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INTRODUCTION AND PERSPECTIVES OF GROWING VARIETIES OF HIGHBUSH BLUEBERRY (VACCINIUM SORYMBOSUM L.) IN THE RIGHT-BANK FOREST-STEPPE OF UKRAINE

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The issues of introduction and spreading of new and promising varieties of Higbush blueberry (Vaccinium corymbosum L.), their state, prospects and economic value are discussed in the article. The results of studying the specific features of adventitious rhizogenesis of the green stem cuttings in the agroecological conditions of the Right-Bank Forest-Steppe of Ukraine are given. It is found that the green stem cuttings of the studied varieties of Highbush blueberry have a low regenerative capacity, the rate of which depends on variety, terms of storing and planting of the cuttings for rooting, type of a shoot and its metamerism.

Highbush blueberry – a valuable high vitamin fruit plant that has nutritional and medicinal value. The plants of the genus *Vaccinium L*. could be found only in botanical gardens, some research institutions and amateur gardening. Lately has been studied the biological characteristics, obtained and propagated valuable varieties.

The value of highbush blueberry is caused by its high content of sugars in their fruits to 8%, organic acids 2.7%, pectin 0.6%, 1% protein, 1.6% fiber, vitamin C 63 mg%, B1 0.02 mg%, 550 mg%, PP, carotene 0.25 mg% and phenolic compounds. The sugar and acids in combination with pectin and tannic matters are causing the taste of berries. On average, 100 g of fresh berries contains 150-300 mg of chlorogenic acid and 300-340 mg of triterpene acids, phylloquinone (vitamin K1) – 0,26-0,32 mg, betanin from 210 to 510 mg. The berries contain the macronutrients such as: sodium to 6, potassium 51, calcium 16, magnesium 7, phosphorus 8 mg%, and micronutrients – iron to 17 mg%, and small amounts of cobalt, iodine, copper, vanadium, and others. In seeds piled up to 32% of oil, in the leaves is more than 10% of tannin [2, 4, 7, 8].

The production by seedbeds of Ukraine of the planting material of highbush blueberry varieties does not satisfy the needs of horticultural farms, farmers and amateur gardeners. One of the main reasons is the fact that the existing methods of its propagation do not always ensure the stability of the results and they are quite time-consuming, thus they are not widely spread [1].

The improvement of planting assortment of highbush blueberry associated with the necessity of deepening information on existing and new varieties; among them a leading position occupied by introduced varieties and breeding patterns. It is important to assess not only the productive potential of plants, the quality of pomology and fruit characteristics, but also their regenerative capacity as a display of component adaptability and economic values [4, 5, 7].

The goal of research was to study the regenerative capacity of perspective varieties of highbush blueberry and development of specific measures and methods for their reproduction from stem graftage technology in Right-Bank Forest-Steppe of Ukraine. In the process was envisioned to perform the following tasks: to evaluate the regenerative capacity of stem stalks depending on the biological characteristics of the variety, to establish the optimal terms of harvesting and planting stalks for their rooting, to determine the impact of metamernost of cutting material and physiologically active substances in the processes of adventitious root formation in stalks.

Research methodology. It was studied the perspective highbush blueberry varieties for the conditions of Right-Bank Forest-Steppe of Ukraine – Blyukrop (*Bluecrop*), Blyugold (*Bluegold*), Duke (*Duke*), Darrow (*Darroy*), Elliot (*Elliot*), Spartan (*Spartan*), Toro (*Toro*) [7]. The experiments were carried out in nurseries of Uman National University of Horticulture, National park "Sofiivka" NAS of Ukraine and company "Brusvyana".

For rooting the stalks were used the glass greenhouses with fractional moisture. The substrate was a mixture of peat (pH 5.2) with clean river sand in the ratio of 4:1. The air temperature in the environment of graftage was 28-30, the substrate – 18-22^{0}C. The relative humidity was between 80-90%, and the intensity of optical radiation – 200-250 Dzh/m^2.sek.

The starting material for graftage were two-year, three-year and four-year uterine plants. In each variant of the experiment were using the stalks that harvested from the apical, medial and basal parts of shoots with one, two, three and four-node with length of 10-15 cm and the rooting was performed by traditional technologies [6]. The observations on the passaging of root formation processes were carried out every 5 days. The repetition of experiment was four-time, in each repetition was 25 stalks. Considering the beginning and mass formation of root, the development of aerial parts and root growth, accounting of rooting was conducted at the end of the growing season, with a determined percentage of rooted stalks, number of roots and length of roots and size of aerial parts of rooted plants. Statistical processing of data was performed by multivariate variance analysis [3], using the computer programs.

The results of research. The results of research indicate that the most effective way of highbush blueberry varieties breeding are green stem graftage – half tree stalks with leaves, regenerative ability of which is specific variety feature. The study of morphogenesis of adventitious roots of stem graftage showed that the regenerative ability depends on the type, duration of shoots provision and planting them on root, type of stalks and its metamernost (Table 1).

According to the research, output indicators of rooted green stem stalks of highbush blueberry studied varieties due to propagation by graftage in the first period ranged from 3.3 to 35.4% depending on which part of the shoot they were harvested, and during graftage on 1-10th of July – from 3,2% to 34.2% and from 1.0 to 4.7% during graftage on 1-10th of August. The greatest rooting was observed in the first period (1-10 June) of the stalks of variety Darrow (35.4%), Blyukrop (34.4%) and Blyuhold (25.3%), harvested from the basal part of three knots shoots. The stalks of varieties Toro, Spartan and Duke take root weaker, respectively 16.9, 18.7, 22.5%. The stalks of variety Elliot took root weakest – 6.6%.

1. Rooting of three-nodal green stem stalks of highbush blueberry varieties depending on the timing of graftage and part of sprout (average for 2010-2012), %

Variety	Part of sprout	June			July			August
		1–10	10–20	20–30	1–10	10–20	20–30	1–10
Blyuhold	A	7,5	7,2	6,1	5,1	4,7	3,2	1,5
	M	13,8	13,6	12,2	9,1	9,1	6,8	1,9
	B	25,3	22,6	21,1	16,6	13,1	9,2	3,1
Blyukrop	A	11,9	11,7	11,7	10,1	10,1	8,4,4	1,6
	M	16,8	16,2	16,2	13,4	12,5	11,4	2,4
	B	34,4	32,1	31,5	25,1	21,7	15,1	3,5
Duke	A	10,2	10,1	10,0	8,7	8,5	7,6	1,4
	M	14,7	14,5	14,5	14,1	13,5	11,2	2,7
	B	22,5	22,4	21,4	21,2	19,5	16,3	3,0
Darrow	A	12,9	12,4	12,2	11,9	11,7	11,5	2,2
	M	18,9	18,7	18,6	18,2	17,1	16,8	3,4
	B	35,4	35,1	34,6	34,2	25,8	17,5	4,7
Elliot	A	3,3	3,2	3,2	3,2	3,2	2,7	1,0
	M	4,9	4,6	4,6	4,1	4,0	3,6	1,5
	B	6,6	6,5	6,5	5,4	5,1	4,7	1,4
Spartan	A	6,3	6,1	6,1	5,8	5,6	5,4	1,6
	M	12,6	12,5	12,5	12,1	11,3	10,8	2,1
	B	18,7	18,7	18,2	18,0	15,8	2,6	3,2
Toro	A	5,6	5,6	5,5	4,8	4,4	4,0	1,6
	M	10,1	9,3	9,1	8,8	8,3	8,1	2,0
	B	16,9	16,6	16,3	16,0	11,6	8,1	3,1
SSD_{05}		*1,2*	*1,4*	*1,2*	*0,9*	*1,1*	*0,6*	*0,2*

Note: A – stalks harvested from the apical part of the shoot, M – medial B – basal.

The output of rooted stalks from the medial part of the sprouts of the varieties Duke and Blyukrop was 14.7 and 16.8%, and Blyuhold and Darrow – 13.8 and 18.9%, Toro and Spartan – 10,1-12,6% and Elliot – 4.9%. The percentage of taken root of the stalks from the apical part of sprout was ranged on average from 3.3 to 12.9% depending on the varietal characteristics.

Depending on the above mentioned results of rooting green stem stalks of highbush blueberry varieties were conventionally divided into three groups: easily rooting (Blyukrop, Darrow), mildly rooting – (Blyuhold, Duke, Toro and Spartan) and weakly rooting – Elliot. According to the early terms of graftage (20-30 May) all

stalks were herbaceous and were proved unsuitable for implantation under conditions of finely dispersed humectation. It is found that the high regenerative ability is manifested in the stalks that were harvested from the basal part of the stem, lower – from the medial part and the lowest – from apical.

The number of nodes in the green stem stalks of highbush blueberry varieties defines their regenerative ability (Table 2 on the example of the variety Blyukrop). The reducing of their number lower three was accompanied by a significant reduction of all parameters of rhizogenesis. Rooting of one-node stalks (the control variant of the experiment) of variety Blyukrop, harvested from the apical part of the stem, averaged over three years, 1.6%, medial – 2.3%, basal – 5.4%. Rooting of two-node stalks that were harvested from the basal part of the stem was 12.3% that on 7.8% more than rooting of similar stalks from the medial part of the stem, and on 9.7% than two-node apical stalks. The significant advantage of rooting was founded three node stalks, independent from the part of the stem from which they were harvested. Rooting of three-node stalks from the basal part of the stem, depending on the variety was in average 22.8%, which is on 22.1% more than two-node and on 29.0% more than similar one-node.

Rooting of three-node styalks from the medial part of the stem are significantly different from one-node and of two-node, respectively, 12.3% and 14.5%. The percentage of rooting stalks of three-node basal variety Blyukrop was 34.4%, of two-node 12.3%, and one-node only 5.4%.

When the number of nodes increases to four in the green stems stalks the regenerative ability is decreased. Thus, the percentage of rooting four-node stalks of Blyukrop variety that harvested from the apical part of the stem was 6.4, medial – 8.1 and basal – 19.2%. Thus, for the graftage of highbush blueberry varieties is optimal the three-node green stem stalks that harvested from the basal part of the stem.

The number and length of roots in the stalks are significantly dependent on the type of stalk and its metadimension (Table 2). Per one stalk the total number of roots of first and second orders of branching in one-node stalks that harvested from the basal part in the phase of intensive growth of stems was 14.2 units and in two-node basal stalks, this index was much higher and amounted up to 25.8 units. The greatest number of roots of first and second orders of branching (41.3 units) are observed in three-node stalks.

Analyzing the growth of the adventive roots in heterogeneous apical and medial stalks should be noted that the significant advantage for this index had also the three-node stalks. In the variant of experiment where the four-node stalks were used from the different parts of the stem, the total length of the adventive roots was significantly lower compared with three-node stalks and was 33.7 in the apical, medial – 54.2 and basal, respectively – 93.1 cm. The intensity of roots regeneration, the number of roots of the first and second orders of branching, their combined length and height of the growth of three-node stalks, dominated the similar indexes in 2-3 times compared with one-node and two-node.

On the green stem stalks the roots form on the basal part and the zone of their formation in the substrate has a well-defined morphological boundaries – 1.0-1.5 cm. The morphogenesis of adventive roots in stalks involves the endogenous phase

consisting of callus genesis and rhizogenesis and exogenous phase with the phases of the roots formation of the first and subsequent orders of branching.

2. The regenerative ability of highbush blueberry green stem stalks of the variety Blyukrop depending on metadimension of stem

(graftage 1-10.VI, the average for 2010-2012)

The part of stem	Rooting, %	Number of roots on the stalk, units	Length of roots on the stalk, cm	Length of the growth, cm
One-node stalks				
Apical	1,6	3,1	9,2	0
Medial	2,3	6,2	18,5	0
Basal	5,4	14,2	38,6	0
SSD_{05}	*0,8*	*1,2*	*3,4*	*0*
Two-node stalks				
Apical	2,6	7,2	21,6	0
Medial	4,5	13,7	39,9	0
Basal	12,3	25,8	67,4	0
SSD_{05}	*1,8*	*2,2*	*3,7*	*0*
Three-node stalks				
Apical	11,9	18,6	54,8	1,4
Medial	16,8	30,1	81,3	8,6
Basal	34,4	41,3	121,5	15,9
SSD_{05}	*3,2*	*3,4*	*4,1*	*1,1*
Four-node stalks				
Apical	6,4	11,5	33,7	1,7
Medial	8,1	20,1	54,2	10,2
Basal	19,2	32,5	93,1	16,5
SSD_{05}	*2,7*	*2,1*	*3,7*	*2,7*

Near the definition of optimal part and the output of stalks from one stem, from which the stalks could be harvested, were set their specific morphological boundaries and dimensions. With the length of stalks 5-10 cm and 15-20 cm of all investigated varieties was observed the significant decrease of their rooting regardless of the part of stem from which they were harvested. The optimal length of stalk of highbush blueberry experimental varieties is 10-15 cm, harvested from the basal part of the stem.

The growth of vegetative and vegetative-generative stems in uterine plants lasting throughout the growing season with an activation of growing processes during the third decade of May to the first decade of July. The most intensive growth of

stems of Blyukrop Duke, Darrow and Spartan varieties in decade were averaged 16,3 ± 3,1 cm. During this period the stalks showed the high ability for rooting. Thus, in determining the optimal terms for breeding varieties of highbush blueberry by medium-stiffened stalks, we should be oriented on the period of the most intensive growth of vegetative stems – 1.VI-15.VII (depending on the soil and climatic conditions of the year).

Conclusions. The success of highbush blueberry (*Vaccinium corymbosum L.*) introduction in Ukraine and the perspectives of its implementation into the culture are largely dependent on the choice of the optimal ways of reproduction. For saving the agronomic-valuable characteristics and varietal properties of highbush blueberry, it is necessary to use breeding by green stem stalks, which will allow to accelerate the breeding of stalks, to increase the output of high quality planting material, to save the genetic homogeneity of varieties-clones, to accelerate the introduction of new and perspective varieties into production, to reduce the time of their entry in fruiting. The degree of rooting of green stem stalks of highbush blueberry varieties are divided into the three groups: easily rooting (Blyukrop, Darrow), middle rooting – (Blyuhold, Duke, Toro and Spartan) and weakly rooting – Elliot. All these features should be considered in the further improvement of technology of growing rooted planting material of highbush blueberry varieties from the stem stalks.

REFERENCES

1. Балабак А.Ф. Кореневласне розмноження малопоширених плодових і ягідних культур / А.Ф. Балабак // Монографія. — Умань: ОП, 2003. — 109с.
2. Буткус В.Ф. Биологическая и биохимическая характеристика голубики высокорослой. Морфологические особенности сортов / В.Ф. Буткус, З.П., Буткене // Тр. АН Лит. ССР.: Сер. В. — 1987. — Т. 2 (98). — С. 28–36.
3. Доспехов Б.А. Методика полевого опыта / Б.А. Доспехов. — М.: Колос, 1985. — 351с.
4. Курлович Т.В. Голубика высокорослая в Беларуси / Т.В. Курлович, В.Н. Босак. — Минск: Беларуская навука, 1998. — 176 с.
5. Павловский, Н. Б. Методы вегетативного размножения голубики высокой (Vaccinium corymbosum L.) / Н. Б. Павловский // Плодоводство: научные труды / Национальная академия наук Беларуси, РУП "Институт плодоводства". — Самохваловичи, 2010. — Т. 22. — С. 328–340.
6. Тарасенко М.Т. Зеленое черенкование садовых и лесных культур / М.Т. Тарасенко. — М.: Изд-во МСХА, 1991. — 270 с.
7. Pliszka K. Borówka wysoka / K.Pliszka // Praca zbiorowa pod red. PWRiL — Warszawa, 2002 — 154 p.
8. Smolarz K. Uprawa borówki i żurawiny / K. Smolarz. — Warszawa: Hortpress Sp. z o.o., 2003. — 89 p.

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Интродукция и перспективы выращивания сортов голубики высокорослой (Vaccinium corymbosum L.) в Правобережной Лесостепи Украины

Обсуждаются вопросы распространения новых и перспективных сортов голубики высокорослой (Vaccinium corymbosum L.), состояние и перспетивы культуры, хозяйственное значение. Приведены результаты изучения специфики адвентивного ризогенеза у зеленых стеблевых черенков у агроекологических условиях Правобережной Лесостепи Украины. Установлено, что зеленые стеблевые черенки исследуемых сортов голубики высокорослой имеют низкую регенерационную способность, а ее уровень зависит от сорта, сроков заготовки и высадки черенков на укоренение, типа побега и его метамерности.

Успех интродукции голубики высокорослой в Украину и перспективы ее внедрения в культуру значительно зависит от подбора оптимальных способов размножения. Для сохранения хозяйственно-ценных признаков и сортовых особенностей голубики высокорослой необходимо использовать способы размножения зелеными стеблевыми черенками в период активного роста побегов, что даст возможность ускорить выращивание саженцев, увеличить выход посадочного материала высокого качества, сохранить генетическую однородность сортов–клонов, ускорить внедрение новых и перспективных сортов в производство, сократить час вступления их в плодоношение с улучшением качества продукции.

Степень укореняемости зеленых стеблевых черенков исследуемых сортов голубики высокорослой разделено на три группы: легкоукореняемые — Блюкроп и Дарроу, среднеукореняемые — Блюгольд, Дюк, Торо, Спартан и слабоукореняемые — Элиот. Количество междоузлий или узлов у зеленых стеблевых черенков определяет их регенерационную способность, уменьшение их количества ниже трех сопровождается достоверным снижением всех показателей ризогенеза. Установлено, что самая высокая регенерационная способность проявляется у черенков из базальной части побега, более низкая — у черенков из медиальной части, а самая низкая — у апикальных черенков. Количество укорененных трехузловых базальных черенков, на примере сорта Блюкроп составило 34,4, двохузловых — 12,3, а одноузловых всего 5,4%.

Количество и длина корневой системы также достоверно зависели от типа черенка и его метамерности. Скорость регенерации придаточных корней, их количество и суммарная длина превышали аналогичные показатели у 2–3 раза по сравнению с одноузловыми и двохузловыми черенками

Все это необходимо учитывать при дальнейшем усовершенствовании технологических аспектов выращивания корнесобственного посадочного материала интродуцированных сортов голубики высокорослой из стеблевых черенков.

Ключевые слова: *голубика высокорослая, сорта, маточные растения, стеблевые черенки.*

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Success of introduction of Highbush blueberry in Ukraine and perspectives of its cultivation depends considerably on the selection of optimal ways of propagation. To maintain economic value and variety peculiarities of Highbush blueberry it is necessary to use the way of propagation by stem stalks during active growth of shoots. This enables to accelerate the propagation of nurslings, to increase planting material yield of high quality, to preserve genetic homogeneity of clone varieties, to enhance introduction of new and promising varieties in production, to reduce the period of their coming into fruit-bearing together with the improvement of product quality.

The levels of rooting ability of softwood stem stalks of studied varieties of Highbush blueberry are divided into three groups: Bluecrop and Darrow root easily, Blue Gold, Duke, Toro, Spartan have medium rooting capacity, and Elliott shows weak rooting. The number of internodes and nodes of stem stalks determines their regenerative capacity. The reduction of their number to less than three is attended by the reduction of all indicators of rhizogenesis. It is found that stalks from basal part of shoot show the highest regenerative capacity, stalks from the middle part show lower capacity and apical stalks show the lowest regenerative capacity. The number of rooted three-node basal cuttings in the example with variety Bluecrop amounted to 34,4, two-node – to 12,3, and one-node – only to 5,4%.

The number and the length of root system also depended on the type of stalk and its metamerism. The regeneration rate of adventitious roots, their number and total length exceeded analogous indicators by 2 — 3 times in comparison with one-node and two-node stalks.

All this should be taken into account in further improvement of technological aspects of growing own-rooted planting material of introduced varieties of Highbush blueberry from stem stalks.

Key words: *Highbush blueberry, varieties, parent plant, stem stalks.*