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The rootstock effect in the Hungarian watermelon production

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Abstract

Due to the importance of the subject, the aim of the experiment was to study the quantitative and qualitative changes in response to watermelon grafting. Combinations of watermelon variety 'Bonta' with interspecific hybrid and *Lagenaria* rootstocks were studied in the experiment. The grafted and non-grafted plants were planted at different row and plant spacing. Fruit number and weight, also yield, have been established. A qualitative analysis followed the harvests. Refractometric value was measured at the beginning of sampling process, using a digital hand refract meter. Total and reducing sugar contents were determined using the Luff-Schorl method.

Key words: *Citrullus lanatus* var. *vulgaris*, grafting, yield, refractometric value, sugar content

Introduction

Watermelon production has a great tradition in Hungary. Descriptions of watermelon cultivation appeared as early as the 18th century, which show that at that time it was one of the most important articles of provision. By the present days, the grafting of watermelon has gained in importance. Due to the extreme weather characteristics of the country, a further considerable increase in the area of grafted plants is expected.

In order to select the suitable combination of rootstock and scion variety it is necessary to know the characteristics of the rootstock: the type of root system, resistance, effect on growth vigour, effect on fruit ripening, etc. As many as 6 to 7 varieties can be considered for watermelon rootstock. In Asia, grafted vegetables had already been brought into cultivation several centuries ago (Lee and Oda, 2003). In Korea and Japan grafted watermelon transplants were produced on a large scale already in 1920 (Lee, 1994), but in the Western world their use in production started only from 2005 onwards (Ristaino and Thomas, 1997). The reason of using grafted transplants consisted in the protection against soil borne pests and diseases, as chemical and genetic methods had failed to reach the desired effect (Oda, 2002). Grafted transplants show a better reaction to novel diseases besides offering a cheaper and more flexible solution compared to the development of a resistant variety by breeding. Simultaneously, it can assist in the improvement of quality and yields (Lee and Oda, 2003; Nisini et al., 2002; Oda, 2002; Rivero et al., 2003; Romero et al., 1997; Shimada and Moritani, 1977; Yetisir and Sari, 2003; Traka-Marovna et al., 2000).

Nowadays, for the use of grafting many other reasons exist, e.g. resistance of grafted plants to low and high temperatures, increased salt tolerance, increased absorption and more efficient use of water (Cohen and Noar, 2002).

Due to the importance of the subject, the aim of the experiment was to study the quantitative and qualitative changes in response to watermelon grafting by the different type of rootstocks, interspecific hybrid and *Laganeria* genus.

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Material and methods

Combinations of watermelon variety 'Bonta' and two rootstock types were studied in the experiment. The interspecific hybrid rootstock was represented by 'RS 841' and the *Lagenaria* genus by the variety 'FR Strong'. It was considered important to study both types of rootstock, due to different characteristics. The experiment was set up in the greatest watermelon growing region of Hungary.

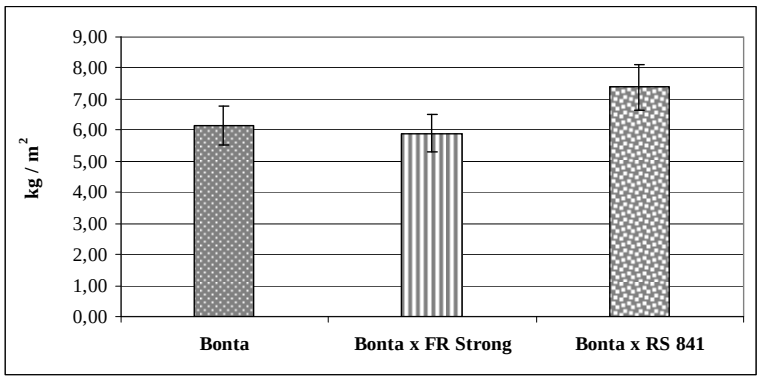
Seeds of the scion variety were sown in polystyrene trays with 96 cells, on 3rd of March 2009. The rootstocks and the own-root plants used for control were sown in soil blocks on 11th of March 2009. The grafting by the simple 'Japanese' one cotyledon grafting method was done on 19th of March 2009. The method essentially consists in leaving one cotyledon of the rootstock and removing the other cotyledon together with the shoot tip, by an oblique (approximately 45°) cut. Also an oblique cut was made on the scion variety hypocotyls and than the two plant parts were carefully fitted together and fixed with special clips. The grafted plants were placed in the grafting chamber where suitable conditions are provided for graft union formation.

The experiment was conducted in the 3 replication on the soil type chernozem belonging to the category I. The grafted and non grafted plants were planted at different row and plant spacing, 3.2 x 1 m (0.31 plant·m^{-2}) and 3.2 x 2 m (0.16 plant·m^{-2}), respectively. Plants received four pesticide treatments over the growing season. No difference was made in the fertirrigation.

Fruit number and weight, also yield, have been established. For the purpose of laboratory analysis 1 fruit per replication was picked in approximately the same state of development. Samples were homogenized in a mixer and the refractometric value was determined by the manual digital refract meter (PAL-1, ATAGO) at the beginning of sample processing, in the optimum time for picking or, at the latest, one day later. The settled refractometric values corresponded to the amount of soluble dry matter (sugar, in this particular case) of the analysed material. Total and reducing sugar contents were determined using the Luff-Schorl method.

Results and discussion

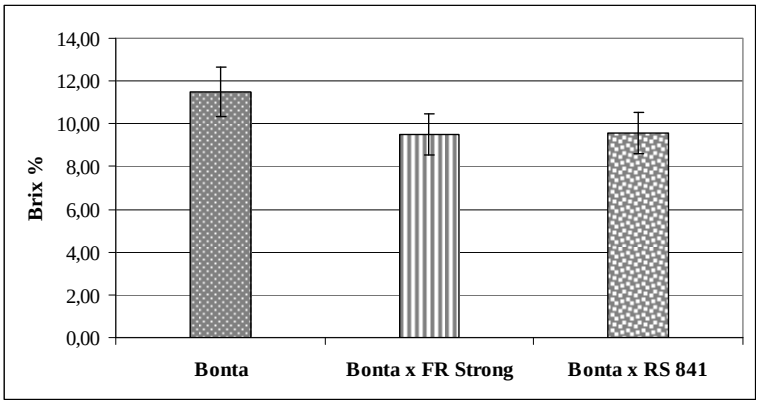
Fruit harvest, consisting of 3 pickings, began on the 6th of July 2009 and terminated with the removal of the plants on the 15th of July 2009. No difference was observed between the time of ripening of the non-grafted and the grafted plants.



Graph 1 Yield of the variety 'Bonta' and grafted variants, 2009

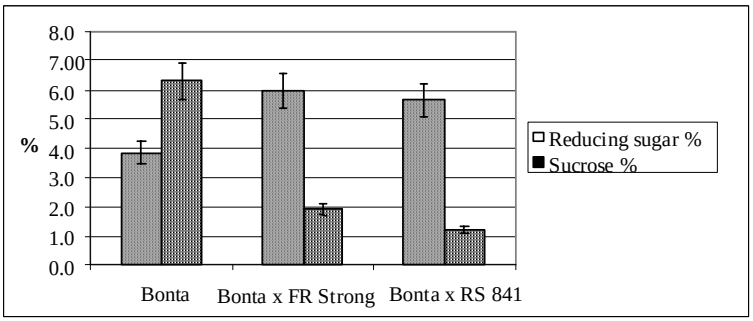
Yield increase in response to grafting is described in the literature and also the yield reducing effect of certain rootstock types. In the experiment, neither rootstock types resulted with significant yield increase. The lowest result was achieved by the 'Bonta' grafted on the rootstock *Lagenaria*, but no significant decrease in yields was observed compared to the non grafted treatment. The highest yield was obtained by the 'Bonta' grafted on the interspecific rootstock 'RS 841' (graph 1).

The highest refractometric values of homogenized watermelon fruits samples, which positively manifested in flavour, showed non grafted plants (graph 2). Grafting with both rootstock types resulted in the decrease of refractometric values. No significant difference was observed between the refractometric values affected by the rootstock types.



Graph 2 Refractometric values of the variety 'Bonta' and grafted variants, 2009

Analysing the sugar content, the percentage of reducing sugars was determined. Glucose and fructose which are reducing sugars, showed an inverse proportion between the grafted and the non grafted variants (graph 3). The sucrose portion and the refractometric values achieved in the graft treatments had the same relationship to data noted in non grafted treatment. The highest refractometric values was obtained on the non grafted 'Bonta' and also the highest sucrose content was registered on this variety, though the highest standard deviation was observed here. The reducing sugar contents of the fruits of 'Bonta' grafted on different rootstocks showed almost the same values.



Graph 3 Sugar contents of the variety 'Bonta' and grafted variants, 2009

Conclusions

In the year of the experiment the variety 'Bonta' grafted on both rootstock types (interspecific hybrid and *Lagenaria*,) proved to be more resistant to adverse weather conditions, which is attributed to the more intense activity of roots. Intensive field vegetable production, including watermelon production, involves great investment and high risks. Grafting, as a kind of vegetative propagation, can reduce the growing risks together with greater yield stability.

The majority of growers and experts generally calculate with higher yield in the case of grafted watermelon, independent of the type of rootstock, compared to non grafted plants. According to this field experiment it can be concluded that grafting did non produce increased watermelon yields in each case. 'Bonta' grafted on the rootstock in *Laganaria* type, 'FR Strong', produced around 4% lower yields than the non grafted plant. On the other hand, the interspecific hybrid rootstock 'RS 841' showed about 20% higher yield than the non grafted variant. In the course of the field tests no sign of postponement of ripening was seen, mentioned by many authors. Based on the respective tests, the rootstock 'RS 841' proved to be superior to rootstock 'FR Strong'.

In the measurement of the refraction in the laboratory tests it was concluded that grafting resulted a decrease of the values registered. None of the plants grafted on either of the rootstock had fruits showing the same or a higher Brix% compared to the fruits of the non grafted plants.

In the determination of sugar content inverse proportionality was found between the reducing and the non reducing sugars. The fruits of the non grafted plants had higher sucrose content than the fruits from the grafted plants. The proportion of the reducing sugars (glucose and fructose) showed an opposite pattern. In

the fruits of the grafted plants higher values of these fractions were measured. Based on these results it can be concluded that the refractometric values and sucrose responsible for the sweet taste are in a close correlation as a high Brix% is coupled with a high sucrose value.

Acknowledgement

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