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DISTRIBUTION PATTERN OF JENGKOL PLANT (Pithecellobium jiringa (Jack) Prain) BASED ON MORPHOLOGICAL TRAIT TO DEVELOP NATURAL MEDICINE FOR DIABETES MELLITUS IN SUMEDANG OF WEST JAVA

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ABSTRACT

Diabetes mellitus is a serious disease that causes dysfunction of organs. Therefore, prevention and its treatment are always developed. The development of natural medicine is increasingly conducted since people prefer to live “back to nature”. Jengkol is one of the natural resources of tropical plant that potentially used as a natural medicine for diabetes mellitus (DM). Unfortunately, there are not any studies have been reported that variety of Jengkol consists of the best components for DM. This study aimed to obtain data on spread patterns and variety of jengkol plant in Sumedang of West Java. The study was conducted from February until July 2015 including several regions of Sumedang through exploration and purposive sampling. Morphological characters were collected using in situ characterization method. The Clustering and Principal Component Analysis (PCA) showed that two accessions of Jengkol, JG4 and JG14, indicated different cluster comparing to another Jengkol accessions in term of fruit and flower characters. In addition, the character of fruit and flower were identified had the highest contribution on Jengkol variation in Sumedang, West Java. This research result can be used for the development of jengkol as natural medicines on related studies in the future

Keywords: Clustering analysis, Jengkol, Principle component analysis (PCA), Purposive sampling

Introduction

Jengkol or dog fruit is a familiar plant among Indonesian people, and it is usually consumed as a favorite processed food. This plant is generally cultivated in plantation or housing area as a home garden, and also can be found in forests of Southeast Asian Countries. Jengkol’s shell, seed, and stem's skin consist of the anti-diabetic substance. According to the World Health Organization (WHO), Indonesia takes the fourth rank in the world on large number of diabetic patient (person suffers from diabetes mellitus) after United Sates, India, and China. Number of diabetic patient in Indonesia is predicted will increase from 8.4 million people in year 2000 to around 21.3 million people in year 2030 (Elysa. 2011). Some researches on jengkol indicate that extract of its stem's skin and seed is able to decrease the level of glucose in blood since it contains phenolic and terpenoid (Razak et al., 2010), therefore it can reduce the risk of diabetes mellitus (DM). Based on the study on jengkol's substances in south of West Java, that showed almost all parts of its shell and stem's skin contain phenolic and terpenoid (Maxiselly et al., 2015), therefore jengkol is potential to be developed as natural medicinal plants industry which is considerably used as alternative medicine.

Main supplier-provinces of jengkol in Indonesia are North Sumatera, West Java, Central Java, and some regions in Kalimantan. Sumedang is one of regencies in West Java which still has jengkol cultivation area. According to a data, jengkol cultivation area in Sumedang had been decreasing since year 2005 to 2006 because of jengkol wood utilization for gasoline (Food Crop Agriculture Office of West Java Province. 2013). Based on the data, an exploration is needed to ascertain the distribution and potentiality of jengkol in Sumedang.

Exploration can be conducted in forests, virgin areas, or areas which have been utilized by local people in small scale, such as private collection garden or home garden (Taber, 2014). In addition, the exploration is able to increase variability and improve genetic source that can be developed in advance. Individual development can be commenced through identifying the distribution pattern. Individual distribution pattern in region is useful to compile preservation strategy of a researched object (Maxiselly, 2011). This distribution pattern can be analyzed based on morphological character to determine the utilization of characterized germplasm. The activity of characterizing jengkol cultivation in Sumedang is expected to become the base in developing natural diabetic medicine of jengkol on similar research in the future.

MATERIALS AND METHODS

The research was conducted in Sumedang from February to July, 2015. The research material was population of jengkol plant that was found at research location. Research tools were Global Positioning System (GPS) to identify coordinate and height of place, roll ruler, *galah* to hook jengkol, digital camera to record documentation, writing tools, and questionnaire to interview the owner of jengkol cultivation at research location.

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Research methods were survey and exploration on the location using purposive sampling to determine research location. Observation included morphological character of jengkol at research location. Observation was conducted through character scoring using modified rambutan descriptor (International Plant Genetic Resources Institute, 2003), since descriptor for jengkol is not available yet.

Principal Component Analysis (PCA) was used to identify character that served high contribution score and influenced variation of observed jengkol plant. This PCA was based on 19 morphological characters on 18 characterized jengkol accessions. Observed characters consisted of quantity and quality. Qualitative characters were leaf base form, leaf apex form, basis folii form, stem color, twig formation, flower position, flower form, fruit form, outside shell color, inside shell color, and seed color. Quantitative character included leaf length, leaf width, stem diameter, fruit diameter, seed diameter, number of fruit per stalk, number of spiral per stalk, and number of fruit per spiral. Clustering Analysis was used to validate the grouping on PCA.

RESULTS AND DISCUSSION

Eigen Value on Table 1 shows that variation on accession grouping was caused by observed character. Its effect reached 95.46 % on PC1 and PC2, while the rest was caused by other factors such as environment. Contribution of a character towards variety can be identified through PCA. PC1 affected to 89.55 % because of its fruit character with discriminant value > 0.9 that included outside shell color, inside shell color, seed color, number of fruit per spiral, and some vegetative characters > 0.5 that included leaf, stem, and twig (Elysa, 2011) (Table 2). Character with discriminant value > 0.5 has positive effect towards genetic variation (Zubair, 2004; Maxiselly et al, 2008).

Table 1. Eigen Value and Variability on 18 Jengkol Accession in Sumedang

PC	Eigen Value	Variability	Cumulative
1	16.120	89.55	89.55
2	1.063	5.91	95.46

Result of PCA per character on the table explains characters which contributed on variation of 18 jengkol plant accessions. Matrix vector value of 19 characters on jengkol plant population can be seen on Table 2. The characters were the grouping base of examined jengkol accession.

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According of previous research stated that generative characters such as flower and fruit affect the grouping of jengkol accession in south of West Java greatly (Maxiselly et al., 2016). The literature is strengthened by this result.

Table 2. Matrix Vector Value of 19 Characters on Jengkol Population

Character	PC1	PC2	PC3	PC4
Leaf Base Form	**0.52**	**0.84**	0.02	0.02
Leaf Apex Form	**0.52**	**0.84**	0.02	0.02
Basis Folii Form	0.04	0.17	**-0.63**	**0.57**
Stem Color	**0.52**	**0.84**	0.02	0.02
Twig Formation	**0.52**	**0.84**	0.02	0.02
Flower Position	0.46	-0.27	**-0.80**	-0.18
Flower Form	0.46	-0.27	**-0.80**	-0.18
Fruit Form	**0.94**	-0.22	0.21	0.10
Outside Shell Color	**0.94**	-0.22	0.21	0.10
Inside Shell Color	**0.94**	-0.22	0.21	0.10
Seed Color	**0.91**	-0.39	0.02	0.00
Leaf Length	0.46	**0.62**	-0.07	0.29
Leaf Width	**0.52**	0.33	0.00	**-0.71**
Stem Diameter	-0.06	**-0.92**	0.17	0.14
Fruit Diameter	0.00	0.00	0.00	0.00
Seed Diameter	0.00	0.00	0.00	0.00
Number of Fruit per Stalk	**0.91**	-0.39	0.02	0.00
Number of Spiral per Stalk	**0.91**	-0.39	0.02	0.00

Number of Fruit per Spiral	**0.94**	-0.33	0.10	0.04

Biplot Graphic indicates that grouping formed on quadrant I and quadrant II. There are 16 accessions on quadrant I (JG1, JG2, JG3, JG5, JG6, JG7, JG8, JG9, JG10, JG11, JG12, JG13, JG 15, JG16, JG17, JG18), while JG4 and JG14 are separated away on quadrant II (Figure 1). JG11 is accession on quadrant I which has distance with other accessions. Figure of dendogram and biplot graphic strengthens that character of generative phase, both fruit and flower, affected jengkol plant's relationship greatly. In exploration, these three accessions had characters of fruit and flower (generative phase) while the others were still on vegetative phase.

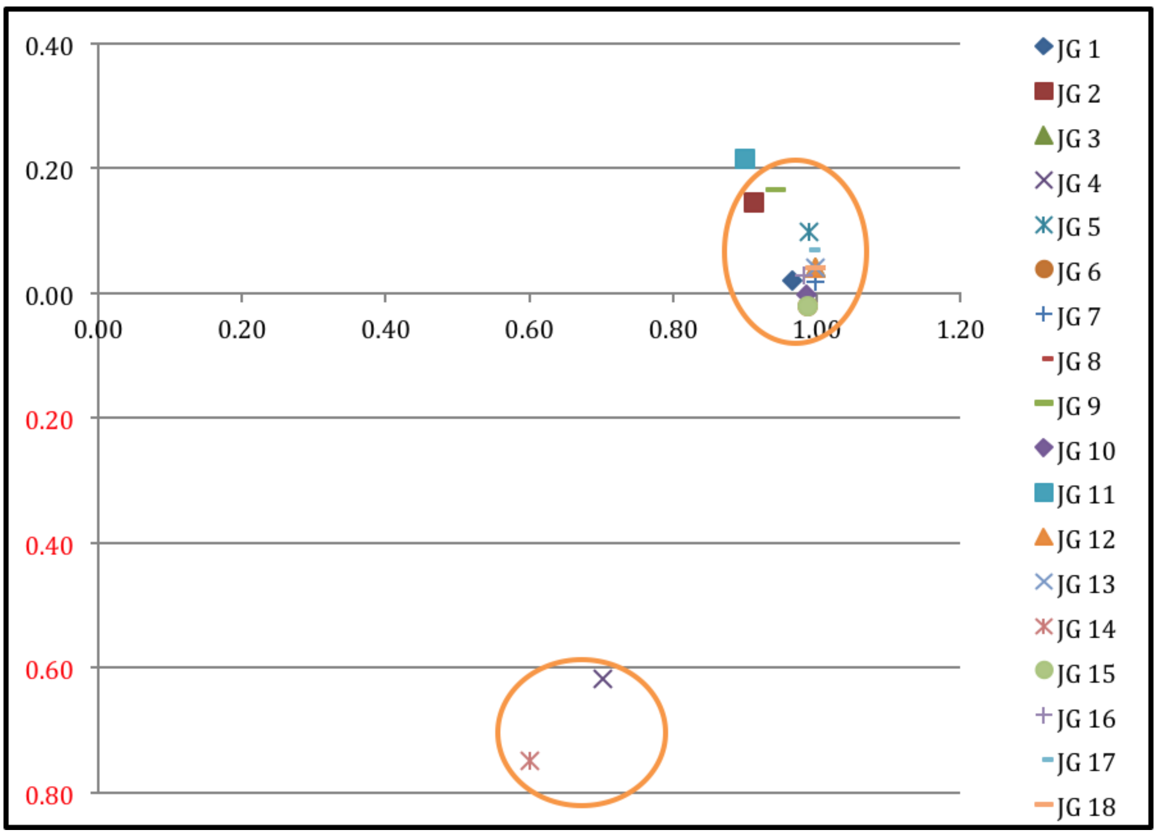

Figure 1. Biplot Graphic of 18 Jengkol Accessions in Sumedang Regency

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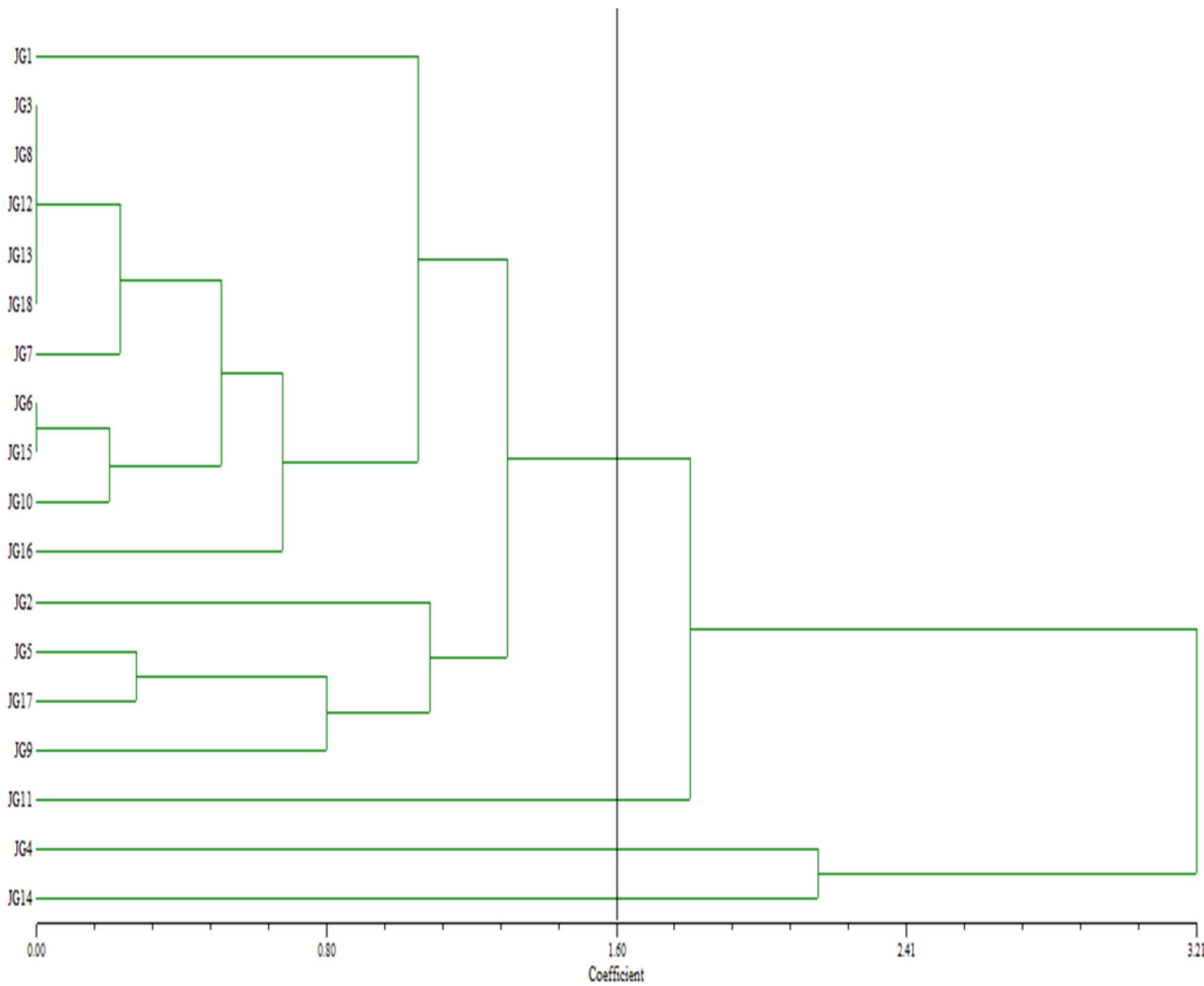

Figure 2. Dendogram of Clustering Analysis on 18 Jengkol Accessions in Sumedang

Result of clustering analysis dendogram showed the same thing with Biplot. Dendogram shows value of variation coefficient has scale of 0.00 - 3.21 (Figure 2). This value indicates high variation on examined accession. The variation was obtained from value of examined character scoring.The more number of examined characters, the clearer of different and similarity among examined accessions (Rohlf, 2001).

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Accessions with nearest correlation are JG 3, JG 8, JG 12, JG 13, and JG 18 with the dissimilarity value is 0.00. This correlation is possibly caused by the similarity value on all examined characters, which were 19 characters. The Accessions that have high dissimilarity value are JG4 and JG14 at 3.21. This has been explained previously that these two accessions have character of fruit component that affected the grouping greatly. In the other hand, JG11 has high dissimilarity since it had flower character, while the others were still in vegetative phase.

The biplot graphic and dendogram shows a random distribution pattern of jengkol plants, although those came from the same place in Sumedang (Figure 1 and 2). Such nonspecific distribution indicates that jengkol plants were probably distributed in other regions with same character on examined accession. Other research stated that the distribution pattern is affected by climate, soil condition, organisms, and human intervention, where Jengkol is able to grow in any areas with height range starts from lowland to highland (Maxiselly and Ustari, 2014). Jengkol planted in the low land will growth faster than in high land area to enter generative phase. These possibly being the cause of examined jengkol plants in Sumedang were in different growth phase, generative and vegetative.

Based on Principal Component Analysis on biplot graphic and Clustering Analysis, there was a random distribution pattern or unspecified area on examined jengkol accessions in Sumedang. There are 2 jengkol accessions, JG 4 and JG 14, which grouped differently from another jengkol accessions. Fruit character was the most influencing character on variation.

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