Improving the technology of obtaining clonal root stocks of stone fruit crops

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Abstract. The aim of the research was to study the effect of the cuttings rooting period on the yield of high-quality rootstocks of stone fruit crops. In accordance with the developed methodology of research, modern rootstocks of stone fruit crops on the Crimean selection station Eureka 99 and Kuban 86 for plum, apricot, peach, and also VSL-2 for cherry and sweet cherry were studied. The paper presents the results of three-year experiments on the study effect of the rooting period hardwood cutting for standard stone seed root stocks. The data of mathematical processing the obtained results indicate the rooting period has a significant impact on the survival of hardwood cuttings. During the experiment, the average for the studied rootstocks during the autumn period of rooting, the survival rate of the cuttings was significantly higher than for the spring by 2.8%. According to the obtained data, on average, in terms of rooting for the stock Eureka 99, the highest survival rate of cuttings in experience was observed, significantly exceeding the figure of the other root stocks by 21.1-25.4%. Output rates of standard rootstocks were adequate for the number of rooted cuttings. The results given in the article indicate that rootstocks Eureka 99 and VSL-2 have the highest yield of rootstocks per hectare observed during the spring planting season, exceeding the autumn planting dates by 109 and 217 thousand pieces respectively. The Kuban 86 rootstock has a reverse pattern. The article presents the results of sorting the obtained rootstocks by quality degrees. According to the data obtained, the highest yield of the first grade seedlings in the experiment was observed on almost all variants during the autumn term of rooting.

1. Introduction

The experience of fruit-growing industry shows that the state and yield of modern fruit plantations depend on the varietal and rootstock composition, as well as on the quality of the produced seedlings [1].

The increase in the production of stone fruit crops requires the improvement of their assortment and cultivation technologies [3]. In the framework of the National Strategy for the Development of Agriculture, adopted in the Russian Federation, fruit growing is one of the priority sectors of agriculture [2, 7]. However, the effective development of this industry is impossible without the development of breeding and nursery. Currently, scientific and industrial organizations of our country are actively working on the development of highly productive varieties and the creation of effective variety-rootstock combinations [5, 8]. On the basis of new varieties and rootstocks, the technologies of cultivation and reproduction of stone fruit crops are being improved [4, 6].
A great deal of work for expanding the range of stone fruit crops, growing in the southern zone of horticulture, was carried out by the staff of the Crimean selection station (Krymsk, Krasnodar Territory). They created a series of rootstocks with various spread, resistant to unfavorable soil conditions (root rot, waterlogging of the soil, etc.), easily propagated by green and hardwood cuttings. However, the choice of the term rooting cuttings of existing and promising stone fruit rootstocks causes some arguments in the scientific community in connection for which reason we have chosen this research topic.

2. Materials and methods

The studies were conducted in a greenhouse complex, located on the territory of the educational and experimental farm of the Stavropol State Agrarian University in 2016-2018, the rooting of cuttings of stone fruit crops was performed at different times.

The aim of the research was to improve the technology of obtaining clonal rootstocks of stone fruit crops.

For studying, modern clonal rootstocks of stone fruit crops of the Russian selection: medium-sized rootstocks Kuban 86, Eureka 99 and VSL-2 were taken, which are the most demanding in intensive industrial horticulture.

In accordance with the developed research methodology, rooting of hardwood cuttings was carried out in 2 periods: spring (10.03) and autumn (10.11). Rooting cuttings were performed in ridges prepared from a mixture of soil and peat soil in 1:1 ratio. Then, planting of rooted cuttings was carried out in ridges 1 m wide according to the 7 x 5 cm scheme, which provided the number of plants per 1 m² - 285.7 pcs. The technology for preparing cuttings for autumn and spring planting was the same.

According to the research methodology, the accounting area of the plot was 1 m², where 300 plants were located. The experience repetition is triple; the location of the plots is according to the method of organized repetitions. Accounting rooting cuttings conducted on the 25th of May and on the 25th of June according to the scheme of experience. At the end of the observation period, yield of rootstocks was carried out. After lifting the quality of rootstocks was determined according to GOST 10.203-97.

3. Results and discussion

As a result of the research, a different reaction of the stocks on rooting period was established. According to the results of mathematical processing data, we can conclude that the highest survival rate of cuttings among the studied rootstocks was noted in Eureka 99, whose figure was significantly higher than the similar results of the other stocks by 21.1-25.4%. Analyzing the results of the remaining stocks in the experiment, it can be noted that the Kuban 86 survival rate of hardwood cuttings on average rooting period was significantly higher than the rootstock VSL-2 by 4.3%. Based on the data obtained, it can be concluded that regardless of the rooting period, the hardwood cuttings of the Eureka 99 stock provided a greater percentage of rooting in the experience relative to similar indicators of the other rootstocks (table 1).

| Rootstock, А | Planting period, В | A, HCP_{05}=4,0 |
|---------------|---------------------|-----------------|
| Eureka 99     | 84,2                | 82.3            |
| VSL-2         | 60,7                | 56,9            |
| Kuban 86      | 51,4                | 61,2            |
| B, HCP_{05}=2,1 | 65,4               | HCP_{05}=8,3    |
|               |                     | Sx=4.2%         |

|               |                     |                 |

Mathematical processing of the comparative assessment results of cuttings rooting showed that on average in the variants with the autumn period, the survival rate of hardwood cuttings was significantly higher than during the spring planting period by 2.8%. The obtained results allow us to conclude that on
average the experiment of the autumn planting period contributed to a better development of the root system and a better survival rate of hardwood cuttings of the considered rootstocks.

Analyzing the data of private differences, it was found that the highest percentage of the hardwood cuttings survival in the experiment was recorded for the Eureka 99 rootstock, which was significantly higher than the rest of the studied rootstocks for all planting times by 13.2-32.8%. Moreover, the greatest survival rate of cuttings in the Eureka 99 rootstock was observed during the spring planting period, exceeding the results in the autumn period by 3.8%. Similar dynamics was observed in the stock VSL-2. However, the rootstock Kuban 86 was observed a different picture. The survival rate of cuttings during the spring planting period here was reliably lower than the same indicator in the autumn period by 19.6%.

The obtained data allow us to state that different rootstocks respond to the planting time of cuttings in various ways. In our opinion, this pattern is explained by the biological features of the rootstocks examined in the experiment and their responsiveness to the weather conditions of the planting period.

According to the industry standard (OST 10.203 - 97), for clone rootstocks of the 1st variety, plant height must be at least 30 cm. Thus, all clone rootstocks that we study, regardless of the planting period of cuttings, reach this height and meet the OST requirements.

First of all, the effectiveness of rooting period is characterized by the number of rooted stocks, i.e. the amount we get per unit area, which provides a rationale for using this reproduction method.

From the counting results of rooted hardwood cuttings of analyzed plum rootstocks, it is possible to calculate the yield per unit area. Thus, the obtained data indicate that the highest yield of rootstocks per 1 ha in the experiment was observed for the Eureka 99 rootstock, exceeding those of the other rootstocks during the spring planting period by 672–938 thousand pieces, and in the autumn - by 269-780 thousand pieces (table 2).

Table 2. Yield of rooted stocks for commercial grades, depending on the cuttings planting time.

| Rootstock | Planting period of cuttings | Yield of rootstocks per 1 ha, thousand pieces | Commercial grade, % | 
|-----------|-----------------------------|---------------------------------------------|---------------------|
|           |                             |                                             | I                  |
| Eureka 99 | spring                      | 2406                                        | 49.1               |
|           | autumn                      | 2297                                        | 51.3               |
| VSL – 2   | spring                      | 1734                                        | 51.6               |
|           | autumn                      | 1517                                        | 55.8               |
| Kuban 86  | spring                      | 1468                                        | 50.1               |
|           | autumn                      | 2028                                        | 55.4               |

At the same time, it should be noted that with the autumn period of planting cuttings on the Eureka 99, the rootstocks yield of the first commercial grade was higher than the second grade by 2.6%. A similar pattern was observed on the Kuban 86 rootstock. With the spring planting period, the yield of the first and second grade seedlings was almost the same. When planting cuttings for rooting in autumn, the yield of the first commercial grade rootstocks exceeded the number of the second grade by 10.8%. In the VSL–2 root stock, the yield of the first grade during the autumn planting period was greater than in the spring period by 4.2%. With the autumn planting period of VSL–2 rootstock cuttings, the yield of the first commercial grade was higher than the second grade by 3.2%. A more significant advantage in the yield of standard seedlings was noted at the autumn planting period of cuttings, where the cuttings yield of the first grade relative to a similar number of rootstocks of the second commercial grade 11.6%.

On the obtained data basis of the calculated number of rooted stocks, it was found that different yield of seedlings by commercial grades were observed on plantings of various rootstocks, depending on the rooting period. On the Eureka 99 plantings when planting cuttings in the spring, the yield of rootstocks of the first and second commercial grade was almost the same (table 3).
The highest percentage of rooted her stocks during the experiment was 99. Kuban 86 in the spring planting period, but the total number of rooted cuttings was inferior to the results of Eureka 99.

| Rootstock | Planting period of cuttings | Yield of rootstocks per 1 ha, thousand pieces | Commercial grade, % |
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|           | autumn                     | 2028                                        | 55.4               |

At the same time, during the autumn planting period for the Eureka 99, the yield of rootstocks of the first commercial grade was higher than the second ones by 2.6%. A similar pattern was observed on the Kuban 86 rootstock. With the spring planting period, the yield of the first and second grade seedlings was almost the same. When planting cuttings for rooting in autumn, the yield of the first commercial grade rootstocks exceeded the number of the second ones by 10.8%.

4. Conclusions

According to the results of the conducted research, different clone root stocks responded for the planting period of hardwood cuttings differently. For the Eureka 99, both planting periods of cuttings provided approximately equal survival, which in the framework of the conducted research was significantly higher than that of the other stocks during the spring planting period by 23.5-32.8%, and during the autumn period by 9.4–23.7%. The planting period had a more significant effect on the rooting rate of hardwood cuttings of the remaining stocks examined in the experiment. So, for the VSL –2 rootstocks, the best planting period is spring, where survival rate was higher than during the autumn planting by 7.6%. In the clone rootstock of Kuban 86, the highest survival rate was noted during the autumn planting period, where the result was significantly higher than with the spring planting period by 19.6%.

After analyzing the results of research, it can be stated that the planting period of cuttings had a significant impact on their survival. The highest percentage of rooted stocks in the experiment was noted on the Eureka 99 variant, which was higher than on the other stocks plantings with the spring planting period of 672–938 thousand pieces, and with the autumn period by 269–780 thousand pieces. However, the rootstocks yield of the first and second grades was almost the same. The highest rootstocks yield of the first grade in the experiment was observed in the VSL-2 during the autumn planting period, but the total number of rooted cuttings was inferior to the results of rootstock Eureka 99. Kuban 86 in the autumn planting period, where the rootstocks yield of the first commercial grade was higher than the second one by 10.8% with a fairly high yield of standard stocks (2028 thousand pieces / ha).

When analyzing the quality of the obtained rootstocks, it was found that in accordance with the quality parameters of seedlings OST 10203 - 97 for the development of the aerial part and the root system of seedlings, the rooting periods of cuttings had a different impact. For the Eureka 99 stock, the best period for rooting was autumn, where out of 2297 thousand rootstocks, 51.3% were of the first commercial grade. On the Kuban 86 stock, a similar pattern was noted. For stock VSL-2, we recommend the autumn period, where out of 1,517 thousand rootstocks, 55.8% were of the first grade. With the spring planting period, this indicator decreased slightly to 1,734 thousand rooted seedlings of the first commercial grade and was 51.6%.

As a result of the obtained data analysis, we can conclude that the Eureka 99 stock differed in the highest number of rooted cuttings, however, the rootstocks yield of the first and second grades was practically the same for both rooting periods. The highest rootstocks yield of the first commercial grade was observed in VSL-2 during the autumn planting period, but the total number of rooted cuttings was inferior to the results of Eureka 99.
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