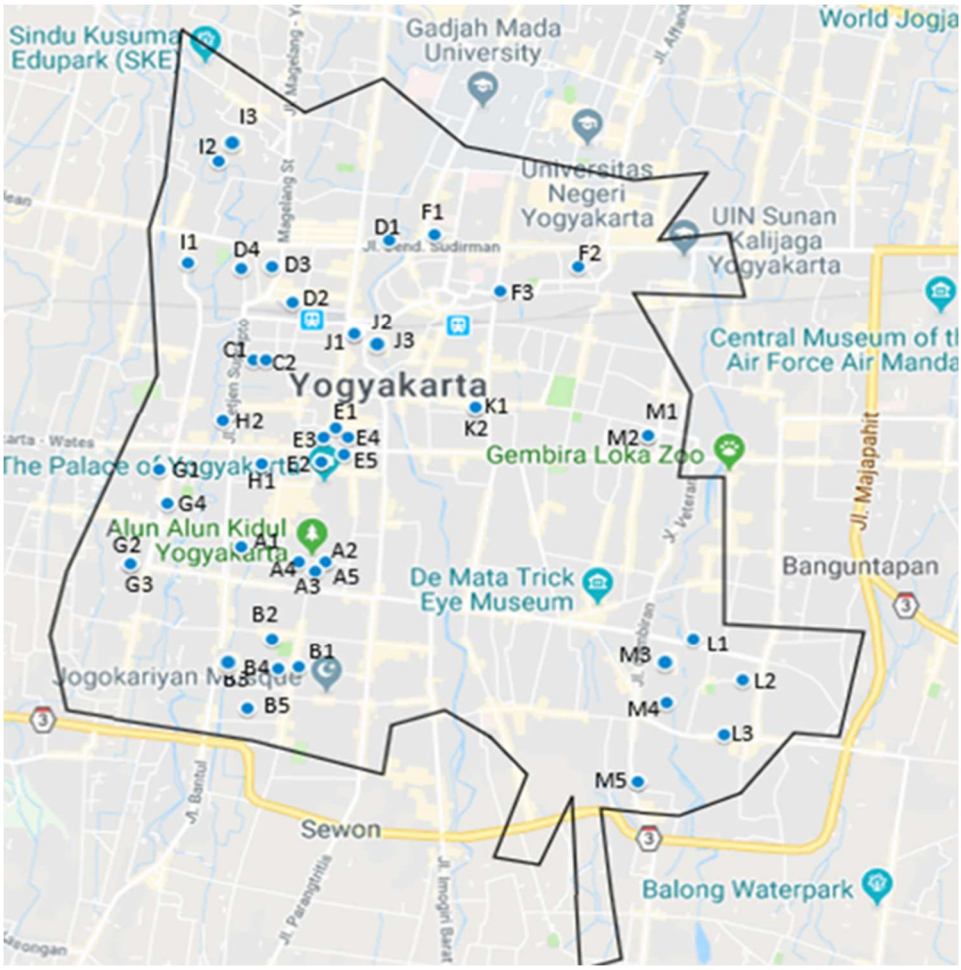

Fig. 2 Distribution map of *kepel* in Yogyakarta Palace Region . A: Kraton; B: Mantrijeron; C: Gedongtengan; D: Jetis; E: Gondomanan; F: Gondokusuman; G: Wirobrajan; H: Ngampilan; I: Tegalrejo; J: Danurejan; K: Pakualaman; L: Kotagede; M: Umbulharja. Number 1-5: Number of samples)

B. Vegetative characters of Kepel in The Palace of Yogyakarta

Characteristics of germplasm plants are an important relationship between the conservation and utilization of plant genetic resources. The characteristics of a plant can be demonstrated using an analysis of genetic diversity through morphological and molecular approaches. Both approaches use markers to demonstrate the characteristics of a plant [25]. Morphological characterization is the starting point in the description and classification of germplasm. Vegetative characterization of *kepel* in The Yogyakarta Palace Region has been identified through 16 variables, including the character of trees, stems, and leaves based on descriptions for *Annonaceae* (*Annona cherimolla*) [17]. Based on the interview with the owner, the *kepel*s located in The Yogyakarta Palace Region are approximately 18 to 100 years old. The origin of this tree generally is from their ancestors planted in the home yard or garden. In comparison, the *kepel* located in the office yard usually comes from a government's green program or preservation program as an identity plant of Yogyakarta province. *Kepel* is one of the alternative plants for greening in urban settlements based on the people's level of aesthetics and income in Rejowinangun, Yogyakarta [26].

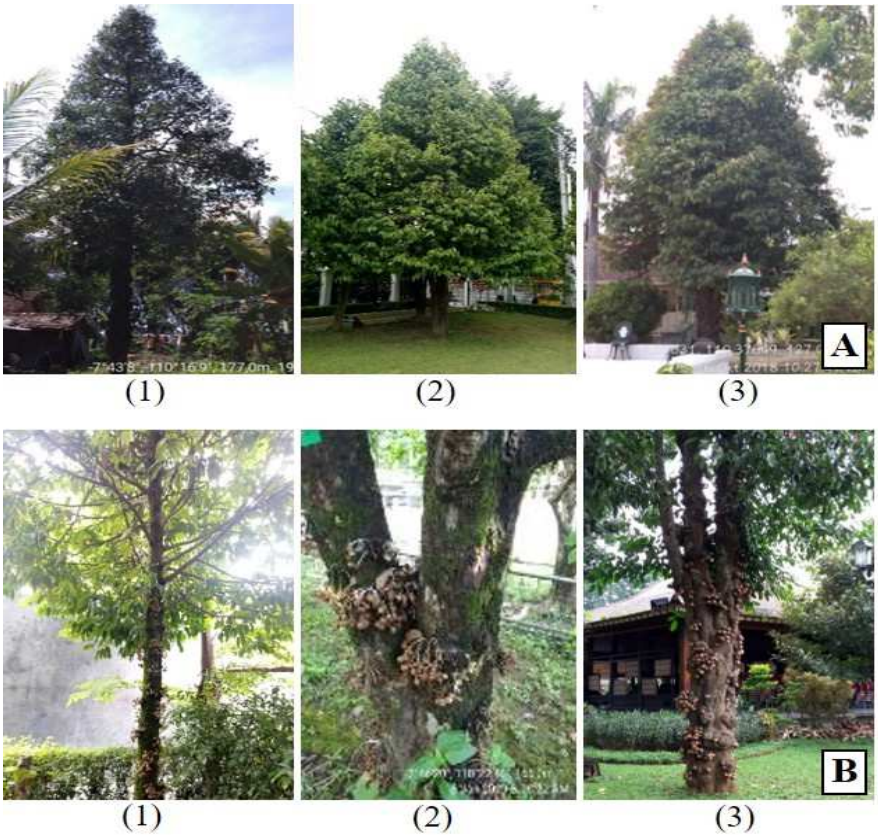

Fig. 3 Vegetative character of *kepel* in The Palace Region of Yogyakarta. A (1-3): canopy shape (pyramidal), B: number of the main stem (1: one stem, 2: two stems, and 3: three stems)

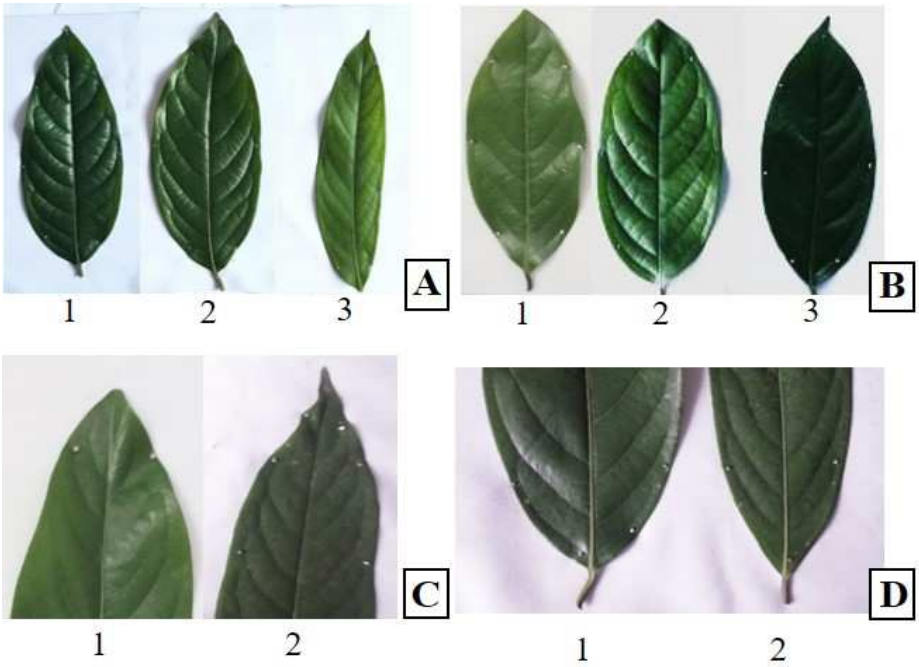

Fig. 4 Vegetative character variations of *kepel* leaf in The Palace Region of Yogyakarta. A: shape of leaf blade (1:ovate, 2: elliptical, 3:lanceolate), B: the color of the leaf (1: light green, 2:green, and 3: dark green), C: the shape of leaf apex (1: taper and 2: pointed), D: the shape of leaf base (1: obtuse and 2: taper)

TABLE I
GENETIC DIVERSITY OF 46 *KEPEL* BASED ON VEGETATIVE CHARACTER IN YOGYAKARTA PALACE REGION

Sample code	Canopy Shape	Stem color	Tree Age (years)	Tree Height (m)	Canopy Diameter (m)	∑ main branches	stem perimeter (m)	No. tubercles
A1	Pyramidal	Beige-green	18	8.0	6.6	2	0.5	16
A2	Pyramidal	Reddish-brown	18	11.0	5.1	1	0.9	9
A3	Pyramidal	Light brown	30	12.0	5.3	1	0.8	9
A4	Pyramidal	Light brown	20	11.0	6.5	1	0.7	5
A5	Pyramidal	Reddish-brown	20	6.5	4.5	2	0.8	15
B1	Pyramidal	Reddish-brown	30	13.0	6.3	2	1.2	11
B2	Pyramidal	Beige-green	20	12.0	5.2	1	0.6	11
B3	Pyramidal	Brown	25	9.5	5.3	1	0.6	5
B4	Pyramidal	Light brown	18	9.7	4.8	1	0.6	12
B5	Pyramidal	Reddish-brown	50	18.0	6.2	1	0.8	12
C1	Pyramidal	Reddish-brown	30	10.0	6.5	1	0.9	18
C2	Pyramidal	Reddish-brown	20	10.0	7.2	1	0.8	10
D1	Pyramidal	Brown	18	11.0	5.2	1	0.6	13
D2	Pyramidal	Light brown	100	17.0	5.7	2	1.5	8
D3	Pyramidal	Light brown	20	10.0	4.9	2	0.6	17
D4	Pyramidal	Light brown	19	10.0	6.7	1	0.8	14
E1	Pyramidal	Beige-green	18	8.2	5.2	2	0.6	10
E2	Pyramidal	Light brown	18	13.0	7.7	3	1.6	24
E3	Pyramidal	Light brown	18	8.2	5.3	2	0.8	7
E4	Pyramidal	Light brown	20	10.0	6.2	2	0.6	19
E5	Pyramidal	Light brown	20	8.4	7.9	3	0.6	32
F1	Pyramidal	Light brown	15	8.2	5.0	1	0.5	8
F2	Pyramidal	Beige-green	100	13.0	8.1	3	1.3	29
F3	Pyramidal	Light brown	20	8.4	4.1	2	0.5	7
G1	Pyramidal	Grey	18	8.8	5.2	2	0.6	11
G2	Pyramidal	Brown	18	13.0	5.8	1	1.0	12
G3	Pyramidal	Brown	10	6.7	4.8	1	0.7	9
G4	Pyramidal	Light brown	18	10.0	7.2	2	0.7	2
H1	Pyramidal	Beige-green	30	9.5	5.8	1	0.9	14
H2	Pyramidal	Light brown	20	6.8	6.0	1	0.6	16
I1	Pyramidal	Light brown	20	11.0	5.6	1	0.6	10
I2	Pyramidal	Brown	20	7.7	3.8	1	0.4	6
I3	Pyramidal	Brown	20	10.0	4.4	1	0.6	10
J1	Pyramidal	Light brown	18	7.9	6.0	1	0.6	9
J2	Pyramidal	Beige-green	20	7.5	6.5	2	0.6	17
J3	Pyramidal	Light brown	20	8.3	5.9	2	0.5	25
K1	Pyramidal	Light brown	20	8.9	5.9	1	0.7	9
K2	Pyramidal	Light brown	100	10.0	6.2	3	1.9	25
L1	Pyramidal	Brown	20	9.4	4.9	1	0.8	12
L2	Pyramidal	Light brown	30	13.0	7.9	2	0.8	1
L3	Pyramidal	Reddish-brown	25	11.0	5.6	1	0.7	6
M1	Pyramidal	Reddish-brown	20	8.2	7.5	1	0.7	14
M2	Pyramidal	Reddish-brown	20	9.5	4.8	2	0.5	7
M3	Pyramidal	Reddish-brown	20	9.2	4.9	1	0.9	15
M4	Pyramidal	Grey	20	9.5	5.2	1	0.7	13
M5	Pyramidal	Grey	30	11.0	7.6	1	0.8	7

A: Kraton; B: Mantrijeron; C: Gedongtengan; D: Jetis; E: Gondomanan; F: Gondokusuman; G: Wirobrajan; H: Ngampilan; I: Tegalrejo; J: Danurejan; K: Pakualaman; L: Kotagede; M: Umbulharja. Number 1-5: number of accessions.

TABLE II
LEAF CHARACTER OF 46 *KEPEL* IN YOGYAKARTA PALACE REGION

Sample code	Leaf Blade Shape	Leaf Base Shape	Leaf Apex Shape	Leaf Color	Leaf Margin	Leaf Length (cm)	Leaf Width (cm)	Petiole Length (cm)
A1	Ovate	Obtuse	Taper	Green	Oblate	19	7.3	1.1
A2	Elliptical	Obtuse	Taper	Green	Oblate	19	6.9	1.2
A3	Lanceolate	Obtuse	Taper	Green	Oblate	18	6.1	0.9
A4	Lanceolate	Obtuse	Taper	Dark green	Oblate	22	7.2	1.3
A5	Elliptical	Obtuse	Taper	Light green	Oblate	19	6.7	1.0
B1	Elliptical	Obtuse	Taper	Dark green	Oblate	15	6.8	1.1
B2	Elliptical	Obtuse	Taper	Green	Oblate	15	6.4	1.0
B3	Elliptical	Obtuse	Taper	Dark green	Oblate	18	7.5	1.0
B4	Elliptical	Obtuse	Taper	Dark green	Oblate	17	7.0	1.3
B5	Elliptical	Obtuse	Taper	Green	Oblate	18	7.0	1.1
C1	Elliptical	Taper	Pointed	Dark green	Oblate	17	6.5	0.9
C2	Lanceolate	Taper	Pointed	Dark green	Oblate	19	6.4	1.1
D1	Elliptical	Taper	Taper	Green	Oblate	15	6.7	0.9
D2	Elliptical	Taper	Taper	Light green	Oblate	18	7.0	0.9
D3	Lanceolate	Taper	Pointed	Green	Oblate	16	5.7	0.9
D4	Elliptical	Taper	Pointed	Dark green	Oblate	17	6.5	0.9
E1	Elliptical	Taper	Pointed	Green	Oblate	15	6.3	0.8
E2	Elliptical	Taper	Taper	Green	Oblate	16	6.3	0.8
E3	Elliptical	Taper	Pointed	Light green	Oblate	14	5.2	0.7
E4	Elliptical	Taper	Pointed	Light green	Oblate	15	6.0	0.9
E5	Lanceolate	Taper	Pointed	Light green	Oblate	20	6.8	1.2
F1	Lanceolate	Obtuse	Pointed	Dark green	Oblate	22	8.0	1.1
F2	Elliptical	Taper	Pointed	Light green	Oblate	15	5.9	1.0
F3	Elliptical	Taper	Taper	Dark green	Oblate	17	6.7	1.2
G1	Elliptical	Obtuse	Taper	Dark green	Oblate	19	7.5	1.3
G2	Elliptical	Taper	Pointed	Dark green	Oblate	20	7.6	1.3
G3	Elliptical	Taper	Pointed	Green	Oblate	20	7.7	1.3
G4	Elliptical	Taper	Pointed	Light green	Oblate	20	8.0	1.1
H1	Elliptical	Taper	Pointed	Dark green	Oblate	18	7.4	1.0
H2	Elliptical	Obtuse	Pointed	Dark green	Oblate	20	8.1	1.1
I1	Elliptical	Taper	Pointed	Green	Oblate	17	6.6	0.9
I2	Elliptical	Taper	Pointed	Dark green	Oblate	18	7.2	1.1
I3	Elliptical	Taper	Taper	Light green	Oblate	16	6.5	1.1
J1	Ovate	Taper	Pointed	Green	Oblate	17	6.9	1.0
J2	Elliptical	Taper	Taper	Light green	Oblate	15	5.6	0.9
J3	Elliptical	Taper	Pointed	Dark green	Oblate	17	6.5	1.0
K1	Elliptical	Obtuse	Taper	Green	Oblate	18	7.7	1.3
K2	Lanceolate	Taper	Taper	Dark green	Oblate	17	6.3	1.2
L1	Elliptical	Obtuse	Pointed	Dark green	Oblate	19	8.2	1.3
L2	Elliptical	Taper	Taper	Green	Oblate	13	5.8	0.8
L3	Lanceolate	Taper	Pointed	Dark green	Oblate	18	6.3	1.0
M1	Lanceolate	Taper	Pointed	Dark green	Oblate	20	7.7	1.3
M2	Ovate	Taper	Pointed	Dark green	Oblate	16	6.3	0.8
M3	Elliptical	Taper	Pointed	Green	Oblate	17	6.7	1.0
M4	Ovate	Taper	Taper	Dark green	Oblate	17	6.4	1.0
M5	Lanceolate	Taper	Pointed	Dark green	Oblate	21	6.6	1.0

A: Kraton; B: Mantrijeron; C: Gedongtengan; D: Jetis; E: Gondomanan; F: Gondokusuman; G: Wirobrajan; H: Ngampilan; I: Tegalrejo; J: Danurejan; K: Pakualaman; L: Kotagede; M: Umbulharja. Number 1-5: number of accessions.

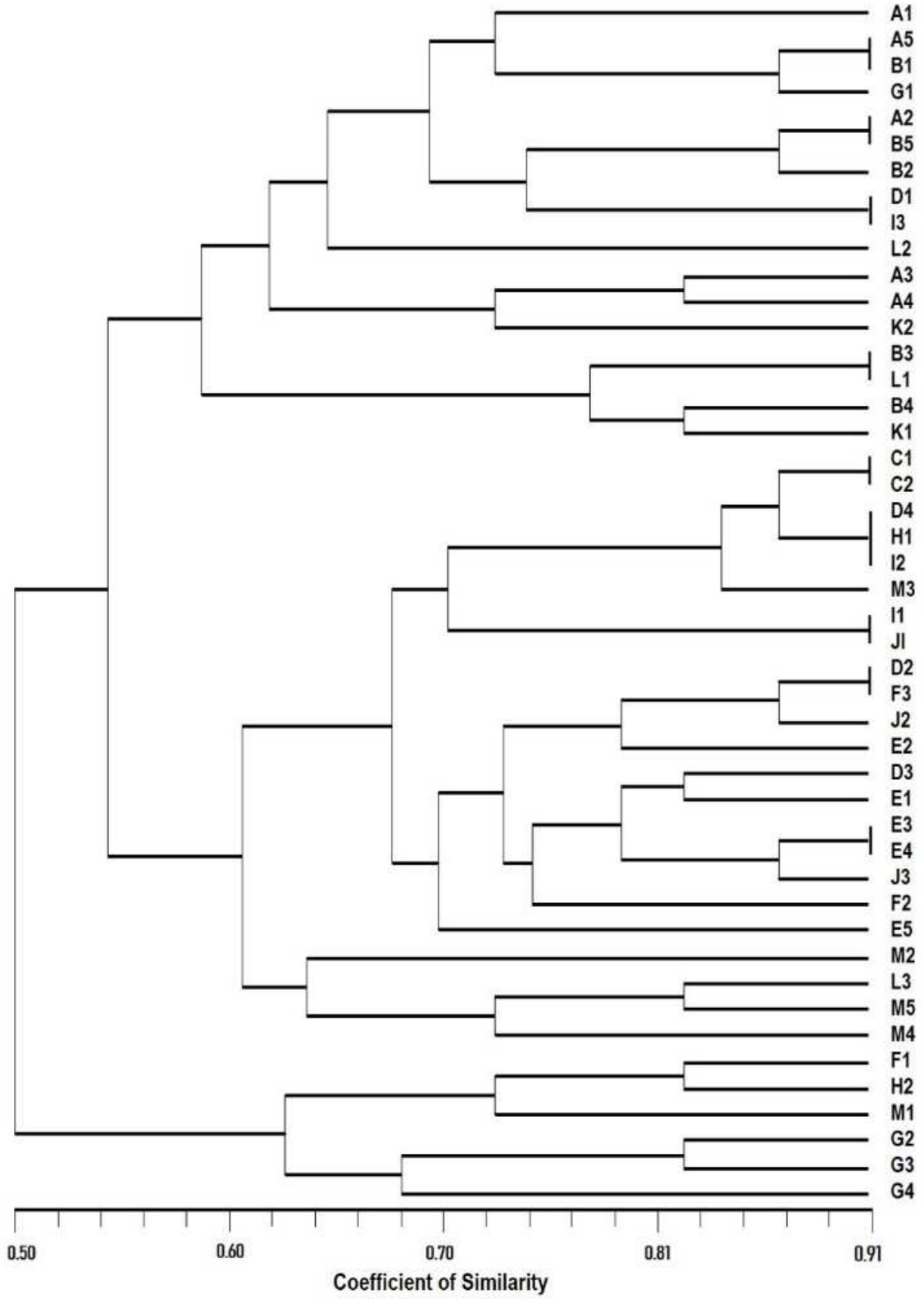

Fig. 5 Dendrogram 46 accessions of *kepel* in the Palace of Yogyakarta based on 14 vegetative characters

Based upon observation and measurement using Clinometer, the height of *kepel* crop in The Yogyakarta Palace Region ranging from 6.5 m to 18 m. The similarities and differences of the vegetative character of the *kepel* in The Yogyakarta Palace Region are shown in Table 1. and Table 2. Of the 46 accessions of *kepel* shows the similarity of character in canopy shape and leaf margin. While there are variations on stem color, tree age, tree height, canopy diameter, number of main branches, stem perimeter, and number of tubercles, leaf blade shape, leaf base shape, leaf apex shape, leaf color, leaf length, leaf width, and petiole length. *Kepel* in the Kulon Progo region also has similarities in the shape of the canopy in the form of pyramidal shape and oblate leaf margin [4]. The data in Table 1. shows that all the *kepel* in The Yogyakarta Palace Region have a canopy shape like a pyramid and have 1-3 primary branches. Canopy diameter ranges between 4. 1 to 8. 1 m. Stem perimeter size 0.4 to 1. 5 m with stem color beige green, reddish-brown, light brown, brown, and grey. The bark of *kepel* fulls attached with abundant tubercles. The tubercles on one-meter-long stem between 1 to 32 tubercles. van Heusden [3] and Lim [5] introduced that the *kepel* is an upright and conical tree that tree height reaches 25 m. The diameter of the stem of up to 40 cm, has a brownish, dark gray to black color, and has the characteristic of being covered with very many tubercles. The number of tubercles in the bark of *kepel* can estimate the number of fruits that will be produced

Data in Table 2. shows that elliptical shapes dominate the leaf blade of 46 kepels in The Yogyakarta Palace Region, but some trees have ovate and lanceolate leaf shapes. All the *kepel*s show that the leaf margin is oblate, not undulate. The leaf base is obtuse and taper, nothing is round and cordate form; meanwhile, the shape of the leaf apex is taper or pointed, nothing is no round shape. The mature leaves color was light green, green, and dark green. Leaves lengths are 14-22 cm, 5.2-8.2 cm wide, and petioles length are 0.8-1.3 cm. Umiyah [27] mentions that *kepel* leaves are simple leaves, left shaped are oval, ovate to lanceolate, adult leaves are dark green, thin, slightly rough, and shiny.

C. Cluster Analysis

Based on the similarity analysis in 46 accessions with 16 variables, *kepel* in The Yogyakarta Palace Region has a correlation coefficient between 0.5 to 0.91 (50-91%). It indicates that the *kepel* in Yogyakarta Palace Region has a high diversity in vegetative characters. Oktavianingsih [15] mentioned that taro in Kalimantan has a high diversity with a similarity coefficient value of 0.615 to 0.974 (61.5–97.4%). Recently, *kepel* propagation is just using the generative method. The vegetative propagation by grafting is still tricky to do. *Annonaceae* family plants are tough to propagate vegetatively, roots are difficult to grow due to endogenous or exogenous influences [28]. This is what causes the diversity of this tree relatively high. Fiani and Yuliah [29] announce that *kepel* species have high genetic diversity based on varied adaptability. Furthermore, cluster analysis indicated nine pairs of accessions with a close relationship with a coefficient of similarity of 0.91 (91%). They are A5 and B1; A2 and B5; D1 and I3; B3 and L1; C1 and C2; D4, H1, and I2; I1 and J1; D2 and F3; and also, E3 and E4 (Figure 5.). Of the nine pairs with close relationships, 7 pairs are located in different districts. This shows that the environment and the place where it grows have less effect on the vegetative diversity of the *kepel* (Figure 2. and Figure 5.).

As shown by the dendrogram in Figure 5, *kepel* in Yogyakarta Palace Region is grouped in 2 large clusters with a similarity level of 0.50 (50%). Cluster A consists of 40 accessions, and cluster B consists of 6 accessions. Cluster A consists of two sub-clusters of A1 with 13 accessions and sub-classes of A2 with 23 accessions. The differences between clusters A and B are mainly on the leaf blade shape, the leaf size (leaf length and leaf width), and the stem color. Cluster A relatively has a smaller leaf compared to the leaf of cluster B. The leaf blade shape of cluster A is elliptic to lanceolate, and the stem colors are beige-green and grey. Cluster B has leaves blade shape elliptical to ovate, and the color of the stem is light brown, brown, and reddish-brown.

Meanwhile, the differentiating between sub-clusters A1 and A2 are on the shape of the leaf base, the shape of leaf apex, and petiole length. The A1 cluster is characterized by the leaf base's obtuse shape, leaf apex's taper shape, and longleaf stalk. In comparison, the A2 cluster is characterized by a spiky shape of leaf base, a pointed shape of leaf apex, and a short leaf stem. Grouping in clusters indicates that the accessions contained in the same cluster have a close relationship between the accessions as they have much in common with morphological characteristics, while the separation of accessions in different groups indicates a distant connection to each other due to significant differences between accessions [30]–[32].

The results of the vegetative characterization of *kepel* cannot be used yet to determine which accessions are superior. To determine the superior accession required vegetative and *generative* characterization of plants. Nevertheless, from the observation data and calculation of the mass of tubercles in the bark, it indicates that the number of tubercles in the accessions of E5 (Gondomanan 5), F2 (Gondokusuman 2), J3 (Danurejan 3), K2 (Pakualaman 2), and E2 (Gondomanan 2) have more abundant of tubercles per meter rod against other accessions. It showed that the five accessions have the potential to get the highest productivity. The tubercle is a small lump like around on a tree trunk and where flowers and fruit emerge. Thus, when the tubercles are more apparent in the bark, it is assumed that trees are more potential to produce flowers and fruit. Another study is necessary to determine the characterization of the generative and molecular character of the *kepel* to acquire more complex information for the *kepel* germplasm database. It is beneficial for *kepel* conservation and breeding.

IV. CONCLUSION

The vegetative character of the 46 *kepel* accession in the Yogyakarta Palace Region has a high diversity with a similarity *coefficient* of 0.5-0.91 based upon the analysis of similarities in 16 variables. The clustering analysis indicated that there exist two clusters at similarity levels 0.5. Cluster A has 40 accessions (87%); cluster B has six accessions (13%). The shape, leaf size, and color of the trunk have a critical role in clustering the tree of *Kepel* in The Yogyakarta Palace Region. Cluster A relatively has a smaller leaf than the leaf of cluster B. The leaf blade shape of cluster A is elliptic to lanceolate, and the stem colors are beige-green and grey.

Cluster B has an elliptical to ovate leaf blade shape, and the stem color is light brown, brown, and reddish-brown

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