# БИОЛОГИЯ
# BIOLOGY

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## Features of biology of the introduced apple-tree sorts in arid conditions of Mangystau

The article presents for the first time the biometrics results (tree height, leafage diameter, bole height and diameter, bine growth) of 11 sorts of 10 year old apple trees regionalized in Kazakhstan. Sorts have been introduced into the local conditions, characterized by extremely high air temperature, poor and weakly structured soil, which contains easily soluble sodium and potassium salts. The article also shows fruit-bearing age, amount of the first harvest and fruits size. It has been established that the biologically high sorts have showed significant decrease of fruit tree height, and also leafage and bole diameter (Asya, Askar, Kandil-sinap, Stolovka). For medium-height sorts the decrease of tree height, leafage and bole sizes is not as significant as for high sorts (Zolotoye prevoshodnoe, Mantet, Florina), and habit of low sorts has not changed (Zailiiskoye). Ontogenetic growth acceleration has been marked, such as earlier age of fruit-bearing (second–fourth year after planting). Fruit weight decrease has also been detected, although the difference in fruit weight between sorts has been preserved. Sorts productivity at 7 year age approximately corresponded with the productivity (at the same age) in more favorable conditions.

*Keywords:* apple tree, sorts, introduction, arid condition, salinization, adaptation, habit, productivity.

Introduction of apple-trees (Malus Mill.) in the Mangyshlak experimental botanical garden has begun since 1973, and the task of attraction of the largest number of wild-growing apple-trees (a method of patrimonial complexes) for their comparative ecological and biological studying and allocation of the steadiest species, versions and forms was originally set. High-quality apple-trees have begun to be attracted on a regular basis since 2006, and present days the collection contains 39 species and 28 sorts of an apple-tree.

Climate of Mangystau is sharply continental, with deficiency of moisture throughout all vegetative period. Average annual air temperature +9.6…+11.5 ºC; absolute minimum air temperature — 34 ºC, absolute maximum air temperature +47 ºC; average annual amount of precipitation of 107–180 mm.

Brown and gray-brown desert soils are characterized by high extent of salinization and also close bedding to a surface of strong breeds (Sarmatian limestones, etc.). Character of vegetation typically desert, with prevalence of semi-bushy Salsolla and ice-holes, in the spring — ephemeral plants and ephemeras [1].

Sharp temperature drops of air and the soil, deficiency of moisture throughout all vegetative period, the increased contents in the soil of readily soluble salts of sodium and potassium, the poor, poorly structured soil complicate an introduction of fruit plants. Special agro methods and ways of cultivation and the maintenance of introduced species have been developed for overcoming adverse factors of the environment: use of the drainage system excluding secondary salinization of the soil; having watered with norm 350–400 t/hectare of 4–6 times a month from May to September; introduction of organic fertilizers and mulching by manure and sawdust of sowing furrows and near barreled circles; on sites with a close disposed of radical breeds — to dig put deep landing holes and trenches with full replacement of soil [2].

Research objective is identification of features of biology of the introduced apple-tree grades in arid conditions of Mangystau.

*Objects and methodology*

11 sorts of an apple-tree zoned in Kazakhstan including 6 sorts of foreign selection (Zolotoye prevoshodnoe, Kandil-sinap, Mantet, Burkhardt's Rennet, Stolovka, Florina) and 5 sorts of the Kazakhstan selection (Asya, Askar, Voskhod, Zailiiskoye, Saltanat) have been chosen as objects of a research. At the beginning of April, 2010 the two-year saplings of the specified grades imparted on annual seedlings of Sivers's apple-tree have been delivered from Issyk arboretum (Almaty) nursery.

Initial condition of the soil was average-clay, low-salty, low-profile, with close bedding to the surface of Sarmatian limestones. For ensuring the best survival and growth deleted the condensed salted top layer of soil, dug out landing holes of 1.5×2.0 meters in size and 1 meter in depth, filling them with specially prepared substratum (mix of not salted sandy soil with manure and sawdust). The distance in ranks made 5 meters, in row-spacing — 3 meters. Watering was carried out to near barreled circles from 20 to 25 times for the vegetative period, the norm of watering was 45–46 l/sq.m.

Observations of growth and development of grades of an apple-tree carried out by the standard technique [3]. Biometric measurements (tree height, diameter of krone, height and diameter of a krone, a gain of sprouts) carried out in 2018 on 20 individuals of each sort, carried out mathematical processing of results by N.L. Udolskaya [4] and G.F. Lakin [5] techniques, with use of the statistical Statgraphics Centurion XV.I programs. The mass of fruits and productivity were determined in 2017 by a weight method from one average model tree.

*Results and discussion*

Broad attraction of sorts of an apple-tree has begun since 2006–2010 on the basis of experience of a successful introduction of specific apple-trees. The mathematical authentic information about a habitus of 11 introduced sorts of an apple-tree growing on the salted soils in the conditions of extreme summer air temperature (is for the first time presented in this article at artificial irrigation).

Terms of passing of phenophases at high-quality apple-trees in general correspond to fenodata of crabs from the section Eumalus Zabel. (real apple-trees) [6]. In the analysis of a collection of fruit plants high extent of variation of terms of approach of phenophases by years of observations at fruit plants of different systematic and geographical origin was repeatedly noted [7].

It is noted also that apple-trees of xeromorphic shape, including Central Asian (Sivers's apple-tree — M. sieversii (Ldb. M. Roem.) and Nedzvetsky's apple-tree — M. niedzwetzkyana Dieck.) are more adapted for local droughty conditions in comparison with mesophilic representatives of the sort Malus and were perspective for cultivation on Mangyshlak [8].

As a result of the analysis of seasonal rhythmic of growth of representatives of a collection of fruit plants it is revealed that terms of the beginning and the end of growth of sprouts are connected not only with meteoconditions of concrete year, but also with their systematic and geographical origin, for example, almonds always finished growth of sprouts earlier, than apricots and cherries. On terms of the beginning and the end of growth of sprouts 8 groups of introduced species have been allocated [7]. On this classification some sorts of an apple-tree belong to group with the early beginning of growth and late terms of its end (IS), but the most part of sorts is carried to group with average terms of the beginning of growth and late completion of growth (joint venture). It is noted also that more long growth of sprouts was observed at young plants at plentiful watering [7].

In the conditions of Mangystau the heat resistance of grades of an apple-tree and also an water-ability and water-retaining ability of leaves which were defined by us for the introduced species of an apple-tree earlier is of great importance. It has been revealed that the heat resistance of 9 species (including Sivers's apple-trees) quite high, damage of a sheet plate at Sivers's apple-tree of 6-year age began at a temperature of 53 ºC, temperature of lethal damage of the sheet 57 ºC [9]. Sivers's apple-tree was characterized by also stable water-ability and rather high water-retaining ability of leaves during the entire period of vegetation [10]. These data allow with a certain share of probability to assume rather high rates of heat resistance and an water ability of leaves at apple-tree sorts, especially at the Kazakhstani sorts created on the basis of Sivers's apple-tree.

We investigated also root system of 5 species of an apple-tree aged from one up to 4 years [11]. It is revealed that root system superficial, wide with high extent of branching. The bulk of roots are located at a depth up to 50–60 cm, in the low-salty soil horizon. The essential factor interfering growth of roots deep into of soil is salinization, i.e. increase in content of chloride and sulfate water-soluble salts, since depth of 60–80 cm. Due to the correlation of elevated and underground parts of a fruit-tree it is necessary to expect

low-tallness of an apple-tree under our conditions, as is observed in fact both as species, so sorts. For example, a sorts Asya and Askar who are characterized as high-tall [12, 13] in the conditions of the salted soil with a close location of a plate of Sarmatian limestone don't exceed 2.2 (Asya) – 2.8 (Askar) meter. In the whole high-tall sorts (on a stock of an apple-tree of Sivers) turn under our conditions into category of average-tall and undersized sorts. Average-tall sorts, in turn, are lower on height in comparison with literary data, the difference makes from 0.5 m (Florina) to 1.5 m (Zolotoye prevoshodnoe) [14, 15] while undersized grades quite match the literary descriptions, for example, Zailiiskoye's sort. At the same time it should be noted that on sites with deep bedding of rocky breeds and rather low extent of salinization of soil height of fruit-trees considerably increases (to 5–6 m), for example, Sivers's apple-tree of 30-year age reaches height of 5.5–7.0 m [16].

Thus, a specific environment of Mangystau leaves a deep mark on process of ontogenesis of introduced species that has been noted already at the very beginning of the introduction researches on Mangyshlak, in particular, at tree species the low-tall, acceleration passing of separate phases of development, reduction of durability were observed [17].

On height (growth force) in local conditions, taking into account reliability of differences between average values (Styyudent's criterion) all sorts can be divided into three groups: rather high (the I group) — Zolotoye prevoshodnoe, Mantet, Saltanat, Stolovka, Kandil-sinap (from 2.46±0.14 to 2.75±0.9 m), the maximum height — 3.3–3.7 m; averages (the II group) — Askar, Voskhod, Zailiiskoye, Burkhardt's Rennet, Florina (from 2.11±0.06 to 2.35±0.15 m), the maximum height — 3.2–2.4 meters; low (the III group) — Asya (1.75±0.11 m), the maximum height — 2.2 meters.

The low coefficient of a variation of average height is noted at sorts Zailiiskoye, Askar, Zolotoye prevoshodnoe, high — at sorts Saltanat and Florina. Scope of a variation (a difference between the minimum and maximum indicators) the biggest at Florina's sort (1.7 m), minimum — at sorts Asya, Askar (1.0 m).

On width (diameter) of krone (in the direction the North — the South and the East-West) all sorts are divided into two identical groups (by criterion of reliability of distinctions): with krone from 2.33±0.12 up to 2.92±0.10 meters (Zolotoye prevoshodnoe, Zailiiskoye, Saltanat, Askar, Mantet) and with krone from 2.11±0.06 up to 1.78±0.11 meter (the Rennet Burkhardta, Kandil-sinap, Florina, Voskhod, Asya, Stolovka). The krone sizes in the direction the East — the West is slightly more, than in the direction the North — the South honor at all sorts (for example, at a sort Zolotoye prevoshodnoe — 2.92±0.10 meters and 2.87±0.10 meters respectively) (Table 1). The exception makes a sort Kandil-sinap which has krone width among more, than in the direction of row-spacing.

Possibly, insignificant increase in width of krone in the direction the East – the West at the majority of sorts is connected with the scheme of landing (ranks are located in the direction the North – the South, distances between trees among less, than distances in row-spacing). At such sorts as Burkhardt's Rennet and Stolovka width of krone is identical in both directions. The smallest coefficient of a variation of average of sign is revealed at sorts Zolotoye prevoshodnoe and Zailiiskoye, the greatest — at sorts Asya and Kandil-sinap. Scope of a variation of sign minimum at a sort Stolovka (1.1–1.2 meters), maximum — at sorts Mantet (1.8–2.3 m) and Zolotoye prevoshodnoe (1.9–2.2 m).

On height and diameter of a shtamb all sorts are divided into three groups (on the basis of Styyudent's criterion). Sorts with the highest shtamb (the I group) — Saltanat, Florina, Zailiiskoye (from 36.90±3.28 to 49.60±7.69 cm) (Table 1). Seven sorts belong to group with the average height of a shtamb (the II group) — Stolovka, Askar, Zolotoye prevoshodnoe, Burkhardt's Rennet, Voskhod, Asya, Mantet (from 22.30±2.70 to 31.70±4.79 cm). The only sort Kandil-sinap belongs to the third group with the lowest shtamb (17.30±4.19 cm).

The lowest coefficient of a variation of average height of a shtamb is noted at sorts Zailiiskoye and Zolotoye prevoshodnoe, the highest — at a sort Kandil-sinap. Scope of a variation of sign minimum at sorts Asya and Kandil-sinap (35–36 cm), maximum — at sorts Saltanat and Askar (73–75 cm).

Sorts with the biggest average diameter of a shtamb (the I group) are Kandil-sinap, Saltanat, Mantet, Zolotoye prevoshodnoe (from 7.70±0.30 up to 8.70±0.55 cm). The maximum diameter of a shtamb is 11 cm (Kandil-sinap, Saltanat, Mantet). Average diameter of a shtamb (the II group) is noted at sorts Voskhod, Florina, Stolovka, Rennet Burkhardta, Zailiiskoye, Askar (from 6.65±0.51 up to 7.40±0.34 cm). The only sort Asya (average diameter of a shtamb of 5.25±0.48 cm) belongs to the third group. On the minimum coefficient of a variation of average values of diameter of a shtamb sorts Voskhod and Stolovka, on maximum — sorts Asya and Askar are allocated.

Table 1

**Biometric indicators of the introduced apple-tree sorts**

| Name of sort | Height (meter) | | | Wide of krone (meter) | | | | | | Size of shtamb (cm) | | | | | | Gain (cm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average | Max | Min | From north to south | | | From east to west | | | Height | | | Diameter | | | Average | Max |
| | | | | Average | Max | Min | Average | Max | Min | Average | Max | Min | Average | Max | Min | | |
| Asya | 1.75±0.11 | 2.2 | 1.2 | 1.82±0.13 | 2.6 | 1.1 | 2.04±0.18 | 3.0 | 1.0 | 27.30±4.05 | 45.0 | 10.0 | | | 2.0 | 11.20 ±2.39 | 31.30 ±6.22 |
| Askar | 2.26±0.10 | 2.7 | 1.7 | 2.36±0.15 | 3.2 | 1.7 | 2.27±0.15 | 3.1 | 1.7 | 31.60±6.86 | 82.0 | 9.0 | 6.65±0.51 | 10.0 | 5.0 | 16.20 ±3.71 | 42.45 ±6.15 |
| Voskhod | 2.23±0.13 | 3.0 | 1.6 | 1.84±0.13 | 2.6 | 1.3 | 1.82±0.14 | 2.7 | 1.2 | 29.50±5.44 | 53.0 | 1.0 | 7.40±0.34 | 9.0 | 6.0 | 12.10 ±3.83 | 26.40 ±8.36 |
| Zailiiskoye | 2.11±0.06 | 2.7 | 1.3 | 2.58±0.11 | 3.3 | 1.9 | 2.66±0.11 | 3.7 | 1.8 | 36.90±3.28 | 70.0 | 17.0 | 6.72±0.30 | 9.0 | 4.0 | 13.70 ±1.31 | 25.10 ±2.03 |
| Zolotoye prevoshodnoe | 2.75±0.09 | 3.3 | 1.9 | 2.87±0.10 | 3.7 | 1.5 | 2.92±0.10 | 3.8 | 1.9 | 30.52±2.98 | 57.5 | 2.5 | 7.70±0.30 | 9.7 | 4.5 | 9.04 ±1.19 | 20.70 ±2.81 |
| Kandil-sinap | 2.46±0.14 | 3.1 | 1.9 | 1.92±0.17 | 2.7 | 1.1 | 2.11±0.16 | 2.7 | 1.3 | 17.30±4.19 | 40.0 | 4.0 | 8.70±0.55 | 11.0 | 6.0 | 20.72 ±3.24 | 45.25 ±6.44 |
| Mantet | 2.62±0.11 | 3.3 | 1.8 | 2.33±0.12 | 3.4 | 1.6 | 2.34±0.12 | 3.6 | 1.2 | 22.30±2.70 | 51.0 | 2.0 | 8.08±0.33 | 11.0 | 5.5 | 12.70 ±1.32 | 30.80 ±2.80 |
| Burkhardt's Rennet | 2.35±0.15 | 3.1 | 1.6 | 2.11±0.14 | 2.6 | 1.3 | 2.12±0.13 | 2.7 | 1.3 | 30.50±4.66 | 56.0 | 14.0 | 6.85±0.48 | 10.0 | 5.0 | 14.42 ±2.35 | 38.40 ±4.74 |
| Saltanat | 2.62±0.17 | 3.4 | 1.9 | 2.40±0.15 | 3.5 | 1.8 | 2.41±0.16 | 3.3 | 1.8 | 49.60±7.69 | 80.0 | 5.0 | 8.15±0.52 | 11.0 | 6.0 | 14.60 ±2.35 | 34.60 ±4.81 |
| Stolovka | 2.63±0.13 | 3.2 | 2.1 | 1.78±0.11 | 2.4 | 1.3 | 1.80±0.11 | 2.5 | 1.3 | 31.70±4.79 | 49.0 | 8.0 | 6.90±0.36 | 9.0 | 5.5 | 18.50 ±3.04 | 40.60 ±5.28 |
| Florina | 2.25±0.14 | 3.0 | 1.3 | 1.88±0.10 | 2.4 | 1.1 | 2.02±0.17 | 2.8 | 1.0 | 47.35±7.43 | 83.0 | 18.0 | 7.20±0.42 | 10.0 | 5.5 | 17.70 ±1.88 | 43.05 ±3.44 |

The scope of a variation of sign, as well as variation coefficient — minimum at sorts Voskhod and Stolovka (3.0–3.5 cm), the maximum scope of a variation of sign (5.0–5.5 cm) is noted at all other sorts, except for a sort of Florina, at which scope of a variation of sign slightly lower (4.5 cm).

Also average and maximum values of a gain of sprouts for the vegetative period (Table 1) have undergone statistical processing, two groups are as a result allocated: the first group includes eight sorts with rather higher rates as average, and maximum gains, the second group includes sorts with rather low indicators of a gain.

To the first group as average, and maximum gains sorts Kandil-sinap, Stolovka, Florina, Askar, Saltanat, Burkhardt's Rennet, Mantet belong, to the second group — sorts Voskhod and Zolotoye prevoshodnoe. Two sorts (Zailiiskoye and Asya) have got into different groups: Zailiiskoye's sort in size of an average gain belongs to the first group, in size of the maximum gain — to the second group; the sort Asya, on the contrary, in size of an average gain of sprouts belongs to the second group (rather low gain), in size of the maximum gain — to the first group.

When determining average and maximum gains the highest average values are revealed at a sort Kandil-sinap (20.72±3.24 cm and 45.25±6.44 cm), the minimum average values — at a grade Zolotoye prevoshodnoe (9.04±1.19 cm and 20.70 ± 2.81 cm respectively). The coefficient of a variation was the smallest at Florina and Zailiyskoye's sorts, the highest — at sorts Asya, Askar. The minimum scope of a variation is noted at sorts Florina, Zailiiskoye, Zolotoye prevoshodnoe (from 14.3 cm to 22.9 cm on an average gain of shanks, from 34.5 cm to 39 cm on the maximum gain of sprouts). The maximum scope of a variation — at sorts Askar, Voskhod (up to 35.6 cm on an average gain and up to 77.5 cm on the maximum gain).

In general rather larger sizes of krone and a shtamb and also size of a gain characterize sorts Mantet and Saltanat. The sort Zolotoye prevoshodnoe, large by the sizes, differs in a low gain of sprouts. The low coefficient of a variation of all parameters of a habitus is characteristic of sorts Zolotoye Prevoshodnoe and Zailiiskoye.

In 2017 the first determination of productivity of the introduced grades (Table 2) has been carried out.

Table 2

**The mass of a fruit and productivity of sorts of an apple-tree for the 8th year after landing**

| Name of sort | Origin of sort | Age introduction in period fructification | Period of maturing of fruits | Mass of fruit, g | Productivity, kg/tree |
|---|---|---|---|---|---|
| Asya | Kazakhstani | 3 | Autumn | 130.6 | 12.4 |
| Askar | Kazakhstani | 4 | Autumn | 138.0 | 21.2 |
| Voskhod | Kazakhstani | 4 | Late-summer | 140.0 | 10.0 |
| Zailiiskoye | Kazakhstani | 3 | Autumn | 120.0 | 10.5 |
| Zolotoye prevoshodnoe | American | 3 | Late-summer | 70.7 | 26.2 |
| Kandil-sinap | Krym | 5 | Autumn | 98.0 | 12.0 |
| Mantet | Canadian | 3 | Early-summer | 131.6 | 19.2 |
| Burkhardt's Rennet | Krym | 3 | Early-summer | 79.7 | 17.0 |
| Saltanat | Kazakhstani | 5 | Autumn | 100.0 | 8.0 |
| Stolovka | European (Baltic) | 5 | Summer | 76.8 | 18.8 |
| Florina | French | 5 | Autumn | 92.8 | 18.0 |

Apparently from Table 2, the first fructification was observed in 2012 (i.e. for the second year after landing) at sorts Asya, Zailiiskoye, Zolotoye prevoshodnoe, Mantet, Burkhardt's Rennet. In 2013 (for the third year after landing) fructification is noted at sorts Askar and Voskhod, in 2014 (for the fourth year after landing) fructification has occurred at sorts Kandil-sinap, Saltanat, Stolovka, Florina.

We repeatedly noted early approach of age of fructification at the introduced species of an apple-tree [7, 8, 18], this regularity was confirmed also at sorts. For the second year after landing, i.e. at three-year age, sorts Asya (according to literary data the first fructification was observed in 9–10 years), Zolotoye prevoshodnoe, Burkhardt's Rennet, Zailiiskoye fructified (usually began to fructify in 5–6 years).

For the 3rd year after landing, i.e. at 4-year age, fructification of sorts Askar (in usual conditions of 7–8 years), Voskhod has begun (earlier approach of age of fructification is noted only on a dwarfish stock). On the 4th year after landing, i.e. at 5-year age, fructification is noted at sorts Kandil-sinap (usually comes in 12–15 years), Saltanat (usually in 7–8 years), Stolovka (usually in 9–10 years). And only at Florina's sort the age of the first fructification corresponded to literary data (3–5 years depending on a stock).

On the period of maturing of fruits the shift of phenophases for earlier terms is also noted that it is especially noticeable at winter and late winter sorts, i.e. sorts from winter become autumn on terms of maturing of fruits (Asya, Saltanat, Florina). Autumn sorts can become late summer (Zailiiskoye), late summer — early summer (Burkhardt's Rennet). Some from autumn (Askar, Voskhod) and summer (Kandil-sinap) sorts didn't change terms of maturing of fruits.

Decrease in mass of fruits of the introduced apple-tree sorts is also noted. The sorts having category fruits «very large» turn into lower category «large» (Asya, Askar, Voskhod) (131–140 g); from category «large» turn into category «above averages» (Zailiiskoye, Saltanat) (100–120 g) and «averages» (Florina) (92 g); from category «averages» — in category «below averages» (Zolotoye prevoshodnoe) (70 g).

The productivity in the first years of fructification in general is close to literary data, for example, the sort Asya yields a harvest of 10–15 kg per a tree, and under our conditions — 12.4 kg per a tree; the sort Kandil–sinap on a stock of M9 gives 10–16 kg per a tree, under our conditions — 12 kg per a tree. Among all introduced apple-tree sorts on productivity the sort Zolotoye prevoshodnoe — 26.2 kg per a young tree is in the lead.

The highest productivity was observed at a sort Zolotoye prevoshodnoe though on the mass of a fruit at a grade the last place. It is obvious that the size of a harvest doesn't depend on age of the introduction in fructification, the harvest of the sorts fructifying from three-year age fluctuates ranging from 10.5 kg per a tree (Zailiiskoye) to 26.2 kg from a tree (Zolotoye prevoshodnoe). At 4-year age the harvest from 10.0 (Voskhod) to 21.2 kg per a tree (Askar), in 5-year-old — from 8.0 (Saltanat) to 18.8 kg per a tree was observed (Stolovka). If to correlate a harvest with habitus, then the lowest tree, with the minimum indicators of height, diameter of krone (a sort Asya) yields a harvest above, than a sort Saltanat (with the maximum indicators of height of a tree, diameter of krone) and Voskhod (with average values of a habitus). In general, sorts with the highest productivity (Zolotoye prevoshodnoe, Askar, Mantet) have fruit-tree height from maximum to an average, diameter of krone maximum, trunk height average, diameter of a shtamb from maximum to an average, a gain of sprouts high (except Zolotoye prevoshodnoe).

The largest fruits under our conditions at a sort Voskhod (140 g), Askar (138 g) and also at sorts Asya, Mantet (131 g) and Zailiiskoye (120 g). Possibly, a sort Askar (except the most productive variety Zolotoye prevoshodnoe) is of the greatest interest on the general combination of positive characteristics (habitus, a gain of sprouts, fruit size, productivity) among other sorts.

Resistance of sorts to diseases and wreckers is of great importance. Historically in the territory of Mangystau fruit plants were grown up only on small oasis sites, were absent as well wood plantings, too arid local climate and extremely high temperatures of air interfered with distribution of a number of diseases of fruit plants. Nevertheless harmful organisms gradually got on the territory of Mangystau together with insufficiently pure landing material when active industrial development of the region has in the late sixties of the XX century begun. It is established that species and sorts of an apple-tree in the old territory of MEBG (at thickened landings) were surprised mealy dew (Podosphaera leucotricha Salm.), tree fir seed moth (Cydia pomonella), Diaspidiotus perniciosus Comst., sometimes scab (Fusicladium dendriticum) [19, 20]. In the new territory of gaden, at observance of the recommended preventive actions [20], mass defeat of grades by wreckers and diseases wasn't observed so far.

## *Conclusion*

Environment of Mangystau (the Western Kazakhstan) have a number of specific features from which dry extremely hot summer and universal salinity of the soils spread by a shell plate most considerably influence growth and development of fruit plants, including apple-trees.

Terms of passing of phenophases of high-quality apple-trees in general corresponded to phenological data of the species and kinds of an apple-tree tested within 45 years from which on rhythms of growth and development representatives of the section Eumalus Zabel are the closest (real apple-trees).

In specific local conditions change of a habitus of sorts of an apple-tree was observed. Biologically tall sorts were characterized by considerable reduction of height of a fruit-tree and also diameter of krone (Asya, Askar, Kandil-sinap, Stolovka). For average-tall sorts reduction of height of a tree, the sizes of krone isn't so big as for tall sorts (Gold excellent, Mantet, Florina), and habitus undersized sorts didn't change (Zailiyskoye).

On average and maximum values of a gain of sharps for the vegetative period of a sort are close among themselves, the gain of sharps is noted by higher at grades Kandil-sinap, Stolovka, Florina, Askar, Saltanat, the low size of a gain characterized such sorts as Voskhod and Zolotoye prevoshodnoe.

Maturing of fruits under our conditions moved for earlier terms therefore the period of maturing of fruits changed, winter and late winter grades became autumn (Asya, Saltanat, Florina), autumn — late summer (Zailiyskoye), late summer — early summer (Burkhardt's Rennet). Some autumn (Askar, Voskhod) and summer (Kandil-sinap) sorts didn't change terms of maturing of fruits.

At the introduced sorts of an apple-tree acceleration of ontogenetic development — approach of age of fructification is noted earlier (on the second — the fourth year after landing). Also reduction of mass of fruits is revealed, however inter sort quality distinctions on the mass of fruits remained. The largest fruits for sorts Voskhod, Askar, Asya are recorded (131–140 g).

The productivity of sorts for the 8th year after landing approximately corresponded to their productivity (at the same age) in more favorable conditions for cultivation. The most big crop is reaped from a sort apple-tree Zolotoye prevoshodnoe (26.2 kg per a tree).

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## Маңғыстаудың аридті жағдайындағы интродукцияланған алма сұрыптарының биологиялық ерекшеліктері

Мақалада алғаш рет Қазақстанда аудандастырылған 10 жылдық алма ағашының 11 сұрыптарының биометриясының (ағаштың биіктігі, тәж диаметрі, ағаш діңінің биіктігі және диаметрі, бұтақ өсімі) нәтижелері ұсынылған. Ауаның өте жоғары температурасы, топырақ құрылымының нашарлығы және тапшылығымен, жеңіл еритін калий және натрий тұздарымен сипатталатын сұрыптар жергілікті жағдайларға интродукцияланған. Сонымен қатар жеміс беру жасы, алғашқы өнімділіктің көлемі және жемістердің өлшемі келтірілген. Биологиялық ұзын биіктіктегі сұрыптарда жеміс ағаштарының биіктігі және де тәж диаметрі мен ағаш діңі едәуір төмендетілгені анықталды (Ася, Асқар, Кандильсинап, Столовка). Орташа биіктіктегі сұрыптар үшін ағаш биіктігі, тәж өлшемі және ағаш діңінің кішірейгені жоғары биіктіктегі сұрыптар сияқты соншалықты көп емес (Золотое превосходное, Мантет, Флорина), ал төмен биіктіктегі сұрыптардың габитусы өзгермеген. Онтогенетикалық дамудың жылдамдатылғаны — ерте жеміс беруі байқалынған (отырғызылғаннан кейін екінші–төртінші жыл). Сонымен қатар жемістердің көлемі кішірейгені анықталды, алайда жемістердің көлемі бойынша сұрыптар арасындағы айырмашылық сақталған. 7-жылдық сұрыптардың өнімділігі шамамен қолайлы жағдайда (сол жасында) өсірілген өнімдерге сәйкес келеді.

*Кілт сөздер*: алма ағаштары, сұрыптар, интродукция, аридті жағдай, сортаңдау, жерсіну, габитус, өнімділік.

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## Особенности биологии интродуцированных сортов яблони в аридных условиях Мангистау

В статье впервые представлены результаты биометрии (высота дерева, диаметр кроны, высота и диаметр штамба, прирост побегов) 11 сортов яблони 10-летнего возраста, районированных в Казахстане. Сорта интродуцированы в местные условия, характеризующиеся экстремально высокой температурой воздуха, бедностью и слабой структурированностью почвы, содержащей легко растворимые соли натрия и калия. Приведены также возраст вступления в плодоношение, величина первого урожая и размеры плодов. Установлено, что у биологически высокорослых сортов наблюдалось значительное уменьшение высоты плодового дерева, а также диаметра кроны и штамба (Ася, Аскар, Кандильсинап, Столовка). Для среднерослых сортов уменьшение высоты дерева, размеров кроны и штамба не столь велико, как для высокорослых сортов (Золотое превосходное, Мантет, Флорина), а габитус низкорослых сортов не менялся (Заилийское). Отмечено ускорение онтогенетического развития — раннее наступление возраста плодоношения (на второй-четвертый год после посадки). Выявлено также уменьшение массы плодов, однако межсортовые различия по массе плодов сохранялись. Урожайность сортов в 7-летнем возрасте приблизительно соответствовала их урожайности (в том же возрасте) в более благоприятных условиях выращивания.

*Ключевые слова*: яблоня, сорта, интродукция, аридные условия, засоление, адаптация, габитус, урожайность.

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