Diversity of morphological characters of 30 local torch ginger accessions from Pangandaran of West Java of Indonesia

Diversity of morphological characters of 30 local torch ginger accessions from Pangandaran of West Java of Indonesia

C Hidayat[1], L Chaidir[1], A Supriadin[1], O T Kurahman[1], and A M Mulya[1]

[1]Department of Agrotechnology, Faculty of Science and Technology, UIN Sunan Gunung Djati Bandung, Indonesia

E-mail: cephidayat62@uinsgd.ac.id

Abstract. Torch ginger (*Etlingera* spp.) is one of the herbal plants native to Indonesia that has long been known and used as medicines. Exploration on torch ginger plant needs to be done to conservate and determine genetic diversity. Study of genetic diversity torch ginger in the district of Pangandaran is important because as long as there has been no study in depth the potential of genetic diversity and phylogenetic relationship germplasm of torch ginger Genetic diversity based on this research had a proportion of 47% of the total of 100% in the PC1-PC3 was based on the analysis Principal Component Analysis (PCA) with the character influencing that form clumps, line leaf midrib, plant height, stem diameter, leaf length, color scales rhizome, stem color, rhizome and the leaf base forms. Based on the results of the genetic diversity cluster analysis found that narrow torch ginger euclidean indicated by coefficient of 0.79 and was divided into six clusters. Accession which had the closest kinship i.e. accession N1 from Cikadu subdistrict of Cintakarya and accession N2 from Cikoang subdistrict of Cintakarya, while accession with the farthest kinship namely accession N29 from Jangraga subdistrict of Mangunjaya with range euclidean of 0.79.

1. Introduction

Torch ginger plants consist of green torch ginger (*Etlingera elatior*) and red torch ginger (*Etlingera hemisphaerica*), which have the potential as functional food material that have various functions, namely antibacterial, natural medicines, cosmetics, beverages and food flavoring [1] so its existence is quite searchable to be utilized by the community. Pangandaran Regency has the potential for torch ginger exploration because due to extensive land and supporting environmental factors. Breeding on torch ginger plants in Pangandaran Regency needs to be done because so far there has been no study of the potential for genetic diversity and kinship relationships of torch ginger germplasm. The existence of germplasm is increasingly narrowed due to genetic erosion caused by human and natural factors. By narrowing the germplasm, the genetic diversity of plants will be smaller and can cause extinction.

The breeding process carried out on torch ginger plants can be done by exploration, identification and characterization through morphological and agronomic characters. Pangandaran Regency is a location that can be used to explore torch ginger plants because it is included to the production center, moreover the community uses the torch ginger commodity itself. Germplasm collections can be used better if the characteristics of the plant are known [2]. The germplasm collection aims to study the level of existing diversity to maintain genetic diversity. Factors that influence the differences in plants are not only because of differences from internal factors, but also external factors. Differences in the appearance of plants can be caused by differences in the nature of plants (genetic) or environmental differences, or because they influence one another [7].

Efforts that need to be done to maintain genetic diversity such as primitive species, wild species, also specific and superior species, namely the preservation of germplasm by means of in situ and ex situ. The existence of high genetic diversity is one of the guidelines that must be noticed to obtain superior

cultivars. If there is a high genetic diversity there is a greater chance of the best character selection when compared to characters which have a low genetic diversity.

The kinship relationship between two individuals or populations can be known by using the similarity of some characters, with the assumption that different characters are caused by differences in genetic array. Kinship is important to know because it has benefit of facilitating the search for substitute varieties if a variety has problems in its cultivation process.

2. Material and Methods

The research was carried out by exploration in the field by collecting torch ginger accessions in Pangandaran District. Exploration activity in Pangandaran District was carried out in several villages which was expected to obtain more collection of torch ginger plants. The method used was a roaming method with purposive sampling method. In this study, objects that are in accordance with the objectives of the study were taken, where the study was carried out in the area in Pangandaran District which found torch ginger plants. Research conducted on individual plants using direct observation for the measurement of morphological characters and using descriptive, namely in examining an object or a class of events in the present with the aim to be able to make characters systematically, factually and accurately about the natures or characteristics and relationships of phenomena observed.

3. Result and Discussion

Principal Component Analysis (PCA) is an analytical method that is often used to determine the diversity in plant collections. PCA is a technique used in order to find out how much a character contributes to diversity so that the results are commonly used to identify traits that become a characteristic of a variety [3]. In this study, the PCA aimed to determine the characters that can affect differences or variations in 30 accessions of torch ginger plants (*Etlingera* spp.) observed in Pangandaran District.

Table 1 Eigenvalue and Variability Values of 20 Characters in 30 *Etlingera* spp accessions in Pangandaran Regency

Component	Eigenvalue	Percent *(%)*	Cumulative *(%)*
1.	3.90	19.52	19.52
2.	3.49	17.44	36.96
3.	2.04	10.18	47.14

The calculation of the PCA was analysed based on 20 characters of torch ginger plant (*Etlingera* spp.), namely: clump shape, rhizome shape, color of rhizome scales, stem color, upper leaf color, lower leaf color, bud color, wax layer, leaf midrib line , leaf texture, leaf tip shape, leaf texture, leaf tip shape, leaf edge shape, leaf edge color, leaf base shape, leaf shape, plant height, stem diameter, leaf length, leaf width and leaf node distance.

The results of the principal component analysis (PCA) showed the presence of eigenvalue, percent and cumulative values. The principal component used was a component that had eigenvalue more than two so that it produced three principal components of eigenvalue and variability values.

Table 1 shows the Eigenvalue of each variable with the percentage in ordered values. These three components were components that had more than two eigenvalue. In the Table 1 it can be seen that the principal component (PC1) had an eigen value of 3.90 with a percentage of 19.51% of the variation of 30 accessions of torch ginger plants (*Etlingera* spp.) from all locations with red and green types. The percentage of PC1 was obtained from the clump shape, leaf midrib, plant height, stem diameter and leaf length. The second component (PC2), the eigenvalue owned was 3.49 with a percentage of 17.44% obtained from the color characteristics of the rhizome scales and stem color. The third component (PC3), the eigen value owned was 2.04 with a percentage of 10.18% obtained from the character of the rhizome form and the base leaf shape.

Table 1 describes the components of PC 1 - PC 3 having a total of 47% of the total 100% proportion of the torch ginger plants variation character that appear and. PC 1 - PC 3 had eigenvalue 2.04-3.90 where the eigenvalue was above two so that PC 1 - PC 3 could be called as the characters that affected variations occurred in 30 accessions of torch ginger plants (*Etlingera* spp .) which consisted of clumps, leaf midrib lines, plant height, stem diameter and leaf length, color of rhizome scales and stem color, rhizome shape and base leaf shape.

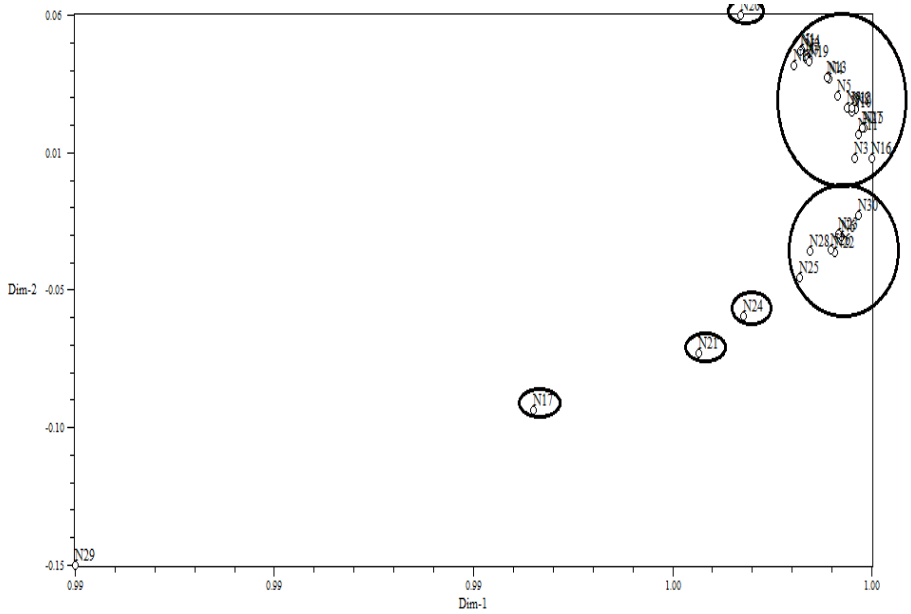

Figure 1 Biplot Graph of Spreading Pattern among 30 Accessions of Torch ginger Plants (*Etlingera* spp.) in Pangandaran District

Explanation:N1= Cikadu Cintakarya; N2= Cikoang Cintakarya; N3= Ciawi Cintakarya; N4= Panglanjan Cintaratu; N5= Bontos Cintaratu; N6= Burujul; N7= Sukarenah; N8= Patinggen; N9= Harjaresik; N10= Kedungwuluh; N11= Sindangwangi; N12= Ciganjeng; N13= Sirungwatang; N14= Cintamaju; N15= Karangsari; N16= Ciawi Cintakarya; N17= Maruyung Sari; N18= Paledah; N19= Sukanagara; N20= Emplak; N21= Pejaten; N22= Karang Torch ginger; N23= Sidamulih; N24= Karang Benda; N25= Karang Jaladri; N26= Sinargalih; N27= Sukamaju; N28= Mangunjaya; N29= Jangraga; N30= Sindangjaya.

In Figure 1, the biplot graph of the torch ginger crop distribution pattern based on 20 characters observed there were six groups. Accession of torch ginger plants (*Etlingera* spp.) which were in the same circle were accessions that had plants with similar character. The first group consisted of only 1 accession, the N20. The second group consisted of 19 accessions namely N14, N13, N19, N1, N2, N3, N4, N5, N7, N8, N9, N18, N10, N11, N16, N12, N15, N27, N29 which clustered close together and were in the same circle and were accessions with similar morphology of clump shape, color of rhizome scales, upper leaf color, wax layer, leaf midrib lines, leaf texture, leaf tip shape and edge color, as for agronomic similarities seen from plant height, stem diameter, leaf length and leaf width.

The third group consisted of 7 accessions namely N30, N23, N6, N26, N22, N28, N25 with similarities in clump morphology, stem color, lower leaf color, wax layer, leaf midrib lines, leaf texture and edge shape while agronomic similarities were shown from leaf length and leaf width. The fourth group consisted only of accession N24, the fifth group consisted only of accession N21 and the sixth group only consisted of accessions N17, each of which had the character of plant height and stem diameter that was different (smaller) than other accessions.

Cluster analysis is an analysis that is used to classify elements that are similar as research objects to be used as clustering that is different and mutually exclusive or special. Cluster analysis is an analysis included in the multivariant statistical analysis of interdependent methods. The purpose of cluster

analysis was to explore the torch ginger plant, which was to classify objects based on similar characteristics among the objects. The objects are classified in one or more clusters or groups so that the objects in one cluster will have similarities with one another.

In the cluster analysis, which can state the distance of non-conformity, is Euclidean Coefficient. The euclidean distance which has a range of more than one indicates a large non conformity coefficient. The small non conformity coefficient states that each genotype with each other has a narrow variation and vice versa if the larger non conformity coefficient, the wider variation in each genotype. The euclidean distance of torch ginger plants in Pangandaran Regency was in the range of 0.05 to 0.79 (Figure 2) which states that the non-conformity coefficients in torch ginger plant populations in all locations had a narrow non conformity stating that the variation contained in the population was narrow..

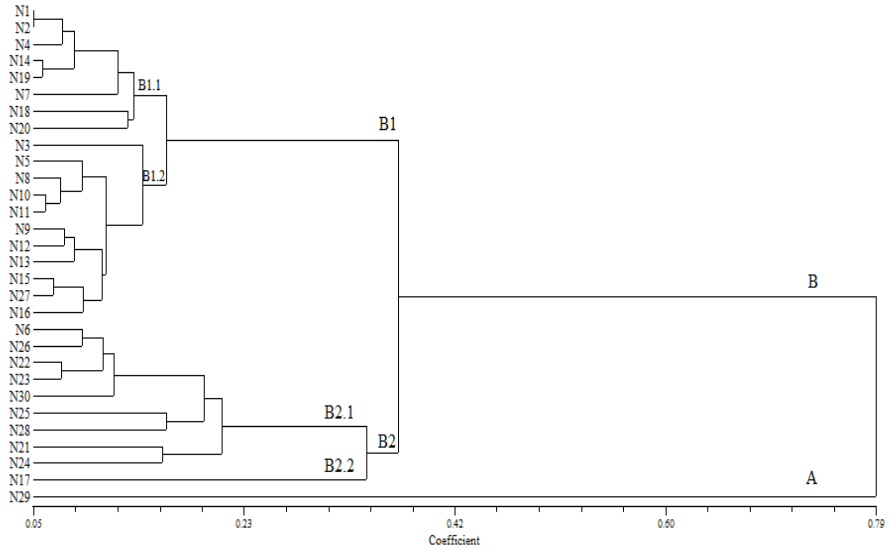

Figure 2. Dendrogram of 30 Accessions Torch ginger

In Figure 2, a dendrogram of a total of 30 accessions torch ginger plants in Pangandaran District had formed two clusters, cluster A and cluster B. Cluster A consisted of only one accession, namely accession N29, namely accession from Jangraga Village, Mangunjaya Subdistrict with an euclidean range of 0.79 which had a phenotypic appearance with quite striking differences, namely from brownish green of rhizome scales and only had 119.1 cm plant height with a stem diameter of 1.36 and leaf length of 3.87, but that did not mean that other characters were very different from other accessions .

Cluster B was a cluster consisting of 2 clusters, namely clusters B1 and B2, each of which also formed sub-clusters. The total accessions contained in cluster B1 were 19 accessions. The B1 cluster consisted of sub-cluster B1.1 and sub cluster B1.2. Sub cluster B1.1 consisted of 8 accessions, namely N1, N2, N4, N14, N19, N7, N18, N20 while the sub cluster B1.2 consisted of 11 accessions namely N3, N5, N8, N10, N11, N9, N12 , N13, N15, N27, N16. Cluster B2 consisted of sub cluster B2.1 and sub cluster B2.2. Sub-cluster B2.1 consisted of 9 accessions namely accession N6, N26, N22, N23, N30, N25, N28, N21, N24 while sub cluster B2.2 consisted of only 1 accession namely N17.

Cluster B had many accessions that had a parallel non conformity distance that means these accessions tended to have morphological appearances that were closely related. Accessions that had the closest kinship were the plants that exist in the accession N1 originating from Cikadu Village, Cintakarya District and N2 accession, originating from Cikoang Village, Cintakarya District with the closest coefficient distance, which was 0.05. This could be due to the location of the accession which is quite close because it is in the same sub-district with relatively similar environmental factors.

If more and more characters are observed, the magnitude of the differences or even similarities between accessions will be increasingly visible [14]. This torch ginger plant in Pangandaran Regency

had a kinship pattern of relationships between accessions and diversity that had been shown based on the results of exploration that can be used for breeding purposes, assembling of new varieties and subsequent superiority.

4. Conclusion

There was a close relationship between torch ginger plants (*Etlingera* spp) with euclidean distance ranges from 0.05 to 0.79 which resulted in two clusters namely cluster A and cluster B which showed variation in torch ginger plants. The farthest kinship relationship was in accession 29, namely accession from Jangraga Village, Mangunjaya Subdistrict with euclidean range of 0.79, while the closest kinship to N1 accession was from Cikadu Village, Cintakarya District and N2 accession, originating from Cikoang Village, Cintakarya District with the closest distance coefficient, which was 0.05 because the locations of the accessions are in the same sub-district with relatively similar environmental factors.

Acknowledgements

We would like to thank the Chairman of Research Center UIN Sunan Gunung Djati Bandung, Dr. Yudi Darmalaksana who had provided research grant in the BOPTAN UIN research grant in 2017.

References

[1] Jackie T, Haleagrahara N, Chakravarthi S 2011 Antioxidant effects of Etlingera elatior flower extract against lead acetate-induced perturbations in free radical scavenging enzymes and lipid peroxidation in rats *BMC Res. Notes* **67:** 1–8

[2] Setyowati M, Hanarida I, Sutoro 2007 Karakteristik Umbi Plasma Nutfah Tanaman Talas (*Colocasia esculenta*) *Bul. plasma nutfah* **13:** 49–55

[3] Afuape S O, Okocha P I, Njoku D 2011 Multivariate Assessment of The Agromorphological Variability and Yield Components among Sweet Potato (*Ipomoea Batatas* (L.) Lam) Landraces *African J. Plant Sci.* **5:** 123-132.

[4] Baihaki A 2000 Teknik Rancangan dan Analisis Penelitian Pemuliaan Fakultas Pertanian Bandung: *Universitas Padjadjaran*.

[5] Barros L M, Paiva J R, Crisostómo J R, Cavalcanti J J V 2007 Cajueiro In : Bruckner C.H. (ed.) : Melhoramento de Fructeiras Tropicais Editoria UFV, *Vicosa* pp. 159-176.

[6] Chaidir L, Hidayat C, Supriadin A, Aina A, Nuryan, Ramdhani M A 2018 Morphological Characterization of Etlingera Elatior (Jack) Explorated in Sukabumi, West Java, Indonesia *IOP Conf. Series: Materials Science and Engineering* **288(2017)** 012091.

[7] Chaidir L, Yuliani K, Qurrohman B F T 2016 Eksplorasi dan Karakterisasi Tanaman Genjer (*Limnocharis flava* (L.) Buch) di Kabupaten Pangandaran berdasarkan Karakter Morfologi dan Agronomi *Jurnal Agro* **3(2)**.

[8] Gardner F P, Pearce R B, Mitchell R L 1991 Physiology of Crop Plants Diterjemahkan oleh Susilo H *Universitas Indonesia Press*: Jakarta.

[9] Habsah M, Lajis N H, Sukari M A, Yap Y H, Kikuzaki H, Nakatani N, Ali A M 2005 Antitumour-Promoting and Cytotoxic Constituentss of Etlingera Elatior *Malaysian Journal of Medical Sciences* **12:** 6-12.

[10] Ibrahim H, Mood J 2001 The Torch Gingers: Sentinels of The Forest *Garden Asia* pp. 12-19.

[11] International Union for the Protection of New Varieties of Plant 1996 Guidelines for the Conduct of Tests for Distinctness, Univormity and Stability: Ginger *(Zingiber officinale* Rosc.)

[12] Lim C K 2001 Taxonomic notes on Etlingera Giseke (*Zingiberaceae*) in Peninsular Malaysia: the "Achasma" taxa and supplementary notes on the "Nicolaia" taxa *Folia Malaysiana* **2:** 141−178

[13] Luc-Cayol F, Fereol L 1997 *Alpinia martinica (Zingiberaceae):* An Intergeneric Hybrid Between *Alpinia Purpurata* and *Etlingera elatior HortSci* **32:** 914- 915

[14] Rohlf F J 2001 NTSYS-pc: Numerical Taxonomy and Multivariate Analysis Sy.