Characterizing the vegetative and fruit of local dwarf banana cavendish from SE Sulawesi

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Abstract. The amount of demand for banana commodities has increased in line with the increase of population as well as mineral and nutritional needs. However, banana production capacity is still low. Generally, banana plants grow well in areas with high light intensity. Banana cultivation as interplant facing problems, such as low light intensity, which affects the growth and production of banana plants. One effort to increase banana production is through the development of banana cultivation that is tolerant of low light intensity. This study aims to compare the character of vegetative and fruit of dwarf cavendish banana originating from two different regions, namely the mainland and the island regions of Southeast Sulawesi, to get the most resistant to low light intensity. The result showed that there is no significant difference between the two. This study provides guidance for further studies on the development of banana cultivation in determining the type of banana that is most suitable for planting on low light intensity.

1. Introduction
Banan as are among the most important food crops not only in Indonesia but also worldwide [1-3]. Banana is a major food staple in the tropics [4]. There any many type of banana such as dessert, cooking and roasting bananas [5-7]. Banana is source of calorie and mineral, as well as most of the vitamins essential for human nutrition [8-9]. Bananas are rich in carbohydrate, vitamins [10-14], and mineral such as potassium, magnesium, phosphorus, iron and calcium [15-16].

Indonesia is the sixth top banana producer [17] among the top 20 banana producing countries in the world. Indonesia produces nearly 5.36 million tons of bananas annually [18]. The demanding banana in Indonesia increase every year is in line with the economic and population growth. Banana production in Indonesia faces major challenges, mainly cause the limitation and availability of land to cultivate banana. Banana is generally grown in open areas because it wants full light intensity. Planting banana under the stand either in the form of plantation crops (such as cocoa) and forestry (such as teak) is inhibited due to not getting enough light. The development banana as an intercrop plant is very interesting. Planting banana as interplant will face the problem with lower light intensity and influence on lower growth and production. One of the efforts to increase banana production is through the development of dwarf banana Cavendish that tolerant to low light intensity. The aim of the research is to selection and characterization of a dwarf banana plant under low light intensity.
2. Materials and Method
This research was conducted in Southeast (SE) Sulawesi Province. The source of germplasm of dwarf cavendish banana comes from two regions, namely the mainland region of Southeast Sulawesi which includes Konawe, Konawe Selatan, Bombana and Kendari, as well as the island region of Southeast Sulawesi which includes Buton, Muna, Wakatobi.

This study consisted of two phases of activity including (1) collection of dwarf banana germplasm from Southeast Sulawesi, and (2) Characterization of vegetative growth and identification of fruit types. Characterization based on banana descriptors issued by the International Plant Genetic Resources Institute (IPGRI).

3. Results and Discussion

3.1. Characterization of vegetative growth
Based on the results of characterization of cavendish dwarf germplasm from the mainland and island region of Southeast Sulawesi, it is known that cavendish dwarf bananas from both regions have relatively uniform morphological characteristics, both vegetative and generative. Based on the characterization guidelines published by IPGRI, the results of the vegetative characterization of the cavendish dwarf germplasm are shown in Table 1.

Based on the nine main vegetative characters, Cavendish dwarf bananas from various regions in Southeast Sulawesi have a high kinship with > 80% kinship coefficient and are in one group, except for germplasm derived from the Southeast Sulawesi Peninsula (Figure 1).

3.2. Fruit character
Based on ten characters of cavendish dwarf bananas, it appears that cavendish dwarf bananas from various regions in Southeast Sulawesi have a high kinship with > 95% kinship coefficient and are in one group, except for germplasm of cavendish dwarf bananas originating from Buton Regency. A typical characteristic of germplasm of cavendish dwarf bananas originating from Southeast Sulawesi is the character of the number of combs per bunch and fruit texture when immature. The kinship relationship between cavendish dwarf bananas in Southeast Sulawesi is shown in Figures 2 and 3.

![Figure 1. Grouping of dwarf banana cavendish based on the vegetative character](image-url)
Table 1. Description of cavendish dwarf banana from SE Sulawesi

| No | Morphological Character                  | Score | Remarks                  |
|----|----------------------------------------|-------|--------------------------|
|    |                                        | Mainland region | Island region | Shade tolerant |                     |
| A. | Vegetative character                   |       |                         |               |                     |
| 1  | Pseudostem height                      | 3     | 3                       | 3             | ≤ 2 m                |
| 2  | Pseudostem aspect                      | 5     | 5                       | 5             | Normal;              |
| 3  | Blotches at the petiole base           | 4     | 3                       | 3             | Small blotches;      |
| 4  | Pigmentation of the underlying pseudostem | 3     | 3                       | 3             | Little;              |
| 5  | Wax on leaf sheaths                    | 3     | 3                       | 3             | little               |
| 6  | Petiole canal leaf I                   | 2     | 1                       | 1             | Margins curved inward (2.7 – 2.9); |
| 7  | Appearance of leaf lower surface       | 3     | 3                       | 3             | Medium                |
| 8  | Edge of petiole margin                 | 1     | 1                       | 1             | Winged and undulating |
| 9  | Shape of leaf blade base               | 1     | 2                       | 2             | Wide with erect margins |
| B. | Fruit character                        |       |                         |               |                     |
| 1  | Number of fruits comb                  | 3     | 3                       | 3             | Little (6–7 comb)    |
| 2  | Immature fruit peel color              | 1     | 1                       | 1             | Green                |
| 3  | Mature fruit peel color                | 2     | 2                       | 2             | Green to yellow      |
| 4  | Cracks in fruit peel                   | +     | 0                       | 0             | Without crack        |
| 5  | Fruit shape (longitudinal curvature)   | 3     | 5                       | 5             | Medium (4-5)         |
| 6  | Transverse section of fruit            | 1     | 1                       | 1             | Slightly ridged      |
| 7  | Remains of flower relicts at fruit apex| 2     | 1                       | 1             | Persistent style     |
| 8  | Pulp color before maturity             | 2     | 1                       | 1             | Milky                |
| 9  | Pulp color at maturity                 | 1     | 1                       | 1             | Sweet                |
Figure 2. Grouping of dwarf banana cavendish based on the fruit character

Figure 3. The different of fruit character of dwarf banana cavendish from Southeast Sulawesi

4. Conclusions
From the study, it could be concluded that based on the vegetative and fruit character, there is no significant difference between dwarf cavendish banana from mainland and island region of Southeast Sulawesi.

References
[1] Samson J A 1992 Tropical fruits 2nd ed (London: Longmans London Tropical Agriculture series)
[2] Nelson S C, Ploetz R C and Kepler A K 2006 Musa species (banana and plantain) (Hawaii, Species Profiles for Pacific Island Agroforestry Permanent Agricultural Resources Holualoa Hawai CR Elevitch)
[3] Aurore G, Parfait B and Fahrasmane L 2009 Bananas raw materials for making processed food products Trends Food Sci Technol 20 pp 78-91
[4] Hölscher D, Dhakshinamoorthy S, Alexandrov T, Becker M, Bretschneider T, Buerkert A, Crecelius A C, Waele D D, Elsen A, Heckel D G et al 2014 Phenalenone-type phytoalexins mediate resistance of banana plants (Musa spp.) to the burrowing nematode Radopholus similis PNAS 111 1 pp 105-10

[5] Swennen R and Vuylsteke D 1987 Morphological taxonomy of plantain (Musa cultivars AAB) in West Africa International Workshop Held on Banana and Plantain Breeding Strategies at Cairns Australia in Australian Centre for International Agricultural Research Proceedings 21 pp 165-71

[6] Sagi L, May G D, Remy S and Swennen R 1998 Recent Development in biotechnological research on banana (Musa spp) Biotechnol Genet Eng 15 p 327

[7] Valmayor R V, Jamaluddin S H, Silayoi B, Kusumo S, Danh L D, Pascua O C and Espino R R C 2000 Banana Cultivar Names and Synonyms in Southeast Asia International Network for the Improvement of Banana and Plantain in Asia and the Pacific Office Laguna Philippines

[8] Muhidin, Leomo S and Rakian T C 2015 Pisang Kate : Sumber pangan dan energi yang terabaikan [Kate’s Banana: Neglected source of food and energy] (Kendari: Kendari Unhalu Press.)

[9] Muhidin, Sadimananta G R, Leomo S, Rakian T C, Arma M J and Suliantini N W S 2016 The response of dwarf banana cavendish growth and production under natural shade International Journal of ChemTech Research 9 12 pp 541-48

[10] Englberger L 2012 Revisiting the vitamin A fiasco: going local in Micronesia Proc. on Biodiversity and sustainable diets united against hunger in Sustainable diets and biodiversity: Directions and solutions for policy, research and action pp 126-33

[11] Ekesa B N, Kimiywe J, Davey M, Dhuique-Mayer C, Bergh I and Blomme G 2013 Contribution of bananas and plantains to the diet and nutrition of Musa-dependent households with preschoolers within Beni and Bukavu territories; Eastern Democratic Republic of Congo Kenyatta University Institutional Repository 24 pp 202-09

[12] Ekesa B N, Miroir C, Blomme G, Bergh I and Davey M W 2013 Retention of provitamin A carotenoids during post-harvest ripening and processing of three popular Musa cultivars in South-Western Uganda Acta Hortic 986 pp 319-30

[13] Ekesa B N, Kimiywe J, Bergh I, Blomme G, Dhuique-Mayer C and Davey M 2013 Content and retention of provitamin A carotenoids following ripening and local processing of four popular Musa cultivars from Eastern Democratic Republic of Congo Sustainable Agriculture Research 2 2 pp 60–75

[14] Kumar G V, Kumar K A, Patel G R R and Manjappa S 2013 Determination of Vitamin C in Some Fruits and Vegetables in Davanagere City (India: Karanataka India Int.)

[15] Wall M M 2006 Ascorbic acid, vitamin A, and mineral composition of banana (Musa sp.) and papaya (Carica papaya) cultivars grown J Food Compos Anal 19 pp 434–45

[16] Eleazu C O and Nwosu P 2015 Nutrient and heavy metal composition of plantain (Musa paradisiaca) and banana (Musa paradisiaca) pels J Nutr Food Sci 5 3 pp 1-3

[17] Yusnita, Daniel E and Hapsoro D 2015 In vitro shoot regeneration of Indonesian banana (Musa spp) cv ambon kuning and raja bulu, planlet acclimatization and field performance Agrivita 37 pp 51-8

[18] FAOSTAT 2014 Food and Agricultural commodities production/Countries (Rome, Italy Commodity Food And Agriculture Organization Of The United Nations Statistics Division)

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