Evaluation of Two Superior Variety Candidates of Melon in West Sumatra, West Java and East Java

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Abstract: The availability of new varieties of melon that suit the consumers demand will make this commodity more marketable that in turn can increase farmers’ income. In general, the desired characteristics of melon are sweet, crisp, strong-scented, rind nets and high self-life. To date there are two candidates of melon hybrid that are being evaluated. To meet the requirements of new varieties, candidates should be tested for stability, yield and adaptability at several planting locations. In 2009 it has been done multiplication test of two candidates of melon variety. The purpose of this study was to obtain two candidates of superior variety of melon having fine and tight nets (>90%). A randomized block design was used in this experiment with four treatments (two hybrid melon candidates: 86H (MB 1) and 78m (MB 2) and two other melon varieties (Tropika and Glamour) as comparison and 6 replications. Each treatment unit consisted of 30 plants. Statistical analysis used was analysis of variance (ANOVA) followed by analysis of the combined range. To differentiate among the treatments, it was performed with LSD 0.05. The results showed that weight character of Melon MB1 and MB2 was slightly lower than that of the comparator in Banyuwangi location while TSS of MB1 was higher. In the same location, the mean net of MB1 is 88.67% with smooth texture and MB2 is 64.67% with coarse texture. Based on the combined range test of fruit and total soluble solid character there was no interaction between location and planted varieties.

Key words: Evaluation • Location • The variety candidate • Melon • TSS

INTRODUCTION

Melon (Cucumis melo L) is an important and a popular horticultural crop in the world with an overall annual production of 26.8 million tons and planted area of about 1.3 million ha [1] where China, Turkey, Iran, the United States and Spain are the major producers. In 2010, China had the largest melon-cultivating area [2]. Melon can grow anywhere in the world due to its good adaptation to various soil types and climatic conditions. Its fruits are preferred because of crispy texture, fresh and flavor-sweet and high variation in color between varieties. The melon fruit contains 93% water and small amount of carbohydrates, sugars, vitamins and minerals. Nutritionists claim that daily consumption of melon can prevent stroke, decrease cholesterol and add energy. Fruit quality is influenced by several factors, including varieties, fertilizers, aeration, temperature and so on [3]. Commonly, poor eating quality is the main reason why the consumers do not purchase more melon. Many farmers in Indonesia prefer to grow melon because it has very short-lived and easily to be traded. However, until now most of melon seeds are still supplied from abroad. In the 2001-2005, Indonesia imported melon seeds as much as 6392 kg, 2910 kg, 3698 kg, 2992 kg and 1653 kg, respectively [4]. In general, hybrid seeds that were introduced were superior in certain properties, therefore, if F1 seeds are replanted, fruits produced will decrease in quality, fruit size and resistance to environmental stresses including wilt disease. Generating melon hybrids at the Indonesian Tropical Fruits Research Institute were initiated by Purnomo et al. [5] through exploration and collection of varieties that have good performance. The hybrids were lined and then top crossed with freely pollinated varieties. F1 hybrids resulted from top cross in melon and other breeding populations need to be evaluated in the field to obtain hybrids that are vigorous for certain characteristics desired such as thick fruit, fruit
color, fruit size, fruit shape, sweetness, fruit flavor, nets, fruit shelf life and disease resistance. The interaction between genotype and environment is a major challenge for plant breeders to develop varieties from selection, as several genotypes show specific reaction to a specific environment. At each site, some varieties were tested at various locations indicate different production capabilities. This is caused by the influence of the interaction between genotype and environment [6, 7]. Indonesian Tropical Fruit Research Institute has conducted a series of melon breeding to produce new varieties since 1999. Until now, it had been acquired two candidates of melon hybrid that are being evaluated. To fulfill the requirements of releasing new varieties, these candidates have to be tested on stability, yield and adaptation ability to several locations. The purpose of this study was to evaluate of two superior variety candidates (accession MB1 and MB2) at three planting locations and to obtain variety candidates of melon possessing smooth and tight nets (> 90%).

MATERIALS AND METHODS

The study was conducted at three locations, namely: 1). Sumani Experimental Farm of Indonesian Tropical Fruit Research Institute (West Sumatra), ± 360 m above sea level (ASL). 2). Subang experimental farm (West Java), ± 84 m ASL. 3). Banyuwangi, East Java, ± 100 m ASL from March to November 2010.

A field trial at each site was arranged in a randomized block design with four treatments (two hybrid melon candidates: 86H (MB 1) and 78m (MB 2) and two other melon varieties (Tropika and Glamour) as comparison and 6 replicates. Each treatment unit consisted of 30 plants.

The selected parental hybrid plants were planted in the filed. The fruit character and potential yield of two hybrid candidates having dominant characters in terms of net-smooth, strong aromatic, crisp, sweet, thick and fleshy were compared with two melon cultivars commonly planted by farmers. In order to release new varieties of melon, multi-location trials have to be conducted to determine the stability of the characters.

Seeds, as planting materials, were produced by planting two female parent plants (86 and 78) and two male parent plants (H and M) and then lining was performed by selfing in which it has reached S; lines. Other activities that had been conducted in Sumani experimental farm were planting male and female parent, selfing for production of female and males parent, hybridization to produce hybrid.

The seeds were soaked in sterile water for 12-18 hours then germinated on wetted straw paper and placed in germination boxes that were facilitated with lamp to produce an average temperature of 37°C for 24-48 hours until the seeds germinate. Furthermore, sprouts were grown in a 250 ml plastic bag containing sterile peat soil medium. Ten days later, the seedlings were planted in the field.

Plants grown in beds, size L x W x H (2,5 x 1,2 x 0,7) m with 0.7 m depth drainage apart were allowed to grow on 2 m long of a bamboo trellis height of 2 m. One bed contained 10 plants. Before planting, the beds were covered with metallic plastic mulch of 2.5 x 1.2 m. While planting, mixture of urea (1.5 g) and TSP (2.0 g) was given to each plant. Furthermore, every week each plant was fertilized with 2 g NPK. During generative phase, plants were fertilized with 3 g NPK/plant at intervals of one week. Afterward, 2 ml/l micro fertilizer was given at flowering phase at one week intervals too. Pest and weed control were carried out as needed.

Seedlings are ready to be planted in the field if they have 2-4 pairs of leaves. In this study the tested four accessions, in fact, could be planted at once in the field, since they had the same condition. However, about 7 days after planting (DAP), it was found the different growth on branches and tendrils among accessions. By 15 DAP, there were variations in flowering time among accessions. Flowers that come out were the female flowers (or perfect flower), always emerging on the branch. In this study only branches at segment 7 to 9 were maintained, but one branch was allowed to hold one fruit.

Pollination was allowed to take place at the 7-9th node following castration and wrapping flower with wax paper. Artificial insemination was done by sowing mature pollen on stigma and then flowers were wrapped again and labeled. Selfing was done when stigma were mature (hours 6:00 to 10:00 GMT).

Physiologically ripe fruits that are indicated with cracks around the stalk and emitted aroma, usually occur 35-40 days after pollination. Harvesting is done by cutting the fruit stalk with a sharp knife or scissors and leaving stalk on the fruit. Fruits were then characterized as variables/criteria established. At processing, seeds were always labeled to avoid exchangeable identity of seeds. The seeds were packed after seeds were completely dried and inflated. Packing should be airtight and vacuum, labeled according to seed identity. Packaged seeds were then stored at temperature and humidity suitable for melon seeds.
The variables measured were the fruit flesh color, fruit flavor/aroma, fruit skin color, soluble solids, net density and fruit weight. Analysis of data used analysis of variance (ANOVA) followed by the combined test of the three tested sites. Among treatments were distinguished by LSD test at 0.05 level.

RESULTS AND DISCUSSION

In Sumani Experimental Farm, the average fruit weight of candidate hybrid C (78M/MB2) was only significantly different from the comparator B (Table 1). In general, the growth of plants in Sumani until the early generative (28 DAP) was good enough. However, when plants entered a period of flowering and pollinating the rain fell heavily, light intensity was low and land was often flooded. As a result, fertilization became ineffective, sun exposure was reduced so that the photosynthesis process was not optimal and finally fruit-filling process was interrupted.

In Subang experimental farm, average fruit weight of accession A (hybrid melon candidate 86H/MB1) was lower than that of the comparator B. The lower weight of fruit in Subang might be because the genetic potential of this accession was not expressed optimally. This was due to low level of soil fertility and also high rainfall, causing plant leaves were damaged and dead, eventually fruit filling process stalled.

In Banyuwangi, the average weight of accession C (hybrid candidate 78M/MB2) was only significantly different from the comparator B (Table 1). In general, plants condition in Banyuwangi until the early generative (32 DAP) was good enough, but when it entered a period of fruits enlargement the rainfall was very high, light intensity was low and land was often flooded. This caused the fertilization to be ineffective, so the process of photosynthesis was not optimal. In addition, the serious attack of stem rot and fruit fly could cause 40%-50% crop loss.

In general, the lower weight of melon fruits produced in Sumani and Subang compared with in Banyuwangi were probably caused by some factors. Ezura [8] noted that number of cells determined differences in fruit size when two genotypes were cultivated at different temperatures or locations. He also noted that fruit size is determined by level of cell proliferation in the early stage of fruit development. Another experiment showed that fruit size of other crops, such as apple [9] and avocado [10], is regulated by the level of cell division after proliferation, as in melon and tomato.

<table>
<thead>
<tr>
<th>Accession Codes</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sumani</td>
</tr>
<tr>
<td>A</td>
<td>1,57 ab *)</td>
</tr>
<tr>
<td>B</td>
<td>1,64 a</td>
</tr>
<tr>
<td>C</td>
<td>1,31 c</td>
</tr>
<tr>
<td>D</td>
<td>1,40 bc</td>
</tr>
</tbody>
</table>

Note: A. 86H/MB1; B. Tropika; C. 78M/MB2; D. Glamour
*) numbers followed by the same letters in the same column are not significantly different at the 0.05 level of LSD test.

Kultur et al. [11] proved that planting spacing or plant density could affect fruit number, yield per plant and average fruit weight. Environment (location) and spacing can affect the productivity of birdnest-type melons. Long et al. [12] found that fruit thinning by leaving one fruit per plant one week before harvest increased fruit size, while according to Suzuki [13], melon fruit size was bigger at higher nodes. Lescovar et al. [14] revealed that excessive rainfall during fruit development would reduce marketable yield.

In Sumani Experimental Farm, the average total soluble solid (TSS) of accession C (78M/MB2) was higher than that of the accession B (Tropical) and D (Glamour) and significantly different. In Subang, mean total soluble solid of accession A was lower than that of accession C, while TSS of accession C was higher than that of accession D. The mean TSS of accession A, B, C and accession D in Subang and Banyuwangi were less than 10° Brix.

The average TSS of melon accession A (86H/MB1), B (Tropika), C (78M/MB2) and D (Glamour) that were planted in three locations did not reach 10°Brix, a minimum standard TSS of melon flesh level to be achieved [15]. Based on US Department of Agriculture standard, a high-quality melon fruit is between 9% - 11% soluble solids [16, 17] and in Japan, a melon with TSS less than 10% has no commercial value [18].

<table>
<thead>
<tr>
<th>Accession Codes</th>
<th>Location</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Sumani</td>
</tr>
<tr>
<td>A</td>
<td>12,47 ab *)</td>
</tr>
<tr>
<td>B</td>
<td>11,70 b</td>
</tr>
<tr>
<td>C</td>
<td>12,88 a</td>
</tr>
<tr>
<td>D</td>
<td>11,89 b</td>
</tr>
</tbody>
</table>

Note: A. 86H/MB1; B. Tropika; C. 78M/MB2; D. Glamour
*) numbers followed by the same letters in the same column are not significantly different at the 0.05 level of LSD test.
Table 3: Fruits performance at three locations.

<table>
<thead>
<tr>
<th>Location and Accession Codes</th>
<th>Mean of net (%)</th>
<th>Flesh color</th>
<th>Fruit flavor/ Aroma</th>
<th>Flesh texture</th>
<th>Skin color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sumani</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>86 (smooth)</td>
<td>White</td>
<td>Fragrant</td>
<td>Crispy</td>
<td>Green</td>
</tr>
<tr>
<td>B</td>
<td>89 (smooth)</td>
<td>Whitish green</td>
<td>Fragrant</td>
<td>Medium</td>
<td>Green</td>
</tr>
<tr>
<td>C</td>
<td>86 (coarse)</td>
<td>Orange</td>
<td>Fragrant</td>
<td>Crispy</td>
<td>Green</td>
</tr>
<tr>
<td>D</td>
<td>89 (coarse)</td>
<td>Orange</td>
<td>Fragrant</td>
<td>Crispy</td>
<td>Green</td>
</tr>
<tr>
<td>Subang</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>&lt;50 (smooth)</td>
<td>White</td>
<td>Fragrant</td>
<td>Crispy</td>
<td>Green</td>
</tr>
<tr>
<td>B</td>
<td>&lt;50 (smooth)</td>
<td>Whitish green</td>
<td>Fragrant</td>
<td>Medium</td>
<td>Green</td>
</tr>
<tr>
<td>C</td>
<td>&lt;50 (coarse)</td>
<td>Orange</td>
<td>Fragrant</td>
<td>Crispy</td>
<td>Green</td>
</tr>
<tr>
<td>D</td>
<td>&lt;50 (coarse)</td>
<td>Orange</td>
<td>Fragrant</td>
<td>Crispy</td>
<td>Green</td>
</tr>
<tr>
<td>Banyuwangi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>88.67 (smooth)</td>
<td>White</td>
<td>Fragrant</td>
<td>Crispy</td>
<td>Green</td>
</tr>
<tr>
<td>B</td>
<td>89.50 (smooth)</td>
<td>Whitish green</td>
<td>Fragrant</td>
<td>Medium</td>
<td>Green</td>
</tr>
<tr>
<td>C</td>
<td>64.67 (coarse)</td>
<td>Orange</td>
<td>Fragrant</td>
<td>Crispy</td>
<td>Green</td>
</tr>
<tr>
<td>D</td>
<td>85.67 (coarse)</td>
<td>Orange</td>
<td>Fragrant</td>
<td>Crispy</td>
<td>Green</td>
</tr>
</tbody>
</table>

Note: A. 86H/MB1; B. Tropika; C. 78M/MB2; D. Glamour

The low TSS can be caused by various factors. Wells and Nugent [19] reported that rainfall at the end stages of fruit development affected melon TSS either positively or negatively, depending on cultivar and that TSS was most influenced by rainfall during the 5 days preceding harvest. Lester *et al.* [20] showed that additional water close to harvest produced fruit with lower TSS and greater volume, whilst Wells and Nugent [21] demonstrated that rainfall events close to harvest detrimentally affected TSS of melon fruit.

The maturity of melon fruit at harvest time and plant spacing also affect TSS. Pierce [22] showed that the soluble solid concentration varies with fruit maturity, in which fruits have 8% to 12% soluble solids when harvested at the hard-ripe or early-slip maturity stage, but fruits picked at full slip usually have approximately 15% soluble solid. Maynard and Scott [23] noted that as within-row spacing increases, yield per plant, number of fruits per plant, weight per fruit and percentage of soluble solids increase.

Type of fertilizer and time of fertilization also affected total soluble solid of melon. Tang *et al.* [24] showed that Potassium increased total soluble solid of melon, while Castelanos *et al.* [25] showed that the excess of Nitrogen could reduce the fruit quality such as TSS, increase the central cavity and decrease the edible parts. In some cases, nitrogen does not influence fruit quality attributes, like total soluble solid content [26]. In contrast, Kirnak *et al.* [27] reported that N application generally had little or no effect on total soluble solid.

Overall, the appearance of all melon accession netting at three locations tended to be almost the same (Table 3). In Sumani experimental farm and Banyuwangi, net properties of accession C were generally coarse and the percentage was still lower than the comparators B and D. On accession A, in contrast, the properties of net were smooth although the percentage was still lower than on accession B and D.

Qualitative characters such as flesh color, aroma, texture flash and skin color for accession A and C that were planted at three locations were nearly the same appearance. Accession A planted in Banyuwangi had white flesh color, fragrant, crisp and yellowish-green skin color similar to the original character (white flesh color, fragrant, crisp and yellowish-green skin color). While, accession C had orange flesh color, fragrant, crisp and yellowish-green fruit skin color, a segment about of 10% and not yet stable according to the original character (orange flesh color, fragrant, crisp and yellowish-green fruit skin color). In Subang, accession A and C had coarse nets, less than 50%. It was due to the growth of the fruit not optimal, because the leaves of plant were damaged by leaf spot disease.

Overall, the appearance of accession A and C at all locations were almost the same as the accession of comparator B and D, the commercial melon varieties. Apart from treatment and soil fertility factors, apparently, the fruit size was more influenced by the nature of the plant itself. Higashi *et al.* [28] showed that although cultivar Fuyu A and Natsu 4 have the similarity in genetic background, when grown in the same conditions, the fruits produced by Fuyu A are larger than those produced by Natsu 4.

Melon fruit characters such as fruit flesh color, netting on the fruit skin and aroma are the specific character/genetic diversity of the existing melon cultivars.
Orange-flesh melon is belong to cultivar *Cucumis melo* L, Reticulatus group, while green-fleshed honeydew is belong to cultivar *C. melo* L, inodorous group [29]. Netted melon, which has a netted, suberized, corklike texture on pericarp is belong to Reticulatus melon (*C. melo L. reticulatus* Naud) [30]. Tang *et al.* [31] noted that the variation in aroma depends on the high diversity of melon cultivars and fruit maturity.

**CONCLUSIONS**

From the Analysis and Description Above, it Can Be Concluded That:

- Fruit weight accession A (MB1) and C (MB2) was slightly lower than that of the comparator in Banyuwangi.
- Accession C (MB2) in Banyuwangi had fruit weight slightly lower than the comparator B, while total soluble solid of accession A (MB1) was higher than the comparator. B
- The mean net of melon at the location of Banyuwangi for accession A (MB1) was 88.67% with net texture smooth, while for accession C (MB2) was 64.67% with coarse texture.

**ACKNOWLEDGMENTS**

We are very grateful to the Research Directorate of Community Services, the Directorate General of Higher Education Ministry of National Education of the Republic of Indonesia for funding (SINTA) this work. We would like to thank Mrs. Ir. Yeni Meldia very much for her guidance, advice and attention during the research.

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