MAGYAR AGRÁR- ÉS ÉLETTUDOMÁNYI EGYETEM

Columella

Volume 9, Number 2, 2022

Columella
Journal of Agricultural and Environmental Sciences

Investigation of different nutrient levels applied during irrigation in the self-rooted and grafted watermelon production

Patrik KRIZSÁN[1,2] – Gábor BALÁZS[2]

1: Institute of Environmental Sciences Department of Irrigation and Land Improvement, Hungarian University of Agriculture and Life Sciences, 5540 Szarvas, Petőfi u. 9., Hungary, e-mail: Krizsan.Patrik@uni-mate.hu
2: Institute of Horticulture, Department of Vegetable and Mushroom Growing, Hungarian University of Agriculture and Life Sciences, 1118 Budapest, Villányi út 29-43., Hungary

Abstract: Our work in the form of water-soluble fertilizers for self-rooted and grafted watermelon cultivation, applied simultaneously with irrigation, it concentrates on examining different nutrient levels during the growing season. Within that, we focused on the application of macronutrients - nitrogen, phosphorus, potassium. Therefore, we set up 4 different nutrient levels for both types of seedlings, in two replicates, of which we developed a phosphorus, a nitrogen, and a potassium overweight nutrient level, and a nutrient level in which all three nutrients were in equal proportions. The latter formed the control. For both self-rooted and grafted seedlings, we wondered whether changes in nitrogen, phosphorus, and potassium would affect, and if so, the positive or negative direction of plant development, or the quality or the weight of the crops. Our research pointed out that at the beginning of the growing season, before or during the first flowering period, higher amounts of phosphorus applied simultaneously with irrigation have a positive effect on the development and yield and quality of grafted plants throughout the growing season. Higher phosphorus content applied by irrigation before and during the first flowering period also promotes flowering of self-rooted plants and improves their crop quality. But in their case, the higher potassium active substance applied during the ripening period has the most positive effect on their yield results. Respectively, the experiment showed that the nutrients applied during nutrient solution are of great importance.

Keywords: watermelon, irrigation, water-soluble, fertilizer, grafted

Received 8 June 2022, Revised 4 November 2022, Accepted 4 November 2022

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License

Introduction

Watermelon cultivation in Hungary has a history dating back decades. Irrigation and nutrient replenishment are essential to produce the best possible quality and quantity of goods, which can take the form of both organic and fertilizer. Irrigation is becoming increasingly important these days, mainly for the cultivation of vegetables in the field, due to extreme weather and prolonged periods of low rainfall. In addition, the importance of nutrients applied during irrigation is widespread. That's why, our work in the form of water-soluble fertilizers for self-rooted and grafted watermelon cultivation, applied simultaneously with irrigation, it concentrates on examining different nutrient levels during the growing season. In the case of both self-rooted and grafted seedlings, we wondered whether changes in the amount of nitrogen, phosphorus and potassium would affect, and if so, in a positive or negative direction the development of the plant or the quantity, quality or weight of the crop. Therefore, we set up 4 different nutrient levels for both types of seedlings, in two replicates, of which we developed a phosphorus, a nitrogen, and a potassium overweight nutrient level, and a nutrient level in which all three nutrients were in equal proportions. The latter formed the control.

The water requirement of watermelon is 400–500 mm (Nagy, 2005), the approx. during its 4-5 month growing season, thus it can be classified as a water-intensive vegetable plant (Hodossi et al., 2004). For this reason, it cannot be successfully grown in Hungary without irrigation. It needs the greatest amount of water during germination, rapid shoot growth and during the period of crop development (Nagy, 1997).

Its transpiration coefficient is 600 (S. Balázs, 2004). In summer, the evaporation of watermelon can reach 1-2 liters per plant per day (Nagy, 2005). Watermelons have a very suboptimal and higher water supply, both in plant development and in crop quality (Nagy, 1997).

In watermelon cultivation, July and August are the most critical months in terms of water supply (Nagy, 2005), as the lowest rainfall falls during the growing season, when the average temperature is the highest, so the evaporation of the melon and the development of the plant occur even the most water-demanding periods (Nagy, 1997). During the growing season, 30-40mm of water replacement irrigation is required several times, depending on the soil binding and the depth of rooting of the plant (Hodossi et al., 2004) The advantages of watermelon irrigation are that higher yield averages (100, 150 t / ha), higher yield safety, higher yield quality, and more balanced crop development and growth can be achieved (Nagy, 2005).

There are several aspects to consider when planning to irrigate a watermelon. It is very important that irrigation should be implemented differently on different soil types (Knott & Tamás, 1973). In addition, it is important to choose the right time and method of watering. Drip irrigation proved to be the best method, which was confirmed by experiments (Nagy, 2005).

Drip irrigation belongs to the group of micro-irrigation. It is generally characteristic of micro-irrigation that at low water pressure, in a short period of time, small cross-section water dispensing elements deliver the irrigation water directly to the root of the plants (Tóth, 2006). One of the main features of drip irrigation is that the use of irrigation water is economical, as it supplies it directly to the root zone of the irrigated plant, thus it can immediately compensate for the emerging water demand of the plant. In addition, in the cultivation of vegetables, nutrients are increasingly being applied in the form of water-soluble fertilizers during drip irrigation, thus enabling nutritious irrigation. The process of this can be fully automated (Kiss & Rédai, 2005). Because of all this, it is favorably used in vegetable production. Initially, it was widespread in greenhouses and film tents (Kiss & Rédai, 2005), but due to its advantages, it has been used more and more often in field vegetable production in recent years (S. Balázs, 2004).

Regarding the nutrient requirements of watermelon, it belongs to the group of high-nutrient vegetable species. It is particularly fond of organic fertilizer. Watermelons need 12.3 kg of nitrogen, 3 kg of phosphorus and 17.9 kg of potassium to produce 10 tonnes. Of the macronutrients - in descending order of watermelon demand – watermelon needs: K, N, Ca, P and Mg. It requires the most potassium and the least magnesium (Nagy, 2000).

Among the micronutrients, the following are essential for watermelon: Fe, Mn, Zn, Ni, Cl, B, Mo (Nagy, 2005). An American study has also pointed to the paramount importance of zinc as well as its yield-enhancing effect in watermelon cultivation (Locascio et al., 1966).

Watermelons belong to the group of the most high-nutrient vegetable species, so it is very important to pay attention to their nutrient

DOI: https://doi.org/10.18380/SZIE.COLUM.2022.9.2.101

supply in order to have the right amount and quality of fruit. With proper nutrient replenishment and irrigation, yields of up to 100-150t/ha can be achieved (Nagy, 2005).

Many nutrients play an important role in watermelon cultivation. These include nitrogen, phosphorus, potassium, calcium, magnesium and molybdenum. Nitrogen is one of the most important macronutrients for watermelons, as it determines the development, shoot growth, flowering, fruit attachment and development of plants (Kertészek Áruháza). An experiment in Croatia in 2000-2001 also highlighted the importance of nitrogen in watermelon cultivation. In the experiment, increasing the nitrogen supply from 115kg/ha to 275kg/ha under optimal and less optimal growing conditions resulted in more intensive shoot growth in the 4th and 7th weeks after planting (Goreta et al., 2005).

A study in Florida also looked at the changes in watermelon cultivation caused by different amounts of phosphorus active ingredients. The largest change was between 0 kg/ha P and 25 kg/ha P nutrient levels, both in terms of average crop weight and yield per hectare. Further increase of phosphorus resulted in only minimal increase, but in some cases deteriorated yields (Hochmuth et al., 1993).

Potassium also plays an important role in watermelon cultivation, as it plays a very important role in the speed of ripening and in ensuring the quality of the crop. In the case of potassium deficiency, the development of the plants is delayed, the fruit will have a low sugar content, water taste and an uncharacteristic flesh color (Nagy, 2000). Calcium has a very important role in the development and flowering of watermelons and also influences the quality of the crop (Scott & McCraw, 1990). In the case of magnesium deficiency, yellowish-green spots initially appear on the leaves of the plant, and then the whole leaf turns yellow, whitens, and dies (Nagy, 2000). Lack of molybdenum can lead to poor plant development, low yields and, in the worst case, plant death. It most commonly occurs on acidic soils (Nagy, 2000).

In the cultivation of watermelons we can also use basic fertilization, nest fertilization, starter fertilization, top fertilization and foliar fertilization. However, the importance of nutrient solution is also growing in the most modern plantations. The nutrient solution is applied by water-soluble fertilizers via a drip system (ICL, 2015). This is actually the application of the topsoil in dissolved form with irrigation water (Nagy, 1994). It is used during the growing season in order to achieve a more efficient and even nutrient application, a continuous supply of nutrients to the plant and better yield data. Thus, yields of up to 50 tons per hectare can be achieved (Nagy, 2005). This is the most effective way of supplying nutrients in mulch cultivation.

Nutrients (mainly nitrogen) applied simultaneously with drip irrigation significantly increase the yield of watermelon, especially on looser soils (Rolbiecki et al., 2020). Other advantages are that the composition and amount of nutrients can be formulated and delivered according to the current phenological stage of the plant, and that it allows immediate intervention in the event of a nutrient deficiency (ICL, 2015).

The advantages of using watermelon grafting is that watermelon becomes much more resistant to various environmental effects, has a positive effect on nutrient and water uptake, as well as the quantity, weight and quality of the crop, and the harvesting season can be better extended to grafted plants. In addition, grafting watermelons is also a solution for controlling infectious pathogens (*Verticillium*, *Fusarium*) and pests (*Meloidogyne* spp.) From various soils. Due to this, watermelons can be grown in the area for up to several years (G. Balázs, 2013; Davis et al., 2008).

Figure 1: Rubin F1 watermelon variety (Photo: Patrik Krizsán).

Table 1: Treatments and their labeling

	Repeat 1	Repeat 2
Grafted seedlings, control treatment	O/1/I.	O/1/II.
Grafted seedlings, phosphorus overweight treatment	O/2/I.	O/2/II.
Grafted seedlings, nitrogen overweight treatment	O/3/I.	O/3/II.
Grafted seedlings, potassium overweight treatment	O/4/I.	O/4/II.
Self-rooted seedlings, control treatment	S/1/I.	S/1/II.
Self-rooted seedlings, phosphorus overweight treatment	S/2/I.	S/2/II.
Self-rooted seedlings, nitrogen overweight treatment	S/3/I.	S/3/II.
Self-rooted seedlings, potassium overweight treatment	S/4/I.	S/4/II.

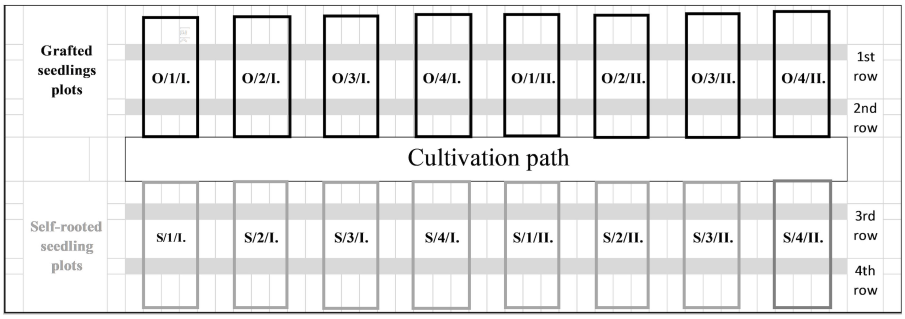

Figure 2: Diagram of the experimental area and arrangement of treatments.

Materials and Methods

Our experiment was carried out in Medgyesegyháza in 2020-2021 on an area of 1000 m^2, during which we examined the effect of different nutrient levels applied simultaneously with irrigation on the development of self-rooted and grafted watermelons, as well as on the quantity, quality and average weight of the crops. The experiment took place in

DOI: https://doi.org/10.18380/SZIE.COLUM.2022.9.2.101

the same area for both years. In the experiment, we also examined the Rubin F1 watermelon variety included in the Syngenta variety selection list for the self-rooted and grafted seedling types, which is illustrated in Figure 1.

We developed a total of 16 experimental plots of about 20 m^2 in the whole area. Each plot consisted of 2 adjacent rows. We examined 3–3 seedlings in both rows, so a total of 6 seedlings were placed in one plot. The plant spacing within the plots was 120 cm between each seedling. From the product of the seedling distance and the 250 cm row spacing, it can be stated that one plant had 3 m^2 of growing area.

The 16 plots were distributed in the area by examining the grafted seedlings in 8 plots and also the self-rooted seedlings in 8 plots. The 8 plots were composed of a control, a phosphorus overweight, a nitrogen overweight, and a potassium overweight nutrient level, which we examined in duplicate.

We distinguished the 16 experimental plots by marking them, which are illustrated in Table 1. The entire experimental area and the location of the treatments are shown in Figure 2. The area did not receive basic fertilization in any of the years to avoid inaccuracy in the experiment.

Nitrogen, phosphorus, and potassium applications were also performed in the most appropriate phenological phases of the plant. For each treatment, all three nutrients were applied in the same period, we only changed their amount to suit the nutrient level. Phosphorus application after planting, before and during the first flowering period; nitrogen application after fruit set during crop growth; and potassium application was taken during the ripening period. Each excess active ingredient was administered in several smaller doses, for better absorption and utilization. We used various water-soluble fertilizers to apply the active ingredients, which I applied simultaneously with irrigation. The water needed for irrigation and fertilizer dissolution was taken from a 11 meter deep well in the experimental area using a pump. However, the salinity of the water obtained from it proved to be high at 1.09 mS/cm and 1.24 mS/cm, which was revealed by the salinity measurements of the water samples taken in the spring.

The application of the additional active ingredients was carried out in such a way that the amount of active ingredient dispensed in the additional treatments was approx it should be 6 times that applied in the control plot. During the experiment, the nutrients could only be applied in the form of complex water-soluble fertilizers, which is why the amount of the other two nutrients increased minimally when the additional active ingredients were dispensed. For this reason, when formulating the fertilizers, we constantly made sure that the 1:2:1 ratio was maintained in favor of the given additional active substance. The total amount of NPK active ingredients applied to the treatments during the whole growing period is shown in Table 2.

Uniform and optimal amounts of fertilizers for the treatments were dispensed through a drip belt using an irrigation system. On the other hand, the application of the additional active substances was carried out in several smaller doses, with an irrigation can, irrigated to the watermelon stems, because this was the only way to carry it out due to the high pressure of the irrigation system. For each plot, we dissolved the excess fertilizers in 5 liters of water and distributed this amount among the 6 seedlings inside the plot. Accurate measurement of fertilizer doses was performed using a gram balance.

In addition to nitrogen, phosphorus and potassium, we also applied calcium and various trace elements (iron, manganese, boron, copper, zinc, molybdenum) during the development of watermelon. In order to examine the utilization of the applied nutrients, we

Table 2: Amount of total NPK active ingredients applied per plot during the growing season 2020-2021

	Control plots (S/1/I., S/1/II., O/1/I., O/1/II.)	Phosphorus overweight plots (S/2/I., S/2/II., O/2/I., O/2/II.)	Nitrogen overweight plots (S/3/I., S/3/II., O/3/I., O/3/II.)	Potassium overweight plots (S/4/I., S/4/II., O/4/I., O/4/II.)
N	24.93 g	66.63 g	144.58 g	63.67 g
P	21.48 g	132.48 g	60.52 g	59.25 g
K	21.35 g	59.05 g	65.645 g	136.35 g

performed the counting of female and male flowers, as well as the measurements and calculations related to the yield, weight and average weight during the growing season. In the course of our work we also performed refraction measurements, the examination of crop weight loss and the sensory examination. Most of the measurements were in both years, but there were some that we only did in 2021.

Results

The results of the measurements, tests and calculations performed in both years of our experiment (2020, 2021) will be described in this chapter in accordance with the development of the watermelon. The weather in the 2020 pilot year made it very difficult for different work processes as well as nutrient deliveries. In addition, the extreme vintage had an adverse effect on both the development and yields of the watermelon, which is why we mostly relied on the average results of the year 2021 and the two experimental years to judge the conclusions.

When processing the results for all measurements, tests and calculations, both for self-rooted and grafted treatments, we used the average of the two replicates for ease of reference. From the sum of the average data obtained every 4 days during flowering-related measurements, it can be seen that during the experimental year, during the experimental year 2020, the application of a higher phosphorus active substance did not result in the formation of a significantly higher number of female flowers, in contrast to the year 2021, when both O/2. and S/2. treatments, more significant female flower differentiation was observed in an area of 1 m^2 (Figure 3). For the other treatments, there was no significant change based on the mean results of the two years.

In the case of male flowers - similarly to female flowers - the application of the higher phosphorus active substance in the experimental year 2020 did not result in a significant change in the number of male flowers in the O/2. and S/2. treatments. This is due to the vintage effect. However, in 2021, and based on the average of the results of the two years, the excess phosphorus in the two mentioned treatments resulted in the formation of higher amounts of male flowers (Figure 4).

Based on the average of the data of the two years, it can be said that the number of crops per treatment was not significantly affected by the different nutrient levels (Figure 5). It follows that the higher yields of each treatment were more significantly due to the higher average weight of the crops (Figure 6).

DOI: https://doi.org/10.18380/SZIE.COLUM.2022.9.2.101

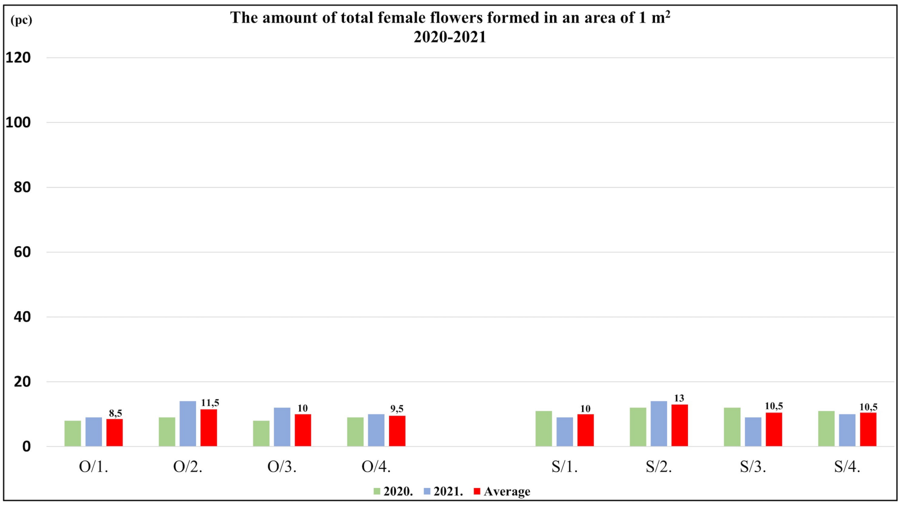

Figure 3: Total amount of female flowers formed in different treatments in an area of 1 m^2 in 2020 and 2021, as well as the average of the data for the two years.

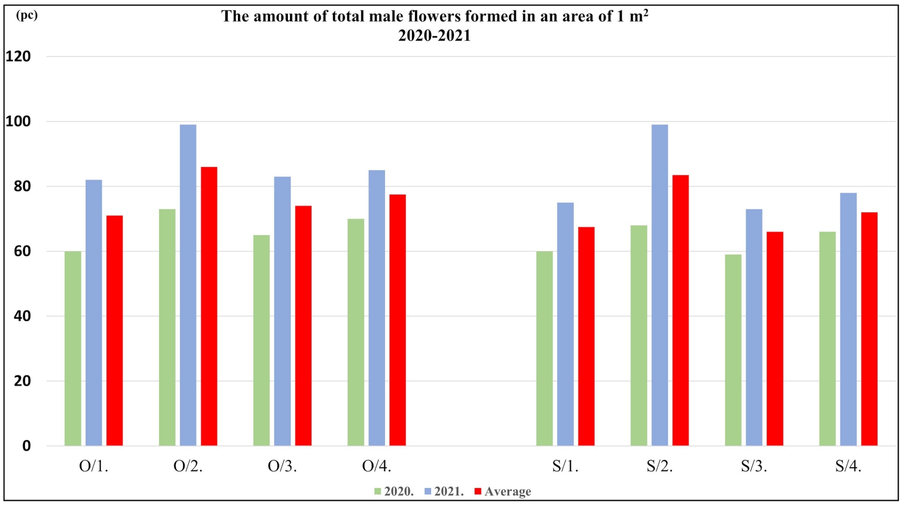

Figure 4: Total amount of male flowers formed in different treatments in an area of 1 m^2 in 2020 and 2021, as well as the average of the data for the two years.

Based on the average data of the two experimental years, it can be said that the higher amount of female flowers differentiated in the S/2. and O/2. treatments resulted in a minimally higher number of harvested crops only in O/2. Looking at the average of the results of the two years, it can be said that in the case of grafted seedlings, the watermelons with the highest average weight were obtained by O/3. treatment, where the growth of the yield was positively influenced by the high nitrogen active substance.

For self-rooted seedlings - based on the average of the data for the two years - the excess active substance application resulted in lower weight crops in both the S/2. and S/3. treatments compared to the control. However, comparing the results of the average yield and number of crops of the S/3 treatment, it can be said that despite the lower average weight, about 10% more yields were formed compared to the control. There was

DOI: https://doi.org/10.18380/SZIE.COLUM.2022.9.2.101

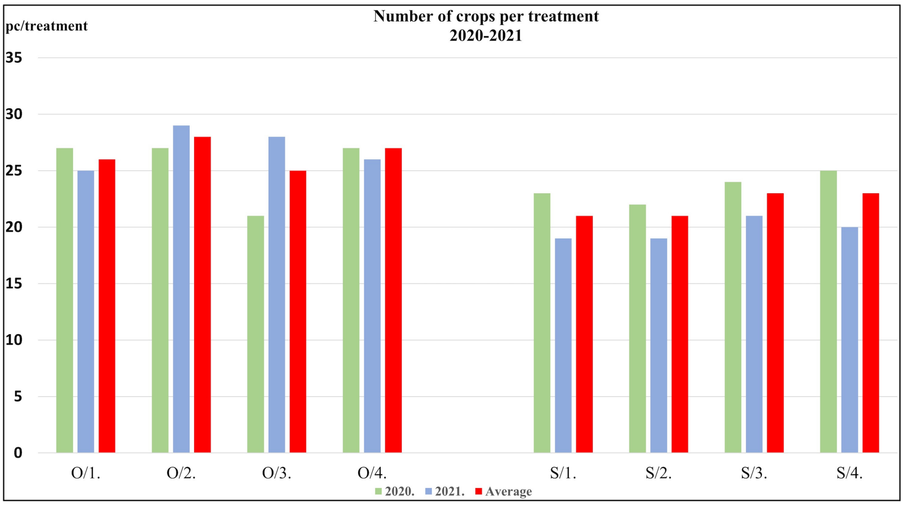

Figure 5: Crops number results per treatment (2020, 2021) and average of data for two years.

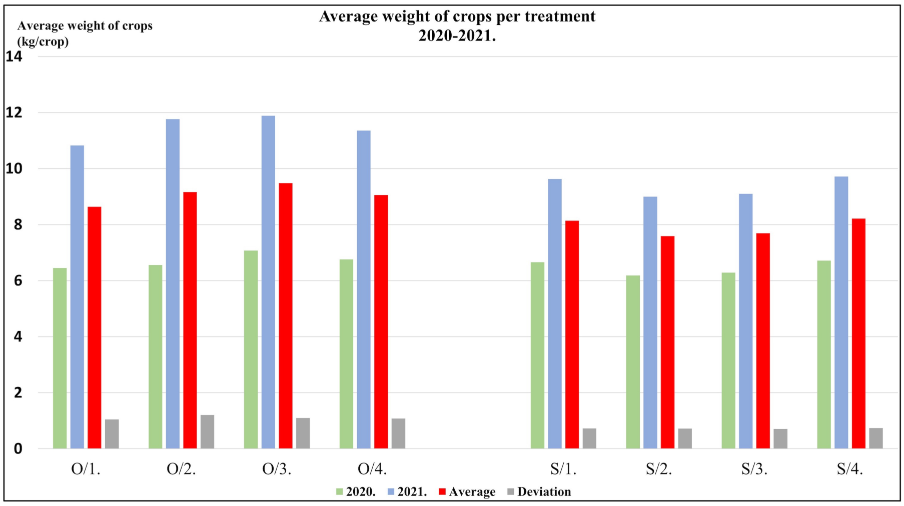

Figure 6: Average crop weight per treatment results (2020, 2021) and the average and standard deviation of the data for the two years.

no significant change in S/4. treatment.

Based on the results of the refraction measurements performed during the two experimental years (Figure 7), it can be stated that only the O/4. treatment had a negative effect on the refraction of the crops. The results of the other treatments did not show a significant difference. For self-rooted plants, S/2. and S/4. treatment resulted in an increase in yield refraction, in contrast to S/3., which showed a small decrease compared to the control.

Sensory examination was performed only in the experimental year of 2021. During the study, the judges did not know which treatment was being tested, so this did not affect the scoring process for them. The tested crops could be scored from 1 to 10, with 1 being the least and 10 being the tastiest watermelon. At the end of the study, we averaged the scores obtained with the number of reviewers (by 10). Thus, for both repetitions of each treatment, we obtained an average score ranging from 1 to 10, which is indi-

DOI: https://doi.org/10.18380/SZIE.COLUM.2022.9.2.101

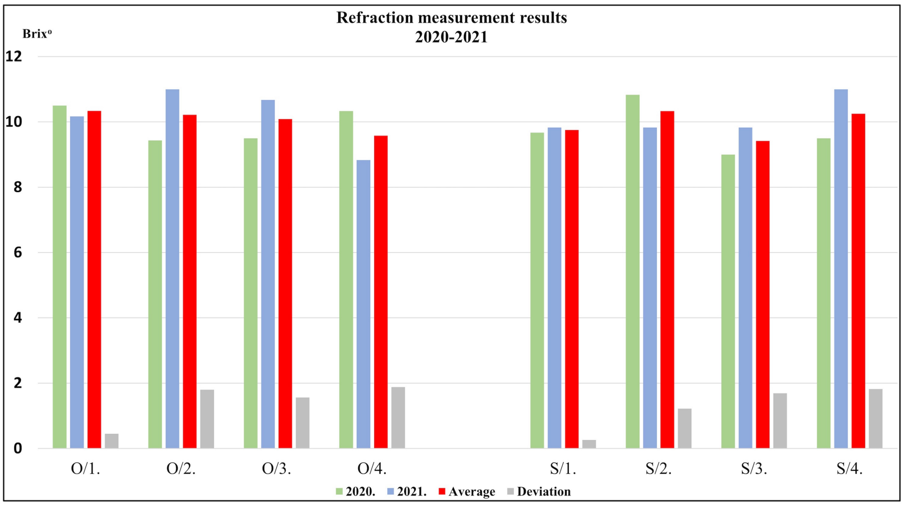

Figure 7: Results of refraction measurements (2020, 2021) and the mean and standard deviation of the data for the two years.

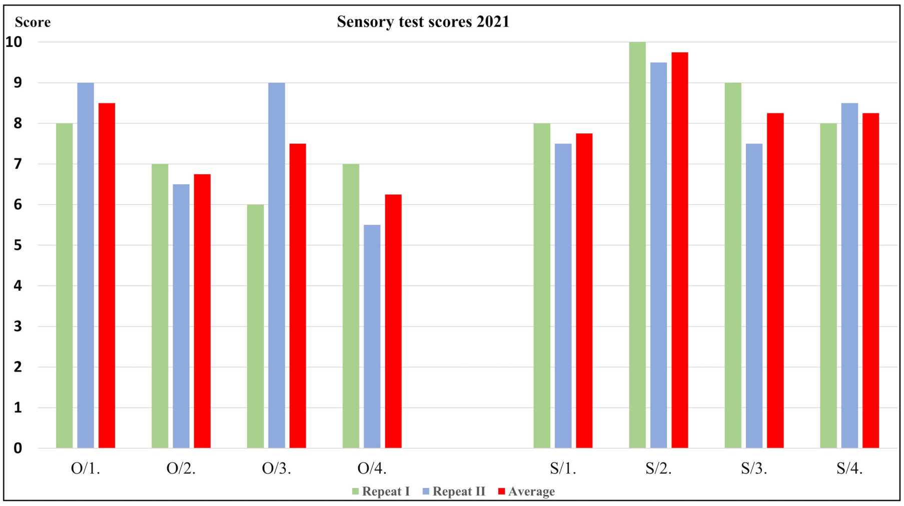

Figure 8: Sensory test scores (2021) and mean scores for replicates.

cated in Figure 8.

Based on the averaged scores, it can be seen that the watermelons grown in the control (O/1.) proved to be the tastiest of the grafted treatments, despite the fact that the refraction values in 2021 were not the highest for this treatment. It is true that, based on dry matter content measurements, O/2. treatment showed the highest value in 2021, however, in the opinion of the reviewers, it was not the tastiest.

Among the self-rooted plants, the yield of S/2. treatment received the highest score based on the averaged scores. Refraction measurements in 2021 showed the highest value in the crop of the S/4. treatment, however, according to the reviewers, the watermelons grown here were not the tastiest.

Crop weight loss was also examined only in the experimental year of 2021. The aim of our study was to investigate the shelf life of watermelons grown in different treatments to see if different nutrient levels in this area affect the quality of the crop. To this end,

Table 3: Weight loss of crops of different treatments (2021)

	Repeat I.	Repeat II.	Average of repetitions
O/1.	3.9%	4.32%	4.11%
O/2.	2.29%	2%	2.15%
O/3.	2.61%	4.64%	3.63%
O/4.	2.04%	4.21%	3.13%
S/1.	3.1%	2.33%	2.72%
S/2.	2.49%	1.91%	2.2%
S/3.	2.25%	2.05%	2.15%
S/4.	1.59%	2.27%	1.93%

we took a crop from each of the two repetitions of each treatment, the weight of which was measured and recorded one by one, after which, for 12 days, the temperature of a store was approx I placed them in a 20°C room. When collecting the samples, I tried to make them approx have the same mass to ensure the accuracy of the results obtained. Then, after 12 days, we again measured the weight of each crop one by one, and the percentage difference between the two measurements gave the degree of decay. The results obtained in the studies are shown in Table 3. After averaging the results of the different treatments, it can be stated that the decrease in the weight of the examined crops was the smallest among the grafted treatments O/2. and among the self-rooted treatments the S/4. treatment. In addition, it can be observed that the crop of self-rooted plants decreased to a lesser extent than the crop of grafted plants.

Discussion

Our experiment showed that at the beginning of the growing season, before or during the first flowering period, higher amounts of phosphorus applied simultaneously with irrigation have a positive effect on the development and yield and quality of *grafted plants* throughout the growing season.

In addition, we were convinced that in the case of self-rooted plants it has a positive effect on the results of the higher amount of potassium active substance applied during the ripening period, also during irrigation, especially in terms of the average weight of the crops and the number of crops per treatment. We found that – similarly to the grafted plants – the higher phosphorus active substance released before and during the first flowering period also promotes the flower formation of the self-rooted and improves their yield quality. All of this proves that it is really necessary to use different nutrient replenishment in the cultivation of self-rooted and grafted plants.

In addition to the results obtained, the experiment showed that the nutrients applied during drip irrigation are of great importance for the development of the plants and the quantity and quality of the crop. Respectively, the efficiency of irrigation is greatly influenced by the vintage effect.

Acknowledgements

I am grateful to my former consultant, Dr. Istvánné Rácz, who helped me without feeling tired. I also owe a debt of gratitude to my Grandparents, who provided the site for my experiment, and to my Parents, who provided assistance throughout the two years with their encouragement and helpful work in the various work processes. Thanks are due to all my family members, friends and acquaintances who helped me with my work and commented on the results of the various treatments during the sensory examinations. Also, thank you to everyone who contributed in some way to the success of my experiment.

References

Balázs, G. (2013). Az oltás hatása, szerepe és jelentősége a magyarországi sárga- és görögdinnye termesztésben. The effect, role and importance of grafting in musk- andwatermelon cultivation in Hungary. In (p. 12-66).

Balázs, S. (2004). Zöldségtermesztők kézikönyve. Budapest: Mezőgazda Kiadó.

Davis, A. R., Perkins-Veazie, P., Hassell, R., Levi, A., King, S. R., & Zhang, X. (2008). Grafting Effects on Vegetable Quality. HortScience **43**(6), 1670-1672. doi: https://doi.org/10.21273/hortsci.43.6.1670

Goreta, S., Perica, S., Dumicic, G., Bucan, L., & Zanic, K. (2005). Growth and Yield of Watermelon on Polyethylene Mulch with Different Spacings and Nitrogen Rates. HortScience **40**(2), 366-369. doi: https://doi.org/10.21273/hortsci.40.2.366

Hochmuth, G. J., Hanlon, E. A., & Cornell, J. (1993). Watermelon Phosphorus Requirements in Soils with Low Mehlich-I-extractable Phosphorus. HortScience **28**(6), 630-632. doi: https://doi.org/10.21273/hortsci.28.6.630

Hodossi, S., Kovács, A., & Terbe, I. (Eds.). (2004). Zöldségtermesztés szabadföldön. Budapest: Mezőgazda Kiadó.

ICL. (2015). Vízben oldható műtrágyák. Retrieved 29.11.2022, from https://icl-sf.com/hu-hu/explore/zoelds-g-gyuemoelcs-s-sz-nt-foeldi-noev-nyek/v-zben-oldhat-m-tr-gy-k/

Kiss, Z., & Rédai, I. (2005). A zöldségtermesztés, -tárolás, -értékesítés szervezése és ökonómiája. Budapest: Mezőgazda Kiadó.

Knott, J. E., & Tamás, K. (1973). Zöldségtermesztők zsebkönyve az usa-ból. Budapest: Mezőgazdasági Kiadó.

Locascio, S., Fiskell, J., Everett, P., & Crall, J. (1966). Watermelon response to copper and a complete micronutrient source. In Proceedings of the florida state horticultural society (Vol. 79, p. 150-154).

Nagy, J. (1994). Dinnye. Budapest: Mezőgazda Kiadó.

Nagy, J. (1997). Dinnye, uborka, tök (kabakosok). Budapest: Mezőgazdasági Szaktudás Kiadó.

Nagy, J. (2000). A dinnye és termesztése. Budapest: Mezőgazdasági Szaktudás Kiadó.

Nagy, J. (2005). A sárga- és görögdinnye. Budapest: Szaktudás Kiadó Ház.

Rolbiecki, R., Rolbiecki, S., Piszczek, P., Figas, A., Jagosz, B., Ptach, W., … Kazula, M. J. (2020). Impact of Nitrogen Fertigation on Watermelon Yield Grown on the Very Light Soil in Poland. Agronomy **10**(2), 213. doi: https://doi.org/10.3390/agronomy10020213

Scott, W., & McCraw, B. (1990). Calcium fertilization and cultivar affect watermelon rind thickness and resiliency. HortScience **25**(9), 1075d-1075. doi: https://doi.org/10.21273/hortsci.25.9.1075d

Tóth, Á. (2006). A XXI. század öntözőrendszerei. Budapest: Visionmaster Studió - Aquarex ’96 Kft.,.