The usage of Slow Released Fertilizer over bio-organic natural fertilizers on fruit stone rootstock

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Abstract. This scientific research work demonstrates the influences and the effect of applying Slow Released Fertilizer (SRF) based on the biodegradable polymer modification (even distribution of bio-polymer and fertilizer) of Azafoska NPK (16:16:16), bio-organic natural fertilizers such as Baikal EM 1 and NPK Liquid Consortia on stone fruit rootstock nursery (Kuban – 86) as plant nutrition. The results based on the analyzed data (plant and root development) that were received from fertigation system through drip lane irrigation (concentration 0.005%) and foliar feeding (concentration 0.005%) procedures on stone fruit rootstock plants within studying fertilizers.

1. Introduction

The use of different types of fertilizers since the end of 1940-th meaningfully increased the production per every decade, allowing the agricultural productiveness to achieve the request for food of the increasing the world human population [1, 2]. The successful implementation of the Food Program largely depends on the intensification of agriculture based on the implementation of achievements and the development of scientific and technological progress. In the intensification of crop production on the conditions of industrial application, theoretical problems and tasks in the development of technologies for feeding fruit and berry crops. There is an increasing need for in-depth study, research and development of a new scientifically grounded technologies for the rational production of berries and fruits, in the development of differentiated methods of feeding fruit trees and berry seedlings and methods that provide a significant increase in the productivity of fruit and berry growing while reducing the cost of production. However, the increasing factor of production of fertilizers, their usage still can be inefficient due to incorrect application. The golden rule of an agriculture is that, almost half of the nitrogen (N) and phosphorus (P) is taken by plants and what is taken must be returned back [3, 4].

The environmental and economic issues that must be resolved through the use of biodegradable polymers firstly involve the degradation of soil fertility, which leads to reduce the implementation of genetic potential of fruit crops, as well as the production cost increases [5]. For a long time, the modification of the mineral feeding system of the fertilizer occurred due to the inclusion of the missing, macro-, meso- and microelements into the complex fertilizers [6,9]. Mineral fertilizers are substances...
of inorganic origin that are necessary for plant nutrition. Scope of application - agriculture, where they are valued for availability, speed of obtaining a positive effect and a wide range of action. Bio-modified/bio-organic natural fertilizers its new product in agrochemical industry, where scientists trying to convert macro elements in the soil from unavailable forms to accessible for the plants.

"Baikal EM 1" is a liquid nutrient and was one of the first bio-organic natural fertilizer on the market in Russian Federation, where the manufacturers were promising that, the nutrient does transformation of non-accessible forms of nutrients into reachable for the plants. Baikal EM 1 is a ready-made microbiological preparation that includes a symbiotic self-regulating complex of knowingly selected natural living microorganisms: various bacteria, including photosynthetic and lactic acid, fixing nitrogen, saccharomycetes, their waste products and liquid obtained during cultivation.

The advantages of mineral fertilizers:

- are able to act in cold soil, including at sub-zero temperatures;
- act almost instantly;
- easily transported.

Despite a number of advantages of mineral fertilizers, gardeners and nursery growers fear that they can harm human health. In practice, only products that are grown in violation of the feeding technology can be harmful, therefore, the plant should receive a balanced nutrient feed, depending on the variety and phenological phase of development, otherwise, overfeed can lead into soil salinity.

Moreover, the non-assimilated nutrients (for example nitrogen due to its volatility) can be lost by leaching or by volatilization into the atmosphere [5, 11], causing serious environmental problems and economic losses. Therefore, the usage of new modified fertilizers is critical issue in agricultural industry that must be well studied and resolved progressively [7, 8, 10].

2. Methodology

1.5 hectare of nursery plant with stone fruit crop (0.5 hectare for each studying case) was planted in August 2019 in Chechen Republic (Russia), at the same type of soil. The case of study is the influence of three different fertilizers (the mixture of biodegradable polymer and Azafoska (16:16:16), bio-organic natural fertilizers Baikal EM 1 and NPK Liquid Consortia) that were applied on the motherplant nursery with the same concentration (0,005%) of reacting agent (macro – and micro-elements). The size of the planting material (Kuban – 86) was almost 40 cm, the root system was well developed (6-8 cm).

- Slow released fertilizer – synthesized within add of biodegradable polymer in Azafoska (16:16:16) production process within mixing, where biopolymer and NPK fertilizer evenly distributed in proportion 1:1. The water was evaporated from the received product and the tablet forms were made from it (Figure 1). Furthermore, 500 g of SRF – product was dissolved in 100 liters’ water and fed to the stone fruit (rootstock) nursery by fertigation and foliar feeding (0,005% concentration for both procedures).
- Baikal EM 1 – 0,5 liters was dissolved in 100 liters’ water and fed by fertigation and foliar feeding to the plant nursery.
- NPK Liquid Consortia – The same procedure was made in this case as in process within Baikal EM-1, where 0,5 liters in 100 liters’ water were dissolved in water and fed by fertigation and foliar feeding procedure.

The feeding procedures (fertilize applying) were done 2 times within each studying object:

- At the beginning of June and end of June – foliar feeding
- At the beginning of July and end of July – fertigation process through drip lane irrigation.
The received results were analyzed visually and the height within roots of the experimental plants were measured with the meter stick.

3. Results and discussion
From the figures below (Figure 1 (a), (b) and (c), the growth of the stone fruit rootstock is demonstrated where different fertilizers (nutrients) were applied, where the development can be seen much better for the plant which was fed by Slow Release Fertilizer (90 cm), where increase from the origin is 50 cm. However, the height of the stem with Baikal EM 1 is almost close to the result with SFR (80 cm). Least result has showed NPK Liquid Consortia within stem development just above 70 cm and increase in stem high is around 30 cm.

![Figure 1 (a)](image1a) The growth of stone fruit rootstock on Slow Released Fertilizer.  
![Figure 1 (b)](image1b) The growth of stone fruit rootstock on bio-organic natural fertilizer Baikal EM 1.  
![Figure 1 (c)](image1c) The growth of stone fruit rootstock on bio-organic NPK Liquid Consortia.

It is clearly to state, that the development of the aerial part of the plant is much well developed for the rootstock that was fed with even distrubuted bio-polymer and Azafoska (16:16:16) than with bio-organic natural fertilizer Baikal EM 1 and NPK Liquid Consortia. The visual survey of the leafs for each studying case has not shown any suspecios for lack of or excess of any macro – or micronutrients. The color of leafs were very clear green and slightly brownish at the very tips of the plant, but its due to the water softenes that was irrigating.

The root development can be detected in the figures below (Figure 2 (a), (b) and (c), where the roots are well-enough branched for all experimental plants. The issue of detecting the real length of the roots for all testing plants was the digging process, as soil refers to alluvial heavy loam (1.57 g/cm3). Alluvial-meadow calcareous soils were formed on carbonate alluvial deposits under meadow herb-grasses under conditions of a rather intense alluvial process.
Therefore, the visual analyzation of the tested plants to be for:

- Slow Release Fertilizer – very strong root system of the stone rootstock, the roots are fully developed and the lengths of the roots - around 20 cm. Increases in the root branching process from the planting start data is almost 2.5 times.
- Bio-organic natural fertilizer Baikal EM – almost close results to SRF in terms of development of roots, by with the growth of lengths did not get it all – 17 cm. Increase from the planted data for 9-10 cm.
- Bio-organic natural fertilizer NPK Liquid Consortia – has shown the lease results in the rooting process as well, however, the root branching process was well enough to be comparative to other nutrients that were used in this research project. The length of the longest root was measured to be just around 14 cm. The root development is less than 2 times from the rootstock planted data.

The other results of growth and root development of the stone fruit rootstocks were tabled (Table 1) with 3 different fertilizers application of stone fruit rootstock nursery. It gives the minimus growth of the plant (root and stem) and maximum. The measurements were done on 100 testing plants and analysed in terms of any limiting factors.
| Part of the analysis | Slow Released Fertilizer. The min/max plant (root) growth of 100 subjects, cm. | Bio-organic natural fertilizer Baikal EM 1. The min/max plant (root) growth of 100 subjects, cm. | Bio-organic natural fertilizer NPK Liquid Consortia. The min/max plant (root) growth of 100 subjects, cm. |
|----------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Aerial part of plants. The height of the plant | 45 - 52 | 38-46 | 25-33 |
| Underground part of the plant. The length of the roots | 14 - 17 | 11 - 15.5 | 7.6 - 11 |

From the table’s results given above (Table 1), 100 plants for each study case were measured in subject of: Development of aerial part of plants and underground part. For the area within Slow Release Fertilizer applying on the rootstocks, the height and root length measured to be min – max (45 – 52 cm) and root developing process min – max (14 – 17 cm) respectively. The same measurements Bio-organic natural fertilizer Baikal EM 1: (38 – 45 cm) for the height of the plant and (11 – 15.5 cm) for the root spread. Moreover, bio-organic natural fertilizer NPK Liquid Consortia (25 – 33 cm) for the height of the plant and (7.6 – 11 cm) for the root length.

4. Summary
To sum up, the influence of 3 different nutrients: the mixture of biodegradable polymer and Azafoska (16:16:16), bio-organic natural fertilizers Baikal EM 1 and NPK Liquid Consortia was studied and analyzed. Its showed that, the usage of biopolymer modified Azafoska gives much promising results than other two well branded bio-organic natural fertilizers. From this research paper, the fact can be stated, that an aerial and underground part of the plants is more progressive within SRF rather than with 2 other studying bio-organic nutrients.

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