MEYVECİLİK ARAŞTIRMA ENSTİTÜSÜ MÜDÜRLÜĞÜ
FRUIT RESEARCH INSTITUTE

e-ISSN: 2148-8770
Yıl /Year: 2023
Cilt(Sayı)/Vol.(Issue): 10(2)
Sayfa/Page: 226-232
Araştırma Makalesi
Research Article

DOI: 10.51532/meyve.1362114

Meyve Bilimi Fruit Science

Geliş Tarihi (date of arrival): 2023-09-29
Kabul Tarihi (date of acceptance): 2023-12-06

The Effect of Different Planting Density on The Vegetative, Pomological qnd Chemical Properties of Some Sea Buckthorn (*Hippophae rhamnoides)* Varieties

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Abstract

This study was carried out in the conditions of Okenov farm, Issyk-Kul region, Cety-Oghuz district. As materials, Athena, Inya, Etna, Dwarf (male) Elizabeth (K) and False oleaster varieties developed by the Scientific Research Institute of Horticulture of Siberia were used. The varieties were evaluated in terms of yield, fruit weight, biochemical contents, morphological and phenological characteristics. At the end of the study, the data obtained from the varieties were evaluated and an economic analysis was made. As a result of the study, Athena and Inya varieties were found to be superior to the control variety in terms of yield (26%) and dry matter (24%). In the experiment, the largest fruits were detected in the Athena variety, which produced 14% larger fruits than the control variety, and the smallest fruits were determined in the Etna variety, which produced 10.2% smaller fruits than the control variety. It was determined that the Etna variety had the highest value in terms of biochemical contents such as Vitamin C, carotene and pectin compared to the other varieties included in the study. Considering all evaluations, Athena and Inya' varieties have been determined as promising varieties for this region.

Key words: Sea buckthorn, phenological observations, adaptation, yield

Farklı Dikim Sıklıklarının Yalancı İğde (*Hippophae rhamnoides*) Çeşitlerinde Vejetatif, Pomolojik ve Kimyasal Özelliklerine Etkisi

Özet

Bu çalışma, Issık-Kul bölgesi, Cety-Oğuz ilçesi, Okenov çiftliği koşullarında yürütülmüştür. Materyal olarak Siberia Bahçe Kültürleri Bilimsel Araştırma Enstitisü tarafından geliştirilen Athena, Inya, Etna, Dwarf (male), Elizabeth (K) yalancı iğde çeşitleri kullanılmıştır. Çeşitler verim, meyve ağırlığı, biyokimyasal içerikler, morfolojik ve fenolojik özellikler bakımından değerlendirilmiştir. Çalışma sonunda çeşitlere ait elde edilen veriler değerlendirilerek ekonomik analiz yapılmıştır. Çalışmada sonucunda Athena ve Inya çeşitlerinin verim (%26) ve kuru madde (%24) bakımından kontrol çeşide göre üstün bulunmuştur. Denemede en büyük meyveler kontrol çeşidine göre %14 daha iri meyve oluşturan Athena çeşidinde en küçük meyveler ise kontrol çeşidine göre %10.2 küçük meyve oluşturan Etna çeşidinde tespit edilmiştir. Etna çeşidinin çalışmada yer alan diğer çeşitlere göre C Vitamini, karoten ve pektin gibi biyokimyasal içerikler bakımından en yüksek değere sahip olduğu tespit edilmiştir. Tüm değerlendirmeler göz önüne alındığında Athena ve Inya çeşitleri bu bölge için gelecek vaat eden çeşitler olarak belirlenmiştir.

Anahtar Kelimeler: Yalancı iğde, fenolojik gözlemler, adaptasyon, verim

Giriş

Modern biochemical studies have established the uniqueness of the composition of sea buckthorn fruits. They contain a whole complex of vitamins, polyphenols, antioxidants and minerals. Wild sea buckthorn is one of the dominants of the Issyk-Kul region. It is distinguished here by significant polymorphism and stable fruiting. Moreover, massive damage to it by pathogenic organisms is observed here to an insignificant extent. In Issykul, since the end of August, harvesting of sea buckthorn has been carried out for the sale of fruits on the local market and in neighboring republics, Kazakhstan and Uzbekistan. The climate of the Issyk-Kul region, especially its coastal part, is favorable for the majority of berries. It is characterized by mildness and the absence of frost. The plantation cultivation of sea buckthorn was restrained due to the circumference of the species and, as a result, problems with harvesting. Altai varieties, especially of the latest generation, allow us to solve this problem however not completely. The recommended scheme for placing sea buckthorn plants in the garden is 4 x 2 m. However, the intensification of this crop predetermines the need to switch to denser plantings. Thus, many years of experience show that the cultivation of sea buckthorn can be considered promising when plants are placed 4 x 1.5 m a noticeable decrease in plant productivity, and the total yield per 1 ha increases by 20-30% (Khabarov, 2003; Zubarev, 2008). The technology of intensive cultivation of sea buckthorn is sufficiently well provided with technical means. However, the widespread introduction of this crop in horticulture hinders the harvest. This technological operation is carried out mainly manually. Of all the costs, mo-

re than 70% falls on the collection of fruits (Bruvelis, 2014; Haak, 2002; Höhne, 2014). There are a number of other approaches to harvesting sea buckthorn, including mechanized. We do not recommend the use of direct combining for a number of reasons, the main of which is significant damage to plants after exposure to shaking mechanisms. As a rule, after two - a maximum of three periods of such a frill, the plant begins to dry out and dies. To date, there are no varieties fully suitable for this type of harvesting. As a definite alternative to manual collection, it is possible to recommend cutting fruit-bearing branches, followed by freezing and shaking the fruits. However, here it is recommended not to cut the entire aerial part according to the type of European technologies, but only partial - no more than 10-15 percent of the total number of cobs. Selective pruning will allow, on the one hand, to control and shape the crown, and on the other hand, it will allow obtaining high-quality fruits that can be used for fresh (frozen) sales in supermarkets. This approach can significantly increase plantation efficiency (Bruvelis, 2014; Singh et al., 2008).

In Kazakhstan, in the early 2000-s, the technology of the sea buckthorn meadow garden was developed, based on fundamentally new basic directions. First of all, this affected the density of plantings, which was increased by more than 10 times (Олейченко, 2001). Then, a variant of complete mowing of the aerial parts of plants with a crop in the 3rd year after planting was tested. This allows you to minimize the cost of manual labor in this operation. The yield obtained in the experiments reached 40 tons in terms of 1 ha. The study of cut bushes showed that they fully grow in a year and form a crop of the same level as in the 3rd year, i.e. about 80 t/ha of fruits can be obtained from a plantation in five years, which ensures high economic efficiency (Олейченко, 2002).

In 2018, experimental work with the sea buckthorn meadow garden was continued in Kyrgyzstan on new generation varieties. The nutritional regime has been improved so much through the use of fundamentally new biostimulants and fertilizers. This made it possible to obtain a basic 40 t/ha under production conditions, and 1.3 times higher in experimental plantings (Oleichenko, 2021).

Climate and soils

The climate of the Issyk-Kul region is characterized by moderation, the absence of extreme temperatures, both in winter and in summer. In the area of the city of Karakol, where the meteorological station is located at 1760 m a.s.l. (Kh 'Okenov' at an altitude of 1620 m a.s.l., 60 km from Karakol), individual elements of continentality appear only in some years.

According to long-term meteorological data, the absolute minimum here is only -260C, recorded in 1954, and has never been repeated. The absolute maximum was reached in August 1984 and amounted to 350C. In the coastal zone, where the Okenov farm is directly located, the minimum and maximum temperatures are higher and lower by about 30C, respectively, and the threat of spring frosts practically reaches 0%.

The length of the growing season is 170-186 days from April to October, and the sum of active temperatures averages 25,000C. The average statistical sum of the height of precipitation is 310 mm, which indicates a certain aridity of the climate. Wind activity is moderate and accompanied by moderate evening breezes.

As shown by analytical data in the composition of the soil fractions with a diameter of more than 1-3 mm. absent, this indicates that the soil was formed on loess deposits. The distribution of various particles along the profile has a certain regularity; fractions of 0.05-0.01 mm are found in the greatest amount in the soil column, where the content varies between 36.3-41.9%. According to the content of physical clay (<0.01 mm.), the soil belongs to medium loams. There is a slight tendency towards an increase in physical clay down the profile. The soil boils from hydrochloric acid from the surface violently.

According to the content of mobile forms of nutrients, the described soil is characterized by average levels of availability. So the content of nitrate nitrogen is from medium to low level of supply, while mobile phosphorus and exchangeable potassium are of medium supply.

An analysis of the soil and climatic conditions of the experimental plot shows that they are practically an ecological optimum zone for growing sea buckthorn cultivars of the Althena selection.

Material and Methods

An experiment to study promising varieties of sea buckthorn grown using the meadow-garden technology was laid and carried out in 2021-2022 in the conditions of the Oken farm, Jety-Oguz district, Issyk-Kul region. A comprehensive assessment of the meadow-garden technology was also carried out according to a set of basic agro-economic indicators.

An experimental plantation was established in 2019 with seedlings of 4 varieties of sea buckthorn introduced from the Research Institute of Horticulture of Siberia named after. M.A. Lisavenko.

Variants of experience and objects of research.

Varieties: 1. Elizabeth (K), 2. Athena, 3. Inya, 4. Etna. The experience was laid in three repetitions, 10

accounting plants in each. Accommodation options are standard. Planting scheme 80 x 30 cm, 40 thousand plants per 1 ha. 6% of male pollinator plants are planted on the plantation.

Table 1. Chemical composition of light chestnut soils
Çizelge 1. Toprakların Kimyasal İçerikleri

Depth (cm)	Humus (%)	CO2 (%)	Mg-eq per 100 g of soil		
			NO_3	P_2O_5	K_2O
0-30	2.5	2.5	4.5	0.23	24.3
30-50	2.1	3.9	3.8	0.22	21.3
50-75	1.6	4.6	3.2	0.19	19.1
75-100	0.0	7.9	0.0	0.0	0.0

An agro-economic assessment of three technologies for growing sea buckthorn was also carried out:

1. Sea buckthorn meadow garden - Planting pattern 80 x 30 cm, 40 thousand plants/ha, 6% pollinators;

2. Traditional - 4 x 2 m, 1250 plants/ha; 3. Traditional intensive - 3 x 1 m, 3333 plants/ha.

All phenological and biometric observations related to the study of the growth, development and fruiting of sea buckthorn were carried out in accordance with the methodological recommendations of the Uman Agricultural Institute "Accounting, observations, analyzes, data processing in experiments with fruit and berry crops" (1987) and the program-method of studying varieties of fruit, berry and nut crops, Michurinsk (1973).

leaves by counting leaves from one visually average plant in each replication. then these values were multiplied.

The number of fruits and their weight were determined by counting and weighing on the scales on all 10 plants of each repetition, and the average weight was determined by weighing the average sample of 100 fruits.

Biochemical analysis of fruits was carried out in the laboratory of mass analyzes of the Kyrgyz National Agrarian University, where samples were delivered, consisting of average samples, uniformly selected in each repetition, 1 kg each. The dry matter content was determined in % refractometric, vitamin C according to Mouri, the amount of sugars according to Bertrand, pectin by the weight method, total acidity according to Ermakov (1978), carotene spectrophotometrically.

Conducted an analysis of economic efficiency and agro-economic justification of the prospects for the

Table 2. Water extracts of light chestnut soils (mg-eq % to dry soil).
Çizelge 2. Toprakların su ekstratları (mg-eq % to kuru toprak)

Depth (cm)	Dense residue	Total HCO_3	CL^{2+}	SO_4^{2-}	Ca^{2+}	Mg^{2+}
0-30	0.083	0.034	0.023	0.0004	0.0072	0.0006
		0.557	0.662	0.0080	0.3750	0.0480
30-50	0.088	0.036	0.023	0.0009	0.0075	0.0013
		0.590	0.662	0.0183	0.3750	0.0986
50-75	0.119	0.036	0.022	0.0018	0.0094	0.0012
		0.090	0.633	0.0367	0.4700	0.0986
75-100	0.110	0.052	0.025	0.0018	0.0089	0.0006
		0.852	0.720	0.0367	0.445	0.490

Observations

Phenological observations: the phase of bud break, the beginning of growth were taken into account. shoots, the beginning and mass ripening and the end of the growing season.

The following biometric indicators were taken into account: the number of productive branches, the wet and dry weight of wood and leaves by simple weighing on a control scale before and after drying in thermostats of all 10 plants in each repetition. Leaf area was calculated by determining the average area of one leaf by taking an average sample of 100 leaves in each replication and measuring their area on a millimeter palette, and the number of

introduction of sea buckthorn meadow-garden technology in Kazakhstan according to generally accepted criteria.

Experimental plot

Planting of the experimental plot was carried out in the period of April 12-14, 2019 with seedlings brought from Barnaul and stored until planting at a temperature of 00C in a refrigerator with air humidity close to 100%. Plowing was carried out on the plot in the autumn to a depth of 45 cm, and in the spring cultivation was carried out with a chisel to a depth of 35 cm. Then furrows were cut with a depth of 15 cm every 80 cm and sea buckthorn bushes were planted in their center after 30 cm.

Before planting, the roots of the seedlings were dipped in clay talker of a special composition. For its preparation, a mini-concrete mixer was used, where a bucket of clay with 30 g of Zeba water gel was poured. A water solution containing fungicide Topsin at a concentration of 1.2 g/l and a huminfolic preparation Humicv at a concentration of 4 g/l was added to the clay. The clay mass was brought to a creamy mass. Before planting, the roots of seedlings were dipped into it, which significantly increased the survival rate of plants.

Then drip lines with a diameter of 16 mm were unwound with droppers every 50 cm and a capacity of 1 l/h. In total, 25 m3 of water was poured onto 1 ha in 1 hour. After planting, post-planting irrigation was carried out at a rate of 40 m3/ha, and then, as necessary, when the soil dried out below 85% of HB.

Irrigation rates on plantations 2-3 years after planting were focused on daily water supply within 10-20 m3. The nutritional regime was based on foliar feeding and fertigation using foliar fattening and fertigation. In the spring according to the DIS, Humic 4/ha was applied, and then a soluble nitrogen-phosphorus fertilizer at a dose of 14+65+ trace elements at a dose of 40 kg/ha. In summer, three times complex fertilizer 15+5+35 + ME at a dose of 30 kg/ha. At the end of August, phosphorus-potassium fertilizers 40+60 were applied at a dose of 25 kg/ha. Foliar feeding was carried out throughout the season in order to harmonize the growth and development of plants. a mandatory element was the use of the innovative cobalt fertilizer Generate, which attracts microorganisms in the root zone. Three treatments were also carried out with chitosan fertilizer Softgardt + Alga600 (algumin type) and twice with Aminopullfortec with an interval of 15 days. At the end of the growing season in mid-September, they were treated with three microelements Zn, B and Si to increase winter hardiness.

Pest and disease control consisted of three fungicide treatments against endomycosis and fusarium, two treatments against mites with acaricides, and two treatments against sea buckthorn flies. Foliar feeding was combined with treatments for pests and diseases.

Harvesting was carried out by cutting fruit-bearing branches at a height of 30 cm from the soil, followed by a stationary separation of the fruits.

Results and Discussion

Phenological observations have established that sea buckthorn has a relatively early start of vegetation compared to other fruit crops (Table 3). An average of 26 days passed from the beginning of the growing season to the start of flowering, and another 60 days to ripening. The male form Gnome, and late control variety Elizaveta.

Flowering female forms. of the four studied varieties lasted about 7 days, the male ones reached 10, which ensured a fairly effective pollination. the entire growing season of sea buckthorn lasted 187 days and ended after an intense frost and subsequent leaf fall on October 10th.

It should also be noted the fundamental difference between the studied Altai varieties and local ecotypes. So if the local wild-growing forms of the turkestanica subspecies begin to ripen in the second half of September and stay on the plants until a steady cold snap, then the Altai varieties, which have other subspecies in their genotype, ripen in early August and, after a month of being on the branches in a mature state, begin to dry out and lose their consumer quality. Attention should be paid to this when plantation cultivation of crops is established by the establishment of physiologically justified agro terms for harvesting.

The vegetative development of plants in the third year after planting was characterized by intensive dynamics of the formation of the aerial part. The studied varieties differed in height and total growth of shoots (Table 4). In the control variety Elizaveta, the growth force determined by the indicator of the total growth was 18% lower, and the bushes were 20 cm smaller than in the Athena variety. The remaining two varieties were close in these indicators to the control variety. A similar relationship was noted when comparing the development of the leaf surface of varieties.

It is believed that the high photosynthetic activity of plantations is ensured when plants create a leaf canopy 3-4 times larger than the area of land on which they were formed. This value is reflected in the leaf index value. In the meadow garden of sea buckthorn, the leaf index was 1.7-1.9 times higher than this value, depending on the variety. The highest value of this indicator was distinguished by the varieties Elizabeth and Athena, the lowest by the variety Etna.

There were no significant differences in leaf morphology in the studied varieties. At the same time, in further studies, more advanced methods for determining the total leaf area should be tested to improve the accuracy of the experiment.

The productivity of plantations was determined by the value of two indicators, the number of fruits on plants and their average weight. The largest number of fruits was formed on the new generation cultivar Athena, which was 14% higher than the control cultivar Elizabeth (Table 5). The smallest amount characterized the most undersized variety Etna, 10.2% less than that of the control variety. In

Table 3. Phenological phases of sea buckthorn varieties
Çizelge 3. Yalancı iğde çeşitlerinin fenolojik dönemleri

Variants/cultivars	Beginning of vegetation	Flowering start	Beginning maturation	Mass maturation	End of vegetation
Elizabeth (K)	10.04	5.05	1.08	5.08	10.10
Athena	9.04	4.05	3.08	7.08	10.10
Inya	9.04	5.05	3.08	7.08	10.10
Etna	8.04	3.05	3.08	7.08	10.10
Dwarf (male)	7.04	1.5	0.0	0.0	10.10
P value	<0.05	<0.05	<0.05	<0.05	3.1

Table 4. Main biometric indicators of plants of sea buckthorn varieties
Çizelge 4. Yalancı İğde çeşitlerinin ana biyometrik göstergeleri

Variants/cultivars	Height (m)	Σ- growth (m/plant)	Number of leaves (pcs/plant)	Average S of one leaf(cm^2)	Leaf area (m^2/plant) / Leaf index
Elizabeth (K)	1.2	3.2	432	4.2	0.18 / 6.8
Athena	1.4	3.8	467	4.4	0.21 / 7.9
Inya	1.2	3.3	424	4.2	0.18 / 6.8
Etna	1.1	3.1	415	4.2	0.17 / 6.4
P value	0.05	<0.05	<0.05	0.05	0.05

Table 5. Productivity of sea buckthorn varieties
Çizelge 5. Yalancı İğde çeşitlerinin üretimi

Variants/cultivars	Number of fruits (pcs/plant)	Average fruit weight (g)	Productivity	
			g/ plant	t/ha
Elizabeth (K)	1066	0.8	852.8	32.1
Athena	1215	0.9	1093.5	41.1
Inya	1020	1	1020	37.7
Etna	957	0.8	765.6	28.8
P value	<0.05	<0.05	<0.05	<0.05

Table 6. The ratio of productivity and vegetative parts of sea buckthorn plants
Çizelge 6. Yalancı İğde çeşitlerinin verimlilik ve bitkisel kısımlarının oranı

Variants/cultivars	Yield (kg/plant)	S-leaves (m^2/plant)	Yield (kg/leaves plant)	Leaf mass (m water- %)		Mass of wood - (mw water- %)	
				Dry (g/plant)	Yield (kg/m)	Dry (g/plant)	Yield (kg/mw)
Elizabeth (K)	0.85	0.18	4.7	252-59	3.4	208-47	4
Athena	1.09	0.21	5.1	294-58	3.7	221-44	4.9
Inya	1.02	0.18	5.7	251-60	4	205-45	5
Etna	0.77	0.17	4.5	237-61	3.2	198-45	3.9
P value	0.05	0.05	0.05	<0.05	0.05	<0.05	<0.05

both cases, the differences were significant. By large-fruitedness, the Inya variety stood out, the fruits of which reached an average weight of 1 g, which is considered a very high indicator. The fruits of the Athena variety were inferior to this variety by 0.1 g and also exceeded the weight of the fruits of the control variety.

By productivity. mainly due to large-fruitedness, two varieties stood out, Athena and Inya. They surpassed the control variety Elizabeth by 28 and 17%, respectively. The variety Etna, along with weak growth, was also characterized by the lowest productivity, yielding about 10% to the control variety. It should also be noted a very high level of productivity of the Athena variety, which exceeded 40 t/ha, and Inya approached this level.

We have comprehensively considered the physiological productivity of varieties based on the ratio of the area of leaves, their weight, as well as wood to the weight of the crop formed on plants. A significant advantage of the Athena and Inya varieties for all these indicators was established (Table 6). So, on average, the yield weight per unit leaf area was 26.6% more than in the control.

The yield weight to dry weight of leaves was higher in these varieties by 24%, and to dry weight of wood by 30.8%. It should also be noted that the least productive cultivar Etna did not differ significantly in these parameters from the control cultivar Elizabeth.

Sea buckthorn is one of the richest in biochemical composition among all horticultural crops. All stu-

Table 7. Biochemical composition of sea buckthorn fruits
Çizelge 7. Yalancı İğde meyvelerinin biyokimyasal içerikleri

Variants/ cultivars	Dry matter (%)	Sugar (%)	Acids (%)	Vit C (%)	Carotene мг%	Pectin (%)
Elizabeth (K)	9	3.6	1.8	103	2.7	0.23
Athena	9.5	2.9	1.7	107	3.1	0.15
Inya	9.3	3.3	1.6	105	2.9	0.22
Etna	10.1	3.5	1.5	112	3.6	0.25
P value	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Table 8. Comparative agro-economic assessment of different technologies for growing sea buckthorn
Çizelge 8. Yalancı İğde yetiştiriciliğinde farklı teknolojilerin ekonomik değerlendirmesi

Indicators	Meadow-garden	Traditional	Traditional-intensive	Harvesting in wild plantations
Productivity for 5 years (t/ha)	85	20	30	2.5
Costs thousand ($/ha)	57.2	25	32.2	4.3
Cost price ($/kg)	0.67	1.25	1.07	1.74
Fruit cost-thousand ($/ha)	221.7	52.2	78.3	5.4
Profit thousand ($/ha)	164.6	27.2	46.1	1.1

Table 9. Cost structure for different technologies
Çizelge 9. Farklı teknolojilerin maliyet yapısı

Indicators	Meadow-garden	Traditional	Traditional-intensive	Harvesting in wild plantations
Cost- thousand ($/ha(100%)	46.7	21.5	17.6	4.3
Planting and cultivation (%)	83.9	56.5	49.3	-
Harvesting (%)	16.1	43.5	50.7	100

died varieties can be attributed to the group of especially valuable ones. They are distinguished by a rather high content of solids, from 9 to 10.1% (Table 7). Moreover, the least productive variety Etna had the highest rate. The varieties that emerged in terms of productivity also surpassed the control variety Elizabeth in this indicator. The content of sugars in fruits and their relationship with acidity determines the taste of fruits. It should be noted that the highest sugar content was characteristic of the Elizabeth and Etna varieties, while the Athena variety was inferior to the control variety by 19.5% in this indicator. His sugar-acid index was 0.3 units lower (2 versus 1.7 units). This indicates a less harmonious taste of this variety. The Athena variety was also inferior to the control variety in terms of pectin content by 35%. However, the variety that emerged from the productivity had the highest content of carotene, one of the most important indicators of biochemical value. According to the content of vitamin C, the varieties did not differ significantly from each other. Only in the Etna variety, its content was 8.7% higher than in the control.

We also evaluated the innovative technology in comparison with the currently existing and implemented in Russia, European countries and China. As noted earlier, the lack of an effective technological solution has largely hampered the prospects for a wide distribution of sea buckthorn, especially in developed countries, where the level of the minimum wage is very significant.

At the same time, the main problem that needed to be solved was the reduction of harvesting costs. With manual collection of the best varieties from the world collection, it does not exceed 20 kg per 7 hour working day. A promising solution is shock freezing of cut branches and separation of fruits by shaking. This makes it possible to raise labor productivity up to 100 kg per shift, but it is hardly economically justified with traditional cultivation methods. Sea buckthorn at a planting density of 1250 to 3300 plants/ha enters commercial fruiting justified for harvesting fruits only 4 years after planting. At the same time, crown restoration can take up to two years, and this largely hinders the introduction and attractiveness of such technologies for large-scale implementation (Tables 8, 9).

In the variant of the meadow-garden, these factors are not decisive, since the full depreciation of plantations and the receipt of significant profits are planned already for the 3rd year after planting. Cutting highly dense plantations allows you to plan a similar harvest for the 5th year after planting, which was experimentally proven by us in the course of research work carried out in the southeast of Kazakhstan. And since harvesting works make up only a small part of the costs and do not exceed 16% with almost 50% with other technologies, the advantage of the technological solution proposed by us is unambiguous.

At the same time, profitability during the five-year technological cycle increases by 3.6-6.1 times, and the cost of production decreases by 1.6-1.9 times, respectively. For comparison, we also show the

option of harvesting fruits in wild plantations practiced in China, India and Kyrgyzstan, which has no further economic prospects and causes significant environmental damage.

Conclusion

As a result of the study, the established productivity parameters of the sea buckthorn meadow garden of 40 t ha^{-1} were achieved in the third year after the plantation was planted. Promising varieties of the last wave of the Altai selection Athena and Inya with an average fruit weight of about 1 g have been identified. Calculations have been made proving a significant advantage of the meadow garden technology over existing developments.

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