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Inheritance of morphological characters on Melon (*Cucumis melo* L. 'Gama Melon Parfum')

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ABSTRACT. Gama Melon Parfum (GMP) is the result of a cross between ♀ Natsuno Omoide (NO_3) originating from Turkmenistan and ♂ Miyamauri (MR_5) originating from Japan. This study aims to determine the inheritance of quantitative and qualitative phenotypic characters of 'GMP' melons cultivated in Bandung and Yogyakarta. Qualitative characteristic in melon plants observed included fruit shape, mature skin color, presence of turbines, fruit aroma, net scoring, fruit flesh texture, taste, seed color, flesh color, and skin surface color pattern. Meanwhile, the quantitative phenotypic characters observed included fruit weight, number of fruits/plants, and harvest time. The phenotypic characters obtained were compared with the results of previous studies related to 'GMP' melon brooders. 'GMP' melon brooders has qualitative phenotypic characters round in shape, mature skin color was brownish orange, had turbines, had a very fragrant aroma, had no net scoring, the fruit texture was crunchy, had a bitter taste, the color of the seeds and flesh was white, and the skin surface color pattern was longitudinal like batik. The results revealed that the 'GMP' melon brooders qualitative phenotypic characters was similar to that of the 'GMP' melons cultivated in Yogyakarta and cultivated in Bandung, except for the mature skin color of the 'GMP' melons cultivated in Bandung. Melon 'GMP' cultivated in Bandung has mature skin color orange. The qualitative phenotype demonstrated by the character of 'GMP' melons cultivated in Yogyakarta and cultivated in Bandung allows 'GMP' melons to be cultivated in a variety of conditions. The quantitative phenotypic characters showed different results between 'GMP' melons cultivated in Bandung and Yogyakarta a 'GMP' melons brooders on fruit weight, number of fruits/plants, and harvest period.

Keywords: 'GMP' melon brooders; 'GMP' melons Bandung; 'GMP' melons Yogyakarta; phenotypic characters; qualitative parameters

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INTRODUCTION

Melon is a high-value horticultural crop that is also a good source of vitamins and minerals for better nutrition (Sunadra *et al.*, 2019; Chotimah *et al.*, 2020). Domestic demand for melons tend to rise year by year in tandem with population growth (Widaryawanto *et al.*, 2017; Yekti *et al.*, 2017). Melon production reached 118,708 tons in 2018, 122,105 tons in 2019, and 138,177 tons in 2020 but this amount can only meet about 40% of national needs, requiring imports to meet the remaining needs (Central Bureau of Statistics, 2020). This demand rises in tandem with the increased consumption of melons for dietary purposes and the use of industrial raw materials like jam and flour (Apsari *et al.*, 2019; Silvianti *et al.*, 2021).

Environmental factors have a big impact on melon plant growth and yield. Melon plants will respond differently depending on altitude and climate (Angmo *et al.*, 2019; Walters *et al.*, 2021). Melon plants can typically grow at altitude of 0-2,000 m asl. However, each melon cultivar must reach a certain height in order to thrive (Setiadi & Parimin, 2001). Agronomists and plant breeders are looking for cultivars that can grow in various environments. On the other hand, every plant breeder faces a significant challenge in developing new superior varieties because of the interaction between genotype and environment (Guimaraes *et al.*, 2016). This is because plant grown in different environments will show genotypes different reactions. Several cultivars that have been planted in different locations showed different results regarding the morphological characters and chemical

processes of these plants due to the interaction between genotype and the environment (Makful *et al.*, 2017; Ewing *et al.*, 2019; Zargoosh *et al.*, 2019; Breseghello & Coelho, 2022).

Gama Melon Parfum (GMP) cultivar is a plant breeding product that has been tested in several locations, including Pangalengan, Bandung and Bokoharjo, Yogyakarta. The Pangalengan area of Bandung is 1,400 meters above sea level, while the Bokoharjo area of Yogyakarta is 150 meters above sea level. Geographical differences, particularly in altitude, will result in variations in the weather and climate of the entire region, particularly in temperature, humidity, and rainfall (Ping *et al.*, 2013; Saeed *et al.*, 2014). According to Andrian *et al.* (2014); Beusekom *et al.* (2015); Gondim *et al.* (2017) the higher a location has a the lower the temperature, the higher the humidity, and the higher the rainfall.

Previous research has found that 'GMP' has phenotypic characteristics such as small fruit size, brownish-yellow mature skin color with unique ornaments forming a longitudinal line, white flesh color, no net, bitter taste, and a very fragrant fruit aroma, suggesting that it could be used as a perfume base material. The female parent, Natsuno Omoide, is responsible for the shape, size, and ornamentation of the 'GMP' fruit peel (Maryanto *et al.*, 2014).

By comparing the brooders of 'GMP,' this study aims to determine the inheritance of the morphological character of 'GMP' tested in two different locations: Pangalengan Bandung and Bokoharjo Yogyakarta concerning the traits inherited by the 'GMP' melon parent both of melon grown in different location. This study is expected to aid in the development of 'Gama Melon Parfum' as a superior cultivar capable of growing in a variety of environments.

MATERIALS AND METHODS

Materials and tools. The material used in this study was melon (*Cucumis melo* L.) 'GMP' cultivated in Jamusan, Bokoharjo, Prambanan, Sleman D.I Yogyakarta and from PT. Nudira Swadaya Indonesia, Pangalengan, Bandung, while the tools used was plastic mulch beds, bamboo to support melon plants, ropes to tie to branches, cameras, and scales to weigh melon.

Planting and cultivation. The seeds of the GMP cultivar were germinated and planted in polybags containing planting media such as soil. After 7 days, the 'GMP' melons were planted in beds that had been shaped and given mulch and bamboo with a spacing of 50 cm. Treatments like fertilization, irrigation, weeding, and lateral branch cutting were used to optimize the growth of the 'GMP' melon plant during its development. Then, select 3-10 fruits to be raised from one melon plant.

Sampling and morphological characters observation. The 'GMP' melon was morphologically identified during its growth period and after it was harvested. The data consists of quantitative and qualitative characters. Fruit shape, mature skin color, turbine presence, fruit aroma, net scoring, fruit flesh texture, taste, seed color, flesh color, and skin surface color pattern were some of the qualitative characteristics observed. The quantitative phenotypic characters observed included fruit weight, number of fruits/plants, and harvest time. Qualitative character data is collected after harvesting, while quantitative data is collected during the plant growth. Visual observation of characters appeared, smelling aroma, and organoleptic testing utilizing all five sense of the bitter taste produced by the 'GMP' melon plant was used to conduct qualitative phenotypic characters. The quantitative phenotypic character observations were done by measuring the parameters created by Maryanto *et al*. (2014) as a reference for the stability of the comparison data.

Data analysis. Data were identified based on International Plant Genetic Resources Institute (2003) morphological characters.

RESULTS AND DISCUSSION

Table 1 shows the findings of a study on the qualitative and quantitative phenotypic characters of the melon cultivar 'Gama Melon Parfum' from Bandung and Yogyakarta.

Table 1. Qualitative and quantitative phenotypic characters of 'Gama Melon Parfum' cultivated from Bandung and Yogyakarta

Qualitative parameters	'GMP' melon brooders	Results 'GMP' melons Bandung	'GMP' melons Yogyakarta
Shape of fruit	Oblate	Oblate	Oblate
Mature skin color	Brownish orange	Orange	Brownish orange
Turbina	Have turbin	Have turbin	Have turbin
Aroma	Strong fragrant	Strong fragrant	Strong fragrant
Netted	Not netted	Not netted	Not netted
Fruit flesh texture	Crunchy	Crunchy	Crunchy
Taste	Bitter	Bitter	Bitter
Seed color	White	White	White
Flesh color	White	White	White
Skin surface color pattern	Longitudinal like batik	Longitudinal like batik	Longitudinal like batik
Quantitative parameters			
Weight	118.5 gram	85.7 gram	118.7 gram
Fruit/plant number	-	5-7 fruit/plant	2-3 fruit/plant
Harvest time	63-65 days	80-90 days	64-71 days

The morphology of the Gama Melon Parfum cultivars seen from bottom, flesh, and seed color shown in Fig. 1 and 2.

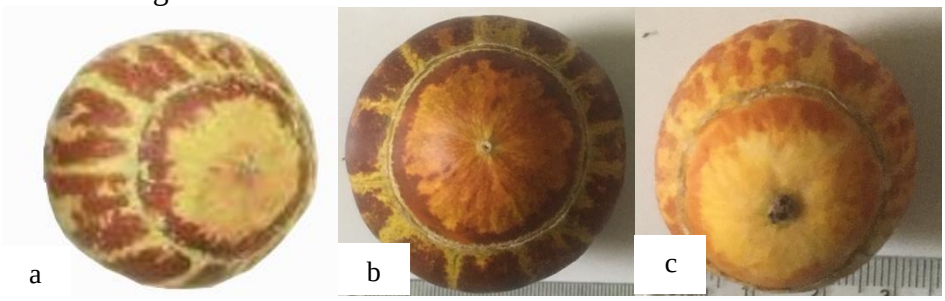

Fig. 1. Gama Melon Parfum Cultivar, see from bottom: a. Brooders; b. Cultivated in Yogyakarta; c. Cultivated in Bandung

Fig. 2. Gama Melon Parfum Cultivar, longitudinal: a. Brooders; b. Cultivated in Yogyakarta; c. Cultivated in Bandung

Table 1 shows that the mature skin color between 'GMP' melons brooders and 'GMP' melons from Bandung in terms of qualitative characters is different. Environmental influences may be the cause of these differences, but qualitative characters are not easily influenced by the environment. According to Muttaqien & Rahmawati (2019), qualitative characters are controlled by a few genes and are influenced by the environment only slightly. According to Maryanto *et al.* (2014) state that 'GMP' melons have a brownish-orange mature skin color and an oblate shape, which may be inherited from the ♀ NO_3 parent, which has an oblate shape, white flesh and seeds, crispy texture, and a longitudinal peel such as batik.

The presence of a very fragrant fruity aroma is the most prominent qualitative phenotypic characteristic of the 'GMP' melon. Hasbullah *et al*. (2019) discovered that the aroma was derived from alcohol compounds (3-penton-2-ol, 1-octanol, and Z4-dodecenol), as well as esters (acetic acid hexyl ester, hexanoic acid, ethyl ester, and hexanoic acid hexyl esters), ketones (2-butanone, 3-hydroxy), and hydrocarbons (2-indecent, 3 methyl (Z) where new aroma compounds not found in

other melon cultivars such as 3-penten2-ol, acetic acid hexyl ester, and 2-butanone, 3-hydroxy have been discovered. The bitter taste of GMP cultivars is a correlation of chemical compounds such as calcium, phenolic, and amino acids during the development phase of GMP melons (Anto, 2015).

Net scoring was not found in 'GMP' melons as in other types of melons. However, 'GMP' melons had other unique characteristics such as the presence of a turbine at the base of the fruit which was shaped like a fruit cap that varies from one-eighth to one-half of the entire fruit size. The existence of this turbine is one of its characteristics because it is usually found in *Cucurbita maxima* in the *Turks' Turban* (Maryanto *et al*., 2014; Saputri *et al.,* 2020). Based on the results of various prior research, did not explain the existence of a relationship between the presence of turbines and nets in 'GMP'. According to Maryanto *et al.* (2014), Gama Melon Parfum cultivars is classified as a winter melon species that has not netted.

In quantitative phenotypic characters, 'GMP' melon brooders with 'GMP' melons cultivated in Yogyakarta and cultivated in Bandung showed different results. The influence of planting time and difference in altitude have an impact on this. Both the 'GMP' melons brooders and the melon 'GMP' cultivated in Yogyakarta were planted in the same area, namely in the fields of Jamusan, Bokoharjo, Prambanan, Sleman D.I Yogyakarta. However, due to differences in planting time, which may be influnced by water availability and daily temperature fluctuations, it shows differences in quantitatif characters. Based on the results of the study Sutrisno & Wijanarko (2019), these two factors could have an impact on plant growth and production. Meanwhile, 'GMP' melon cultivated in bandung showed different results than 'GMP' melon brooders due to the difference in altitude. The Bandung melon was grown at an altitude of 1,400 meters above sea level, while the Yogyakarta melon and 'GMP' melons brooders were grown at an altitude of 150 meters above sea level. The genotype and the environment then interact as a result of the altitude. Polygenic will interact with a variety of environmental factors that affect plant growth, such as water, nutrients, temperature, sunlight, soil moisture, and so on (Iwo & Odor, 2018; Oliveira *et al.,* 2019).

The findings of the research fruit plants which grown in the lowlands flower earlier than fruit plants grown in the highlands, according to Affandi *et al*. (2013); Yaqoob & Nawchoo (2015); Amirah (2016); Lestari *et al.* (2016). This is since the intensity of solar radiation in the lowlands is higher than in the highlands, requiring fruit trees in the highlands to take longer to initiate reproductive development (Pan & Guo, 2016; Rezazadeh *et al*., 2018). Furthermore, due to the number of fruits/plants, there is a difference in fruit weight between the 'GMP' melons cultivated in Bandung and brooders of 'GMP' melon and 'GMP' melons cultivated in Yogyakarta. Fruit volume and weight per unit of fruit will increase with a small number of fruits/plants. This is because the photosynthate produced by the leaves is only concentrated in some fruits, thereby reducing the competition for photosynthate use between fruits (Gumelar *et al.,* 2014; Zamzami *et al.,* 2015; Habibah *et al.,* 2018). The findings of Widyastuti *et al.* (2022) also state that lowland gardens produced fruit that was significantly heavier than highland gardens. High temperatures are thought to have a positive impact on melon fruit weight. Sumarni *et al.* (2009), stated that lowlands with high temperatures are suitable for the formation of fruit and seeds in plants, based on their research findings.

The result of this study revealed that the 'GMP' melon can thrive in both the lowlands and the highlands, specifically Bokoharjo Yogyakarta and Pangalengan Bandung. This study can be used as a reference the development of GMP cultivars for highland and lowland areas.

CONCLUSION

The inheritance of qualitative phenotypic characters in 'GMP' melon brooders with 'GMP' melons cultivated in Yogyakarta and cultivated in Bandung showed no significant differences in characters, except for the mature skin color of 'GMP' melons cultivated in Bandung. This allows 'GMP' melons plants in the next generations to have an appearance similar to the previous generation because chacacter traits are influenced more by internal factors in the form of plant genetics.

Environmental influences, particularly altitude, cause differences in quantitative phenotypic characters between 'GMP' melon brooders with melon 'GMP' cultivated in Yogyakarta and cultivated in Bandung. Character differences emerge in quantitative characters because these are characters that are easily influenced by their surroundings.

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