

Vegetative Reproduction through Green Cuttings of the Introduced Form *Weigela florida* f. “*Bristol ruby*” (Caprifoliaceae) in the Conditions of the Tashkent Botanical Garden (Uzbekistan)

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Abstract

For the first time, work was carried out on the vegetative reproduction of *Weigela florida* f. “*Bristol Ruby*” (Caprifoliaceae) was introduced into the Tashkent Botanical Garden (Uzbekistan) through green branches. As a result of the research conducted, it was noted that the vegetative reproduction possibilities of the “*Bristol Ruby*” form of *Weigela florida* were high. When placed on stimulants of two types (kornevin, heteroauxin), it became known that kornevin stimulants are effective in taking root. It was found that the effective way to multiply this form by green branches in a vegetative way—when placed on the stimulator of kornevin from the middle part of the rod, the indicators of root extraction of the cuttings were 93.3%, which is more effective than other options. When vegetative reproduction of this decorative form, it is recommended that the seedlings come to the standard state in 3 - 4 years and the root extraction indicators are high—this is its use as the second row shrubs in the case of growing on strongly saline soils in the conditions of Uzbekistan. The cultivation of green cuttings of the form in the fog showed that they are more effective than in the open ground.

Keywords

Form *Weigela florida* f. *Bristol Ruby* (Caprifoliaceae), Vegetative Reproduction, Green Shoots, Growth Regulators, Biologically Active Substances, Tashkent Botanical Garden, Uzbekistan, Introduction

1. Introduction

The family Caprifoliaceae includes 15 genera and about 500 species—deciduous or evergreen shrubs, rarely low trees or grasses, distributed mainly in the Northern hemisphere, in temperate and subtropical zones. Only the species of the largest genera (*Viburnum* and *Lonicera*) enter the Southern Hemisphere. Most of the species of this family are forest plants, characteristic of deciduous and mixed, less often coniferous forests. Representatives of the family Caprifoliaceae are characterized by opposite, usually whole or lobed leaves, less often pinnate and trifoliate. There are various types of inflorescences: two-three-flowered, semi-contic, complex corymbose, racemose, spikelike. The flowers are regular or irregular, with a double (usually five-membered) perianth. Calyx with a tube that fuses with the ovary and a three-to-five-notch or lobed bend. The corolla is tubular, spikelike or funnel-shaped, with a three-to-five-lobed bend. There are 5 stamens, less often 2 - 4, they are attached to the corolla tube. The ovary is lower or semi-lower. Fruit—berry, drupe, box, less often the fruit is dry, leathery, non-opening. Among the honeysuckle there are many ornamental shrubs, the fruits of some are used for food. Types of viburnum and elderberry have long been used in folk medicine [1].

The family also includes decorative shrub species and forms that belong to the genus *Weigela* Thunb. This genus is named after the German professor of chemistry, pharmacy and botany Christian Ehrenfried von Weigel. In the genus *Weigela* there are 15 species of beautiful-flowering, deciduous shrubs, from East Asia, 3 of which grow in the flora of the Far East [2].

Representatives of this genus grow wild in East and Southeast Asia, one species on the island of Java. In Russia, 3 species are found in the forests of the Far East, 9 species have been introduced. Moisture-loving, more or less shade-tolerant ornamental shrubs. Propagated by cuttings and seeds, sown in the nearest spring after harvesting, usually in greenhouse conditions. Deciduous erect shrubs that do not form stolons. Winter buds with a few pointed scales. The leaf arrangement is opposite. Leaves petiolate, rarely almost sessile, pilate or pilate-toothed, without stipules.

The flowers are solitary or one to six (rarely more), on young, elongated, leafy shoots in the axils of the upper leaves, white, yellowish, pink, purple or dark red, almost sessile or on more or less developed pedicels, sometimes fusing into a common peduncle. Calyx with five lobes connected at the bottom or separated; corolla tubular-bell-shaped or funnel-shaped, double-edged or slightly zygomorphic, with five lobes, the tube is much longer than the lobes. There are five stamens, they are shorter than the corolla; anthers are linear, free or soldered under the stigma around the column, the column is sometimes protruding; the stigma is capitate or cap-shaped; the ovary is dioecious, oblong. The capsule is woody or cartilaginous, from narrowly cylindrical to ovoid-ellipsoidal, narrowed at the top into a spout formed by the upper part of the ovary, opening in two flaps, with the seed carrier remaining in the form of a central column. Seeds are angular,

small, often winged [3].

The aim of this study is to reproduce vegetatively through the green branches of the form *Weigela florida* f. “*Bristol Rubru*” (Caprifoliaceae), introduced in the conditions of the Tashkent Botanical Garden.

2. Materials and Methods

The object of this study was a perennial decorative shrub introduced to the Tashkent Botanical Garden, widely used for landscaping in the conditions of Uzbekistan—*Weigela florida* f. *Bristol Rubru*.

Field experiments, observations of experiments, selection and preparation of land plots were carried out according to the methods of B. A. Dospekhov [4], N. R. Rakhmatova [5] and O. V. Khaylova, N. I. Denisov [6].

For many trees and shrubs, green cuttings are one of the most productive ways of vegetative reproduction. In June-early July, when the plants are in the active growth phase, it is the best time for green cuttings. With the help of green cuttings, many trees and shrubs can be propagated, but it must be borne in mind that the ability to root cuttings depends on the type and variety of the plant.

The method of propagation by green cuttings is based on the ability of stem cuttings to form adventitious roots, which is expressed in different plants to different degrees. The younger herbaceous perennials and shrubs have the greatest ability to differentiate, and to a lesser extent—tree species, especially the most ancient conifers, although among them there are species with a high ability to root with green cuttings. Easily rooted are lianas (*Clematis*, *grapes*, *Maiden grapes*, *Actinidia*, *Hydrangea petiolaris*), many shrubs (*lilac*, *hydrangeas*, *Ligustrum*, *Lonicera*). The process of formation of adventitious roots on cuttings begins with the formation of a callus as a reaction to injury. Callus gives cuttings resistance to adverse environmental conditions and the penetration of infections [7].

It is known that the process of root regeneration is regulated by growth substances-auxins, carbohydrates and nitrogenous substances. In many species and varieties, under the influence of growth regulators, the percentage of rooting cuttings increases, the number of roots, the quality of plants, and the rooting time is reduced. Some hard-to-root crops become easy-to-root, but sometimes, depending on the biological characteristics of a particular species or variety, there may be no response to stimulants.

Good root formation stimulants are:

Heteroauxin (indolylacetic acid (IAC)—from 50 to 200 mg/l,

Kornevin (indolylbutyric acid (BCI)—1 g/l of water,

Zircon (a mixture of hydroxycinnamic acids)—1 ml/l of water.

Treatment with stimulants should be carried out in the dark, at a temperature of +18, ..., +22 degrees. Cuttings are immersed in the solution so that the leaves are not processed. The concentration of the solution and the exposure time must be maintained accurately, their excess can lead not to an increase in the effect, but to a toxic effect. Therefore, it is better to use Kornevin in solution and main-

tain a strict exposure for 16 - 20 hours, rather than dusting the cuttings with it [8].

3. Results and Discussion

1) **Green cuttings** are leafy parts of the stem with one or more buds. The best material for cuttings are lateral shoots formed on the growth of the previous year in the lower, but well-lit part of the crown, which have large developed buds and do not bear signs of diseases. In the process of harvesting cuttings, it is important to ensure the preservation of moisture in the tissues, on which the success of rooting largely depends. At all stages of working with cuttings, they should not be allowed to dry out, cut shoots should be immediately put in water in the shade. The pruning cuttings is started as soon as possible. Cuttings are cut 8 - 12 cm long with two or three internodes, plants with short internodes may have more of them. When cutting at the optimal time, it is better to use the middle and lower parts, and later—the upper part of the shoot. Cuttings are sprayed with water and placed under a non-woven covering material before planting to prevent them from wilting.

Finished cuttings are planted in pre-prepared spreading ridges. Cuttings are planted at a distance of 5 - 7 cm from each other to a depth of 1.5 - 2 cm. For most tree and shrub species, the optimal temperature is +20, ..., +26 degrees and humidity is 80% - 90%. Cuttings need to be regularly viewed, remove fallen leaves and non-rooted specimens. With the beginning of rooting, the plantings are ventilated, opening the film first for 1 - 2 hours, each time increasing the time, the number of sprays is reduced. After hardening the rooted cuttings, the film is removed [7].

2) **Green cuttings** are one of the most promising methods of vegetative propagation, which allow obtaining root-related plants on an industrial scale. Green cuttings are based on the natural ability of plants to regenerate—the restoration of lost organs or parts, the formation of complete plants from leafy stem cuttings after the formation of adventitious roots. Regeneration manifests itself differently and depends on many factors: life form, hereditary characteristics, age, condition of the mother plants, rooting conditions, etc. Green cuttings make it possible to increase the yield of cuttings from one mother plant and significantly (4 - 5 times) reduce the area of the queen cells. It allows you to expand the number of species and varieties that can reproduce vegetatively, and is indispensable for the rapid reproduction of plants that are available in limited quantities (valuable breeding forms, rare varieties, healthy clones). A significant advantage of green cuttings is the physiological integrity and genetic uniformity of root-related plants. Green cuttings also contribute to the improvement of the planting material: growing shoots are less populated by pests than lignified ones. This technology provides not only a high reproduction rate, but also a shorter growing period. It is successfully combined with other methods: microclonal propagation, propagation by green grafting, lignified cuttings, layering. It is

possible to combine green cuttings with picking strawberry rosettes and growing seedlings of flower, vegetable and medicinal plants. In the technology of green cutting, modern means of mechanization and automation of technological processes can be used. Rooting of green cuttings and, in part, their rearing are carried out in protected soil under controlled conditions, and the results do not depend on adverse climatic factors. Due to the intensive use of protected soil (dense placement of cuttings per unit area, the use of containers, the development of the vertical profile of greenhouses, the introduction of crop rotation), green cuttings are cost-effective [9] [10] [11].

2 species of *Weigela* category naturally growing in the Tashkent Botanical Garden: *Weigela praecox* ба *W. florida* DC. and 2 decorative forms—*Weigela florida* f. *variegata* Bailey and *W. florida* f. “*Bristol Ruby*” has been introduced and is now reproduce and care for these plants in the Botanical Garden collections.

Weigela praecox—the birthplace of the USSR (Far East). Korea, China. Shrubs up to 2 m in height. Leaves 3 - 7 cm. The flowers are single or 3, pink or red.

W. florida—grows wild in Northern China and Korea. Bush up to 3 m high. Leaves from ovate-oblong to back-ovate, 5 - 10 cm long. The flowers are 3 - 4, rarely 6 in the axils of the leaves, pink or red on the outside, whitish on the inside. Flowering in April-May.

***W. florida* f. *variegata* Bailey**—the most elegant and frost-resistant form with smaller leaves. The length of the sheet is 5 cm. The height of the bushes and the diameter of the crown is 2 - 2.5 m. The flowers are up to 3.5 cm in diameter, intensely pink, collected in a brush, with small leaves at the base.

***W. florida* f. “*Bristol Ruby*”**—the bush grows up to three meters in height. The crown is spreading-3-3.5 meters in diameter, the stems are straight, long. The leaves are bright green, opposite, petiolate, with serrated edges, without stipules. Winter buds have several pointed scales. The bush does not shed its leaves until late autumn, which increases its attractiveness and decorativeness. The flowers are arranged in one or several pieces on elongated, leafy shoots growing from the axils of the upper leaves. Their color can be white, yellow, orange, pink, purple, dark red. The flower consists of five petals connected in the form of a bell. *W. florida* f. “*Bristol Ruby*” blooms in May-June, in a warm climate, it can bloom a second time—in August. The color of the flower’s changes over time—the recently bloomed flowers are pale, but over time their color becomes bright and saturated. *Weigela* blooming is a great decoration for any garden and plot, but even without flowers, it looks quite beautiful [8].

All these species and forms are widely used as ornamental shrubs in landscaping in climatic conditions of the Republic.

The age of the maternity tree in the Tashkent Botanical Garden is 5 years old. The seeds of this form are reproduced even through one year branches, due to complete ripening and vegetative way—a good reproduction. When multiplying in a vegetative way, it retains the properties of the landscape, while fully retaining the signs of motherhood.

3) Green cuttings are one of the most effective ways to propagate garden plants. The long-developed method of rooting leafy stems gives good and stable results in the cultivation of various crops, but the reproduction of promising varieties and rootstocks of fruit is still a difficult task [12].

For vegetative reproduction of the *Weigela florida* form “*Bristol Ruby*” in the conditions of the Tashkent Botanical Garden, green cuttings were taken from one-year green branches of the motherhood tree. From one-year-old branches, cuttings were made in three types from the bottom of the stem, from the middle part and from the thin part of the stem. The length of the cuttings was 8 - 12 cm, depending on the range of shoots. That is, in the cuttings from the lower colon part of the rod, the distance between the buds was observed to be longer than the cuttings from the colon part in sabali (17.07.2020 y.). The prepared cuttings were treated for 12 hours with the help of geteroauksin and stimulator kornevin. Cuttings were put on the polishing water spraying equipment. The Working Mechanism of the water spraying equipment is adapted to water spraying every 40 minutda 1 min. The top of the device is shaded with a mesh set.

The cuttings in the control option were planted directly. Cuttings were planted in the range between 10 cm, rod between 6 - 8 cm. A month later, a collection of callus began to form in the cuttings. In late August, the first primary roots began to form in the cuttings. From the same time, the shoots began to wake up on top of the ground, and the growth of the cuttings was noted.

At the end of the first year of vegetation, the root-taking indicators of cuttings, multiplied in different variants, were analyzed and the following results were obtained:

In the cuttings placed on the kornevin stimulator, the indicator of root extraction in the colon part was 72.2%, in the middle part 93.3%, the root extraction of cuttings from the thin part was 77%; in the cuttings placed on the heteroauxine stimulator, the root-taking indicators were 54.5% in the colon, 87% in the middle part, and 61.5% in the thin part (**Figure 1**).



Figure 1. General view of vegetative reproduction cuttings through green branches.



Figure 2. General view of the flowering of one-year cuttings.

And in the control variant of vegetative reproduction cuttings, the results were obtained as follows: 41% in the colon, 67% in the middle part and 61.5% in the thin part took root.

Also, the flowering status was noted in 4% - 6% of the green cuttings that took root. The number of flowers was 1 - 3 and the duration of flowering was 12 - 14 days. All the blossoming cuttings were formed from the cuttings from the middle part of the branch (**Figure 2**).

Rooted cuttings were planted on an open ground from the second year. When proper agrotechnical activities were carried out on the care of planted seedlings, their conservation at the end of the second year's vegetation was 100%.

4. Conclusions

As a result of the research conducted, it was noted that the vegetative reproduction possibilities of the “*Bristol Ruby*” form of *Weigela florida* are high. When vegetative reproduction of this landscape forms, it is recommended that the seedlings come to the standard state in 3 - 4 years and the root extraction indicators are high—this is its use as the second yarush shrubs in the case of growing on strongly saline soils in the conditions of Uzbekistan.

In the experiments, it was observed that the root extraction indicators in the form control option were low. When placed on stimulants of two types (kornevin, heteroauxin), it became known that kornevin stimulants are effective in taking root.

In summary, it was found that the effective way to multiply this form by green branches in a vegetative way—when placed on the stimulator of kornevin from the middle part of the rod, the indicators of root extraction of the cuttings were 93.3%, which is more effective than other options.

It also showed that the cultivation of green cuttings of the form in the fog is more effective than on open ground.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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