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Exploration of the Dayak Onion (*Eleutherine palmifolia (L.) Merr*) in the Borderlands of North Kalimantan, Indonesia

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Abstract. The Dayak onion (*Eleutherine palmifolia (L.) Merr*) is a plant endemic to Kalimantan, Indonesia, known for its medicinal properties. This study explores the distribution and morphological diversity of Dayak onions in the border areas of North Kalimantan, encompassing Tana Tidung, Bulungan, Malinau Regencies, and Tarakan City. Fifteen unique accessions were collected, and their morphological traits were characterized both qualitatively and quantitatively. The distribution analysis revealed an even spread of Dayak onions across the studied regions. The diversity analysis, using the Shannon-Wiener index, indicated variations in certain quantitative traits like plant height and root length, while qualitative traits like leaf and bulb characteristics remained largely uniform. Principal Component Analysis (PCA) identified key morphological characters contributing to the observed diversity, and cluster analysis revealed kinship relationships among the accessions, with some groups showing high similarity coefficients. This research provides valuable insights into the distribution, diversity, and genetic relationships of Dayak onions in North Kalimantan, contributing to potential agricultural and conservation applications.

Keywords: dayak onion; Eleutherine palmifolia; morphological diversity; North Kalimantan; germplasm

INTRODUCTION

The Dayak onion, *Eleutherine palmifolia* (L.) Merr, a plant endemic to Kalimantan Province, is renowned for its multifaceted medicinal properties. Valued by the Dayak people, this herb is traditionally utilized to treat a myriad of ailments, including breast and bowel cancers, diabetes, hypertension, ulcers, high cholesterol levels, and stroke prevention.

The chemical compounds contained in Dayak onions include 15 compounds, including flavonoid derivatives and naphtaquinone (Prayitno et al., 2018). Dayak onion bulbs contain bioactive compounds, such as phenols, flavonoids, and their derivatives, which play a role in preventing various types of diseases (Wijayanti & Hasyati, 2018). Dayak onions contain various types of bioactive compounds that can be used for treatment, including naphthoquinone triterpenoids and their derivative compounds, such as elacanicin, eleutherol, isoeleoutherol, eleutherin, and isoeleutherin (Sirhi et al., 2017). According to Ekawati (2018), dayak onion Eleutherine americana (L.) Merr is one of the medicinal plants. Dayak onion contains flavonoids and anthocyanins that function as antioxidants and lactagogum.

Dayak onions are distinguished by their high content of flavonoids and anthocyanins acting as potent antioxidants and lactagogues. Bioactive and antioxidant compounds such as phenol, flavonoids, tannin, anthocyanin, steroid, alkaloid, terpenoid, and saponins are richly found in onion dayak. These compounds can inhibit and reduce free radicals (Yuswi, 2017). Flavonoids are part of a large group of phenolic compounds in the phenylpropanoid pathway (Linatoc et al., 2018). Dayak onions contain bioactive compounds such as fatty acid esters, isoquinoline, xanthones, naphthalene, and phenolics (Munaeni et al., 2019). The flavonoid content in the form of isoliquiritigenin and polyphenols in the form of areoxyresveratrol are largely responsible for antioxidant activity by donating electrons to stabilize free radicals. Based on this, Dayak onions have great potential as a source of antioxidants (Prasetya, 2023).

This plant thrives in various soil types and textures, including loam and sand, and is characterized by a relatively short harvesting period. The Dayak onion plant comprises leaves, stems, bulbs, flowers, and fruit, each part holding unique utility, hence its classification as a multifunctional plant.

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Dayak onion bulbs contain flavonoids, which are useful for blood circulation and prevent blockages in blood vessels so that blood can flow normally. Flavonoids also reduce cholesterol content and fat deposits in blood vessel walls (Setyawan & Burhanto, 2019). Brazil emerges as a primary distribution center, boasting 250 species and 30 genera (Inácio et al., 2022).

Propagation of Dayak onion involves exploration, followed by identification and characterization based on morphological traits and clustering analysis. Exploration and identification activities are important activities in agricultural development. This activity is useful for anticipating or minimizing the extinction of plant germplasm (Setyowati et al., 2018). Exploration in local communities provides insights into genetic kinship and is crucial in identifying superior varieties. This initial step is pivotal for collecting comprehensive morphological and genetic data. Identification, as described by Simangunsong et al. (2017), is a process aimed at cataloging traits into a database prior to initiating plant breeding programs. According to Nikirahayu et al. (2021), yield enhancement can be achieved through the selection of superior varieties and appropriate planting media.

Plant diversity is a critical factor in plant breeding, offering a selection of characters for breeding purposes. Characterization is important to identify important traits found in local rice so that they can be utilized in plant breeding activities (Rembang et al., 2018). Post-exploration characterization aims to understand the morphological traits and potential benefits of the plants. This involves using both qualitative and quantitative morphological characters observed directly in the field. Phenotypic appearances provide insights into the variances among individual Dayak onion plants, aiding in the description of species for genetic sourcing in plant breeding. This study's primary objective was to ascertain the distribution of Dayak onions in the border areas of North Kalimantan Province, including Tana Tidung Regency, Bulungan Regency, Malinau Regency, and Tarakan City.

METHODS

The research was systematically conducted in several stages:

1. Germplasm Collection

   Locations for germplasm collection were determined based on inputs from key informants such as agricultural offices, extension workers, and the local community. This was followed by interviews to gather data on location existence, cultivation practices, etc. Subsequent field visits enabled data collection on geographical coordinates, ambient temperature, and altitude. The sampling of Dayak onions employed purposive sampling methodology. In this study, purposive sampling was employed to select Dayak onion samples that met specific criteria, such as size (0.3-0.5 cm) and being free from defects, pests, and diseases. This method was chosen to ensure the collection of high-quality germplasm for further analysis and characterization.

Figure 1. Dayak local onion distribution map

Thirty plant samples were collected from these 15 locations, including five locations in Bulungan Regency, three in Tana Tidung Regency, four in Tarakan City, and three in Malinau Regency. The variation in the number of accessions from each location provides insights into the species' distribution, likely influenced by propagation techniques and the purposive sampling method. While purposive sampling targets specific characteristics

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and may lead to biased or incomplete data, it is valuable for sample selection in this context.

2. Observation of Morphological Characters
   The research observations were bifurcated into qualitative and quantitative character studies. The qualitative observation encompassed eight characters: leaf color, presence of hair on leaves, leaf shape, leaf edge shape, leaf venation, Bulb color, Bulb surface, and Bulb shape. Quantitatively, five characters were assessed: plant height, leaf count, root length, Bulb length, and Bulb diameter. Data collection and documentation were undertaken for both qualitative and quantitative morphological characterizations of the various Dayak onion accessions. This process included identification and re-characterization through replanting.
3. Data Analysis
   The distribution of local Dayak onions in North Kalimantan was mapped using QGIS software. Both qualitative and quantitative observational data were utilized to assess the diversity of Dayak onions, applying the Shannon-Wienner index.

The selection of observed variables for morphological characterization was comprehensive, aiming to discern the quantitative traits that account for differences/variations among Dayak onion types, thus determining the level of morphological characters. Principal Component Analysis (PCA) is a linear combination of observed variables; the information contained in the principal component is a combination of all variables with certain weights. The linear combination chosen is the linear combination with the largest variety that contains the most information. The main components are orthogonal and uncorrelated, and the information does not overlap. The results of this procedure will later be used in further analysis, such as grouping and principal component regression analysis. The main goal of PCA is to reduce data complexity by reducing dimensions, revealing patterns or structures contained in the data, and eliminating correlations between existing variables. Principal Component Analysis (PCA) was conducted to identify characteristics significantly impacting diversity. Cluster analysis (dendrogram) was utilized to group local Dayak onions based on similarity in characteristics. PCA will identify patterns in a data set, finding similarities and differences between each factor. Because PCA functions as a strong model for analyzing data. The results of this procedure will later be used in further analysis, such as grouping and principal component regression analysis (Saputri et al., 2023).

The main goal of PCA is to reduce data complexity by reducing dimensions, revealing patterns or structures contained in the data, and eliminating correlations between existing variables (Ruhiyat et al., 2023). Principal Component Analysis (PCA) is a powerful statistical technique that allows for efficient analysis and interpretation of large multi-variate datasets. It can effectively identify subtle elemental trends significant to exploration project targeting that may be missed if only the primary and pathfinder elements are addressed. Principal Component Analysis (PCA) was conducted to identify characteristics significantly impacting diversity. Cluster analysis (dendrogram) was utilized to group local Dayak onions based on similarity in characteristics. PCA will identify patterns in a data set, finding similarities and differences between each factor. Because PCA functions as a strong model for analyzing data (Nasution, 2019).

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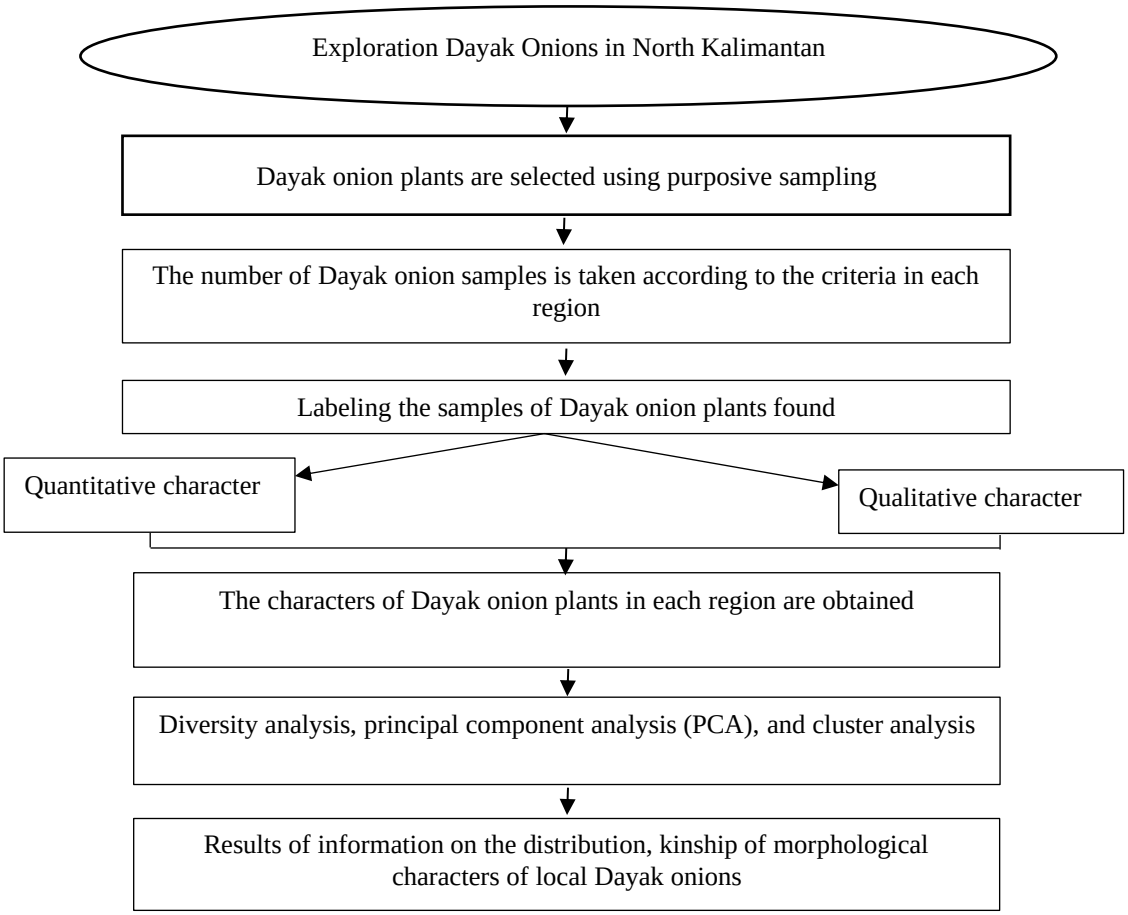

Diagram 1. Selection exploration of dayak onion plant diversity

Diagram 1 outlines the process of studying Dayak onion diversity in North Kalimantan. It begins with purposive sampling of Dayak onion plants, followed by labeling and character analysis (both quantitative and qualitative). The data is then analyzed for diversity, principal components, and clusters, leading to information on the distribution, kinship, and morphological characteristics of local Dayak onions.

RESULTS AND DISCUSSION

Distribution of Local Dayak Onion

The germplasm collection process identified 15 unique Dayak onion accessions, coded as B1, B2, B3, B4, B5, K1, K2, K3, T1, T2, T3, T4, M1, M2, and M3. The distribution map (**Figure 1**) illustrates that these onions are evenly distributed across Tana Tidung Regency, Bulungan Regency, Malinau Regency, and Tarakan City, indicating their endemic nature in these regions. This distribution is also reflected in the variation of regional names for Dayak onions, such as tiwai onions and forest onions. The study notes that propagation of Dayak onions is primarily done through bulbs, as seed production is challenging.

Mean Quantitative Character

The quantitative characteristics of the Dayak onion accessions were analyzed, as shown in **Table 1**. Dayak onion is an annual herbaceous plant, typically measuring 30-60 cm in height, with leaf widths of 1-3 cm. The plant features single, pointed leaves with flat or non-serrated edges, small flowers, and red bulbs (Harlita et al., 2018). The mean values for plant height, leaf count, root length, bulb length, and bulb diameter for each accession provide a detailed understanding of the plant's morphological variation across different locations.

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Table 1. Mean of quantitative characters

Accession	Plant Height (cm)	Leaf Count (leaves)	Root Length (cm)	Bulb Length (cm)	Bulb Diameter (mm)
B1	28,1	2,0	3,7	2,6	4
B2	21,2	1,3	1,2	2,6	4
B3	25,9	1,3	1,9	2,5	4
B4	24,2	1,0	2,7	3,0	4
B5	23,7	1,0	3,2	3,4	4
K1	25,4	1,8	3,8	2,5	4
K2	24,1	1,0	2,3	1,9	4
K3	21,3	0,9	1,9	2,5	4
T1	13,1	1,2	1,4	2,0	4
T2	14,0	1,1	2,6	2,3	4
T3	13,8	1,0	2,5	2,4	4
T4	17,1	1,0	2,5	2,7	4
M1	24,7	1,1	2,9	2,5	4
M2	2,4	1,7	3,4	2,7	4
M3	23,2	1,2	3,9	3,2	4

Mean Qualitative Character

The qualitative character analysis of the Dayak onion (*Eleutherine palmifolia* (L.) Merr) accessions reveals a high degree of uniformity across several key characteristics. As indicated in **Table 2,** these traits include the absence of leaf hairs, a linear leaf shape, flat leaf edge shape, tapered leaf bones, smooth bulb surface, and a subglobose bulb shape. This consistency in qualitative traits suggests a stable morphological identity among the different accessions, regardless of their geographical location.

Diversity of Local Dayak Onions

The diversity of local Dayak onions (*Eleutherine palmifolia (L.) Merr*) was analyzed using the Shannon-Wiener index, which aimed to assess the variation in both quantitative and qualitative characters across 15 plant accessions. This index is a crucial tool for understanding biodiversity within species, offering insights into the range of variability and potential adaptability of these plants. Based on the available data and the calculated Shannon-Wiener index (H'), the diversity of the Dayak onion plants varied among different characters (**Table 3**). For instance, plant height exhibited moderate diversity with an index value of 2.7. This suggests a considerable range of variation in plant height among the accessions, which could be attributed to genetic differences or environmental influences. In contrast, root length characters showed moderate diversity with a lower index value of 1.3, indicating less variability compared to plant height. Bulb length and diameter displayed low diversity, with index values of 0.3 and 0.6, respectively. Such low diversity values suggest a more uniform bulb size and shape across the accessions.

Interestingly, the number of leaves also showed low diversity with an index value of 0.1, pointing towards a consistent leaf count among the Dayak onion plants. Similarly, several qualitative characters such as leaf hair, leaf shape, leaf edge shape, leaf bone, leaf tip shape, leaf surface, and leaf shape all registered a diversity index of 0.00, indicating no variability and a high degree of uniformity across these traits. Bulb color, however, fell into the moderate diversity category with an index value of 1.44, reflecting some variation in this trait among the Dayak onion accessions. Leaf color also showed some diversity, albeit low, with an index value of 0.26. These findings underscore the importance of considering both qualitative and quantitative traits in assessing plant biodiversity.

The moderate to low diversity observed in certain characters of Dayak onions could be significant for agricultural practices, breeding programs, and conservation strategies, as it highlights the traits that are most stable and those that show greater variation within this species. This information can be used to develop new varieties with improved traits, such as higher

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yields, disease resistance, or better adaptability to different environments. Additionally, understanding the genetic diversity of Dayak onions can help to conserve this valuable plant resource and ensure its long-term survival.

Table 2. Mean qualitative characters

Accession	Leaf Color	Leaf Hair	Leaf Shape	Leaf Edge Shape	Leaf Bone	Leaf Tip Shape	Bulb Color	Bulb Surface	Bulb Shape
B1	Dark green (143A)	No	Linear	Flat	Parallel	Acuminate	Dark red (53A)	Smooth	Subglobose
B2	Dark green (143A)	No	Linear	Flat	Parallel	Acuminate	Dark red (53A)	Smooth	Subglobose
B3	Dark green (143A)	No	Linear	Flat	Parallel	Acuminate	Dark red (53A)	Smooth	Subglobose
B4	Dark green (143A)	No	Linear	Flat	Parallel	Acuminate	Dark red (53A)	Smooth	Subglobose
B5	Dark green (143A)	No	Linear	Flat	Parallel	Acuminate	Dark red (53A)	Smooth	Subglobose
K1	Dark green(143A)	No	Linear	Flat	Parallel	Acuminate	Maroon (59A)	Smooth	Subglobose
K2	Dark green (143A)	No	Linear	Flat	Parallel	Acuminate	Maroon (59A)	Smooth	Subglobose
K3	Dark green (143A)	No	Linear	Flat	Parallel	Acuminate	Maroon (59A)	Smooth	Subglobose
T1	Dark green (143A)	No	Linear	Flat	Parallel	Acuminate	Pink (52B)	Smooth	Subglobose
T2	Light green (143B)	No	Linear	Flat	Parallel	Acuminate	Pink (52B)	Smooth	Subglobose
T3	Light green (143B)	No	Linear	Flat	Parallel	Acuminate	Pink (52B)	Smooth	Subglobose
T4	Light green (143B)	No	Linear	Flat	Parallel	Acuminate	Pink (52B)	Smooth	Subglobose
M1	Light green (143B)	No	Linear	Flat	Parallel	Acuminate	Merah (N45A)	Smooth	Subglobose
M2	Dark green (143A)	No	Linear	Flat	Parallel	Acuminate	Merah (N45A)	Smooth	Subglobose
M3	Dark green (143A)	No	Linear	Flat	Parallel	Acuminate	Merah (N45A)	Smooth	Subglobose

Principal Component Analysis and Cluster Analysis

In this study, Principal Component Analysis (PCA) and Cluster Analysis were utilized to discern the morphological diversity within Dayak onion (*Eleutherine palmifolia* (L.) Merr) accessions. The PCA was particularly focused on identifying distinct morphological characters that contribute to the diversity among the

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accessions. The determination of the main components denoted as main components (MC) was based on their eigenvalues. Components with eigenvalues less than 1 were excluded from the analysis. Through this approach, four main components were identified among the 15 Dayak onion accessions, each with an eigenvalue greater than 1, cumulatively accounting for 1% of the total diversity observed.

Table 3. Diversity of local dayak onions

Quantitative Character	Shannon Index H'	Qualitative Character	Shannon Index H'
Plant Height	2,7	Leaf Color	0,26
Number of Leaves	0,1	Presence of Leaf Hair	0,00
Root Length	1,3	Leaf Shape	0,00
Bulb Length	0,3	Leaf Edge Shape	0,00
Bulb Diameter	0,6	Leaf Bone	0,00
Fresh Weigh	1,7	Leaf Tip Shape	0,00
		Bulb Color	1,44
		Bulb Surface	0,00
		Bulb Shape	0,00

Further exploration using PCA on 15 qualitative and quantitative traits of these accessions revealed five components with eigenvalues exceeding 1. These collectively accounted for a substantial 99,89% of the cumulative diversity. The first main component (MC1) was particularly dominant, exhibiting an eigenvalue of 120,71 and contributing to 95,33% of the diversity. This component was influenced by various traits such as leaf color, hairiness, shape, edge shape, and several Bulb characteristics including color, surface, and dimensions. Subsequent components, MC2 to KU5, contributed to the remaining diversity, with MC2 adding 97,94%, MC3 99,04%, MC4 99,68%, and MC5 99,89%.

In addition to PCA, kinship analysis utilizing phylogenetic methods was employed for a deeper understanding of the relationships between the species. Phylogenetic analysis of plants is important information for the application of hybridization practices (Retnaningati, 2017).

Family relationship analysis aims to group (cluster) plant populations based on the same characters or characteristics to determine distant or close relationships. The similarity coefficient value can indicate how closely related a population is (Azizah et al., 2019). The primary goal of this kinship analysis was to cluster the Dayak onion plants among the different accessions based on their morphological similarities.

The dendrogram of the Dayak onion population, determined by the similarity coefficient values, indicated the degree of kinship among the accessions. Higher similarity coefficients suggested closer relationships, which in turn implied lower genetic distances between the Dayak onion plants of different accessions. This aspect of morphological variation due to environmental factors was also noted by Suryani & Owbel (2019) and was corroborated by Prasetyo et al. (2023), who observed similarities in pineapples grown in various locations. The dendrogram in **Figure 2**, which resulted from this cluster analysis, illustrated groups of Dayak onions that were similar across different locations, highlighting the environmental influence on morphological traits.

Table 4. Principal component analysis of local dayak onions

Component	Eigenvalue	Variance (%)	Cumulatif (%)
MC1	120.71	95.33	95.33
MC2	3.30	3.61	97.94
MC3	1.40	1.10	99.04
MC4	0.80	0.63	99.68
MC5	0.27	0.21	99.89

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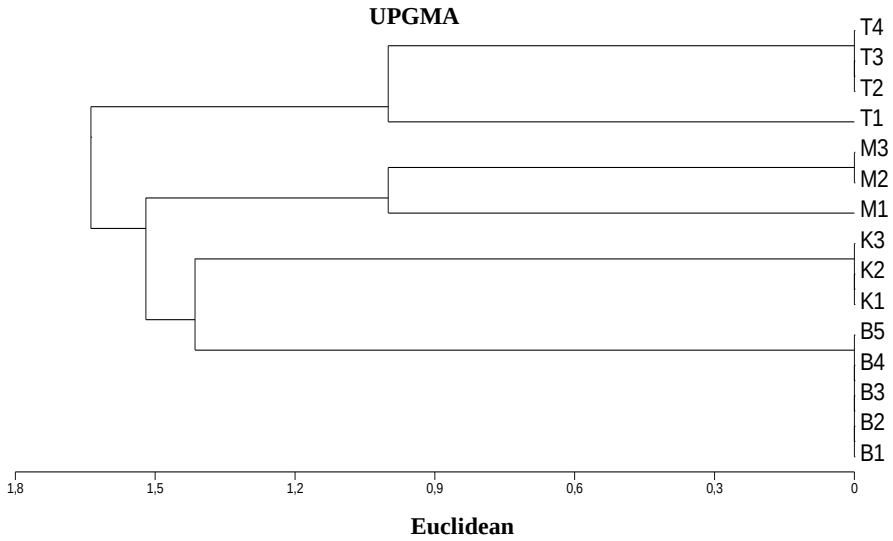

Figure 2. Dendrogram of 15 dayak onion accessions

CONCLUSION

The study's findings reveal a diverse distribution of local Dayak onions across several regions: Tana Tidung Regency with three locations, Bulungan Regency with five, Malinau Regency with three, and Tarakan City with four. A significant kinship relationship among the Dayak onion accessions was observed, particularly within groups B1, B2, B3, B4, and B5; K1, K2, and K3; M2 and M3; as well as T2, T3, and T4, all showing a 100% similarity coefficient. Notably, a high degree of genetic similarity (90% similarity coefficient) was also evident between accessions T2, T3, and T4 with T1, and between M2 and M3 with M1. The lowest observed similarity coefficient, at 83%, was between the groups B1, B2, B3, B4, and B5 and the group T1, T2, T3, and T4. These findings highlight the genetic diversity and relationships among the Dayak onion populations in these regions, providing valuable insights for future agricultural and conservation efforts.

REFERENCES

Azizah, U. D. L., Yulianti, F., Adiredjo, A. L., & Sitawati. (2019). Genetic Relationship Analysis of Strawberry (Fragaria Sp) Germplasm Based on Morphology Character and Random Amplified Polymorphic DNA (RAPD). *Plantropica Journal of Agricultural Science*, *4*(1), 77–85.

Ekawati, R. (2018). Pertumbuhan, Produksi Umbi dan Kandungan Flavonoid Bawang Dayak dengan Pemberian Pupuk Daun Growth, Bulb and Flavonoid Production of Bawang Dayak with Foliar Fertilization. *Jurnal Agrosintesa*, *1*(1), 1–9.

Harlita, T. D., Oedjijono, & Asnani, A. (2018). The antibacterial activity of dayak onion (Eleutherine palmifolia (L.) merr) towards pathogenic bacteria. *Tropical Life Sciences Research*, *29*(2), 39–52. https://doi.org/10.21315/tlsr2018.29.2.4

Inácio, C. D., Lozano, E. D., Antunes, K., Báez-Lizarazo, M. R., & Eggers, L. (2022). Exploring sisyrinchium (Iridaceae) diversity in the atlantic forest biome: three new species in S. sect. Viperella. *Phytotaxa*, *541*(2), 153–164. https://doi.org/10.11646/phytotaxa.541.2.5

Linatoc, A. C., Idris, A., & Bakar, M. F. A. (2018). Influence of Light Intensity on the Photosynthesis and Phenolic Contents of Mangifera Indica. *Journal*

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v7i2.1659

of Science and Technology, *10*(4), 47–54. https://doi.org/10.30880/jst.2018.10.04.009

Munaeni, W., Widanarni, Yuhana, M., Setiawati, M., & Wahyudi, A. T. (2019). Phytochemical Analysis and Antibacterial Activities of Eleutherine bulbosa (Mill.) Urb. Extract against Vibrio parahaemolyticus. *Asian Pacific Journal of Tropical Biomedicine*, *9*(9), 397–404. https://doi.org/10.4103/2221-1691.267669

Nasution, M. Z. (2019). Penerapan Principal Component Analysis (PCA) dalam Penentuan Faktor Dominan Yang Mempengaruhi Prestasi Belajar Siswa (Studi Kasus : SMK Raksana 2 Medan). *Jurnal Teknologi Informasi*, *3*(1), 41–48.

Nikirahayu, M., Syafi;i, M., Agustini, R. Y., & Soedomo, P. (2021). Keragaan karakter morfologi bawang merah (Allium ascalonicum L.) varietas katumi dan violetta 3 agrihorti di lembang. *Jurnal Agrotek Indonesia*, *2*(6), 55–61. https://doi.org/10.33661/jai.v6i2.5239

Prasetya, I. W. S. W. (2023). *Potensi Kandungan Fitokimia Bawang Dayak (Eleutherine palmifolia (L.) Merr) sebagai Sumber Antioksidan* (Vol. 2).

Prasetyo, H. I., Wijana, G., & Darmawati, I. A. P. (2023). Inventarisasi dan karakterisasi morfologi dan agronomi tanaman nanas (Ananas comosus (L.) Merr) pada beberapa sentra produksi di pulau jawa, indonesia. *Agro Bali : Agricultural Journal*, *6*(2), 405–412. https://doi.org/10.37637/ab.v6i2.1222

Prayitno, B., Mukti, B. H., & Lagiono. (2018). Optimasi Potensi Bawang Dayak (Eleutherine Sp.) sebagai Bahan Obat Alternatif. *Jurnal Pendidikan Hayati*, *4*(3), 149–158.

Rembang, J. H. W., Rauf, A. W., & Sondakh, J. O. M. (2018). *Morphological Character of Local Irrigated Rice on Farmer Field in North Sulawesi*.

Retnaningati, D. (2017). Hubungan Filogenetik Intraspesies Cucumis melo L. berdasarkan DNA Barcode Gen matK Intraspecies Phylogenetic Relationship of Cucumis melo L. based on DNA Barcode Gen matK. *Jurnal Biota*, *2*(2), 62–67.

Ruhiyat, Ardana, N. K. K., Amany, N., Irawan, T. K., Raymond, R., Karunia, R., & Fauzia, S. (2023). Perbandingan Metode KNN, Naive Bayes, dan Regresi Logistik Binomial dalam Pengklasifikasian Status Ekonomi Negara. *Jambura Journal of Mathematics*, *5*(2), 404–418. https://doi.org/10.34312/jjom.v5i2.21103

Saputri, S. R., Prang, J. D., & Nainggolan, N. (2023). Level of Similarity in Districts Based on Socio-Economic Indicators Using Principal Component Analysis in North Minahasa Regency, North Sulawesi Province. *Jurnal LPPM Bidang Sains Dan Teknologi*, *8*(1), 1–8.

Setyawan, A. B., & Burhanto. (2019). *Efektifitas Teh Bawang Dayak untuk Menurunkan Tekanan Darah pada Pasien Hipertensi*.

Setyowati, M., Irawan, J., & Marlina, L. (2018). Karakter Agronomi Beberapa Padi Lokal Aceh. *Jurnal Agrotek Lestari*, *5*(1), 36–50.

Simangunsong, A. D., Respatijarti, & Damanhuri. (2017). Eksplorasi dan karakterisasi pisang mas (Musa spp) di kabupaten nganjuk, mojokerto, lumajang, dan kediri. *Jurnal Produksi Tanaman*, *5*(3), 363–367.

Sirhi, S., Astuti, S., & Esti, F. R. (2017). Iptek Bagi Budidaya dan Ekstrak Bawang Dayak Sebagai Obat Alternatif. *Jurnal Akses Pengabdian Indonesia*, *2*(2), 1–7.

Suryani, R., & Owbel. (2019). Pentingnya eksplorasi dan karakterisasi tanaman pisang sehingga sumber daya genetik tetap terjaga. *Agro Bali (Agricultural Journal)*, *2*(2), 64–76.

Wijayanti, S. d, & Hasyati, N. (2018). Potensi Ekstrak Umbi Bawang Dayak

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https://doi.org/10.37637/ab.v7i2.1659

(Eleutherine palmifolia (L.) Merr) dalam Mencegah Ulcerative Colitis pada Mencit yang di Induksi DSS (Dextran Sulphate Sodium). *Jurnal Ilmu Pangan Dan Hasil Pertanian*, *2*(1), 40–52.

Yuswi, N. C. R. (2017). Antioxidant Extraction of Bawang Dayak (Eleutherine Palmifolia) with Ultrasonic Bath (Study type of solvent and Extraction Time). *Jurnal Pangan Dan Agroindustri*, *5*(1), 71–79.