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INFLUENCE OF OPAQUE WALL GREENHOUSE MICROCLIMATE ON MELON GROWTH AND FRUITING

Gheorghita HOZA[1], Maria DINU[2], Alexandra BECHERESCU[3], Claudia-Loredana DRAGOMIR[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, Bucharest, Romania
[2]University of Craiova, 13Alexandru Ioan Cuza Street, Craiova, Romania
[3]University of Life Sciences "King Mihai I" from Timişoara, 119 Calea Aradului Street, Timişoara, Romania

Corresponding author email: dragomir_claudia95@yahoo.com

Abstract

Melon (Cucumis melo) belongs to the Cucurbitaceae family and is suitable for cultivation in various systems, such as cultivation in the field, solariums and greenhouses. The present study refers to the behavior of 3 hybrids grown in protected spaces, in the Chinese solarium of the Faculty of Horticulture in Bucharest, in the climatic and social context of 2021.3 hybrids of different origins were used: one Dutch (Antalya F1), one Chinese and one Korean. The culture was established by planting the seedlings, the technology specific to melons was applied in protected spaces. In the case of vegetative growth, but also fruiting, all hybrids had a favorable evolution, even if the temperature was higher than the limit cited in the specialized literature for Cucurbitaceae (35˚C). The plants showed very good vegetative growth, over 2.5 m high, formed between 11 and 19 shoots. From the point of view of fruiting, the hybrids had a production per plant between 0.91 kg for the Korean hybrid, and 3.22 kg for the Chinese hybrid. They stood out for their high SUS content and superior organoleptic qualities.

Key words*: Chinese solarium, hybrids, production protected culture.*

INTRODUCTION

The yellow watermelon (*Cucumis melo*, Fam. *Cucurbitaceae*) is among the most highly regarded vegetable species globally due to its aromatic and uniquely flavored fruits. It is cultivated on every continent, with the most extensive cultivation found in Asia, America, and Europe (FAO, 2022). In Romania, it is commonly grown in open fields. However, to obtain fruits earlier and ensure an extended consumption period, it is also cultivated in protected spaces, albeit on a much smaller scale. It is generally consumed fresh as a dessert fruit, in fruit salads, or combined with other foods; it can also be processed into juices, syrups, or jams and has health benefits due to its complex composition, especially carotenoid substances (Esteras et al., 2018). The fruits are rich in nutrients, especially provitamin A and vitamin C (Lester, 2008; Mohamed and Maha-Mohamed, 2016), and the content of phytonutrients is influenced by the variety and cultivation area (Singh et al., 2022). Carotenoid substances, besides their important role in human health, also play a role in plant development, photosynthesis, and photoprotection (Maoka, 2020). The accumulation of phytonutrients in fruits is influenced by the genetic characteristics of the variety, the stage of development, and environmental factors (Batkat et al., 2017; Bernillon et al., 2013). Light, in terms of quantity and quality, significantly influences the accumulation of phytonutrients in watermelons, especially carbohydrates (Yang et al., 2019). The type of soil, fertilization, and irrigation also influence the quality of watermelons (Jifon et al., 2012). The quality of the fruits is influenced by the cultivation technology, requiring the limitation of the use of pesticides and chemical fertilizers harmful to the environment. In this regard, Soare et al. (2018) have shown that using the biofertilizer Lignohumat at a rate of 200 g/ha resulted in yellow watermelon fruits with higher total dry matter content (TDS), acidity, and reducing sugars, while at a concentration of 100 g/ha, antioxidant activity increased. The potassium content in the soil influences the postharvest quality of the fruits, commercial appearance, and phytonutrient content (Lester et al., 2010). Additionally, to produce fruits with a low potassium content, demanded by consumers with kidney diseases, potassium can be reduced in the nutrient solution for soilless culture (Asao et al., 2013). Mulching the soil in greenhouses with biodegradable film improved the yield and quality of watermelons produced in the cold season (Wang et al., 2022). Using the natural predator *Phytoseiulus persimilis* to reduce mite infestation in yellow watermelons reduced the infestation rate to less than 1% (Calin et al.), resulting in superior quality fruits. To stimulate plant growth and root system, seed coatings from Brassica species have been tested with good results, whose effect can be enhanced by adding microorganisms from the genus Trichogramma (Galleti et al., 2015). The quality of watermelons also depends on the harvest time. To achieve acceptable quality, the soluble dry matter content at harvest should be above 9% (Calixto et al., 2022). Storing them while maintaining quality is quite difficult because they do not tolerate temperatures below 5-10°C depending on the variety, and during storage, firmness and carbohydrate content decrease significantly, posing a challenge for researchers (Saltveit, 2011).

MATERIALS AND METHODS

The experimental research was conducted in the Chinese-style greenhouse within the University of Agronomic Sciences and Veterinary Medicine, while the physico-chemical analyses and tasting session were carried out in the Vegetable Cultivation Laboratory of the Faculty of Horticulture, Bucharest. The cultivation of yellow watermelons was established on April 2, 2022, using three hybrids of yellow watermelon: V1 - Antalya F1, a vigorous hybrid with high resistance to Fusarium wilt and moderate resistance to powdery mildew.

The fruits have a medium size, with a yellow, textured skin covered by a network of healed cork. The flesh is crunchy, green, and has a specific aroma. V2 - the Chinese hybrid, with medium growth vigor, forms spherical, orange, pubescent fruits with concentric rings around the stem when reaching harvest maturity.

Figure1. Antalya F1

Figure 2. Chinese hybrid

The flesh is orange-colored, juicy, and sweet, while the seeds are small. V3 - the Korean hybrid, with medium growth vigor, bears small-sized, pear-shaped fruits with pronounced stripes and yellow skin.

Figure 3. Korean hybrid

The pulp is firm, juicy, sweet, and aromatic, with a yellowish-white color, and small seeds. The experiment was organized in subdivided plots with three repetitions per variant and 5 plants per repetition.

The Chinese-style greenhouse is oriented in an east-west direction, with plant rows aligned north-south. It has a vertical, opaque wall on the northern side, while the opposite side is made of transparent polyethylene film, semi-circular and sloping towards the south, ensuring favorable exposure to sunlight for the plants. The ends of the greenhouse are fixed, with one having an access door, which also aids in air ventilation within the growing space.

The cultivation was initiated on April 2nd using seedlings produced in a warm greenhouse, aged 42 days, with a spacing of 0.8 meters between rows and 0.5 meters between plants within rows. The cultivation was mulched with gray agrotextile placed on the ground after installing the drip irrigation system and before planting the seedlings.

The land was prepared according to specific technology for establishing crops in protected spaces, with the specification that before planting, fertilization with Italpolina fertilizer at 2 t/ha was applied along the row, incorporating it into the soil. This fertilizer contains 4% total nitrogen, 4% phosphorus pentoxide, 4% potassium oxide, 0.5% magnesium oxide, and 41% organic carbon, ensuring a balanced nutrition regime for the plants in the first weeks after planting.

During the vegetation period, specific care activities for yellow watermelon cultivation in protected spaces were performed without interventions on plant height growth. Weekly measurements were taken regarding plant height and the number of shoots per plant. At harvest, the number of harvested fruits per plant, average, production, fruit pericarp firmness using the FT 327 penetrometer with an 11 mm^2 cylinder (piston, probe) on 5 fruits/hybrid from 3 points of the fruit, soluble dry matter content (ºBrix) determined with the HI96800 digital refractometer by analyzing fruit juice on 5 fruits/hybrid with 3 determinations/fruit were determined.

The obtained fruits were also organoleptically analyzed during a tasting session at the Vegetable Cultivation Laboratory. Twelve individuals, students, and faculty members participated, each completing a tasting form. Standard deviation was calculated for the performed determinations, and correlation coefficients were calculated to determine the influence of growth on fruiting.

RESULTS AND DISCUSSIONS

The comparative analysis of the three hybrids of yellow watermelons, originating from different sources, showed that they behaved differently in terms of vegetative growth and productivity under the same technological conditions. Regarding plant height, it was found that the Antalya hybrid exhibited the highest vigor, with the stem reaching 4.1 m at the end of the vegetation period and the highest weekly growth increment, ranging between 0.15 m and 0.37 m. The Chinese and Korean hybrids had a weaker vigor, with stems reaching approximately 2.6 m in height and a weekly growth increment ranging between 0.05 m and 0.10 m for the Chinese hybrid and between 0.03 m and 0.08 m for the Korean hybrid (Table 1).

Table 1 Stem Growth Dynamics in Some Yellow Watermelon Hybrids

Hibrids	Date	Stem height (m)	Growth Increment (m/week)
Antalya F1	29.05	2.90	-
	5.06	3.27	0.37
	12.06	4.20	0.93
	18.06	5.00	0.80
	26.06	5.75	0.75
	3.07	6.20	0.45
Chinese	29.05	2.25	-
	5.06	2.35	0.10
	12.06	2.40	0.05
	18.06	2.50	0.10
	26.06	2.55	0.05
	3.07	2.60	0.05
Korean	29.05	2.40	-
	5.06	2.40	0
	12.06	2.43	0.03
	18.06	2.50	0.07
	26.06	2.57	0.07
	3.07	2.65	0.08

The yellow watermelons are characterized by a high capacity for lateral shoot formation, which is a particularity of plants in the Cucurbitaceae family. In the analyzed hybrids, the number of lateral shoots ranged from 11 in the Chinese hybrid to 19 in the Antalya hybrid, with the Korean hybrid having 15 (Figure 4). The presence of lateral shoots on the plant is important because female flowers form on these shoots, and their appearance can be influenced through repeated pruning techniques in cultivation technology.

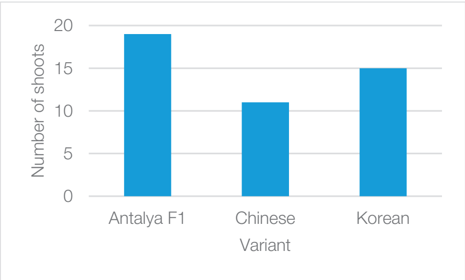

Figure 4. Lateral Shoot Capacity

In the specific conditions of the Chinese-style greenhouse, the yellow watermelon fruited well (Table 2), with the recorded productivity elements indicating this aspect. Analyzing the average weight of fruits, it was observed that the Antalya and Chinese hybrids had average fruit weights of 992 g and 946 g, respectively, while the Korean hybrid produced fruits weighing 416 g, being a hybrid with small fruits. The number of fruits harvested per plant, reaching commercial size, was similar for the three hybrids, with 2.4 fruits for the Chinese hybrid and 2.2 fruits for the other hybrids. The fruit production per plant recorded different values, being greatly influenced by the biological characteristics of the hybrids, and implicitly by the average fruit weight. The lowest production, 0.915 kg/plant, was obtained with the Korean hybrid, which has small pear-shaped fruits, compared to hybrids and varieties of yellow watermelons cultivated in Romania. For the Antalya and Chinese hybrids, the production was similar, with 2.18 kg/plant and 2.27 kg/plant, respectively. Reporting the yellow watermelon production per square meter, the Chinese hybrid was the most productive with 5.67 kg/m², followed by Antalya F1 with 5.45 kg/m², while the lowest production was obtained with the Korean watermelon, 2.29 kg/m².

Table 2. Productivity elements in the analyzed hybrids

Hibrids	Number of Harvested Fruits per Plant		Average Fruit Weight, g		Average Production per Plant		Average Production in	
	(pieces)	Standard deviation	(g)	Standard deviation	(kg)	Standard deviation	(kg/sm)	Standard deviation
Antalya F1	2.2	0.2449	992	2.4494	2.18	0.0244	5.45	0.0244
Chinese	2.4	0.3511	946	4.0824	2.27	0.0163	5.67	0.0163
Korean	2.2	0.3741	416	1.6329	0.915	0.040	2.29	0.0408

At harvest, the yellow watermelon fruits were quite firm, and the values obtained for firmness were in line with data presented in specialized literature. Determinations conducted by Haiyong Zhao et al., 2023, on yellow watermelon fruits showed that the pericarp firmness ranged between 4 and 6 kgf/cm², which is close to the values obtained in this study (4.3-5.8 kgf/cm²) (Figure 5), while the soluble dry matter content ranged between 8.64% and 10.85%, compared to a soluble dry matter content of 11.1% for the Korean hybrid and 7.6% for the Chinese hybrid cultivated in the Chinese-style greenhouse in Romania (Figure 6).

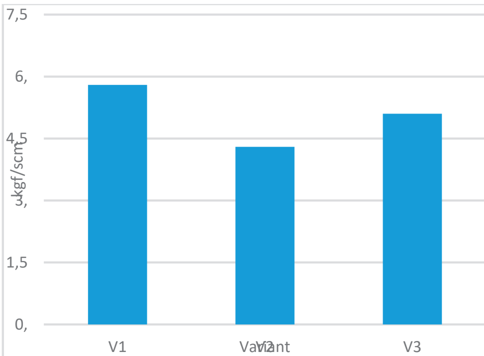

Figure 5. Pulp Firmness

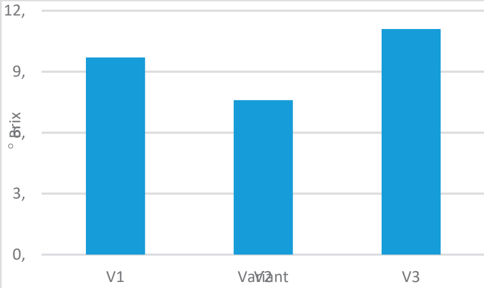

Figure 6. Soluble Dry Matter Content

The sensory evaluation of the fruits showed that the Antalya hybrid had superior quality characteristics compared to the other two hybrids, expressed through size, pulp color, taste, aroma, and soluble dry matter content (Figure 7).

Figure 7. Fruit Quality Indicators

By correlating plant growth data with those related to productivity, it was found that a higher vegetative growth slightly negatively influences production (Figures 8 and 9), but it has a beneficial effect on firmness and soluble dry matter content. Leaf area growth also increases the capacity for synthesis and the storage of organic substances (Figures 10 and 11).

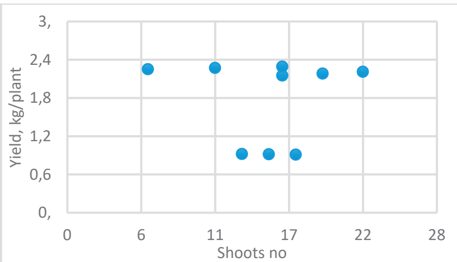

Figure 8. The correlation between the number of lateral shoots and production per plant (r = 0.029)

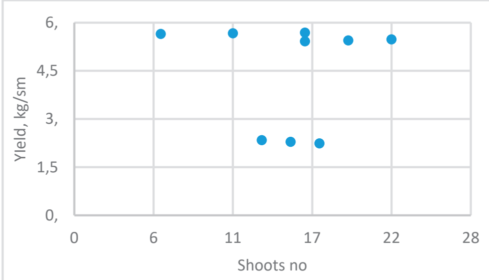

Figure 9. The correlation between the number of lateral shoots and production per square meter (r = - 0.04)

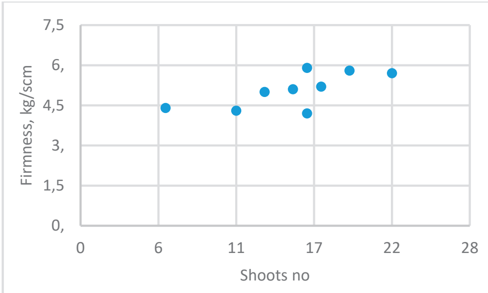

Figure 10. The correlation between the number of lateral shoots and firmness (r = 0.69)

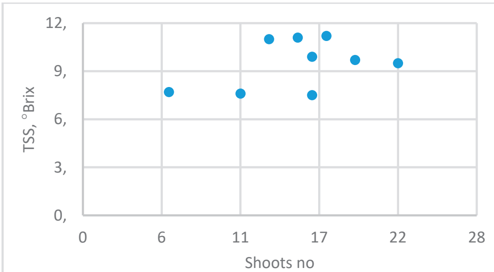

Figure 11. The correlation between the number of lateral shoots and soluble dry matter content (r = 0.41)

CONCLUSIONS

The different behavior of the yellow watermelon hybrids was due to their biological characteristics rather than the growing conditions. The hybrid with the highest vegetative growth was Antalya, while the Chinese and Korean hybrids reached similar values in terms of stem growth and number of lateral shoots. These hybrids are productive, with the highest production achieved by the Chinese hybrid at 5.67 kg/m², closely followed by Antalya F1 at 5.45 kg/m², while the lowest production was recorded for the Korean hybrid, which has smaller fruits, at 2.29 kg/m². The fruits are of very good quality, appreciated by consumers, with the highest score obtained in the tasting session by the Antalya hybrid with 32.3 points, while the Chinese and Korean hybrids scored 27.3 and 25.1 points, respectively. This recommends them to Romanian consumers for diversifying the assortment of yellow watermelons on the Romanian market, especially during the summer and beyond.

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