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Variation and phenetic relationships of *Dendrophthoe pentandra* (L.) Miq. from various host trees based on morphological characters

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ABSTRACT. *Dendrophthoe pentandra* (L.) Miq.; Loranthaceae) is a shrub parasitic on various host tree species. This species is often used for herbal medicinal ingredients by local communities based on the spesies of host tree. The morphological characteristics of *D. pentandra* are important to study because their adaptation to different host trees may resulting population of ecotypes. This study aims to determine the variation of *D. pentandra* accession characters on different host tree species based on morphological characters and to determine morphological phenetic relationships between accessions. Besides studies of *D. pentandra* accessions in Yogyakarta Province have never been conducted in full. Sample collection (accession) of *D. pentandra* was conducted for various host tree species from various locations, including roots, stems, leaves, flowers, and fruit. Morphological characterization and scoring of each accession were conducted to create a similarity matrix using the Jaccard Coefficient formula. Based on the similarity matrix between OTUs and the UPGMA algorithm, it can be formed into a dendrogram. The results showed that the morphological variations of *D. pentandra* were found in phyllotaxis, leaf thickness, petiole length, number of stomata density per field of view, flower color, crown tube length, corolla lobe length, petal length, stamen : corolla lobe ratio, fruit color, and seed color. The population of *D. pentandra* in Yogyakarta can be divided into two groups, *D. pentandra* which has alternate and opposite arrangements in phyllotaxis. The accession dendrogram of *D. pentandra* in Yogyakarta was divided into five clusters starting from a similarity index of 0.089 to 0.952. Thus, the diversity of morphological variations of *D. pentandra* on host trees is high.

Keywords: Dendrogram; morphological variations; phenetic relationship; phyllotaxis; principal component analysis

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INTRODUCTION

Indonesia is a country with very high biodiversity, therefore increasing its function and use in society is very important (Daryono *et al*., 2022). One of the medicinal plants that is widely used by Indonesian people is *Dendrophthoe pentandra* (L.) Miq. (Tristanti *et al.*, 2013). This is added to the safety of *D. pentandra* for consumption as a medicinal plant because it does not have excessive toxic effects on humans (Wongkar *et al.*, 2015; Yee *et al*., 2017).

D. pentandra is a plant that comes from the Loranthaceae family which is found as a parasitic plant on various tropical trees. This parasite harms the host plant by inhibiting growth, aborting branches, causing death in the host plant (Solikin, 2017; Haryanta *et al*., 2020). *D. pentandra* is commonly found in urban areas that have parks to residential areas (Haryanta *et al.*, 2020). Widespread distribution is conducted by frugivorous birds that consume fruit and spread their seeds on various trees through their feces (Putra & Nurlaily, 2021).

D. pentandra classified as plant parasites on stems (stem parasites) and include hemiparasites (parasites that still conduct photosynthesis) (Nickrent *et al.*, 2010; Guo & Ruan 2019). In Indonesia, this plant has a negative name because it is a semi-parasitic plant that can damage and inhibit the growth of the various trees it hosts (Muttaqin *et al*., 2021; Solikin, 2021). *D. pentandra* growing on hosts on different parts of the wood and bark of the stem can also show variations in morphological characters, this is due to the chemical composition and hardness of the wood or bark of the different host trees (Marvibaigi *et al*., 2014; Kumar *et al.*, 2015; Ajithkumar *et al.*, 2021).

D. pentandra as a medicinal plant has bioactivity that depends on its host, such as *D. pentandra* in avocado plants contains higher tannins, vitamin B1, vitamin C and calcium than other host plants (Ishiwu *et al*., 2013; Marvibaigi *et al*., 2014). Flavonoid compounds from *D. pentandra* leaf extract on cocoa tree hosts have benefits as a source of antioxidants (Artanti *et al.*, 2012; Fitrilia *et al*., 2015; Sembiring *et al*., 2016; Kasmiyati & Kristiani, 2022). Then, *D. pentandra* extract from cherry host trees is hypoglycemic and can be used as a diabetes mellitus drug because it can actively inhibit the action of the α-glucosidase enzyme and has antidiabetic activity (Artanti *et al*., 2012; Osadolor *et al.*, 2014; Hardiyanti *et al.*, 2018; Tioline *et al.*, 2021). The younger the leaves of *D. pentandra*, the more chemical content contained in it (Tinungki *et al.,* 2018). The results also showed that the content of secondary metabolites such as saponins, terpenoids, alkaloids, flavonoids, and tannins in *D. pentandra* had the effect of lowering blood glucose levels (Yuda *et al.*, 2018).

Based on the many benefits and variations that can occur in *D. pentandra* in various host trees, it is necessary to conduct taxonomic research through phenetic analysis. Phenetic analysis of *D. pentandra* accessions in the Yogyakarta Province needs to be conducted to determine the morphological variations. In addition, it is also necessary to study the kinship relationship of *D. pentandra* accessions to different host trees, in this instance, plant taxonomy and biosystematics research is required. This research will be able to explain and clarify the variations in morphological characters and kinship relationships of *D. pentandra* accessions on various host trees in this province.

Taxonomic research through phenetic analysis itself can be used to identify the level below the species such as accessions and grouping them at the intraspecies level (Bhandari *et al.*, 2017). Then biosystematic research regarding kinship at the level below species such as accessions can be used to look for diversity in plants (Guna & Purnomo, 2021). Taxonomic and biosystematic studies of *D. pentandra* accessions in the Yogyakarta Province have never been conducted in full. Therefore, it is required to conduct further phenetic research to determine the characteristics of each accession of *D. pentandra* on various host trees.

MATERIALS AND METHODS

Phenetic study area. This research was conducted at Laboratory of Plant Systematics, Faculty of Biology, Universitas Gadjah Mada. The specimen samples used were *Dendrophthoe pentandra* (L.) Miq on various host trees. Sampling locations were determined using the cruising method, considering the prevalence of parasites, altitude, host, and canopy covering four regencies in Yogyakarta Province: Bantul, Gunungkidul, Sleman and Kulon Progo regencies.

Sampling of *D. pentandra*. Sampling of *D. pentandra* was collected by observing several identification keys that distinguished it from other species, the bulging crown tube, the flower crown consisting of five petals, and the ovoid or oblong fruit. In addition, there are identification keys for this species based on identification keys for parasites (Backer & Bakhuizen van den Brink, 1965; Barlow, 1967). Sampling was conducted in several stages, the first was taking pictures of *D. pentandra* on its host tree. Then samples were taken using a gaff including parts of twigs, flower bunches, and fruit. The samples taken are those whose host plant species are known. After that, the samples that have been obtained are put into a ziplock and given a name using a label containing the accession code, location name, and host tree name. The samples were then taken and observed at Laboratory of Plant Systematics, Faculty of Biology, Universitas Gadjah Mada.

Morphological character data collection. There are two types of morphological characters collected, quantitative morphological characters and qualitative morphological characters. The observed phenotypic characters were roots, stems, leaves, flowers, fruits and seeds. Quantitative morphological characters were measured using a ruler and caliper. The color of the leaves, flowers, fruits, and seeds were determined using colorcut software. Furthermore, micromorphological observations of stomata were also conducted to determine the number of stomata on leaves per field of view. Preparation of stomata micromorphology preparations was conducted using the upper leaves

of various accessions obtained. The prepared preparations were then observed using a microscope and optilab with 10× magnification.

Data analysis. Quantitative and qualitative morphological character data collected in this study were then analyzed descriptively and statistically. Descriptive analysis was conducted to look for general characteristics or special properties of the specimens studied, while statistical analysis was conducted using the phenetic numerical classification method. Numerical analysis begins with scoring which consists of two kinds of data characters, binary and multistate. Then scoring is done for each character that has previously been converted into binary data (Table 1). After scoring, standardization is then conducted to minimize data bias. The calculation of the similarity index between OTUs is done by looking at the results of the character assessment or the scoring. Furthermore, grouping (clustering) is conducted based on the similarity value that has been obtained. In this study, the similarity index was searched using Jaccard's coefficient calculations. After that, a similarity index matrix can be compiled using a computer program, the multi-variate statistical package (MVSP). After obtaining the similarity matrix, the dendrogram can be reconstructed using the clustering method with unweighted pair group method using arithmetic averages (UPGMA) algorithm. The dendrogram formed consists of dendrograms based on morphological characters. After that, principal component analysis (PCA) analysis can be conducted to determine the distinctive characteristics of each group or cluster that is formed (Tabachnick BG & Fidell, 1989).

Table 1. Scoring and coding morphological characters of *D. pentandra*

No	Character	Score
1	Leaf edge	0 = repandus, 1 = integer
2	Leaf shape	0 = penninerve, 1 = rectinerve
3	Leaf shape based on ratio	0 = elliptic, 1 = oblong
4	Leaf tip shape	0 = acute, 1= acuminate, 2 = obtuse
5	Leaf base shape	0 = acute, 1 = attenuate, 2 = truncate
6	Leaf color	0 = 61781E -8E8F2D (lighter green), 1 = 4A6345-57643D (darker green)
7	Phyllotaxis	0 = opposite, 1 = alternate
8	Single or compound leaves	0 = single leaf, 1 = compound leaf
9	Leaf length	0 = <100 mm, 1 = ≥100 mm
10	Leaf width	0 = ≥50mm, 1 = <50mm
11	Leaf thickness	0 = <0.5mm, 1 =≥0.5mm
12	Stem length	0 = <7 mm, 1 = ≥7 mm
13	Number of stomata per field of view	0 = <100, 1 ≥100
14	Flower type	0 = raceme, 1 = panicle
15	Flower color	0 = BOAC47-D4CD3D (yellowish), 1 = 5F573F-967744 (greenish)
16	Wreath length	0 = ≥45 mm, 1 = <45 mm
17	Stamen length	0 = <15 mm, 1 = ≥15 mm
18	Pistil length	0 = <16 mm, 1 = ≥16 mm
19	Lobe length	0 = <6 mm, 1 = ≥6 mm
20	Crown tube length	0 = <10 mm, 1 = ≥10 mm
21	Petal length	0 = ≥3.6 mm, 1 = <3.6 mm
22	Ratio of stamens and corolla lobes	0 = 3:1, 1 = 2:1
23	Number of flowers per bunch	0 = ≥9, 1 = <9
24	Fruit width	0 = ≥7.1 mm, 1 = <7.1 mm
25	Fruit length	0 = <11 mm, 1 = ≥11 mm
26	Fruit color	0 = A57100-F1C070 (more yellow), 1 = 444d09-756036 (more green)
27	Seed color	0 = 494EA6-8F934 (greener), 1 = B1934D-EA0690 (whiter)
28	Seed length	0 = ≥8.5mm, 1 = <8.5mm
29	Seed width	0 = ≥4.1mm, 1 = <4.1mm

RESULTS AND DISCUSSION

Morphological variation of *D. pentandra*. Based on the sampling that was conducted in four regencies including Bantul, Gunungkidul, Sleman, and Kulon Progo regencies, each obtained a

different number of samples. The following is a list of sampling locations where *D. pentandra* accessions were found on different host trees used in the study (Table 2).

Table 2. List of *D. pentandra* accessions on various host trees in Yogyakarta Province

No.	Regency	District	Host tree	Accession name
1	Bantul	Sewon	*Persea americana*	OTU 1
2		Banguntapan	*Tectona grandis*	OTU 2
3		Banguntapan	*Plumeria alba*	OTU 3
4		Sewon	*Ceiba pentandra*	OTU 4
5		Sewon	*Mangifera indica*	OTU 5
6		Sewon	*Morus alba*	OTU 6
7	Sleman	Mlati	*Averrhoa bilimbi*	OTU 7
8		Mlati	*Syzygium aqueum*	OTU 8
9		Seyegan	*Morus alba*	OTU 9
10		Mlati	*Psidium guajava*	OTU 10
11		Mlati	*Stelechocarpus burahol*	OTU 11
12		Mlati	*Ficus racemosa*	OTU 12
13		Pakem	*Pinus merkusii*	OTU 13
14		Pakem	*Bauhinia purpurea*	OTU 14
15		Mlati	*Polyathia longifolia*	OTU 15
16		Mlati	*Melaleuca leucadendra*	0TU 16
17		Mlati	*Ficus benjamina*	0TU 17
18		Mlati	*Theobroma cacao*	0TU 18
19		Mlati	*Mangifera indica*	OTU 19
20		Mlati	*Terminalia catappa*	OTU 20
21		Mlati	*Coffea arabica*	OTU 21
22		Mlati	*Tectona grandis*	OTU 22
23		Mlati	*Ricinus communis*	OTU 23
24		Mlati	*Citrus sinensis*	OTU 24
25		Mlati	*Terminalia catappa*	OTU 25
26	Kulon Progo	Temon	*Morus alba*	OTU 26
27		Temon	*Mangifera indica*	OTU 27
28		Wates	*Ficus benjamina*	OTU 28
29		Temon	*Acacia oraria*	OTU 29
30		Wates	*Polyathia longifolia*	OTU 30
31		Temon	*Moringa oleifera*	OTU 31
32		Temon	*Lansium domesticum*	OTU 32
33	Gunungkidul	Paliyan	*Morus alba*	OTU 33
34		Playen	*Tectona grandis*	OTU 34
35		Playen	*Terminalia catappa*	OTU 35
36		Playen	*Mangifera indica*	OTU 36

Based on the samples obtained, there were a total of 36 samples consisting of 27 different species of host trees. Of the 36 samples, there were six samples obtained in Bantul Regency and seven samples obtained in Kulon Progo Regency. Then Sleman Regency had the highest number of samples (18 samples), while the fewest samples were obtained in Gunungkidul regency (four samples). Based on observations made on the morphology of all samples obtained several characters varied among *D. pentandra* accessions. The variations in these morphological characters include the organs of leaves, flowers, fruits, seeds, stems, and roots presented in the following Fig. 1.

Fig. 1. Variation of morphological characters in *Dendrophthoe pentandra* accessions: a-b. leaf base shape; c-d. stomata per field of view; e-f. phyllotaxis; g-h. whole leaf; i-j. bunches of flowers; k-l. flowers; m-n. fruit; o-p. seed; q-r haustorium and stem

The stem and roots of *D. pentandra* (Fig. 1q-1r) are described as a shrub having ligneous stems, stem stand and the direction of growth of stem branches is pendulous, axillary bud layout, and brown in color. Then the roots are described as having sucker roots modified into haustorium and spherical in shape. The difference in the size of the roots and stems is influenced by the intensity of light and the hardness of the bark and the type of host tree. If the canopy of the host tree bark is not hard and soft like the *Polyalthia longifolia* tree in (Fig. 1r) then the haustorium can easily penetrate inside,

whereas in the host tree canopy the bark is hard like the guava tree in (Fig. 1q) then the growth of *D. pentandra* is less fertile because of the haustorium being able to penetrate the inside of the host tree.

D. pentandra leaves (Fig. 1g-1h) are described as having quantitative characters in the form of leaf length ranging from 71.6-159.1 mm, leaf width ranging from 31.6-70.5 mm, and leaf thickness ranging from 0.3-0.7mm. Then there is the accession of *D. pentandra* which has an opposite arrangement in phyllotaxis which has a smaller stem size, which ranges from 1.9-4.6 mm (Fig. 1a), while the accession of *D. pentandra* and has phyllotaxis an opposite arrangement has a size ranging from 9-24mm. (Fig. 1b). Then the number of stomata per field of view was divided into two, <100 (Fig. 1c) and ≥100 (Fig. 1d). This quantitative variation that occurs is influenced by environmental factors in the form of shade and light intensity (Anni *et al*., 2013; Suci & Heddy, 2018).

The qualitative character of the leaves of *D. pentandra* has the shape of a repandus leaf edge, the shape of pinnate leaf bones, and includes a single leaf. Leaf shape is divided into two, elliptic and oblong. Then for the phyllotaxis it is divided into two, opposite and alternate (Fig. 1e-1f). Then at the tip of the leaf there are leaves that have acute, acuminate, and obtuse forms. Then at the base of the leaves, there are leaves that have acute, attenuate, and truncate shapes. Based on the color of the accession leaves of *D. pentandra*, there are variations that can be divided into two based on color detection using ColorCut v1.30. Leaf color that shows a color code of less than 60000 has a darker green color (Fig. 1g), while the leaf color code with a code of more than 60000 has a lighter green to yellowish leaf color (Fig. 1h).

The flowers of *D. pentandra* (Fig. 1k-1l) are described as having the quantitative characters of the bouquet length ranging from 30.1-56.2 mm, the pistil length ranging from 11.7-21.7 mm, and the stamens ranging from 11-20.7mm. Then it has a crown tube ranging from 7.2-11.9 mm, and has a corolla lobe length ranging from 3.9-9.3 mm, flower clusters ranging from 4 (Fig. 1i) to 13 flowers (Fig. 1j) and in the opposite arrangement in phyllotaxis it has a ratio of stamens: corolla lobes, 3:1, whereas in the opposite arrangement in phyllotaxis, it has a ratio of stamens: corolla lobes, 2:1. *D. pentandra* has a type of flower that is raceme in bunches and the color of the flower is divided into two flowers, a yellowish flower with the code BOAC47-D4CD3D (Fig. 1k) and a greenish-yellow flower with the code 5F573F-967744 (Fig. 1l).

The fruit of *D. pentandra* (Fig. 1m-1n) was described as having a fruit length ranging from 8.4-11.7 mm and a fruit width ranging from 6.1-8.4 mm. Then for fruit color which shows a color code with the range A57100-F1C070 has a yellowish fruit color with an egg shape (Fig. 1m) and belongs to *D. pentandra* accession with opposite leaf arrangement. Then the color of the fruit which shows code 444d09-756036 has a yellow-green color with an oval fruit shape (Fig. 1n).

Seeds of *D. pentandra* (Fig. 1o-1p) have a seed length ranging from 6.3-9.9 mm and a seed width ranging from 2.9-4.9 mm. Then for the qualitative seed color which shows a color code with the range 494EA6-8F934 has a greenish seed color and belongs to *D. pentandra* accession with opposite arrangement in phyllotaxis (Fig. 1m). Then the color of the seeds showing the code B1934D-EA0690 has a yellowish-white color and belongs to the *D. pentandra* accession with alternate arrangement in phyllotaxis (Fig. 1n). The seeds of *D. pentandra* are one in number and covered by the sticky part of the fruit.

The variation in morphological characters in *D. pentandra* accession can be influenced by biotic and abiotic factors. These biotic factors include the characteristics of the host plant (Teodoro *et al.*, 2013; Dlama *et al.*, 2016) and competition between parasites (Monica *et al*., 2017). While abiotic factors can be influenced by the availability of water, nutrients, and minerals (Kolodziejek *et al.*, 2013), as well as light intensity or the environment (Luo *et al.*, 2016; Solikin, 2021). The variations in morphological characteristics that occur in these plants can be in the form of variations in qualitative and quantitative morphological characteristics (Weihan *et al*., 2020).

Phenetic analysis of *D. pentandra***.** All accession data that has been characterized and scored are then standardized to calculate the similarity index so that data is obtained in the form of 0 and 1. Based on these data, OTUs similarity index can be calculated using a computer program, the MVSP

with the Jaccard Coefficient formula to create a matrix similarity. Based on the similarity matrix, a dendrogram can be formed using the clustering method with the UPGMA algorithm in Fig. 2.

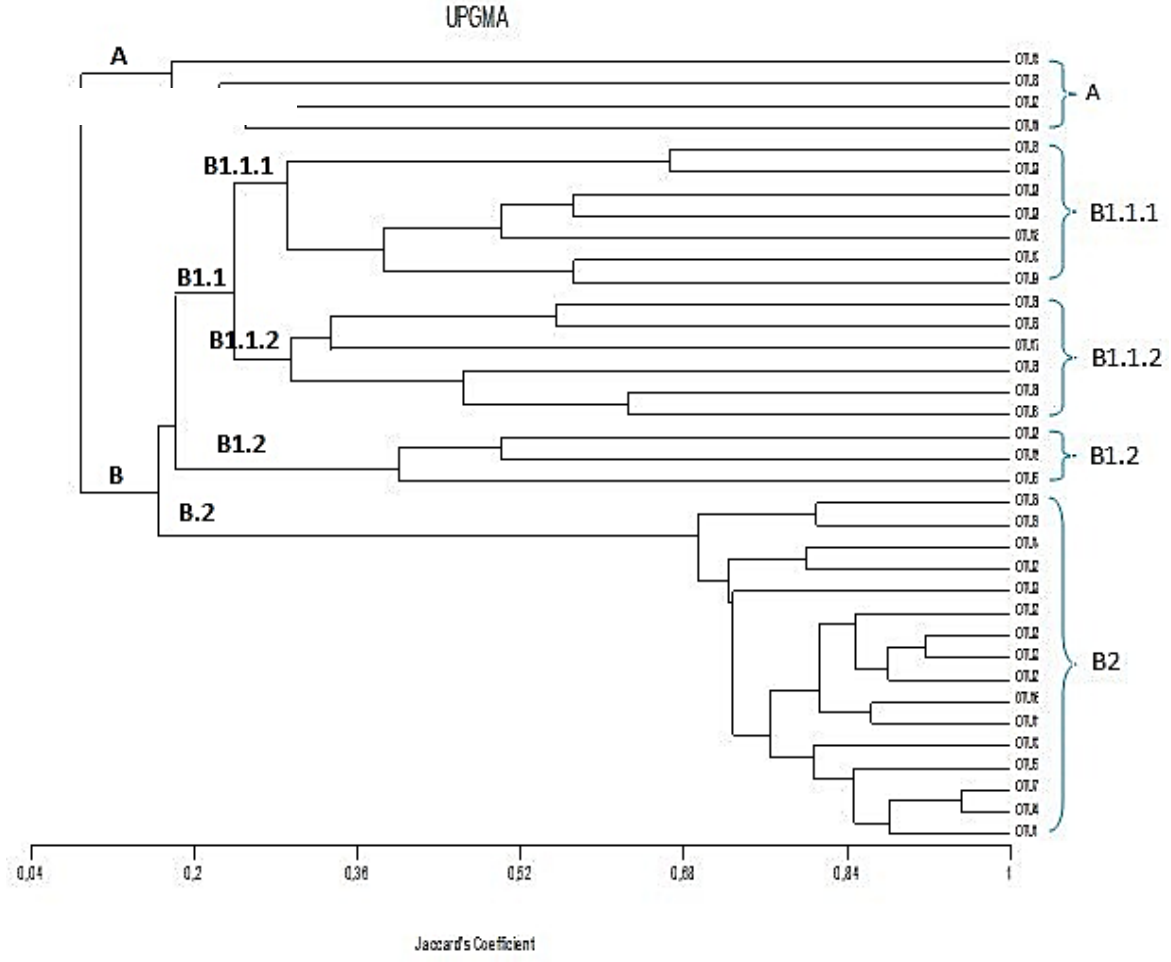

Fig. 2. Phenetic relationship dendrogram of *Dendrophthoe pentandra* accession in Yogyakarta Province based on morphological characters

There are 36 OTUs that have similar characters and form two large groups or supergroups, supergroup A and supergroup B which start branching and unite at a similarity index (IS) of 0.089 (Fig. 2). The similarities in these characters include having the edge shape of repandus leaves, having the shape of pinnate leaf reinforcement, including single leaves, and raceme flowers type. Meanwhile, the differences in morphological characters between supergroup A and supergroup B distinguished the two supergroups, supergroup B having a leaf length of ≥100 mm, while supergroup A having a leaf length of <100 mm. Besides that, supergroup A has a leaf width of <50 mm and the number of flowers per bunch is >9. Supergroup A forms one cluster, cluster A which consists of 4 OTUs, accession numbers 10, 15, 27 and 32 which are clustered at a value of 0.178. While supergroup B experienced several branches and produced four clusters, clusters B1, B1.1.1, B1.1.2 and B2. The next branching occurs in cluster B at a similarity point of 0.165 which forms clusters B1 and B2 with different main characters in the phyllotaxis. Cluster B1 has an opposite arrangement in phyllotaxis, while cluster B2 has an alternate arrangement in phyllotaxis. Cluster B.1 then branched out at point 0.181 to become cluster B1.1 and cluster B1.2.

Cluster B1.2 has morphological characters that make it clustered, having flower wreath length ≥45 mm, seed length ≥8.5 mm, and seed width ≥4.1 mm. Cluster B12 also has a leaf tip shape, acuminate, which is different from the other clusters, which are acute. Cluster B1.1 then branched again into 2 clusters, B1.1.1 and cluster B1.1.2 which were clustered at IS 0.24. Cluster B1.1.1

consists of accessions numbers 9, 13, 18, 20, 28, 26, and 31, while cluster B1.1.2 consists of accessions numbers 8, 17, 30, 33, 35, and 36 and is grouped at IS 0.294.

The similarity of morphological characters between clusters B1.1.1 and B1.1.2 is that both of them have a stamen : corolla lobe ratio of 3:1. Differences in morphological characters between clusters B1.1.1 and B.1.1.2 can be seen in the morphological characters of leaf color, leaf base shape, and seed length. Cluster B1.1.1 has a lighter green leaf color than cluster B1.1.2 because it has a color code of >60000. Then in cluster B1.1.1, it has a truncate leaf base shape, while cluster B1.1.2 has an acute leaf base shape. For seed length, cluster B1.1.1 has a length of ≥8.5 mm, while cluster B1.1.2 has a seed length of <8.5 mm. Cluster B1.2 consists of 3 OTUs, accession numbers 6, 19, and 29 which are clustered at IS 0.4. Cluster B1.2 has morphological characters that make it clustered, having a bouquet length of ≥45 mm, seed length ≥8.5 mm, and seed width ≥4.1 mm. Cluster B12 also has a leaf tip shape, which is acuminate, different from the other clusters, which are most acute.

Cluster B2 has the highest number of OTUs, 16 OTUs in accession numbers 1, 2, 3, 4, 5, 7, 11, 12, 14, 16, 21, 22, 23, 24, 25 and 34 which are grouped at IS 0.699. The difference between cluster B2 and the other four clusters is the morphological character of the phyllotaxis followed by other morphological characters such as leaf thickness, petiole length, number of stomatal densities per field of view, flower color, crown tube length, lobe length, petal length, stamen ratio : corolla lobes, fruit color, and seed color. Cluster B2 has an alternate arrangement in phyllotaxis, while the other four clusters have an opposite arrangement in phyllotaxis. Based on the phyllotaxis, many morphological characters were found that distinguished it from the other four clusters, clusters A, B1.1.1, B1.1.2, and B1.2. Cluster B2 has a thinner leaf thickness of <5 mm, but has a longer petiole length than the other four clusters, ≥7 mm. Then on the character of the number of stomata per field of view cluster B2 has a greater number of stomata ≥ 100. Then cluster B2 also has a crown tube length ≥ 10 mm, lobe length ≥ 6 mm, and petal length < 3.6 mm. In addition, cluster B2 has a ratio of stamens: corolla lobes that is different from the other four clusters, 3:1, while the other four clusters, including cluster A, cluster B1.1.1, cluster B1.1.2, and cluster B12, have a ratio of 2:1.

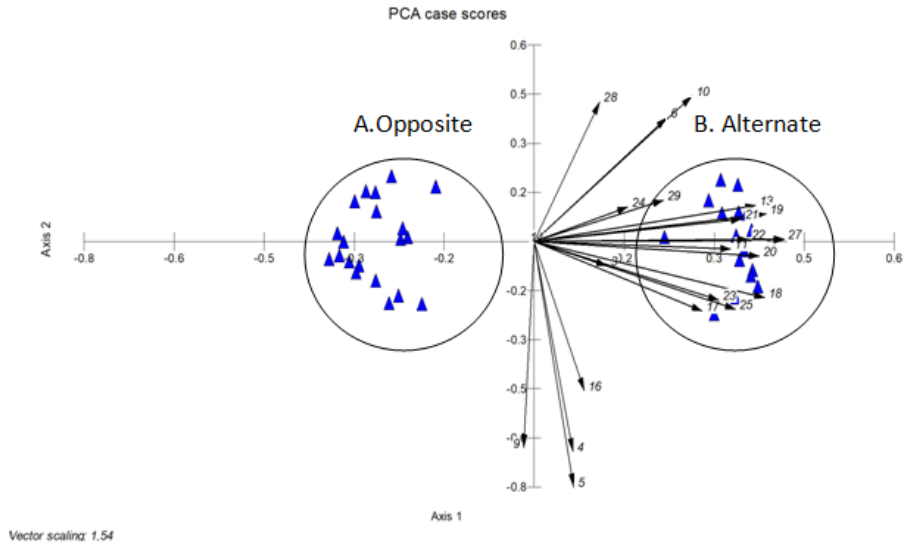

Fig. 3. Euclidean biplot type scatter plot graph from principal component analysis on the phenetic relationship dendogram of *Dendrophthoe pentandra* accession in Yogyakarta Province based on morphological characters

Other morphological character differences between the B2 cluster and the other four clusters are related to the color of flowers, fruits, and seeds. The flower color of cluster B2 has a greenish yellow color with a color code between 5F573F-967744, in contrast to the other four clusters which have a yellowish color with a color code between BOAC47-D4CD3D. Then the color of fruit cluster B2 has a yellow-green color with the color code 444D09-756036, in contrast to the other four clusters which have a yellowish color with the color code A57100-F1C070. Then for the color of the B2 cluster

seeds, B1934D-EA0690 has a whitish seed color, in contrast to the other four clusters which have a greener color with the color code 494EA6-8F934.

To clarify the character of the cluster forming, PCA analysis was conducted in the form of a Euclidean Biplot type scatter plot using the MVSP program, visualized in Fig. 3. There are two major groups, the vegetative character of the leaves in the form of phyllotaxis. This phyllotaxis is one of the most striking characters based on PCA analysis. The phyllotaxis varies in that there is one opposite group and one group that alternates arrangement. The two groups have the appearance of morphological characters that make them grouped differently. Group A is a collection of *D. pentandra* accessions from cluster A, cluster B1.1.1, cluster B1.1.2, and cluster B1.2 with the main characters opposite arrangement in phyllotaxis. Meanwhile, group B is a collection of *D. pentandra* accessions in cluster B2 with the main character being an alternate arrangement in phyllotaxis. Phyllotaxis was followed by other morphological characters such as leaf thickness, petiole length, number of stomata per field of view, flower color, crown tube length, corolla lobe length, calyx length, stamen : corolla lobe ratio, fruit color, and seed color. It can be concluded that there are two groups, the group with the opposite and alternate arrangement in phyllotaxis.

CONCLUSION

It can be concluded that the phyllotaxis divides *Dendrophthoe pentandra* (L.) Miq. into two groups, the variations were in the morphological characters of leaf thickness, petiole length, number of stomata per field of view, flower color, crown tube length, corolla lobe length, calyx length, stamen: corolla lobe ratio, fruit color, and seed color. Based on the variation of morphological characters obtained, a phenetic relationship dendrogram was formed between *D. pentandra* accessions in Yogyakarta Province which produced five clusters with a similarity index (IS) of 0.089.

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