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Research Article

Quantitative Traits of Melodi Gama-3 Melon (*Cucumis Melo* L.), A New Superior Cultivar, on Rainy Season and Altitude Variation

Rizko Hadi[1,2], Yasir Sidiq[1,3], Sigit Dwi Maryanto[1,4], Budi S. Daryono[1*]

[1] Laboratory of Genetics and Breeding, Faculty of Biology, Universitas Gadjah Mada, Jl. Teknika Selatan, Sinduadi, Yogyakarta, 55281, Indonesia

[2] Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Palangka Raya, Jln. Yos Sudarso, Palangka Raya, Central Kalimantan, 73111, Indonesia

[3] Biology Education Department, Faculty of Teacher Training and Education, Universitas Muhammadiyah Surakarta, Kartasura 57162, Indonesia

[4] Biotechnology Department, Plant Production and Biotechnology Division, PT SMART Tbk, Jl. Cijayanti, Babakan Madang, Bogor, 16810, West Java, Indonesia

*E-mail : bs_daryono@mail.ugm.ac.id; rizkohadi@mipa.upr.ac.id

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Abstract

Melodi Gama 3 is a superior melon cultivar candidate which was developed presently. Purposes of this study were to determine quantitative traits of the Melodi Gama 3, as well as to compare it to commercial melon cultivars, based on trial on rainy season and altitude variation. Materials used were Melodi Gama-3 seeds originated from Laboratory of Genetics, Faculty of Biology, Universitas Gadjah Mada, and commercial cultivars seeds, i.e., Action 434, Glamour Sakata, MAI, and LADIKA, respectively. The trial had been conducted at three variations of altitude i.e., mediumland, lowland, and beach shore, respectively, in period of rainy season. The quantitative traits, that were fruit weight and girth, flesh, and rind thickness, as well as vertical and horizontal diameter (longitudinal section), respectively, had been observed and measured at the Laboratory of Genetics, Faculty of Biology, Universitas Gadjah Mada. Data then analyzed with Honestly Significant Different test following balanced ANOVA, all using PKBT-STAT 2 software. Results showed that all the quantitative traits, except for flesh thickness, were influenced very significantly by interaction of cultivars x locations ($P < 0.01$). The Honestly Significant Difference test indicated that the Melodi Gama-3 had higher measurement of its quantitative traits (fruit weight: 2.68 kg; fruit girth: 55.45 cm; rind thicknesss: 0.93 – 1 cm; vertical diameter: 15.94 – 18.19 cm; horizontal diameter: 17.79 cm) than other cultivars. It was revealed that the Melodi Gama-3 was best planted at lowland altitude. Plant breeders should benefit from this study for the Melodi Gama-3 has great potency to be bred based on its traits comparison with commercial cultivars.

Introduction

Melon is one of the horticultural products that have a high economical potency. With total production of melon agriculture in world amounted to 31,053,716 tons in 2009, an increase of 0.3

% from the previous year (Anonymous, 2011), and assuming that the melon agricultural production continues to increase in recent years, this agricultural sector would increasingly push the world economy with amount of money circulating in it. In Indonesia, melon per capita consumption in 2011 was 0.42 kg, with a growth of as much as 166.67 % from the previous year (Center for Agricultural Data and Information Systems, 2012).

Despite the promising potency, melon agriculture is not without problem. Pests and diseases (virus) (Anagnostou et al., 2000), complexity of the plant treatment, and low-quality production are some of the problems faced by melon farmers. That is why the availability of superior melon seeds is expected. Nonetheless, the seeds of which circulated widely on market are mostly imported seeds, resulting to the costs incurred by the melon farmers becomes higher (Aristya and Daryono, 2010). In addition, in case the seeds are planted again in next generation, the results would not satisfy expectations, such does not produce fruit, or fruit that is produced is not uniform both in taste and shape. This occurrence then leads to farmer dependency on imported seeds (Rashidi and Seyfi, 2007). Therefore, the availability of superior local seeds at affordable prices that could compete with the quality of imported seeds is one of necessity.

Breeding of local melon is conducted to meet demand for superior local seeds. The breeding could be done conventionally by crossing parents that have desired traits. Laboratory of Genetics, Faculty of Biology, Universitas Gadjah Mada (UGM) has a high attention to the breeding of local melon, with products of which are Gama Melon Basket, Melodi Gama-1 (Maryanto, 2011), and Melodi Gama-3 (Daryono et al., 2012).

The Melodi Gama-3, further called as MG3, was a cultivar resulted from crossing of Melodi Gama-1 and LD-3 cultivars (Daryono et al., 2012). This cultivar had superior traits, namely, tolerant to powdery mildew (Rozikin, 2013), fruit with sweet taste and fragrant aroma, thick flesh, and could be harvested in about 2 months of planting period (Daryono et al., 2012). Thus, the MG3 cultivar is expected to be the superior local seeds that could compete with imported seeds in the market. In addition to the superior traits mentioned, Imama (2013) revealed that MG3 has resistance to the stress of flood. This resistance could be a potential superior trait for that melon is, mostly, a warm area crop, and thus, the MG3 could be expected to be cultivated in every season with the same result.

Purpose of this study was to determine quantitative traits of MG3 cultivar based on trial on rainy season and altitude variation. On the other hand, this study was also to compare the mentioned quantitative traits of MG3 than commercial cultivars based on trial on rainy season and altitude variation.

Materials and Methods

Plant Materials and Procedure

Materials used in this study were MG3 seeds obtained from the Laboratory of Genetics, Faculty of Biology, UGM, and Action 434, Glamour Sakata, MAI, and LADIKA cultivars seeds, respectively, as commercial cultivars. The study was conducted in rainy season, at three variations of altitude i.e., lowland, mediumland, and beach shore, located on different provinces, namely, Daerah Istimewa Yogyakarta, East Java, and Central Java, respectively (Figure 1 and Figure 2).

Traits Measurement and Statistical Analysis

Observations and measurements of the quantitative traits, those were fruit weight, fruit girth, flesh thickness, rind thickness, as well as vertical and horizontal diameter of fruit (longitudinal section), respectively, had been carried out in the Laboratory of Genetics, Faculty of Biology, Universitas Gadjah Mada. Data were then analyzed using balanced ANOVA followed by Honestly Significant Difference (HSD) test (Gomez and Gomez, 2005) using software PKBT-STAT 2 (Suwarno, 2008).

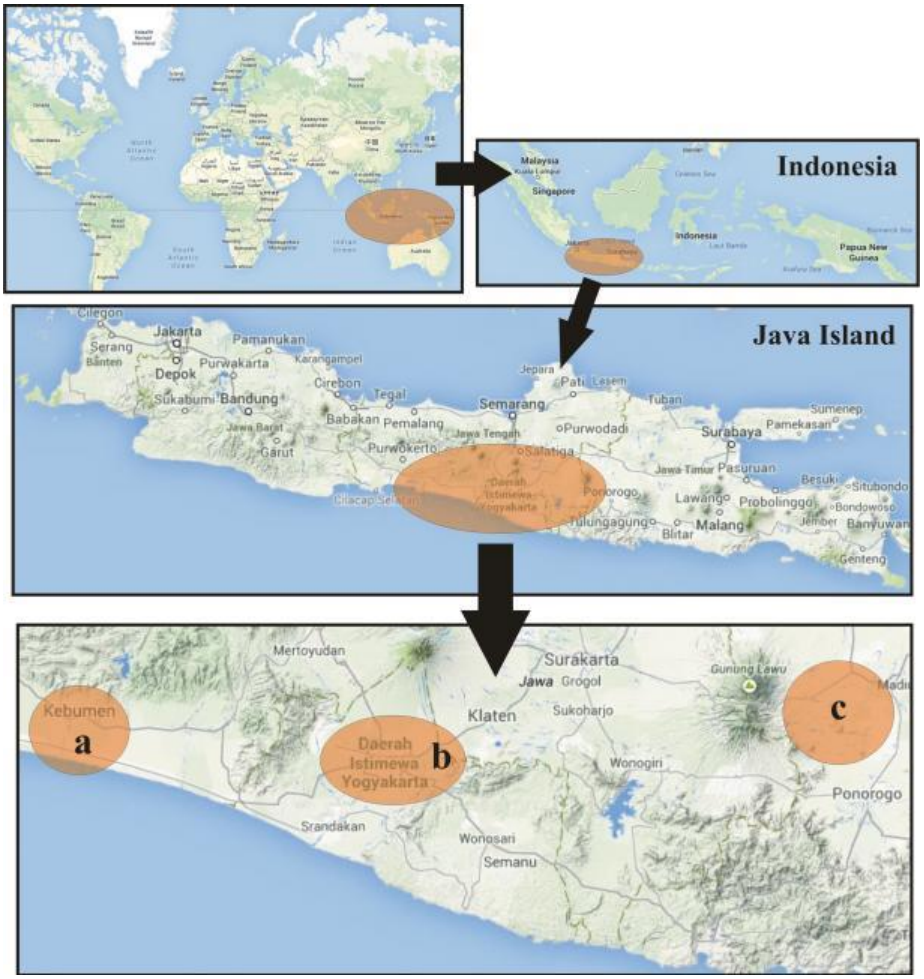

Figure 1. Locations of trial (in orange circle): a) Province of Central Java, Residency of Kebumen, b) Province of Daerah Istimewa Yogyakarta, Residency of Sleman, and c) Province of East Java, Residency of Magetan (Map source: Google Map, 2014).

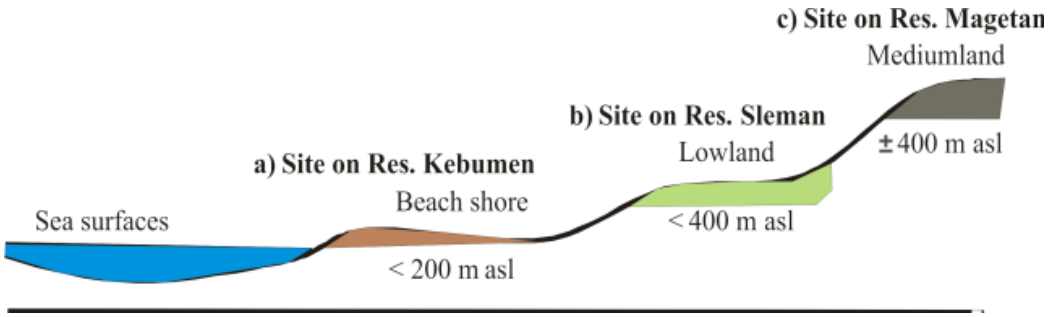

Figure 2. Illustration of altitude elevation for sites of trial. a) Central Java Province, Kebumen Residency. The site located around the sand dunes near the coast that was in the sub-residency of Bulus Pesantren; b) Daerah Istimewa Yogyakarta Province, Sleman Residency. The site located around the lowland that was in the sub-residency of Berbah, and c) East Java Province, Magetan Residency. The site located around the mediumland, that was in the sub-residency of Parang (Altitude grouping source: Syukur et al., 2012).

Results and Discussion

Results

MG3 was a new cultivar, obtained from the crossing of female (♀) Melodi Gama-1 and male (♂) LD-3 parents (Daryono et al., 2012), that had globular fruit shape and golden yellow rind of riped fruit (Figure 3). Quantitative traits have different properties than qualitative traits, i.e.

gradually different (could be given scale), could be measured, was strongly influenced by the environment (Syukur et al., 2012) and were influenced by many genes (with minor contribution of each gene) (Crowder, 2010). In this study, the quantitative traits of MG3 had been analyzed to complete the already existing data on (Daryono et al. 2015).

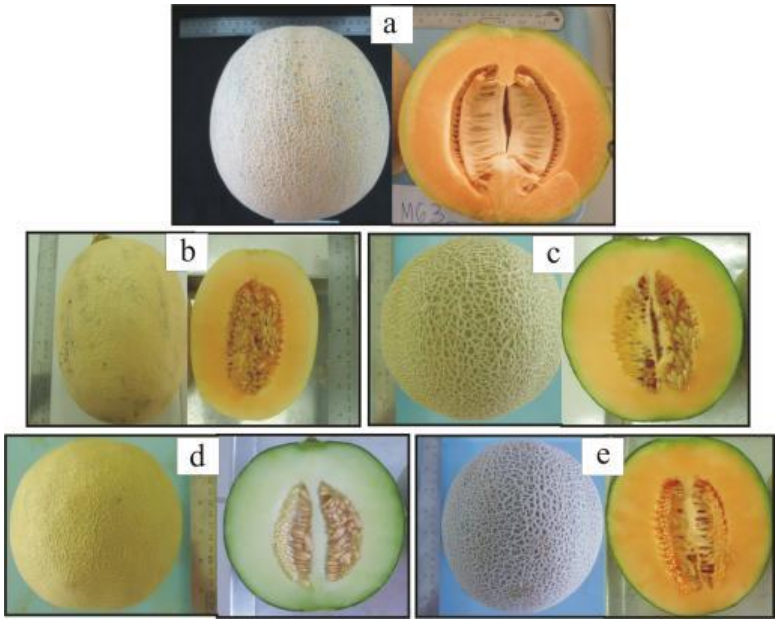

Figure 3. Mature fruit profile of all cultivars used. a) Melodi Gama-3 (MG3); b) LADIKA; c) MAI; d) Action 434; and e) Glamour Sakata.

Analysis of Variance (ANOVA)

There was a highly significant differences ($P < 0.01$) between locations for all of the quantitative traits, ANOVA showed. While for variation source of cultivars, it also showed a highly significant differences ($P<0.01$) for most of the quantitative traits measured except rind thickness ($P > 0.05$). Interaction of cultivars x locations affected the whole quantitative traits of the melon cultivars, except for flesh thickness. ANOVA showed that in all quantitative traits measured, except for flesh thickness, there was a highly significant differences ($P < 0.01$) for source of variation of interaction cultivars x locations. The flesh thickness trait, on the contrary, did not had significant difference ($P > 0.05$) for the interaction of cultivars x locations source of variation. ANOVA recapitulation of the quantitative traits could be seen in Table 1 - 3. These results indicated that there was a statistical difference between the cultivars or the locations in terms of size of all quantitative traits, except for flesh thickness. To get more details, these differences were determined through the HSD test.

Table 1. Mean square recapitulation of ANOVA of the quantitative traits of melon cultivars

Source	df	Fruit weight	Fruit girth	Flesh thickness	Rind thickness	Vertical diameter	Horizontal diameter
Locations	2	11.60	2,425.54	11.24	0.44	291.18	247.97
Cultivars	4	0.67	68.62	0.65	0.03	3.14	7.23
Cultivars* locations	8	0.24	32.80	0.06	0.09	2.63	3.53
Error	24	0.02	2.43	0.07	0.02	0.63	0.45

Honestly Significant Difference (HSD) Test

Fruit weight of the melon cultivars had statistical differences between each location. HSD test showed that, for MG3, the mean of fruit weight on the location of Daerah Istimewa Yogyakarta

had statistically higher values than at other locations. The mean of fruit weight on the location of Central Java has the lowest value for the MG3. The differences of value between the highest and the lowest mean was very large (Figure 4). With basis on these results, it was indicated that the fruit size of MG3 harvested from the location of Daerah Istimewa Yogyakarta and the location of Central Java were very largely different because of the large differences between the mean values of their fruit weight. The HSD test also showed that MG3 fruit weight's mean value on the location of Daerah Istimewa Yogyakarta did not significantly different than Action cultivar fruit weight's mean value on the same location. The fruit weights of other cultivars had significantly different mean values that were lower than MG3 and Action (Figure 4). Thus, it was indicated that the cultivars of MG3 and Action were more superior in fruit size compared than other cultivars, in according to fruit weight.

Table 2. F value recapitulation of ANOVA of the quantitative traits of melon cultivars

Source	Fruit weight	Fruit girth	Flesh thickness	Rind thickness	Vertical diameter	Horizontal diameter
Locations	204.76	724.10	575.72	11.41	432.59	676.59
Cultivars	33.90	28.19	9.23	1.65	4.95	15.94
Cultivars* Locations	12.32	13.47	0.83	4.72	4.15	7.79
CV	10.70%	3.93%	10.21%	19.18%	5.87%	5.46%

Table 3. P value recapitulation of ANOVA of the quantitative traits of melon cultivars

Source	Fruit weight	Fruit girth	Flesh thickness	Rind thickness	Vertical diameter	Horizontal diameter
Locations	0.0000^{**}	0.0000^{**}	0.0000^{**}	0.0090^{**}	0.0000^{**}	0.0000^{**}
Cultivars	0.0000^{**}	0.0000^{**}	0.0001^{**}	0.1938^{ns}	0.0047^{**}	0.0000^{**}
Cultivars* Locations	0.0000^{**}	0.0000^{**}	0.5865^{ns}	0.0014^{**}	0.0031^{**}	0.0000^{**}

Note: ** = significant at P < 0.01, ns = non-significant at P > 0.05

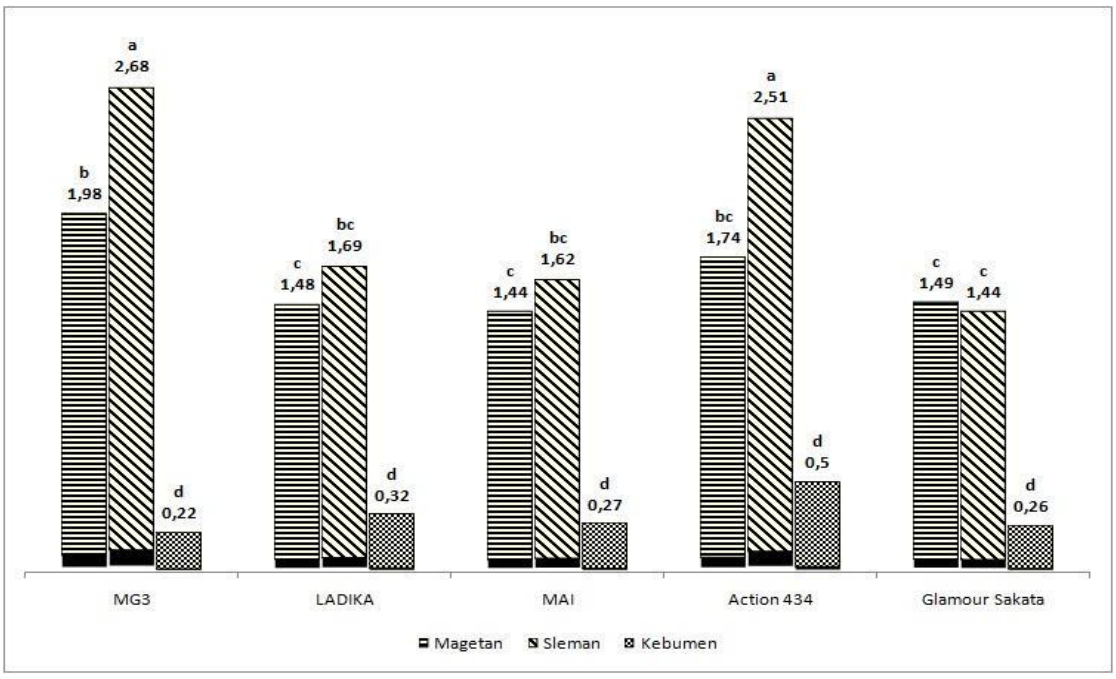

Figure 4. HSD test of the mean of fruit weight (kg), cultivars x locations interaction. Identical label letters denoted no significant differences between each cultivars x locations.

Fruit girth of the cultivars had statistical differences between each location. The HSD test showed that, for MG3, the mean of fruit girth on the location of Daerah Istimewa Yogyakarta had statistically higher values than at other locations. Meanwhile, the mean of fruit girth on the location of Central Java had the lowest value for MG3. The difference of values between the highest and the lowest mean was very large (Figure 5). With basis on these results, it was indicated that the fruit size of MG3 harvested from the location of Daerah Istimewa Yogyakarta and the location of Central Java were very largely different because of the large differences between the mean values of their fruit girth. The HSD test also showed that MG3 fruit girth's mean value on the location of Daerah Istimewa Yogyakarta did not significantly different than Action fruit girth's mean value on the same location. The fruit girths of other cultivars have significantly different mean values that were lower than MG3 and Action (Figure 5). Thus, it was also indicated that MG3 and Action were more superior in fruit size compared than other cultivars, in according to the fruit girth.

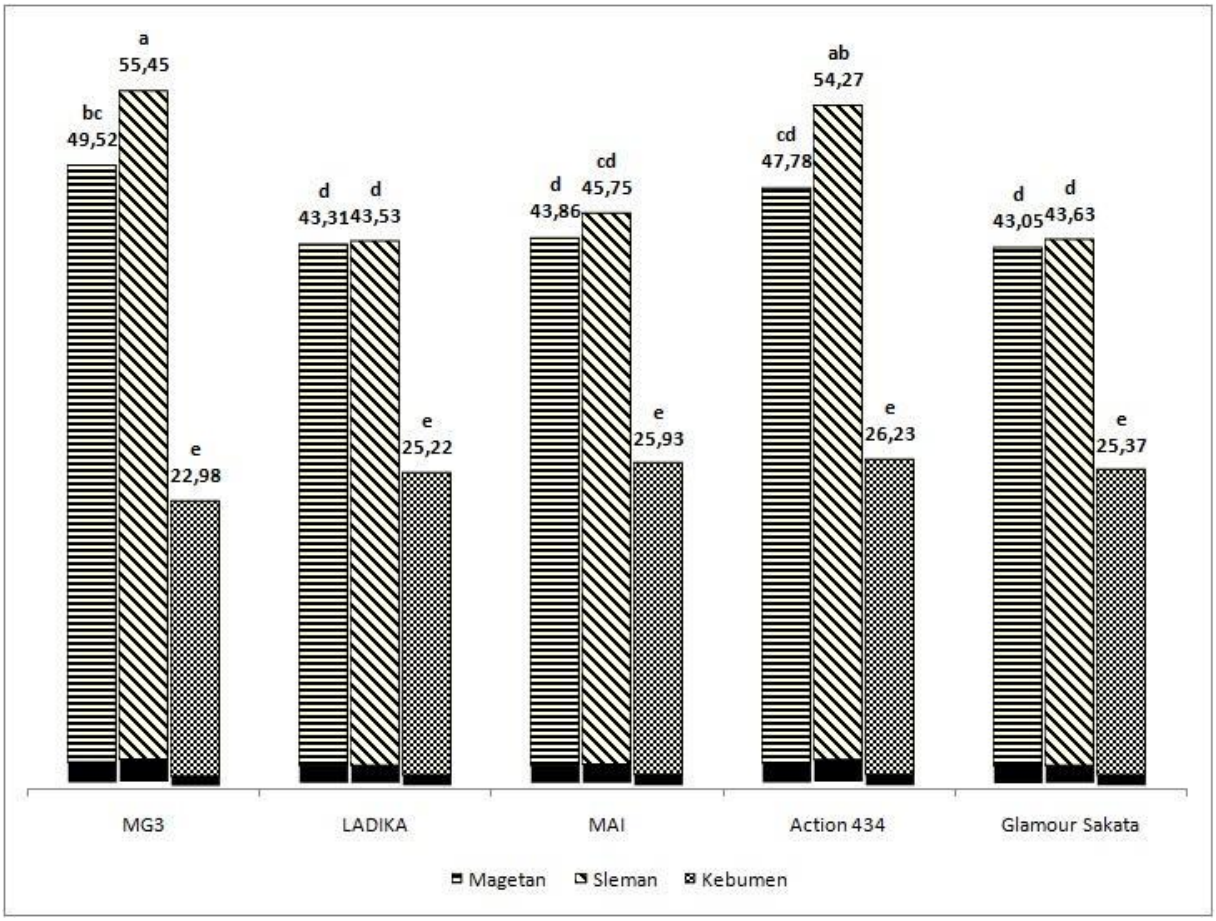

Figure 5. HSD test of the mean of fruit girth (cm), cultivars x locations interaction. Identical label letters denoted no significant differences between each cultivars x locations.

Rind thickness of the cultivars had statistical differences between each location. The HSD test showed that, for MG3, the mean of rind thickness on the locations of Daerah Istimewa Yogyakarta and East Java, which were not statistically different, had statistically higher values than on the location of Central Java (Figure 6). The HSD test also showed that the rind thickness's mean values of MG3 on the locations of Daerah Istimewa Yogyakarta and East Java did not statistically different than the mean values of LADIKA cultivar on the locations of Central Java and East Java, MAI cultivar on all locations, Action on the locations of Daerah Istimewa Yogyakarta and East Java, as well as Glamour cultivar on the locations of Daerah Istimewa Yogyakarta and East Java, respectively (Figure 6).

Fruit vertical diameter of the cultivars had statistical differences between each location. The HSD test showed that, for MG3, the mean of fruit vertical diameter on the locations of Daerah

Istimewa Yogyakarta and East Java, which were not statistically different, had higher values than on the location of Central Java (Figure 7). With basis on these results, it was indicated that the fruit size of MG3 harvested from the locations of Daerah Istimewa Yogyakarta and East Java were very largely different than one that harvested from the location of Central Java because of the large differences between the mean values of their vertical diameters. The HSD test also showed that the vertical diameter's mean value of MG3 on the location of Daerah Istimewa Yogyakarta was not statistically different than the mean values of LADIKA on the location of Daerah Istimewa Yogyakarta, Action on the location of Daerah Istimewa Yogyakarta, as well as Glamour on the location of East Java, whilst, the vertical diameter's mean value of MG3 on the location of East Java was statistically different only than the mean values of all cultivars on the location of Central Java (Figure 7).

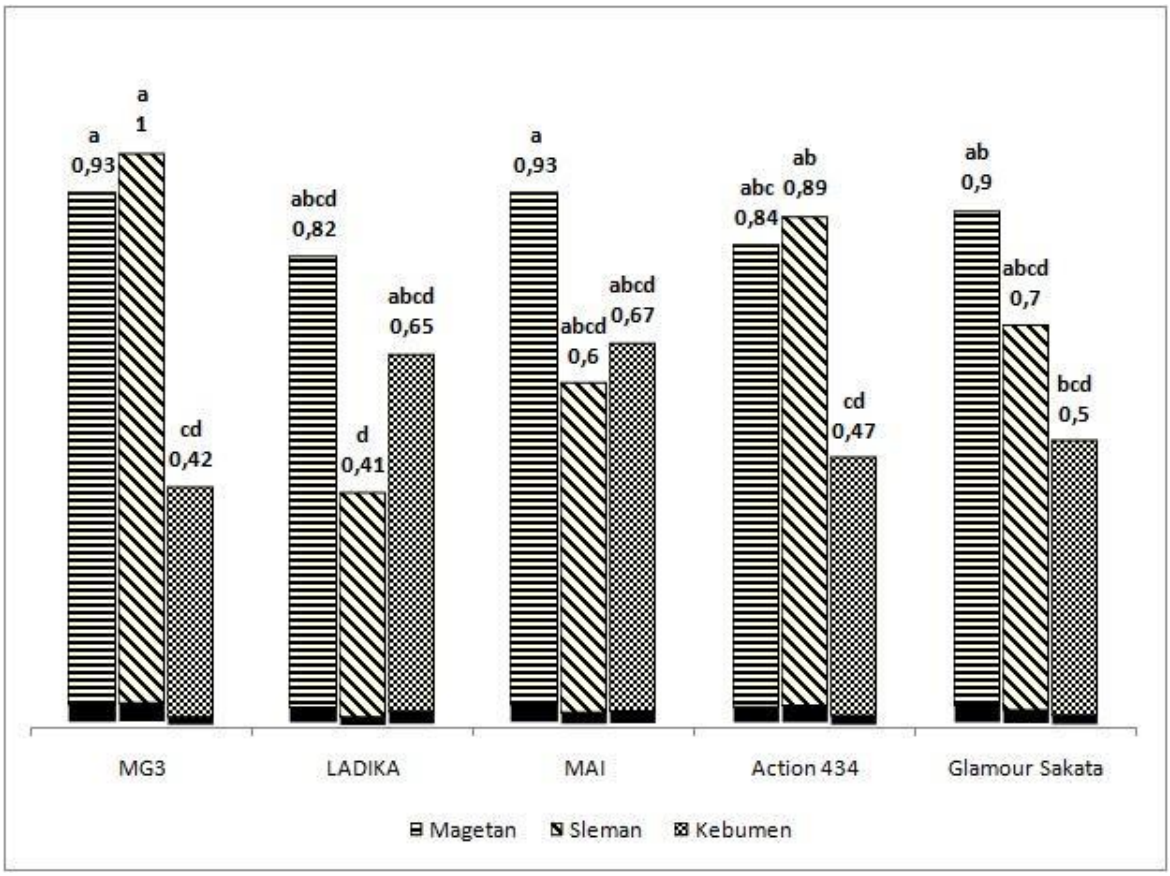

Figure 6. HSD test of the mean of rind thickness (cm), cultivars x locations interaction. Identical label letters denoted no significant differences between each cultivars x locations.

Fruit horizontal diameter of the cultivars had statistical differences between each location. The HSD test showed that, for MG3, the mean of fruit horizontal diameter on the location of Daerah Istimewa Yogyakarta had statistically higher values than at other locations. On the other hand, the mean of fruit horizontal diameter on the location of Central Java had the lowest value for the MG3. The difference between the highest and the lowest was very large (Figure 8). With basis on these results, it was indicated that the fruit size of MG3 harvested from the locations of Daerah Istimewa Yogyakarta and Central Java were very largely different because of the large differences between the mean values of their fruit horizontal diameter. The HSD test also showed that the horizontal diameter's mean value of MG3 on the location of Daerah Istimewa Yogyakarta was not statistically different than the mean value of Action on the same location, whilst others had statistically different values, that were lower than MG3 and Action (Figure 8). Thus, it was also indicated that MG3 and Action were more superior in fruit size compared than other cultivars, in according to the fruit horizontal diameter.

Discussion

The trial results indicated that Melodi Gama-3 (MG3) cultivar was best planted on Daerah Istimewa Yogyakarta location. HSD test recapitulation of MG3 showed that, for all quantitative traits measured, Daerah Istimewa Yogyakarta location harvest had the highest value than other locations. The only exceptions were found in rind thickness and vertical diameter traits of MG3 harvested from location of East Java that had non-statistically different values than MG3 harvested from location of Daerah Istimewa Yogyakarta (Figure 9). HSD test (Figure 4-9) showed that the harvest of Central Java location had the smallest quantitative traits value, except for the rind thickness trait, among all of harvest locations (Figure 6).

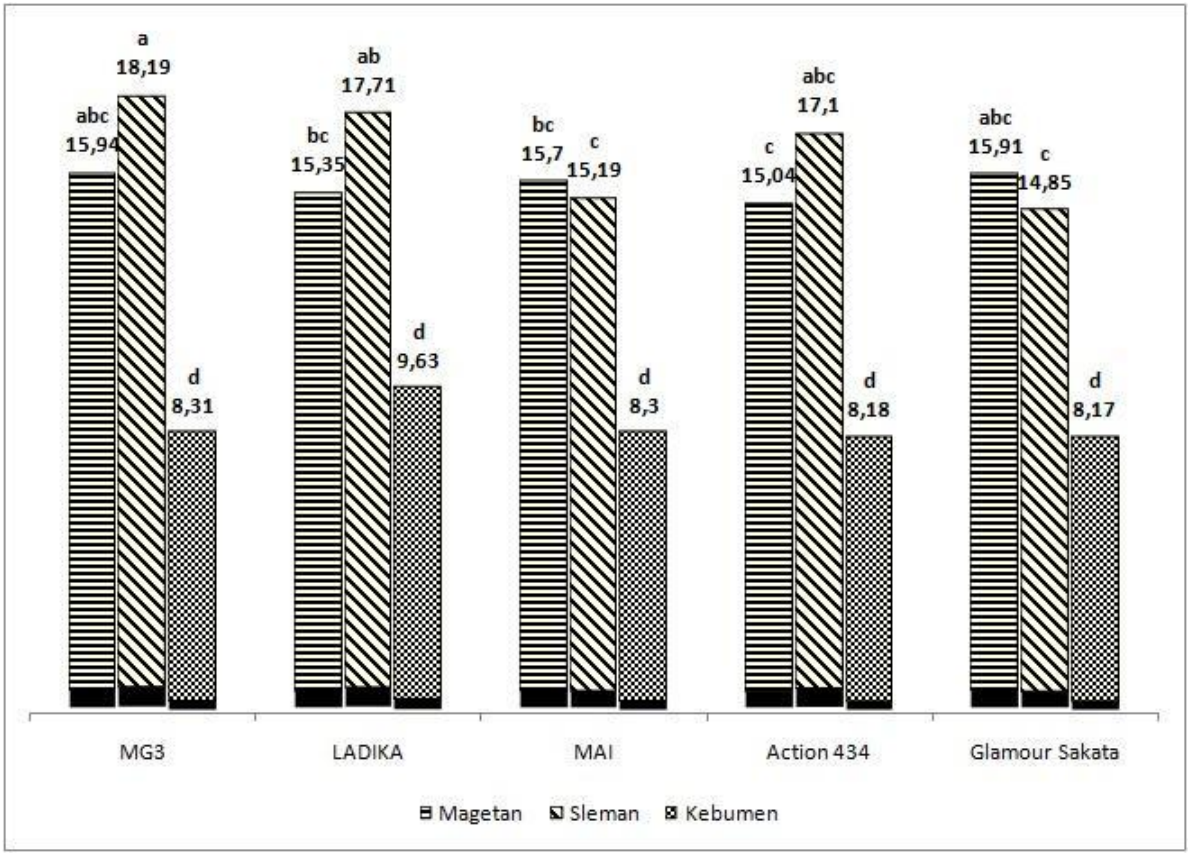

Figure 7. HSD test of the mean of fruit vertical diameter (cm), cultivars x locations interaction. Identical label letters denoted no significant differences between each cultivars x locations.

Most of the quantitative traits of melon cultivars were influenced by planting location. The influences were occurred because of those different locations resulted in different environments. Environments has been known to have great impact on quantitative traits (Syukur et al., 2012). Particularly in this study, the trial was conducted on locations that have different altitude i.e., mediumland, lowland, and beach shore, respectively (Figure 2), thus, also caused differences in temperature, sunlight intensity, and soil conditions.

The results showed that MG3 had quantitative traits values that were similar as well as higher than commercial cultivars. The values of fruit weight, fruit girth, and fruit vertical diameter, respectively, were recorded even higher than most of the commercial cultivars, excluding only Action cultivar (Figure 4, Figure 5, and Figure 7). These results gave rise to impression that MG3, in quality, could compete against the commercial cultivars on market, thereby, increasing economic potential of this new cultivar.

The results also indicated that MG3 has flood resistance trait as it had mostly better quantitative traits values than commercial cultivars while it was planted in the rainy season. This finding was important because melon generally are drain season horticultural crop. This

information could be benefitting for melon breeder as they could plant melon in all season in a year.

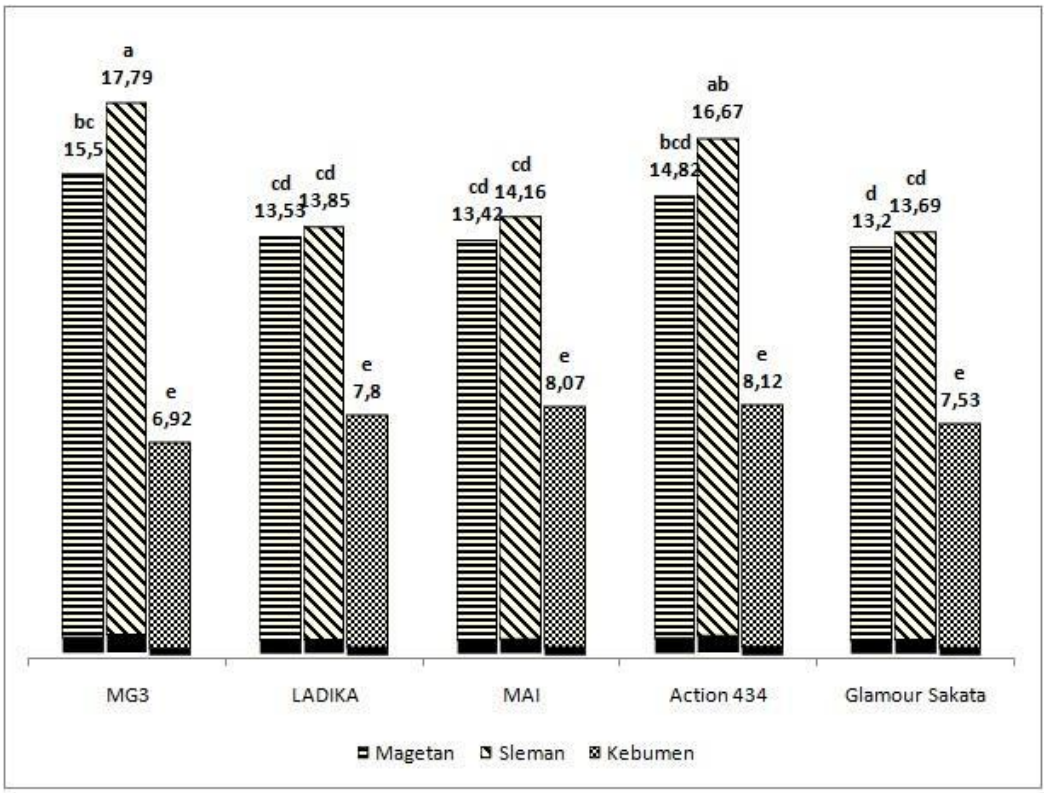

Figure 8. HSD test of the mean of fruit horizontal diameter (cm), cultivars x locations interaction. Identical label letters denoted no significant differences between each cultivars x locations

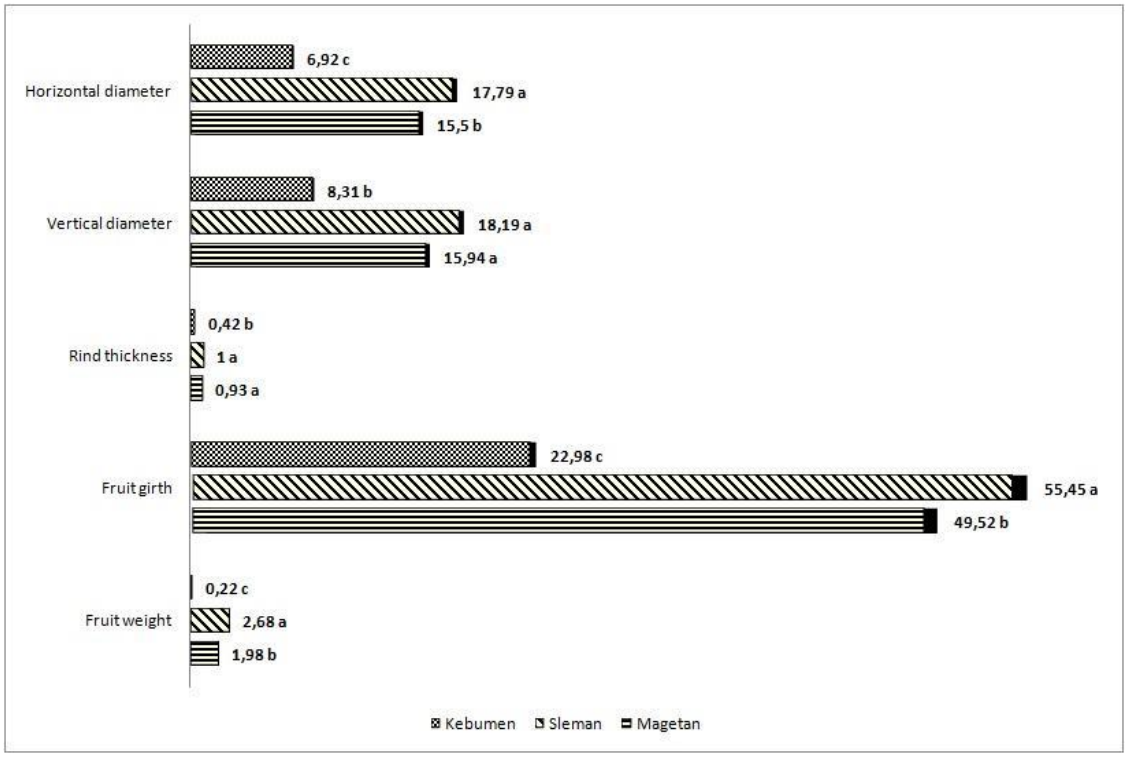

Figure 9. HSD test recapitulation of quantitative traits mean of MG3 resulted from multi-location trial. Identical label letters on each trait denoted no significant differences between each location.

Conclusions

It was revealed that the Melodi Gama-3 was best planted at lowland altitude. Plant breeders should benefit from this study for the Melodi Gama-3 has great potency to be bred based on its traits comparison with commercial cultivars. Continuous research on the same kind of trial needs to be done in attempt to develop MG3 further. For further research, climate and environmental parameters data are recommended to be collected, complementing the already existing information about environmental conditions that are best for melon cultivars.

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