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Exploration of Citrus Germplasm in Mount Leuser National Park Region

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Abstract

Citrus holds significant economic value and nutritional benefits in Indonesia, with varieties like lemon, mandarin orange, and grapefruit being extensively grown for consumption and industrial purposes. The diversity of citrus germplasm plays a crucial role in developing superior varieties that can withstand diseases and environmental changes. This study aimed to assess the diversity of citrus plant germplasm in Gunung Leuser National Park (TNGL), North Sumatra, known for its rich biodiversity. The research involved administrative preparations, field surveys to collect citrus samples from various locations in TNGL, morphological and genetic analysis, and the development of improved varieties through plant breeding. The observations revealed that citrus in TNGL belongs to the Rutaceae family, characterized by compound leaves, thorny stems, strong taproots, and fruits resembling Citrus sinensis. These traits indicate adaptation to local conditions and potential for enhancing citrus varieties' adaptability and productivity. This research is anticipated to support the sustainable management of citrus germplasm and will be published in a reputable national journal.

Keywords: Biodiversity, Endemic, Local, TNGL, Variety

1. Introduction

Citrus holds significant economic value and is rich in nutritional content in Indonesia. Varieties such as orange, lemon, mandarin, and grapefruit are extensively grown across the country for both consumption and industrial purposes (Rai et al., 2020). Due to its high genetic diversity, citrus germplasm is crucial for developing superior and disease-resistant varieties (Darusman et al., 2020). However, there is a need to explore further citrus germplasm, particularly in TNGL, a biodiverse forest area (Purnomo & Hendrajaya, 2021). Each citrus variety exhibits varying levels of resistance and suitability to different types of land (Nazari & Karyadi, 2024).

Indonesia boasts a diverse range of citrus germplasm distributed throughout the country, showcasing abundant genetic and morphological variations (Kandowangko & Febriyanti, 2023). Developing local plants is essential for breeding, environmental conservation, and enhancing plant species diversity for food security purposes (Solikin, 2012). Local plants generally exhibit better resistance to environmental conditions (Avianto & Susila, 2024). The diversity of citrus germplasm is crucial in sustaining citrus production and breeding varieties that can withstand climate change and pest pressures (Sari et al ., 2020).

Gunung Leuser National Park (TNGL) in North Sumatra, Indonesia, is a biodiverse forest covering approximately 7,927 square kilometers, making it one of the largest tropical rainforests globally. The park is home to a wide range of flora and fauna, including elephants, Sumatran tigers, orangutans, and hornbills (Laurance, 2018). Research conducted in Gunung Leuser National Park has identified 54 species of edible wild fruits, 47 plant species with various uses in the ecotourism zone, and 158 medicinal plant species utilized by traditional healers in nearby communities (Febrianti et al., 2022). Given this rich biodiversity, the careful and sustainable preservation of citrus germplasm in TNGL is crucial. Therefore, comprehensive research on citrus germplasm exploration in this area is imperative.

2. Material and Methods

The research employs a methodological framework that integrates a more holistic and sustainable approach. Figure 1 presents a subsequent refinement of the aforementioned method.

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The preparation of administration, materials, and tools entails a series of critical steps, including the formulation of SMAKSI (see Attachment 1), the acquisition of materials and tools, budgetary preparation, logistics arrangement, selection of the research team, training and coordination, administrative documents, and communication arrangement. These steps are instrumental in ensuring the seamless and effective execution of the research.

A systematic approach is employed in executing field surveys and observations at multiple locations within Gunung Leuser National Park (TNGL) (see Figure 2). This methodology aims to procure citrus germplasm samples that are representative of the intended study population. Implementing survey techniques that have been proven to be effective, in conjunction with the utilization of appropriate equipment, is instrumental in ensuring the optimization of data collection processes.

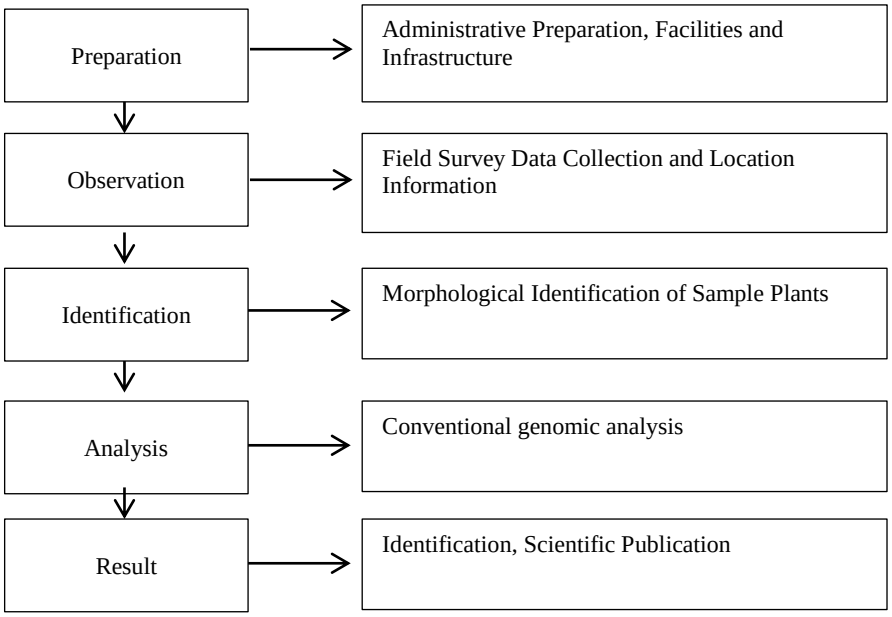

Figure 1. Research flow diagram

Figure 2. Research Location Map (Ketambe Research Center)

A comprehensive analysis of the collected citrus germplasm is imperative to ascertain its characteristics, encompassing plant morphology and environmental adaptation in TNGL. This analysis entails direct observation and measurement in the field, complemented by subsequent laboratory analysis at the Gunung Leuser University, Aceh. Conventional genetic analysis aims to enhance the comprehension of the genetic diversity present within citrus germplasm. Obtaining identification of underutilized citrus varieties and plasma nutfah in the National Genebank of Indonesia (TNGL) for evaluation of their potential based on the criteria outlined in the Plant Descriptor guide (Tjitrosoepomo, 2009). In order to support the management of citrus germplasm in TNGL, it is imperative to publish research findings in reputable scientific journals and distribute pertinent information to key stakeholders, including farmers, researchers, and local government entities.

3. Results and Discussion

3.1. Leaf Morphology

The typical shapes of orange leaves consist of circular,

elliptical, and elongated forms. Orange leaves J.TNGL-01 and J.TNGL-02 have been categorized as compound leaves with a single leaflet.

Based on observations made in the field, it can be determined that the leaves exhibit an oval-elongated, elliptical shape characterized by a blunt base and a pointed tip reminiscent of a spear. The foliage transforms coloration as it matures, progressing from a pale yellowish-green hue in its early stages to a vibrant green in its prime and ultimately to a deep, dark green in its advanced state. The leaves are characterized by their slim wings and prominent serrated margins. The upper leaf surface exhibits a smooth and lustrous appearance, whereas the underside texture is rough. The leaves range from 30 cm to 6 cm, with a predominant length of approximately 22 cm. Similarly, the width of the leaves spans from 7.5 cm to 2 cm, with a prevailing width of approximately 6 cm. The measurement of the leaf stalk ranges from 0.5 cm to 1 cm in length, as illustrated in figure 3. On the other hand, the presence of an alternating vein pattern results in an asymmetrical arrangement of branches, impacting the dispersal of nutrients and the ability of leaves to adapt to specific environments (Jian-peng et al ., 2019).

Figure 3. J.TNGL Orange Leaves

The leaf surfaces of all five species exhibit uniform characteristics, precisely a smooth and shiny texture. The thickness of the leaves suggests that the cuticle development on the leaf's surface is of high quality, as Li et al. (2021) stated.

These leaves demonstrate resemblances to those of the kaffir lime, indicating that the petioles on the lime are underdeveloped, while on the kaffir lime, they are well-developed, resulting in the appearance of grooves on the leaves (Sato & Tanaka, 2018).

3.2. Stem Morphology

Based on Figure 4, it can be observed that there is a diverse range of colors present in the stems and branches, including shades of brown, greenish-brown, brownish-green, and green. The stem exhibits an irregular and undulating shape, while the branches are cylindrical and sparsely distributed. The vertical dimension of this plant varies between 14 meters and 18 meters. The branches are considered adventitious, displaying water shoots, and are plagiotropic in nature, characterized by fan-shaped branches. The bark measures approximately 0.2 cm in thickness, whereas the branches and twigs range from 0.1 cm to 0.15 cm in thickness. Thorns on the stem and water shoots measure between 5 cm and 8 cm, whereas thorns on the twigs vary from 1.5 cm to 5 cm in length. There is variation in color among the branches, with some appearing brownish-black and others displaying a greenish-white hue (Mazzini & Poi, 2010; Catalano et al ., 2020).

Figure 4. Stem and Thorns of J.TNGL Orange

The surface tends to exhibit a rough texture in the older region of the skin, whereas in the younger region, it has a smooth texture. Thorns on its branches characterize this particular citrus plant. According to Cooper and Owen-Smith (1986), thorns serve as a deterrent against herbivores by impeding their feeding rate and decreasing the extent of damage caused. Large and elongated thorns are present on the main stems and water shoots, while smaller thorns are found on the lateral fan branches.

The apical meristem of the water shoot is situated at the tip and is surrounded by leaf nodes. At the pinnacle, branch buds exist. The shoot cells will increase in size as they are located further away from the tip of the stem. Environmental factors, including the presence of water and nutrient concentrations, also influence the growth trajectory

of these shoots (Fichtner et al ., 2021).

3.3. Root Morphology

The root characteristics of oranges (see Figure 5) include a tap root system, also known as a single root system, in which the primary roots grow downward and reach considerable depth. Observations conducted in the field indicate that the roots of one specific orange tree (J-TNGL 01) possess considerable strength, even in the presence of fallen conditions, allowing for continued healthy growth. Water absorption and nutrients heavily depend on single roots, particularly root hairs. Acting as the primary conduit for nutrient uptake, they play a crucial role in determining the overall well-being of plants (Duddek et al., 2023).

Figure 5. Branching of J.TNGL Orange Roots

3.4. Fruit Morphology

The orange fruits obtained from the research sites share morphological characteristics with Citrus sinensis fruit, as illustrated in Figure 6. For further information on the specific traits, please refer to the figure. A fruit is a plant's reproductive organ that typically has a spherical shape with a rounded base and apex. The hue of the fruit's skin changes, transitioning from a light green shade in its youthful stage to a darker green color in its mature state, ultimately taking on a yellowish-green tint when fully ripe. The external layer of the epidermis exhibits a smooth and robust texture. The flesh of the fruit has a yellowish-white or translucent appearance. The fruit grains are rounded to slightly oval, with the seeds possessing a large, rough, flat surface. The orange peel is characterized by its porous walls and pectin-containing glands.

The development of the classification system relies on morphological traits (Murtando et al., 2016). The environment plays a significant role in the growth and development of plants. Various environmental elements may lead to alterations in the structure or function of a plant of a similar type (Rezkianti et al., 2016). Based on the findings of Zamzamiyah and Ashari (2020), the attributes of oranges in TNGL diverge from those of commercially available oranges, though some resemblances are observed concerning specific characteristics as evidenced by previous studies.

Figure 6. J.TNGL Orange Fruit

4. Conclusion

This research demonstrates that the citrus in Gunung Leuser National Park (TNGL) contains a wide variety of genetic resources, which can be enhanced to enhance national food security and resilience to climate change. The examination of morphological and genetic traits indicates that the citrus trees in the TNGL region are classified within the Rutaceae family. They exhibit compound leaves, stems with thorns, a well-developed taproot system, and fruit resembling Citrus sinensis. The adaptation process seems to be affected by environmental conditions specific to a particular locality.

Distinguished from other citrus species, this unique specimen suggests the potential for developing more resilient and superior germplasm varieties. This research highlights the significance of preserving and controlling the citrus germplasm in TNGL as a valuable genetic asset. In the forthcoming time, it is anticipated that the findings of this research will provide valuable support for making informed decisions in the management of germplasm and

will contribute to conservation endeavors and the sustainable utilization of citrus germplasm in Indonesia.

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References

Avianto, Y., & Susila, W. A. (2024). Application techniques of photosynthesis bacteria and its effect on the growth and yield of local Bantul shallot variety (*Allium cepa var. aggregatum* cv. Crok Kuning). *Jurnal Agronomi Tanaman Tropika, 6*(2), 185–198. https://doi.org/10.36378/juatika.v6i2.3577

Elliott, S., & Brimacombe, J. (1987). The medicinal plants of Gunung Leuser National Park, Indonesia. *Journal of Ethnopharmacology, 19*(3), 285–317. https://doi.org/10.1016/0378-8741(87)90006-7

Catalano, C., Ciacciulli, A., Salonia, F., Russo, M. P., Caruso, P., Caruso, M., Russo, G., Distefano, G., & Licciardello, C. (2020). Target-genes reveal species and genotypic specificity of anthocyanin pigmentation in citrus and related genera. *Genes, 11*(7), 807. https://doi.org/10.3390/genes11070807

Cooper, S. M., & Owen-Smith, N. (1986). Effects of plant spinescence on large mammalian herbivores. *Oecologia, 68*(3), 446–455. https://doi.org/10.1007/BF01036753

Darusman, L. K., Sari, D. R., & Siregar, U. J. (2020). Eksplorasi plasma nutfah jeruk di kawasan hutan produksi dan hutan lindung Provinsi Aceh. *Jurnal Penelitian Sains & Teknologi Lingkungan, 8*(2), 135–146.

Duddek, P., Ahmed, M. A., Javaux, M., Vanderborght, J., Lovric, G., King, A., & Carminati, A. (2023). The effect of root hairs on root water uptake is determined by root-soil contact and root hair shrinkage. *New Phytologist*. https://doi.org/10.1111/nph.19144

Febrianti, D., Harisandy, M., & Suwardi, A. (2022). The diversity of plant species in the ecotourism zone of Gunung Leuser National Park, Tangkahan, Indonesia. *Jurnal Biologi Tropis.* https://doi.org/10.29303/jbt.v22i2.3367

Fichtner, F., Barbier, F., Stephanie, C., Kerr, C., Dudley, P., Cubas, P., Colin, G., Turnbull, N., Philip, B., Brewer, P., & Beveridge, A. C. (2021). Different plasticity of bud outgrowth at cauline and rosette nodes in *Arabidopsis thaliana*. *bioRxiv*. https://doi.org/10.1101/2021.09.26.461886

Jian-peng, D., Hang, L., Xiao-Ling, P., Chao-Ni, Z., Tian-Huai, Y., & Xian-Min, J. (2019). Research progress of quantum memory. *Acta Physica Sinica.* https://doi.org/10.7498/APS.68.20190039

Kandowangko, N. Y., & Febriyanti, F. (2023). Genetic diversity of the genus Citrus in Tomini Bay coastal areas, Indonesia based on morphological characters. *Biodiversitas, 24*(5). https://doi.org/10.13057/biodiv/d240549

Laurance, W. (2018). Taman Nasional Gunung Leuser di Sumatera menghadapi ancaman serius. *Mongabay-Indonesia.*

Li, X., Chen, Y., Zhao, L., Wang, Q., & Liu, H. (2021). Structural characteristics of leaf cuticles across different citrus species. *Journal of Plant Biology, 64*(3), 275–285.

Mazzini, R. B., & Pio, R. M. (2010). Morphological characterization of six citrus varieties with ornamental potential. *Revista Brasileira De Fruticultura, 32*(2), 463–470. https://doi.org/10.1590/S0100-29452010005000043

Murtando, H., Sahiri, N., & Madauna, I. (2016). Identifikasi karakter morfologi dan anatomi tanaman jeruk lokal (*Citrus sp.*) di Desa Karya Agung dan Karya Abadi Kecamatan Taopa Kabupaten Parigi Moutong. *Jurnal Agrotekbis, 4*(6), 642–649.

Nazari, A. A., & Karyadi, B. (2024). Morphological characterization and conservation of Nagami Citrus (*Citrus japonica*) as an antioxidant and nutrient source. *Jurnal Agronomi Tanaman Tropika.* https://doi.org/10.36378/juatika.v6i2.3472

Purnomo, H., & Hendrajaya, H. (2021). Keanekaragaman plasma nutfah jeruk di Indonesia. *Jurnal Hortikultura Indonesia, 12*(2), 156–163. https://doi.org/10.29244/jhi.12.2.156-163

Rai, M. R., Chawla, R., & Mirza, A. (2020). Study on different extraction methods and antimicrobial potential of citrus peel and leaf. *International Journal of Current Microbiology and Applied Sciences, 9*(11), 246–254. https://doi.org/10.20546/IJCMAS.2020.911.029

Rezkianti, V., Maemunah, & Lakani, I. (2016). Identifikasi morfologi dan anatomi jeruk lokal (*Citrus sp.*) di Desa Hangira dan Desa Baleura Kecamatan Lore Tengah Kabupaten Poso. *Jurnal Agrotekbis, 4*(6), 412–418.

Sari, R. K., Nurfauzi, I., & Muhtadi, A. (2020). Keanekaragaman plasma nutfah jeruk (*Citrus spp.*) pada kebun percobaan Balai Penelitian Tanaman Jeruk dan Buah Subtropika Pasuruan. *Jurnal Hortikultura Indonesia, 11*(3), 219–227.

Sato, M., & Tanaka, K. (2018). Comparative analysis of petiole development in lime and kaffir lime leaves. *Botanical Studies, 59*(4), 312–318.

Solikin. (2012). Eksplorasi buah lokal Madura Jawa Timur. *Prosiding Seminar Nasional Perhorti Kerjasama dengan UPN "Veteran" Jatim 2012*.

Suwardi, A., Navia, Z., Harmawan, T., Syamsuardi, S., & Mukhtar, E. (2020). Wild edible fruits generate substantial income for local people of the Gunung Leuser National Park, Aceh Tamiang Region. *Ethnobotany Research and Applications, 20,* 1–13. https://doi.org/10.32859/era.20.11.1-13

Tjitrosoepomo, G. (2009). *Morfologi tumbuhan* (Cetakan ke-17, revisi). Gadjah Mada University Press.

Zamzamiyah, I., Nabila, & Ashar, S. (2020). Eksplorasi dan karakterisasi tanaman jeruk purut (*Citrus hystrix*) di Kabupaten Tulungagung. *Jurnal Agrotekbis, 8*(11), 1041–1049.