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FERTILIZATION IMPACT ON THE GROWTH AND NUTRITIONAL STATUS OF CHERRY PLANTING MATERIAL FROM BIGARREAU BURLAT CULTIVAR ON MAXMA14 ROOTSTOCK, GROWN IN CONTAINERS - FIRST RESULTS

Vanya AKOVA, Irina STANEVA, Viktorija NIKOLOVA, Stefan GANDEV

Fruit Growing Institute, 12 Ostromila St., Plovdiv, Bulgaria,

Corresponding author email: vannnia85@abv.bg

Abstract

At the Fruit Growing Institute in Plovdiv, Bulgaria through pot experiment was made an attempt to establish the impact of different fertilizer rates on growth characteristics and nutritional status of plants from 'Bigarreau Burlat' cultivar, grafted on MaxMa14 (P. mahaleb x P. avium) rootstock and grown in containers. The following variants were tested: Variant I - Control (non-fertilizer), Variant II - $N_1P_{0.25}K_{0.5}Mg_{0.1}$, Variant III - $N_2P_{0.5}K_1Mg_{0.2}$ and Variant IV - $N_{3.2}P_{0.8}K_{1.6}Mg_{0.32}$. The results show that, at the three fertilized variants are obtained plants with a height of 129 to 148 cm and a stem diameter of 11.3 to 12.8 mm, as with increasing the fertilizer rate increases plant height. It was found that plants of the control variant are characterized by lower average height values (68 cm) and stem diameter (8.2 mm) compared to the fertilized plants, the differences being statistically significant. It is concluded that fertilization with Kristalon by YARA in fertilizer rates $N_1P_{0.25}K_{0.5}Mg_{0.1}$; $N_2P_{0.5}K_1Mg_{0.2}$; $N_{3.2}P_{0.8}K_{1.6}Mg_{0.32}$ results in the production of cherry planting material suitable for fruit orchards.

Key words*: cherry, container growing, fertilization, growth behaviour, planting material.*

INTRODUCTION

Fruit growing is one of the most intense sub-branches of horticulture in Bulgaria, linked not only with large pre-capital investments and annual significant production costs but also with high income opportunities (Manolova, 2005). The production of necessary quantities of planting material is the main prerequisite for the development of the sub-branch. Nowadays, in the Bulgarian fruit growing, mainly the conventional production of trees in nursery is applied. It has a number of drawbacks, such as the need for crop rotation, the reduction of the root system when removing plants from the soil, the need for a wide range of machines, etc. A new approach in the production of fruit planting material is the container growing. Its advantages are easier controlling the pH of the nutrient substrate, optimal fertilization and irrigation, and more effective control of diseases and pests (Ruter, 1993). Container-grown plants have a greater fine root mass compared to field-grown plants (Gilman & Beeson, 1996). According to Harris and Gilman (1993) and Mathers et al. (2007) container plants have a lower rate of dying after being planted in the field, due to the larger fine root mass and their undamaged root system. Fertilization is one of the most important practices for the quality of container grown plants, because they are grown in a limited nutritional volume which prevents their growth (Landis, 1989). According to Oliet et. al. (2004) fertilization can increase the growth of plants, improve their nutrient supply and increase the resistance to water stress, low temperatures and diseases.

The aim of the study was to assess the impact of fertilization on the growth and nutritional status of cherry planting material from 'Bigarreau Burlat' cultivar on MaxMa14, produced in containers.

MATERIALS AND METHODS

The study was conducted in the period 2017-2018 at the Fruit Growing Institute in Plovdiv, Bulgaria. Cherry plants from 'Bigarreau Burlat' cultivar, grafted on MaxMa14 (*P. mahaleb* x *P.*

avium) rootstock under conditions of container growing experiment were studied. The MaxMa14 rootstock was produced in 2017 at the Production laboratory for in vitro propagation in the Fruit Growing Institute - Plovdiv. The micropropagated plants were grown in plastic containers of 7.5 litters capacity. A mixture of peat and perlite in a 2:1 ratio was used for the substrate. The plants were grown outdoors in a shaded field and fertilized with ammonium nitrate (NH_4NO_3). In August the rootstocks were grafted with 'Bigarreau Burlat' cultivar. The fertilization experiment was set in 2018 in four variants with eleven replications, each plant considered a separate replicate.

Variants of the experiment:

I. Control (non-fertilizer);

II. $N_1P_{0,25}K_{0,5}Mg_{0.1}$/ container;

III. $N_2P_{0,5}K_1Mg_{0.2}$ / container;

IV. $N_{3.2}P_{0.8}K_{1.6}$ $Mg_{0.32}$ / container

Fertilization with increasing nutrient rates was applied on the surface four times. The fertilization was carried out with a combined Kristalon compound fertilizer by YARA – N(20%) - P_2O_5(5%) - K_2O(10%) - MgO(2%), applied every 20 days, the first introduce being made at the beginning of May. The soil moisture in the containers was maintained to a field capacity, taking into account the specific temperature conditions and the amount of precipitated rainfall when the irrigation dose was determined. The following biometric characteristics were recorded: stem diameter (mm) - 5 cm above the place of grafting; plant height (cm) - from the place of grafting to plant tip and volume of root system (cm^3). The volume of the root system was measured by the method of Burdett (1979).

In order to determine the nutritional status of the plants, a chemical analysis of the leaves was carried out. Samples of 15 fully developed leaves from each replication of the variants were taken. Total concentrations of nitrogen, phosphorus, potassium, calcium and magnesium were determined by standard methodologies (Tomov et al., 1999; Campbell & Plank, 1998; Karageorgiev, 1977; Stoilov, 1968).

The results obtained are subjected to mathematical analysis using the method developed by David B. Duncan (Duncan, 1955; Harter, 1960). Software used in the study are "R-3.1.3" in combination with "RStudio-0.98" and installed package "agricolae 1.2-2" (Mendiburu, 2015).

RESULTS AND DISCUSSIONS

The results show that the YARA Kristalon mineral fertilization has a significant impact on the growth of stem diameter and plant height (Figure 1). It has been found that all fertilized variants have higher values for both measured characteristics than the control, the differences being statistically significant.

The stem diameter of the control plants was 8.17 mm and the height 68.18 cm. The low-fertilized plants (var. II) have a higher stem diameter of 12.83 mm, which is approximately 0.5 times higher than the non-fertilized plants (var. I). Medium and high fertilizer rates (var. III and var. IV) have been found to stimulate the growth of the stem diameter, but compared to the low fertilizer rate (var. II) the effect of the fertilization on the stem thickening is lower. This is probably due to the increased amount of applied nitrogen. According to Marschner (1995) an excessive increase in the amount of nitrogen can lead to inhibition of growth.

The plants of the fertilizer variants (var. II var. III and var. IV) have a height of 129 to 148 cm and those of the control variant are characterized by lower values for height (68 cm). Experimental data suggest that increasing the fertilizer rate increases the height of the plants. Differences compared with unfertilized control are statistically significant.

On Figure 2 is represented the volume of the root system. The data show that fertilization affects more the upper part of the plant rather than the root system.

The differences between the tested variants are statistically non-significant. However, it is noticeable that the average values of the root system volume of the medium- and high-rate fertilized plants (var. III - 231.67 cm^3 and var. IV - 233.33 cm^3) are lower in relation to unfertilized plants from var. I (245 cm^3) and the low-rate fertilized from var. II (268.33 cm^3). The one-year results do not give any reason to explain this fact.

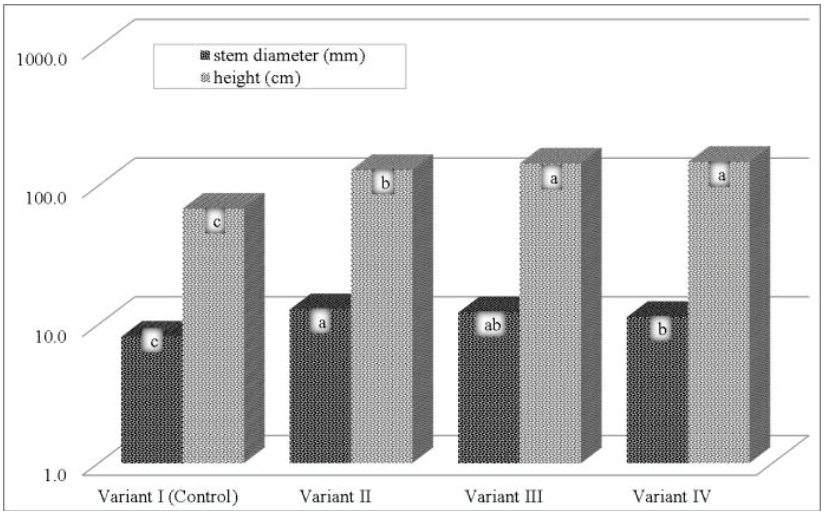

Figure 1. Stem diameter (mm) and height (cm) of cherry planting material at the end of vegetation

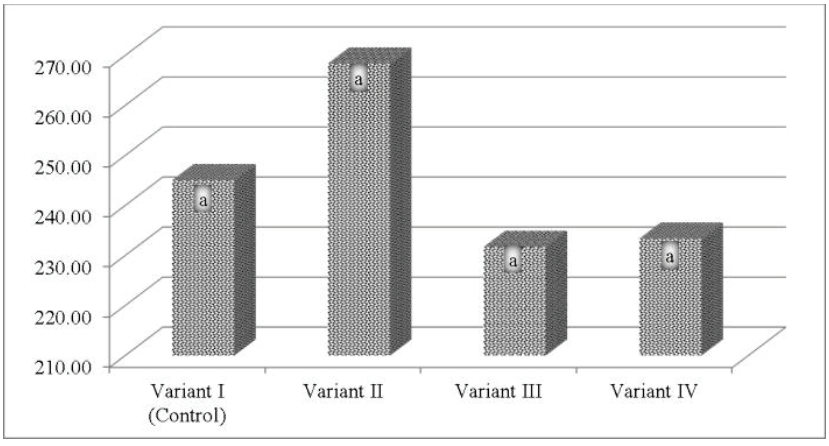

Figure 2. Root system volume (cm^3) of cherry planting material at the end of vegetation

Figure 3. Cherry planting material at the beginning end at the end of vegetation

The influence of the various fertilizer rates on the content of macroelements in the leaves is presented in Figure 4.

It was found that with the applied fertilizing rates the content of N and K in the leaves increases straightforward to the fertilizer rate. Foliar nitrogen ranges from 1.24% at the control to 3.67% for Variant IV. The K content of the fertilized plants ranges from 3% to 3.24% (var. II, var. III and var. IV) and is about three times higher than that of the control plants (1.25%). With P no such dependence is observed, its higher concentration (0.61%) is on Variant III. The differences in the percentage of Ca and Mg between all variants are statistically non-significant and there is no clear trend. Applying the high fertilizer rate (Var. IV) leads to a decrease of Ca and Mg content in the leaves.

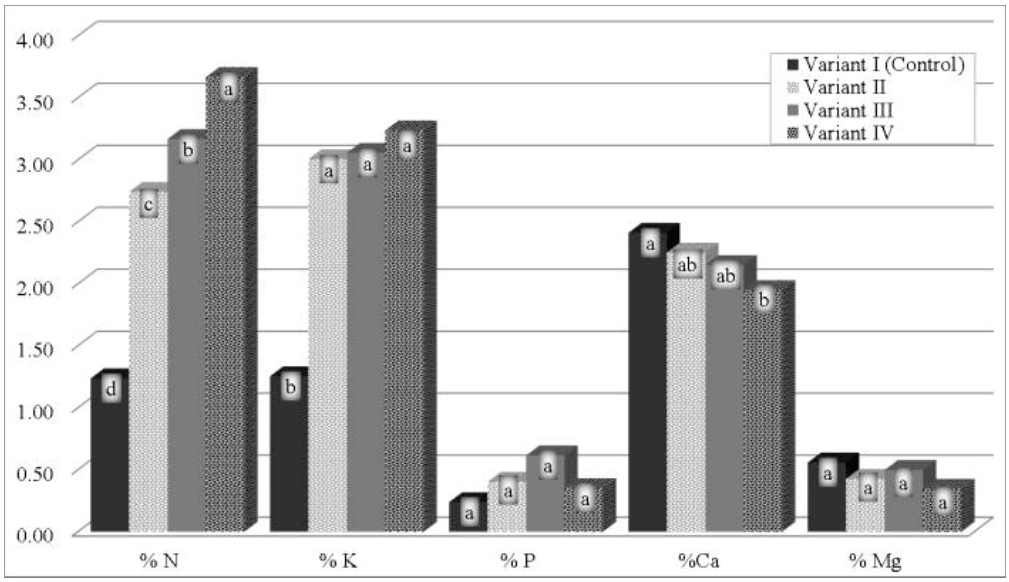

Figure 4. Contents of the macroelements in the leaves

CONCLUSIONS

Fertilization with Kristalon by YARA in fertilization rates $N_1P_{0,25}K_{0,5}Mg_{0.1}$; $N_2P_{0,5}K_1Mg_{0.2}$ and $N_{3.2}P_{0.8}K_{1.6}Mg_{0.32}$ leads to the production of cherry planting material of larger sizes than the control (unfertilized) trees.

The fertilization rates $N_2P_{0,5}K_1Mg_{0.2}$ and $N_{3.2}P_{0.8}K_{1.6}Mg_{0.32}$ result in a lower stem thickness and root system volume compared to the fertilizer rate $N_1P_{0,25}K_{0,5}Mg_{0.1}$.

For practice it is recommended the fertilizer rate $N_1P_{0,25}K_{0,5}Mg_{0.1}$. when producing container-grown planting material of 'Bigarreau Burlat' cultivar on MaxMa14 (P. mahaleb x P. avium) rootstock.

The growth characteristics and the content of macroelements in the leaves of the grafted plants of the 'Bigarreau Burlat' cultivar on MaxMa14 (P. mahaleb x P. avium) rootstock are affected from fertilization with the combined fertilizer Kristalon by YARA. Fertilization leads to a better nutritional supply compared to the control.

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