Phenotypic Characters Stability of Melodi Gama-3 Melon (*Cucumis melo* L.) Cultivar in Rainy Season Based on Multilocation Test

Budi Setiadi Daryono[1], Rizko Hadi[1], Yasir Sidiq[1], and Sigit Dwi Maryanto[1]

Abstract—***The study was conducted to determine the stability of MG3 cultivar characters in rainy season based on multilocation test. Used materials were MG3 melon cultivar originating from the Laboratory of Genetics, Faculty of Biology, UGM, and Action 434, Glamour Sakata, MAI, and LADIKA melon cultivars as commercial cultivars. Multilocation test was conducted in March – July 2013 (rainy season) in 3 provinces i.e., East Java, Daerah Istimewa Yogyakarta, and Central Java. Observation of phenotypic characters was conducted at the Laboratory of Genetics, Faculty of Biology, Universitas Gadjah Mada. Qualitative phenotypic characters data of cultivar MG3 and cultivars Action 434, Glamour Sakata, MAI, and LADIKA were compared qualitatively, while the quantitative characters data were analyzed by balanced ANOVA using PKBTSTAT 2.0 software. The results showed that fruit weight, fruit girth, skin thickness, and fruit vertical and horizontal diameter (longitudinal section) has a very significant difference by looking at the interaction of cultivar x locations, while flesh thickness has no significant difference. Qualitative characters were discussed according to its uniformity in three location. It was concluded that melon can also give yield in rainy season. MG3 was unstable for fruit weight and girth, skin thickness, and fruit vertical and horizontal diameter characters, while stable for flesh thickness character. MG3 having uniformity for fruit shape, unripe and ripe skin color, netting intensity, flesh color, flesh texture, and water content characters from three cultivating location, while for netting distribution, cavity shape, flesh flavor, and flesh aroma characters, it have not uniform yet.***

Keywords—Melon cultivar, MG3, phenotypic character, stability, multilocation test.

I. Introduction

Melon is a fruit plant that native to warm areas or deserts. [1] stated that this plant originated from the Mediterranean region which is the area adjacent to West Asia, Europe, and Africa. Nevertheless, DNA sequences study showed that the melon's wild progenitor appeared in India [2]. Melon plants then spread to the Middle East, Europe, and at 14th century was introduced in America [1]. At the end of that, this plant was spread throughout the world, especially in tropical and subtropical regions. Now, a lot of hybrid melon cultivars have been produced as a result of seed technology development.

Melon is one of horticulture products with high sales value. With the total world agricultural production of melon in 2009 amounted to 31,053,716 tons, an increase of 0.3% from the previous year [3], and assuming that melon farming production continued to increase in recent years, this agricultural sector will increasingly drive world's economy with the amount of money enveloped in the circulation. In Indonesia, melon consumption per capita in 2011 was 0.42 kg, with growth of as much as 166.67% from a year earlier [4].

Despite the potency, it does not mean melon farming have no problem. Pests and diseases (virus) [5], complexity of plant care, and low quality of production are some of the problems faced by melon farmers. That is why the availability of superior melon seeds and pest resistance is expected. Nevertheless, the seeds which widely circulated are mostly imported seeds so it costs higher [6]. In addition, if this seeds are planted back, the results will not satisfy expectation such as, it does not produce fruit, or the fruit produced is not uniform in flavor and shape. These causing farmers depend on imported seeds [7]. Therefore we need local seeds at low prices that can compete with the quality of imported seeds.

Assembly of local melon seeds need to be conducted to meet the demand for high quality local seeds. Seeds can be assembled conventionally by crossing a parent who has the desired properties [8]. Genetics Laboratory of the Faculty of Biology UGM is one of few that has a high attention to assembling local melon seeds. Among the melon seeds that had been assembled and were developed by Genetics Laboratory, Faculty of Biology UGM were Melon Gama Basket, Melodi Gama-1 [9], and Melodi Gama-3 [10].

Melodi Gama-3 was the result of crossing cultivars of Melodi Gama-1 and LADIKA-3 [10]. Melodi Gama-3 (MG3) has superior characters that are tolerant to powdery mildew [11], fruit with sweet taste, fragrant aroma, thick flesh, and can be harvested in about 2 months [10]. MG3 cultivars are expected to be local seeds that can compete with imported seeds in the market. In addition to all of superior characters that had been told before, previous study had reported that MG3 has resistance with wet condition pressure [12]. This resistance is a potential superior character because commonly melon is warm area plant. Therefore, it is expected that this cultivar can be cultivated in any season with same yield.

Even so, in releasing new cultivars to market, it is necessary to have assurance that character of these cultivars have stable. This also applies to the MG3, since this cultivar is a new cultivar. Characters stability that required to be recognized especially are fruit characters. It is because of fruit is one of agricultural products which are bought and sold on the market. The stability of this character should be tested on various types of location to ensure that these characters do not change in different types of location. This study was conducted to determine

[1]Budi Setiadi Daryono, Rizko Hadi, Yasir Sidiq, and Sigit Dwi Maryanto is with Departement of Biology, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, Indonesia. E-mail: privateadi@gmail.com.

the stability of MG3 cultivar characters in rainy season based on multilocation test.

II. METHOD

A. Materials and Procedure

Materials used in this study were MG3 melon cultivar seeds originating from the Laboratory of Genetics, Faculty of Biology, UGM, and Action 434, Glamour Sakata, MAI, and LADIKA melon cultivars seeds as commercial cultivars.

The study was conducted in March – July 2013 (rainy season). Multilocation test was conducted in 3 provinces i.e., East Java, Daerah Istimewa Yogyakarta, and Central Java. Observation of melon phenotypic characters was conducted at the Laboratory of Genetics, Faculty of Biology, Universitas Gadjah Mada.

Observed phenotypic characters were divided into qualitative and quantitative character of the fruit each cultivar. Qualitative characters include fruit shape, skin color of unripe and ripe fruit, netting distribution and intensity, fruit cavity shape (longitudinal section), flesh color, fruit aromas, fruit water content, flesh flavor, and flesh texture, whereas quantitative characters include fruit weight, fruit girth, fruit horizontal and vertical diameter (longitudinal section), fruit skin and flesh thickness. Some characters were observed with reference to [13] and [14].

B. Data Analysis

Qualitative phenotypic characters data of cultivar MG3 and cultivars Action 434, Glamour Sakata, MAI, and LADIKA were compared qualitatively, while the quantitative characters data were analyzed by balanced ANOVA using PKBTSTAT 2.0 software.

III. RESULT AND DISCUSSION

Melon fruit characters were divided into quantitative and qualitative character. Quantitative characters, including fruit weight , fruit girth, flesh thickness, skin thickness, fruit vertical and horizontal diameter (longitudinal section), were analyzed by balanced ANOVA using PKBTSTAT 2.0 software. Summary of analysis results were shown in Table 1. Qualitative character, including fruit shape, skin color of unriped and riped fruit, netting distribution and intensity, fruit cavity shape (longitudinal section), flesh color, flesh aromas, fruit water content, flesh flavor, and flesh texture, were compared qualitatively as shown in Table 2.

It was shown that fruit weight, fruit girth, flesh thickness, and fruit vertical and horizontal diameter (longitudinal section) has a very significant difference by looking at cultivar (Table 1). This suggests that these characters have very different measurement between cultivar. Meanwhile, skin thickness has no significant difference by looking at cultivar (Table 1). It means that skin thickness resemble for each other cultivars.

It was shown that fruit weight, fruit girth, skin thickness, and fruit vertical and horizontal diameter (longitudinal section) has a very significant difference by looking at the interaction of cultivar x locations (Table 1). This suggests that these characters were unstable based on multilocation test. Flesh thickness has no significant difference by looking at interaction of cultivar x location (Table 1). It suggests that flesh thickness character was stable based on multilocation test.

MG3 melon cultivar was shown having uniformity for fruit shape, unripe and ripe skin color, netting intensity, flesh color, flesh texture, and water content characters from three cultivating location, while for netting distribution, cavity shape, flesh flavor, and flesh aroma characters, it have not uniform yet. MG3 have globular fruit shape (Figure 2), green unripe skin color, golden yellow ripe skin color, intense netting, orange flesh color, juicy flesh texture, and high water

content (Table 2). The superior character of MG3, i.e. sweet flesh flavor and fragrant flesh aroma as said in [10] appeared in fruit that cultivated in Sleman, D. I. Yogyakarta (Table 2). Nevertheless, it was shown that other characters which could be considered superior, i.e. globular fruit shape, golden yellow skin color, intense netting, orange flesh color, and juicy flesh texture, have achieved uniformity based on multilocation test.

The cultivars of LADIKA, MAI, Action, and Glamour were used as comparison in this study. LADIKA was shown having uniformity for unripe and ripe skin color, netting distribution and flesh color characters from three cultivating location, while having no uniformity for fruit shape, netting intensity, cavity shape, flesh flavor, texture, and aroma, and water content characters (Table 2). LADIKA have green unripe skin color, yellow ripe skin color, dense netting distribution, and orange flesh color. LADIKA, together with Melodi Gama-1, was the parent of MG3 melon cultivar [10]. Comparing character of LADIKA ripe skin color, which is yellow, with MG3 ripe skin color, which is golden yellow, gave impression that ripe skin color of MG3 was the result of interacting gene between LADIKA and Melodi Gama-1, which has green ripe skin color [9], with LADIKA as dominating side. MAI was shown having uniformity for fruit shape, unripe skin color, flesh color, and texture characters from three cultivating location, while having no uniformity for ripe skin color, netting distribution and intensity, cavity shape, flesh flavor, and water content characters. MAI have globular fruit shape, green unripe skin color, orange flesh color, and crunchy flesh texture. Action was shown having uniformity for unripe skin color and flesh aroma characters from three cultivating location, while having no uniformity for fruit shape, ripe skin color, netting intensity and distribution, cavity shape, flesh color, flesh flavor, flesh texture, and water content characters. Action have green skin color and not fragrant flesh aroma. Glamour was shown having uniformity for unripe and ripe skin color, netting distribution, flesh color, and flesh aroma characters from three cultivating location, while having no uniformity for fruit shape, netting intensity, cavity shape, flesh flavor, flesh texture, and water content characters. Glamour have green unripe and ripe skin color, very dense netting, orange flesh color, and not fragrant flesh aroma (Table 2). LADIKA and MAI are local commercial cultivars, while Action and Glamour are imported cultivars from Thailand and Japan respectively.

Characters which were observed in this study were characters that affect the value of melon in the market. The results suggest that there are two types of phenotypic characters considering factor controlling it, i.e. phenotypic characters which were controlled solely

by genes and phenotypic characters which were controlled by genes and its interaction with environment.

Commonly, melon was warm areas plant. Nevertheless, the result showed that melon can also give yield in rainy season. In MG3 case, [12] had reported it has resistance with wet condition pressure. It deserves to be discussed if other cultivar also potential to have this kind of resistance. Most of all, it is the kind of treatment that should be considered to obtain the best yield.

From the study, it seems that differences in location affect the characters. Multilocation test in this study were conducted in Magetan, East Java (60-1660 m asl), Sleman, D. I. Yogyakarta (< 200 m asl), and Kebumen, Central Java (< 200 m asl). Altitude as a factor affecting fruit phenotypic character deserves to be discussed. Adding to altitude, there were other factor that differencing all the location, i.e. temperature, sunlight intensity, and soil condition.

Nevertheless, the results showed that MG3 can be planted in different type of location while having better yield than other cultivars. The results also showed that LADIKA, MAI, Action and Glamour cultivars does not have good yield in different type of location except in Sleman, D. I. Yogyakarta (< 200 m asl). It suggests that they are not suitable to be planted in different type of location except in a location type similar with Sleman, D. I. Yogyakarta (< 200 m asl). The results also gave impression that MG3 melon cultivar was unstable for fruit weight, fruit girth, skin thickness, and fruit vertical and horizontal diameter (longitudinal section) characters, while stable for flesh thickness character, in rainy season based on multilocation test.

IV. Conclusion

Melon can also give yield in rainy season. MG3 melon cultivar was unstable for fruit weight, fruit girth, skin thickness, and fruit vertical and horizontal diameter (longitudinal section) characters, while stable for flesh thickness character, in rainy season based on multilocation test. MG3 melon cultivar was shown having uniformity for fruit shape, unripe and ripe skin color, netting intensity, flesh color, flesh texture, and water content characters from three cultivating location, while for netting distribution, cavity shape, flesh flavor, and flesh aroma characters, it have not uniform yet.

Acknowledgement

We would like to give our best gratitude to DIKTI for the grant, and to LPPM UGM and KP4 UGM for providing us assistance.

References

[1]. Tim Bina Karya Tani, Budidaya Tanaman Melon: Teknik Budidaya dan Penanganan Pasca Panen, Bandung: Yrama Widya, 2009.

[2]. P. Sebastian, et al., "Cucumber (Cucumis sativus) and Melon (C. melo) Have Numerous Wild Relatives in Asia and Australia, and The Sister Species of Melon is From Australia," PNAS Early Edition, pp. 1 – 5, 2010. Available: http://www.pnas.org/content/early/2010/07/22/1005338107.full.pdf+html. [Accessed Aug. 5, 2013].

[3]. Anonim, "World Melon Production has Increased in Recent Years," freshplaza.com, Jan. 11, 2011. [Online]. Available : http://www.freshplaza.com/news_detail.asp?id=88442. [Accessed Aug. 15, 2013].

[4]. Pusat Data dan Sistem Informasi Pertanian, Statistik Pertanian. Agricultural Statistics 2012, Kementerian Pertanian, 2012. [E-book]. Available: http://pusdatin.deptan.go.id/admin/satlak/Statistik_Pertanian_2012.pdf. [Accessed Aug. 15, 2013].

[5]. K. Anagnostou, et al., "Inheritance and Linkage Analysis of Resistance to Zucchini Yellow Mosaic Virus, Watermelon Mosaic Virus, Papaya Ringspot Virus, and Powdery Mildew in Melon," Euphytica, vol. 116, pp. 265 – 270, 2000. Available: http://www.biu.ac.il/LS/People/staff/Perl_Articles/Ref19.pdf. [Accessed Aug. 16, 2013].

[6]. G. R. Aristya, and B. S. Daryono, "Karakter Fenotip dan Kandungan Nutrisi Melon Varietas Baru "Melodi Gama-1" Hasil Uji Multilokasi di Musim Kemarau," In Prosiding Seminar Nasional Biologi "Perspektif Biologi dalam Pengelolaan Sumberdaya Hayati" Fakultas Biologi Universitas Gadjah Mada Yogyakarta, 2010, pp. 596 – 603.

[7]. M. Dwiragupti, "Melon Kini Sudah Merakyat," Trubus, no. 281, Th. XXIV, pp. 8 – 10, 1993 In G. R. Aristya, and B. S. Daryono, "Karakter Fenotip dan Kandungan Nutrisi Melon Varietas Baru "Melodi Gama-1" Hasil Uji Multilokasi di Musim Kemarau," In Prosiding Seminar Nasional Biologi "Perspektif Biologi dalam Pengelolaan Sumberdaya Hayati" Fakultas Biologi Universitas Gadjah Mada Yogyakarta, 2010, pp. 596 – 603.

[8]. G. R. Aristya, and B. S. Daryono, "Karakterisasi Fenotip dan Pewarisan Sifat Ketahanan Terhadap Penyakit Powdery Mildew Pada Tanaman Melon (Cucumis melo L.) var. Tacapa Hasil Pemuliaan Tanaman", In Prosiding InSINas, 2012, pp. 258 – 264. Available : http://insentif.ristek.go.id/PROSIDING2012/file-PG-Word_43.pdf. [Accessed Aug. 16, 2013].

[9]. S. D. Maryanto, "Perbandingan Karakter Fenotip Buah Melon (Cucumis melo L.) Kultivar Melodi Gama-1, Gama Melon Basket, dan Kultivar Komersial Pada Uji Multilokasi dan Multimusim," Undergraduate Thesis, Fakultas Biologi, Universitas Gadjah Mada, Yogyakarta, 2011.

[10]. B. S. Daryono, et al., "Perakitan Melon (Cucumis melo L.) Kultivar Melodi Gama-3 Dalam Rangka Penguatan Industri Pertanian Nasional," In Prosiding Seminar Nasional Dan Call for Paper EP UNNES Semarang, 2012, pp. 245 – 256.

[11]. Rozikin, "Ketahanan Tanaman Melon (Cucumis melo L.) Kultivar Melodi Gama-3 Terhadap Jamur Tepung," Seminar Report, Fakultas Biologi, Universitas Gadjah Mada, Yogyakarta, 2013.

[12]. H. Imama, "Pewarisan Ketahanan Tanaman Melon (Cucumis melo L.) Kultivar Melodi Gama 3 Terhadap Cekaman Kekeringan dan Penggenangan," Seminar Report, Fakultas Biologi, Universitas Gadjah Mada, Yogyakarta, 2013.

[13]. Descriptors for Melon (Cucumis melo L.), International Plant Genetic Resources Institute, Rome, Italy, 2003. Available : http://indoplasma.or.id/deskriptor/IPGRI/deskriptor%20melon.pdf. [Accessed Aug. 13, 2013].

[14]. Panduan Pengujian Individual Kebaruan, Keunikan, Keseragaman, dan Kestabilan : Melon (Cucumis melo L.), Pusat Perlindungan Varietas Tanaman, Departemen Pertanian Republik Indonesia, 2006. Available : ppvt.setjen.deptan.go.id. [Accessed Aug. 13, 2013].

[15]. Y. Sidiq, et. al., "Uji Adaptasi Multimusim Karakter Fenotip kultivar Melodi Gama-3 (Cucumis melo L.) : Usaha Penguatan Industri Benih Nasional," In Prosiding Seminar Nasional "Biologi, Sains, Lingkungan, dan Pembelajarannya" Prodi Biologi FKIP UNS Surakarta, 2013, pp. 1 – 5.

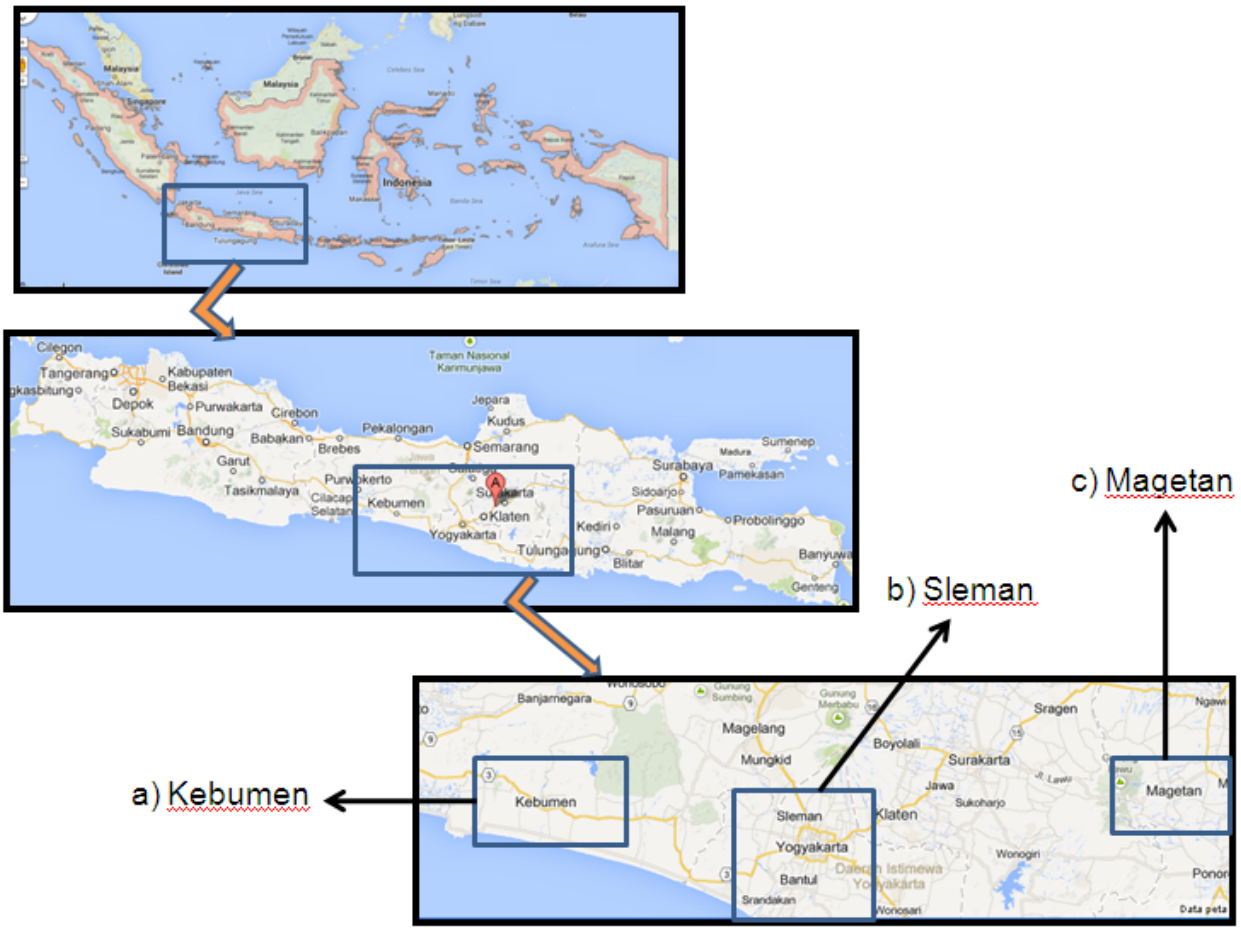
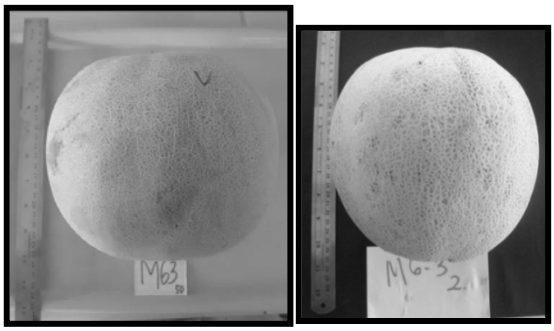


Figure 1. Multilocation test conducting provinces, i. e., a) Central Java, Residency of Kebumen, b) D.I. Yogyakarta, Residency of Sleman, dan c) East Java, Residency of Magetan (Map source : Google Map, 2013)



(a) (b)

Figure 2. Fruit Shape of MG3 Cultivar. Even though having differences in size (see Table 1.), MG3 melon cultivar mostly have globular fruit shape (see Table 2.). It applied for fruit which were harvested in Magetan, East Java (a), Sleman, D. I. Yogyakarta (b), and Kebumen, Central Java (c)

TABLE 1.
ANOVA RESULTS SUMMARY OF QUANTITATVE PHENOTYPIC CHARACTERS

Character	Cultivar	Cultivar*Location	kk (%)
Fruit Weight	**	**	10.70
Fruit Girth	**	**	3.93
Flesh Thickness	**	tn	10.21
Skin Thickness	tn	**	19.18
Vertical Diameter	**	**	5.87
Horizontal Diameter	**	**	5.46

* significant at P < 0.05; ** significant at P < 0.01; tn not significant

TABLE 2.
QUALITATIVE PHENOTYPIC CHARACTERS OF MELON CULTIVARS CULTIVATED IN 3 DIFFERENT LOCATION

Character	Cultivar														
	MG3			LADIKA			MAI			Action			Glamour		
	Loc. 1*	Loc. 2	Loc. 3	Loc. 1**	Loc. 2	Loc. 3	Loc. 1**	Loc. 2	Loc. 3	Loc. 1**	Loc. 2	Loc. 3	Loc. 1**	Loc. 2	Loc. 3
Fruit Shape	Globular	Globular	Globular	Globular	Elliptical	Flatened	Globular	Globular	Globular	Oblate	Globular	Globular	Flattened	Globular	Globular
Unripe Skin Color	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Ripe Skin Color	Golden Yellow	Golden Yellow	Golden Yellow	Yellow	Yellow	Yellow	Green	Glaucous	Green	Green	Chartreuse	Green	Green	Green	Green
Netting Distribution	Very Dense	Very Dense	Dense	Dense	Dense	Dense	Very Dense	Very Dense	Dense	Very Dense	Very Dense	Dense	Very Dense	Very Dense	Very Dense
Netting Intensity	Intense	Intense	Intense	Intense	Intense	Not Intense	Intense	Very Intense	Less Intense	Intense	Very Intense	Intense	Intense	Very Intense	Intense
Cavity Shape	Elliptical	Elliptical	Oval	Oval	Elliptical	Elliptical	Elliptical	Oval	Oval	Oval	Round	Elliptical	Elliptical	Oval	Oval
Flesh Colour	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Green	Green	White	Orange	Orange	Orange
Flesh Flavor	Not Sweet	Sweet	Not Sweet	Not Sweet	Less Sweet	Less Sweet	Not Sweet	Sweet	Not Sweet	Not Sweet	Less Sweet	Not Sweet	Not Sweet	Sweet	Less Sweet
Flesh Texture	Juicy	Juicy	Juicy	Juicy	Crunchy	Crunchy	Crunchy	Crunchy	Crunchy	Crunchy	Crunchy	Juicy	Crunchy	Spongy	Juicy
Flesh Aroma	Less Fragrant	Fragrant	Not Fragrant	Less Fragrant	Not Fragrant	Not Fragrant	Not Fragrant	Not Fragrant	Not Fragrant	Not Fragrant	Not Fragrant	Not Fragrant	Not Fragrant	Not Fragrant	Not Fragrant
Water Content	High	High	High	High	Very High	High	High	Very High	High	High	Very High	High	High	Very High	High

Loc. 1 : Magetan, East Java; Loc. 2 : Sleman, D. I. Yogyakarta,; Loc. 3 : Kebumen, Central Java
* Data had been published in [13]
**Data originated from [9]