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IDENTIFICATION OF MORPHOLOGY AND DIVERSITY OF PORANG PLANTS (*AMORPHOPHALLUS MUELLERI* BLUME) IN KUMPEH ULU DISTRICT, MUARO JAMBI REGENCY

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ABSTRACT

Porang (Amorphophallus muelleri Blume) is a group of tuber plants that are useful as food and medicine so that they have bright prospects for development. In Jambi Province, especially in Muaro Jambi Regency, porang plants are found growing wild among duku trees. This study aims to determine the morphological character of porang plants and to determine the level of diversity and kinship of porang plants found in Kumpeh Ulu District, Muaro Jambi Regency. The research was carried out from August to September 2021, in 18 villages located in the Kumpeh Ulu District. The research was conducted using a non-experimental descriptive method with proportionate stratified random sampling, and the sample was measured quantitatively and qualitatively. The morphological identification of porang plants from 18 villages in Kumpeh Ulu District showed similarities in bulbil shape, bulbil surface colour, bulbil surface texture, bulbil flesh colour, leaf shape and petiole colour. However, there were differences in leaf colour, tuber flesh colour, tuber surface texture and tuber shape.

Keywords: Amorphophallus muellery, Porang, morphological markers, tuber plants

INTRODUCTION

Porang (*Amorphophallus muelleri* Blume) included to the Araceae family, which is a group of tuber plants that have potential for development in Indonesia due to having a lot of benefits. According to Aisah, Soegianto and Basuki (2017) porang can be used as food ingredients, namely making noodles (shirataki) and tofu (konyaku) and the glucomannan content in porang can be used as raw materials for medicine (Wigoeno et al., 2013). According to Alifianto, Azrianingsih and Rahardi (2013) the glucomannan content in porang tubers is good for people with type 2 diabetes, maintains blood sugar conditions, and has made tablets to run a diet program.

Porang plants have not been widely cultivated in Indonesia. These plants grow wild in farmers' gardens, yards and forest edges and can grow well from an altitude of 0-900 m above sea level, but the presence of porang is not evenly distributed so it is rather difficult to find. Porang usually grows wild under stands of trees, shrubs and among bamboo plants because porang belongs to a group of plants that are shade tolerant with 40% sunlight intensity (Udarno, 2020).

The amount of *Amorphophallus muelleri* B germplasm richness in Indonesia is quite large, but it has not received maximum attention and handling, and has not been used for plant breeding purposes. According to Fehr (1993) that breeding is an attempt to assemble genetic diversity into a new species that has advantages over existing species, so that in breeding a plant commodity, genetic variability or diversity is a major requirement. The diversity of germplasm must be considered to achieve the breeding goal due to selection activities in breeding are highly dependent on the genetic diversity of the plant. Identification of morphological characters can be used to see the differences and similarities of plants based on their morphological characters (Miswarti et al., 2017).

The identification of porang plants diversity based on morphological characters has been widely reported, especially for the island of Java. The diversity of porang plants has also been studied in various regions i.e; identification of morphology and agronomic variables of Amorphophallus in Central Java and East Java (Rahayu et al., 2013), on the distribution map of porang in Malang Raya (Alifianto et al., 2013), on analysis of genetic variation of porang in East Java based on the trnL intron sequence (Rosidiani et al., 2013), exploration and identification of morphological characters of porang in East Java (Sulistiyo et al., 2015), genetic diversity of porang in West Java (Nikmah et al., 2017) and identification of morphology of porang in Nganjuk, Madiun, and Bojonegoro regencies (Aisah et al., 2017), observation of the morphological characters of porang plants in the Lamongan sub-district (Ekowati et al.,2017), diversity of morphological characters and seed growth of Amorphaluus muelleri plants in Pakuwon (Firdaus et al. 2022).

The results of the research by Sulistiyo et al. (2015) who explored and identified the morphological characters of porang in the

Regencies of Malang, Blitar, Madiun, Nganjuk and Ponorogo revealed that the diversity of morphological characters of porang plants were identified at leaf morphology, i.e., leaf color, leaf length, leaf width and number of leaves. The morphological diversity of porang plants can also be found in the pseudo-stem or what in the research is referred to as the stalk, namely pseudo-stem diameter, pseudo-stem color, pseudo-stem pattern shape and pseudo-stem color. In addition, bulbil and porang tubers have a high diversity of weight characters.

Porang plants requires shade to grow well, so the most suitable land is under stands of annual forest trees, such as: Teak, Mahogany, Sengon, Jabon and others (Hidayat et al., 2013). Based on the preliminary survey, many porang plants in Kumpeh Ulu district, Muaro Jambi Regency were found growing under the shade of duku, areca nut, and palm trees which certainly have different ecologies.

Previous information indicates that is urgently needed to determine the extent of the morphological diversity of porang in Kumpeh Ulu District, Muaro Jambi Regency to explore the genetic diversity of porang plants for the development of superior porang plants. The exploration and identification of the morphology of the porang plant is an activity to collect data on the morphological character of the porang plant by observing, measuring and analyzing it. So that through these samples the morphological characteristics can be identified (Zakaria et al., 2019).

The utilization and management of the existing porang germplasm were still need optimization, so it is suspected that there are several sources of porang germplasm that have been eroded or lost. This study aims to determine the morphological character of porang plants and to determine the level of diversity and kinship of porang plants found in Kumpeh Ulu District, Muaro Jambi Regency.

METHODS

The research was carried out for three months (July to October 2021) in Kumpeh Ulu District, Muaro Jambi Regency. The number of plant samples was taken based on the proportion of the existing porang plantations. The material used in this study is the growing wild porang plants found at farmers' gardens and around community settlements in the Kumpeh Ulu District, Muaro Jambi Regency.

Questionnaires were used to obtain information from farmers and the GPS was needed to determine the coordinates of the sampling point. Additional tools were Porang plant descriptor book, Munsell plant tissue colour chart, caliper, ruler, scales, camera, label paper and stationery.

The study was conducted using a descriptive non-experimental method with proportionate stratified random sampling, which is a sampling technique suitable used of the non-homogeneous characteristics population. Data observation was performed by direct visualization, measurement with tools and interviews with farmers or people who recognise porang plants. Measurements were carried out both quantitatively and qualitatively. The technique of measuring

agronomic morphological characters was carried out by referring to the similar topic research (Aisah et al., 2017; Sumarwoto, 2005).

The variables observed in this study were the vegetative and reproductive organs of the porang plant, both qualitatively and quantitatively measured, namely; leaf colour, leaf edge shape, leaf shape, leaf edge colour, leaf surface position, petiole colour, tuber shape, tuber outer colour, tuber inner colour, stem height, stem circumference, leaf width and tuber diameter based on the study of Sumarwoto (2005). The results of field observations on porang specimens from all the sites of the study were classified and arranged in a form of matrix and then analyzed for similarity and difference to determine their cluster. Analysis of the clustering of inter-accession similarity was carried out using NTSYS ver. 2.02 for the clustering of SAHN by UPGMA (Unweighted Pair Group Method with Arithmetic Average).

RESULTS AND DISCUSSIONS

Porang Plant Exploration

Porang plant exploration activities were carried out in 18 (eighteen) villages in Kumpeh Ulu District, with a total population of 60 porang plants collected. The number of plant samples was taken based on the area of porang in the village. The soil pH conditions at each location were indicated in the neutral criteria, which ranged from 6.4 to 6.9 (Table 1).

Table 1 Accession number, sample code, location, soil pH, altitude, and coordinate of porang exploration at Kumpeh Ulu District

Accession Number	Code Sampel	Location (Village)	Soil pH	Altitude m asl	Coordinate	
					X	Y
1	A-1	Arang Arang	6,8	23	1354758,8	1034758,8
2	A-2	Arang Arang	6,8	23	13548,1	1034748,2
3	A-3	Arang Arang	6,8	23	13559,1	1034717,5
4	A-4	Arang Arang	6,8	23	13554,7	1034705,5
5	K-1	Kasang Kumpeh	6,8	19	13409,1	1034010,3
6	K-2	Kota Karang	6,7	29	13401,4	1034129,4
7	K-3	Kasang Kota Karang	6,7	28	13510,1	1034111,7
8	K-4	Kasang Lopak Alai	6,8	20	13427,7	1034141,1
9	K-5	Kasang Pudak	6,5	32	13538,3	1034054,1
10	L-1	Lopak Alai	6,8	24	13418,3	1034151
11	M-1	Muara Kumpeh	6,4	13	13559,8	1034021,3
12	M-2	Muara Kumpeh	6,4	13	13355,8	1034006,3
13	M-3	Muara Kumpeh	6,4	13	13347,7	1033934,7
14	M-4	Muara Kumpeh	6,4	13	13320,3	1033931,3
15	M-5	Muara Kumpeh	6,4	13	13340,4	1033920,8
16	M-6	Muara Kumpeh	6,4	13	13409,2	1033925,5
17	M-7	Muara Kumpeh	6,4	13	13408,6	1033948,6
18	M-8	Muara Kumpeh	6,4	13	13409,3	1033920,4
19	M-9	Muara Kumpeh	6,4	13	13407,2	1033911,9
20	M-10	Muara Kumpeh	6,4	13	13406,3	1033859,5
21	P-1	Pudak	6,8	17	13358,4	1034043,7
22	P-2	Pudak	6,8	17	13326,2	1034046,9
23	P-3	Pemunduran	6,7	16	13439,4	1035201,2
24	P-4	Pemunduran	6,7	16	13409	1035107,7

25	P-5	Pemunduran	6,7	16	13416,2	1035057,4
26	P-6	Pemunduran	6,7	16	13400,5	1035101,3
27	P-7	Pemunduran	6,7	16	13342,6	1035054,3
28	P-8	Pemunduran	6,7	16	13336,9	1035052,6
29	R-1	Ramin	6,3	19	13200,8	1034946,5
30	S-1	Sakean	6,8	21	13358,7	1034335,3
31	S-2	Sakean	6,8	21	13353,2	1034310,9
32	S-3	Sakean	6,8	21	13351,8	1034251,3
33	S-4	Sakean	6,8	21	13351,8	1034251,3
34	S-5	Sakean	6,8	21	13402	1034246,7
35	S-6	Sumber Jaya	6,8	19	13633,5	1034531,4
36	S-7	Solok	6,9	38	13405,8	1034252,5
37	S-8	Solok	6,9	38	13405,4	1034238,1
38	S-9	Solok	6,9	38	13412,7	1034213,9
39	S-10	Sungai Terap	6,7	17	13636,6	1034512,3
40	S-11	Sungai Terap	6,7	17	13630,2	1034445,9
41	S-12	Sipin Teluk Duren	6,5	17	13452,5	1034922,1
42	S-13	Sipin Teluk Duren	6,5	17	13508,5	1034902,7
43	S-14	Sipin Teluk Duren	6,5	17	13514,5	1034843,2
44	S-15	Sipin Teluk Duren	6,5	17	13530,1	1034825,8
45	T-1	Tarikan	6,7	30	13600,7	1034422,3
46	T-2	Tarikan	6,7	30	13543,9	1034422,7
47	T-3	Tarikan	6,7	30	13532,3	1034424,4
48	T-4	Tarikan	6,7	30	13518,5	1034424,6
49	T-5	Tarikan	6,7	30	13508	1034421,7
50	T-6	Tarikan	6,7	30	13454,2	1034423
51	T-7	Teluk Raya	6,7	13	13301,2	1035043,9
52	T-8	Teluk Raya	6,7	13	13301,3	1035029,7
53	T-9	Teluk Raya	6,7	13	13258,7	1035016,2
54	T-10	Teluk Raya	6,7	13	13306,1	1035009,6
55	T-11	Teluk Raya	6,7	13	13323,4	1034954,3
56	T-12	Teluk Raya	6,7	13	13350,7	1034950,5
57	T-13	Teluk Raya	6,7	13	13410,3	1034954,5
58	T-14	Teluk Raya	6,7	13	13425,7	1034948,8
59	T-15	Teluk Raya	6,7	13	13436,3	1034939
60	T-16	Teluk Raya	6,7	13	13441,9	1034933,9

The ability of plants to carry out the nutrient absorption process was influenced by the main factor that is the level of soil acidity or soil pH. Table 1 indicated that the soil pH in Kumpeh Ulu sub-district ranges from 6.4 to 6.9 where the pH range is very suitable for growth of porang plant. Porang plants can grow and develop well on light textured soil media with a pH range of 6-7.5 (Puslitbangtan, 2015). In general, plants can grow well in soils that have a neutral pH, soil pH that is in the neutral range can provide soil nutrient availability at an optimum level because most of the nutrients are easily soluble in water. According to Kusuma & Yanti (2021) that the pH value indicates the amount of hydrogen ion concentration (H+) and (OH-) in the soil, the presence of this determines whether nutrients are easily absorbed by plants, therefore the state of soil pH greatly affects morphological characters from plants. Study of Fitmawati *et al.* (2021) revealed that soil pH is one of the main environmental factors affecting the morphological growth of bamboo plants due to the availability of soil nutrients was influenced by soil pH.

Porang plants that grow wild in Kumpeh Ulu District were found in villages that have altitudes between 13-38 m above sea level (m asl) and were most commonly found in areas with an altitude of 13 m asl. Whereas in other places, such as Malang Raya, porang plants were found in locations that have altitudes between 34 – 931 m asl (Alifianto et al. 2013). In Kuningan, West Java, porang plants were found at altitudes between 200 – 400 m asl (Udarno, 2020). The results of the study by Qur'ani et al (2020) concluded that the morphological differences in porang plants were influenced by the height where the plant grew, where the response to the highest morphological stem height was found in Kowel Village (36 m asl) of 62.8 cm, leaf canopy width and weight the largest tubers are found in Panglungan Village (613 m asl) of 64.4 cm and 801.2 g. In addition, the morphological response to the height of the stem and leaf canopy of the porang plant is influenced by air temperature, where the air temperature in a place is strongly influenced by the altitude. According to Andrian et al (2014) that geographical differences such as differences in altitude above sea level (asl) will lead to differences in the overall weather and climate in that place, especially air temperature.

The porang habitat in Kumpeh Ulu which grows wild was generally found below stands of duku and durian plants. Apart from these two main types of stands, around where the porang grows there are also several shrubs that shade the porang. Porang plants can grow well at a shade density of 40%, because porang plants are a C3 type of plant, so they do not require large amounts of light (Supriyono et al. 2022).

Morphological Characters of Porang Plants

a. Appearance of Quantitatively Measured Character

Observations of several characters that measured quantitatively were carried out on sample plants by direct observation in the field, including stem height, stem circumference, leaf width and tuber diameter (Table 2).

Based on Table 2, it can be seen that the morphological diversity measured quantitatively resulted in a fairly wide variation between the characters of stem height, stem circumference, leaf width and tuber diameter. On the character of stem height, the highest stem was 84.2 cm and the lowest was 34.3 cm with an average stem height of 58.61 cm and the coefficient of diversity in stem height was 20.79%. According to Sari and Suhartati (2015) that porang plants can grow up to 1.5 meters in height depending on age and soil fertility.

For the stem circumference character, the largest size was 23.21 mm and the lowest was 7.62 mm with an average value 11.90 mm with a coefficient of variation 25.94 %. In leaf width, the largest value was 11.9 cm and the lowest was 4 cm and the average leaf width was 6.79 cm with a coefficient of diversity 23.16%. For the tuber diameter criteria. the highest value was 86.02 mm and the smallest was 11.02 mm with an average tuber diameter 49.63 mm and a coefficient of diversity 23.55 %.

Tabel 2 Morphological diversity measured quantitatively

Accession Number	Code Sampel	Location (Village)	Quantitative Characters			
			Stem Height (cm)	Stem Diameter (mm)	Leaf Width (cm)	Tuber Diameter (mm)
1	A-1	Arang Arang	55	11,62	6,8	42,5
2	A-2	Arang Arang	50	11,36	5	45,2
3	A-3	Arang Arang	45,5	16,44	8,5	40
4	A-4	Arang Arang	84	17,2	4,2	48
5	K-1	Kasang Kumpeh	57,5	8,95	6,6	38,01
6	K-2	Kota Karang	49	9,01	6,6	11,01
7	K-3	Kasang Kota Karang	63	11,16	7,4	42,13
8	K-4	Kasang Lopak Alai	70,4	11,68	5,5	55
9	K-5	Kasang Pudak	63,8	12,69	5,8	34,4
10	L-1	Lopak Alai	45,8	12,02	7,8	48,3
11	M-1	Muara Kumpeh	64,8	9,47	5,1	41,86
12	M-2	Muara Kumpeh	81	15,72	6,9	54,84
13	M-3	Muara Kumpeh	84,2	15,73	6,1	68,21
14	M-4	Muara Kumpeh	68	9,16	5,1	40,18
15	M-5	Muara Kumpeh	68	9,18	5,7	45,83
16	M-6	Muara Kumpeh	81,5	14,94	5,7	55,61
17	M-7	Muara Kumpeh	77	15,3	5,5	54,77
18	M-8	Muara Kumpeh	57	7,62	6,5	48,25
19	M-9	Muara Kumpeh	68	9,75	5,9	53,56
20	M-10	Muara Kumpeh	51,5	8,31	5	53,76
21	P-1	Pudak	66,5	14,03	6,2	39,4
22	P-2	Pudak	51	10,02	5,6	36,3
23	P-3	Pemunduran	73	13,07	6,3	43,14
24	P-4	Pemunduran	74	16,8	5,6	52,95
25	P-5	Pemunduran	61	12,15	4	62,49
26	P-6	Pemunduran	77	23,21	6,2	54,08
27	P-7	Pemunduran	68	16	5,8	41,8
28	P-8	Pemunduran	46	9,04	5,8	34,59
29	R-1	Ramin	49	7,43	6,4	36,75
30	S-1	Sakean	38	14,02	6,9	47,06
31	S-2	Sakean	56	18,07	7	63,7
32	S-3	Sakean	69	11,01	9,7	72,1
33	S-4	Sakean	60	15,07	7,6	86,02
34	S-5	Sakean	45,8	12,02	7,8	58
35	S-6	Sumber Jaya	44	10,74	7,9	40,84
36	S-7	Solok	53	11,06	8,3	74,31
37	S-8	Solok	55	7,62	7,3	44,32
38	S-9	Solok	63	13,28	11,9	53,6
39	S-10	Sungai Terap	58,1	10,5	4,3	44,08
40	S-11	Sungai Terap	74,2	10	6,4	43

41	S-12	Sipin Teluk Duren	61	9,92	7,8	63,92
42	S-13	Sipin Teluk Duren	75	15,7	5,3	47,51
43	S-14	Sipin Teluk Duren	72	13,08	7,4	45,07
44	S-15	Sipin Teluk Duren	65	8,06	6,4	40,27
45	T-1	Tarikan	44,3	9,01	6,2	69,4
46	T-2	Tarikan	46,4	10,6	6	53,8
47	T-3	Tarikan	47,5	10,01	5,4	44,8
48	T-4	Tarikan	34,3	11,03	6,3	57,09
49	T-5	Tarikan	49,5	12,01	10,2	49,01
50	T-6	Tarikan	44,6	12	6,4	47,06
51	T-7	Teluk Raya	61	17	5,4	49,09
52	T-8	Teluk Raya	45,5	10,5	8,7	43
53	T-9	Teluk Raya	58	9,05	8,8	47,7
54	T-10	Teluk Raya	54	12	9	42
55	T-11	Teluk Raya	53,9	12,69	9,1	53,4
56	T-12	Teluk Raya	49,6	10	8,2	51,7
57	T-13	Teluk Raya	47,1	9,35	6,6	59,2
58	T-14	Teluk Raya	46,5	10,35	8,6	57,8
59	T-15	Teluk Raya	52	10,6	10,4	68
60	T-16	Teluk Raya	43	8,66	6,5	37,9
	∑		**3516,8**	**714,07**	**407,4**	**2977,67**
	AVERAGE		**58,61**	**11,90**	**6,79**	**49,63**
	sdv		**12,18**	**3,09**	**1,57**	**11,69**
	Min		**34,3**	**7,43**	**4**	**11,01**
	Max		**84,2**	**23,21**	**11,9**	**86,02**
	CV (%)		**20,79**	**25,94**	**23,16**	**23,55**

Morphological diversity measured quantitatively in porang plants resulted in 3 relative criteria that were narrow for the character of stem height, very broad for the character of stem circumference and broad for the character of leaf width and tuber diameter. The broad and very broad criteria indicated high diversity in the observed porang plant population while the stem height character produced relatively narrow criteria indicating that there was no diversity.

According to Hidayat et al. (2013) porang plant tubers every 3-4 years will produce flowers which then become fruit in cobs containing hundreds of seeds. These seeds are the ones that will fall out and fall to the ground so that porang are often found growing close together, this allows for crossbreeding between populations in one environment. In general, forest plants interbreed (outcrossing), only a few are capable of inbreeding (Kartikawati and Sumardi, 2017). So that there is a wide genetic diversity in porang due to cross-breeding that occurs.

Quantitative characters are generally controlled by many genes (polygenic) each

of which has little effect on the expression of a trait and was heavily influenced by the environment (Syukur et al., 2012). The observed variability in a trait must be distinguished by genetic or environmental factors. Likewise, in the observation of some traits, one must be able to explain the cause due to differences between genes that are carried by one individual from another or by differences in the environment of each individual in which they grow. Statements that are quantitative in nature between the role of reactive genetic factors and environmental factors in giving the final appearance or observed phenotype (Hairinsyah, 2010). The results of study by Lizawati *et al.*, (2017) also reported that there were differences in morphology and essential oil content in cinnamon bark plants that grow at various altitudes in West Sumatra.

b. Appearance of Qualitatively Measured Characters

Observations of the qualitatively measured character of porang plant samples that were leaf colour, leaf edge shape, leaf shape, leaf edge colour, leaf surface position, petiole colour, tuber shape, outer tuber colour and inner tuber colour revealed the diversity in the porang plant population observed in Kumpeh Ulu District. Data from the analysis of the qualitatively measured of morphological characters of porang plants in Kumpeh Ulu District were presented in Table 3.

Table 3 exhibited that the leaf colour of the porang plant indicated 4 phenotypic characters. i.e. 8.33% white leaves, 15% greenish yellow leaves, 33% green leaves and 43.33% dark green leaves. The edge leaf shape had 2 phenotypic characters that were wavy 38.33% and sinuate which had a fairly large percentage 61.67%. The leaf shape had broad criteria with 4 phenotypic characters dominated with the 3 lobes leaf shape 51.67% while the lowest was > 9 lobes with a value of 1.67%. Leaf border colour had 4 phenotypic characters with the highest percentage was green 73.33% and the lowest was 0. In other words, the variability in leaf edge colour characters was very narrow. The position of the leaf surface had 3 phenotypic characters with the highest proportion was the horizontal 61.67% then the bent shape 21.67% and the lowest was the drooping shape 16.67% which indicated the narrow criteria of the position of the leaf surface. The petiole colour character consists of 2 classes that were 100% light green and 0% green revealing that the colour diversity of the petiole in porang plants was very narrow.

The tuber shape of the porang plant had 4 characters where the rounded shape was the highest 81.67% followed by the oval shape with a value of 18.33% while the cylindrical and elliptical shapes were 0%. This situation exhibited the narrow diversity of the tuber shape of porang plants. The tuber outer colour had 2 phenotypic characters that were 73.33% of light brown and 26.67% of dark brown. Moreover, there were 3 phenotypic characters for the tuber inner colour which were the highest of yellow 63.33% then followed by orange 36.67% and white was 0%.

Porang Plant Relationship Analysis

The descriptive analysis resulted 13 characters measured quantitatively and qualitatively from 60 samples of the porang plant

Table 3 Diversity of qualitative characters in the porang plant population

Parameters	Phenotype Character	Percentage (%)
Leaf Colour	White	8.33
	Yellow or Greenish Yellow	15
	Green	33.33
	Dark Green	43.33
Leaf Edge Shape	Full	0
	Wavy	38.33
	Winding (sinuate)	61.67
Leaf Shape	3 lobes	51.67
	4-6 lobes	38.33
	7-9 lobes	8.33
	>9 lobes	1.67
Leaf Edge Colour	White	3.33
	Yellow	23.33
	Orange	0
	Green	73.33
Leaf Surface Position	Dropping	16.67
	Flat	61.67
	Bowl shape	21.67
Petiole Colour	Light green	100
	Green	0
Bulb Shape	Rounded	81.67
	Oval	18.33
	Cylindrical	0
	Ellipse	0
Bulb Outer Colour	Light brown	73.33
	Dark brown	26.67
Bulb Inner Colour	White	0
	Yellow	63.33
	orange	36.67

Source: Data Analysis

population which showed that there was variability in each character. Based on these characters, the genetic diversity of the porang plant population was then estimated using multivariate analysis (cluster analysis) whose results were in the form of a dendrogram which was presented in Figure 1. The results of the multivariate analysis indicated that there was genetic diversity of the porang plant population in Kumpeh Ulu District.

The results of porang plant phylogeny analysis of 13 morphological characters yielded dendrograms with similarity levels ranging from 0.29 to 0.77 or morphological diversity of 0.23% to 71% for 60 porang plants. All porang plant samples united at a similarity coefficient of 0.29 and formed 2 main groups, group I and group II were separated because of the intermediary characters that distinguished the two groups, namely leaf blade width, tuber diameter, leaf shape and outer tuber color (Fig. 2). Group I consisted of 59 porang plant samples which were

divided into three groups, namely IA, IB and IC with a similarity coefficient of 0.41. Groups IA, IB and IC are united because there are 4 of the same characters, namely leaf edge color, petiole color, tuber shape and tuber color and stem height.

The results of the kinship analysis showed that there were porang plants in different locations that had a fairly high degree of similarity, as in group IA there were 6 samples of porang plants, namely T9, T11, M4, M9, P3, and S13 with a similarity coefficient of 0.77. The high level of similarity is caused by the many characters in common between the samples, while the lowest similarity level is found in samples K3 and M2 which have a similarity coefficient of 0.53. Group IB consisted of 7 samples of porang plants L1, T14, M3, P1, M6, P5, and S12 with a similarity coefficient of 0.62. The IC group had a similarity coefficient of 0.69 for the samples A3, A5, S2, and S4. The lowest level of similarity was found in sample K1 with a similarity coefficient of 0.45. This lower level of similarity compared to the others is due to the fact that there are fewer similar characters among the observed porang plant samples, so that the kinship relationship is relatively distant. According to Chai-Wen (2006) in Sulistiyo et al. (2015) that the value of genetic diversity in germplasm collections is high if it has a genetic similarity coefficient of less than 0.5, and the level of genetic diversity in germplasm collections is low if it has a genetic similarity coefficient of more than 0.5 or close to 1.

The lower the level of similarity, the higher the level of diversity, and it is suspected that the similarity of the genotypic composition tends to be even lower, which is caused by technical factors of cultivation, as well as the environment in which the plants grow. Hadiyanti et al. (2018) stated that diversity within species arises because there are differences that appear in each member of the species even though genetically no two individuals are the same in one species. This happens because environmental factors also influence the appearance of certain traits as phenotypic diversity, therefore kinship analysis between genotypes is recommended using combination data from qualitative and quantitative characters so that genetic distance information is more informative (Rohaeni & Greece 2017)

Porang plants in Kumpeh Ulu District grow a lot in the soil pH range of 6.7, altitude 13 m asl, have dark green leaves with a stem circumference of 23.21 mm, this size is quite large compared to porang plants in other villages. According to Supriyono et al (2022) that, the circumference of the stem in porang plants can be used as a reference to determine the effect of the environment because the stem is an organ that distributes nutrients from the roots to the leaves and distributes photosynthetic products to all plant tissues. Qur'ani et al. (2022) and Firdaus et al. (2022) reported that the appearance of porang plant forms is controlled by the genetic properties of the plant under the influence of environmental factors. Environmental factors that are believed to influence changes in plant morphology include: soil conditions and altitude.

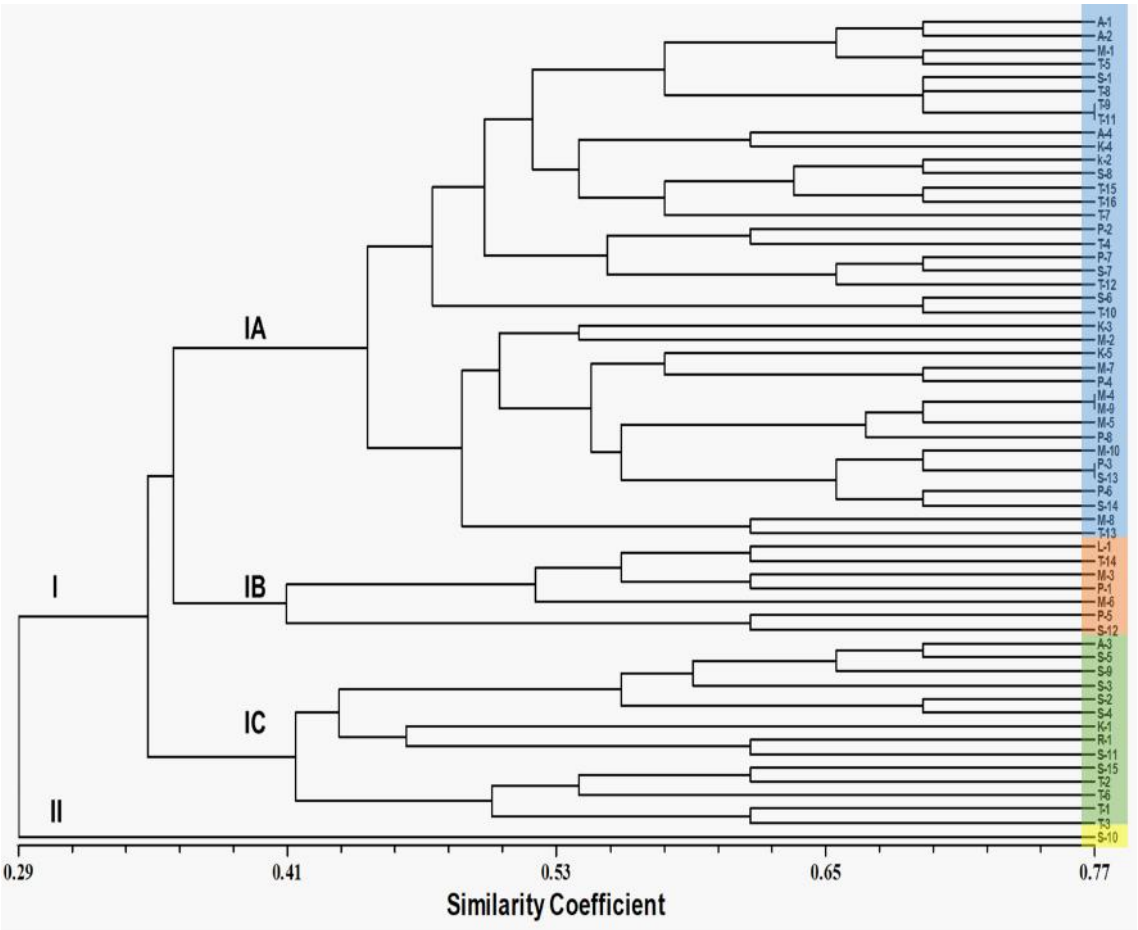


Figure 1 Dendrogram of genetic diversity grouping of 60 porang plant populations based on 13 characters

The grouping of genotypes in Figure 1 was due to the large number of the same morphological characters so that they have close kinship relationships. According to Sokal and Sneath (1963) and Ferita, Tawarati and Syarif (2015), the more similarities in character you have, the greater the similarity value which means the closer the kinship between the groups and vice versa. The results of grouping and descriptions of each group then analysed based on the characterizing characters (Table 4 and Figure 2).

Cluster analysis (kinship analysis) is often used to estimate the extent of diversity or genetic kinship of a population of living things. The kinship closeness among individuals in the plant population was mesured by using morphological characters as markers or differentiators. Morphological characters can be used as identities and as prediction of individual level kinship (Yuniarti, 2011). In addition to this, Palupi and Daryono (2021) found that the differences in morphological characters are worthwhile as a source of germplasm for plant breeding.

Table 4 The results of grouping and descriptions of each group based on the characterizing characteristics

Group	Sub Group	Sample	Character Identifier
I	IA	A1, A2, M1, T5, S1, T8, T9, T11, A4, K4, K2, S8, T15, T16, T7, P2, T4, P7, S7, T12, S6, T10, K3, M2, K5, M7, P4, M4, M9, M5, P8, M10, P3, S13, P6, S14, M8, T13	The color of the leaves is dark green, the surface position of the leaf blade is flat, the shape of the leaves is 4-6 lobes, the outer color of the bulb is light brown. Stem circumference 7.62-23.21 mm; leaf blade width 4.2-10.2 cm; Bulb diameter 11.01-74.31 cm
	IB	L1, T14, M3, P1, M6, P5, S12	Leaf color is yellow-green, leaf shape is meandering, leaf shape is 7-9 lobes. The surface position of the leaf blade is horizontal. Stem circumference 9.92-15.73 mm; leaf blade width 4.0-8.6 cm; bulb diameter 39.4-68.21 mm
	IC	A3, S5, S9, S3, S2, S4, K1, R1, S11, S15, T2, T6, T1, T3	Green leaf color, wavy leaf shape, 3-lobed leaf shape, leaf blade surface position, bowl shape, ovate tuber shape Stem circumference 7.43-18.07 mm; leaf width 5.4-11.9 cm; bulb diameter 40-86.02 mm
II		S10	White leaf color, leaf shape> 9 lobes, Drooping Leaf Surface Position, dark brown outer color Trunk circumference 10.5; leaf blade width 4.3 cm; tuber diameter 44.08 mm

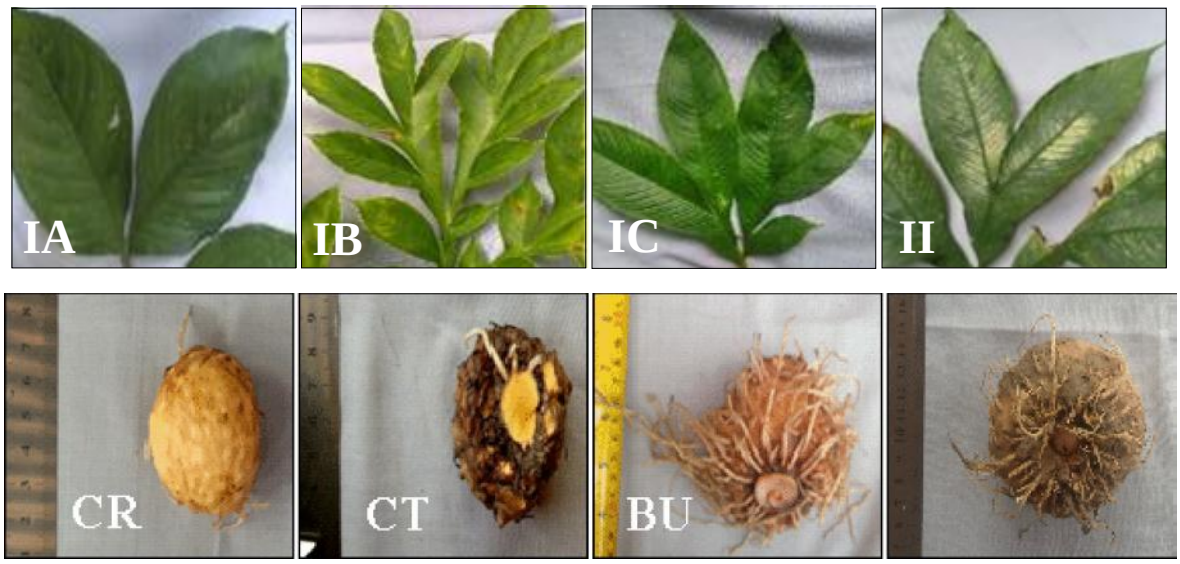


Figure 2 Morphological characters of porang leaf color group I; (IA) The leaves were dark green, (IB) The color of the leaves was greenish yellow, (IC) The leaf edge color was green, and group II The color of the leaves was whitish. the color of the leaf edges was green. The outer color of the porang tuber (CR) was light brown, and (CT) was dark brown. The shape of the porang tuber (BU) was round and (OV) Ovate

CONCLUSIONS

Identification of the morphology of porang plants in Kumpeh Ulu District, Muaro Jambi Regency, found similarities in the morphological characters of leaf edge color, petiole color, tuber shape and tuber color and stem height. However, there are differences in the width of the leaf blade, tuber diameter, leaf shape and outer color of porang tubers.

Based on the morphological similarity of porang plants in Kumpeh Ulu District, it has

a similarity level between 0.29 and 0.77 or morphological diversity of 0.23% to 71%. All porang plant samples united at a similarity coefficient of 0.29 and formed 2 main groups, namely: group I consisted of 59 porang plant samples and group II consisted of 1 (one) porang plant sample (S10). Group I was divided into three groups, namely sub groups IA, IB and IC with a similarity coefficient of 0.41.

The results of the kinship analysis showed that there were porang plants in different locations that had a fairly high level of similarity. In group IA, there were 6 samples of porang plants, namely T9, T11, M4, M9, P3, and S13 with a similarity coefficient of 0.77.

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