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Article

Compatibility of Pear Variety Buds on Different Rootstocks

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Abstract: This research investigates two pear varieties, Olive de Serr and Zimnyaya Nashvati, grafted to several rootstocks and reports their potential interactions, which is a significant missing piece of information regarding which combinations would provide the highest reliability of bud take and seedling performance in local conditions. Using standard horticultural practices, field experiments were performed to evaluate the bud survival and seedling growth and the overall compatibility of four rootstocks (control) Khan Nashvati, Almurt, Yurt Nashvati and Quince A at the Karakalpak Scientific Experimental Station. Results demonstrate that compatibility is highly rootstock dependent. Among the rootstocks, Almurt outperformed the others with the highest bud take rate of 83.1%, which is 8.2% above the control. On the other hand, the weakest compatibility was demonstrated by Yurt Nashvati with bud take of only 61.9% in Zimnyaya Nashvati. Higher establishment rates and increased growth of seeds from Almurt were also confirmed by seedling measurements, further elucidating the Almurt advantage. These findings emphasize the potential benefits of using the most appropriate rootstocks in high density pear orchards. Almurt is a potential rootstock for regions with similar environmental conditions, providing more consistent graft success and better seedling growth. This destructively supported simplistically, high-quality pear orchard systems.

Keywords: pear, rootstock, graft, bud, compatibility.

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1. Introduction

The purpose of analyzing the use of pear rootstocks in pear seedling cultivation is to select and recommend rootstocks for low-growing intensive pear orchards for production.

When fruit trees are grafted onto weakly growing rootstocks, the quality of fruits generally improves, their average uniformity increases, sugar content rises, and their color becomes more attractive. Additionally, pear orchards grown from low-growing rootstocks, when properly cared for, yield high-quality harvests, with 90-95% of the total harvested product being standard fruits, including 80% first-grade fruits. In European countries, slow-growing rootstocks are used in various ways depending on the location, particularly in England, France, Italy, the Netherlands, Belgium, Germany, and Spain, where they are widely utilized.

In recent years, 40-50% of seed orchards in the USA are grown on vegetative clonal rootstocks. In Canada, great importance is also attached to growing fruit trees on dwarf vegetative rootstocks. Orchards grown on medium and low-growing vegetative rootstocks are widespread in Australia as well and are making inroads into Latin American countries [1].

In England, at the East Malling Experimental Station, scientific research conducted by E.M. Beyer and P.W. Morgan revealed that apple rootstocks should be prepared in a separate mother nursery. According to these recommendations, the rootstock plants were densely planted, spaced 40-50 cm apart within rows, and were subjected to pruning and mounding techniques [2], [3].

The selection of rootstocks plays a crucial role in choosing rootstock varieties and developing pear cultivation technology on weakly growing, vegetatively propagated rootstocks [4], [5]. It is one of the main factors in the life of fruit trees, and, as I.V. Michurin stated, the rootstock is the foundation of the fruit tree [6]. Rootstocks are primarily classified into three types based on their growth characteristics: strong, medium, and weakly growing (dwarf) [7], [8].

Today, the following quince rootstocks can be used for pear seedlings: Quince "A," "BA-29," "R3," "C-A," "U," "Alushtinskaya," "R," and "C."

The bud grafting method is widely used in the propagation of pear seedlings. In many nurseries, seeds of wild pear species and cultivated varieties were sown, and seedlings and clonal rootstocks were cultivated. In the nursery, in accordance with production requirements, the processes of bud graft take, rootstock identification, preparation for grafting, proper selection of the scion, and plant establishment were monitored.

In general, for modern intensive-type pear orchards, it is important to improve the technology of growing seedlings on dwarf rootstocks suitable for the conditions of our republic and adapted to specific regions, as well as to develop their scientific foundations.

2. Methodology

Scientific research was conducted in the field experimental plots of the Kegeyli Scientific Experimental Station of the Research Institute of Horticulture, Viticulture and Winemaking named after Academician M. Mirzaev, located in the Kegeyli district of the Republic of Karakalpakstan. The study of fruit plant varieties was carried out based on generally accepted methods: "Program and Methodology for the Study of Varieties of Fruit, Berry, Subtropical, Nut-Fruit, and Grape Collections" (Leningrad, 1970), Kh.Ch.Buriev [9] "Methodology of Calculations and Phenological Observations in Conducting Experiments with Fruit and Berry Plants" (2014), and A.N. Tatarinov's (1971) methodological guide on the vegetative propagation of apples and pears. Statistical processing of the experimental data was conducted using the method of variance analysis according to B.N. Dospekhov (1985) [10].

For grafting pear varieties Olive de Serr and Zimnyaya nashvati, Khan nashvati (control), Almurt, Yurt nashvati, and Quince A rootstocks were selected.

3. Results

In our studies, when grafting pear varieties Olive de Serr and Zimnyaya nashvati onto different rootstocks, the highest bud take rate was observed on the Almurt rootstock, amounting to 83.1%. This indicator was 8.2% higher than the control. The lowest bud take rate of pear varieties was observed when grafted onto the Yurt nashvati rootstock, where the bud take rate for the Olive de Serr variety was 70.6%, and for the Zimnyaya nashvati variety - 61.9%.

Observations showed that the survival rate of pear seedlings of the Olive de Serr variety grafted onto the Khon nashvati (control) rootstock was 74.9%, with a seedling diameter of 1.5 cm. On the remaining rootstocks, seedling survival rates were 83.1%, 70.6%, and 74.1%, respectively, with seedling diameters of 1.7 cm, 1.6 cm, and 1.8 cm. When grafting the buds of the pear variety Zimnyaya nashvati onto different rootstocks, the bud survival rates were 68.9%, 81.4%, 61.9%, and 69.2%, respectively, and the seedling diameters ranged from 1.6 cm to 1.7 cm.

When grafting buds of pear varieties Olive de Serr and Zimnyaya nashvati onto the Khan nashvati rootstock, good preservation of the buds was observed. When the Olive de Serr pear variety was evaluated 15 days after autumn grafting onto the Khan nashvati (control) rootstock, the percentage of failed buds was 11.7%. The average mortality rate of grafted buds across all rootstocks was 36.8% [11]. It was noted that when grafting Olive de Serr variety buds onto pear rootstock, 9.6% of the buds died in autumn, while for the second studied variety, Zimnyaya nashvati, it was 9.7% (Table 1).

When grafting buds of the Olive de Serr variety onto the Quince A rootstock, 9.9% of the buds died in autumn, while for the second studied local variety, Zimnyaya nashvati, it was 18.2%, or 8.3% higher.

The average indicator for all rootstock samples was 14.2%, with Pear and Quince A variants showing lower rates. Compared to the Quince A variant, the grafted samples of Yurt nashvati and Pear rootstocks had 128.3% and 143.3% less mortality, respectively.

The impact of winter processes on pear variety buds grafted onto various rootstocks was also observed [12]. Depending on the rootstock, the percentage of graft buds that died due to winter weather conditions ranged from 7.3% to 25.1% for the pear varieties Olive de Serr and Zimnyaya nashvati.

The survival of graft buds during the autumn-winter period depended on the type of rootstock as follows. For the pear varieties Olive de Serr and Zimnyaya nashvati, the compatibility between rootstock types and the graft showed its influence. On the Khan nashvati rootstock, the bud survival rate for Olive de Serr and Zimnyaya nashvati varieties was 83.1%. In comparison, the survival rate of graft buds during the autumn-winter period on the Almurt rootstock was 79.4%. This indicator was found to be 3.7% lower than the control [13].

When bud grafting the pear variety Olive de Serr nashvat, the survival rate across rootstock types showed low variability, with a coefficient of variation (V=8.2%) for dead buds in the autumn inspection. The standard deviation of the figures was X=10.8±3.9%.

Table 1. Bud take of pear varieties on different rootstocks
(Field observations, Karakalpak Scientific Experimental Station, 2025).

Variety of rootstock	Olive de Serr			Zimnyaya nashvati		
	Percentage of arrested buds, %					
	autumn time	spring time	total	autum n time	spring time	total
Khan nashvati (control)	11,7	25,1	36,8	12,7	18,4	31,1
Almurt	9,6	7,3	16,9	9,7	8,9	18,6
Yurt nashvata	12,1	17,3	29,4	16,3	19,4	35,7
Quince A	9,9	10,7	20,6	18,2	19,9	38,1

The influence of rootstock types on scion bud take has even affected the number of seedlings obtained from a given nursery area. The observations also determined the results of the main measurement indicators for pear seedlings of the Olive de Serr and Zimnyaya Nashvat varieties [14].

Observations showed that the seedling viability of the Olive de Serr pear variety, grafted onto the Khan nashvati (control) rootstock, was 74.9%, with a seedling diameter of 1.5 cm. For the remaining rootstocks, seedling viability was 83.1%, 70.6%, and 74.1%, respectively, with seedling diameters of 1.7 cm, 1.6 cm, and 1.8 cm (Table 2).

When observing the Zimnyaya Nashvati pear variety, the seedling viability for those grafted onto the Khan nashvati (control) rootstock was 68.9%, with a seedling diameter of 1.5 cm [15]. For this variety on the remaining rootstocks, seedling viability was 81.4%, 61.9%, and 69.2%, respectively, with seedling diameters of 1.6 cm, 1.6 cm, and 1.7 cm.

Table 2. Results of the main measurement indicators for seedlings of Olive de Serr and Zimnyaya Nashvati pear varieties

(Field observations, Karakalpak Scientific Experimental Station, 2025).

Variety of rootstock	Olive de Serr			Zimnyaya nashvati		
	SGSE/ %	DS/sm	RL/sm	SGSE/ %	DS/sm	RL/sm
Khon nashvati (control)	74,9	1,5	26	68,9	1,5	25
Almurt	83,1	1,7	28	81,4	1,6	27
Yurt nashvata	70,6	1,6	28	61,9	1,6	26
Quince A	74,1	1,8	30	69,2	1,7	28

Comment: SGSE*- Percentage of successful grafted seedling establishment,* ***DS****- diameter of seedlings,* ***RL****- root length.*

4. Conclusion

The results of this study demonstrate that rootstock selection is a determining factor in the graft compatibility both of bud survival and plants development tasks (pear varieties Olive de Serr and Zimnyaya Nashvati) after budding. Highest bud take rate (83.1%) and higher compatibility with succeeding rootstocks were presented by the Almurt rootstock among tested options, while Yurt Nashvati showed lowest bud survival and growth indicators. The results suggest that Almurt can be a suitable rootstock to improve production in intensive pear orchards particularly in the environmental conditions of Karakalpakstan as well as in places with a similar climate. In practice, this implies that focusing on rootstock–scion combinations that are most compatible can make orchards more efficient, produce better seedlings, and yield more fruit in the long run. However, more trials are needed to determine, in the longer term, the performance of these orchards, the quality of resultant fruits and the physiological mechanisms of the rootstock–scion interaction over a broader range of climates and soil types, which might validate other rootstocks that might offer access to even greater resilience or productivity benefits.

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