

Evaluation of compatibility of promising pear cultivars with rootstocks of VNIISPK breeding

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Abstract. The paper presents the results of assessing the compatibility of 22 pear cultivars promising for industrial production with dwarf rootstocks based on common quince of VNIISPK breeding. There was good accretion with the rootstock and full-fledged development of 10 pear cultivars: Yeseninskaya, Tyutchevskaya, Muratovskaya, Pamyati Yakovleva, Bryanskaya Krasavitsa, Belorusskaya Pozdnya, Nika, Lira and Conference, as well as Alaya, an elite form of VNIISPK breeding. 5 pear cultivars had negative affinity: Orlovskaya Krasavitsa, Orlovskaya Letnya Skorospelka from Michurinsk, Rusanovskaya and Tikhii Don. They require an intermediary with good compatibility with the stock. Satisfactory compatibility was revealed for Ploshanskaya as well as for 7 pear cultivars in the nursery, the consequence of which was good accretion with rootstocks, but weak development of grafts and low yield of seedlings in production (Annushka, Prosto Maria, Pamyatnaya, Chizhevskaya, Krasavitsa Chernenko, Vidnaya).

1 Introduction

In modern market conditions, the most important task of horticulture in Russia is the development of means to intensify the production of fruit products. A particularly relevant issue is the cultivation of pear cultivars in Central Russia, where production is limited by the lack of dwarf rootstocks that can accelerate the entry of cultivars into fruiting and increase production efficiency. One of the main requirements for rootstocks is the ability to restrain the growth of cultivars grafted on them, accelerate the time of their entry into fruiting and, finally, their compatibility with the cultivars grafted on them. The productivity and durability of plantings, the quality of fruits and their storage ability, the strength of plant growth and their resistance to diseases and adverse environmental factors depend on the degree of this compatibility [1]. The right choice of the rootstock allows cultivars to increase the realization of their potential in productivity and fruit quality [2-4]. This is especially true for the production of pear fruits using common quince as a rootstock, which has been long and successfully used in the world fruit growing as an intensive pear rootstock [1, 3-9]. Until recently, the insufficient winter hardiness of common quince remained a serious obstacle to its use in the central regions of Russia. Due to breeding

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work, dwarf rootstocks with good winter hardiness were developed [10; 11]. However, the grafting of pears on quince is remote intergenerational, and therefore not all pear cultivars are able to grow fully and bear fruit on it. In this regard, the purpose of our work was to assess the compatibility of pear cultivars promising for industrial production and common quince rootstocks of VNIISPK breeding and to identify effective graft-rootstock combinations adaptive for cultivating orchards using intensive technologies in the central region of Russia.

2 Methods and material

The studies were carried out in 2008-2009 and 2019-2020 in the nursery of the Russian Research institute of Fruit Crop Breeding (VNIISPK). 22 pear cultivars from the VNIISPK genetic collection were studied in the experiment. The pear cultivars were grafted according to the generally accepted method in the nursery by oculation on common quince seedlings of VNIISPK breeding. The repetition of the experiment was threefold with the use of at least 30 plants in each variant. The planting scheme was 20 cm x 90 cm. The agronomic technique of the experiment was generally accepted. The research methodology was based on observations and records according to the "Program and methodology of fruit, berry and nut cultivar study» (Orel, 1999) [12] and visual assessment of compatibility in fruit crops according to Korovin (1978) [2]. Mathematical processing of the obtained observation results was carried out using the Microsoft Excel program.

3 Results and discussion

3.1. Survival rate of buds of pear cultivars on common quince of VNIISPK breeding

When grafting pear cultivars on quince, 90-100% survival rate of the buds was observed after a month (Table 1). The degree of accretion with the rootstock depended on the quality of maturity of the scion buds used for grafting. Thus, the pear buds cut for oculation from the upper and lower parts of the cuttings showed a slightly lower degree of accretion with the rootstock than the rest of the buds. In most pear cultivars, a full-fledged formation of young tissue was noted at the place of accretion of the scion and rootstock, and the shield itself, like the bud, had a normal and healthy appearance. Only Tikhii Don, Vidnaya and Ploshanskaya in all variants of the experiment showed a more depressed state compared to the other cultivars. A slight wrinkling of the cover tissues of the shield indicated insufficient moisture supply of the scion, which explained 12-18% of the death of the buds during the autumn revision. There was no early awakening of the buds. The spring observation showed the complete preservation of the buds of Yeseninskaya and Belorusskaya Pozdnya, which was due to the high winter hardiness of these cultivars and good accretion with the rootstock. On the contrary, Conference, an insufficiently winter-hardy cultivar for central Russia, having excellent accretion with common quince, showed 70-90% loss of scions due to damage by unfavorable factors of the winter period.

Table 1. Results of pear cultivars oculation on quince seedlings of VNIISPK breeding.

Pear cultivars	Suvival rate of buds, %	Preservation of buds, %	Seedlings obtained, %
Pamyati Yakovleva	100	75	70
Prosto Maria	100	50	45
Conference	100	20	20
Annushka	100	10	10

Yeseninskaya	95	95	95
Belorusskaya Pozdnya	95	95	95
Bryanskaya Krasavitsa	95	80	75
Nika	95	70	55
Alaya	90	75	65
Lira	90	65	60
Tikhiy Don	85	45	40
Vidnaya	85	20	15
Ploshanskaya	85	15	10

For 2 years of observations, the lowest percentage of the yield of pear seedlings was noted for Annushka, Vidnaya and Ploshanskaya. Except Conference, all incompatible and poorly compatible with quince pear cultivars (Tikhiy Don, Vidnaya, Ploshanskaya, Annushka) showed a high death of scions already in the nursery and had a low yield of seedlings in percentage of those grafted, which was less than 50%. The best result of accretion and preservation, a high yield of pear seedlings with good quality was noted for Yeseninskaya, Belorusskaya Pozdnya, Pamati Yakovleva, Bryanskaya Krasavitsa, Alaya, Lira and Nika.

3.2. The quality of pear seedlings in cultivar-rootstock combinations with common quince

In the conditions of the nursery, 22 pear cultivars from the Institute collection were tested. The cultivars were grafted by the method of occultation on common quince seedlings of VNIISPK breeding. Pear seedlings of the best quality were obtained for the following cultivars: Conference, Pamati Yakovleva, Yeseninskaya, Alaya, Nika, Bryanskaya Krasavitsa, Belorusskaya Pozdnya, Tyutchevskaya and Muratovskaya (Table 2). These cultivars showed intensive growth, a good root system of seedlings and strong accretion with the rootstock. Unlike pear rootstock, common quince fosters active branching of annual growth already in the nursery for most well-compatible pear cultivars: Belorusskaya Pozdnya, Yeseninskaya, Tyutchevskaya, Muratovskaya, Pamati Yakovleva and Conference. In single plants, flower buds already appeared in the first year of development, which caused partial flowering of two-year-old pear seedlings. Alaya, Nika and Bryanskaya Krasavitsa had no branches, but they had full-fledged active growth. The formation of flower buds were not noted, however, the annual shoots of the scions were somewhat thicker than when ocultating on pear rootstocks. Also, in the course of the research, it was found that many cultivars of pears, having shown high quality of seedlings in the nursery and strong accretion with the rootstock, showed indirect signs of incompatibility with the rootstock. There is reason to believe that such cultivar-rootstock combinations may not be effective enough, due to poor compatibility with common quince. Thus, the presence of overgrowth during the growing season (Prosto Maria, Vidnaya), a phenotypic change in the color of the bark of annual growth (Ploshanskaya), an excrescence at the place of accretion (Krasavitsa Chernenko) and a weak growth of annual growth in all variants of the experiment indicated an insufficiently complete accretion of the components of grafting.

Table 2. Quality indicators of pear seedlings on common quince.

Cultivars	Length of growth, cm	Number of branches, pcs.	Average length of branches, cm	Total length of growth, cm	Diameter of scion root neck, mm	Diameter of stock root neck, mm	Number of skeletal roots, pcs.	Length of skeletal roots, cm	Presence of overgrowth, %
Conference	146.3	1.0	9.3	155.6	14,3	15,3	14,3	35,0	0,0
Pamyati Yakovleva	146.0	2.8	6.6	164,5	15,8	16,8	8,6	38,0	0,0
Yeseninskaya	144.0	5.8	25.8	293,6	13,6	16,8	21,4	32,0	0,0
Alaya	141.0	0.0	0.0	141,0	11,4	14,0	10,8	41,0	0,0
Nika	140.0	0.0	0.0	140,0	14,4	15,8	14,6	29,0	0,0
Bryanskaya Krasavitsa	138.0	0.0	0.0	138,0	12,6	14,2	18,0	35,0	0,0
Belorusskaya Pozdnya	132.0	5.2	35.6	317,1	14,2	15,4	10,4	36,0	0,0
Ploshanskaya	119.0	0.0	0.0	119,0	15,5	16,5	9,0	30,0	0,0
Prosto Maria	112.0	0.0	0.0	112,0	12,8	14,8	13,2	27,6	22,2
Lira	108.0	0.0	0.0	108,0	11,0	12,0	17,0	26,0	0,0
Annushka	103.5	0.0	0.0	103,5	13,0	14,0	18,0	30,0	0,0
Tikhiy Don	88.0	0.0	0.0	88,0	9,6	10,2	6,4	23,6	100,0
Vidnaya	73.3	0.0	0.0	73,3	8,3	9,7	13,3	20,0	33,1
LSD _{0,5}	12.1								

Annushka, Pamyatnaya and Chizhovskaya showed no signs of negative affinity, however, despite the strong accretion with the rootstock, there was a late awakening of the buds, weak growth of scions and low yield of pear seedlings, which may also indicate incompatibility with rootstocks.

3.3. Compatibility of common quince seed stocks with pear cultivars

As a result of studying the cultivar-rootstock combinations of 22 pear cultivars and quince seedlings, it was found that the best accretion with rootstocks and active growth were noted in Yeseninskaya, Tyutchevskaya, Muratovskaya, Pamyati Yakovleva, Belorusskaya Pozdnya and Conference (Table 3). The absence of signs of incompatibility with the stock and strong accretion in the nursery conditions were revealed for Alaya, Nika, Lira and Bryanskaya Krasavitsa. A slight excrescence at the place of accretion was noted for Pamyati Yakovleva and Tyutchevskaya, however, no other signs of incompatibility were revealed, but on the contrary, there was a strong accretion, active growth and a high yield of high-quality seedlings in the nursery. Hereinafter, the excrescence at the place of accretion disappeared. When grafted on quince, all signs of negative affinity were shown by Orlovskaya Krasavitsa, Orlovskaya Letnya, Skorospelka from Michurinsk, Rusanovskaya and Tikhiy Don. These pear cultivars are recommended to be grafted on quince only through compatible insert components. During the research, 7 pear cultivars were also found, which did not show obvious signs of incompatibility with rootstocks, but showed the yield of seedlings of satisfactory quality. This was a consequence of the late awakening of buds in spring, weak growth of shoots during the growing season, the formation of shoots on the rootstock and the appearance of cracks in the place of accretion with the scion. Perhaps, they will develop better on the insertion rootstock, or they need more time for full accretion of the graft components. Research in this direction will be continued, but based

on the results obtained, it can already be approved that a compatible insert component should be used in cultivar-rootstock combinations for the propagation of Ploshanskaya, Prosto Maria, Annushka, Krasavitsa Chernenko, Vidnaya, Pamyatnaya and Chizhovskaya in production conditions. With its help, a high yield of high-quality pear seedlings can be achieved in the nursery.

Table 3. Compatibility of common quince with pear cultivars.

Pear cultivars		
Well compatible	Satisfactorily compatible	Incompatible
Yeseninskaya	Ploshanskaya	Skorospelka from
Pamyati Yakovleva	Prosto Maria	Michurinsk Orlovskaya
Muratovskaya	Annushka	Krasavitsa Orlovskaya
Belorusskaya Pozdnya	Krasavitsa Chernenko	Letnya
Nika	Vidnaya	Rusanovskaya
Bryanskaya Krasavitsa	Pamyatnaya	Tikhiy Don
Tyutchevskaya	Chizhovskaya	
Alaya		
Lira		
Conference		

4 Conclusion

A general assessment of the compatibility of 22 pear cultivars with common quince rootstocks showed a strong accretion and active growth of 10 cultivars: Yeseninskaya, Tyutchevskaya, Muratovskaya, Pamyati Yakovleva, Bryanskaya Krasavitsa, Belorusskaya Pozdnya, Nika, Lira, Conference and Alaya. All of them are well compatible with quince and are promising for production using intensive technologies in the conditions of the central part of Russia. Orlovskaya Krasavitsa, Orlovskaya Letnya, Skorospelka from Michurinsk, Rusanovskaya and Tikhiy Don showed obvious incompatibility in cultivar-rootstock combinations with common quince of VNIISPK breeding, they can be cultivated only with the use of a compatible insert rootstock. Annushka, Prosto Maria, Pamyatnaya, Chizhevskaya, Krasavitsa Chernenko, Vidnaya and Ploshanskaya showed satisfactory compatibility, and it is recommended to propagate them using an intermediary from a compatible insert.

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