Effect of nutrient supply on the linear indicators and output of standard grafted sweet cherry seedlings under differentiated irrigating regime

O A Nikolskaya\textsuperscript{1} and N V Kurapina\textsuperscript{2}

\textsuperscript{1} FSBEI Federal Research Centre of Agroecology, Complex Melioration and Forest Reclamations RAS, 97, Universitetskiy prosp., Volgograd, 400062, Russia
\textsuperscript{2} FSBEI HE Volgograd State Agrarian University, 26, Universitetskiy prosp., Volgograd, 400002, Russia

E-mail: n.kurapina@mail.ru

Abstract. The results of four-year research on application of fertigation with Ammophos, Master NPK 18:18:18+ME and combined effect of fertigation and foliar sprays with biostimulant Isabion on linear growth and output of grafted seedlings of sweet cherry Vasilisa variety on low productive chestnut soils of Volgograd region presented in the article. It is defined that the combined feeding of plants was more effective. The seedlings had height of 1.99 m with output of 1\textsuperscript{st} class seedings of 90 \%. Growing grafted seedlings without additional feeding found to be ineffective.

1. Introduction
In modern times, the most effective system of growing fruit crops is intensive orchards. Under this system, the plantations are based on condensed scheme of planting the fruit trees, including stone fruit crops. One of the leading factors that make possible to conduct intensive gardening is usage of high-performance planting material with fast entry into the productive period and able to bear economically profitable yields due to the big expenses. Therefore, it makes high demands to the producers of stone fruit seedlings to raise vigorous plants.

Scientists in different environmental conditions studied effects of adequate supply of nurseries with nutrients and moisture. Practically all of them pointed significance of rational water regimes and well light conditions [1]. The thickening of stems, growth of roots and increasing in leaf mass of young trees are promoted by enhanced nitrogen nutrition not less than 70 kg ha\textsuperscript{-1} [2-3].

Studies of growing sweet cherry rootstocks on south of Russia point importance to form fertile soil layer with a good structure in order to seedlings start producing fibrous root systems. Thus, the technology of growing sweet cherry rootstocks provided cutting furrows in which substrates added. The best results of forming root systems were obtained with adding nitrogen, wood chips, volcanic ash and manure into the furrows. During the vegetative period root systems supplied with sodium humate and agrochemical Agrovit Kor [4].

Another problem in nurseries of stone fruit crops is weak branching of inoculants that leads to prolonging period until fruit bearing to 5-6 years and does not fit to the demand of intensive growing system. Besides varietal features, good nutrient and water supply of plants ensure establishment of 3 to 6 lateral branches in annual seedlings [5].
Optimization of plant nutrition in modern times is due to the justification of doses and timing of the introduction of macro-and microelements, as well as the expansion of the assortment of fertilizers and agrochemicals. Scientists from Brazil learned possibility of use systems to control releasing fertilizers in the soil by means of polymer and clay systems [6]. New coming fertilizers and agrochemicals mostly studied on field crops, but practically there is no research on tree crops, including stone fruit crops [7-9]. Therefore, our survey is aimed at determining the impact of various organo-mineral nutrition options on the growth and development of grafted sweet cherry seedlings in the nursery.

2. Materials and methods
The studies were conducted in 2017-2020 in laboratory "of Plant Breeding, Seed production and Nursery" FSC of "Agroecology, integrated reclamation and protective afforestation wounds" in Dubovsky district of Volgograd region. The experiment was laid down in three-fold repetition with a randomized single-tier placement of options. All necessary measurements, records and observations were carried out in compliance with the requirements of generally accepted research methods: Dospekhov B. A. [10], Markov Y. A. [11], Pleshakov V. N. [12].

The climate of the territory is arid with low productive light chestnut soils. The content of humus in the layer of 0,0-0,25 cm is 1,75 %. Natural vegetation is of steppe type. The years of research characterized as: 2017 – drought (GTR = 0,6); 2018 – drought (GTR = 0,5); 2019 – slightly drought (GTR = 0,7); 2020 – acutely arid (GTR = 0,3).

The objects of research were sweet cherry seedlings of the Vasilisa variety grafted on the rootstock of the Antipka (Prunus mahaleb). Grafted seedlings were grown in the open ground with a placement scheme of 0.1x1.5 m. Irrigation was carried out through the drip lines and consisted in maintaining soil moisture until the beginning of active growth of seedlings in a layer of 0.2 m not lower than 80% LWC, followed by an increase in the depth of soil wetting to 0.4 m and maintaining humidity not lower than 80% LWC until the end of active growth, followed by a decrease in pre-irrigation soil moisture in a layer of 0.4 m to 70% LWC. Presented irrigation regime was performed by assigning on average of 22 irrigations with rates 50 and 100 m$^3$ ha$^{-1}$, total average irrigating rate was 1775 m$^3$ ha$^{-1}$.

Experience scheme consisted of the following options:

- 1 (control) – from the phase of the bud break to the beginning of active growth of the trunk applied 3 feedings through drip line (fertigation) with mineral fertilizers N12P5 active matter per ha each 10 days, to phase of the start of bark maturity fertigation with N12 each 14 days;
- 2 – until the phase of the trunk growth beginning fertigation by the option 1, then 2 foliar sprays with biostimulant Isabion with intervals of 14 days, dosage 2 l ha$^{-1}$;
- 3 – until the phase of the trunk growth beginning fertigation by the option 1, then fertigation with complex fertilizer "Master" (NPK 18:18:18+ME) each 14 days, dosage 5 kg ha$^{-1}$ until the phase of trunk growth cease.

Used fertilizers and agrochemicals: N$_{12}$P$_{5}$ - ammonophos is small-hygrosopic, well soluble mineral fertilizer. Isabion (aqueous solution) is an organic biostimulator of growth, it provides plants with the necessary amino acids and peptides, contains: complex organic compounds - 625 g l$^{-1}$, including free amino acids 103 g l$^{-1}$, total nitrogen 109 g l$^{-1}$; organic carbon 294 g l$^{-1}$; minerals and ballast substances: calcium 4 g l$^{-1}$; sulfates 11 g l$^{-1}$; ash residue with trace elements 40 g l$^{-1}$; chlorides 23 g l$^{-1}$; active sodium 17 g l$^{-1}$. Master (18.18.18+3Mg) - completely soluble microcrystalline fertilizer. Contains available N 18.0 %, P$_{2}$O$_{5}$ 18.0 %, K$_{2}$O 18.0 %, MgO 3.0 %, SO$_{3}$ 6.0 %; Fe EDTA 0.07 %, Mn EDTA 0.03 %, B 0.02 %, Zn EDTA 0.01 %, Cu EDTA 0.005 %.

Final parameters of seedlings estimated according to the state standard R 53135-2008 [13].

3. Results
The major indicator of the development of grafted seedlings, adequate sufficiency of light, soil moisture, macro- and microelements is linear growth of central stem. The growing pattern of seedlings
during the season can be divided into three periods: 1) until the beginning of active growth of the central stem, when it elongates slightly; 2) the period of active growth with vigorous elongation; 3) the period of preparation for rest. Linear elongation of central stem of grafted sweet cherry seedlings according to the research options is presented on figure 1. In our experiments, the active growth of central stem was observed from June, 14-th to August, 10-th.

![Figure 1. Average linear elongation of central stem according to the research options.](image)

As shown on figure 1, during the period before the start of active growth of the central stem, sweet cherry seedlings in all variants developed almost the same with a deviation of 1 cm from each other. This is explained by the fact that mineral nutrition was given the same as well as the other conditions not varied. Starting from the middle of June, when fertilizers applied according to the research scheme, seedlings heights differ. As shown on figure 1, the greatest increase in stems height was observed in the second and third variants of the experiment. The weekly increase in these variants ranged from 14 to 19 cm, while in the control variant the increase was from 8 to 16 cm.

The final evaluation of the effectiveness of the application fertilizers and growth stimulators lies in the consistency of trees to the parameters of state standard and how many plants are consistent with the standard. The output data of grafted sweet cherry seedlings Vasilisa variety and parameters of consistency with the state standard presented in the table 1.

| Research options | Biometric data          | Output data, % | Output over control, % |
|------------------|-------------------------|----------------|------------------------|
|                  | Height, m               | Stem diameter, mm | 1 sort | 2 sort | 3 sort | 1 sort |
| Option 1 (control) | 1.62                    | 49             | 71        | 26     | 3      | -      |
| Option 2          | 1.99                    | 60             | 90        | 8      | 2      | + 19   |
| Option 3          | 1.96                    | 57             | 84        | 12     | 4      | + 13   |

Note: The Lowest Average Difference 4 %

The height of sweet cherry seedlings in the first (control) option reached 1.62 m. Application of fertilizers Master and Isabion brought positive effects on biometric indexes of seedlings of sweet cherry. The height of the stem at the end of the growing season in the second option reached 1.99 m,
which exceeded the control by 23%. At the same time, the height of seedlings in the third option reached 1.96 m and it was 21% higher than the control and 2.5% lower than the plants in the second option. The lowest percentage of the yield of seedlings of the first sort, and accordingly a higher yield of the second class was noted in the first (control) option. Due to the combined use of treatments with agrochemical Isabion and complex Master, the percentage of seedling output increased significantly. Thus, the output of seedlings of the first sort increased from 71% to 90 and 84% accordingly.

Stem diameter increased from 49 to 60 mm under the impact of foliar treatments with Isabion. Under influence of complex Master, the stem diameter increased from 49 to 57 mm.

4. Discussion
Obtained data correspond with results of research conducted by different authors as well as our previous investigations [14-15]. It is obvious that growing nurseries in modern conditions cannot be fulfilled without using stimulants of growth of different origin. Under impact of stimulants, plants had greater values of vigor and productivity, they sustained negative environmental conditions more effectively. Thus, good results showed application on fruit trees such agrochemicals as Nutrisol, Samorod, Mival Agro.

5. Conclusion
It should be noted that the effectiveness of the applied feedings was different. Among the studied fertilizing products Isabion was more effective. The best option was agrochemical of biological origin. At the same time, the differences between the second and third treatment options are not very significant, and, to a certain extent, the effectiveness of each chemical varies over the years, and therefore, in our opinion, a strict preference for any drug is not valid. All types of feedings have a positive effect on the growth of rootstocks and seedlings as well.

References
[1] Shumakova K B and Burmistrova A Y 2012 Raising seedlings of fruit crops under drip irrigation. Doklady TSHA 284 286-288
[2] Bussi C, Huguet J G, Besset J and Girard T 1994 Effects of nitrogen fertilization applied during trickle irrigation on the growth and fruit yield of peach. European Journal of Agronomy 3 243-248
[3] Artacho P and Bonomely C 2017 Net primary productivity and allocation to fine-root production in field-grown sweet cherry under different soil nitrogen regimes. Scienta Horticulturae 219 207-215
[4] Ashinov M I, Berbekov V N and Akhmatova Z P 2011 Efficiency of usage organo-mineral substrates for raising seedlings of stone fruits. Pollitamatic network electronic scientific journal of KubSAU 65 341-348
[5] Burlak V A 2018 Branching of sweet cherry seedlings in nursery. Bulletin of agricultural science of Taurida 15(178) 42-46
[6] Daitx T S, Mauler R S, Giovanela M and Carli L N 2019 Biodegradable polymer/clay systems for highly controlled release of NPK fertilizer. Polymers for Advanced Technologies 30-3 631-639
[7] Vinter M A 2018 Producing of seedlings of fruit cultures in Russia: Problems and Decisions. Fruit growing and viticulture of the South of Russia 52(4) 42-49
[8] Szewczuk A, Gudarowska E 2004 The effect of soil mulching and irrigation on yielding of apple trees in ridge planting. Journal of fruit and ornamental plant research XII P 139-146
[9] Kashin V I 2002 Nursery as a main chain in scientific-practical supply in horticulture branch of Russia. Fruit and berry growing in Russia IX 3-28
[10] Dospekhov B A 2014 Metods of field experiments (Moscow: Alians) 351
[11] Markov Y A 1985 Programm and Methods of research on irrigation of fruit and berries (Michurinsk) 118
[12] Pleshakov V N 1983 *Methods of field experiments under conditions of irrigation* (Volgograd: VNIIOZ) 148
[13] GOST R 53135-2008 Seedlings of fruits, berries, subtropical, nuts, citrus cultures and tea. *Tehinical conditions* 2009 (Moscow, Standartinform) 45
[14] Merezhko I M 1991 *Quality of seedlings and productivity of fruit plantations* (Kiev: Urozhay) 152
[15] Nikolskaya O A, Kikteva Y N and Kurapina N V 2019 The impact of irrigation on the growth and development of seedlings of stone fruit crops in the nursery. *Oroshayemoye zemledeliye* 1 42-45