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Full Length Article

Evaluation of Different Muskmelon (*Cucumis melo*) Cultivars and Production Systems in Oman

AKINO OHASHI, FAHAD A. AL-SAID[1] AND IQRAR AHMAD KHAN
Department of Crop Sciences, College of Agricultural and Marine Sciences, Sultan Qaboos University, P.O. Box 34, Al-Khoud-123, Muscat, Oman
[1]Corresponding author: faalsaid@squ.edu.om

ABSTRACT

Muskmelon (*Cucumis melo* L.) has great potential to become an important horticultural crop for export from Oman. In this study, 32 muskmelon cultivars (cvs.) were compared with one Omani cultivar for different quality attributes like total soluble solids (TSS), fruit length and weight etc. in spring 2005 to fetch marketable access in Japanese market, where muskmelon regarded as a high-class and sacred fruit. Only eight cultivars produced fruits with TSS in the range of 10-15%. To meet the quality standards set by the Japanese Government for muskmelon imports, cv. Sunrise was further scrutinized for planting in spring and fall season, 2006 by employing conventional Omani cultivation method as control and Japanese methods viz. pinching and disbudding. The TSS did not exceed 13% in all treatments applied in spring and fall seasons. However, muskmelon grown by Japanese methods had less fruit TSS percentage, while significant variation was observed in fruit length, weight and circle ratio than control in spring, while in fall season except TSS, fruit weight, length and width were reduced significantly in all treatments than spring season. No significant difference was observed in circle ratio of fruits when melons were grown by Japanese method in both seasons. Overall studies revealed that Japanese high quality of melon is not primarily due to cultivar characteristic but due to some other factors.

Key Words: Muskmelon; Season; Fruit thinning; Fruit yield; Fruit quality

INTRODUCTION

Muskmelon (*Cucumis melo* L.) traditionally a desert plant with a variety of shapes and flesh color belongs to cucurbitaceae family and highly valued fruit in Japan. Orange-fleshed muskmelon (*Cucumis melo* L., Reticulatus Group) and green-fleshed honeydew (*C. melo* L., Inodorus Group) (hereafter referred to as muskmelon & green honeydew, respectively) melon pieces are common components of fresh-cut fruit products (Saftner & Lester, 2009). However, most of the melons cultivated and sold in Japan are reticulatus melon (*C. melo* L. *reticulatus* Naud.) called "Netted Melon", which has a netted, suberized, cork-like texture on the pericarp. It was introduced from England to Japan in 1923, where it was cultivated only for imperial family (Long, 2005). Since Japan has high annual rainfall and non-suitable temperature for melon cultivation, protected facilities such as vinyl green houses including heating was required to grow melon at that time. Such high cost resulted in only few financial groups and imperial household cultivated melon.

Japanese regard melon as high-class and sacred fruit. This custom still affects Japanese life and netted melon can be sold as a gift as well. Sweetness or sugar content is the most important factor to determine the eating quality of melon fruits (Mutton *et al*., 1981). The average wholesale price for the imported and domestic melon was US$ 1.54 and 4.24 kg^{-1} per fruit in 2006 (Anonymous, 2006) following the standards set 13-15% TSS and 1.2-1.7 kg in combination with perfect circle of yellow, green or orange colored juicy flesh with melting quality fruits (Seko, 1999). In Japan, a melon with less than 10% TSS has no commercial value (Seko, 2004). Fruit thinning done by hand or chemicals is a common technique applied in the commercial production of fruit. Number of fruits per plant i.e., 2, 3, 4 and free setting on net melon production manifested that plants with fewer fruit produced a higher fruit weight with low yield per plant non-etheless higher TSS percentage was achieved in fruits harvested from plants with smaller number of preset fruits (SuGon *et al*. 2003; Purquerio & Filho, 2005). Melon fruit thinning may allow the remaining fruits on vine to grow larger (Long, 2005). Similarly, Long *et al.* (2004) found that fruit thinning leaving one fruit per plant first week before harvest increased the fruit size in combination with TSS percentage that could reach 18%.

Optimum temperature for melon production is 34°C and permissible range is from 10°C to 45°C (Baker & Reddy, 2001). Average high and low temperatures in Japan (Tokyo) are 9°C (January) to 31°C (August) and 1°C

(January) to 24°C (August), respectively Therefore Oman has more favorable climatic conditions than Japan regarding melon production. Similarly the quality of melon cultivated in Oman can be expected to be more sweet and superior to melon produced in Japan, if it is grown by improved cultivation methods. Under these climatic variations, present studies were planned to evaluate the response of different Japanese cultivars and production techniques for quality muskmelon production and to enhance export from Oman to foreign potential markets.

MATERIALS AND METHODS

Experiments were carried out at Agricultural Experimental Station (AES), College of Agriculture and Marine Sciences, Sultan Qaboos University, Muscat, Sultanate of Oman. Seeds of 32 melon cultivars were obtained from Japan and seeding commenced in February, 2005. Five seeds of each cultivar were sown in paper pots filled with Bio-Mix potting substratum soil in a shade house at AES and 40 seeds of a locally available exotic melon cultivar, Polidor-II (*C. melo*) was set as control. At two true leaves, four healthy seedling of each Japanese cultivar and thirty seedlings as control were transplanted to open field with well prepared soil beds of a 2 m gap of each covered with black 300 µ UV + IR polyethylene mulch. Experimental plot in the field consisted of six 30 m long rows. Four seedling of same cultivar planted next to each other as a group having 1 m distance of planting and 1.5 m kept between different cultivars giving a total of 28 seedlings of the seven Japanese melon cultivars in each row. All plants were covered with white agryl net to prevent damage from white fly, wind and sand until female flower started to initiate. The Omani conventional cultivation method was followed to evaluate these cultivars.

In the second experiment, a reference muskmelon cv. “Sunrise” recommended by Ministry of Agriculture in Oman was grown twice in spring and fall, 2006 following Japanese cultivation techniques. A set of 96 seeds was sown in plastic pots filled with power potting soil kept under shade house over an iron mesh table suitable for water drainage. Pots covered with plastic sheet to maintain 30 ± 2°C needed for germination. Field prepared by lying one drip irrigation hose in each row before transplanting. Five days before transplanting (12th day from sowing) iron mesh moved to field to allow the seedling to adjust the field environment for hardening. At fruit set, number of fruits per plant was planned as two, four, six (Japanese production technique) and free setting as control for each row. At leaf senescence, which occurred around 30-45 days from pollination the fruits were analyzed for different quality attributes like fruit length, width, weight and number of fruits per plant as described by Nunez-Palenius *et al*. (2007). Circle ratio was obtained by subtracting width from length and TSS was measured using a Digital Brix refractrometer (Atago PAL-1, 0-53%). Fruit set position was only observed in second study.

The experiments were laid out following Randomized Complete Block Design (RCBD) and replicated three times. Analysis of variance of the data from each attribute was computed using the STATISTICA computer program. The Least Significant Difference test at 5% level of probability was used to test the differences among mean values (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Evaluation trial. There was no significant difference in 32 muskmelon cultivars and Omani cultivar regarding TSS and fruit width inversely the fruit weight, fruit length, circle ratio and number of fruit per plant. TSS was highest in Andersen (15%) followed by Smash melon, Aristo seika and Rock star (12%). Lewis had a TSS of 11% and cultivar Picaso melon, Bonus 2gou and Monami red showed 10% along with control (Table I). Since a minimum TSS of 10% is required for commercial value in Japan (Seko, 2004). Compared with control, average TSS percentage and fruit width of Japanese cultivars showed no significant differences. On the other hand average fruit weight and fruit length of all cultivars was 25% lighter and 15% shorter than control (Fig. 1). This is probably because the number of fruit per plant in the 32 cultivars was higher (75%) than that of control; therefore fruit sizes were smaller than in the control. This is in consistent with reports of Purquerio and Filho (2005) that plants with fewer fruits produced a higher average fruit weight. SuGon *et al*. (2003) reported that fruit weight, leaf number and leaf area decreased with higher fruit number. Seko (2002) reported that average fruit size of melon was increased by leaving one fruit per plant. Long *et al*. (2004) revealed that number of fruits per plant affect TSS in melon but the data of this experiment showed no significant differences, which could be due to little rather than significant variation among 32 cultivars.

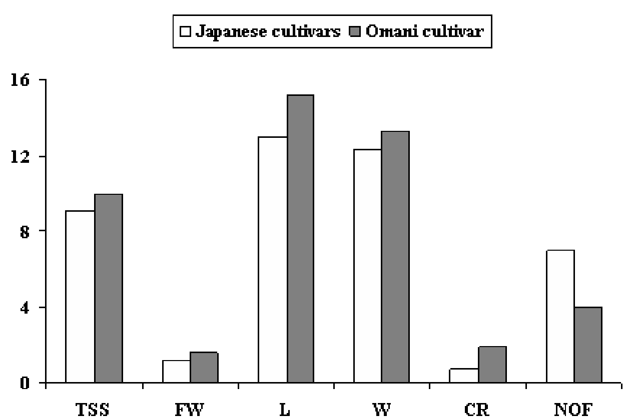
The mean circle ratio of Japanese cultivars and the control was 0.7 and 1.9 respectively, which revealed that the control cultivars have longer fruits relative to their width. Average fruit circle ratio of the 32 cultivars was 63% higher than the control. This may be due to cultivar differences and or smaller fruit size, which itself was due to higher fruit number per plant. These results support the findings of Kamiya (1992) that larger fruits are usually longer and smaller fruits are more circular. From these results, it can be concluded that Japanese high quality melon (specially high TSS) grown in Japan is not primarily due to cultivar characteristics rather than other factors like cultivar adjustability to different climatic conditions (temperature, sunshine, precipitation), management of different cultural practices (fertilization, number of fruits per plant, fruit setting position, trimming & irrigation) and soil condition (soil type & drainage) (Seko, 2004).

Evaluation of Japanese cultivation method for Omani melon (spring & fall, 2006). Sunrise was recommended Omani muskmelon, set as reference cultivar, with no such

Table I. Evaluation of 32 muskmelon cultivars along with control (Omani cultivar) regarding their quality in spring 2005

Cultivar Name	TSS (%)	Weight (kg)	Length (cm)	Width (cm)	No. of fruits per plant^{-1}
Andersen	15.0	1.1	12.2	11.7	6.0
Smash melon	12.0	1.4	14.2	13.2	8.3
Aristo seika	12.0	1.4	15.2	12.7	8.3
Rock star	12.0	1.4	15.2	12.7	5.3
Lewis	11.0	0.8	12.2	11.3	7.3
Picaso Melon	10.0	0.4	8.6	9.0	6.3
Bonus 2gou	10.0	1.2	13.8	12.3	5.8
Monami red	10.0	1.3	12.6	13.8	4.0
Roze	9.5	1.2	13.4	12.4	5.3
Aristo Natsu 2	9.5	1.4	13.3	13.5	3.8
Sky green	9.5	1.1	12.1	12.5	10.3
Syaron 2gou	9.0	1.2	13.4	12.8	5.3
Maple	9.0	0.9	12.5	10.9	7.5
Yubarikei	9.0	1.0	12.1	11.9	10.0
Andes	9.0	1.6	14.1	13.7	4.5
Marionet S1gou	9.0	1.2	13.3	12.6	9.3
Happiness melon	9.0	1.2	12.2	12.9	7.0
Ruiah red	9.0	0.9	11.9	11.9	6.3
Ichiba kouji	9.0	1.3	12.6	12.1	8.5
Syaron 2gou	9.0	0.6	11.0	10.7	7.8
Rolan L	9.0	1.3	13.5	13.4	5.4
Tirol	8.0	1.4	12.6	13.3	3.8
Idol	8.0	1.6	14.7	12.5	7.0
Earl's dance	8.0	1.5	14.4	13.3	10.8
Canal haruakikei	8.0	1.1	12.8	11.8	8.8
Kuruger	8.0	1.1	12.9	12.3	7.5
Napori	7.5	0.8	11.8	10.5	5.8
Maruseiyu	7.0	1.4	14.3	12.5	5.5
Panna	7.0	1.1	12.8	12.0	6.3
Canal 261	7.0	1.1	12.3	12.1	8.8
Ichiba kouji red	7.0	1.2	13.2	12.9	10.8
Earl's Bravo	6.0	1.4	13.8	13.1	6.0
Control	10.0	1.6	15.2	13.3	4.0

Fig. 1. Comparison of different quality attributes in 32 Japanese (average) and Omani muskmelon cultivars, TSS: Total soluble solids (%); FW: Fruit weight (kg); L: Length (cm); W: Width (cm); CR: Circle ratio and NOF: Number of fruits per plant

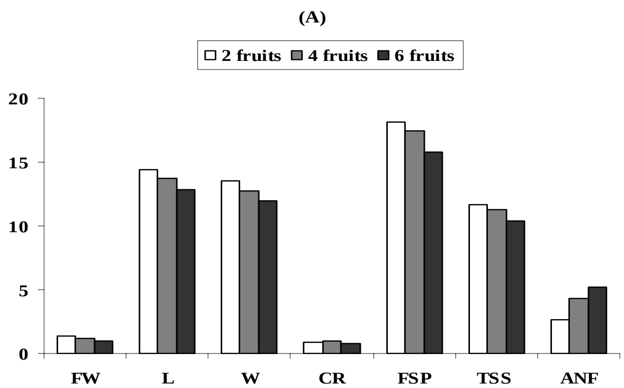


practices, which is evaluated on the basis of Japanese method of plant training i.e., pinching/disbudding (two, four or six fruits per plant). Significant differences were observed in fruit weight, length and width as muskmelon grown by Japanese method in both spring and fall, 2006 conversely circle ratio in both the seasons (Fig. 2). However non-significant results were observed for TSS in spring season but these were significant in fall, 2006. None of the treatments produced 13% TSS, in both spring and fall season. The TSS was 11.7 and 12.4%, respectively for spring and fall season when two fruits were left on the plant. However, no significant difference was observed in average TSS% of fruits cultivated by Japanese methods between spring and fall, 2006 but highly significant differences were observed in case of fruit weight and average fruit weight of muskmelon was 100% higher than fruits harvested in fall, 2006 while fruit length was 37% higher in spring than that of grown in fall. Similarly, fruit width was 24% higher in spring than cultivated in fall, 2006 and fruit setting percentage in spring 2006 was 90% higher than that in fall, 2006. Although two, four and six fruit per plant were retained as treatment after pollination of flowers, the actual number of fruits per plant at harvest was 2.6, 4.3 and 5.2 in spring compared to 2.1, 4 and 5 in fall, 2006. This may be attributed to light intensity, temperature or fruit abortion (Purquerio *et al*., 2003). Fruit set position was at higher nodes in spring when two fruits per plant were left contrary to six fruits per plant in fall. These findings indicated that lesser the number of fruits per plant and larger the size of fruit at harvest. However, no significant interaction of fruit TSS was seen with number of fruits per plant in present studies when melons were grown by Japanese cultivation method.

Comparison of Japanese and Omani cultural practices on muskmelon quality. Interesting results were obtained when muskmelon cultivated by Omani cultural practices. Some results showed significant differences between treatments cultivated by some of the Japanese and the control by Omani cultural practices.

Spring 2006. TSS percentage and fruit width of muskmelon cultivated by Japanese methods was 10 and 5% lower than control. Inversely average fruit weight of muskmelon cultivated by Japanese methods was 50% higher. Similarly, fruit length of muskmelon grown by Japanese methods was 16% longer than control, while circle ratio was significantly on lower side in control (Fig. 3). There were significant differences in average TSS of muskmelon cultivated by Japanese methods, which was 10% lower than the control. This might be due to larger fruit size since average weight and length of melons grown by Japanese methods were 50% and 16% higher than those grown by Omani methods. It is reported that smaller fruit size of net melon have good external and internal qualities but larger fruits tend to have poor netting on the pericarp, pale flesh color, low sugar content and poor fragrance (Kamiya, 1992). In spring 2006 experiment, fruit set position must have arisen on higher nodes than fall because damage by fruit fly necessitated fruit removal and fruit had to be set at higher nodes. According to Kamiya (1992), Wakaume (2001), Seko (2002) and Suzuki (2004), fruit size of melon was larger at higher nodes.

Fig. 2. Effect of Japanese production techniques on Omani muskmelon quality A: spring and B: fall, 2006, FW: fruit weight (kg); L: length (cm); W: width (cm); CR: circle ratio; FSP: fruit set position; TSS: total soluble solids (%) and ANF: actual number of fruits per plant



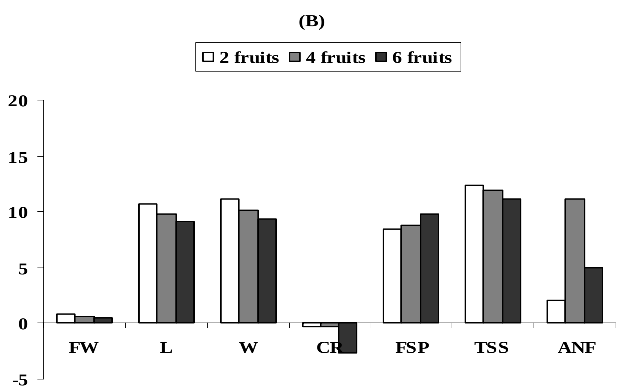
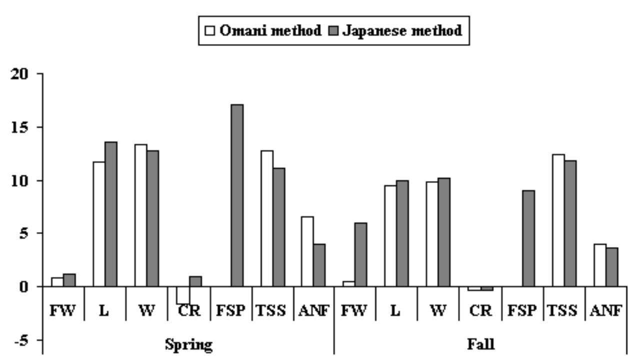


Fig. 3. Comparison of Omani and Japanese cultivation method on muskmelon quality in spring and fall, 2006, FW: Fruit weight (kg); L: length (cm); W: width (cm); CR: circle ratio; FSP: fruit set position; TSS: total soluble solids (%) and ANF: actual number of fruits



Average circle ratio of melons grown by Japanese and Omani methods was 0.9 and -1.6, respectively in the spring, 2006 experiment. Since circle ratio was calculated by subtracting width from length, melon grown by Japanese methods showed a positive circle ratio with longer fruits than those grown by Omani method. This is probably, because a larger fruit is more vertically expanded than a smaller fruit, which has great horizontal expansion fruits (Kamiya, 1992).

Fall 2006. Average TSS, weight, length, width and circle ratio of muskmelon fruits in fall, 2006 did not show significant differences between melons cultivated by Japanese and Omani methods. This is probably because node for fruit bearing position in fall were lowers than in spring. Therefore, average TSS converges because of similar fruit size between the treatment and the control (Fig. 3). Similarly, the average circle ratio did not show differences between melon grown by Japanese and Omani methods. This is probably because fruit set position were not as high as those in spring, 2006, therefore fruit sizes were similar to those of the control.

CONCLUSION

Under both Omani and Japanese muskmelon production techniques, none of the treatments reached 13% TSS. So there is dire need to evaluate other Japanese cultural practices for melon cultivation that would improve TSS such as making ridges in field, comparison of different planting times, more precise irrigation at each growth stage and fertilization that were not practiced in present studies. Since a minimum TSS of 10% is required for commercial value in Japan, eight cultivars having TSS in between 10-15% should be considered for future studies to meet the quality standards set by Japanese Government for muskmelon export.

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