

IMPACT OF DIFFERENT ROOTSTOCKS ON THE YIELD AND FRUIT WEIGHT OF WATERMELONS

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ABSTRACT

The paper presents the results of research on the impact of rootstocks of different origins on the yield and fruit weight of watermelons. Field research was conducted in 2021 at the Kobišnica site in the vicinity of Negotin, on chernozem soil. Two varieties of watermelon were used as a test material (namely, Mirsini F1 and Crimson sweet), as well as two rootstocks of different origins (namely, Emphasis F1 and Strong Tosa F1). Research results have showed that the average fruit weight of the yield per plant and the total yield of the Mirsini F1 variety grafted on the Emphasis F1 rootstock was higher than in the same variety grafted on the Strong Tosa F1 rootstock. The average fruit weight of yield per plant and the total yield of the Crimson sweet variety grafted on the Emphasis F1 rootstock has also showed better results in comparison to the same variety grafted on the Strong Tosa F1 rootstock.

Key words: *Citrullus lanatus* L, grafting, fruit mass, yield.

INTRODUCTION

Watermelon is an annual vegetable that recognizes two basic methods of cultivation, namely by direct seeding or planting seedlings. In practice, two seedling production techniques are applied, i.e. ordinary and grafted seedlings, whereby one most often resorts to Lagenaria or hybrid rootstocks. According to Bekhardi et al (2011), modern watermelon cultivation technology is based on cultivation from seedlings which can either be produced without grafting or by grafting the scion on the rootstock. The procedure of grafting watermelon onto a pumpkin, squash, or gourd is practiced in numerous important watermelon-producing regions around the world (Choi et al, 2002). According to Zhang et al (2019), the agrotechnical procedure of grafting in the production of watermelon seedlings is an important part of the modern technology of watermelon cultivation. The main reason for grafting vine crops is to ensure the protection against soil diseases (Pamplomates et al, 2002). An additional benefit of grafting is a greater potential for increased production, better quality, and especially for longer preservation of freshness. Furthermore, it is possible to achieve earlier ripening and higher fruit yield. The Assel research (2007) confirmed that grafted watermelons can be cultivated under more humid conditions, whereby the plants would have a higher number of fruits per plant and a higher yield in comparison with the ungrafted ones. In addition to protecting watermelons against harmful organisms, grafting can greatly contribute to the mitigation of abiotic stresses caused by drought, cold, high temperatures, heavy metals, salinity, and a lack or excess of biogenic elements (Gaion et al, 2018).

When growing watermelons from grafted seedlings, it is necessary to select the proper combination of rootstock and scion, depending on the agroecological conditions of the cultivating area, market requirements, and resistance to certain pests and diseases. Lagenaria gourd (*Lagenaria siceraria*) and pumpkin and butternut squash hybrids *Cucurbita maxima* × *C. moschata* proved to be the most suitable in the fight against *Fusarium* and *Verticillium* species. Due to a large selection of hybrid varieties of watermelon, as well as scions and rootstocks of different origins, there is a problem with compatibility. Therefore, testing is necessary before introducing either into production (Djurovka and Ilin, 2002). Likewise, experience is needed in choosing the appropriate rootstock and scion, because incompatibility is a possibility (Ranjan and Kumari, 2015). The conducted research aimed at establishing the compatibility of hybrid watermelon varieties Mirsini F₁ and Crimson sweet with rootstocks of different origins, namely Emphasis F₁ (*Lagenaria siceraria*) and interspecies hybrid Strong Tosa F₁ (*C. maxima* × *C. moschata*).

MATERIALS AND METHODS

A field experiment was conducted in 2021 at the Kobišnica site, in the Municipality of Negotin, on the farm of the Ilić family, according to the randomized block design in four iterations. Watermelon hybrid varieties Mirsini F₁ and Crimson sweet were tested, and grafted on the rootstocks Emphasis F₁ and Strong Tosa F₁. The experiment was set up on the chernozem soil type. Seedling production was carried out in 7x7 cups filled with orange Pindstrup rootstock, pH value 6.0, granulation 0-6 mm. Protection against the *Pythium spp.* seedling lodging disease was carried out by watering with a solution of Proplan 722 SL in a concentration of 0.15%. Watermelon and rootstock were sown on March 10, 2021. The technique of grafting into gaps was applied. After grafting, the seedling was watered twice with the Starter preparation, in the ratio (10:52:10). The planting took place at the stage of 5 to 6 developed leaves at a height of about 10 to 15 cm. During the vegetation period, conventional crop care was carried out (protection, drip irrigation system, and fertigation). The following measurements were performed on the trial variants: fruit weight (kg), fruit number, fruit weight per plant (kg), and total yield (t ha⁻¹). The Emphasis F₁ is a grafting rootstock suitable for all watermelon hybrids and it ensures crop uniformity. The plant has great vigour, while germination, sprouting and initial growth are uniform. This rootstock shows high tolerance to *Fusarium* and a high acceptance percentage. The Strong Tosa F₁ is a rootstock created by the hybridization of *Cucurbita maxima* and *Cucurbita moschata* which is suitable for melons and watermelons. It is characterised by strong growth and resistance to cold conditions. Plants grafted onto this rootstock respond well to both first and last planting dates. Its advantage is a high tolerance to *Fusarium* and maximum tolerance to biological/physiological drying. It has a high percentage of germination and growth, as well as plant uniformity.

RESULTS AND DISCUSSION

Numerous papers around the world examine the impact of grafting on yield, the number of fruits, and the average weight of watermelon fruits. The selection of a rootstock is based on its tolerance to harmful organisms and stressful conditions, and the selection of a scion is based on the expected yield and fruit quality. The success of grafting depends on the compatibility of the rootstock and scion according to the environmental conditions and the method of production (Ceylan et al. 2017). It is well-known that the fruit weight largely depends on the plant variety and applied agrotechnical techniques. It is also well-known that there are different requirements regarding the size in different markets. While countries of Northern Europe demand medium-sized

fruits at the level of 5kg ($\pm 10\%$), consumers in our country demand extremely large fruits weighing between 8 and 10kg, and even larger. The average fruit weight during the experiment was 8.29 kg. The average fruit weight was larger in Mirsini F₁ (8.76 kg) variety in comparison to Crimson sweet (7.38 kg). When it comes to the rootstock impact, it has been established that the rootstock Emphasis F₁ in both varieties ensured the forming of larger fruits, unlike the Strong Tosa F₁ rootstock.

Table 1. Average fruit weight (kg)

Rootstock	Average watermelon fruit weight (kg)	
	Mirsini F ₁	Crimson Sweet
Emphasis F ₁	8.95	7.97
Strong Tosa F ₁	8.58	7.69
Average	8.76	7.83
LSD 005	0.36	0.25
001	0.43	0.29

In annual research into the yield and sweetness of watermelon, Sedlar (2019) established the compatibility of early varieties Early Samantha and Lady with rootstocks Emphasis (*Lagenaria siceraria*) and Vitaly (*Cucurbita maxima* × *C. moschata*) in agroecological conditions of eastern Croatia. Grafted watermelons form significantly larger fruits, but they also ensure greater *Fusarium* resistance. Rašković and Djurovka (2009) state that grafting has a positive impact on the fruit yield per plant, but that rootstocks Emphasis and native gourd (*Lagenaria*) had an equal effect.

Table 2. Total yield per plant (kg)

Rootstocks	Average watermelon fruit weight (kg)	
	Mirsini F ₁	Crimson Sweet
Emphasis F ₁	10.91	9.96
Strong Tosa F ₁	10.46	9.61
Average	10.68	9.78
LSD 005	0.49	0.37
001	0.52	0.46

The production profitability of different varieties largely depends on early-stage production, i.e. on the time of ripening of the first fruits. However, the total yield is a realistic indicator of the impact of applying certain procedures or agrotechnical measures. A high yield is the goal of every producer, and it depends on a number of different factors (Dardić et al. 2010). Zhang et al (2019) state that the increase in yield is mostly attributed to the developed Koen system which results in improved absorption of water and nutrients.

The total average yield per plant considering all test variants amounted to 10.23 kg, which is equivalent to the yield of 51.26 t per ha⁻¹. It is important to note that no significant difference in yield was found depending on the rootstock, nor between the tested varieties. Watermelon grafting has a positive effect on plant growth and yield without quality loss (Ozlem A. et al., 2007).

Table 3. Total yield (t ha⁻¹)

Rootstock	Total yield (t ha ⁻¹)	
	Mirsini F ₁	Crimson Sweet
Emphasis F ₁	54.67	49.91
Strong Tosa F ₁	52.41	48.16
Average	53.52	49.01
LSD 005	2.31	1.83
001	3.13	2.01

The total watermelon yield was established on the basis of the number of fruits per plant, average fruit weight, and the number of plants per m². The highest total yield was achieved with the Mirsini F₁ variety on the Emphasis F₁ rootstock (54.67 t ha⁻¹). The same variety on the Strong Tosa F₁ rootstock also achieved a higher yield compared to the Crimson sweet variety. The difference in total yield between the combinations with the highest and lowest values was 13.5%. The obtained results are following the research of Toth et al. (2015) where the Columbia and Kodak varieties grafted on the Azman rootstock did not significantly differ from the statistical standpoint in terms of total yield (102.2 and 79.0 t ha⁻¹). Similar results were obtained by Calabota (2007), determining the difference in the total yield of Mediteria F₁ hybrids grafted on the Lagenaria (115.0 t ha⁻¹) and Bombo (173.0 t ha⁻¹) rootstocks.

CONCLUSIONS

Based on the presented research on the impact of rootstocks on fruit weight, yield per plant, and total yield of two hybrid watermelon varieties (namely, Mirsini F₁ and Crimson sweet) on rootstocks Emphasis F₁ (*Lagenaria siceraria*) and Strong Tosa F₁ (*C. maxima* × *C. moschata*) in the climatic conditions of eastern Serbia, one can conclude that both used rootstocks had an equal effect on the afore-mentioned characteristics. The average fruit weight per plant and the total yield in the variety Mirsini F₁ grafted on the Emphasis F₁ rootstock was higher than in the same variety grafted on the Strong Tosa F₁ rootstock. The average fruit weight per plant and the total yield in the variety Crimson sweet grafted on the Emphasis F₁ rootstock also showed better results in comparison with the same variety grafted on the Strong Tosa F₁ rootstock.

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