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Promising varieties of fruit crops of local and introduced selection in Kazakhstan

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Abstract. The article presented the results of many years of research by the Kazakh Scientific Research Institute of Fruit and Vegetable Growing LLP on the study and improvement of apple and pear varieties. The relevance of the work is due to the need to increase the adaptability, yield and quality of fruit production in the south and south-east of Kazakhstan. The study was aimed at the agrobiological evaluation of local and introduced varieties in order to identify the most promising forms for intensive horticulture. Over the past 20 years, 97 apple varieties and 25 pear varieties have been submitted for state variety testing, and more than 70 new varieties have been added to the institute's gene pool, including 'Honeycrisp', 'Champion', 'Red Chief', 'Pink Lady', 'Samurlet', 'Lyra', 'Muratovskaya' and others. The research was conducted in 2022-2024 in the climatic conditions of the south and south-east of the republic. The evaluation was based on a number of economically valuable characteristics: early fruiting, yield, adaptability, fruit shelf life, resistance to diseases (scab, powdery mildew, bacterial burn) and pests. As a result, varieties with the highest degree of adaptability, stable productivity (up to 550 cwt/ha), high taste qualities and suitability for storage were selected. The article contains characteristics of 12 apple varieties and 10 pear varieties, including data on biological and economic indicators. The practical significance of the work lies in the possibility of using the results obtained when planting industrial orchards and optimising the variety composition in regions with similar growing conditions

Keywords: winter hardiness; yield; adaptability; apple tree; pear tree; disease resistance

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Introduction

The natural and climatic conditions of southern and south-eastern Kazakhstan create favourable conditions for the development of industrial horticulture, especially for the cultivation of pome fruits. Fertile soils, a developed irrigation network and active temperatures ranging from 2,600 to 4,000°C allow for the successful cultivation of varieties of different origins and ripening times. Apple and pear trees occupy a leading place in the structure of fruit plantations in the republic, providing the main share of commercial production and playing an important role in the country's food security. In recent decades, breeding institutions in Kazakhstan, including the Kazakh Scientific Research Institute of Fruit and Vegetable Growing (KazNIIPO), have been actively working to expand and improve the assortment by introducing varieties from the United States, Canada, Australia, the Czech Republic, Russia and other countries. The institute's gene pool includes more than 1,800 samples collected from regions with different climatic conditions, which serves as the basis for adapting new varieties to the specifics of the southern regions of Kazakhstan. The study of wild species growing in Central Asia plays an important role in expanding the genetic diversity of fruit crops. Research by U. Manapkanova *et al.* (2025) on the genetic diversity of wild cherry species in Kazakhstan and Uzbekistan revealed a high level of intraspecific variability and the presence of hybrid forms with valuable drought and frost resistance traits, which is of considerable interest for breeding programmes. As noted by R. Sestras & A. Sestras (2023), intensive horticulture places increased demands on the varieties used. These include high yield, resistance to major diseases (scab, powdery mildew, bacterial burn), long shelf life of fruits, high commercial and taste characteristics, as well as adaptability to local soil and climatic conditions.

The development of fruit growing as a priority sector of the agro-industrial complex of the Republic of Kazakhstan largely depends on the scientifically based formation of the varietal composition of fruit crops. Given the long-term nature of apple and pear trees, mistakes in the selection of varieties can reduce the productivity of plantations over 20-25 years of operation, resulting in significant economic losses (Sviridova & Vlasov, 2019). Therefore, as noted by A. Smykov (2020), one of the most important areas of breeding work is the effective use of the gene pool of fruit crops and its constant enrichment with promising forms adapted to the soil and climatic conditions of the region. Fruit quality is a key indicator determining the commercial attractiveness of a variety on the market. Studies show that, along with the biological characteristics of plant growth and development, resistance to stress factors and productivity, the commercial characteristics of fruit – weight, size, shape, colour and taste – are the most stable varietal traits (Havryliuk *et al.*, 2022; Du *et al.*, 2025; Ghonimy *et al.*, 2025). Modern domestic and foreign market requirements dictate the need to grow varieties with high organoleptic characteristics and attractive appearance. Recent studies emphasise the importance of using molecular markers and genetic certification in the selection of breeding material. The work of Y. Yefremova *et al.* (2023) shows that marker-assisted selection (MAS) significantly accelerates the process of breeding varieties resistant to *Plasmopara viticola*, scab and other stressors. These approaches are particularly relevant in the context of climate change and for Kazakhstan, where it is necessary to create adaptive forms with complex resistance to abiotic and biotic environmental factors.

The aim of this study was to conduct a comprehensive agrobiological assessment of promising apple and pear varieties of local and introduced selection in the conditions of southern and south-eastern Kazakhstan in order to identify the most productive and adapted forms suitable for introduction into industrial production and further use in breeding programmes to create new competitive varieties.

Materials and Methods

Field studies were conducted in 2022-2024 at the experimental site of the Talgar Regional Branch of KazNIIPO LLP (Almaty Region, Talgar District, Almalyk Village, Kazakhstan), located in the foothills of the Zailiyskiy Alatau at an altitude of 1,070 m above sea level. The soils of the site are grey-brown, loamy, with a pH level of 7.1-7.3, humus content of 2.1-2.3%, and average mobile phosphorus and potassium content.

Research subjects:

- Apple tree (11 varieties): 'Voskhod', 'Makpal', 'Anel', 'Damira', 'Aizere', 'Dauren', 'Samurlet', 'Champion', 'Pink Lady', 'Honeycrisp', 'Red Chief'. Year of planting – 2011, planting pattern 5×3 m, rootstock – Arm-18. Control variety – 'Golden Delicious'.
- Pear (9 varieties): 'Aydana', 'Bostandyk', 'Nagima', 'Karyndas', 'Lyra', 'Harrow Sweet', 'Muratovskaya', 'Kyrgyzskaya Zimnyaya', 'Prosto Maria'. Year of planting – 2010, planting pattern 5×3 m, rootstock – EMA. Control variety – 'Talgar Beauty'.

The experiment was laid out using the Randomised Complete Block Design method in three replicates. Each replicate consisted of 5 trees of each variety (15 trees per variety in total). The variants were arranged in strips, taking into account the prevailing wind direction. Studies were conducted in accordance with the methodological guidelines of E. Sedov & T. Ogoltsova (1999). The following characteristics were taken into account: 1. Winter hardiness – based on the degree of freezing of wood, cambium and generative buds after natural overwintering, visually on a damage scale (1-5 points), as well as in the laboratory (after forced freezing and staining of the cambium with a tetrazolium solution). 2. Disease resistance (scab, powdery mildew) – visual assessment of the degree of damage to leaves and

fruits on a 5-point scale during the growing season (Mavlyanova, 2015). 3. Yield – recorded in kilograms per tree and converted to hectares using formula (1):

$$Y = (M \times N \times 10{,}000) / (S \times n), \quad (1)$$

where M is the average yield per tree, N is the number of trees per hectare, S is the area between rows and within rows, and n is the number of trees counted.

The quality of the fruit was determined organoleptically (appearance, taste, aroma, juiciness) on a 5-point scale; the weight of a single fruit, dry matter content (refractometrically), titratable acidity, vitamin C content (by iodometry) (Gritsenko *et al.*, 2022). In Table 1, the characteristics of the fruit included weight and taste qualities, determined on the basis of organoleptic tasting on a 5-point scale. The weight of the fruit was indicated in grams as the average value for a sample of 10-20 fruits, with an accuracy of 5 g. Taste was assessed based on a combination of characteristics such as sweetness, acidity, aroma and juiciness. Average yield was expressed in centners per hectare (c/ha) and was calculated based on data for 2022-2024 from experimental plots, converted to 1 hectare. The shelf life of the fruit reflected the duration of their storage at a temperature of 0...+2°C and a humidity of 85-90%, until they lost their marketable appearance and taste. The NSR05 indicator (the smallest significant difference at a significance level of 5%) was used to assess the reliability of differences between varieties in terms of yield. Drought resistance was determined by the water-holding capacity of the leaves, water deficit and turgor recovery according to the method of S. Temirbekova *et al.* (2023).

Intensive cultivation techniques included spindle-shaped pruning, drip irrigation, gentle pruning, mineral nutrition according to growth stages, and inter-row mulching. The results were processed using analysis of variance (ANOVA) with the NSR05 criterion (smallest significant difference) to determine the reliability of differences between variants. The processing was carried out using Statistica 13.0 and Excel 2016 software. The significance threshold was $p < 0.05$. The study was conducted in accordance with the ethical principles of the Convention on Biological Diversity (1992) and the Convention on International Trade... (2000). The involvement of experts for organoleptic evaluation complied with the ethical standards of the WMA Declaration of Helsinki (1964).

Results and Discussion

As a result of many years of breeding work by KazNIIPO LLP, 97 apple varieties and 25 pear varieties were submitted for state variety testing. Of these, 27 apple varieties and 3 pear varieties were included in the State Register of Breeding Achievements Approved for Use in the Republic of Kazakhstan. Over the past 20 years, as part of the introduction programme, about 50 foreign apple varieties have been tested and introduced, including 'Honeycrisp', 'Champion', 'Red Chief', 'Pink Lady', 'Samurlet', 'Quinte', 'Jenny Grant', and others. Twenty-one pear varieties have been introduced, including 'Lyra', 'Yesenevskaya', 'Muratovskaya', 'Cheremshina', 'Vrodliva', 'Claude Sablin', 'Williams', and others. Table 1 presents the production and biological characteristics of promising apple and pear varieties, both locally bred (KazNIIPO LLP) and adapted varieties from other countries, based on data for 2022-2024.

Table 1. Key indicators for promising fruit crop varieties of local and introduced selection (average values for 2022-2024)

Variety name	Ripening period	Fruit quality		Average yield (centners per hectare)	Fruit shelf life
		foetal weight (g)	fruit flavour, points		
Apple tree					
'Anel'	summer-autumn	210	4.8	240	until December
'Voskhod'	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
'Honeycrisp'	winter	250	4.8	550	until April
'Red Chief'	winter	210	4.8	550	until March
'Golden Delicious'	winter	180	4.5	160	until May
HCP_{05}				17.0	
Pear					
'Nagima'	autumnal	190	4.8	180	until December
'Karyndas'	autumnal	170	4.5	160	until January
'Bostandyk'	winter	170	4.4	170	until December
'Aydana'	winter	150	4.3	160	until December
'Prosto Maria'	winter	230	4.5	200	until December

Table 1. Continued

Variety name	Ripening period	Fruit quality		Average yield (centners per hectare)	Fruit shelf life
		foetal weight (g)	fruit flavour, points		
Pear					
'Lyra'	winter	205	4.3	175	until December
'Harrow Sweet'	winter	210-450	4.7	205	until December
'Kyrgyzskaya Zimnyaya'	winter	210	4.0	170	until April
'Muratovskaya'	autumnal	180	4.3	–	until November
'Talgar Beauty'	winter	179	4.5	150	until February
HCP_{05}				12.0	

Note: NSR05 – the smallest significant difference at a significance level of 5%; the lack of yield in the 'Muratovskaya' variety is due to insufficient observations during the study period, as the variety is currently undergoing adaptation testing
Source: compiled by the authors based on data from NASEC (n.d.)

Apple tree variety 'Voskhod'. Variety bred by KazNIIPO LLP. Winter ripening period, high winter hardiness. Resistant to powdery mildew and scab. Medium-sized tree with a rounded, compact crown. It starts bearing fruit 2-3 years after planting in the garden. High yield. The fruits are large, up to 260 g, candlestick-shaped, light yellow in colour with a delicate blush (Fig. 1). The taste is sweet and sour, with a pleasant aroma. The flesh is white, dense, tender, juicy, and fine-grained. The fruits ripen in mid-September. They can be stored until April. The variety is regionalised in the Almaty and Zhambyl regions.

Figure 1. Apple tree variety 'Voskhod'
Source: photo by the authors

Apple tree variety 'Makpal'. A variety bred by KazNIIPO LLP. A winter-ripening variety. High winter hardiness. Resistant to powdery mildew and scab. Medium-sized trees with oval crowns of medium density. Begins bearing fruit in the third year after planting in the orchard. High yield. Fruits are large, up to 205 g, elongated-conical in shape, mainly yellow in colour with a bright red blurred blush over most of the fruit. The flesh is white, with a medium aroma. The fruits ripen in mid-September. They can be stored until April. Regionalised in the Almaty region.

Apple tree variety 'Anel'. Created at KazNIIPO. Obtained by crossing the varieties 'Starkrimson' and 'Aport'. Trees with moderate growth, winter-hardy, disease-resistant. Bears fruit in the third year after planting in the garden. The fruits are above average in weight, very attractive, have a solid bright crimson colour, excellent dessert taste, and are fragrant (Fig. 2). The fruits ripen in late summer and can be stored in the refrigerator for three months. It is regionalised in the Almaty, Zhambyl and Zhetysu regions.

Figure 2. Apple tree variety 'Anel'
Source: photo by the authors

Apple tree variety 'Damira'. A variety bred by KazNIIPO LLP, created by crossing the 'Fantasia' and 'Almaty Sinap' varieties. The variety is winter-hardy and resistant to major diseases. The tree has a spreading crown, suitable for intensive orchards. It starts bearing fruit 3-4 years after planting. The variety is high-yielding. The fruits are medium to above average in size, elongated and conical in shape. The skin colour is bright red all over the fruit. The flesh 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'. A variety bred by KazNIIPO LLP, ripening in autumn and winter. Winter-hardy. Disease-resistant. Medium-sized tree with a rounded, spreading, moderately dense crown. Begins bearing fruit 2-3 years after planting in the orchard. High-yielding variety. The fruits are medium-sized, 200-220 g, elongated-conical, yellow in colour, with a raspberry blush, blurred and striped over most of the fruit, sweet in taste, with a strong aroma, creamy, juicy, dense and tender flesh. The fruits ripen in mid-September. They can be stored in the refrigerator until April.

Apple tree variety 'Dauren'. A variety bred by KazNIIPO LLP, parent forms 'Sinap Almatinsky' and 'Fantasia'. The trees are winter-hardy. The crown is pyramidal in shape and spreads under the weight of the harvest. It starts bearing fruit 3-4 years after planting in the orchard. The fruits ripen in autumn-winter and can be stored until April. The fruits are candlestick-shaped, mainly greenish-yellow in colour, with a blurred blush over most of the fruit (Fig. 3). The fruits are highly attractive and have a dessert flavour. The variety is undergoing state variety testing.

Figure 3. Apple tree variety 'Dauren'
Source: photo by the authors

'Pink Lady' apple variety. This variety was bred in Austria and ripens in winter. The tree is conical and dense. The fruits are large, up to 6-10 cm in diameter, and round-conical in shape. The apples weigh 180-200 g. The skin is thick, shiny, and greenish-yellow in colour. It is covered with a blush, which can range from light pink to red. The flesh is cream-coloured, dense, and very juicy. The taste is pleasant, sweet and sour, with a hint of vanilla and forest berries. Harvesting begins in late October or mid-November. The fruits store well and are suitable for transport. They can be stored in a refrigerator, cellar or cool basement for up to 10 months. They retain their taste until May.

'Honeycrisp' apple variety. American variety. Winter consumption period (removable maturity in mid-September, consumer maturity in early November). Highly winter-hardy. In the first 3-4 years, the tree has a narrow oval shape, later – a compact wide oval shape. The fruits are large, weighing 180-250 g, uniform in size, elongated-rounded-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 moderately shiny. The flesh is yellowish-cream, dense, crumbly, crisp, very juicy, with a light aroma. The taste is excellent, harmoniously sweet and sour. The fruit can be stored in the refrigerator for 6-7 months. The variety is resistant to scab.

'Champion' apple variety. Variety of Czech origin. Variety – self-infertile. Trees are weak in growth, with a compact, oval, medium-dense crown. Apple fruits are large, oval-cylindrical, regular in shape. The skin is smooth, thin, but quite strong and elastic, greenish-yellow in colour, covered with an orange-red blush. The flesh is light cream in colour, sweet in taste, with a slight sourness, and amazingly juicy. The fruit's shelf life is not the longest, but under the right storage conditions, the fruit remains 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 4-5 years.

Apple tree variety 'Red Chief'. Selected in the USA as a clone of the 'Red Delicious' variety. Trees are of medium vigour, with a broad pyramidal crown of medium density. Bears fruit mainly on spurs. The fruit is above average size and large (180-210 g), truncated-conical, sometimes slanted, of average uniformity. The surface is broadly ribbed. The skin is of medium thickness, with a waxy coating. The main colour is greenish-yellow, the overcolour is a dark red striped blush, later bright red, merging and covering the entire fruit. The subcutaneous dots are large, numerous and clearly visible. The flesh is light cream, medium density, fine-grained, medium juiciness, dessert flavour (4.8 points), with a strong aroma. The fruit reaches harvest maturity in the second half of September. Shelf life is 6-7 months. Mainly used fresh. It starts bearing fruit on low-growing rootstocks in the third year, with a yield of up to 55 t/ha and regular fruiting. The variety is characterised by insufficient winter hardiness and average drought resistance. It is moderately susceptible to scab and resistant to powdery mildew.

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

Pear variety 'Nagima'. Selected by KazNIIPO LLP. Autumn ripening period. Good winter hardiness. Medium-sized tree. Broad pyramidal, dense crown. Begins bearing fruit in the fourth year after planting in the orchard. Average yield. Susceptible to bacterial blight. Large, broadly pear-shaped fruit (Fig. 4). Yellow-green colour with a scarlet blush on the sun-exposed side. Juicy, sweet flesh with excellent taste. Undergoing state variety testing.

Pear variety 'Bostandyk'. Selected by KazNIIPO LLP. Winter ripening period. High winter hardiness. Tall tree. Broad rounded crown, medium density. Begins bearing fruit in the 5th year after planting. High yield. Medium-sized, round fruit with a juicy sweet-sour taste. Main colour is green-yellow. Harvest maturity occurs in mid-September, fruit can be stored until December. Passes state variety testing.

Figure 4. Pear variety 'Nagima'
Source: photo by the authors

Pear variety 'Aydana'. Selected by KazNIIPO LLP. Winter ripening period. High winter hardiness. Medium-sized tree. Pyramidal crown. Begins bearing fruit in the third year after planting on quince rootstock. High yield. Medium to large, round fruit with a juicy sweet-sour taste. Main colour is green-yellow. Harvest maturity occurs in mid-September, fruit can be stored until December. The variety is resistant to bacterial burn and is included in the State Register of Selection Achievements Recommended for Use in the Republic of Kazakhstan.

Pear variety 'Karyndas'. Selected by KazNIIPO LLP. Autumn ripening period. High winter hardiness. Medium-sized tree. Broad pyramidal crown, medium density. Begins bearing fruit in the fourth year after planting. High yield. Moderately resistant to bacterial burn. Medium-sized pear-shaped fruit. Main colour is yellow with a red blush (Fig. 5). Juicy, grainy flesh with a sweet-sour taste. Can be stored until mid-January. Passes state variety testing.

Figure 5. Pear variety 'Karyndas'
Source: photo by the authors

'Harrow Sweet' pear variety. A winter ripening variety, bred in Canada. The fruit is pear-shaped, weighing 260-450 g, sometimes up to 500 g, with greenish-yellow skin and a blurred tan on the sunny side, turning yellow when fully ripe. The flesh is juicy, sweet with a pleasant sourness, and fragrant. The fruit reaches harvest maturity at the end of September. Under normal conditions, it can be stored for about 2-3 months, and in the refrigerator until early March. It has high winter hardiness. Resistance to diseases and pests is quite high. Fruiting begins in the 3rd-4th year after planting. Fruiting is regular, stable, and high-yielding. The 'Harrow Sweet' pear is relatively new but promising for Kazakhstan. The trees are low-growing, up to 3 m.

'Prosto Maria' pear variety. The tree is medium-sized, can grow up to 3 m tall, and has a broad pyramidal crown with a diameter of up to 2.5 m (at 10 years of age). This tree is considered a late variety – it bears fruit in autumn (October). The fruits are round and pear-shaped, smooth, shiny, with thin skin. The main colour is greenish-yellow with a faint reddish blush. The fruits are large, weighing 200-230 g. It is worth noting that it is advisable to pick the fruits when they are unripe, as they store well and ripen in a dark, cool place for 90 days.

Figure 6. Pear variety 'Prosto Maria'
Source: photo by the authors

Pear variety 'Kyrgyzskaya Zimnyaya'. Kyrgyz variety, winter ripening period. Resistant to bacterial burn disease. Medium-sized tree. Broad pyramidal crown, medium density. High yield, large, oblong fruit, golden yellow in colour with a bright carmine blush. The flesh is creamy, coarse-grained with a tart taste. High shelf life and transportability.

Pear variety 'Muratovskaya'. Autumn variety bred by the All-Russian Scientific Research Institute of Fruit Crop Breeding. Medium-sized trees. The tree crown is broad-pyramidal, of medium density. The predominant type of fruit formation is simple and complex ringlets. The fruits are medium-sized, uniform, pear-shaped, with ribbing at the top of the fruit, slightly slanted. The flesh is light yellow, dense, tender, buttery, juicy, with a sweet and sour taste and a slight aroma. The appearance of the fruit is rated at 4.5 points, and the taste at 4.3 points. Harvest maturity occurs in the last ten days of August – early September, and the fruit can be stored until November. The variety is early-fruiting, high-yielding, and winter-hardy. It is resistant to major diseases.

Pear variety 'Lyra'. An early winter pear variety bred by the All-Russian Scientific Research Institute for Fruit Crop Breeding. The trees are large with a broad pyramidal crown of medium density. The predominant types of fruit formations are ring-shaped and spear-shaped. The fruits are large, weighing 205 g, attractive in appearance, uniform in size, broadly pear-shaped or elongated pear-shaped, and slanted. The surface of the fruit is smooth and broadly ribbed.

The skin of the fruit is smooth, dry, and dull. Colour at harvest maturity: the main colour is greenish, with a light tan covering a smaller part of the fruit in a brownish-red colour. The flesh is white, creamy, dense, fine-grained, very juicy, with a good sweet taste and a slight sourness, with a faint aroma. The fruit reaches harvest maturity in September. The consumer period lasts from early October to late December. Yields are high and regular. Winter hardiness is average. The variety is resistant to major diseases.

The differences in productivity and adaptability of modern apple and pear varieties obtained during the study are consistent with current trends in the introduction and selection of pome crops. The high yield of intensive plantings of a number of 'Golden Delicious' clones, as well as the stable yield of 'Honeycrisp' and 'Pink Lady', correspond to the literature data that the key quantitative characteristics – early fruiting, regularity of fruiting, resistance to scab/powdery mildew – are important for the introduction and selection of new varieties. 'Pink Lady' correspond to the literature data that key quantitative traits – early fruiting, regularity of fruiting, resistance to scab/powdery mildew and fruit quality – are formed by a combination of additive and non-additive effects and benefit significantly from the selection of low-growing rootstocks and high-density planting schemes. This is confirmed by the comprehensive review by R. Sestras & A. Sestras (2023). The issue of genetic diversity of the assortment used is important for Kazakhstan. The data obtained in this study on the differentiation of varieties in terms of resistance and fruit quality fit into a broader picture: molecular genetic studies by M. Omasheva *et al.* (2018) show that both local and introduced genotypes with a wide range of variability coexist in the country's collections and production orchards, which creates a basis for targeted selection for specific environmental stressors.

The practical differences between the apple varieties tested in terms of shelf life and storage quality are consistent with numerous reports on the role of ethylene inhibitors (1-MCP) and controlled atmosphere regimes. Studies by E. Cocci *et al.* (2014), R. Fernandes *et al.* (2021), S. Steffens *et al.* (2022) showed that 1-MCP treatment slows down respiration and softening, maintains acidity and turgor during long-term storage and subsequent "shelf life", which directly correlates with the ability of individual clones to remain marketable until late spring, as noted in this study. This provides technological leeway for extended sales and smoothing out price volatility.

'Harrow Sweet' deserves special attention among pears: in this study, it combined high productivity with satisfactory fruit quality. These observations have a genetic basis, which explains the better field tolerance noted in the literature and in practice compared to a number of older varieties and makes it a promising component of the intensive orchard assortment (Maag *et al.*, 2024). The advantages of intensive technologies (drip irrigation, trellis, compacted schemes) shown in this study (accelerated entry into fruiting, more uniform crop load) correspond to data from Europe and Central Asia: the optimal combination of low-growing rootstocks and training systems provides early economic benefits without compromising basic quality indicators. At the same time, the literature highlights the potential risks of ultra-intensive orchards – a more vulnerable root system and related phenomena in the case of unfavourable rootstock-scion combinations and moisture/temperature stresses (Lezzer *et al.*, 2022). These factors should be taken into account when scaling up technologies in arid regions. Thus, the summarised data indicate the importance of a comprehensive approach to assortment formation based on scientific achievements, genetic diversity and breeding work. This makes it possible to significantly increase the sustainability and productivity of fruit crops that meet the requirements of modern intensive horticulture.

Conclusions

Many years of research conducted at the experimental site of KazNIIPO LLP have made it possible to significantly expand and update the range of apple and pear varieties by including promising forms of both local Kazakhstani and foreign selection in the variety study. Among the locally selected apple varieties, such varieties as 'Damira', 'Anel', 'Dauren' and 'Aizere' were highly valued for their combination of economically valuable characteristics. These varieties were distinguished by their high adaptability to the conditions of the Zailiyskiy Alatau, good shelf life, high organoleptic indicators (taste 4.7-5.0 points) and average yield of 195 to 240 centners per hectare. Winter varieties ('Dauren', 'Damira', 'Aizere') were also characterised by a long shelf life (until May-June). In pear breeding, the varieties 'Nagima', 'Karyndas', 'Aydana', 'Bostandyk' were selected, which showed resistance to stress factors, stable yield (up to 200 cwt/ha), good taste (4.3-4.8 points) and shelf life until January-February. Some varieties (e.g., 'Kyrgyzskaya Zimnyaya', 'Harrow Sweet') were characterised by high marketability and versatility in use.

In addition, apple varieties from other countries ('Champion', 'Samurlet', 'Pink Lady', 'Red Chief', etc.) and pear varieties were successfully introduced, which made it possible to expand genetic diversity and conduct a comparative assessment with Kazakhstani analogues. These varieties demonstrated high yields (up to 550 cwt/ha for apple trees and up to 205 cwt/ha for pear trees), high organoleptic characteristics, and good adaptability to the agro-ecological conditions of south-eastern Kazakhstan. The study confirmed the feasibility of introducing new-generation varieties into commercial plantations focused on intensive horticulture. The results are important for the development of variety policy and breeding programmes in the context

of climate change. Prospects for further research include an in-depth assessment of the resistance of the studied varieties to abiotic stresses and biotic pathogens, as well as the use of molecular markers for accelerated selection of adaptive forms.

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Conflict of Interest

None.

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Казакстандагы жергиликтүү жана интродукцияланган селекциядагы жемиш өсүмдүктөрүнүн перспективдүү сорттору

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Аннотация. Бул макалада алма жана алмурут сортун изилдөө жана жакшыртуу боюнча Казакстандын мөмө-жемиш жана жашылча өстүрүү боюнча илимий-изилдөө институту (Казахстандын мөмө-жемиш жана жашылча өстүрүү боюнча илимий-изилдөө институту) тарабынан жүргүзүлгөн узак мөөнөттүү изилдөөлөрдүн жыйынтыктары келтирилген. Бул иштин актуалдуулугу Казакстандын түштүк жана түштүк-чыгыш аймактарынын шарттарында мөмө-жемиш продукцияларынын ыңгайлашуусун, түшүмдүүлүгүн жана сапатын жакшыртуу зарылдыгынан келип чыгат. Изилдөөнүн максаты интенсивдүү багбанчылык үчүн эң келечектүү формаларды аныктоо максатында жергиликтүү жана интродукцияланган сортторду агробиологиялык баалоону жүргүзүү болгон. Акыркы 20 жылда мамлекеттик сорттун сыноосуна 97 алма жана 25 алмурут сорту тапшырылган, ал эми институттун генофондуна 70тен ашык жаңы сорттор кошулган, анын ичинде ‘Honeycrisp’, ‘Champion’, ‘Red Chief’, ‘Pink Lady’, ‘Samurlet’, ‘Lyra’, ‘Muratovskaya’ жана башкалар. Изилдөө 2022-жылдан 2024-жылга чейин республиканын түштүгүнүн жана түштүк-чыгышынын климаттык шарттарында жүргүзүлгөн. Баалоо бир катар экономикалык жактан баалуу белгилердин негизинде жүргүзүлдү: эрте бышышы, түшүмдүүлүгү, ыңгайлашуусу, сактоо мөөнөтү жана ооруларга (козу карын, порошоктуу көктүн, оттун күйүшү) жана зыянкечтерге туруктуулугу. Натыйжада, эң жогорку ыңгайлашуу даражасына, туруктуу түшүмдүүлүгүнө (550 ц/га чейин), эң сонун даамына жана сактоо мөөнөтүнө ээ болгон сорттор аныкталды. Макалада биологиялык жана экономикалык көрсөткүчтөр боюнча маалыматтарды камтыган 12 алма жана 10 алмурут сорту баяндалат. Изилдөөнүн практикалык мааниси алынган жыйынтыктарды коммерциялык бакчаларды түзүүдө жана окшош өстүрүү шарттары бар аймактарда сорттук курамды оптималдаштырууда колдонуу мүмкүнчүлүгүндө жатат

Негизги сөздөр: кышкы чыдамкайлык; түшүмдүүлүк; ыңгайлашуу; алма дарагы; алмурут; ооруларга туруктуулук

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Аннотация. В статье представлены результаты многолетних исследований ТОО «Казахский научно-исследовательский институт плодоовощеводства» по изучению и совершенствованию сортимента яблони и груши. Актуальность работы обусловлена необходимостью повышения адаптивности, урожайности и качества плодовой продукции в условиях юга и юго-востока Казахстана. Исследование было направлено на агробиологическую оценку сортов местной и интродуцированной селекции с целью выявления наиболее перспективных форм для интенсивного садоводства. За последние 20 лет на государственное сортоиспытание было передано 97 сортов яблони и 25 сортов груши, а в генофонд института привлечено свыше 70 новых сортов, в том числе такие, как ‘Honeycrisp’, ‘Champion’, ‘Red Chief’, ‘Pink Lady’, ‘Samurlet’, ‘Lyra’, ‘Muratovskaya’ и др. Исследования проводились в 2022-2024 гг. в климатических условиях юга и юго-востока республики. Оценка осуществлялась по ряду хозяйственно-ценных признаков: скороплодность, урожайность, адаптивность, лежкость плодов, устойчивость к болезням (парша, мучнистая роса, бактериальный ожог) и вредителям. В результате выделены сорта с наивысшей степенью адаптации, стабильной продуктивностью (до 550 ц/га), высокими вкусовыми качествами и пригодностью к хранению. Статья содержит характеристику 12 сортов яблони и 10 сортов груши, включая данные о биологических и хозяйственных показателях. Практическая значимость работы заключается в возможности использования полученных результатов при закладке промышленных садов и оптимизации сортового состава в регионах с аналогичными условиями выращивания

Ключевые слова: зимостойкость; урожайность; адаптивность; яблоня; груша; устойчивость к болезням