

Elements of Commercial Cultivation Technology of Seabuckthorn (*Hippophae rhamnoides* L.) in Siberia, Russia

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ABSTRACT

Seabuckthorn (*Hippophae rhamnoides* L.) cultivar "Chuiskaya" is distinguished by the intensive fruiting in the central part of Altai forest-steppe. In efficiency, it surpasses the cultivar "Jivko", used for medical purposes, as it accumulates the high quantity of carotenoids. Among the different cultivars and hybrids Chuiskaya, 377-72-31, 579-73-1 are promising one for the machine harvesting. The yield was not lowered after activator's action or at the level of fruiting. "Chuiskaya" and "Jivko", 13-68-19, 722-77-1 were characterized by the least force of separation of the fruits from the branches (159-175 g). The length of a fruit stalk of the studied cultivar plants was 3.1-4.0 mm. After the application of seabuckthorn harvesting machine in 3-4 years old plantations, plants were distinguished by good growth, and high efficiency of fruiting. The result of solving the problem of machine harvesting is defined by the choice of effective estimate criteria. Thus, two ways of machine harvesting (shaking off the harvest, when seabuckthorn harvesting combine mobility and the second one, cutting of branches and stationary separation of the fruits at the following separation of a heap), showed that it was necessary to work out new method, providing the following: Early ripening of the fruit; moderate growth without singling out the main stem in a crown; heightened rigidity of branches, including increment of the vegetation; fruiting part thinned out; separation of fruits without tearing of peel, when activators act and preservation of active growth of bushes after combine harvesting.

Key words: Seabuckthorn, cultivars, spacing, nitrogen fixation and harvesting machines.

INTRODUCTION

Seabuckthorn is characterized by high potential of adaptability in the main regions of Horticulture in Russia. The variety of biologically active substances has been identified in the fruits and other parts of this plant, improving the immunity status of a human being. Besides, seabuckthorn is of great importance for soil preservation from the erosion and nitrogen fixation. Now in Russia and other countries, a variety of medicinal products from the fruits and leaves of seabuckthorn have been developed.

For the increase of the fruit production, we requires the development of technical means for the effective picking of the harvest in the plantations. We came to conclusion that the method of fruits shaking is the most promising. This method was the basis for the design of the first seabuckthorn harvesting machine. "MOY-1", developed at the Lisavenko Horticulture Institute for Siberia. But the machine could not give the necessary productivity during the harvesting of fruits. At the end of 1980s, our Institute decided to solve the problem by using mobile link technology as a base. Now a days, it is quite possible due to the development of new cultivars and hybrids by breeders of the our institute that the fruits are easily separated from the branches by these machines.

DEV ELOPMENT OF HARVESTING TECHNOLOGY

The result of solving the problem of machine harvesting is defined by the choice of some effective criteria. Thus, two ways of machine harvesting (shaking off the harvest, when seabuckthorn harvesting uses mobility and the second one, provides cutting of branches and stationary separation of the fruits at the following separation of a heap) showed that it was necessary to work out new method, using the following:

- a) Early ripening of the fruit
- b) Moderate growth, without singling out the main leader in a crown
- c) Heightened rigidity of branches, including increment of the vegetation
- d) Fruiting part should be thinned out
- e) Separation of fruits without tearing of peel, when activators act
- f) Preservation of active growth of bushes after harvesting

Technology of seabuckthorn harvesting is based on the method of preliminary cutting of branches along with fruits, which evaluates availability of the plants according to the following main criteria:

- a) Ability for active regeneration
- b) High level of productivity in a fruiting year, accounting for increment of 1 m of the branches. There must be rich biochemical composition of fruits and leaves in the young (1-2 years) branches,
- c) Availability of an old wood for obtaining medical super sorbet.
- d) Prevailing (not less than 70-75%) of fruits in a heap structure, above the mass of leaves.

Total estimate formula of development or using of cultivars and hybrids for the machine harvesting is based on a complex account of the above-mentioned criteria. The level of production, the duration of exploitation period of plantations, combining the following indices: M (availability of cultivars for machine harvesting) = M_1 (completeness of the fruit picking) + M_2 (completeness of catching fruits) + M_3 (preservation of fruits without mechanical injuries) + M_4 (degree of juice leakage) + M_5 (degree of the harvest separation from admixtures) + M_6 (yield of specimens) + I_1 (injury degree of above ground organs, when using harvesting technique) + I_2 (root system injury) + I_3 (growth force of above ground organs) + I_4 (injuries by biotic abiotic factors) + T (the duration of plantations cultivation).

Our joint observation with research worker N.V. Mikhailova showed, that the universal cultivar "Chuiskysya" is distinguished by the intensive fruiting in the central part of Altai forest-steppe. In efficiency, it surpasses the cultivar "Jivko", used for medicinal purposes, as it accumulates the high quantity of carotenoids (Table 1). Taking into account, that decline of shoot growth was not observed in experimental dense stands and the yield has been raised for the 4 years, it is necessary to carry out studies on closer spacing of seabuckthorn plantation.

Table 1. The fruit yield of seabuckthorn cultivars at different spacing (t/ha) (plantations of 1992)

Planting spacing (m)	Year				Average, 1994-1997
	1994	1995	1996	1997	
<i>Chuiskaya variety</i>					
4.0 x 1.0 (St)	6.8	26.1	16.9	24.4	18.5
4.0 x 0.8	8.8	31.1	21.1	27.9	22.2
3.5 x 1.5	6.3	21.6	15.9	20.0	15.9
3.5 x 1.0	9.1	34.6	17.7	25.7	21.7
3.5 x 0.8	10.1	39.6	18.8	31.6	25.0
3.0 x 1.5	7.5	25.9	15.4	20.6	17.3
3.0 x 1.0	8.4	39.5	19.4	33.2	25.1
3.0 x 0.8	9.0	39.0	20.1	36.4	26.2
<i>Jivko variety</i>					
4.0 x 1.0 (St)	7.0	13.6	16.0	21.6	14.5
4x0.8	9.1	14.4	15.6	25.8	16.2
3.5 x 1.5	4.6	13.5	12.5	20.3	12.7
3.5 x 1.0	7.5	13.7	18.8	24.1	16.0
3.5 x 0.8	9.4	17.1	15.4	33.2	20.0
3.0 x 1.5	5.6	13.5	12.7	26.3	14.5
3.0 x 1.0	13.8	16.0	16.8	•29.5	19.0
3.0 x 0.8	9.4	17.6	16.4	24.3	16.9

Among the different cultivars and hybrids, Chuiskaya 377-72-31, 579-73-1 is a promising one for the machine harvesting. The yield was not lowered after activators application or at the level of fruiting. Chuiskaya and Jivko, 13-68-19, 722-77-1 were characterized by the least force of separation of the fruits from the branches (159-175 g). The length of a fruit stalk of the studied cultivar plants was 3.1-4.0 mm. After the application of seabuckthorn harvesting machine twice (in 3-4 years old plantations), plants were distinguished by good growth and high yield of fruit (Table 2).

Results of 1994 have been obtained at the age of 3 years. According to the established norms, plantations are exploited only after 4 years of seabuckthorn growth at the orchard. The 377-72-3 and 722-77-1 hybrids had the least decline of productivity, the yield of which was higher for the first three years of fruiting.

We should note that experiments with fruits picking were carried out using technical means, which influenced the plants undesirably, because bark and cambium injuries were observed in the plants. From the other side, the calculations of economical efficiency of using machines for harvesting, showed full compensation of the cost of seabuckthorn harvesting machine in tow and half year.

Table 2. Structure of seabuckthorn hybrids' fruiting in 1996, after picking of fruit with the help of combine machine during the 1994-97

Varieties	For 10 cm of branch			Number of fruits in a bud	Weight of 100 fruits (g)
	buds with fruits (g)	fruits (pcs)	mass of fruits, g		
377-72-3	12.4	46.0	33.0	3.7	59.3
579-73-1	12.7	53.6	39.4	4.2	73.5
286-74-1	10.8	52.4	37.8	4.8	72.2
219-73-1	15.7	75.5	44.8	4.8	59.3

Hybrids 722-77-1, 377-72-3, 219-73-1, had a high yield after mechanical harvesting (13.2-14.5 t/ha (Table 3).

Taking into account the ability of seabuckthorn to accumulate the nitrogen in the soil, the scientific method to estimate the nitrogen-fixing ability of the cultivars and hybrids is being developed now, considering their genetic origin, age and cultivation conditions. Investigation program is based on the method of caps and intact nodules. Thus, according to information of Mikhailova and Tyuleikin, nitrogen-fixing ability is raised during the period of active growth of shoots and leaf surface of seabuckthorn plants in June-July months. First of all, young plants are characterized by high level of nitrogen accumulation, including soils with lesser nitrogen accumulation. This observation allows us to consider seabuckthorn as a medicinal crop, highly effective not only in an orchard, but as an important element of agricultural landscape of the whole agriculture. One of the variants of this activity, perennial coulisse plantations, solving the problem of snow accumulation in the snow-storm regions, improving water supply and nitrogen balance, such seabuckthorn cultivars have been selected, which ensure nitrogen fixation in the soil up to 72-120 kg/ha.

Table 3. The yield of selected forms of seabuckthorn after harvesting of fruits with the help of self propelled machine in 1994 and 1995 (t/ha) (plantations of 1992)

Varieties	Year			Average
	1994	1995	1996	
377-72-3	15.9	14.7	11.8	14.1
219-73-1	21.4	11.3	11.0	14.5
579-73-1	16.9	15.3	7.5	13.2
722-77-1	15.3	11.8	12.6	13.2

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