



High-potential domestic and foreign varieties of fruit crops in Kazakhstan

Saule Zh. Kazybayeva¹, Moldir T. Yerbulekova^{1*}, Zhanar K. Kadirsizova¹, Svetlana P. Alekseenko¹, Aigerim A. Seisenova²

1. Kazakh Scientific Research, Institute of Fruit and Vegetable Growing LLP, Almaty, Republic of Kazakhstan

2. International Engineering Technological University, Almaty, Republic of Kazakhstan

* Corresponding author's E-mail: phdplovdiv12@yandex.kz

ABSTRACT

The article presents the long-term results of the “Kazakh Research Institute of Fruit and Vegetable Growing” LLP on improving the assortment of fruit crops. The “State Register of Breeding Achievements Recommended for Use in the Republic of Kazakhstan” includes 22 varieties of apple trees and 3 varieties of pears. Over the past 20 years, 97 varieties of apple trees and 25 varieties of pears have been transferred to the State Variety Testing; about 50 varieties of apple trees have been brought into the gene pool of the “Kazakh Research Institute of Fruit and Vegetable Growing” LLP - Honey Crisp, Champion, Red Chive, Pink Lady, Samurlet, Quinty, Jenny Grent and others, 21 varieties of pears - Lyra, Yesenevskaya, Muratovskaya, Cheremshina, Vrodliva, Claude Sablinsky, Williams and others. The introduced varieties were studied in the climatic conditions of the south and southeast of Kazakhstan for economically valuable traits such as early fruiting, productivity, adaptability, fruit quality, resistance to major diseases (scab, powdery mildew, and fire blight) and pests, etc. The article provides an economic and biological descriptions of 7 apple and 4 pear varieties of domestic selection, as well as 5 apple and 5 pear varieties of foreign selection. Data on their biological and economic indicators, and their suitability for intensive gardening technologies are presented. In addition, the paper analyzes the prospects for further improvement of the assortment due to the introduction of new varieties and breeding work. The results obtained can be used not only in scientific research, but also in the establishment of modern industrial gardens aimed at increasing the productivity and quality of fruit products.

Key words: Apple tree, Variety, Winter hardiness, Productivity, Adaptability, Fruit quality.

Article type: Research Article.

INTRODUCTION

Gardening is a priority sector of the agro-industrial complex of the Republic of Kazakhstan, where the main products are fruits, berries and their processed products, as a result of consumption of which a person receives the necessary vitamins, minerals, and essential organic acids. However, gardening is a complex system of cultivating fruit plants, which is based on the integrated use of natural, material, financial and labor resources (Danilova *et al.* 2021). Currently, horticulture does not meet the population's needs for fruit and berry products. The recommended medical level of fruit consumption is 90-100 kg per capita annually. However, the actual level of consumption of fruits and berries in recent years has averaged 50-60 kg per capita annually. At the same time, fruit consumption in foreign countries is much higher: in Italy 187 kg, in France 135 kg, in Germany and the USA about 126 kg per capita annually. The total consumption of fruits and berries in Kazakhstan is just over 8 million tons, of which 2.5 million tons is provided by domestic production and 6.8 million tons by import. The supplier

countries of fruits and berries are Turkey, Spain, Moldova, Poland and China (Wei *et al.* 2018). The natural conditions of the Republic of Kazakhstan are favourable for growing fruit crops, especially the main crop - apple trees. The vast thickets of wild apple trees in the mountains of the Zailiysky and Dzhungarsky Alatau, distinguished by a variety of forms, indicate that this region is one of the centres of origin of the cultivated apple tree (Dzhangaliev *et al.* 2001; Dzhangaliev 2003). In the zones recommended for planting fruit crops, there are fertile soils, and sufficient irrigation sources. The sum of active temperatures (2600–4000 °C) contributes to the ripening of apple fruits of almost any period, of any origin. Thus, in the "State Register of Selection Achievements Recommended for Use in the Republic of Kazakhstan", along with Kazakh, Russian, Uzbek, Baltic, Ukrainian, American, New Zealand, Australian and Japanese varieties are included (Dzhangaliev *et al.* 2001). The basis for creating new varieties of apple and pear is the gene pool concentrated in KazNIPO, which includes more than 1800 samples. The gene pool was created over seven decades by introducing from all regions of the world where garden crops are grown. The current assortment of apple trees is diverse, including varieties of different origins, both local and ancient, and introduced from other apple growing regions (State Register of Breeding Achievements Approved for Use in the Republic of Kazakhstan, 2024). Of greatest interest are varieties of Kazakh selection, since it is their biological characteristics that most fully meet the growing conditions in the regions of Kazakhstan favourable for apple cultivation. In global production, preference is given to apple varieties that guarantee commercial success and satisfy the market in terms of fruit quality for the next 10–20 years. Therefore, in modern horticulture, varieties with the necessary economically valuable and adaptively significant characteristics are used (Kenzheali & Makhmetova 2024).

Relevance. Intensification of the fruit growing and viticulture industry involves planting gardens with adapted varieties, with high yield and quality of fruits of various ripening periods and purposes, resistant to the most dangerous diseases, high-tech. The variety in fruit growing and viticulture, as in any other branch of agricultural production, is one of the factors determining economic efficiency. The basis for improving the assortment is the gene pool of fruit, berry crops and grapes, replenished with new achievements of world selection. The issues of replenishment, study and preservation of the gene pool of fruit, berry crops and grapes are of the utmost importance and relevance in the conditions of improving the assortment, when the market economy dictates new requirements. The aim of the research is to study the introduced and local varieties and to select winter-hardy, adapted productive varieties for introduction into production.

To achieve the research objective, the following tasks are performed: investigating the gene pool of fruit trees in collection plantings, selection of promising samples from them for production and for selection work; and investigating the adaptive potential of varieties in terms of resistance to abiotic environmental factors, early maturity, commercial and consumer qualities of fruits.

MATERIALS AND METHODS

The research was conducted at the experimental site of the Russian Federation "Talgar" of "KazFVRI" LLP, located at an altitude of 1070 meters above sea level in Zailiysky Alatau in the village of Almalyk, Talgar district, Almaty region. The objects of the study were apple and pear. The study included 11 apple varieties of foreign and Kazakh selection (Voskhod, Makpal, Anel, Damira, Aizere, Dauren, Samurlet, Champion, Pink Lady, Honey Crisp, and Red Cheev). The year of planting the garden was 2011, laid out according to the 5 × 3 m scheme, rootstock - Arm-18. The zoned and widely cultivated variety Golden Delicious served as a control. Also studied were 9 pear varieties of Kazakh and foreign selection (Aidana, Bostandyk, Nagima, Karyndas, Lira, Khor Sweet, Muratovskaya, Kyrgyz Winter, and Prosta Maria). The year of planting the garden was 2010, the laying scheme was 5 × 3 m, rootstock - EMA. The Talgar Beauty served as a control. The research work was carried out in 2022–2024. The surveys and observations were carried out according to the methodology "Program and methodology for studying varieties of fruit, berry and nut crops" (Pomology 2010), according to the main economic and biological characteristics, such as winter hardiness, stability, fruit quality, suitability for intensive cultivation technologies. We used a variety study methodology including consideration of economic and biological characteristics such as winter hardiness, disease resistance, fruit quality, and suitability for intensive cultivation technologies. The methodology is based on classical approaches to assessing fruit crops recommended in the textbook edited by Academician G V Eremin (2004). Investigating the resistance of fruit crops to drought conditions is a key area of breeding work. One of the methods for assessing drought resistance is the analysis of

the water regime of plants, including the determination of the water-holding capacity of leaves, the level of moisture loss and the rate of turgor restoration (Arifova et al. 2021).

Modern methods of studying and breeding fruit crops emphasize the integration of traditional knowledge with scientific approaches. In their study, Leakey *et al.* (2022) emphasize the importance of an interdisciplinary approach, including the assessment of genetic diversity, biochemical analysis of fruits, and analysis of the resistance of varieties to adverse environmental factors.

RESULTS

As a result of many years of work by the selection team of KazFVRI, 97 apple and 25 pear varieties were submitted for State Variety Testing. The State Register of Breeding Achievements Approved for Use in the Republic of Kazakhstan includes 27 varieties of apple trees and 3 varieties of pear trees. Over the past 20 years, about 50 varieties of apple trees have been introduced – Honey Crisp, Champion, Red Cheve, Pink Lady, Samurlet, Quinti, Jenny Grant and others, 21 varieties of pears – Lira, Yesenevskaya, Muratovskaya, Cheremshina, Vrodliva, Klod Sablinsky, Williams and others. Below are the production and biological characteristics of apple and pear varieties bred by KazFVRI LLC and adapted foreign varieties (Table 1).

Brief description of the studied pome crops

Apple tree variety Voskhod. Variety bred by "KazFVRI" LLP. Winter ripening period, high winter hardiness. Resistant to powdery mildew and scab. The tree is medium-sized, the crown is round, compact. It begins to bear fruit 2-3 years after planting in the garden. The yield is high. The fruits are large, up to 260 g, candile-shaped, light yellow in color with a delicate blush (Fig. 1). The taste is sweet and sour, with a pleasant aroma. The pulp is white, dense, tender, juicy, fine-grained. The fruits ripen in mid-September. They are stored until April. The variety is zoned in the Almaty and Zhambyl regions.



Fig. 1. Apple tree variety Voskhod

Apple variety Makpal. Variety selected by "KazFVRI" LLP. Variety of winter ripening period. High winter hardiness. Resistance to powdery mildew and scab. The trees are medium-sized, the crown is oval, medium density. It begins to bear fruit in the 3rd year after planting in the garden. The yield is high. The fruits are large, up to 205 g, elongated-conical in shape, the main color is yellow with a bright red blurred blush on most of the fruit. The pulp is white, the aroma is medium. The fruits ripen in mid-September. They are stored until April. Zoned in the Almaty region.

Table 1. Main indicators of promising domestic and foreign varieties of pome crops (cf. for 2022-2024)

Name of the variety	Ripening period	Fruit quality		Average yield (c ha ⁻¹)	Fruit shelf life
		Fruit weight (g)	Fruit flavour (g)		
Apple					
Anel	summer-autumn	210	4.8	240	Until December
Sunrise	winter	260	5.0	220	Until April
Makpal	winter	205	4.7	230	Until April
Damira	winter	225	5.0	195	Until April
Aizere	winter	220	5.0	210	Until April

Dauren	winter	270	4.8	200	Until May
Pink Lady	winter	200	4.7	500	Until June
Samurlet	late summer	210	4.6	350	Until January
Champion	winter	220	4.6	350	Until February
Honey Crisp	winter	250	4.8	550	Until April
Red Cheve	winter	210	4.8	550	Until March
Golden Delicious	winter	180	4.5	160	Until May
NSR ₀₅				17.0	
Pear					
Nagima	autumn	190	4.8	180	Until December
Karyndas	autumn	170	4.5	160	Until January
Bostandyk	winter	170	4.4	170	Until December
Aidana	winter	150	4.3	160	Until December
Just Maria	winter	230	4.5	200	Until December
Lyra	winter	205	4.3	175	Until December
Horus Sweet	winter	210-450	4.7	205	Until December
Kirghiz winter	winter	210	4.0	170	Until April
Muratovskaya	autumn	180	4.3		Until November
Talgar beauty	winter	179	4.5	150	Until February
NSR ₀₅				12.0	

Apple tree variety Anel. Created in KazFVRI LLP. Obtained by crossing the varieties Starkrimson × Aport. Trees with restrained growth, winter-hardy, resistant to diseases. Bears fruit in the 3rd year after planting in the garden. Fruits are above average weight, very attractive, have a solid bright crimson color, excellent dessert taste, aromatic (Fig. 2). Fruits possess a late summer ripening periods, they are also stored for 3 months in the refrigerator. Zoned for Almaty, Zhambyl, Zhetysu regions.



Fig. 2. Apple tree variety Anel.

The Damira apple variety. The variety was bred by KazFVRI LLP and was created by crossing the Fantasia × Sinap Almaty varieties. The variety is winter-hardy and resistant to major diseases. The tree crown is spreading, suitable for planting an intensive garden. It begins to bear fruit 3-4 years after planting in the garden. The variety is productive. The fruits are medium and above average in size, elongated-conical in shape. The cover color of the fruits is bright red throughout the fruit. The pulp is white, fine-grained, and has a good taste. It can be stored until April. The variety is undergoing State variety testing.

Apple tree variety Aizere. Variety bred by KazFVRI LLP, autumn-winter ripening period. Winter-hardy. Resistant to diseases. The tree is medium-sized, the crown is round, spreading, medium-dense. It begins to bear fruit 2-3 years after planting in the garden. High-yielding variety. Fruits are medium-sized 200 - 220g, elongated-conical, yellow in color, the blush is raspberry, blurred and striped over most of the fruit, sweet taste, with a strong aroma, the pulp is creamy, juicy, dense, and tender. The fruits ripen in mid-September. They are stored in the refrigerator until April.

Apple tree variety Dauren. Variety bred by KazFVRI LLP, parental forms Sinap almatinsky × Fantaziya. Trees are winter-hardy. Crown shape is pyramidal, spreads under the weight of the crop. It begins to bear fruit in the 3-4 year after planting in the garden. Fruits ripen in autumn and winter, stored until April. Fruit shape is candle-shaped, the main color is greenish-yellow, blurred blush over most of the fruit (Fig. 3). Fruits are highly attractive, and dessert taste. The variety is undergoing State variety testing.



Fig. 3. Apple tree variety Dauren.

Apple tree variety Pink Lady. The variety was bred in Austria, winter ripening period. The tree is cone-shaped, dense. The fruits are large, up to 6-10 cm in diameter, round-conical in shape. The weight of apples reaches 180-200 g. The skin is dense, shiny, its color is greenish-yellow. Covered with a blush, the color of which can be from light pink to red. The pulp is cream-colored, dense and very juicy. The taste is pleasant, sweet and sour, with a taste of vanilla and wild berries. The harvest begins in late October or mid-November. The fruits are well stored, suitable for transportation. They can be stored in the refrigerator, cellar or cool basement for up to 10 months. They retain their taste until May.

Honey Crisp apple variety. American selection variety. Winter consumption period (removable maturity in mid-September, consumer maturity - early November). Highly winter-hardy. The tree has a narrow oval shape in the first 3-4 years, later - compact broadly oval. The fruits are large, weighing 180-250 g, uniform, elongated-round-conical, sometimes asymmetrical, yellowish-light green with an orange-red blurred blush on most of the fruit and dull red strokes and spots on its background. The skin is of medium thickness, very dense, smooth, and medium-shiny. The pulp is yellowish-cream, dense, chipping type, crispy, very juicy, with a light aroma. The taste is excellent, harmonious sweet and sour. The fruits are stored in the refrigerator for 6-7 months. The variety is resistant to scab.

Apple tree variety Champion. Variety of Czech origin. Variety is self-sterile. Trees of weak growth force, with a compact, oval, medium-dense crown. The fruits of the apple tree are large, oval-cylindrical, regular in shape. The skin is smooth, thin, but at the same time quite strong and elastic, greenish-yellow in color, covered with an orange-scarlet blush. The pulp is light cream in color, sweet to taste, with a slight sourness, amazingly juicy. The keeping quality of the fruits is not at the highest level, but in the right storage conditions, the fruits remain in excellent condition for 5-6 months. Transportation requires good packaging. Ripening period is the end of September. Trees begin to bear fruit on medium-sized rootstocks in the 4th-5th year.

Apple variety Red Chew. It was isolated in the USA as a clone of the Red Delicious variety. Trees medium vigor, crown broadly pyramidal, medium density. Fruiting mainly on rings. Fruits above average size and large (180–210 g), truncated-conical, sometimes beveled, of medium uniformity. The surface is widely ribbed. The skin is of medium thickness, with a waxy coating. The main color is greenish-yellow, the cover color is dark red striped blush, later bright red, merging and covering the entire fruit. Subcutaneous dots are large, numerous, clearly visible. The pulp is light cream, of medium density, fine-grained, of medium juiciness, dessert taste (4.8 points), with a strong aroma. Removable maturity of the fruits occurs in the second half of September. The shelf life is 6–7 months. They are used mainly fresh. It begins to bear fruit on dwarf rootstocks in the third year, the yield is up to 55 tons ha⁻¹, fruiting is regular. The variety is characterized by insufficient winter hardiness and average drought resistance. Moderately susceptible to scab, resistant to powdery mildew.

Apple tree variety Samurlet. Late summer, universal. The tree is large and fast growing. The crown is medium dense and rounded. The fruits are large, with an average weight of 210 g, uniform, ovoid, and regular in shape. The surface of the fruit is slightly ribbed. The pulp is white, medium-dense, prickly, medium-coarse, fine-grained, and very juicy. The taste is sweet and sour, with a strong aroma. Resistant to diseases and pests. Winter-hardy, drought-resistant and heat-resistant.

Pear variety Nagima. From the selection of KazFVRI LLP. Autumn ripening. Good winter hardiness. The tree is medium-sized. The crown is broadly pyramidal and dense. It begins to bear fruit in the 4th year after planting in the garden. The yield is average. It is affected by fire blight. The fruits are large, broadly pear-shaped (Fig. 4). The color is yellow-green with a scarlet blush on the sunlit side. The pulp is juicy, sweet, and has high taste qualities. It is undergoing State variety testing.



Fig. 4. Nagima apple tree variety.

Pear variety Bostandyk. Variety selected by KazFVRI LLP. Winter ripening period. High winter hardiness. The tree is tall. The crown is wide and rounded, of medium density. It begins to bear fruit in the 5th year after planting. The yield is high. The fruits are medium-sized, round, juicy, and have a sweet and sour taste. The main color is green and yellow. Removable maturity occurs in mid-September, and the fruits are stored until December. It is undergoing State variety testing.

Pear variety Aidana. Variety selected by KazFVRI LLP. Winter ripening period. High winter hardiness. The tree is medium-sized. The crown is pyramidal. It begins to bear fruit in the 3rd year on the quince-A rootstock after planting. The yield is high. The fruits are medium and large in size, round in shape, juicy, with a sweet and sour taste. The main color is green-yellow. Removable maturity occurs in mid-September, the fruits are stored until December. The variety is resistant to fire blight and is included in the State Register of Breeding Achievements Recommended for Use in the Republic of Kazakhstan.

Pear variety Karyndas. Variety selected by KazFVRI LLP. Autumn ripening. High winter hardiness. The tree is of medium height. The crown is broadly pyramidal, of medium density. It begins to bear fruit in the 4th year after planting. The yield is high. It is moderately resistant to fire blight. The fruits are medium-sized, pear-shaped. The main color is yellow with a red blush (Fig. 5). The pulp is juicy, grainy, with a sweet and sour taste. It can be stored until mid-January. It is undergoing State variety testing.



Fig. 5. Apple tree variety Karyndas.

Pear variety Khorru Sweet. Winter ripening variety, Canadian selection. Fruits are pear-shaped, weighing 260-450 g, sometimes up to 500 g, the skin is greenish-yellow with a washed-out tan on the sunny side, turns yellow when fully ripe. The pulp is juicy, sweet with a pleasant sourness, aromatic. Fruits reach removable maturity at the end of September. Under normal conditions, they are stored for about 2-3 months, in the refrigerator until the beginning of March. High winter hardiness. Resistance to diseases and pests is quite high. Fruiting begins in the 3-4th year after planting. Fruiting is regular, stable, and the yield is high.

Pear Harrow Sweet. is a relatively new, but promising for Kazakhstan. Trees are low-growing up to 3 m.

Pear variety Prosta Maria. The tree is medium-sized, can grow up to 3 meters, while it has a broad pyramidal crown with a diameter of up to 2.5 meters (at the age of ten). This tree is considered a late species - it bears fruit in the fall (October). The fruits are round, pear-shaped, smooth, shiny, with a thin skin. The main color is greenish-yellow with a weak reddish blush. The fruits are large 200-230 g. Noteworthy, it is advisable to collect the fruits unripe, since they are perfectly stored and ripen in a dark, cool place for 90 days, after which they are purchased.



Fig. 6. Pear variety Just Maria.

Pear variety Kyrgyz winter. Kyrgyz variety, winter ripening. Resistant to disease - fire blight. The tree is medium-sized. The crown is broadly pyramidal, medium density. The yield is high, the fruits are large, oblong, golden-yellow in color with a bright carmine blush. The pulp is creamy, coarse-grained with a tart taste. High keeping quality and transportability.

Pear variety Muratovskaya. Autumn variety of selection of VNIISPK. Trees medium size. The tree crown is broadly pyramidal, of medium density. The predominant type of fruit formations is simple and complex rings. Fruits medium-sized, uniform, pear-shaped, with ribbing at the top of the fruit, slightly beveled. The pulp is light yellow, dense, tender, oily, juicy, sweet and sour taste with a slight aroma. The appearance of the fruit is estimated at 4.5 points, the taste - at 4.3 points. Removable maturity occurs in the last ten days of August - early September, the fruits can be stored until November. Variety early-ripening, high-yielding, the variety has high winter hardiness. Resistant to major diseases.

Pear variety Lira. Early winter pear variety bred by the All-Russian Research Institute of Fruit Crops Breeding.

The trees are large with a broadly pyramidal crown of medium density. The predominant types of fruit formations are ring and spear. The fruits are large, weighing 205 g, attractive in appearance, uniform, broadly pear-shaped or elongated-pear-shaped, beveled. The surface of the fruit is smooth, broadly ribbed. The skin of the fruit is smooth, dry, and dull. Color during the period of removable maturity: the main color is greenish, the covering color is in the form of a light tan on the smaller part of the fruit of a brownish-red color. The pulp is white, creamy, dense, fine-grained, very juicy, with a good sweet taste with a slight sourness, with a weak aroma. The removable maturity of the fruits occurs in September. The consumer period lasts from the beginning of October to the end of December. The yield is high and regular. Winter hardiness average. Sort resistant to major diseases.

DISCUSSION

The development of the fruit growing and viticulture industry, which contributes to strengthening the food security of the Republic of Kazakhstan, is largely determined by the range of crops grown.

In fruit growing and viticulture, the role of the variety is more significant compared to other branches of agriculture due to the fact that fruit and grapes are perennial crops, and mistakes made when choosing a variety affect the entire period of operation, which lasts 15-25 years. Optimization of the assortment is carried out on the basis of the gene pool created in KazFVRI LLC, which is annually replenished with new achievements of world selection and is preserved in selection gardens and *in vitro*. Modern requirements for varieties are quite high and include such indicators as the intensity of the variety, its adaptability, resistance to diseases and pests, improved chemical composition, polyploid level of varieties. Varieties with a high level of such indicators have been created in a number of foreign countries and in the CIS countries. The development of selection largely depends on the expansion of the gene pool through the introduction of new varieties and their adaptation to local conditions. Research in Kazakhstan shows that the use of new genotypes can increase crop yields and resistance to diseases (Kulzhanov *et al.* 2022). Modern research confirms the effectiveness of molecular markers in the selection of breeding materials, which allows accelerating the process of creating new varieties with high resistance to biotic and abiotic stresses. For example, the use of marker selection has made it possible to successfully isolate grape genotypes with resistance to *Plasmopara viticola* (Romadanova *et al.* 2024). This method is also promising for breeding apple and pear trees, especially in a changing climate. Requirements for varieties are constantly changing over time and it is necessary to create new, more modern varieties. Currently, the gene pool is being replenished with the latest achievements of world selection. As a result of many years of work at the Samara Research Institute "Zhigulevskie Gardens", new varieties of apple trees of winter and late winter ripening periods have been created. The new varieties have high adaptability to the conditions of the region, early entry into the fruiting period, improved fruit quality: Skif, Prince Zasekin, Sinap Samara, Spartanets, and Pamyat Kedrina (Kuznetsov 2020). The gene pool collection of the Federal State Budgetary Scientific Institution "NBS-NNC" in the "Crimean Experimental Station of Horticulture Department" has identified 59 genotypes with economically valuable traits. As a result of a comprehensive study of apple tree breeding forms, 3 samples were identified that are recommended for the State variety testing and planting of intensive fruit plantations - Krymskaya Osen, Medea, Scythia (Arifova *et al.* 2021). Based on long-term data, the Federal State Budgetary Scientific Institution "North Caucasus Federal Scientific Center for Horticulture, Viticulture, and Winemaking" has identified elite forms: Istok and the scab-immune Granatovoe variety as promising for the production and selection of apple trees for a set of target traits: high productivity potential, adaptability to abiotic and biotic stressors of the cultivation region, increased commercial attractiveness and high taste qualities of fruits (Ulyanovskaya & Belenko 2022). The Far Eastern Research Institute of Agriculture has produced higher-quality apple varieties that, according to their morphological characteristics, belong to the transitional apple tree. In the conditions of the Middle Amur region, the most highly adaptive varieties are those of local selection, including the new Far Eastern Zolotistoe variety and the Zvezda Vostoka variety, which will later be submitted to the State testing. The varieties are highly resistant to a complex of harmful abiotic and biotic factors (Kulikov *et al.* 2022). The article presents the results of a comprehensive assessment of apple varieties and elite forms based on the main economically valuable traits using field and laboratory research methods. Promising varieties are identified: Soyuz, Karmen, Lyubimovoe Dutovoy, Zolotaya Korona and Elite 12/2-20-35 of regional selection, the Pinova variety of foreign selection, which possess valuable traits: early maturity, productivity, stability of fruiting, high quality and standard of fruits for industrial cultivation and use in the selection process for a set of traits (Ulyanovskaya & Belenko 2020). According to the results of long-term surveys in some horticultural areas of Karakalpakstan and the Khorezm region of the Republic of Uzbekistan, in terms of varietal and diversity, apple trees are superior to other fruit crops. Local apple trees

belong to the *Malus* species. (Sieversii Ledeb.) *M. Roem* and its subspecies - *M. sieversii* subsp. *turkmenorum* (Juss) Likg, *M. sieversii* var. *niedzwedzkyana* (Dieck) Likh. The Turkmen apple tree is a very drought-resistant and salt-tolerant species. Varieties of this subspecies of apple tree are known in Turkestan as "Babarabskaya", and in the Khorezm region as "Khazarapskaya". Both of these forms of the Turkmen apple tree are resistant to environmental stress factors (Akhmetova 2025). In terms of commercial and consumer qualities, new innovative winter consumption varieties bred by VNIISPK are not inferior to foreign ones, and in terms of resistance to scab and adaptability, they are significantly superior. The varieties "Akademik Savelyev", "Aleksandr Boyko", "Aphrodite", "Vavilovskoye", "Ivanovskoye", "Prazdnichnoye", "Rozhdestvenskoye" are recommended for cultivation in intensive gardens (Krasova *et al.* 2022). The following varieties are classified as highly resistant to scab and powdery mildew: summer varieties (Fortuna), autumn varieties (Carmen, and Talisman), winter varieties (Talida, and Nika). Varietal characteristics of commercial qualities of fruits in terms of attractiveness (fruit weight, taste, and appearance) were identified and varieties with a high content of dry matter (Fortuna, and Nika), vitamin C including summer varieties Fairy, Fortuna (17.0-14.5 mg / 100 g) were identified (Shakhmirzoev & Kaziev, 2020). The evaluation and presentation of the results of the pear gene pool study in the conditions of the central subzone (Krasnodar) for the main economically valuable traits are carried out. The following varieties are distinguished by productivity: Alexandra, Bere Klerzho and Slavyanka; the following varieties are distinguished by resistance to high temperatures: Assol, Abbat Fetel, Verbena, Vilena, Duet, Krasivaya, Lyuberskaya, Malyshka, Melitopolskaya sochnaya, Samorodok, Flamenco and elite forms: B-18-46, No. 32, No. 16. Based on the research results, a source of drought resistance was obtained: the pear variety Rannyaya Sergeeva, which transmits its trait to 50% of seedlings in a hybrid family. Competitive varieties are recommended for environmental testing: Duet and Avgustovskaya dew (Prichko *et al.* 2021). The Research Institute of Fruit Crop Breeding presented the results of a study on the effect of post-harvest treatment with biological preparations on the shelf life of pear fruits. It was found that the treatment of Povislaya pear fruits with the Tven preparation ensures the preservation of commercial qualities and extends the shelf life (Semeikina 2017). The Russian Research Institute of Fruit Crop Breeding (VNIISPK) established that all varieties and hybrid seedlings are susceptible to pear rust, regardless of their genetic origin - varieties and forms derived from the common pear (*P. communis* L.), Ussuri pear (*P. ussuriensis* Maxim), sand pear [*P. pyrifolia* (Burm.) Nakai] and interspecific hybrids within the genus *Pyrus* L. (Dolmatov *et al.* 2021). At the North Caucasus Federal Scientific Center for Horticulture, Viticulture and Winemaking (NCFCR-HVW), using the genetic collection of stone fruits (*Prunus* L.) crops - genus cherry (*P. avium* L.), common cherry (*P. cerasus* L.) and plum (*P. domestica* L.), made it possible to identify donors and sources of valuable traits of stone fruit crops, and new local varieties were created, characterized by a set of economically valuable traits for modern production and selection (Zaremkov *et al.* 2021). Hardy pear varieties in the conditions of the central fruit-growing zone of Belarus have been identified, which possess the ability of fruits to retain their commercial and taste qualities for a long period: Bere Russkaya (*P. communis* × *P. ussuriensis*); Chudesnitsa, and Yakovlevskaya (*P. communis* × *P. pyrifolia*); Novogodnyaya, and Yanvarskaya (*P. communis* L.), which will be used for further breeding work (Yakimovich *et al.* 2024). The most promising varieties are those of Khabarovsk, Krasnoyarsk, Sverdlovsky, and Altay selection, which have high adaptability combined with good productivity and fruit quality in the monsoon climate in the south of Primorsky Krai. Varieties selected for individual traits are recommended for further selection. In terms of winter hardiness are Altayskaya Krasavitsa, Veselinka, Vnuka, Kuyumskaya, Lada, Sverdlovchanka, and Tema. In terms of yield and taste of fruits are Altayskaya Krasavitsa, Veselinka, and Perun. In terms of a set of economically valuable traits, the best varieties in local conditions are Altayskaya Krasavitsa and Sverdlovchanka (Yakimovich *et al.* 2018). Intensive pear varieties should be suitable for creating small-sized crowns and dense planting, early-bearing, produce stable yields and be resistant to unfavourable biotic and abiotic conditions of cultivation sites. At the same time, it is necessary to have high commercial and taste qualities of fruits with a long shelf life of winter varieties (Solonkin *et al.* 2022). IN 2016 Beurré Alexandre Lucas introduced for suitability for fruit processing. The variety is distinguished by high taste and commercial qualities of fruits, the average weight of which varies from 179.5 to 197.4 g. The average organoleptic assessment of fresh fruits is 4.5–4.7 points. The fruits of the Bere Alexander Luca pear variety are suitable for the production of direct-squeezed juice, mashed fruits with sugar and puree frozen with sugar, and are limitedly suitable for the production of fruit nectars (Sherlock 1996). A comparative assessment of the varieties is given in terms of water content, water deficit, water-holding capacity of leaves, and the degree of turgor restoration. The Sverdlovchanka, Skazochneya, and

Severyanka Krasnoshchekaya varieties, which exceed the drought resistance indicators of the control Krasnobokaya variety, were selected for use in breeding in the conditions of the sharply continental climate of the Orenburg region (Lokhova & Feshchenko 2021). The Russian Research Institute of Horticulture has included 50 new apple varieties in the “State Register of Breeding Achievements...”, including 20 varieties immune to scab (Sedov *et al.* 2021).

CONCLUSION

The results of the long-term work allowed us to update the fruit assortment of apple and pear trees. They replenished them with new varieties of local selection of apple trees: Damira, Alen, Dauren, Adina, Aizere, Nursat, Podarok Nurtazina, as well as pears: Nagima, Aidana, Karyndas, Bostandyk, Krasa Semirechye and others. The gene pool was replenished with foreign varieties of apple trees from near and far abroad: Champion, Samurlet, Pink Lady, Red Chiv, Quenty and others, as well as pears: Williams, Just Maria, Lira, Muratovskaya, Khorru Sweet, Red Anzhu, Yesenvskaya and others, and they were assessed according to their main economically valuable characteristics (adaptability, early fruiting, yield, fruit taste and others).

ACKNOWLEDGMENTS

The authors of the article thank the staff of the department of "Breeding of fruit and berry crops and grapes" and other laboratories of the institute for their enormous long-term work in creating new varieties of apple and pear trees and for their assistance in replenishing the gene pool of KazFVRI LLP with introduced varieties of fruit crops.

FINANCING

This the work was carried out within the framework of program-targeted financing for scientific, scientific and technical programs of the Ministry of Agriculture of the Republic of Kazakhstan for 2024-2026 (BR22884599).

REFERENCES

- Akhmetova, D 2025, Anthropogenic impact on soil and vegetation in Turkistan region: chemical composition and heavy metal contamination. *Journal of the Geographical Institute “Jovan Cvijić” SASA*, 75: 1–15.
- Arifova, Z, Chelebiev, E, Smykov, A, Khalilov, E & Uskov, M 2021, Drought resistance of apple tree and raspberry varieties and forms promising for the Crimea region. *E3S Web of Conferences*, 254: 01015.
- Danilova, A, Suleimenova, N, Vinokurov, A, Isakova, E & Abildaev, Y 2021, Development of horticulture in arid conditions of Kazakhstan using innovative hydrogel technology ‘AQUASORB’ in soil. *International Journal of Agricultural Resources, Governance and Ecology*, 17: 225-237.
- Dolmatov, E, Khrykin, T & Gaplaev, MS 2021, Pyrus-dwarf project: interim results. *IOP Conference Series: Earth and Environmental Science*, 677: 012090.
- Dzhangaliev, A 2003, The wild apple tree of Kazakhstan. *Horticultural Reviews*, 29: 63-304.
- Dzhangaliev, A, Salova, T & Turekhanova, R 2001, Dikie plodovye rasteniia Kazakhstana [Wild fruit plants of Kazakhstan]. Kazakh State Institute of Scientific and Technical Research, Almaty [In Russian].
- Kenzheali, Y & Makhmetova, A 2024, Analysis of sustainable agricultural development in Kazakhstan: key economic and climatic indicators. *Eurasian Journal of Economic and Business Studies*, 68: 47-60.
- Krasova, N, Ozherelieva, Z, Galasheva, A & Lupin, M 2022, Production and biological assessment of VNIISPK cultivars of various ploidy for the zone of temperate continental climate. *Plants*, 11: 2770.
- Kulikov, IM, Burmenko, JV, Svistunova, NY, Evdokimenko, SN, Sazonov, FF, Tumaeva, TA & Konovalov, SN 2022, Regionally adapted model of an ideal *Malus × domestica* Borkh apple variety for industrial-scale cultivation in European Russia. *Agriculture*, 12: 2124.
- Kulzhanov, SN, Kazybayeva, SZ, Tazhibayev, TS, Azhitaeva, LA & Yessenaliyeva, M 2022, Effect of climatic conditions on the productive and biochemical characteristics of grape varieties grown on sierozem soil. *Eurasian Journal of Soil Science*, 11: 174-183.
- Kuznetsov, A 2020, New varieties of apple trees for the Middle Volga region. *Selection and Variety Breeding of Garden Crops*, 7: 85-90.
- Leakey, RR, Tientcheu Avana, ML, Awazi, NP, Assogbadjo, AE, Mabhaudhi, T, Hendre, PS, Degrande, A, Hlahla, S & Manda, L 2022, The future of food: domestication and commercialization of indigenous food crops in Africa over the third decade (2012–2021). *Sustainability*, 14: 2355.

- Lokhova, A & Feshchenko, E 2021, Elite forms of willow-leafed pear (*Pyrus salicifolia* Pall.) in the steppe zone of the Southern Urals as a seed rootstock for pear. *E3S Web of Conferences*, 254: 01030.
- Pomology, R 2010, Fruit production and research in Russia. *Chronica*, 50: 25.
- Prichko, T, Mozhar, N & Droficheva, N 2021, Assessment of the productive potential and quality of pear fruits of different ripening periods grown in southern Russia. *E3S Web of Conferences*, 254: 01025.
- Romadanova, NV, Aralbayeva, MM, Zemtsova, AS, Alexandrova, AM, Kazybayeva, SZ, Mikhailenko, NV, Kushnarenko, SV & Bettoni, JC 2024, In vitro collection for the safe storage of grapevine hybrids and identification of *Plasmopara viticola* resistance genes. *Plants*, 13: 1089.
- Sedov, E, Serova, Z, Sedysheva, G, Makarkina, M & Korneeva, S 2021, Contemporary horticulture in Russia: achievements and challenges. *Sovremennoe Sadovodstvo – Contemporary Horticulture*, 70: 1-10.
- Semeikina, V 2017, New pear varieties bred by the Lisavenko Research Institute of Horticulture of Siberia. *Siberian Horticultural Bulletin*, 23: 55-60.
- Shakhmirzoev, R & Kaziev, M 2020, Biological potential of the Carmen apple variety in the south of Dagestan. *Proceedings of the Dagestan Agricultural Academy*, 18: 45-49.
- Sherlock, WJ 1996, The pastoral theme in the short stories of AP Chekhov. Cornell University, Ithaca, NY.
- Solonkin, A, Nikolskaya, O, Kikteva, E & Seminchenco, E 2022, Creation of high-quality varieties of common pear (*Pyrus communis* L.) in the Lower Volga region. *Agricultural Biology*, 57: 981-991.
- Ulyanovskaya, E & Belenko, E 2020, Using the genetic diversity of the *Malus* genus to solve priority breeding tasks. *BIO Web of Conferences*, 25: 02001.
- Ulyanovskaya, E & Belenko, E 2022, Comprehensive study of *Malus* genus resources for the creation of adaptive cultivars. *BIO Web of Conferences*, 45: 02027.
- Wei, P, Umirzakov, SY & Kenzhalina, ZS 2018, Economic development of fruit and vegetable industry in Kazakhstan. *Journal of Advanced Research in Law and Economics*, 9: 2885-2891.
- Yakimovich, O, Martsinkevich, T & Bogdan, T 2018, Variety study of introduced pear varieties under conditions of Belarus. *Fruit Growing*, 30: 51-56.
- Yakimovich, O, Martsinkevich, T & Bogdan, T 2024, The Kalyadnaya – a new Belarusian late-ripening pear variety. *Belarusian Science*, 36: 147.
- Zaremuk, RS, Dolya, YA, Kopnina, T & Kochubey, A 2021, Efficiency of breeding use of *Prunus* L. biodiversity. *E3S Web of Conferences*, 254: 01027.