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ORGANIC FOLIAR FERTILISERS INFLUENCE ON SOME PEACH VARIETIES

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Abstract

Foliar fertilization is a fundamental instrument in orchard management, having an important role in obtaining good-quality crops and being essential in maintaining fruit yield, as frequent fertilization assures sufficient mineral nutrients for tree growth. Foliar fertilisers have countless benefits for plants, produce a rapid effect in comparison with soil fertilization and are easily assimilated. Foliar fertilisers also increase plant resistance to diseases and pests thus decreasing the environmental impact of chemical fertilisers. The presented data are partial results of the PhD thesis. The experiment was conducted in 2024 at a fruit tree nursery located in Lugoj, Timis County (45°42'22.1"N 21°51'36.1"E). The research focused on analyzing four peach varieties: "Tokinostate", "Eureka," "Desert Gold" and "Elbertina." These varieties were treated with three different organic foliar fertilisers - Albit, Cropmax, and Naturamin Plus - applied during three distinct growth phenophases. The studied varieties were differently influenced by the applied fertilisers. Soluble solid content was improved in most of the varieties when using organic fertilisers.

Key words*: fruit mass, soluble solid content, size index, fruit hardness.*

INTRODUCTION

Fertilization of fruit trees is an essential component of technology since it has a substantial impact on crop quality and production (Baldi et al., 2005, Dascălu et al., 2023). Climatic conditions and management techniques have a substantial effect on the efficiency of fertilization (Cai et al., 2023). Organic fertilisers can improve peach root production and lifetime (Baldi et al., 2010).

Foliar fertilization has become an essential management technique in intensive orchards offering a promising potential for improving fruit quality at a low cost and low environmental effect (Csihon et al., 2021). Sprays deliver nutrients to plants faster than soil fertilization (Septar et al., 2022). The quick responsiveness, efficacy and eradication of deficiencies caused by nutrients make foliar spraying superior to soil treatment (Ali et al., 2014). When conducting foliar spray experiments, physico-chemical characteristics must be taken into consideration (Fernández et al., 2006). Foliar fertilisers, especialy the organic ones, can have significant positive influences on the soluble solid content of the fruits (Dascalu et al., 2024).

In terms of both economic and nutritional value, peaches (*Persica vulgaris* L.) rank as the second most significant deciduous fruit crop in the world (Cai et al., 2023). Peaches contain antioxidant phytochemicals, vitamins, minerals, fibres, which have beneficial effects on human health (Tomás-Barberán et al., 2013, Byrne et al 2012). This species responds well to fertilization and is a major consumer of N and K (Damianov et al., 2022).

For hundreds of years, peaches have been a staple of the human diet. In the last decades, however, the amount of peaches consumed per person has decreased significantly (Bento et al., 2022; Anthony & Minas, 2021).

According to consumer surveys, fruit that is unpleasant, browned, not at optimal maturity (such as overripe or too green), or has an unusual texture are the reasons why peach consumption has decreased (Crisosto & Labavitch, 2002; Koneru, 2013).

Fertilization is a preharvest factor with great influence on fruit quality (Minas et al., 2018). For example, an excessive fertilization with N prevented peaches from accumulating sugar (Jia et al., 1999), possibly because of the shading of

the fruits by the surrounding rich foliage (Wert et al., 2009).

MATERIALS AND METHODS

Four peach varieties with a close ripening period (second decade of August) were analyzed for the research: "Tokinostate", "Eureka", "Desert Gold" and "Elbertina" (Figure 1). Each variety was treated with 3 organic foliar fertilisers at three different growth phenophases, and for each variety controls were chosen which were not fertilized. The used foliar fertilisers were: Albit (dose: 150 mL/ha), Cropmax (dose: 1.5 L/ha), Naturamin Plus (dose: 1 kg/ha). The first treatment was applied in the second decade of May and the following treatments were applied about 21 days apart.

The experiment took place during 2024, at the nursery of the University of Life Sciences "King Mihai I" from Timişoara, in Lugoj, Timis County (45°42'22.1"N 21°51'36.1"E).

The trees on which the experiment was conducted were planted in 2015, at distances of 4x4 m. Oradea rootstock was used when the four peach varieties were grafted, and their crown shape has been formed to be an "improved vase".

In order to determine the influence of fertilisers, the following parameters were analyzed on the fruits: size index, mass, hardness, soluble solid content and stone percentage. For each parameter, 15 fruits picked at optimal maturity were analyzed. The estimated yield per tree was also determined.

Determination of the size index resulted from caliper measurements on the large diameter, small diameter and height of the fruit, and then the SI=(D+d+h)/3 (SI=Size index; D=large diameter; d=small diameter, h=height) formula was used.

The mass of the fruit was measured using the Kern PES620-3M analytical balance. Fruit hardness was determined with the Lutron FR-5105 penetrometer and the soluble solid content was determined with the ATAGO PAL 3870 digital refractometer. The stones were weighed separately and the stone percentage was determined in relation to the fruit weight.

Concerning the fruit yield per tree, about 10 days after the last spraying, fruits of each tree were counted, and after harvesting, the average mass of 30 fruits was calculated and multiplied by the number of fruits.

Data were analyzed using SAS Studio SAS® Studio 3.8 software's One Way Anova test.

Figure 1. The studied varieties and genotypes of peaches

RESULTS AND DISCUSSIONS

The results determined for the examined parameters are presented in Figures 2-7.

Size index

Size of the fruits of "Tokinostate" variety ranged from 52.09 mm (Control) to 61.05 mm (Albit), with a mean value of 56.62 mm. The best results were obtained when Albit fertiliser was used (mean 59.04 mm) and the worst in case of the control (mean 54.19 mm). No significant differences were recorded (p-0.1123).

Fruits of "Eureka" variety ranged in size from 55.42 mm (Cropmax) to 66.21 mm (Naturamin), with an average of 61.42 mm. The best results were obtained with Naturamin fertiliser (mean 63.07 mm) and the worst with Cropmax (mean 58.76 mm). No significant differences were recorded (p-0.2948).

Size of the fruits of "Elbertina" variety ranged from 46.50 mm (Cropmax) to 56.45 mm (Albit), with a mean of the experiment of 51.19 mm. The best results were obtained with Albit fertiliser (mean 53.40 mm) and the worst with Cropmax fertiliser (mean 48.34 mm). No significant differences were recorded (p-0.0856).

Fruits of "Desert Gold" variety ranged in size from 52.93 mm (Cropmax) to 61.55 mm (Albit), with a mean of 57.37 mm. The best results were obtained with Albit fertiliser (mean 58.32 mm) and the worst with Cropmax fertiliser (mean 54.92 mm). No significant differences were recorded (p-0.33).

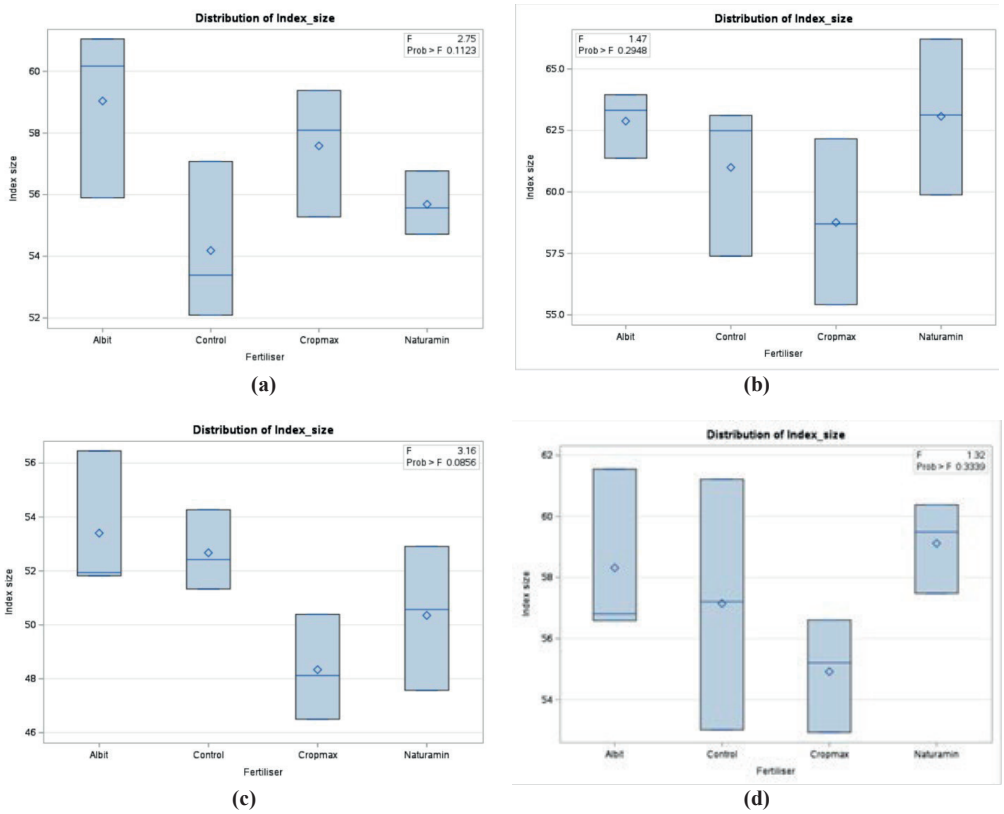

Figure 2. The influence of the fertilisers on the index size (mm)**:** (a) "Tokinostate"; (b) "Eureka"; (c) "Elbertina"; (d) "Desert Gold"

Fruit mass

The mass of the fruits of "Tokinostate" variety ranged from 109.40 g (Control) to 149.80 g (Cropmax), with a mean of 125.03 g.

The highest values were recorded when Cropmax fertiliser was applied (mean 133.30 g) and the lowest in case of the control (mean 116.60 g), with no significant differences recorded (p-0.3551).

Fruits from "Eureka" variety had a mass ranging from 100.50 g (Cropmax) to 185.50 g (Naturamin), with an experiment mean of 149.66 g. The highest values were obtained with Naturamin fertiliser (mean 157.77 g) and the lowest with Cropmax (mean 125.83 g). There were no significant differences recorded (p-0.1646).

The fruit mass of "Elbertina" variety ranged between 72.40 g (Cropmax) and 113.60 g (Albit), with a mean of 87.325 g. The highest masses were obtained in case of Albit fertiliser (mean 95.77 g) and the lowest with Cropmax (mean 76.53 g). There were no significant differences recorded (p-0.1104).

"Desert Gold" peaches' mass ranged from 98.40 g (Cropmax) to 152.80 g (Control), with a mean of the experiment of 122.03 g. The highest results were obtained with Albit fertiliser (mean 129.10 g) and the lowest with Cropmax (mean 110.07 g). Significant differences were not recorded (p-0.4978).

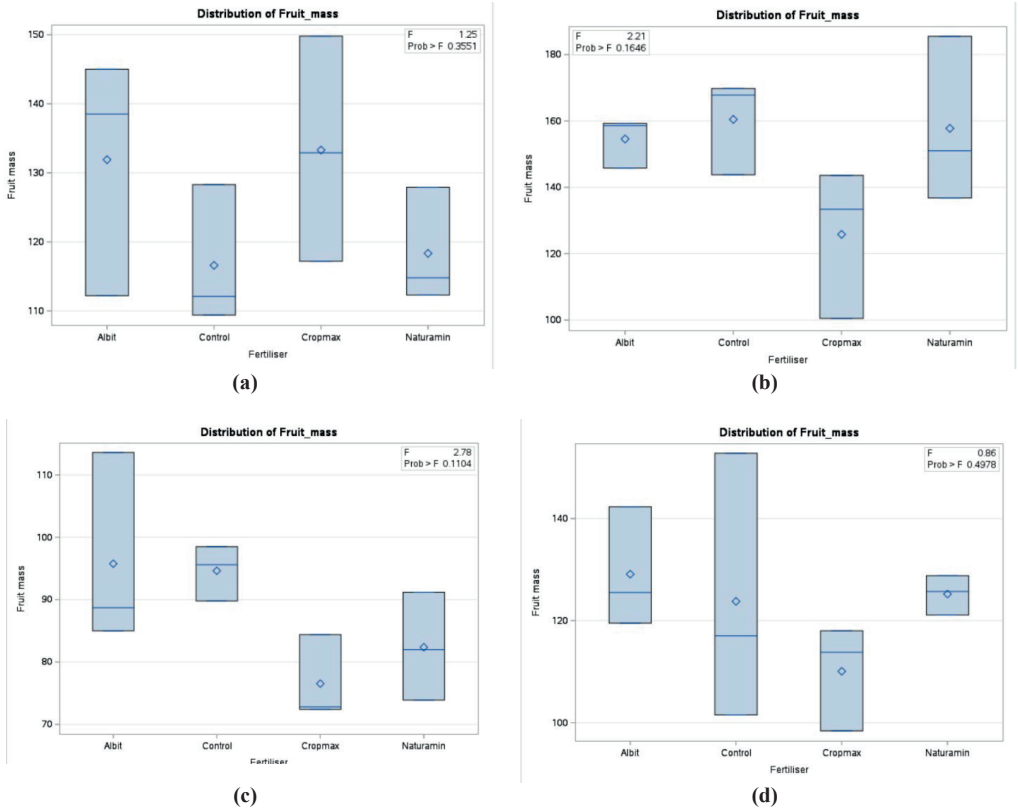

Figure 3. The influence of the fertilisers on the fruit mass (g): (a) "Tokinostate"; (b) "Eureka"; (c) "Elbertina"; (d) "Desert Gold"

Fruit hardness

"Tokinostate" fruits hardness ranged from 1255.00 kg/cm^2 (Naturamin) to 2501.00 kg/cm^2 (Control), with a mean of the experiment of 1977.25 kg/cm^2. The highest values were obtained in the control samples (mean 2233.67 kg/cm^2), and the lowest with Naturamin (mean 1500.67 kg/cm^2), but without significant differences (p- 0.0885).

The hardness of the fruits of "Eureka" variety ranged from 363.00 kg/cm^2 (Naturamin) to 851.00 kg/cm^2 (Albit), with a mean of the experiment of 554.66 kg/cm^2. The best results were obtained with Albit fertiliser (mean 693.33 kg/cm^2) and the worst with Naturamin (mean 374.33 kg/cm^2). Significantly positive differences were recorded for Albit and Cropmax samples compared to Naturamin and the control.

Fruits of "Elbertina" variety had hardness ranging from 340.00 kg/cm^2 (Naturamin) to 696.00 kg/cm^2 (Albit), with a mean of the experiment of 466.50 kg/cm^2. The highest values were recorded with Albit fertiliser (mean 574.33 kg/cm^2) and the lowest with Naturamin (mean 414.00 kg/cm^2). There were no significant differences recorded (p-0.1763).

Fruit hardness of "Desert Gold" variety ranged from 306.00 kg/cm^2 (Albit) to 1507.00 kg/cm^2 (Cropmax), with a mean of the experiment of 689.67 kg/cm^2.

The highest values were obtained with Cropmax fertiliser (mean 862.00 kg/cm^2) and the lowest with Albit (mean 418.00 kg/cm^2), with no significant differences (p-0.4272).

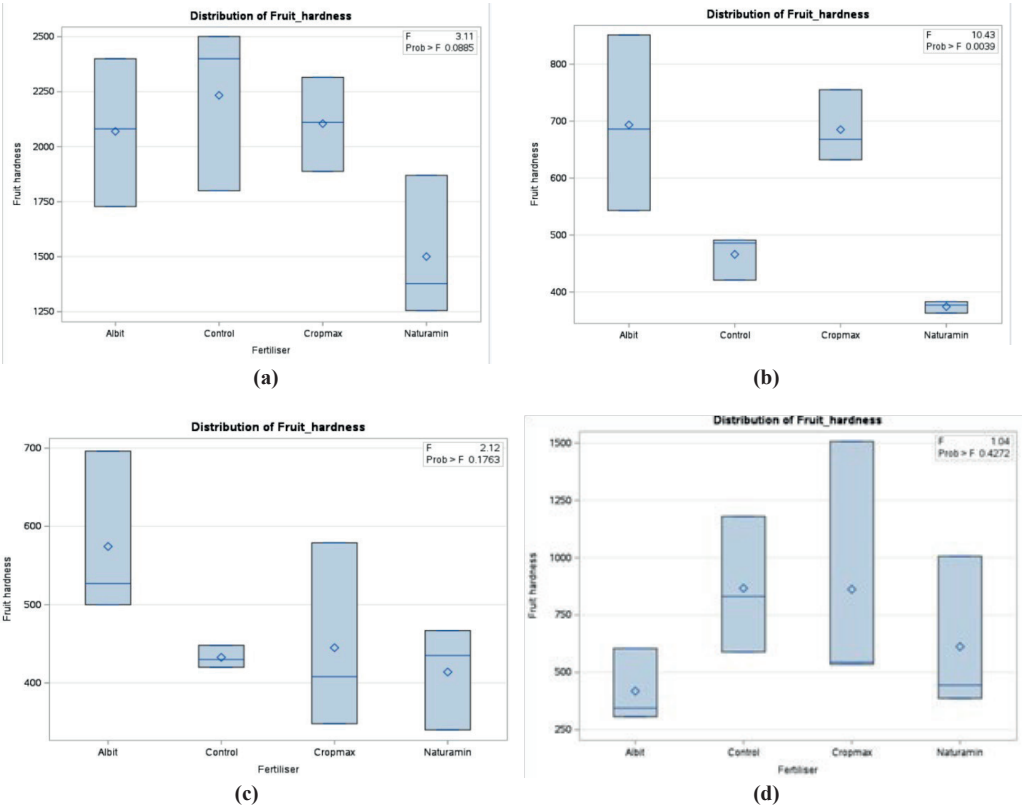

Figure 4. The influence of the fertilisers on the fruit hardness (kg/cm^2): (a) "Tokinostate"; (b) "Eureka"; (c) "Elbertina"; (d) "Desert Gold"

Soluble solid content

The soluble solid content of "Tokinostate" fruits ranged from 15.10 %Brix (Naturamin) to 22.70 %Brix (Cropmax), the average of the experiment being 20.83 %Brix. The highest values were recorded with Cropmax fertiliser (mean 21.93 %Brix) and the lowest with Naturamin fertiliser (19.53 %Brix), but without significant differences (p-0.4101).

The soluble solid content of the fruits of "Eureka" variety ranged from 10.30 %Brix (Control) to 12.90 %Brix (Albit), the mean of the experiment being 11.37 %Brix. The highest values were recorded with Albit fertiliser (mean 11.60 %Brix) and the lowest in case of the control (10.73 %Brix), but without significant differences (p-0.4898).

The soluble solid content of "Elbertina" fruits ranged from 17.90 %Brix (Control) to 22.70 %Brix (Albit), with the mean of the experiment of 20.02 %Brix. The highest values were recorded in the fruits treated with Albit fertiliser (mean 21.97 %Brix) and the lowest in the control samples (18.37 %Brix). Significantly positive differences were recorded for Albit and Cropmax variants compared to Naturamin treatments and to the control.

The soluble solid content of "Desert Gold" fruits ranged between 15.00 %Brix (Control) and 23.10 %Brix (Cropmax), the average value of the experiment being 18.99 %Brix. The highest values were recorded with the Cropmax fertiliser (mean 22.10 %Brix) and the lowest in the control (16.20 %Brix). Significantly positive differences were recorded for two variants (Cropmax and Albit), compared to the control and Naturamin variants.

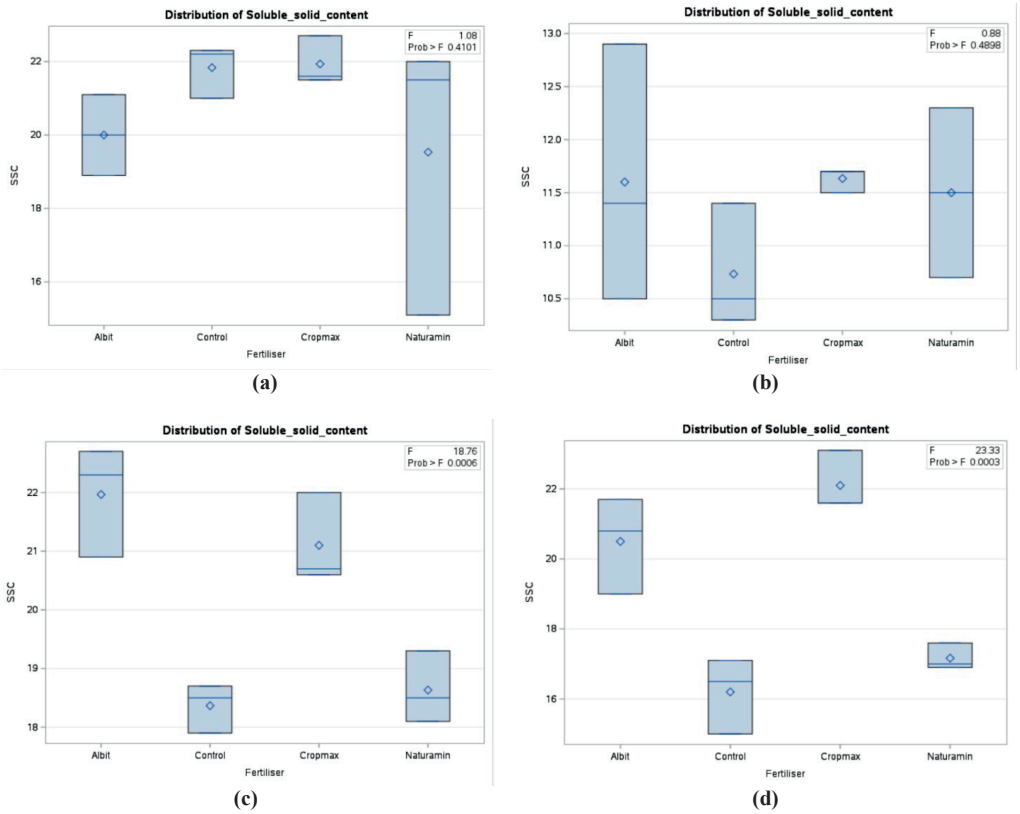

Figure 5. The influence of the fertilisers on the soluble solid content (%Brix): (a) "Tokinostate"; (b) "Eureka"; (c) "Elbertina"; (d) "Desert Gold"

Stone percentage

"Tokinostate" fruits had a stone percentage ranging from 5.21% (Cropmax) to 7.13% (Control), with an average of 6.1%. The lowest stone percentage was recorded when using Cropmax fertiliser (5.26%) and the highest in case of the control (6.85%). Significantly positive differences were recorded for Cropmax and Naturamin fertilisers compared to the control of the experiment.

Fruits of the "Eureka" variety had their stone percentage values ranging from 5.23% (Naturamin) to 8.76% (Cropmax), with an experiment mean of 6.72%. The lowest stone percentage was recorded for Naturamin fertiliser (5.80%) and the highest for Cropmax fertiliser (7.51%). No significant differences were recorded (p-0.0684).

The stone percentage of "Elbertina" fruits ranged from 3.14% (Control) to 5.36% (Cropmax), with an average of 4.32%. The smallest stone was recorded in the control (3.35%), and the highest when Cropmax fertiliser was used (5.09%). There were significantly positive differences for the control of the experiment in comparison with Cropmax fertiliser.

"Desert Gold" fruits had stone percentage values ranging from 4.74% (Naturamin) to 6.91% (Cropmax), with an experiment mean of 5.83%. The best results were recorded for Naturamin (5.12%) and the worst for Albit (6.38%). There were no significant differences.

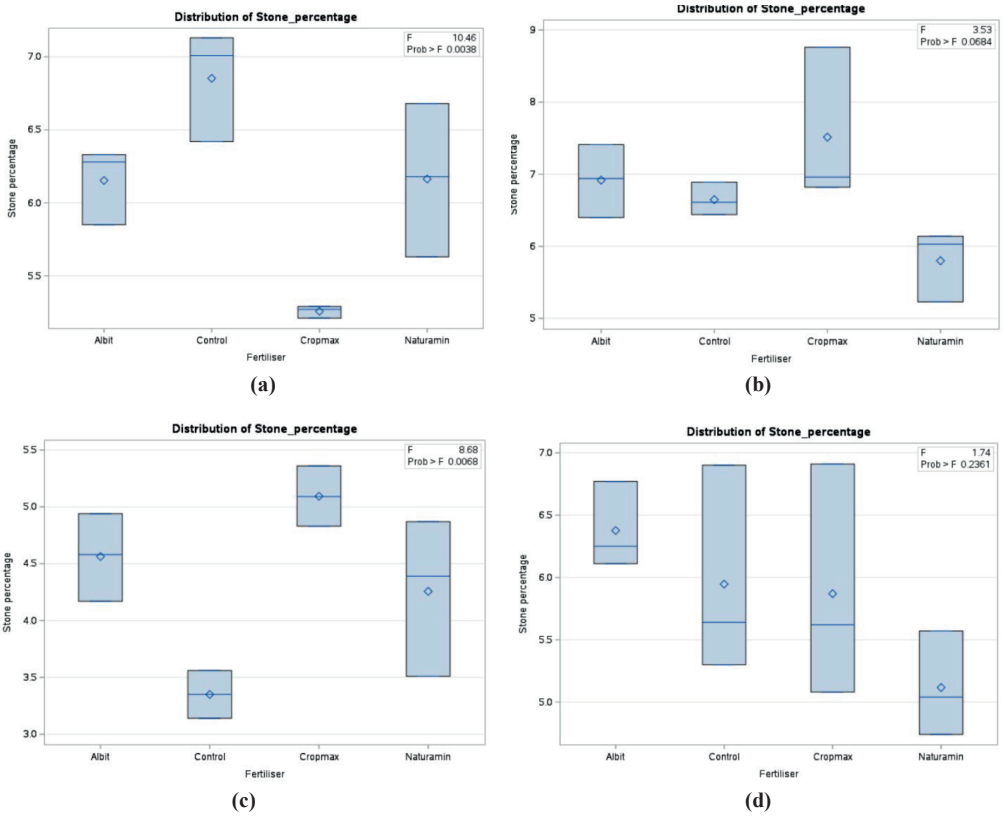

Figure 6. The influence of the fertilisers on the stone percentage (%): (a) "Tokinostate"; (b) "Eureka"; (c) "Elbertina"; (d) "Desert Gold"

Fruit yield per tree

The fruit yield per tree of "Tokinostate" variety ranged from 22.11 kg/tree (Control) and 59.52 kg/tree (Albit), with an average of the experiment of 35.07 kg/tree. The best values were recorded when using Albit fertiliser (46.28 kg/tree) and the worst results when Naturamin fertiliser was applied (25.98 kg/tree). Significantly positive differences were recorded for Albit fertiliser compared to Naturamin fertiliser.

The fruit yield per tree in case of "Eureka" ranged from 39.90 kg/tree (Control) to 45.22 kg/tree (Naturamin), with an average of 42.05 kg/tree. The best values were recorded with Naturamin fertiliser (42.84 kg/tree), and the worst results in the control (41.07 kg/tree). There were no significant differences recorded.

In case of "Elbertina" variety, the fruit yield per tree ranged from 32.24 kg/tree (Cropmax) and 49.20 kg/tree (Control), with a 41.48 kg/tree average. The best values were recorded in the control (48.00 kg/tree) and the worst for Cropmax fertiliser (35.73 kg/tree). Significantly positive differences were recorded for the control variant, and Albit fertiliser compared to Cropmax fertiliser, and for the control compared to Naturamin.

"Desert Gold" variety had a fruit yield per tree interval ranging from 21.90 kg/tree (Control) to 69.62 kg/tree (Cropmax), with an average of the experiment of 45.47 kg/tree. The highest values were recorded with the Cropmax fertiliser (60.25 kg/tree), and the lowest results with the control (23.23 kg/tree). There were significantly positive differences for Cropmax, Naturamin and Albit fertilisers compared to the control. Significantly positive differences were also recorded for Cropmax compared to Albit fertiliser.

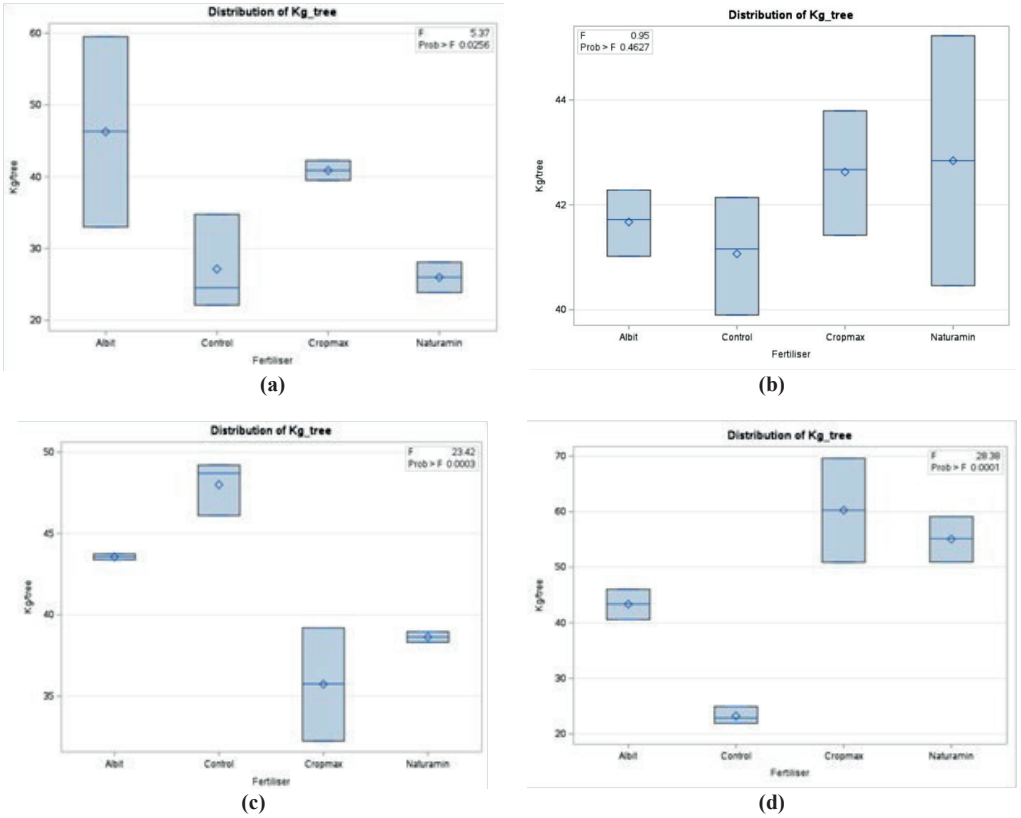

Figure 7. The influence of the fertilisers on fruit yield per tree (kg/tree): (a) "Tokinostate"; (b) "Eureka"; (c)"Elbertina"; (d) "Desert Gold"

CONCLUSIONS

Each fertiliser had different influences on the analyzed parameters of the four peach varieties. Statistically significant results were recorded for hardness, soluble solid content, stone percentage and yield per tree. As for the other two parameters, size index and fruit mass, even though statistically significant results were not recorded, the highest values, for all varieties, were obtained when fertilisers were used.

For hardness, significant differences were recorded only for "Eureka" variety, with positive influences of Albit and Cropmax fertilisers in comparison with the control, but also with Naturamin fertiliser.

Soluble solid content was improved in most of the varieties when using organic fertilisers. Statistically significant results were recorded in "Elbertina" and "Desert Gold" varieties, with positive influence of Albit and Cropmax fertilisers in comparison with the control and Naturamin fertiliser.

Regarding stone percentage, significant results were recorded for "Tokinostate" and "Elbertina" varieties. In case of "Tokinostate", Cropmax and Naturamin fertilisers had a significant influence compared to the control, the lowest stone percentage being obtained when using these fertilisers. In "Elbertina" variety, the lowest stone percentage was obtained in the control, with significant differences between it and Cropmax fertiliser.

In terms of yield per tree, statistically significant results were recorded for "Tokinostate", "Elbertina" and "Desert Gold" varieties, but the most representative results were obtained for "Desert Gold" variety, in which the use of Cropmax fertiliser resulted in almost three times the yield of the control.

Further studies are required, particularly concerning how fertilisers influence the internal properties of the fruits.

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