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VEGETATIVE REPRODUCTION OF *VIBURNUM* L. GENUS SPECIES BY STEM CUTTINGS

Demchenko O.O.,

Demchenko S. K.

National University of Life and Environmental Sciences of Ukraine

Methods of vegetative reproduction of species of Viburnum L. *by stem cuttings were analyzed. Vegetative reproduction of species was made by rooting green and arboreal cuttings. Different terms, substrates and stimulators were tested. It was founded, that the most effective for Viburnum is green grafting.*

Vegetative reproduction, viburnum, substrates, stem, cutting

Study of reproduction is necessary for the introduction of plant. The extent and perspectives of the practical use of exotic species are largely determined by their reproductive capacity and selection of the best ways of reproduction.

Vegetative propagation method has advantages over seed method, which is the reduction of terms of growing of planting stock, speed the transition to the generative stage of development, ensuring transmission to the descendants of all agronomic traits. This way of reproduction gives an opportunity to get a reproduction out of introducents, which are not fruiting or do not form complete seeds in new conditions for existence.

Among different ways of vegetative reproduction important place has the reproduction by engraftments. This theory was developed yet in 1878 by Herman Vehting. He proved than each branch, which was separated from the mother - plant can create buds on the morphologically upper end and roots on the lower end [8]. For viburnums the vegetative reproduction has a great significance. For cultivars this is the only way of reproduction, which gives an opportunity to save the individual

characteristics of plants. Viburnums propagated by cuttings, jigging, grafting, root sprouts and dividing of the bush.

Information concerning about the vegetative reproduction of the viburnums we may meet in works of Z. I. Ivanova [8, 9], D. A. Komissarov [12], M. T. Tarasenko [17], R. H. Turetska [18, 19], I. R Kisilevsky [11], O.V. Bilik [3, 4], V. K. Balabushka [1, 2], E. D. Soloduhin [16], B. S. Ermakov [7], M. L. Reva [14], O.V. Negoda [13], M. V. Andrienko [15]. We should mention, that overwhelming parry of the works about Viburnum opulus L. and its cultivars, and there is no information in general about most number of introducents.

Number of species of Viburnum has a high level of the root forming and they can be reproduced by the green engraftments with the great effect [17]. According to B. S. Ermakov [7] green cuttings is the main industrial method of viburnum's reproduction. Not for all types of viburnums green cuttings gives good results of making roots, but for some types all 100 % of engraftments form roots. In the literature we may meet conflicting information on about the optimal timing of cuttings. According to V. S. Vakula, U. A. Bibikova [5] high capacity for rooting keeps for a long period (from 5 to 10 VII), what is connected with a respective condition of shoots. The optimal condition of shoots for cuttings is characterized by small, lack of fat, high enough amount of water [18].

There is no consensus about the appropriate reproduction of viburnums by the arboreal cuttings. According to some authors breeding of viburnums by arboreal cutting has low effectiveness. O.V Bilik gives information about high level of rooting engraftments [4].

To improve the methods of vegetative propagation of viburnums we took a series of experiments was conducted with recommendations of Z.I Ivanova [8, 9], O. V. Bilik [3], I.R. Kisilevsky [11], V. K. Balabushka [1, 2]. It tested methods of vegetative propagation by rooting of green and arboreal cuttings, using different substrates, stimulators and terms of cuttings.

Objective of research – to analysis methods of vegetative reproduction species of stem cuttings under steppes of Ukraine, to establish the optimum time cuttings, to

determine the effectiveness of stimulators of rhizogenesis, pick substrates for cuttings.

Materials and methods. The study conducted in 2000-2003 in the National Botanical Garden of M. M. Grishko NAS (National Academy of Sciences) of Ukraine, Botanical Garden of O. V. Fomin, Kiev National University of T. Shevchenko. Conducted experiments with vegetative propagation with stem cuttings of 11 species and 5 cultivars of viburnum: *V. opulus* L., *V. op. ' Roseum'*, *V. op .'Nanum'*, *V. lantana* L., *V. l. 'Aureum'*, *V. l. 'Variegatum'*, *V. carlesii* Hemsl., *V. rhytidophyllum* Hemsl., *V. lentago* L., *V. rufidulum* Raf., *V. prunifolium* L., *V. veitchii* C. H. Wright, *V. burejaeticum* Rgl. et Herd., *V. buddleifolium* C. H. Wright, *V. sargentii* Koehne, *V. s. 'Flavum'*. To determine the stimulaition rhyzogenesis in cuttings viburnum used the flowing ingredients: heteroauxin (concentrations of 50 to 200 mg/ l at 24 hours exposure) and naftylotstova-acid (1% power), « Fumar» (10 g /l dimetilovogo amino ester of fumaric acid exposure 14 hours). Control cuttings were not treated with the growth substances. Such substrates for rooting were tested: river sand, a mixture of peat and sand in the ratio 1:2 and perlite.

Results of research. We found that the regenerative ability of viburnum can be divided into 2 groups:

1) taxon's with high generative ability (*V. opulus, V. op. 'Roseum', V. op. 'Nanum', V. sargentii, V. s. 'Flavum', V. rhytidophyllum, V. buddleifolium)*;
2) taxon's with satisfactory regenerative ability (*V. lantana, V. l. 'Aureum', V. l. 'Variegatum', V. carlesii, V. lentago, V. burejaeticum, V. ?rufidulum, V. prunifolium).*

Rooting green cuttings of the first group reaches 70, 1 – 73, 4 % even without the use of rhizogenesis stimulants, percent rooting cuttings of the second group is 44,6 – 75,4 % with stimulants (Table1).

Green cuttings are cut 10-15 sm long, with 2-3 internodes. Upper section made direct and over the leaves , the lower- diagonal (40-45°) under the leaves. Low pair of leaves removed, the upper half shorted. Bazal part of cuttings treated with

stimulants of rhyzogenesis. Cutting planted in cold greenhouses, which were covered with the foil.

On the way out rooted cuttings significantly affect the composition of the substrate. The best substrate appeared to be a mixture of peat and sand.

A viburnum cutting with a high regenerative ability of good root formation was preceded by the appearance of abundant callus. Species with satisfactory regenerative ability is also formed callus of most cuttings, but rooting percent of cuttings they have is significantly lower. In species viburnum first to place a cut wound callus formed, then there is overgrowth of tissue around the recesses of the bait (partially or entirely). Typically, the root form in the tissues of cuttings and sprout through the callus. It also forms roots, but in fewer. Viburnums roots may appear throughout the depth of the bait and form fetlock (in species with high regenerative ability). Viburnums root period is from 12- 18 days (V. op.'*Roseum*') to 25-30 days (*V. rufidulum*).

During the growing season the ability of cuttings for rhyzogenesis may change. Cuttings that procured from t00 young shoots are not able to form roots. In the initial period of intensive growth of shoots are herbaceous and weak. These cuttings at planting quickly rot, there root is low. Gradually shoots are becoming wooden. Viburnums cuttings root best in state of half wooden, with young but mature tissues. Particularly significant difference in the perpetuation cuttings. When comparing the results of 2-9 days later than cuttings optimal period. until early (20 V), the optimal (20 VI) and late period of cuttings. During the early period of all was the low percentage of rooted cuttings. Roots in cuttings of this period appeared in 2-9 days later than cuttings optimal period until the end of the end of the growing season were poorly developed, stipulating that bad wintering. Later, with the grows and formation of a more wooden shoots sharply increased the percentage. of rooted cuttings. In late terms cuttings when finished runners growth and almost become wooden, rooting of cuttings dramatically decreased and in most species was absent. Thus, the optimal time cuttings due, above all, by the degree of maturation of the shoots, mostly coinciding with the state of half- wooden. Terms the best possible

rooting for species Viburnum come to the decade of June, but they can move in either direction depending on the weather conditions of the year. Therefore, use only of calendar dates when selecting the optimal period cuttings is impossible.

Some authors [3, 8] believe that the optimal timing of cuttings can be correlated with the corresponding of the fenophase breeding plants, namely the phases of mass flowering and fading blooms. We found that the genus is not appropriate , because in this period shoots are herbaceous and are not suitable for cuttings.

For viburnums with satisfactory regenerative ability period of a successful cuttings is not long (14-20) days, high regenerative ability - much longer (up two month).

Established that the use of stimulant speeds up and improves the rooting of cuttings. According to our observations the best results of rooting green cuttings viburnum (subject to the terms and techniques of cuttings were obtained using heteroauxin at a concentration of 100 mg /l (Table 1).

Thus the cuttings developing stronger root system, they are less demanding conditions to take root, root formation is reduced period 5- 7 days (Table 2). Positive results are obtained of cuttings and other growth promoters.

Entrenched cuttings require additional rearing in the part of nursery. When transplanting rooted cuttings in autumn after year of rooting, much peat of it callus until the spring. Transplantation in the spring is optimal after buds were opened. Until that time occurs rooting of a part of cuttings, which are formed only in a year of planting of callus that often occurs in species of the section Lantana. Thus increased output of rooted cuttings. Entrenched cuttings of viburnum completely winter- hardy and do not require special shelter. Terms of nursery rearing constitute was 1-2 years.

Research on rooting of particles wooden cuttings of viburnums particles carried. In three terms of cuttings: in December, in February, and March.

Table 1

Rooting of cuttings of green taxa in sort *Viburnum* L.
After cultivation them by stimulators of rhyzogenesis

Species, cultivar	Rooting, %				
	Water (control)	heteroauxin 50 mg/l	heteroauxin 100 mg/l	α- naftylotstova acid, 1 % powder	"Fumar"
V.opulus	73,4 ± 2,1	84,3 ± 1,8	96,2 ± 3,8	80,6 ± 2,4	91,8 ± 3,6
V.op. 'Roseum'	70,1 ± 2,8	78,4 ± 2,0	90,4 ± 2,6	74,6 ± 2,8	84,3 ± 4,2
V.op. 'Nanum'	71,4 ± 3,0	85,1 ± 3,2	96,5 ± 2,7	72,6 ± 2,8	90,8 ± 3,8
V.lantana	1,5 ± 0,4	67,5 ± 1,6	75,4 ± 3,0	56,2 ± 2,5	58,4 ± 1,9
V.l. 'Aureum'	0,0	21,6 ± 0,8	36,4 ± 1,4	13,6 ± 1,1	28,4 ± 2,0
V.l 'Variegatum'	0,0	15,6 ±0,4	29,8 ± 1,2	11,6 ± 1,0	26,9 ± 1,8
V.carlesii	0,0	29,0 ± 2,6	48,6 ± 1,8	16,2 ± 2,1	14,8 ±2,1
V.rhytidophyllum	68,4 ± 3,1	76,8 ± 2,8	98,6 ± 1,2	88,7 ± 2,5	76,4 ± 3,2
V.lentago	0,0	37,5 ± 2,6	44,6 ± 2,0	26,8 ± 2,6	29,8 ± 2,4
V.rufidulum	0,0	32,4 ± 1,6	48,6 ± 2,2	21,4 ± 2,0	23,8 ± 2,2
V.prunifoliom	0,0	33,6 ± 2,4	47,4 ± 2,5	20,8 ± 1,8	23,0 ± 2,4
V.veitchii	0,0	30,6 ± 2,0	47,2 ± 3,1	28,8 ± 1,9	30,1 ± 2,6
V.burejaeticum	0,0	38,6 ± 2,8	51,8 ± 2,4	40,1 ± 2,4	46,6 ± 2,9
V.buddleifolium	56,3 ± 2,8	74,6 ± 2,9	95,4 ± 3,2	76,4 ± 3,2	78,6 ± 3,7
V.sargentii	71,4 ± 2,6	78,4 ± 2,7	93,8 ± 3,6	81,2 ± 3,0	84,7 ± 3,4
V. .s.'Flavum'	71,4 ± 2,6	78,4 ± 2,7	93,8 ± 3,6	81,2 ± 3,0	84,7 ± 3,4

Table 2

Rooting of cuttings of green taxa in sort *Viburnum* L.
(in the numerator – by control (of water), in the denominator – with the processing by heteroauxin, 100 mg/l)

Species, cultivar	The number of rooted cuttings, %	The average number of roots cuttings of 1, p.	The total length of roots in an average of 1 cuttings, sm	The length of growth of arboveground paets of 1 cutting, sm
V.opulus	73,4 ± 2,1 96,2 ± 3,8	12,6 ± 4,6 34,2 ± 5,1	109,3 ± 14,3 191,8 ± 10,4	10,4 ± 2,6 30,5 ± 2,4
V.op. 'Roseum'	70,1±2,8 90,4 ± 2,6	10,4 ± 1,1 24,6 ± 1,2	80,1 ± 9,6 124,6 ± 8,4	7,8 ± 1,8 26,2 ± 2,5
V.op. 'Nanum'	71,4 ± 3,0 96,5 ± 2,7	3,1 ± 0,6 6,3 ± 1,1	31,4 ± 5,2 85,4 ± 6,1	2,4 ± 0,8 5,8 ± 1,1
V.lantana	1,5 ± 0,4 80,4 ± 3,0	1,2 ± 0,3 9,0 ± 0,8	8,1 ± 0,7 84,3 ± 4,6	3,5 ± 0,2 19,6 ± 3,1
V.l. 'Aureum'	0,0 36,4 ± 1,4	0,0 2,3 ± 0,6	0,0 8,4 ± 1,1	0,0 3,8 ± 1,0
V.l. 'Variegatum'	0,0 29,8 ± 1,2	0,0 2,6 ± 0,8	0,0 9,5 ± 1,2	0,0 3,5 ± 1,3
V.carlesii	0,0 46,8 ± 1,8	0,0 4,7 ± 1,1	0,0 24,4 ± 2,3	0,0 12,2 ± 2,6
V.rhytidophyllum	68,4 ± 3,1 98,6 ± 1,2	11,8 ± 3,2 20,6 ± 4,1	121,6 ± 16,1 208,4 ± 20,6	24,6 ± 4,8 48,1 ± 6,9
V.lentago	0,0 44,6 ± 2,0	0,0 2,6 ± 0,9	0,0 12,8 ± 2,8	0,0 4,0 ± 1,2
V.rufidulum	0,0 48,6 ± 2,2	0,0 3,0 ± 0,9	0,0 10,6 ± 2,8	0,0 8,5 ± 1,8
V.prunifolium	0,0 47,4 ± 2,5	0,0 2,7 ±0,8	0,0 11,4 ± 2,7	0,0 2,5 ± 0,8
V.vietchii	0,0 47,2 ± 3,1	0,0 7,1 ± 1,8	0,0 61,2 ± 3,1	0,0 10,2 ± 3,1
V.burejaeticum	0,0 51,8 ± 2,4	0,0 8,4 ± 2,1	0,0 74,1 ± 3,8	0,0 22,6 ± 4,1
V.buddleifolium	56,3 ± 2,8 95,4 ± 3,2	10,2 ± 2,6 18,8 ± 4,6	125,0 ± 15,5 198,8 ± 18,3	20,2 ± 5,3 45,1 ± 4,6
V.sargentii	71,4 ± 2,6 93,8 ± 3,6	8,1 ± 2,4 30,9 ± 5,0	84,3 ± 10,8 168,4 ± 16,5	11,2 ± 1,8 28,9 ± 3,5

Harvested in December and February cuttings before planting in the soil were stored in a cold .cellar under a layer of wet sawdust. Planted cuttings in spring in pre-prepared ridge lines of the scheme 25x10 to a deeps of 5-8 swm, so that above ground remained two buds. For planting cuttings was chosen area with enough fertile, light-

textured soil. We have not get significant positive results with rooting study options, as rooted cuttings yield stood at 3-8 %.

In stem of cuttings propagation, there are several ways of vegetative propagation. The downside of reproduction by jigging and dividing the bush is comparatively small number of new plants, so in terms of production appropriate to use other means of reproduction. Types of sections Lentago (V. lenyago, V. prunifolium, V. rufidulum) can reproduce by root sprouts that they form in a large quantity.

Further study needs way of micropagation of viburnum by the grafting. In the literature there is no information about this method of reproduction of viburnum, but mentions that viburnum carlesii traditionally propagated by budding on V. lantana. Great interest makes stem forms of viburnums obtained by grafting. Already in 1912 in nursery in Poland [10], along with other species and cultivars being offered viburnum opulus for trunk- canopy height of 120-150 cm and 150-180 obtained by grafting. Unfortunately, nowadays stem forms viburnum almost non- existent.

Conclusions

Thus, based on those studies, we found that most effective way micropagation viburnum is green cuttings. Cuttings better handle by heteroauxin in concentration of 100 mg|/l and use as a substrate for cuttings mixture of sand and peat. Employ propagation by wooden cuttings is impractical.

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ВЕГЕТАТИВНОЕ РАЗМНОЖЕНИЕ ВИДОВ РОДА *VIBURNUM* L. СТЕБЛЕВЫМИ ЧЕРЕНКАМИ

Демченко Е.А., Демченко С.К.

Проанализированы способы вегетативного размножения видов рода Viburnum L. *стеблевыми черенками. Проведено вегетативное размножение видов рода путем укоренения зеленых и одревесневших черенков. Испытаны разные сроки, субстраты и стимуляторы ризогенеза. Установлено, что самым эффективным является зеленое черенкование калин.*

Вегетативное размножение, Viburnum, *субстрат, стеблевой, черенок*