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Growth Performance, Yield Components, and Consumer Preference of Eleven Muskmelon Varieties in Songkhla Province

Karistsapol Nooprom*, Kamonthip Nicomrat, Supakracha Apiratikorn and Pawika Boonyapipat
Faculty of Agricultural Technology, Songkhla Rajabhat University, Songkhla

*Corresponding author e-mail: karistsapol.no@skru.ac.th
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ABSTRACT

The objective of this study was to evaluate the responses of eleven muskmelon varieties in terms of growth performance, yield components, and consumer preference. The experiment was conducted under greenhouse conditions in Songkhla Province, southern Thailand, using a completely randomized design (CRD) with three replications and twelve plants per replication. Results revealed significant differences ($P \leq 0.05$) among the muskmelon varieties. Green Shizuoka, Orange Pearl and Takami exhibited superior growth performance, particularly in stem diameter and leaf area index (LAI), and reached harvest maturity earlier than the other varieties, with harvest dates occurring 1.56 to 2.44 days earlier. Orange Pear, Green Rocky and Orange Rocky produced higher yield components, including fruit length, width, and weight. Regarding fruit quality, Green Pearl and Alpha had the highest total soluble solids, with 15.77 ° Brix and 15.31 ° Brix, respectively. Consumer preference, evaluated using a nine-point hedonic scale, indicated that Green Rocky, Orange Rocky and Alpha received higher mean scores for taste (7.40–8.00), texture (7.30–8.00), and overall liking (7.45–8.17) than the other varieties. Therefore, Orange Pearl, Green Rocky, Orange Rocky and Alpha were identified as the most suitable varieties for comercial production in Songkhla Province and surrounding areas of southern Thailand.

Keywords: muskmelon, growth performance, yield components, consumer preference, greenhouse cultivation

Introduction

Muskmelon (*Cucumis melo* var. *reticulatus*) is a member of the *Cucurbitaceae* family, which also includes watermelon, squash, pumpkin, gourd, and cucumber [1]. The species is believed to have originated in central Africa and subsequently spread rapidly to Asia, where a

wide range of varieties were developed through selection [2]. Numerous botanical varieties of muskmelon have been described, such as netted melons, cantaloupe melons, winter melons, snake melons, and mango melons. Technically, “cantaloupe” refers only to those muskmelons with a rough, warty rind, although the term is often used interchangeably with netted muskmelons [3].

Muskmelon is one of the most economically important and widely consumed fruit vegetables in many parts of the world [4], particularly in China, Turkey, the United States, Spain [5], and Brazil. China is the leading producer, accounting for approximately 62 % of global production, followed by Turkey and Brazil [6]. The fruit is popular among consumers for its sweet flavor, pleasant aroma, and high nutritional value. Muskmelon is a rich source of vitamins A and C [7] and contains antioxidant compounds that can protect body cells against cancer [8]. Additionally, it is low in calories and fat, making it a healthy fruit choice.

In recent years, muskmelon has gained popularity among consumers in southern Thailand because of its sweetness, fragrance, and nutritional benefits. The Malaysian market has also imported melons from southern Thailand, especially from border provinces such as Narathiwat and Songkhla. However, the cultivated area remains limited compared to market demand. In southern Thailand, muskmelon cultivation remains limited, resulting in inadequate production to satisfy both domestic consumption and export markets. Promoting melon cultivation among local farmers could therefore create valuable economic opportunities at household and national levels.

Greenhouse cultivation is preferred by farmers because it helps prevent pest infestation and protects plants from unfavorable environmental conditions. Melons require consistent management and proper care to achieve high fruit quality. In southern Thailand’s tropical climate, fungal diseases such as downy mildew, Fusarium wilt, and mosaic leaf disease are prevalent, which can severely affect productivity. Moreover, yield and fruit quality vary greatly among cultivars, as different varieties exhibit distinct adaptability to local environmenttal conditions [9]. A wide range of melon varieties, both locally bred and imported, are currently available in Thailand [10]. This study aimed to evaluate the growth performance, yield components, and consumer preference of eleven muskmelon varieties to identify suitable cultivars for commercial production in Songkhla Province and adjacent provinces.

Materials and Methods

1. Materials and methods

The experiment was conducted in a greenhouse at the Faculty of Agricultural Technology, Songkhla Rajabhat University, Songkhla Province, southern Thailand. Eleven muskmelon varieties—Galia, Jing Yuan, Green Shizuoka, Orange Sakura, Takami, Green Pearl, Orange Pearl, Green Rocky, Orange Rocky, Ichiba, and Alpha—were evaluated under controlled conditions. The experiment followed a Completely Randomized Design (CRD) with three replications and twelve plants per replication. Seeds were sown in seedling trays filled with peat moss (Y.V.P. Inter Trade Co., Ltd.). Seedlings with two to three true leaves were transplanted into polyethylene bags (8 cm diameter × 13 cm length) containing a 1:1 (v/v) mixture of coarse sand and coconut coir dust. The growing bags were arranged with a planting spacing of 50 × 80 cm inside the greenhouse. A nutrient solution modified from Thong-aram [11] was supplied through a drip fertigation system four times daily, with each irrigation lasting 15 minutes. Throughout the experiment, the nutrient solution was maintained at pH 5.8–6.5 and an electrical conductivity (EC) of 2.0–3.0 mS cm^{-1}. No insect pest control was required because the greenhouse structure effectively prevented pest intrusion. Weeds were removed manually by hand-pulling, and no disease control measures were applied in order to assess the natural disease tolerance of each variety under greenhouse conditions.

2. Growth observations

Seedling survival rate was recorded at 30 days after transplanting (DAT). Leaf area index (LAI) was measured using a CI-202 Portable Laser Leaf Area Meter (CID Bio-Science, USA). The number of days from transplanting to first flowering and to harvest was recorded for each variety. Stem diameter was measured at 2 cm above the soil surface before har-vest. Fruits were harvested at the full-slip stage, identified by cracking at the abscission layer, and then incubated for three days prior to yield evaluation.

3. Yield and fruit quality measurements

Yield components—including fruit weight, fruit length, fruit width, pulp thickness, rind thickness, fruit cavity length, and cavity width—were measured using five replicates per variety. Total soluble solids (TSS) were determined with a refractometer and expressed in °Brix. Fruit firmness was analyzed using a texture analyzer (HDP/BS blade set, 5 kg load cell) with a test speed of 5.0 mm s^{-1}, a distance of 38 mm, and a post-test speed of 10 mm s^{-1}.

4. Sensory evaluation

For consumer preference testing, samples were cut into 1-inch-thick slices and fur-ther divided into four equal portions. Each sample was coded with a random three-digit number and presented individually to 30 untrained panelists aged 20–22 years, recruited from students at Songkhla Rajabhat University. A nine-point hedonic scale (1 = dislike extre-mely, 5 = neither like nor dislike, 9 = like extremely) was used to evaluate appearance, taste, texture, and overall liking. Evaluations were conducted in individual booths under con-trolled sensory conditions, with samples served at room temperature within 1 hour after slicing.

5. Statistical analysis

All growth and yield data were analyzed using analysis of variance (ANOVA). Mean comparisons were performed using Duncan's Multiple Range Test (DMRT) at the 5 % signi-ficance level.

Results and Discussion

1. Growth parameters

The growth performance of the eleven muskmelon varieties showed significant varia-tion in stem diameter, leaf area index (LAI), days to first pollinated flower, and days to har-vest (Table 1). Jing Yuan exhibited the greatest stem diameter (10.64 mm), which was not significantly different ($P \leq 0.05$) from Galia, Green Shizuoka, Takami, Orange Pearl, Green Pearl, and Orange Rocky (ranging from 9.87 to 10.62 mm). In contrast, Alpha and Green Rocky recorded the smallest stem diameters at 8.74 mm and 8.33 mm, respectively. Higher LAI values were observed in Galia, Jing Yuan, Green Shizuoka, Orange Sakura, Takami, Green Pearl, Orange Pearl, and Green Rocky, with values ranging from 377.80 to 429.96. The lowest LAI values were found in Ichiba (332.07) and Alpha (293.93).

The earliest occurrence of the first pollinated flower was observed in Orange Rocky, Galia, Alpha, Green Pearl, and Green Rocky, appearing between 12.44 and 13.78 days after transplanting (DAT). In contrast, Green Shizuoka, Takami, and Orange Pearl showed the latest flowering dates, ranging from 15.00 to 16.33 DAT.

For the harvest period, Takami reached maturity earliest at 44.66 DAT, which was not significantly different ($P \leq 0.05$) from Green Shizuoka and Orange Pearl (44.67–46.11 DAT). The latest harvests were recorded in Galia, Green Pearl, Green Rocky, Orange Rocky, Ichiba, and Alpha, which matured between 47.22 and 48.55 DAT.

Table 1 Stem diameter, leaf area index, days to first pollinated flower, and days to harvest of eleven muskmelon varieties grown under greenhouse conditions in southern Thailand

Varieties	Stem diameter (mm)	Leaf area index (LAI)	Days to first pollinated flower (DAT)	Days to harvest (DAT)
Galia	10.62^{a}	425.43^{a}	12.66^{e}	48.39^{a}
Jing Yuan	10.64^{a}	401.75^{ab}	14.66^{bc}	46.33^{b}
Green Shizuoka	10.35^{ab}	423.73^{a}	16.39^{a}	44.67^{c}
Orange Sakura	9.59^{bc}	421.85^{a}	14.55^{bcd}	46.22^{b}
Takami	10.24^{ab}	429.96^{a}	16.33^{a}	44.66^{c}
Green Pearl	10.15^{ab}	413.19^{a}	13.11^{de}	47.89^{a}
Orange Pearl	10.20^{ab}	404.80^{ab}	15.00^{ab}	46.11^{bc}
Green Rocky	8.83^{d}	377.80^{abc}	13.78^{bcde}	47.22^{ab}
Orange Rocky	9.87^{abc}	353.77^{bc}	12.44^{e}	48.55^{a}
Ichiba	9.22^{cd}	332.07^{cd}	13.44^{cde}	47.55^{ab}
Alpha	8.74^{d}	293.93^{d}	12.89^{e}	48.11^{a}
F-test	*	*	*	*
C. V. (%)	4.29	7.63	5.56	1.79

DAT = Days after transplanting

* = Means with the same letter are not significantly different (P ≤ 0.05) by DMRT.

2. Yield component parameters

Significant differences were observed among the eleven muskmelon varieties for all yield components (Table 2). Orange Pearl produced the heaviest fruits (1.56 kg), which was

not significantly different (P ≤ 0.05) from Green Rocky (1.53 kg) and Orange Rocky (1.41 kg). The remaining varieties had lower fruit weights, ranging from 1.02 to 1.36 kg.

Green Rocky produced the longest fruits (15.27 cm), which was statistically similar (P ≤ 0.05) to Orange Pearl, Orange Rocky, and Galia (14.12–13.91 cm). Medium fruit lengths were recorded in Green Shizuoka, Orange Sakura, Green Pearl, and Ichiba (12.63–12.97 cm), while

Table 2 Fruit weight, fruit length, fruit width, pulp thickness, and fruit coat thickness of eleven muskmelon varieties grown under greenhouse conditions in southern Thailand

Varieties	Fruit weigh (kg)	Fruit length (cm)	Fruit width (cm)	Pulp thickness (mm)	Fruit coat thickness (cm)
Galia	1.36^{b}	3.94^{abcd}	13.97^{a}	3.16^{b}	1.01^{ab}
Jing Yuan	1.02^{d}	11.96^{ef}	12.70^{ab}	2.81^{c}	0.76^{cd}
Green Shizuoka	1.07^{d}	12.63^{de}	12.47^{ab}	2.86^{c}	0.65^{de}
Orange Sakura	1.18^{cd}	2.97^{bcde}	13.30^{ab}	2.87^{c}	0.78^{cd}
Takami	1.10^{d}	11.78^{ef}	13.04^{ab}	2.90^{bc}	0.75^{cd}
Green Pearl	1.30^{bc}	12.82^{cde}	13.43^{ab}	3.54^{a}	0.94^{ab}
Orange Pearl	1.56^{a}	14.24^{ab}	13.99^{a}	3.44^{a}	0.88^{bc}
Green Rocky	1.53^{a}	15.27^{a}	13.69^{ab}	3.10^{bc}	0.55^{e}
Orange Rocky	1.41^{ab}	14.12^{abc}	13.81^{ab}	3.18^{b}	0.72^{cd}
Ichiba	1.32^{bc}	12.73^{cde}	13.46^{ab}	3.09^{bc}	0.76^{cd}
Alpha	1.15^{cd}	10.81^{f}	12.32^{b}	2.97^{c}	1.05^{a}
F-test	*	*	*	*	*
C.V. (%)	7.24	5.74	6.26	4.88	10.7

* = Means with the same letter are not significantly different (P ≤ 0.05) by DMRT.

Alpha, Jing Yuan, and Takami produced the shortest fruits (10.81–11.78 cm).

For fruit width, Orange Pearl had the widest fruits (13.99 cm), although the difference was not statistically significant ($P \leq 0.05$) compared with the other varieties (12.61–13.97 cm).

Regarding pulp thickness, Green Pearl exhibited the highest value (3.54 cm), which was not significantly different ($P \leq 0.05$) from Orange Pearl (3.44 cm). Orange Rocky, Galia, Green Rocky, Ichiba, Alpha, and Takami showed moderate pulp thickness (2.90–3.18 cm), whereas Green Shizuoka, Orange Sakura, and Jing Yuan had the lowest values (2.81–2.87 cm).

The thickest rind was found in Alpha (10.05 mm), followed by Galia (10.01 mm) and Orange Pearl (9.40 mm), with no significant differences among them ($P \geq 0.05$). Orange Sakura, Jing Yuan, Ichiba, Takami, and Orange Rocky had moderate rind thickness (7.20–8.80 mm), while Green Shizuoka and Green Rocky had the thinnest rinds (5.55 mm and 6.50 mm, respectively).

No specific control variety was designated in this study because the objective was to compare the growth, yield, and quality performance across all eleven varieties under identical conditions. Therefore, all varieties were evaluated equivalently without assigning a control treatment.

Significant differences were observed among the eleven muskmelon varieties in fruit cavity dimensions and total soluble solids (TSS) (Table 3). Green Rocky and Orange Pearl showed the greatest fruit cavity lengths, measuring 9.38 and 9.12 cm, respectively. These were followed by Galia, Orange Sakura, Orange Rocky, and Ichiba, which recorded moderate cavity lengths ranging from 7.35 to 8.44 cm. The remaining varieties had shorter fruit cavity lengths of 6.48 to 6.83 cm.

The widest fruit cavity was found in Alpha (6.82 cm), although it was not significantly different ($P \leq 0.05$) from Galia, Orange Sakura, Orange Pearl, Orange Rocky, and Ichiba, which ranged from 6.07 to 6.45 cm. Jing Yuan, Green Shizuoka, Takami, and Green Pearl recorded narrower cavity widths of 5.43 to 5.78 cm.

Regarding fruit quality, the highest TSS values were observed in Green Pearl (15.77 °Brix) and Alpha (15.31 °Brix), with no significant difference ($P \leq 0.05$) between them. Moderate TSS levels were found in Orange Sakura, Orange Pearl, Green Rocky, Jing Yuan, Green Shizuoka, and Orange Rocky (12.42–13.69 °Brix), while Galia, Takami, and Ichiba exhibited lower TSS values (10.88–11.26 °Brix).

Table 3 Fruit cavity length, fruit cavity width, firmness, and total soluble solid of eleven muskmelon varieties grown under greenhouse conditions in southern Thailand

Varieties	Fruit cavity length (cm)	Fruit cavity width (cm)	Firmness (g)	Total soluble solid (ºBrix)
Galia	8.44^{b}	6.14^{abc}	2,520.00^{a}	11.26^{d}
Jing Yuan	6.48^{d}	5.63^{cd}	1,447.00^{c}	12.72^{c}
Green Shizuoka	6.83^{d}	5.43^{d}	1,470.00^{c}	12.71^{c}
Orange Sakura	7.35^{c}	6.18^{ab}	1,397.00^{c}	13.69^{b}
Takami	6.76^{d}	5.70^{bcd}	2,009.00^{b}	11.31^{d}
Green Pearl	6.81^{d}	5.78^{bcd}	1,408.00^{c}	15.77^{a}
Orange Pearl	9.12^{a}	6.07^{abc}	1,380.00^{c}	13.61^{b}
Green Rocky	9.38^{a}	6.28^{a}	2,623.00^{a}	13.22^{bc}
Orange Rocky	8.25^{b}	6.45^{a}	1,909.00^{b}	12.42^{c}
Ichiba	7.64^{c}	6.36^{a}	2,012.00^{b}	10.88^{d}
Alpha	6.54^{d}	6.82^{a}	2,084.00^{b}	15.31^{a}
F-test	*	*	*	*
C.V. (%)	3.22	4.34	5.45	3.46

* = Means with the same letter are not significantly different (P ≤ 0.05) by DMRT.

Based on sensory evaluation, panelists preferred muskmelon varieties with a combination of firm texture and high sweetness. The most favored cultivars were Green Rocky (high firmness, moderate sweetness), Alpha (moderate firmness, high sweetness), and Orange Rocky (moderate firmness, moderate sweetness). In contrast, varieties such as Galia (high firmness,

low sweetness), Jing Yuan (low firmness, moderate sweetness), and Green Pearl (low firmness, high sweetness) received lower overall acceptance scores.

The present study revealed that the muskmelon varieties could be classified into two groups based on fruit coat color. The light-orange-rind group consisted of Galia, while the green-rind group included Ichiba, Jing Yuan, Takami, Green Pearl, Green Shizuoka, Green Rocky, Orange Sakura, Orange Rocky, Alpha, and Orange Pearl.

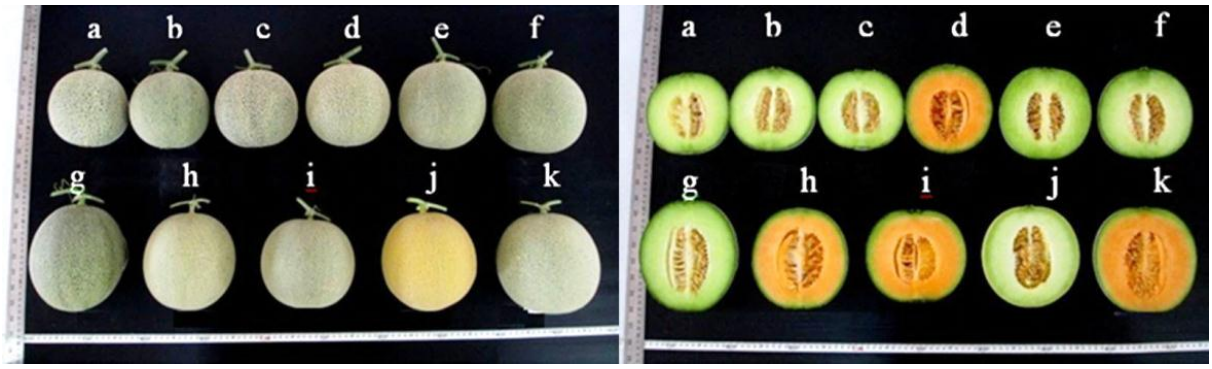

Figure 1 External and internal fruit characteristics of eleven muskmelon varieties at harvest stage: (a) Ichiba, (b) Jing Yuan, (c) Takami, (d) Orange Sakura, (e) Green Pearl, (f) Green Shizuoka, (g) Green Rocky, (h) Orange Rocky, (i) Alpha, (j) Galia, and (k) Orange Pearl.

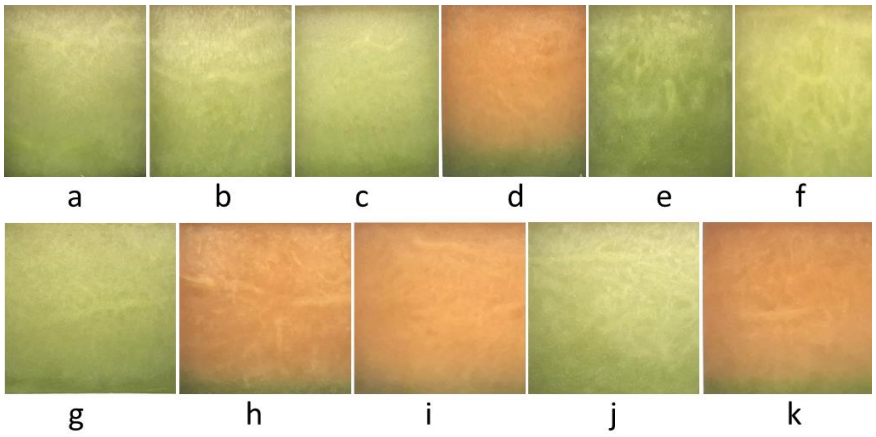

Figure 2 Pulp color and internal characteristics of eleven muskmelon varieties at harvest stage: (a) Ichiba, (b) Jing Yuan, (c) Takami, (d) Orange Sakura, (e) Green Pearl, (f) Green Shizuoka, (g) Green Rocky, (h) Orange Rocky, (i) Alpha, (j) Galia, and (k) Orange Pearl.

Pulp color was categorized into three groups. The white-pulp group comprised Galia; the light-green-pulp group included Ichiba, Jing Yuan, Takami, Green Pearl, Green Shizuoka, and Green Rocky; whereas Orange Sakura, Orange Rocky, Alpha, and Orange Pearl were

grouped as light-orange-pulp cultivars. These color variations at harvest are illustrated in Figures 1 and 2.

3. Sensory evaluation

The sensory evaluation of eleven muskmelon varieties, conducted using a 9-point hedonic scale, revealed no significant differences ($P > 0.05$) in appearance liking among the varieties, with mean scores ranging from 6.50 ± 1.10 to 7.82 ± 0.63. Green Rocky received the highest taste score (8.00 ± 0.90), which was not significantly different from Orange Sakura, Orange Rocky and Alpha (7.20 ± 1.10–7.94 ± 0.65). Similar trends were observed for texture and overall liking. Green Rocky achieved the highest texture and overall liking scores (8.00 ± 0.97 and 8.17 ± 0.85, respectively), though the differences were not significant compared with Orange Rocky and Alpha, which scored 7.30 ± 1.08–7.59 ± 0.61 for texture and 7.45 ± 0.88–7.94 ± 0.65 for overall liking. These results indicate that Green Rocky, Orange Rocky and Alpha were the most preferred varieties in terms of taste, texture, and overall acceptability among consumers (Table 4).

The growth performance of the eleven muskmelon varieties, including flowering and harvesting times, reflects their unique genetic backgrounds and breeding histories. This variation aligns with previous studies showing that plant growth characteristics are largely determined by genetic factors and their interaction with the environment [12, 13]. Breeding programs have been developed to produce muskmelon cultivars suitable for diverse climatic and soil conditions. In the present study, the days to first male and female flowering were relatively consistent among varieties, supporting the findings of Tira-umphon and Leonorasae [10], who reported that male and female flowers of cantaloupe varieties tend to bloom within a similar period. Distinct differences in external morphology, such as fruit skin color, shape, and internal structure, were also observed, consistent with observations by Alenazi et al. [14].

Interestingly, the eleven varieties tested were harvested slightly earlier than their reported maturity periods. This observation aligns with local findings from Kao Yo and Khuan Niang sub-districts, Songkhla Province, southern Thailand, where Japanese-type muskmelons, such as Kimoji, ripen earlier (48–50 days after transplanting) compared with the standard 55-day harvesting period, likely due to the coastal microclimate. Similarly, Apiratikorn et al. [15] reported significant varietal differences in growth and yield characteristics among four muskmelon cultivars, all of which were well adapted to cultivation in Songkhla Province and nearby areas.

Table 4 Mean liking scores for appearance, taste, texture, and overall acceptability of eleven muskmelon varieties grown under greenhouse conditions in southern Thailand

Varieties	Appearance	Taste	Texture	Overall liking
Galia	6.50±1.10^{ns}	6.28±1.22^{d}	5.56±1.24^{c}	6.17±1.33^{d}
Jing Yuan	6.83±1.38^{ns}	6.28±1.44^{d}	6.06±1.30^{c}	6.33±1.13^{d}
Green Shizuoka	7.33±0.76^{ns}	7.00±1.08^{bcd}	7.00±1.02^{b}	7.11±1.02^{bc}
Orange Sakura	7.65±0.58^{ns}	7.20±1.10^{abc}	7.15±0.93^{b}	7.15±0.81^{bc}
Takami	6.67±0.97^{ns}	6.39±1.24^{cd}	6.66±1.16^{c}	6.50±1.15^{cd}
Green Pearl	7.11±1.02^{ns}	6.83±1.42^{bcd}	7.00±1.45^{b}	6.83±1.15^{bcd}
Orange Pearl	7.20±0.83^{ns}	6.75±1.16^{bcd}	7.05±0.99^{b}	6.80±1.15^{bcd}
Green Rocky	7.67±0.68^{ns}	8.00±0.90^{a}	8.00±0.97^{a}	8.17±0.85^{a}
Orange Rocky	7.60±0.54^{ns}	7.40±1.04^{ab}	7.30±1.08^{ab}	7.45±0.88^{ab}
Ichiba	6.83±0.85^{ns}	6.33±1.41^{cd}	6.17±1.38^{c}	6.39±1.19^{cd}
Alpha	7.82±0.63^{ns}	7.94±0.65^{a}	7.59±0.61^{ab}	7.94±0.65^{a}

Means with the same letter are not significantly different ($P \leq 0.05$) by DMRT.

The yield component data from the present study also exhibited significant differences among the varieties. According to general principles of plant breeding and cultivar adaptation as outlined by Poehlman & Sleper [16], the observed performance suggests that Galia and the other tested cultivars may be well suited to local conditions.

The sweetness levels of the tested muskmelon varieties (13–15 °Brix) fall within the typical range reported for Japanese-type melons. Moreover, no pest or disease infestations were observed throughout the experimental period, confirming the advantages of greenhouse cultivation in maintaining stable humidity and temperature, facilitating weed control, and minimizing pest incidence. According to Saikhao *et al*. [17], muskmelon production in mesh-net or semi-closed greenhouses with automated drip systems effectively reduces the use of

pesticides and mitigates the risk of disease and insect damage, while enabling continuous, high-quality production even during the rainy season [18].

The sensory evaluation results support previous findings that consumer acceptance of muskmelon depends on multiple quality components, including sweetness, aroma, firmness, and color [19]. Pardo *et al*. [20] further emphasized that consumer preference is positively correlated with fruit sweetness and pH, whereas excessive firmness negatively affects textural perception. The present study confirmed that varieties such as Green Rocky, Orange Rocky, and Alpha achieved high scores for taste, texture, and overall liking, indicating their potential suitability for commercial production and consumer markets in southern Thailand.

Conclusion

Significant differences ($P < 0.05$) were observed among the eleven muskmelon varieties. Green Shizuoka, Orange Pearl, and Takami showed faster growth and earlier maturity, while Orange Pearl, Green Rocky, and Orange Rocky produced the largest fruits. The sweetest fruits were Green Pearl and Alpha, with total soluble solids of 15.77 and 15.31 °Brix, respectively. Consumer testing indicated that Green Rocky, Orange Rocky, and Alpha were the most preferred varieties.

Suggestion

Future research should examine the physiological and biochemical traits that influence consumer preference—including flesh firmness, aroma, sugar–acid balance, and volatile compounds—to better clarify the relationship between yield and sensory quality. Stu-dies on disease tolerance and environmental stress resistance under the humid conditions of southern Thailand are also needed. Incorporating qualitative consumer insights, such as focus groups or interviews, would help deepen the understanding of market preferences. Additional trials across seasons, production systems, and greenhouse types, along with economic and postharvest evaluations, are recommended to strengthen cultivar selection for commercial production in southern Thailand.

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