Rheological evaluation of industrial tomato varieties

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SUMMARY

Tomato is one of the most popular crop in the world and in Hungary as well. Nowadays the main quest of the producers is to fulfil the requirements of the industry. For the mechanical harvest proper varieties are needed with special physical parameters (e.g. flesh firmness). The aim of our experiment was to choose the proper genotype with good agronomical parameters (yield, brix%, earliness).

To select the appropriate genotypes, rheological parameters were measured in raw and processed condition.

Three genotypes were tested (Roma, Rio Grande and Kecskeméti 549) for the following parameters: firmness (g/cm^2), force needed to tear the skin [bioyield point (g)] and flesh firmness (g).

According to the results, Rio Grande genotype had the highest fruit firmness (1363 g/cm^2) which was more than two times higher compared to Roma (594 g/cm^2).

The bioyield point and firmness of skin were measured by rheological methods. The highest value of bioyield point was measured in Kecskeméti 549 and Rio Grande (92,44 and 92,10 g/cm^2 respectively). The highest value of flesh firmness was detected in Rio Grande genotype (42,61 g/cm^2).

To summarize, the most suitable genotype for processing in our trial was the Rio Grande.

Keywords*:* industrial tomato, rheological evaluation, tomato genotypes

INTRODUCTION

Tomato (*Lycopersicon lycopersicum* L.) belongs to the *Solenaceae* family and is originated in western South America (Helyes, 1999). Nowadays, it is one of the most important vegetable crop with 4.85 million ha of area harvested worldwide (FAO, 2017). Its importance is outstanding in Hungary as well, it has the fourth biggest harvesting area among vegetables.

In Hungary, the total production area of tomato was 2500 hectare (KSH, 2018), with more than 110,000 tonnes of harvested tomatoes. All of the produced tomato is processed by Hungarian factories. The principal tomato processing company in Hungary, Univer, was the 37th in the world ranking in 2018 (Rimóczi, 2018).

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 (*Roma, Rio Grande* and *Kecskeméti 549*) were evaluated. The main characteristics of the genotypes are shown in *Table 1*. The sowing date was 23 of April, and the planting date was 29 of May 2019, with 70×40 cm arrangement. The arrangement was with 12 plants per row, 3 row per parcel. There were a total of 9 parcels, with 3x3 repetitions.

Table 1. Main characteristics of the evaluated genotypes

Genotype	Origin	Berry weight	Growing season
Kecskeméti 549	Hungary	50-60 g	120-125 days
Roma	USA	~60 g	120-125 days
Rio Grande	USA	~85 g	125-135 days

The harvesting was on the 21 of August. The genotypes were evaluated for the following parameters: firmness (g/cm^2), force needed to tear the skin [bioyield point (g)] and flesh firmness (g). Firmness was measured with a Magness-Taylor manual penetrometer. The measurements of the bioyield point and flesh firmness were conducted on a TA.XTplus Texture Analyzer (Figure 1).

The device is a texture analysis instrument which is capable of measuring virtually any physical product characteristic such as hardness, fracturability, adhesiveness, gel strength, extensibility of foods, cosmetics, pharmaceuticals, gels, adhesives and other consumer products. The TA.XTplus is commonly employed to measure and quantify fundamental, empirical and imitative tests in both compression and tension, covering those relating to texture analysis, materials properties as well as effects of rheology of solid, semi-solid, viscous liquid, powder and granulate materials (I1).

Figure 1. TA.XTplus Texture Analyzer

The rheological evaluations were performed at the Agricultural Laboratory Centre, University of Debrecen.

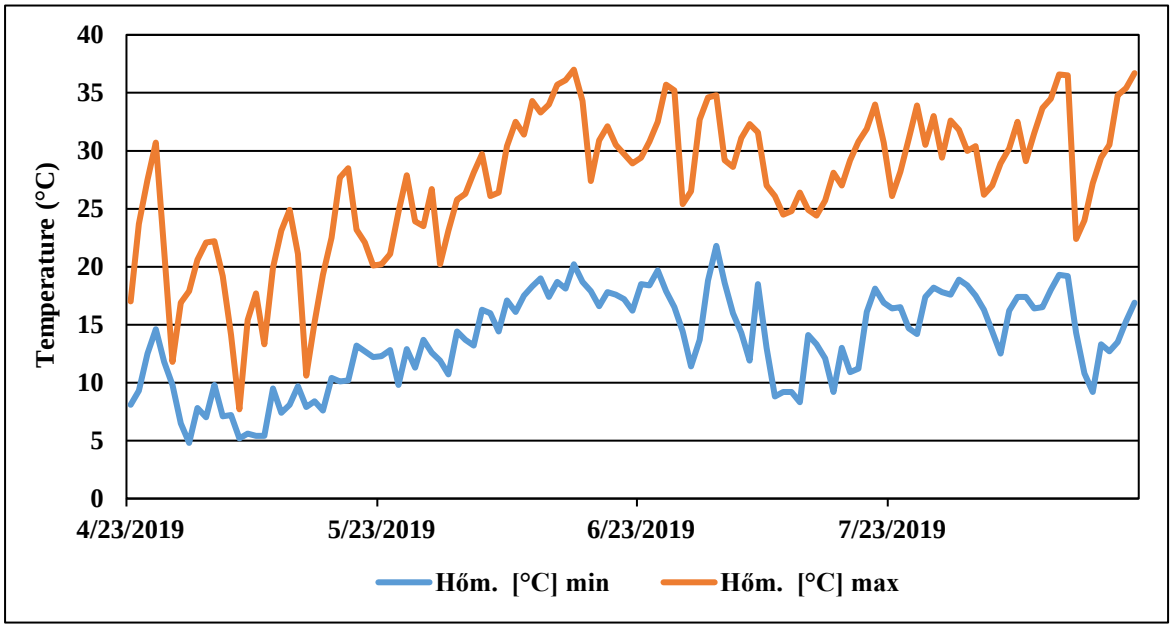

Figure 2. Temperature data of the growing season

The temperature data of the growing season is shown in *Figure 2*. As the figure shows, there were several days with more than 32 °C, which is the maximum temperature where lycopene synthesis can occur (Tomes, 1963).

RESULTS AND DISCUSSION

Firmness

One of the most important expectation of industrial tomato is the possibility of mechanical harvest. To satisfy this requirement, the firmness of the berry must be more than 1 kg cm^{-2}. The results are shown in *Figure 3*.

The highest firmness of fruit was detected in the samples of *Rio Grande* genotype (1.36 kg cm^{-2}). From the examined varieties the *Roma* did not fulfilled the expectation of the industry with it's firmness being less than 1 kg cm^{-2} (0.59 kg cm^{-2}). These results compared to our previous examinations are adequate, with values between 0.92 kg cm^{-2} and 1.6 kg cm^{-2} (Tóth – Takácsné Hájos, 2018; Tóth et. al., 2019).

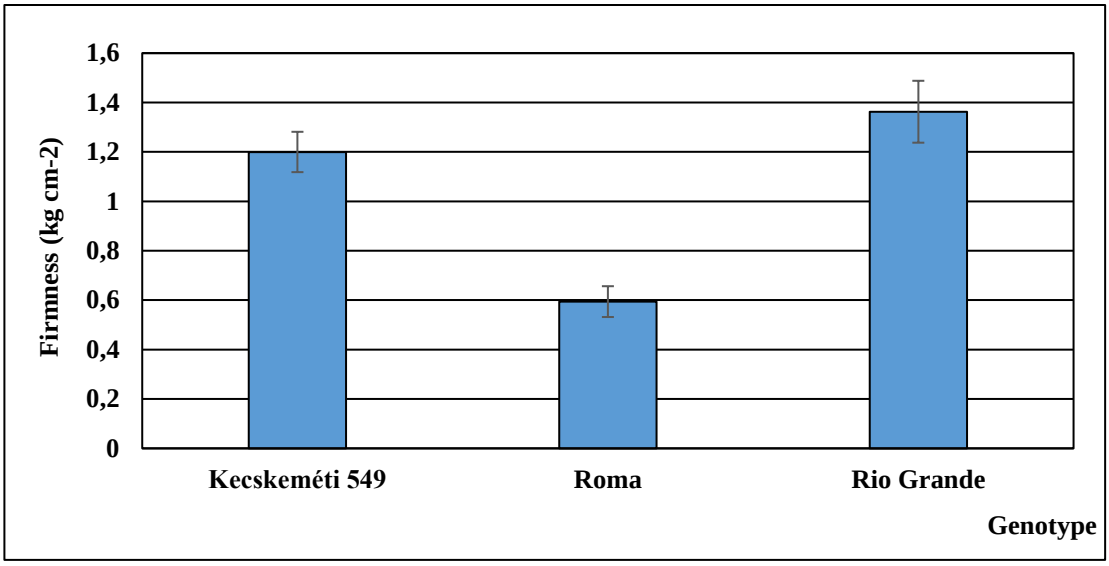

Figure 3. Firmness of the evaluated genotypes (Debrecen, 2019)

Force needed to tear the skin (Bioyield point)

The bioyield point is the point at the force/deformation curve where a drop or no increase in force takes place with an increase in deformation. It shows how much force the berry can tolerate before the flesh ruptures. The evaluated genotypes' bioyield point is shown is *Figure 4.*

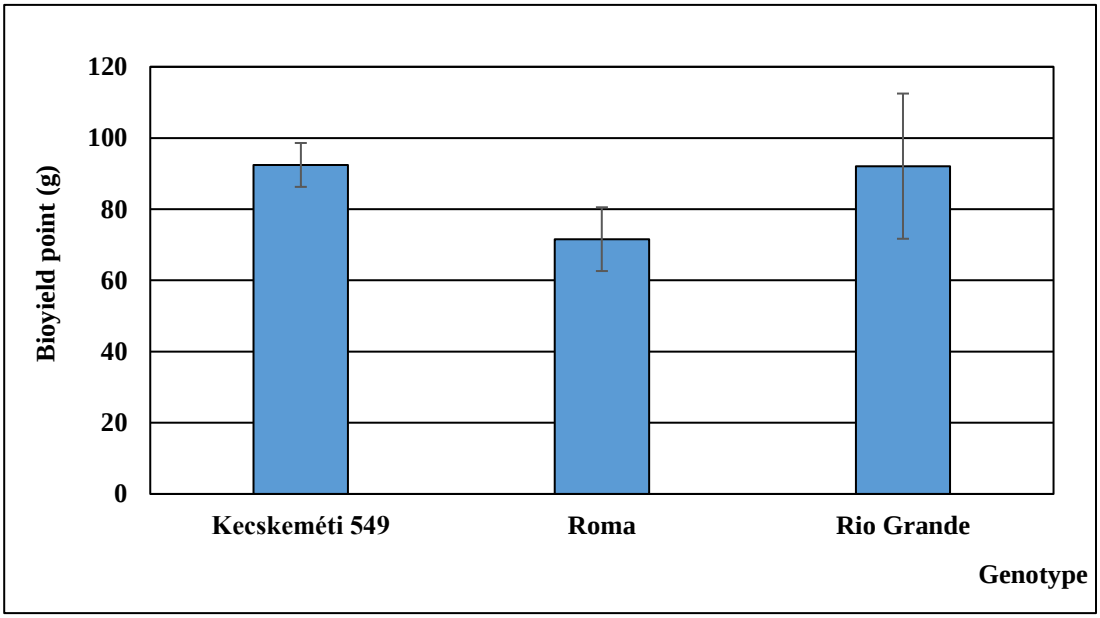

Figure 4. Bioyield point (g) of the evaluated genotypes (Debrecen, 2019)

According to the results, the *Roma* has the lowest value (71.58). The *Kecskeméti 549* and *Rio Grande* genotypes had nearly equivalent bioyield points (92.44 and 92.10). Bioyield point is strongly related with flesh firmness. These are the main characteristics that determines the qualitative parameters of the berries for mechanical harvest.

Flesh firmness

Flesh firmness is strongly related to the bioyield point. The results are shown in *Figure 5*.

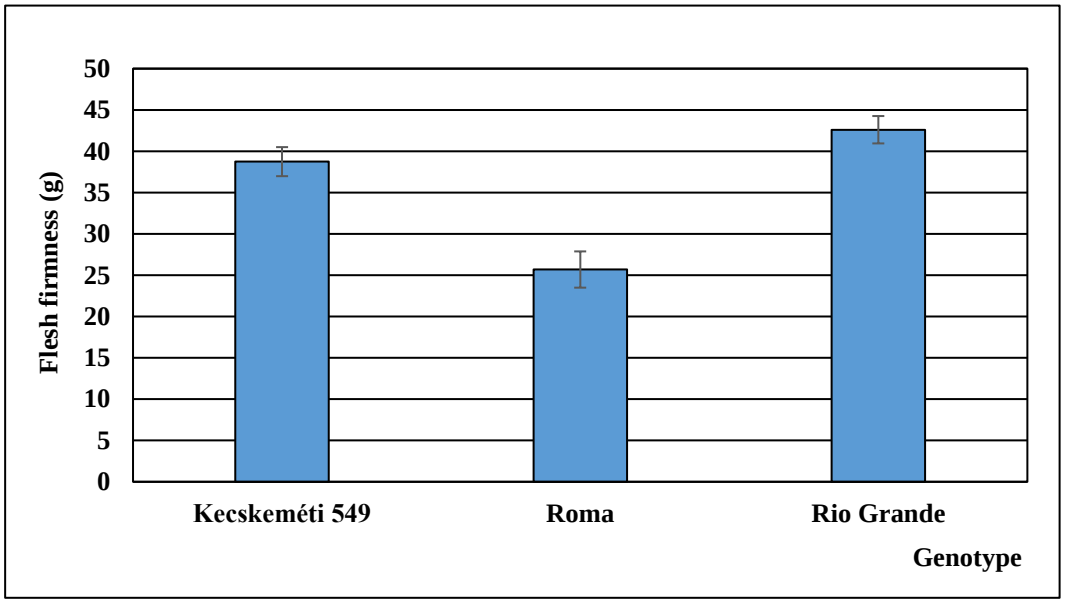

Figure 5. Flesh firmness of the evaluated genotypes (Debrecen, 2019)

According to the results, the *Roma* has the lowest value (25.69). The highest bioyield point belongs to the *Rio Grande* genotype (42.61).

CONCLUSION

The experiment was carried out between 23 of April and 21 of August 2019. 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 firmness (g/cm^2), force needed to tear the skin [bioyield point (g)] and flesh firmness (g).

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

ACKNOWLEDGMENTS

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