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The Hardiness of Sea Buckthorn Cultivars in Estonian Climatic Conditions

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ABSTRACT

Research on sea buckthorn cultivars in Estonia started in 1973. In 40 years, 52 cultivars have been introduced from Russia (mainly from Barnaul, Moscow and Nizhni-Novgorod), Belarus, Germany and Finland. At present, the list of cultivars recommended for growing in Estonia includes the cultivars `Avgustinka`, `Botanitcheskaya`, `Botanitcheskaya lyubitelskaya`, `Otradnaya` and `Trophimovskaya`. There are 856 ha of sea buckthorn plantations in Estonia.

Estonian winters are characterized by periods of very cold weather followed by days with above-freezing temperatures. This fluctuation leads to winter damage in sea buckthorn. Sea buckthorn buds and bark on the trunk and larger branches are most exposed to winter damage. Harvesting sea buckthorn berries by cutting of branches weakens shrubs and is conducive to winter damage. The state of the shrubs was evaluated in mid-July on a scale from 1 to 9.

Key words: Sea buckthorn, cultivars, adaptation

INTRODUCTION

In Estonia, the first trials with sea buckthorn (*Hippophaë rhamnoides* L.) were carried out in the middle of the 20th century with the goal of revegetation of alvars and sandy areas. Research on sea buckthorn cultivars was started in 1973. In 40 years, 52 cultivars from Russia (Barnaul, Moscow, Nizhni-Novgorod), Belarus, Finland and Germany were introduced in Estonia. Many sea buckthorn cultivars do not adapt to the climatic conditions in Estonia, where the vegetative period lasts 150 to 180 days and winters are characterized by intermittent frosts and thaws, which is conducive to winter damage on sea buckthorn shrubs. Larger orchards in Estonia have adopted a harvesting technology whereby fruit-bearing branches are cut off and frozen at -20 ºC to separate the berries. Using this harvesting technology removes a large share of foliage, which interferes with the ability of shrubs to prepare for the winter. Buds are the parts of sea buckthorn plants that are the most sensitive to winter damage, followed by the bark on the trunk and larger branches.

The aim of this paper is to evaluate winter hardiness of different sea buckthorn cultivars based on the state of the shrubs and to ascertain cultivars best suited for commercial orchards.

MATERIALS AND METHODS

Sea buckthorn cultivar comparison trials were started at Rõhu Experimental Station by planting 14 cultivars with 21 shrubs each in 1988 and seven German and Russian cultivars with 15 shrubs each in 2005.

At 26 years of age, the surviving of shrubs was counted; the state of the shrubs was evaluated on a 9-point scale and the circumference of the trunks of the larger shrubs was measured.

In Polli, a collection of sea buckthorn cultivars was planted in 2005, with 2 to 5 shrubs per cultivar. In the winter of 2012, winter damage to the shrubs was evaluated on a 9-point scale, where 1 stood for an undamaged shrub and 9 for a dried shrub. In the fall of 2014, when the shrubs in the orchard were 10 years old, the state of the shrubs was evaluated again on a 9-point scale; in an older, 15-year-old orchard (planted in 2000), the number of surviving shrubs was counted and the state of the surviving shrubs was evaluated. The research team also visited six sea buckthorn growers in Estonia, of which five were in Southern and one in Northern Estonia. The area of the plantations ranged mostly from 0.1 to 3 hectares, with the largest being 20 hectares.

The state of shrubs and the extent of damage were evaluated on a 9-point scale as follows:

1 – the shrub has dried;

2 – the crown has dried, a few shoots on the trunk or thicker branches growing from dormant buds;

3 – bigger branches have a limited number of one-year shoots;

4 – half of the crown has dried, the shrub has many one-year shoots;

5 – the state of the shrub is satisfactory; 1- to 3-year-old branches that have dried are being replaced by young shoots;

6 – a large part of one-year shoots have dried; young shoots are short; yield is low;

7 – the state of the shrub is good; young shoots are 20 cm long; yield is satisfactory;

8 – the state of the shrub is good; young shoots are 20 to 30 cm long; yield is satisfactory;

9 – the state of the tree is very good; young shoots are over 30 cm long; yield is good.

The results were converted for dispersion analysis using √X+½ and the results were evaluated using the Duncan test.

RESULTS AND DISCUSSION

Sea buckthorn is an introduced species in Estonia. Sea buckthorn has a characteristically short rest period. In Central Russia (Moscow), buds finish their rest period already in November, and in favorable temperatures the water starts to be absorbed into cell proteins. Long thaw periods in mid-winter reduce the winter hardiness of the generative parts of buds. The generative buds of male plants are particularly sensitive.

In the collection of sea buckthorn cultivars in Polli, winter damage occurred on 8-year-old shrubs in spring 2012. The extent of damage was varied by cultivar. Cultivars 'Tarmo', 'Otradnaya', 'Gibrid Perchika', 'Botanicheskaya aromatnaya' suffered extensive damage that destroyed over ½ of the crown. Other cultivars lost a part of 1- to 3-year old branches, which led to crop failure.

In 2014, the state of shrubs was evaluated in different experimental and commercial plantations (Table 1). The state of shrubs depended on the adaptive capacity of cultivars. Cultivars that are not characterized by slowdown in the growth of shoots and keep their leaves on until permanent cold weather in December are not winter resistant in Estonia. On the other hand, the shrubs of cultivars 'Vorobyevskaya', 'Botanicheskaya', 'Botanicheskaya aromatnaya', 'Botanicheskaya lyubitelskaya', 'Avgustinka', and 'Trophimovskaya' were in good condition both in commercial orchards and in the 26-year-old experimental orchard at Rõhu. These cultivars originate from the Botanical Garden of Moscow State University where they were obtained by free pollination between specimens of the Baltic and Siberian races of sea buckthorn.

The condition of the shrubs was worse in the 10-year-old plantation where berries had been harvested by cutting off the fruit-bearing branches but the shrubs of cultivars 'Botanicheskaya lyubitelskaya', 'Botanicheskaya aromatnaya', 'Botanicheskaya', and 'Tytti' had fared somewhat better than others.

In the experimental orchard planted in 2000, which was first used for studying the effect of fertilizing on shrub growth and later for comparing harvesting technologies, 44% of the 98 shrubs of the cultivar 'Botanicheskaya' had survived and the average state was 7.3. The cultivar 'Prozrachnaya' had survived 67% of shrubs of with the average state 8.1. Harvesting technology used in this orchard – removing fruit-bearing branches with a considerable part of foliage – weakened the shrubs and led to losing many shrubs due to winter damage.

The comparison trial of German and Russian sea buckthorn cultivars established in 2005 revealed a difference in their adaptive capacity in the Estonian climatic conditions. The shrubs that fared relatively well were of cultivars 'Botanicheskaya' (9.0), 'Otradnaya' (8.5), and 'Leikora' (8.0).

The shrubs of cultivars 'Hergo' (6.8), 'Askola' (6.7), 'Botanicheskaya lyubitelskaya' (6.3), 'Gibrid Perchika' (6.1), and 'Podarok sadu' (5.8) fared satisfactorily. The shrubs of cultivars 'Sirola', 'Frugana', 'Habego', and 'Hergo' did not fare well (3.2 to 5.0). The shrubs of cultivars 'Dar Katuni', 'Grodenskaya', 'Maria', and 'Mendelyevskaya' were destroyed in the 10-year-old orchard. The shrubs had suffered serious damage; their crowns were destroyed. There were a few shoots on the trunks of some shrubs but some shrubs had been lost in case of cultivars 'Nivelena', 'Pantelyevskaya', 'Plamennaya', 'Zolotaya rannaya', and 'Tarmo'.

CONCLUSIONS

Our research indicates that cultivars bred in the Botanical Garden of Moscow State University – 'Vorobyevskaya', 'Botanicheskaya', 'Botanicheskaya aromatnaya', 'Botanicheskaya lyubitelskaya', 'Avgustinka', and 'Trophimovskaya' – are better suited for larger commerical orchards. We conclude that the harvesting technology whereby fruit-bearing branches are cut off from shrubs along with a large share of foliage reduces the winter resistance of shrubs.

Breeding new winter hardy cultivars is important in the Baltic countries, as introducing cultivars from continental Siberia and Western Europe has not been promising.

Table 1. State of sea buckthorn shrubs in 2014 and the extent of winter damage in 2012.

Cultivar	*State of shrubs in Polli, winter damage*		*Rõhu Experimental Station, 2014*		*Commercial orchards, 2014*
	2012 (1 to 9)	*2014 (1 to 9)*	*Surviving shrubs, %*	*State of shrub (1 to 9)*	*State of shrub (1 to 9)*
Botanicheskaya	2.3 a	4.8 a	28	8.3 a	8,2 a
Botanicheskaya lyubitelskaya	2.0 a	5.5 a	5	8.0 a	8,1 a
Botanicheskaya aromatnaya	5.5 c	5.0 a	19	8.7 a	8,0 a
Avgustinka	4.7 bc	3.5 b	5	7.0 b	8,1 a
Otradnaya	6.5 c	3.5 b	33	8.6 a	8,0 a
Gibrid Perchika	6.5 c	3.0 b	38	8.7 a	5,9 b
Trophimovskaya	3.0 ab	3.0 b	19	8.7 a	8,0 a
Vorobyevskaya	2.0 a	4.0 b	38	8.7 a	8,3 a
Podarok sadu	4.0 bc	4.0 b	48	7.0 b	4,3 b
Terhi	3.7 ab	3.0 b	-	-	-
Tarmo	7.3 c	2.5 c	-	-	-
Tytti	1.7 a	4.5 a	-	-	-
Nivelena	5.0 bc	2.0 c	-	-	-
Zolotaya rannaya	3.7 ab	2.0 c	-	-	-
Plamennaya	2.3 a	2.0 c	-	-	-

Different letters per column indicate a significant difference.

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