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APRICOT RESPONSE TO RADICULAR AND FOLIAR APPLICATION OF FERTILIZERS UNDER DOBROGEA CONDITIONS

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Abstract

Drought and heat stress are significant factors limiting fruit crop yield in arid conditions. Foliar fertilization is a common practice of supplying fruit crop production with mineral nutrients, especially under limited soil nutrient availability conditions. Nutrient management is a determining element of the technology in fruit quality. In this study we aimed to evaluate the impact of a the radicular (NPK+S) and foliar (Cropmax) fertilizer on fruit quality parameters in an apricot orchard during 2019 -2021 period. According to our results, the weight of the fruits increased by 30% in the b1 treatment (radicular fertilizer with NPK+S) and 34% in the b2 treatment (radicular and foliar fertilizer with Cropmax) at Olimp cultivar and by 40% in the b1 treatment and 53% in the b2 treatment at Goldrich cultivar in the three years of study compared to the control treatment. In conclusion, the fruit quality can be improved in apricot orchard using of the radicular and foliar fertilizer.

Key words: *climate conditions, fertilization, fruit size, Prunus armeniaca, weight.*

INTRODUCTION

Apricot (*Prunus armeniaca* L.) is a mesotonic diploid fruit tree species belonging to the *Rosaceae* family and originated from Central Asia (Janick, 2005). Globally, the apricot orchard systems are shifting from medium-low planting densities (600-750 trees/ha) to high-density (1000-1250 trees/ha) plantings (Giovannini et al., 2010).

Essential plant nutrients are mainly applied to soil and plant foliage for achieving maximum economic yields (Fageria et al., 2009). The fertilization is a great way to maintain the health and vigor of trees. Fruit tree crops are agricultural commodities of great biological and economical importance, and therefore, precise knowledge of treatments that boost fruit production and quality, is of great importance. The quality of fruits, except for genetic characteristics, are significantly influenced by cultivation techniques. Fertilization is one of these practices. Nowadays foliar fertilization has become a basic management tool in the intensive orchards. Perennial fruit trees are frequently exposed to various abiotic stresses during their lifetime that limit crop yield and quality. Foliar fertilizers have an interesting potential to improve fruit quality, with relatively low costs and low environmental impact (Csihon et al., 2021). Application of sprays supplies nutrients to plants more rapidly than the soil fertilization (Tagliavini et al., 2002; Nagy et al., 2012; 2019).

The benefits of biostimulators on fruit quality are also confirmed by other researchers (Hudina et al., 2003; Basak & Mikos-Bielak, 2008; Nagy et al., 2019; Csihon et al., 2013; 2021).

The aim of this work was to provide data on the effect of "Cropmax" foliar biostimulator on the fruit quality in an apricot orchard.

MATERIALS AND METHODS

Experimental site. The experimental lot is located in Valu lui Traian commune, Constanta district, Dobrogea region, Romania. The climate is semiarid, with a climatic water deficit (WD), ranging from approximately -400 mm on the Black Sea coast to -320 mm (Paltineanu et al., 2007). The soil is a calcareous chernozem with clayey texture and alkaline soil pH that has good soil structure (0-60 cm deep, with 27-32% w/w clay content,

1.6-2.8% w/w humus content, 1.5-6.8% w/w carbonate content), while in the unstructured subsoil, the humus content is less than 1% w/w and carbonates from 9 to 14% w/w; the slope of the land is between 2.0 and 2.5% (Paltineanu et al., 2011).

The apricot orchard was planted in spring of 2012. Trees were grafted on Constanța 14 rootstock and designed with spacing of 4 x 2.5 meter with north-south row orientation. The canopy shape was a classic vase with the height of 2.5 m.

The experiment design was based on the split-plot method with three treatments: **1)** radicular fertilizer with NPK+S, 15: 15: 15 + 12.8; **2)** radicular and foliar fertilizer (Cropmax); **3)** control, each one containing four replicates. The soil management system is represented by clean cultivation both between tree rows and in the row. Plant protection refers to the principles of integrated pest management.

The climatic data: solar radiation, air temperature, relative humidity, wind speed at the height of 2 m, precipitation (P) and Penman-Monteith reference evapotranspiration have been recorded by an automatic weather station (iMetos, IMT 300, Pessl Instruments, Austria) by a 1-h step. These data have been periodically processed as diurnal means and used in calculations.

Applied treatments. The main objective of this study was to evaluate the impact of radicular and foliar fertilizer on the fruit quality in an apricot orchard. The trial consisted of three treatments (control, radicular fertilizer and radicular+foliar fertilizer). The first treatment with foliar fertilizer was applied in full bloom in 2019, 2020 and 2021, then the treatments were repeated 3 times (Table 1). Biostimulant treatment was applied to apricot orchard in the vegetation phases with 0.5 L/ha dosage (Figure 1). Every spring, in the apricot orchard was applied to the soil the complex NPK fertilizer enriched with easily absorbable S (15: 15: 15+12.8), 500 kg/ha, respectively. Each treatment was applied to 16 trees.

Table 1. Foliar fertilizer application moments (2019-2021)

2019	2020	2021
01.04.2019	08.04.2020	19.04.2021
13.05.2019	17.05.2020	11.05.2021
29.05.2019	31.05.2020	09.06.2021
12.06.2019	17.06.2020	25.06.2021

Figure 1. Foliar fertilizer applied at apricot orchard

Applied materials. The apricot tree (*Prunus armeniaca*) has been selected for this study as it is one of the most cultivated fruit tree species worldwide, especially in the warm temperate climate regions. Olimp is an apricot cultivar obtained at Research Station for Fruit Growing (RSFG) Baneasa and patented in 1994 (Figure 2). Goldrich is a cultivar of apricot of American origin (Figure 3).

Figure 2. Olimp cultivar

Figure 3. Goldrich cultivar

NPK complex fertilizers, with a balanced formula in the content of nitrogen (N), phosphorus (P), potassium (K), guarantee a fertilization rich in nutrients with direct results on increases in the quality and quantity of fruit products. Cropmax is a complex super concentrate nutrient for foliar fertilization, which is 100% natural, produced by Farming Holland BV. Cropmax fertilizer presents the following chemical composition: growth plant stimulator (auxines, cytokinins, gibberelins), organic amino acids, vegetal vitamins, vegetal enzymes, macroelements: N - 0.2%, P - 0.4% , K - 0.02%, Fe - 220 mg/L, Mg - 550 mg/L, Zn - 49 mg/L, Mn - 54 mg/L, Cu - 35 mg/L, other elements: B, Ca, Mo, Co, Ni - 10 mg. Being a natural product, Cropmax is well absorbed by leaves and stems. Influence on photosynthesis leads to the increase of carbohydratesamount. Also, are reduced metabolic deficiencies.

Assessed parameters. Each year was tested average samples of 15 fruits/treatment. Fruit growth was monitored by measuring longitudinal and transversal fruit diameter and fruit height after harvest. The measurements were performed using a metric digital caliper (Insize Co., Ltd. China). The average weight of a fruit was determined by weighing 10 fruits/treatment and dividing by the number of weighed fruits. The weighing of the fruit was performed with a precision balance (Kern & Sohn GmbH, Germany). Fruits of Olimp were harvested between the 8th to the 9th of July in 2019, from 16th to the 17th of July in 2020 and 25th to the 26th of July in 2021. Fruits of Goldrich were harvested between the 26th to the 27th of June in 2019, from 1st to the 2nd of July in 2020 and 8th to the 9th of July in 2021.

Data analyses. SPSS 14.0 software and Microsoft Office Excel were used for the analysis of variance and various calculations for fruit quality properties. Different letters in the graphs indicate significant differences for the probability (P) ≤ 0.05 according to Duncan's multiple range test.

RESULTS AND DISCUSSIONS

Climate conditions. In the experimental period, in the growing season, the climate conditions are characterized by mean annual values of temperature and precipitation of 19.5 °C and 213.8 mm, respectively, and precipitation is not uniformly distributed across the growing season. The reference evapotranspiration was 717.0 mm with mean values of 134.0, 150.0 and 134.7 mm month^{-1} during summer months: June, July and August. The climatic water deficit (WD= P-(PM-ET0)) is high in the summertime (-79 mm in June, -124.3 mm in July and -125.0 mm in August) and its sum for growing season is -500.2 mm (Septar et al., 2022). The mean value of yearly and monthly climate data during the growing season in the experimental period is shown in the Figure 4 (a, b) and Figure 5 (a, b).
The period of experiment (2019-2021) was considered as a relatively normal period, with monthly temperature means of 22.3°C in June, 24.0°C in July and 23.9°C in August, respectively.

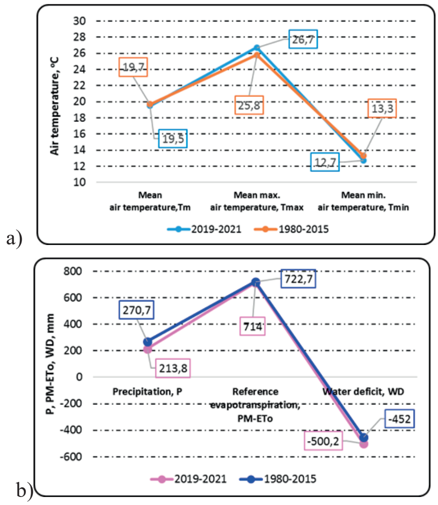

Figure 4. The mean values of annual air temperature, maximum air temperature, minimum air temperature (a), precipitation, reference evapotranspiration and water deficit (b) during the growing season in the 2019-2021experimental period versus the long-term, 1980-2015, Valu lui Traian, Romania

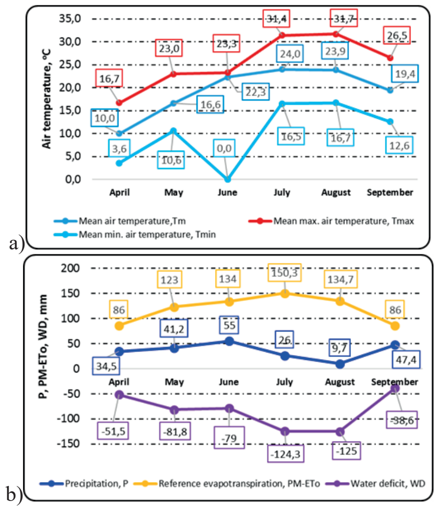

Figure 5. The mean value of monthly air temperature, maximum air temperature, minimum air temperature (a), precipitation, reference evapotranspiration and water deficit (b) during the growing season in the 2019-2021 experimental period versus the long-term, 1980-2015, Valu lui Traian, Romania

Biometric measurements and weight of apricot fruits. After harvesting, in the laboratory, biometric measurements and fruit weighing were performed. The presented values represent average values of the three years of study.

In the Olimp cultivar, the fruits had a longitudinal diameter of 45.98 mm to 54.14 mm, with the largest longitudinal diameter in the b2 treatment. There were significant differences among the studied treatments on fruit longitudinal diameter as indicated by different letters according to probability (P) ≤ 0.05 according to Duncan's multiple range test, Figure 6a. The transversal diameter of the fruits had the same trend. The lowest value was obtained in treatment b3, 41.5 mm and the highest value in treatment b2, 47.3 mm, respectively. Significant differences between the studied treatments in terms of fruit transverse diameter are shown in Figure 6b. The apricot fruits had a height of 53.8 mm to 60.5 mm. Figure 6c shows significant difference between the fertilizer treatments and control treatment regarding the fruits' height.

The fruit weight determined on the fruits of the studied treatments had the same trend. The highest value was recorded in treatment b2, 71.0 g respectively, and the lowest value in treatment b3, 52.9 g. Figure 6d shows significant difference between the fertilizer treatments and control treatment regarding the fruits weight.

In the Goldrich cultivar, fruits had a longitudinal diameter of 46.8 mm to 56.8 mm, with the largest longitudinal diameter in the b2 treatment. Figure 7a shows significant differences between the studied treatments as indicated by different letters according to probability (P) ≤ 0.05 according to Duncan's multiple range test. The transverse diameter had the same trend. The highest value was obtained in treatment b2, 51.0 mm, Figure 7b. Fruit height of the Goldrich cultivar ranged from 50.4 mm to 60.2 mm. Figure 7c shows significant differences between the studied treatments in terms of fruit height. The fruit weight determined on the fruits of the studied treatments varied between 87.1 g in the b2 treatment and 56.9 g in the b3 treatment. Significant differences between the studied treatments are shown in Figure 7d.

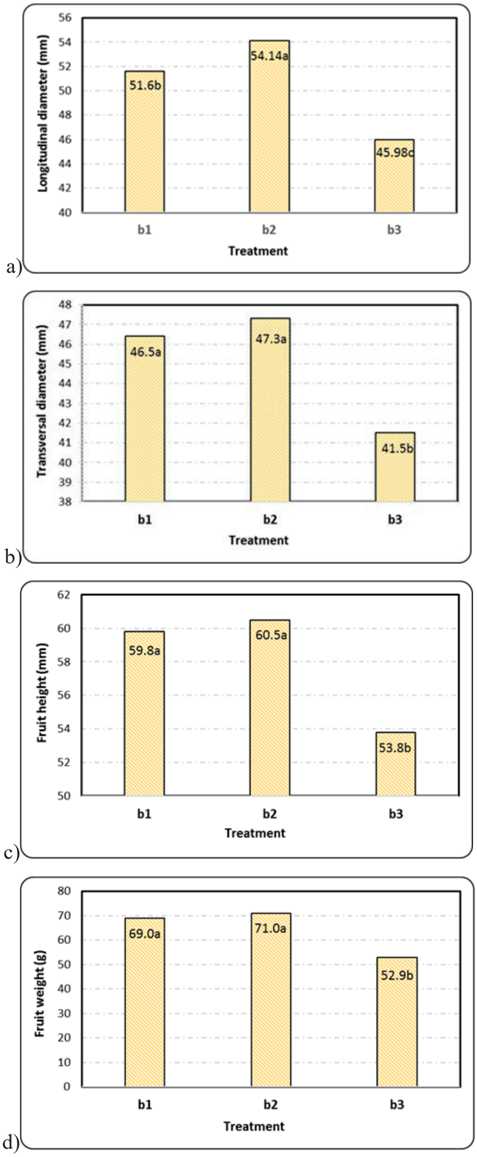

Figure 6. Longitudinal diameter (a), transversal diameter (b), fruit height (c) and fruit weight (d) of the fruits to Olimp cultivar, 2019-2021

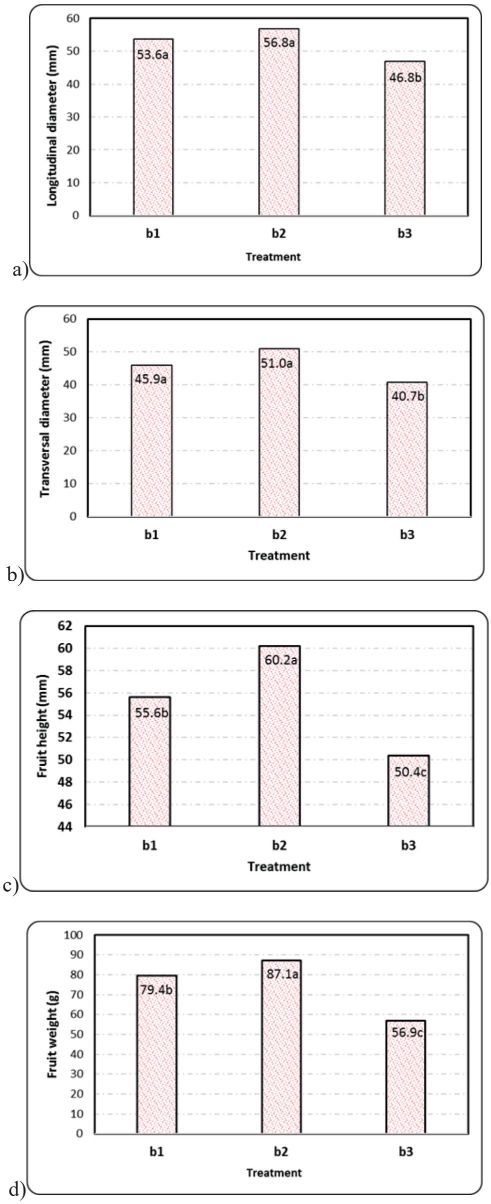

Figure 7. Longitudinal diameter (a), transversal diameter (b), fruit height (c) and fruit weight (d) of the fruits to Goldrich cultivar, 2019-2021

CONCLUSIONS

The obtained results show that the combined use of radicular and foliar fertilization contributes to the improvement of fruit quality.

In Olimp and Goldrich cultivars, fruit weight was higher compared to the control treatment using radicular fertilization with NPK+S and foliar fertilization with Cropmax.

Application of bio-stimulator treatments resulted in improvement of all biometric indicators for apricot fruits.

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