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INVESTIGATION OF APRICOT REPRODUCTIVE STRUCTURES, CREATION AND PROPAGATION OF NEW FORMS

SUMMARY

One of the main problems of modern fruit agriculture is creation of new productive apricot cultivars by hybridization method with suitable selection of parent couples with functional gametes. Analysis of male generative sphere development in 25 apricot cultivars demonstrated that they have different quality of pollen grains. The least amount of morphologically proper pollen grains was noticed in cultivars Dionys, Harcot, Mamai thus they should be used as maternal forms. The greatest pollen grains viability is typical for cultivars Ananasny Tsiurupinsky, Krasny Vympel, Magistr and Holovous that are recommended as paternal forms. In the process of parent forms selection flower structure should be considered since flowers with short pistils have undeveloped embryo sacs with undifferentiated egg apparatus. In the flowers with long pistils two ovules are usually, initiated one of which gradually degenerates and the other develops successfully. Under the pollen grains placement on the stigma proper ones enlarge rapidly, pollen tube develops and mitosis of generative cell occurs in it resulted in the formation of two sperms. Pollen tube grows and comes to the embryo sac, pours its content and double fertilization occurs. Using of embryoculture and in vitro cultivation of hybrid embryos on the modified Murashige and Skoog, Gamborg & Eveleigh, Monnier and Quoirin & Lepoivre media gave us possibility to obtain seedlings of 12 breeding combinations. Such complex of investigation methods allows creating new apricot forms for their further use in breeding and propagation processes.

Key words: apricot, new form, generative sphere, embryoculture, in vitro

INTRODUCTION

Apricot (*Prunus armeniaca* L., SYN. *Armeniaca vulgaris* Lam.) is one of the most popular and promising stone fruit. Its fruits have high taste qualities due to the presence of sugars, organic acids, pectin, vitamins, anthocyanins, minerals, etc. The apricot fruits are used fresh, in confectionery production and medicine. As a food product apricot has been used over the millennia. It is grown and cultivated in many warm temperate countries of Europe, Central Asia, the Caucasus, Ukraine, Moldova and in the southern regions of Russia. Modern scientist distinguish between three and six possible places of the apricot origin,

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most likely it's from the Tian Shan region of China (Dalby, 2003; Folta, 2009). During the cultivation of apricot many of its cultivars have been created, but there is still a need in new genotypes and forms with a complex of economically-valuable traits that would be adapted to the particular growing conditions and would have exceeded the available cultivars (Fideghelli and Strada, 2008; Gorina, 2014).

Therefore, the aim of our study was to identify the best ways of getting new apricot genotypes for the subsequent breeding process.

MATERIAL AND METHODS

The objects of the research were 25 apricot cultivars with different useful qualities, which were included in the process of intervarietal hybridization: Krymsky Amur, Stark Early Orange, Harcot, Krymsky Medunezh, Dionys, Mamai, Ananasny Tsiurupinsky, Krasny Vympel, Magistr, Holovousy, Pretendent, Rodnik, Zorky, Oranghevokrasny, Shalah, Veecot, Saliut, Voski, Zard, Shantunsky, Olimp, LE-836, NJA. Obtained immature embryos of various hybrid combinations were used as explants for in vitro culture. They were cultured on modified Murashige & Skoog (1962), Gamborg & Eveleigh (1968), Monnier (1973), Quoirin & Lepoivre (1977) media. For in vitro chemotherapy 3 to 6 mg/l ribavirin was added to the culture medium on the first stage of cultivation. Seedlings with an extensive root system and shoots were planted in the pots with soil substrate for their adaptation to the native conditions.

RESULTS AND DISCUSSION

Many cultivars of apricot are susceptible to late-winter and early-spring air temperature fluctuations, which are specific to the southern regions and their generative buds are damaged with spring frosts. It remains relevant to create cultivars with the slow development of generative buds and their long period of dormancy (Sholokhov, 1961; Gorina, 2014, etc.). Cytoembryological studies of apricot by S.I. Elmanov, A.M. Sholokhov and E.A. Yablonsky (1969) and our observations have demonstrated that the mechanism of incompatibility blocking is a multi-stage process. It can occur in the time of pollen grains' germination, growth of pollen tubes in the tissue of the pistil, fertilization and embryogenesis. Frost resistance and winter-hardiness of apricot cultivars are greatly depended upon the genotype and development of generative buds.

Analysis of the male generative sphere development in 25 apricot cultivars has demonstrated that they possess pollen of different quality. The smallest number of morphologically normal pollen grains is formed in cultivars Dionys, Harcot, Mamai, therefore it is advisable to use them as a parent form. The highest vitality of pollen was in cultivars Krasny Vympel, Magistr and Holovousy, which are recommended as paternal forms. For example, cultivar Ananasny Tsyurupinsky has over 90% of morphologically normal pollen grains. More than 50% of them are fertile and on 15% sucrose solution via 6 hours after sowing they sprouted and gave long (more than 10 diameters of the pollen grain) pollen

tubes. When selecting the original forms the structure of flower should be also taken into account, because flowers with short pistils have undeveloped embryo sacks, the egg apparatus is undifferentiated. In flowers with long pistils two ovules are usually placed, one of which gradually degenerates, and the other develops normally. When applied on the stigma of the pistil normally developed pollen grains rapidly swell, pollen tube develops and division of the generative cell resulted in two sperms formation occurs in it. The sprouting pollen tube reaches the embryo sac, pours out its contents and double fertilization takes place.

It should be noted, that apricot is peculiar to the protandry phenomenon that should be considered in hybridization. From many available cultivars in our collection compatible, high yield cultivars with high quality of fruits and frost-resistance that could be used as parental forms have been selected. For example, cultivar Krymsky Amur with large high quality fruits is well compatible with frost-resistant cultivar Harcot that is also resistant to the Sharka virus, but sensitive to the spring frosts. As the result of their crossing, interesting hybrids could be obtained. Development of hybrid embryos *in vitro* could pass the different ways – via callusogenesis and via direct organogenesis (Figures 1 and 2). Crossing between cultivar Shalah with large high-quality fruits and frost-resistant cultivar Veecot could produce the hybrids with large fruits of new colours and taste resistant to stress environmental factors (Figures 3 and 4).



Figure 1. Callus induction and organogenesis *in vitro* of immature embryos from hybrid combination Krymsky Amur and Stark Early Orange cultivars

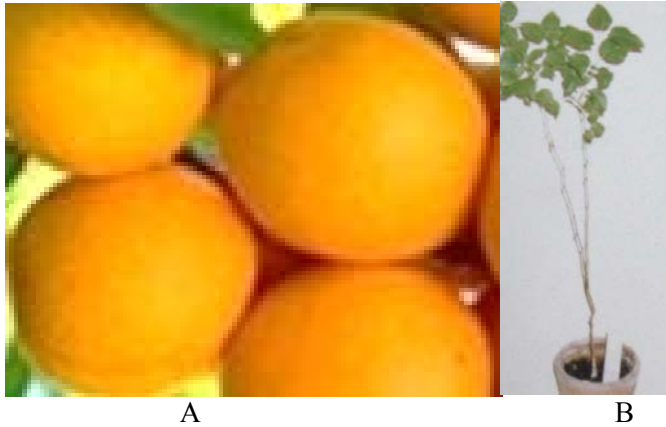


Figure 2. Fruits of the original maternal cultivar Krymsky Amur (A) and hybrid form produced by crossbreeding between cultivars Krymsky Amur (A) and Stark Early Orange (B)

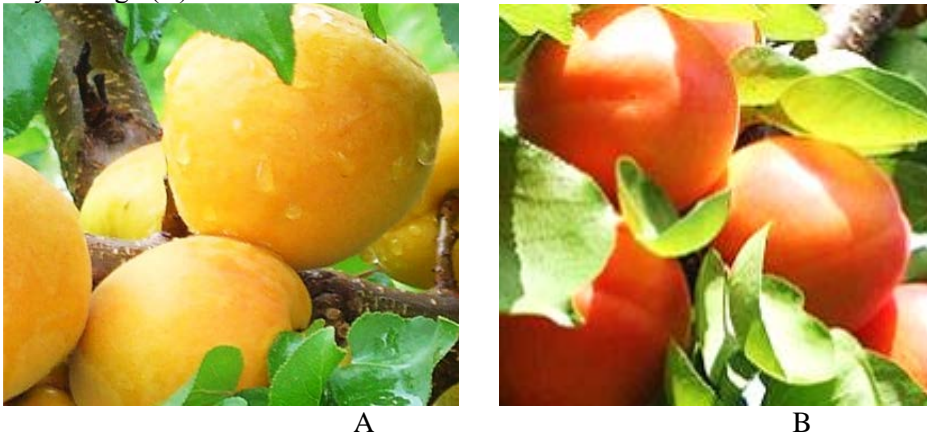


Figure 3. Fruits of the initial forms: cultivar Shalah (A) and cultivar Veecot (B)



Figure 4. Hybrid form the result of crossing cultivars Shalah and Veecot, grown *in vitro* from the immature embryo

70 seedlings the result of twelve crossing combinations (Krymsky Medunezh x Stark Early Orange; Krymsky Amur x Henderson; Saliut x Dionys; Pretendent x Rodnik; Pretendent x Olimp; Shalah x Veecot; Shalah x LE-836; Voski x LE-836; Oranzhevokrasny x NJA; Pretendent x Lakomy; Zorky x Olimp; Zorky x Ananasny Tsiurupinsky) were obtained *in vitro* from the immature embryos and plantlets were adapted to the native conditions (Figure 5).

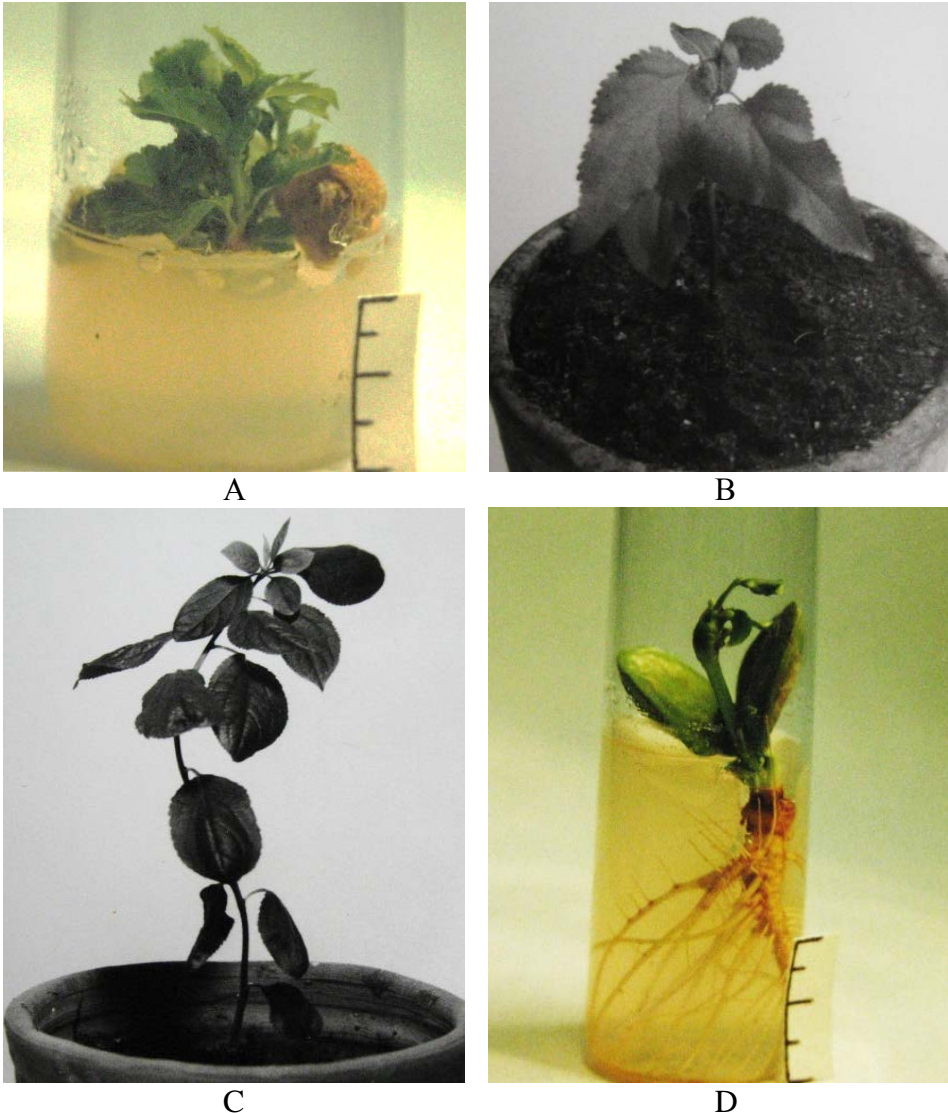


Figure 5. Hybrid forms cultured *in vitro* from the immature embryos result of crossing cultivars Saliut x Dionis (A), Pretendent x Rodnik (B), Oranzhevokrasny x NJA (C) и Krymsky Amur x Henderson (D)

The results of our investigation and data presented by other researchers (Mitrofanova et al., 2000; Pintea, 2014) illustrate possibilities for increasing effectiveness of new apricot cultivars breeding due to the use of embryoculture method along with hybridization.

CONCLUSIONS

Thus, on the base of our investigations it could be concluded that complex approach is necessary to increase the effectiveness of the breeding process aimed in obtaining new cultivars with high-quality fruits, resistant to stressful environmental factors. It includes biological and phenological studies, investigations of generative sphere and strict selection of the parent forms according to their characteristics, as well as the use of in vitro culture method for growing up immature embryos and their virus free, as well as for propagation of obtained valuable genotypes.

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