

Rheological evaluation of industrial tomato

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SUMMARY

Today, tomato has the second largest harvesting area globally, and the fourth largest in Hungary. The importance of industrial tomato is growing year by year, and one of the most important tasks is to satisfy the needs of the industry. To meet these needs, the producer has to find the proper genotype, which can achieve up to 100 t ha⁻¹ crop yield. This quality has high importance to be researched.

The experiment was carried out in the Botanical and Exhibition Garden of the University of Debrecen, with 3 examined genotypes. The planting date was 3 of May 2018. The harvesting was two-threaded. On 27 of July the physical parameters – fruit shape index (length/diameter), firmness (kg cm⁻²), water-soluble dry matter content (Brix%) and weight of the berries (g) – were evaluated. On 15 of August the rheological parameters were examined – the force needed to tear the skin – bioyield point (g) and flesh firmness (g).

The fruit shape index was oval (between 1.19 and 1.24) for all the examined genotypes. The firmness was between 0.92 (UG1122713 F₁) and 1.05 (Prestomech F₁) kg cm⁻², which compliance the needs of the industry. The water-soluble dry matter content was suitable, with a value between 4.49 (Prestomech F₁) and 4.65 (UG1122713 F₁) Brix%. The weight of the berries was between 45.94 (UG989 F₁) and 49.37 (Prestomech F₁) g per piece.

The bioyield point was between 76.00 (UG1122713 F₁) and 85.16 (UG989 F₁) g. The flesh firmness was between 33.68 (UG1122713 F₁) and 42.81 (UG989 F₁) g.

Finally, we can conclude based on the obtained data that the UG989 F₁ hybrid was the most proper for the applied cultivation conditions. This genotype can be recommended for the farmers even in extreme weather conditions.

Keywords: industrial tomato, rheological evaluation, tomato genotypes

INTRODUCTION

Tomato (*Lycopersicon lycopersicum* L.) belongs to the *Solanaceae* family. The species originated in Central America. It was brought to Europe by the Spanish conquistadors in the 15th century. The first written records about tomato were found in Italy and dated back to 1544. Two centuries passed before it became widespread in the continent, the first record that said it is edible only date back to 1710 (Helyes, 1999).

Nowadays it is the second most important vegetable crop after onion with 4.8 million ha of area harvested worldwide (FAO, 2018). Its importance is outstanding not only worldwide, but also in Hungary.

In Hungary the total production area of tomato was 2500 ha (KSH, 2018) including 1800–2000 ha of industrial tomato, which is nearly 80% of the total area (I1). The production was more than 100,000 t, and in the next 2–3 years more expansion is expected. All of the produced tomato is processed by Hungarian factories (Univer) (Rimóczi, 2018).

There are many reports about the qualitative evaluation of agricultural products (Arana, Jarén and Arazuri, 2004; Jarén and García, 2002; Peris, 1983). In the case of industrial tomato, concrete specifications are demanded by the industry (Calvo, 1996). Because most quality factors are related to physical properties in most of the cases it is possible to develop quality evaluation methods based on these properties (Ruiz and Chen, 1990).

One of the most important quality parameters is firmness (Wu and Abbott, 2001), which is an index of the mechanical, chemical and rheological properties of the fruit (Vursavus and Kesilmis, 2016). Different methods exist to examine this parameter, such as the Magness-Taylor test (Plocharski et al., 2000), or rheological evaluation of flesh firmness.

The skin resistance (bioyield point) is closely linked with firmness. It is very important during transportation, because cracks in the skin allows the juice to flow out, and damaged berries can easily become rotten (Arazuri et al., 2006). According to previous reports, the most common technique to measure skin resistance was puncture test (Catala et al., 1982). Another important parameter that defines the quality of tomato is the water-soluble dry matter content. The widely used method to determine this parameter is refractometry (Arazuri et al., 2006).

The main purpose of the experiment was to find the most proper genotype for industrial growing even in extreme weather conditions.

MATERIAL AND METHODS

The experiment was conducted in the Botanical and Exhibition Garden of the University of Debrecen. In order to have representative results about the species, 3 genotypes (Prestomech F₁, UG989 F₁, UG1122713 F₁) were evaluated. The planting date was 3 of May 2018.

The harvesting was two-threaded. The first date was 27 of July 2018. This time the following physical

parameters were evaluated – fruit shape index (length/diameter), firmness (kg cm⁻²), water-soluble dry matter content (Brix%) and weight of the berries (g). The second harvest was on the 15 of August 2018. At this time, rheological evaluations of berry were realised which means the skin resistance measurement (Bioyield point) (g), and the flesh firmness.

The rheological evaluations were performed with a TA.XTplus Texture Analyser instrument, P/2N needle probe in the Food Science Institute, University of Debrecen.

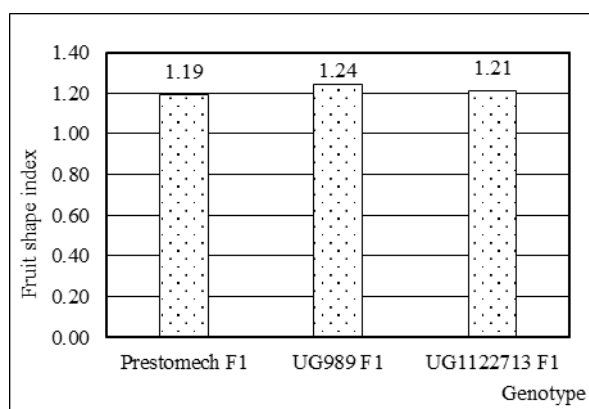
RESULTS AND DISCUSSION

Fruit shape index

The fruit shape index is the length of the berry divided by its diameter. When the result equals to 1, the berry is spherical. However, result >1 means the berry is oval, otherwise <1 means the berry is flat.

For mechanical harvest, the best shape is oval, with a fruit shape index less than 2.0. The evaluated genotypes’ fruit shape index is shown in *Figure 1*.

Figure 1: Fruit shape index of the evaluated tomato genotypes (Debrecen, 2018)



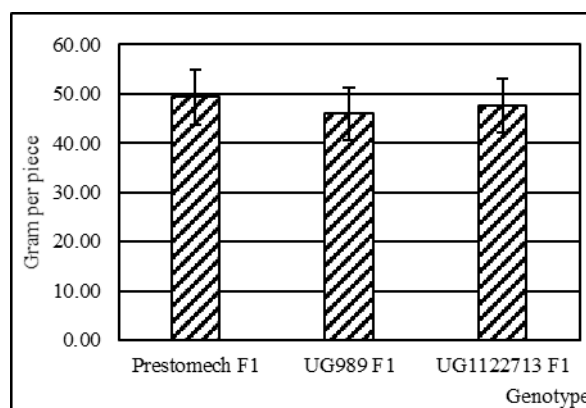
According to the obtained results, all examined genotypes met the requirements. Even the *Prestomech F1*, which had the smallest value, fulfils the requirements of the industry.

Weight of the berries

Individual berry weight plays a major role in mechanical harvest as it is closely related to the size of the berries. During mechanical harvest, the unified berry size is favourable. It most easily can be accomplished by using a genotype of almost the same berry weight. The evaluated genotypes berry weight is shown in *Figure 2*.

According to the results, all three genotypes are suitable for mechanical harvest, as all have a pointing error nearly 10%.

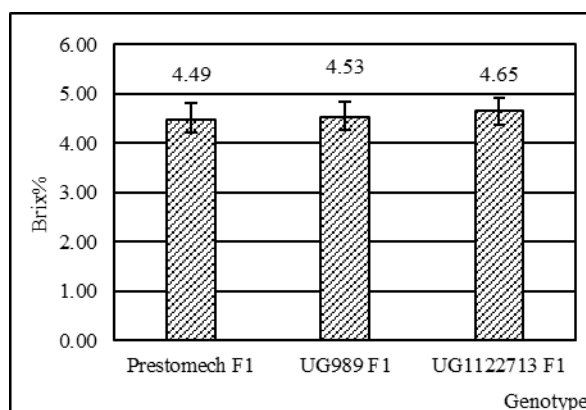
Figure 2: Weight of the berries of the evaluated tomato genotypes (Debrecen, 2018)



Water-soluble dry matter content (Brix%)

To have a proper nutrient content quality for tomato one of the most important parameters is the proper sugar-acid proportion (10:1). This parameter was evaluated after the harvest and the results are shown in *Figure 3*.

Figure 3: Water-soluble dry matter content (Brix%) of the evaluated tomato genotypes (Debrecen, 2018)



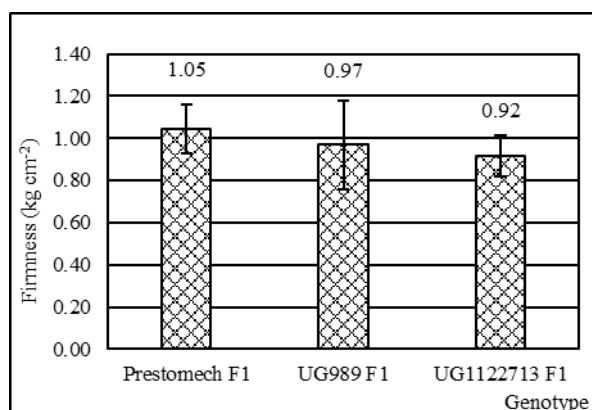
According to the results, the genotypes’ Brix% was between 4.49% and 4.65%, which fulfils the needs of the industry.

Firmness

The most important expectation of industrial tomato is the possibility of mechanical harvest. To satisfy this expectation the berry must have a firmness more than 0.90 kg cm⁻². The results are shown in *Figure 4*.



Figure 4: Firmness of the evaluated tomato genotypes (Debrecen, 2018)

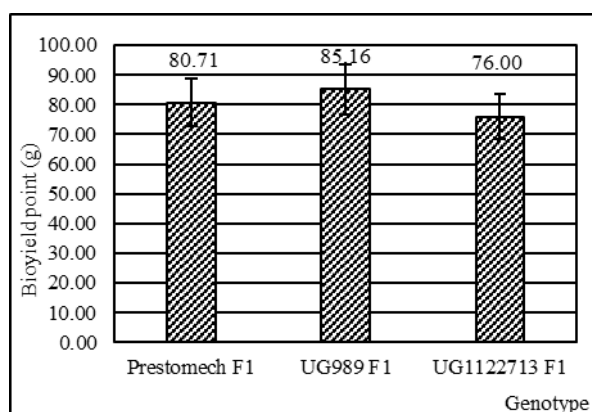


The highest firmness of fruit was detected in the samples of *Prestomech F₁* genotype (1.05 kg cm⁻²). All examined varieties fulfilled the requirements of mechanical harvest with values between 0.92 kg cm⁻² and 1.05 kg cm⁻².

Force needed to tear the skin (Bioyield point)

The bioyield point is the indicative of initial cell rupture in the cellular structure of the material. It shows how much force the berry can tolerate before the flesh splits. The evaluated genotypes' bioyield point is shown in Figure 5.

Figure 5: Bioyield point (g) of the evaluated tomato genotypes (Debrecen, 2018)

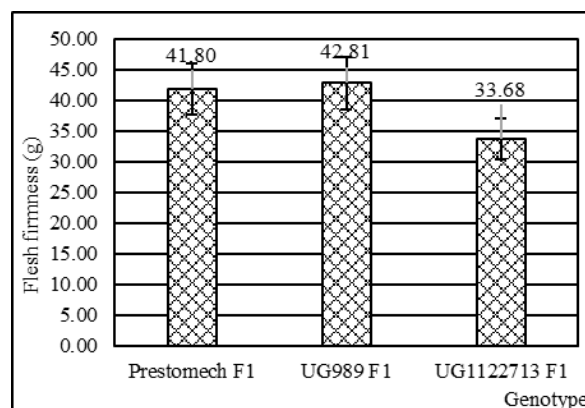


According to the obtained results, the *UG1122713 F₁* has the lower value (76.00). The highest bioyield point belongs to the *UG989 F₁* genotype (85.16).

Flesh firmness

Flesh firmness is strongly related to the bioyield point. The results are shown in Figure 6. As the data obtained, the received results are consistent with the results of the examination of the bioyield point.

Figure 6: Flesh firmness of the evaluated tomato genotypes (Debrecen, 2018)



CONCLUSION

The experiment was carried out between 3 of May 2018 with 2 different harvesting times (27 of July and 15 of August). The data are represented in the mean of the three examined genotypes. The aim was to evaluate the physical and rheological parameters to determine the proper genotype for the applied cultivation conditions, and for the farmers to cultivate even in extreme weather conditions. To define these properties, we evaluated the fruit shape index (length/diameter), firmness (kg cm⁻²), water-soluble dry matter content (Brix%), weight of the berries, bioyield point (g) and flesh firmness (g).

According to the results, we can conclude that based on the obtained data the *UG989 F₁* hybrid was the most proper for the applied cultivation conditions. This genotype can be recommended for the farmers even in extreme weather conditions.

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