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Characterization of Plant Growth, Yield and Fruit Quality of Rockmelon (*Cucumis melo*) Cultivars Planted on Soilless Culture

¹Norrizah Jaafar Sidik, ¹Saiyidah Nafisah Hashim, ²Yaseer Suhaimi Mohd and ³Shamsiah Abdullah

¹Department of Biology, Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia

²Malaysian Agricultural Research and Development Institute, MARDI Headquarters, P.O. Box 12301, General Post Office, 50774 K.L., Malaysia

³Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia

Corresponding Author: Norrizah Jaafar Sidik, Department of Biology, Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia

ABSTRACT

Rockmelon is belongs to one of Cucurbitaceae family. It is widely cultivated for commercialization. In this experiment, three different rockmelon cultivars were selected to be studied. Seed morphology, plant growth yield and fruit quality of rockmelon cultivars (Glamour, Honeymoon and Champion) planted in coco peat were evaluated. Plant was irrigated through fertigation technique and grown under rain shelter. After five weeks, fruit was harvested and tested for ascorbic acid and Total Soluble Solid (TSS) content. Among all three cultivars studied, seed of rockmelon cv. Glamour measured with highest seed biomass (0.034 g). It also gave the best germination response (99%) with highest seedling height (12.14 cm) and widest leaf area (244.5 cm²). For fruit performance, cv. Honeymoon yielded fruit with highest fresh weight (2.24±0.04 kg) and widest diameter (54.86±0.586 cm). However, overall rockmelon cv. Champion remains as the best quality cultivar studied. The fruit measured with thickest mesocarp (37.23±1.60 mm) and contained with highest percentage of ascorbic acid (30.43%) and TSS (16%). As conclusion, all rockmelon cultivars tested have been successfully grown in coco peat and cv. Champion was the best cultivar to be planted as it gave the best fruit value.

Key words: *Cucumis melo*, cultivar, soilless culture, plant growth, morphology and fruit quality

INTRODUCTION

Rockmelon (*Cucumis melo*) is related to pumpkin, squash, cantaloupe and other plants that vines on the ground. It belongs to Cucurbitaceae family and most of it habitat was found in temperate region of Africa, Central Asia and Mediterranean. Rockmelon which also known as muskmelon is contain with very sweet and juicy tastes. It also enriched with many nutritional values. Rockmelon had caught commercial interest in several countries such as Europe, United States, Mediterranean and Asiatic countries (McCreight *et al.*, 1993). This fruit could bring benefits to country economically including the wild types and numerous varieties (Silberstein *et al.*, 1999). Thus, rockmelon are undoubtedly was one of the most economically important and favorite fruit plants.

Recently, with the increasing in human population, it is noted that there is emphasis on mass vegetable and fruit production all year around. In response towards this demand, Maloupa (2002) had stated that further development is needed to achieve target of optimizing crop yield by intensifying agriculture. This had encouraged in production of selected breed with different varieties that consume with interested genes and could propagate actively. Hybrid plant is one of the plant varieties where in application of this had cause large initiative in production of hybrid rockmelon fruits or known as cultivar.

Malaysia is one of the country that imported seed of rockmelon cultivar from other country especially Europe and Japan. As those cultivars are not originally cultivated in this country, the seed viability and growth response need to be tested. Roach and Wulff (1987) stated that it is important to determine seed dormancy, dispersal and germination rates. Apart from that, the best cultivar needs to be identified. This could be done through quality tests especially on the fruit total sugar content, freshness, weight, vitamin C texture, fruit size, skin color, flesh firmness, acid/sugar ratio and more (Crisosto and Crisosto, 2005).

It is important for the growers and other that involved in the delivery chain to acknowledge the fruit quality in the consumer's perspective by documenting descriptive information on the new fruit cultivars. The information could be a great help for the consumers in cultivars selection as different fruit cultivars may appear with different organoleptic characteristics (Liverani *et al.*, 2002; Crisosto *et al.*, 2003). Thus, this experiment was carried out to identify the best rockmelon cultivar to be planted within soilless culture with high yield, TSS and Vitamin C content.

MATERIALS AND METHODS

Plant materials: Three rockmelon cultivars were selected. Seeds were imported (Glamour, Japan; Honeymoon and Champion, Europe) and they were packed with each packet filled with hundred of seeds. Seeds were weighed and measured. All the cultivars can be harvested between 60-75 days as recommended by the producers.

Seed germination and seedling transferred: Seeds were sown on peat moss filled in germination tray. After a week, germinated seed of all rockmelon cultivars were transferred into coco peat. The experiment was carried out under rain shelter at MARDI, Serdang.

After a month, seedling survival rate were measured. The seedling height was measured started from the lower part of the stem till the shoot apex. Twenty leaves were randomly chosen from each plant cultivar and the leaves areas were measured.

Flower measurement: At fifth week, flower developed and the flower genders were identified. Flower color was recognized and it height, width and number of petals was measured.

Fruit quality attributes: On the seventh to eight weeks after seedling transferred and grown in coco peat, fruits were harvested and its fresh weight was weighed and diameters were measured. Fruits were cut into half and the length of fruit mesocarp (flesh) and exocarp (skin) were measured using vernier caliper. The color of the fruit mesocarp was observed and classified subjectively. Brix test was analyzed by using Agate PR-1 hand refractometer.

Dichlorophenolindophenol (DCPIP) test were used to identify the Vitamin C content. 0.1% ascorbic acid was used to decolorize blue DCPIP solution. Drop by drop of fruit juice were titrated into 1 mL of DCPIP solution and stopped until the solution decolorized. Then the percentage of Vitamin C was calculated (Ranganna, 1977).

Statistical analysis: The statistical analysis was carried by using analysis of variance (ANOVA) performed by SAS (Statistical Analysis Software). Means were separated by Tukey's test and statistical significance was accepted when the probability is equal or less than 0.05 ($p \leq 0.05$).

RESULTS AND DISCUSSION

Seed morphology: Figure 1 shows images and colors of the rockmelon cultivars seeds. The thickness of the seed coat was within 0.5 mm and with small pressured, seed was easily to break up. From the observation of the seed's structure, all seeds have tip ends at the front and rounded bottom shape. This defined the unique characteristics of angiosperm plant which allow the seed testa to break down easily during the germination process (Krempels, 2011).

Seed biomass, length and width were recorded in Table 1. Seed of cv. Glamour performed with highest biomass (0.03 g), length (0.96 cm) and width (0.45 cm) measurement. There was a significant different ($p \leq 0.05$) in seed biomass of all cultivars. Meanwhile there were no significant differences ($p \geq 0.05$) on the seed length and width between all cultivars.

Germination rate and survival rate: After a week the seeds were germinated and during the germination process, imbibitions process induced the whole seed to germinate by put out the pressure from the water that used to swollen the seed. As a result the seed ruptured and radical emerged (Ehiagbonare and Onyebi, 2009).

Plant germination rate were analyzed and cv. Glamour gave the highest germination rate (99%) compared to other cultivars (Fig. 2). There were significant different ($p \leq 0.05$) in the germination rate between all cultivars. From result analysis, it was found that rockmelon cv. Glamour with highest seed weight, width and length allow large water uptake during imbibitions

Table 1: Seed biomass, length and width for different rockmelon cultivars

Cultivars	Seed biomass (g)	Seed length (cm)	Seed width (cm)
Glamour	0.03±0.0002 ^a	0.96±0.07 ^a	0.45±0.01 ^a
Honeymoon	0.02±0.0002 ^b	0.96±0.03 ^a	0.43±0.01 ^a
Champion	0.02±0.0001 ^b	0.93±0.01 ^a	0.44±0.01 ^a

Means followed by the same letters within each column did not differ significantly at $p > 0.05$



Fig. 1(a-c): Seed of different rockmelon cultivars (a) Glamour (light yellow), (b) Honeymoon (metallic red) and (c) Champion (light yellow)

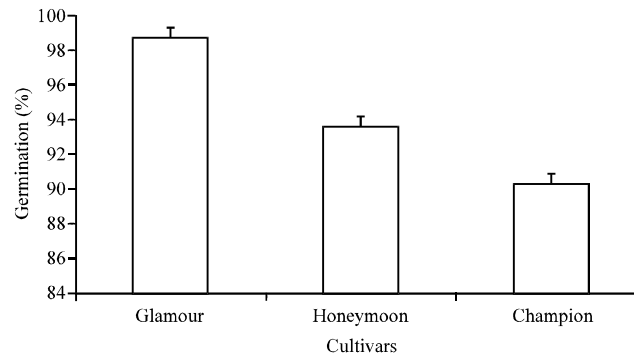


Fig. 2: Seed germination of different rockmelon cultivars

Table 2: Plant leaf area, seedling height and growth rate of 3 rockmelon cultivars

Cultivars	Leaf area (cm ²)	Seedling height (cm)	Growth rate (cm day ⁻¹)
Glamour	244.50±1.84 ^a	12.14±0.20 ^a	4.97 ^a
Honeymoon	208.20±0.28 ^a	7.61±0.21 ^c	3.67 ^c
Champion	132.60±0.57 ^a	10.12±0.23 ^b	3.89 ^b

Means followed by the same letters within each column did not differ significantly at $p \geq 0.05$

by seed to germinate successfully. Obroucheva and Antipova (1997) stated that imbibition between seeds differs very much in relation to the seed weight, permeability, size, structure, chemical composition and seed-water contact areas. This statement further strengthen by Malcolm *et al.* (2003) that revealed heavier seeds have a higher germination percentage and germinate faster.

Succesfully germinated seedling was transplanted to the coco peat and successfully grew with 100% survival rate. Sheldrake (1989) further stated that special characteristics of coco peat with high water hold availability give a good aeration to root zone. It is also are environmentally sustainable and lots of other research were succeed on applying it as the plant growth media (Reynolds, 1974; Meerow, 1994). All those three cultivars studied was found able to grow on coco peat and can be cultivated on this tropical country within the tropical temperature.

Plant vegetative growth: After four weeks, the seedling total leaf area, height and growth rate were measured (Table 2). Result shows that cv. Glamour had the widest leaf area ($244.5 \pm 1.84 \text{ cm}^2$), the highest plant height ($12.14 \pm 0.20 \text{ cm}$) and the most rapid growth rate (4.97 cm day^{-1}). From statistical analysis, there were significant differences ($p \leq 0.05$) in the seedling height and plant growth rate. Meanwhile, there were no significant different ($p \geq 0.05$) in the leaf area between each rockmelon cultivars studied. Result demonstrated that leaf area may be the factor that influenced the plant height and growth rate. The result is corroborated with Heagle *et al.* (1983) and Balasubramanian *et al.* (2007) findings that the seedling growth rate was directly proportional with the plant leaf area.

Plant flowering stage: During the flowering stage, flowers gender were identified (Fig. 3) and each of the flower's length and width were measured (Fig. 4). All cultivar's flower comprised 5 numbers of petals with yellow color for both male and female. Flower gender was recognized by

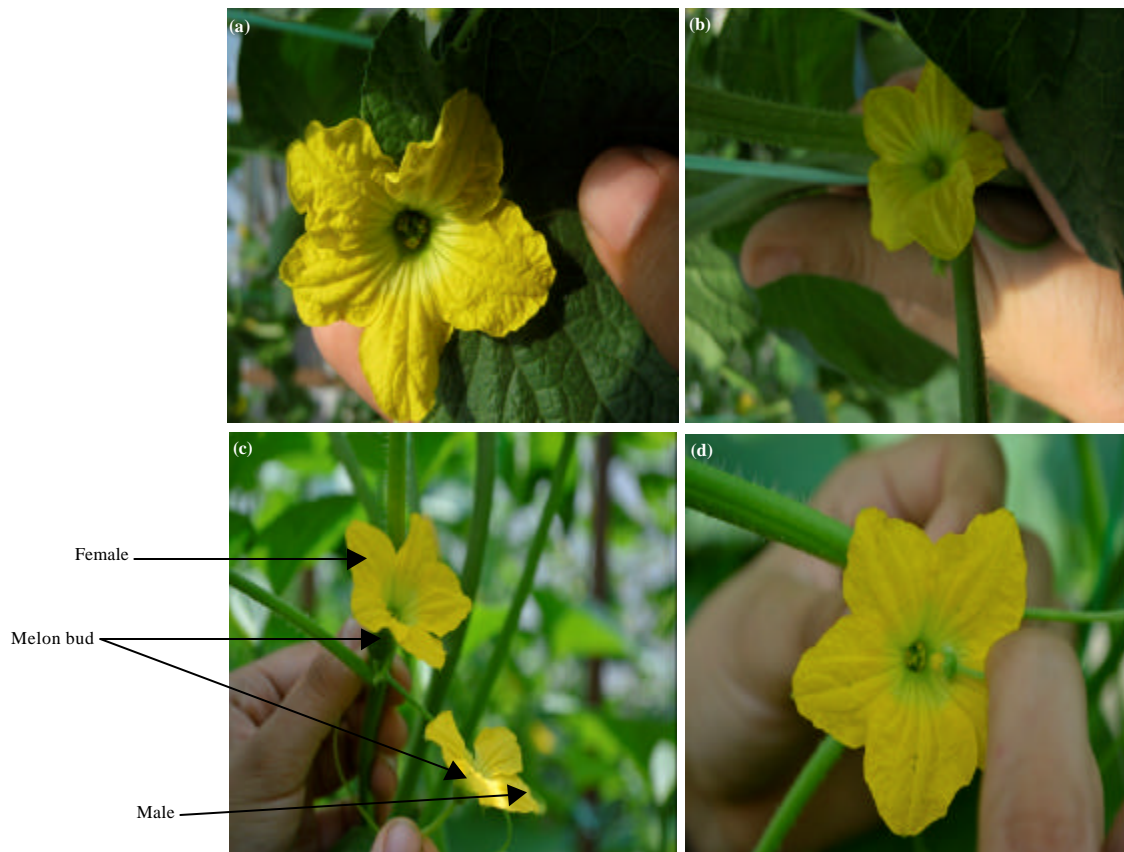


Fig. 3(a-d): (a) Female flower, (b) Male flower, (c) Male and female flower differentiate by the size of its bud and (d) Male flower's petals were removed and pollen was stuck on the sticky stigma for fertilization

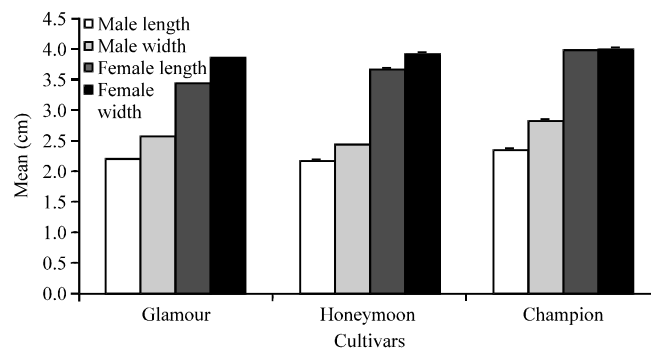


Fig. 4: Height and width of male and female flower after 5 weeks

the size of the flower bud where female had a larger bud compared to male. Female flower consists of sticky plane that allowed the pollens from male flower to attach and fertilized the female egg. During the experiment, pollination process was done manually.

Female flower's length and width was much larger compared to the male flower. Rockmelon cv. Champion has shown the longest and widest flower size with male (2.37 ± 0.01 , 2.85 ± 0.01 cm) and female (3.98 ± 0.01 , 4 ± 0.04 cm). There was a significant different ($p \leq 0.05$) on the male and female flower length and width for all rockmelon cultivars.

Fruit diameter and fresh weight: Within seven to eight weeks, fruit was harvested. Rockmelon cv. Honeymoon gave the highest value for the fruits diameter (54.86 ± 0.59 cm), followed by cv. Glamour (53.18 ± 0.43 cm) and cv. Champion (51.94 ± 0.50 cm). There was a significant different ($p \leq 0.05$) in the fruit diameter of all cultivars.

Data for the fruit fresh weights was presented (Table 3) and cv. Honeymoon gave the highest fruit fresh weight (2.24 ± 0.04 kg). There was no significant different ($p \geq 0.05$) in the fruit fresh weight between all cultivars. Result shows that cv. Honeymoon had the largest fruit diameter (Fig. 5) and fruit fresh weight (Table 3). It was found that both fruit diameter and fresh weight were significantly related ($p \leq 0.05$). The remark was similar with previous studied by Viera *et al.* (1981) where increment in fruit's diameter also significantly contribute in the increment of the fruit's fresh weight. Thus, highest fruit's fresh weight might be due to the high fruit's diameter.

Fruit was cut into halves and each cultivar gave different color of mesocarp (flesh). The mesocarp and exocarp (skin) length was measured which represents the thickness of the fruit's skin. Result shows that cv. Champion gave the longest mesocarp (37.23 ± 1.60 mm) and exocarp (11.93 ± 0.92 mm) (Table 3). There were significant differences ($p \leq 0.05$) in the length of fruit mesocarp and exocarp for all rockmelon cultivars tested.

Total soluble solids (TSS) and ascorbic acid: Crisosto and Crisosto (2005) had stated that the degree of consumer preferences was significantly related to the TSS. However, the acceptance value for maximum TSS was depended on the cultivar. The fruits color, TSS and ascorbic acid of fruits

Table 3: Fruits fresh weight, mesocarp and exocarp thickness of different rockmelon cultivars

Cultivars	Fresh weight (kg)	Mesocarp thickness (mm)	Exocarp thickness (mm)
Glamour	1.86 ± 0.06^a	32.77 ± 0.47^a	4.57 ± 0.18^b
Honeymoon	2.24 ± 0.04^a	33.51 ± 1.79^a	4.55 ± 0.13^b
Champion	2.23 ± 0.19^a	37.23 ± 1.60^b	11.93 ± 0.92^a

*Means followed by the same letters within each column did not differ significantly at $p \geq 0.05$

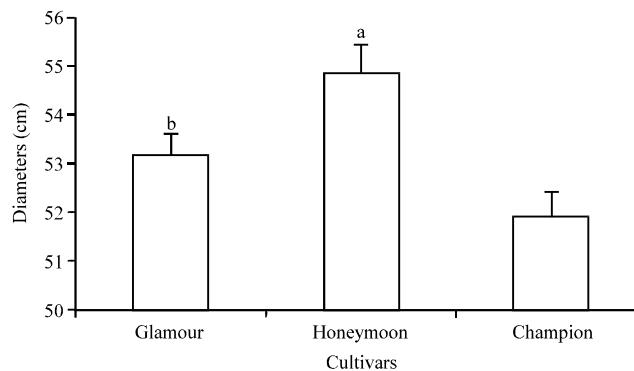


Fig. 5: Fruit diameter of different rockmelon cultivars, *Means followed by the same letters did not significantly differ by Tukey test at $p \geq 0.05$

Table 4: Fruit's color, ascorbic acid percentage and total soluble solids for different cultivars

Cultivars	Flesh color	Ascorbic acid (%)	TSS (%)
Glamour	Slightly orange	28.00 ^b	14 ^b
Honeymoon	Whitish orange	14.58 ^c	12 ^c
Champion	More orange	30.43 ^a	16 ^a

Means followed by the same letters within each column did not differ significantly at $p \geq 0.05$

were measured on each cultivar. Table 4 shows that cv. Champion gave the highest value for TSS (16%) which represented the highest amount of sugar content. Similar to the fruit's ascorbic acid constituent, cv. Champion contained the highest vitamin C percentage (30.43%). There were significant differences in the fruit vitamin C and TSS for all rockmelon cultivars studied ($p \leq 0.05$). Among all the cultivars, cv. Champion brought up the finest quality fruit based on its vitamin C value and the TSS.

Through comparison between all the cultivars studied, the fruit quality was evaluated based on its TSS and vitamin C content. Cultivars were arranged in descending order: Champion>Glamour >Honeymoon. For the flower data during flowering stage, cv. Champion had the longest and widest male and female flower. In the same time it also discovered that cv. Champion perform good fruit quality preference. This shown that the flower size may affect the fruit quality. Studied found that there were significantly related between the flower length and width to the fruit TSS and Vitamin C content ($p \geq 0.05$).

CONCLUSION

All three rockmelon cultivars were able to survive and growth using soilless culture system. Rockmelon cv. Glamour shows the best seed morphology and plant growth performance. Results revealed that the highest leaf areas contribute to highest plant growth rate. Other than that, highest fruit's fresh weight seemed to be influenced by the high fruit's diameter because cv. Honeymoon produced heaviest and largest fruit diameter. Rockmelon cv. Champion shows the best fruit preferences with high quality as the fruit mesocarp was thick and nutritive contained with large number of vitamin C and TSS.

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