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RESEARCH ON THE BEHAVIOUR IN THE CONTROLLED POLLINATION PROCESS OF SOME ABORIGINAL APPLE VARIETIES

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Abstract

This article presents the study on the behaviour of a local apple variety 'Măr dulce' in the process of pollination with two valuable varieties that are found in the European assortment. It was studied the behavior in the pollination process of two hybrid combinations C1 - 'Măr dulce' x 'Orion' and C2 - 'Măr dulce' x 'Bistrițean' where the maternal parent is the old apple variety 'Măr dulce' and the paternal parent is represeted by pollen from the apple varieties 'Orion' and 'Bistrițean'.This study provides a novelty for a future selection of elite genotypes for the production of hybrids with an increased resistance to Venturia inaequalis.The studies were conducted in the spring of 2019 and the controlled pollination method was used, which involves a number of steps as: pollen harvesting, pollen maturation, castration of the maternal parent, pollination when the ovarian exudate appears on the stigma and isolation of pollinated branches. After these steps, the number of linked flowers, the number of maturated hybrid fruits and the growth of hybrid fruits resulting from C1 and C2 hybrid combinations were studied.

Key words*: apple, pollination, scab, Venturia inaequalis.*

INTRODUCTION

Globally and locally, one of the diseases that causes the greatest material damage in apple crops is scab (Mitre et al., 2001; Oroian et al., 2006; Babuc, 2012; Le Camp B. et al., 2019).
The scab, caused by *Venturia inaequalis*, has become one of the most important and difficult to control diseases. Due to the need for very good planning of the application of fungicides with apple phenophases, but also due to the difficulty of eradication, fungicides are relatively ineffective, or to be effective requires a very large number of sprays which are contraindicated both for the consumer and from the point of view of very high costs.
The best way to fight scab remains in the hands of breeders and is dependent on the development of new apple species that are resistant to scab (Mihăescu, 1977; Brown, 2003; Ion et al., 2011).
In order to achieve good apple hybrids that present a good resistance to apple scab is required to perform different tests and to use several methods, the method that was used in this study is the controlled pollination (CP).
Controlled pollination is an essential method in apple breeding programs, it is used especially to make high quality seeds that quickly form the desired genotypes (Băncilă, 2003; Sestraș, 2004; Sestraș et al., 2008; Asănică and Hoza, 2013).

MATERIALS AND METHODS

In this study was used the controlled pollination method. Some of the most important steps regarding the working method that we used in the pollination process are:
• choosing parents;
• establishing cross combinations;
• pollen harvesting;
• pollen maturation;
• castration of the maternal parent;
• pollination when the ovarian exudate appears on the stigma.
The pollination works took place in April -May 2019 in an apple orchad located in Mihaești, Valcea County, Romania.
Two-hybrid apple combinations were studied, where paternal parents (pollen) are represented by two valuable varieties from the European assortment, the varieties 'Orion' and 'Bistrițean' and as a maternal parent was used the old apple variety 'Măr dulce' which proved

to be a variety with a special genetic resistance to diseases and pests.

The pollen from varieties taken in the study was harvested and maturated in the spring of 2018 and has been stored in the refrigerator at a maximum temperature of 4ºC.

On the chosen flower of the apple variety, the stamens were removed and then pollination was performed with exogenous pollen from the paternal parent chosen for hybridization.

Then we isolated the branch fragment with the pollinated flowers in a paper bag so that only the pollen from the paternal parent proposed in the pollination scheme participates in the fertilization process.

Figure 1. A. Stamen harvesting, B. Pollen maturation

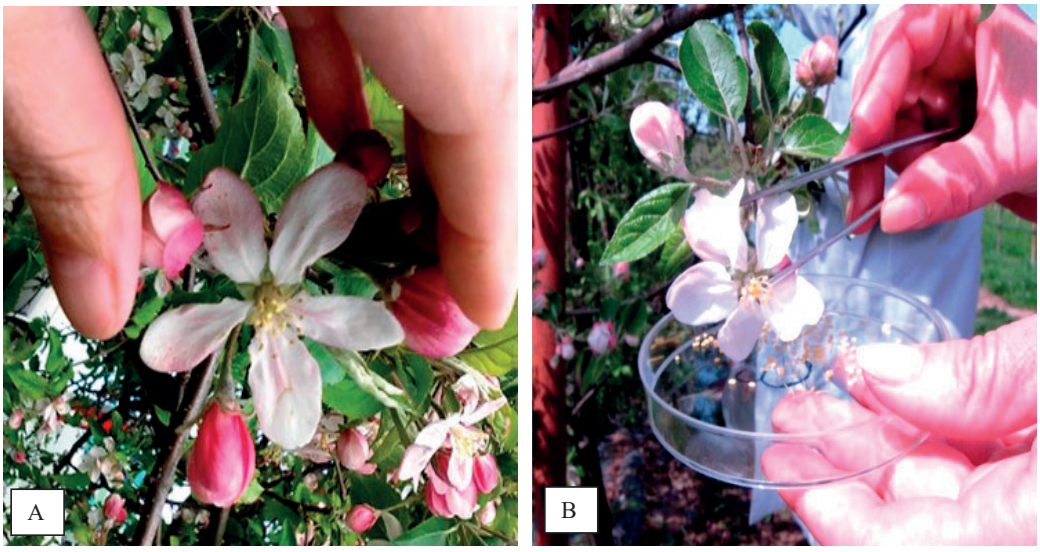

Figure 2. A. Choosing the flowers for pollen harvesting, B. Harvesting the pollen

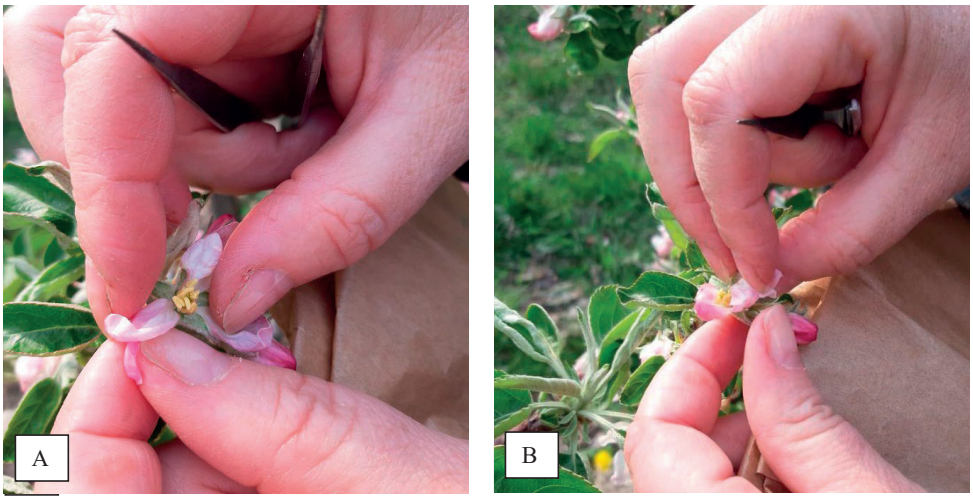

Figure 3. A. Choosing and opening the flower, B. Castration of the maternal parent

Table 1. Scheme of sexual hybridization ♀ x ♂

No. combination	Hybrid cross combination	No. of pollinated flowers
C1	'Măr dulce' x 'Orion'	172
C2	'Măr dulce' x 'Bistrițean'	196

As seen in Table 1 the following hybrid cross combinations were performed:
- hybrid combination C1 - 'Măr dulce' x 'Orion';
- hybrid combination C2 - 'Măr dulce' x 'Bistrițean'.

For hybrid combination C1 were pollinated 172 flowers and for hybrid combination C2 were pollinated 196 flowers.

Figure 4. Isolated branches with pollinated flowers

RESULTS AND DISCUSSIONS

Table 2. Cross combinations, fruit set

No. combination	No. of pollinated flowers	Fruit set (number; %)
C1	172	172; 100%
C2	190	190; 97%

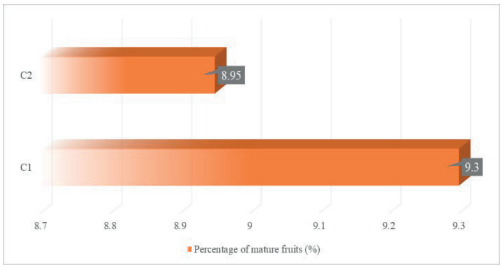

Figure 5. Percentage of matured fruits (%)

From Figure 5 we notice that at the hybrid combination C1 a percentage of 9.3% was achieved, representing a total of 16 matured fruits. For the C2 hybrid combination was achieved a percentage of 8.95% representing 17 matured fruits. The present results could be the effects of several factors, such as the authenticity of the genotypes analyzed (of varieties and offspring) or the method applied. Use in the process of breeding some indigenous varieties of apple, well adapted to the Romanian climate can be an interesting principle regarding the induction of natural genetic resistance to *Venturia inaequalis.*

Figure 6 shows the growth of the fruits of the hybrid combination C1 - 'Măr dulce' x 'Orion'. It is found that the hybrid fruits had a faster growth in the first period studied, they increased 2.2 cm between 15-22.04.2019, after this date the growth rate started to slightly decrease to 1.8, this increase was recorded at 7 days between 22.04.2019 - 06.05.2019. In the time interval 06-13.05.2019, there was the smallest increase of hybrid fruits (0.4 cm). From these, it results that the average growth rate at 7 days is 1.5 cm.

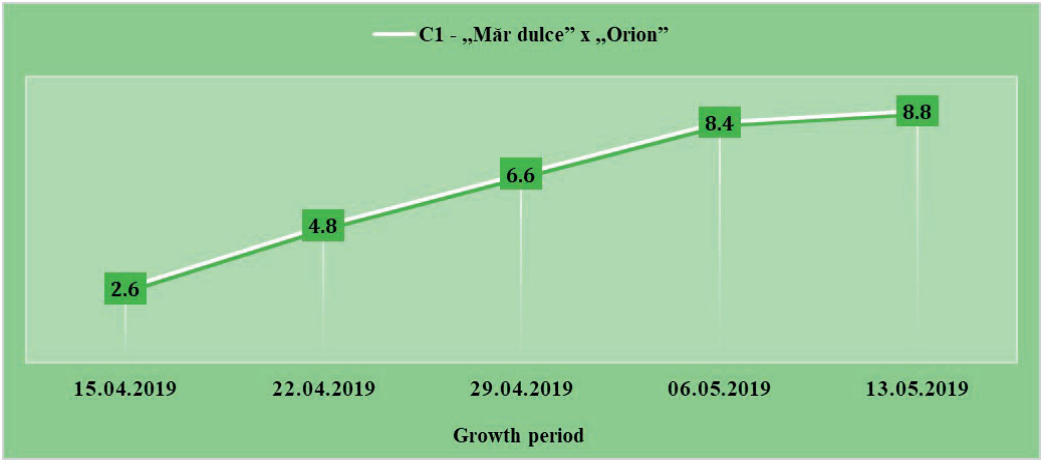

Figure 6. Growth rate of Hybrid Combination C1 - 'Măr dulce' x 'Orion' (cm)

The results in figure 7 clearly show a slow growth of hybrid fruits in the C2 hybrid combination ('Măr dulce' x 'Bistrițean'). In the first period studied, the strongest growth is recorded, being 1.9 cm, the smallest increase is 0.6 cm and it was recorded twice between 29.04.2019 - 13.05.2019.

Undoubtedly, the study of varieties with very good resistance to scab in pollination processes is important, but the revaluation and reconsideration of an old local variety such as 'Măr dulce' it can form a starting point in improving new stable and durable characters, better adapted to the conditions in our country.

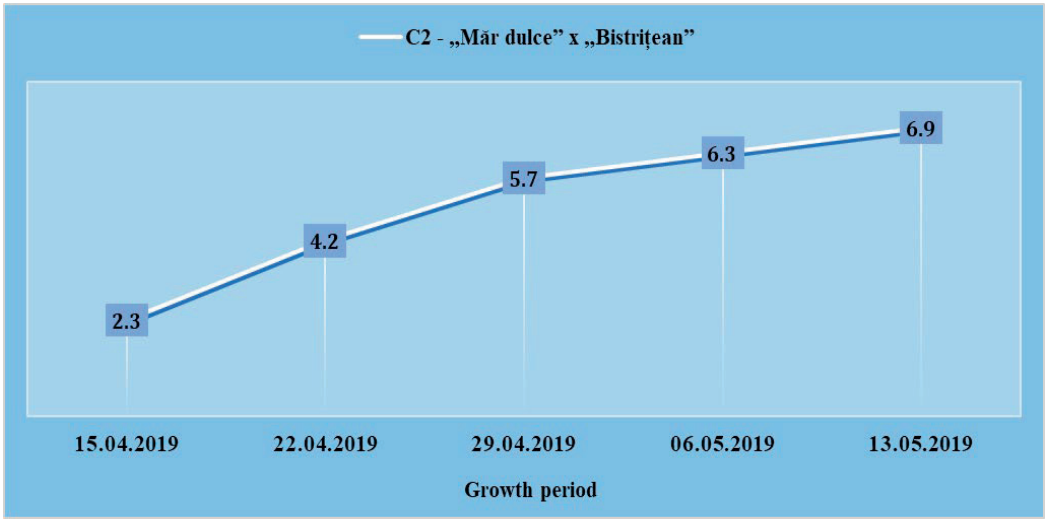

Figure 7. Growth rate of Hybrid Combination C1 - 'Măr dulce' x 'Bistrițean' (cm)

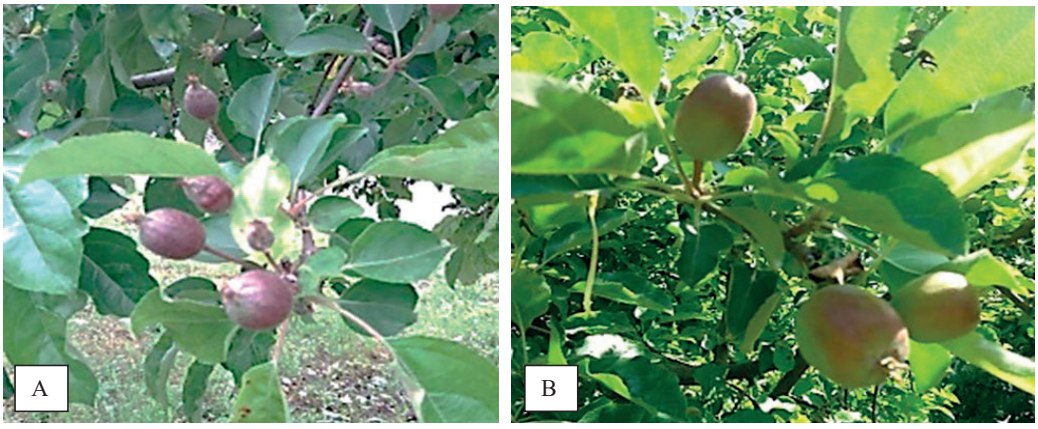

Figure 8. A. Hybrid fruits of the C1 hybrid combination, B. Hybrid fruits of the C2 hybrid combination

CONCLUSIONS

The results obtained in 2019 come with more information by exploring a regional apple population 'Măr dulce', it is very well adapted to the pedoclimatic conditions in Romania.

The conclusions emphasized that:

- in the combination 'Măr dulce' x 'Orion' from the total of 172 pollinated flowers, a 100% success was obtained in terms of fruit setting;
- as regards the maturing of the fruits in the cross combination 'Măr dulce' x 'Orion' 9.3 % of the hybrid fruits were matured, and to the cross combination 'Măr dulce' x 'Bistrițean' 8.95 % of the hybrid fruits were matured.

After studying the growth rate at 7 days, it was noticed the following:

- hybrid combination 'Măr dulce' x 'Orion' recorded a higher increase than the hybrid combination 'Măr dulce' x 'Bistrițean';
- the largest increase was recorded twice, the fruits grew 2.2 cm between 15-22.04.2019 at hybrid combination 'Măr dulce' x 'Orion';
- the smallest increase was recorded on 13.05.2019, being 0.4 cm in the hybrid combination 'Măr dulce' x 'Orion';
- to the hybrid combination 'Măr dulce' x 'Bistrițean' the largest increase in fruit was recorded in the first period studied, the fruits increasing by 1.9 cm.

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