Current Trends in Natural Sciences
Vol. 10, Issue 19, pp. 387-393, 2021
https://doi.org/10.47068/ctns.2021.v10i19.051
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

BIOMETRIC CHARACTERISTICS OF 'ORIZONT' APRICOT CULTIVAR UNDER STRESS HYDRIC CONDITIONS

Leinar Septar [1,*], Cristina Moale [1], Larisa Tilinca [1], Ioan Stoli [1]

[1]Research Station for Fruit Growing (RSFG) Constanta, 25 Pepinierei Street, Valu lui Traian, Constanta, Romania

Current Trends in Natural Sciences

Abstract
Irrigation is a major activity in arid and semi-arid regions for many crops, including orchards. The deficit irrigation is an alternative in the context of global warming. The crop studied was apricot, 'Orizont' cultivar, 16 years old, grafted on the 'Constanta 14' rootstock. The planting distance was 4 m between the rows and 5 m between trees in the row. Fruit size and weight are important qualities and yield traits in apricot (Prunus armeniaca L.), but the factors that influence fruit size and weight remain to be explored. The fruit biometrical characteristics was influenced by the irrigation regime, with the irrigated treatment with 100% AHI (T1) showing significantly (P <5%) higher differences versus T2 and T3. As with fruit biometrical characteristics, the fruit weight determined on the fruits of the studied treatments had the same trend. In this study, we investigated the impact of stress hydric on fruit size and weight at 'Orizont' apricot cultivar in 2019-2020 period.

Keywords: climatic conditions, longitudinal diameter of fruit, Prunus armeniaca L, weight of fruit.

1. INTRODUCTION

At present and more so in the future, irrigated agriculture will take place under water scarcity. Insufficient water supply for irrigation will be the norm rather than the exception, and irrigation management will shift from emphasizing production per unit area towards maximizing the production per unit of water consumed, the water productivity (Fereres and Soriano, 2007). To cope with scarce supplies, deficit irrigation, defined as the application of water below full crop-water requirements (evapotranspiration), is an important tool to achieve the goal of reducing irrigation water use (Fereres and Soriano, 2007). The concept of regulated deficit irrigation (RDI) was first proposed by Chalmers et al. (1981) and Mitchell and Chalmers (1982) to control vegetative growth in peach orchards, and they found that savings in irrigation water could be realized without reducing yield. Nevertheless, experiments with RDI have been successful in many fruit tree and nut species such as apricot (Ruiz-Sánchez et al., 2000), almond (Goldhamer et al., 2000), pistachio (Goldhamer and Beede, 2004). If deficit irrigation (DI) is used, monitoring the soil or plant water status is even more critical for minimizing risk, given the uncertainties in determining the exact water requirements. In Romania, apricot is highly appreciated, but its favorability area is relatively restricted from the climate view point. It finds proper climate conditions in Dobrogea region, Romania, (winter temperatures not too low), more favorable than in other regions of the country.

*Corresponding author, E-mail address: septarleinar71@gmail.com

Current Trends in Natural Sciences
Vol. 10, Issue 19, pp. 387-393, 2021
https://doi.org/10.47068/ctns.2021.v10i19.051
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

The purpose of this study is to establish the impact of stress hydric on biometric characteristics of the apricot fruits.

2. MATERIALS AND METHODS

Study area. The studied orchard is located in village Agigea (44º05' Northern latitude and 28º37' Eastern longitude), Dobrogea region, Romania. The experiment location has an average altitude of 30 m and is situated about 2 km from the Black Sea. This is a semi-arid region with a climatic water deficit (WD, as difference between the annual values of precipitation (P) and Penman-Monteith reference evapotranspiration (PM-ETo) of about -405 mm on the Black Sea costal area (Paltineanu et al., 2007). The climate conditions at the experimental site are specific for a semiarid region, with a mean annual air temperature of 12.0°C, a mean annual precipitation amount of 425.8 mm and reference evapotranspiration totalizes 827.5 mm annually for 1980÷2009 period (Paltineanu et al., 2016a). Climatic data were recorded by automatic weather stations (WatchDog Weather Station 2000, Spectrum Technologies Inc., Aurora Illinois, USA and iMetos, IMT300, Pessl Instruments, Austria) by a 1-h step. These data were periodically transferred to a laptop and processed as diurnal means and used in calculations. The soil is a calcaro-calcic chernozem (*World Reference Base for Soil Resources, 2006) with a loamy texture and alkaline pH, a proper soil structure and high fertility in topsoil (0-60 cm). Land slop is between 1.0 and 3.0% and soil bulk density around 1.20 g cm^{-3}.

Experimental design and irrigation application. The split-plot experiment described here is mono-factorial with irrigation strategy having three graduations. The apricot tree (*Prunus armeniaca L.*) was selected for this study because is representative for this region. The biological material is representing by 'Orizont' cultivar omologated in 2004. The study was carried out during two years (2019÷2020). The fruit trees were planted in spring 2004, in a 4m x 5m layout. The studied plots comprised three adjacent fruit tree rows with the central row containing three trees for measurements and observations. The canopy shape was a classic vase and the soil management systems was clean cultivation both between tree rows and in the row. The irrigation regime consisted of the following treatments: T1- irrigated at 100% AHI (active humidity interval), T2-irrigated at 70% AHI and T3-control, non-irrigated treatment. The watering method used was drip irrigation. The dripper spacing was 0.6 m and the dripper discharge about 2.0 Lh^{-1}. The irrigation aplicated in June and August in 2019 and from May to August in 2020. We applied only four irrigations in 2019 with 20 mm in T1 and 10 mm in T2, totaling 80 mm in T1 and 40 mm in T2, respectively. However, there were six irrigation applications during the dryer period in 2020, each of 20 mm in T1 and 10 mm in T2, totaling 120 mm and 60 mm, respectively. No water was applied in T3.

Soil water content measurements. Soil water matric potential (SWP) was measured with Watermark resistance blocks (6450 Watermark Soil Moisture Sensor, Spectrum Technologies, Inc) installed for each fruit tree at four depths: 20, 40, 60 and 80 cm at a 150 cm distance from the tree trunk. The sensors were placed on the same vertical line at 45° angles below horizontal according to the method described by Paltineanu and Howse (1999). These data were recorded by WatchDog dataloggers (WatchDog Model 1650 Data Logger, Spectrum Technologies, Inc) and downloaded periodically by a laptop (Figure 1). The relationships between SWP measured with the Watermark sensors and soil water content (SWC) measured gravimetrically were previously determined from

*Corresponding author, E-mail address: septarleinar71@gmail.com

Current Trends in Natural Sciences
Vol. 10, Issue 19, pp. 387-393, 2021
https://doi.org/10.47068/ctns.2021.v10i19.051
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

field data (Paltineanu et al., 2011b); these relationships were then used to transform soil water matric potential readings into SWC values during the experiment.

Figure 1. Laptop and WatchDog datalogger

Fruit determinations. 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 an 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). Fruit were harvested between the 16th to the 18th of June in 2019 and from 23rd to the 24th of June in 2020.

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.

3. RESULTS AND DISCUSSIONS

Climate conditions

During the growing season in the experimental period the mean yearly maximum and minimum air temperatures were 26.9 and 12.9°C, respectively, versus the long-term yearly means of 22.5 and 14.8°C. The mean annual air temperature was 19.9°C, versus 18.5°C for long-term, showing a trend of warming in the area. In the growing season, the mean annual precipitation amount was 159.2 mm, versus 224.2 mm for long-term, almost similar, and mean annual reference evapotranspiration was 735.9 mm, versus 661.5 mm for long-term, showing also a trend of dryness. ETo values were on average 145.0, 147.0 and 136.4 mm month^{-1} during June, July and August, respectively. The average value of climatic water deficit (WD) in the growing season of the study period was -576.0 mm, versus -437.3 for long-term. The mean value of yearly and monthly climate data during the growing season and outside growing season in the experimental period is shown in the table 1 (a, b).

The period of experiment (2017÷2020) was considered as a relatively normal period, showing however an aridization trend, with monthly temperature means of 22.7°C in June, 23.8°C in July and 24.6°C in August, respectively.

*Corresponding author, E-mail address: septarleinar71@gmail.com

Current Trends in Natural Sciences
Vol. 10, Issue 19, pp. 387-393, 2021
https://doi.org/10.47068/ctns.2021.v10i19.051
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Table 1a. The mean value of annual climate data during the growing season and outside it in the 2017÷2020 experimental period versus the long-term, 1980 ÷ 2009, Agigea, Romania

Climatic data	Growing season		Outside of growing season	
	2017÷2020	1980÷ 2009	2017÷2020	1980÷ 2009
Mean air temperature, T_{med} (°C)	19.9	18.5	6.3	5.5
Mean maximum air temperature, T_{max} (°C)	26.9	22.5	11.1	12.3
Mean minimum air temperature, T_{min} (°C)	12.9	14.8	1.7	2.7
Precipitation, P (mm)	159.2	224.2	148.4	201.6
Reference evapotranspiration, PM-ET_0 (mm)	735.9	661.5	168.8	166.0
Water Deficit/Water Excess, WD/WE (mm)	-576.0	-437.3	-21.2	35.6

Table 1b. The mean value of monthly climate data during the growing season and outside growing season in the experimental period 2017÷2020, Agigea, Romania

Climatic data	Growing season						Outside of growing season					
	Apr	May	Jun	Jul	Aug	Sep	Jan	Feb	Mar	Oct	Nov	Dec
Mean air temperature, T_{med} (°C)	11.0	17.0	22.7	23.8	24.6	20.4	0.3	3.4	7.4	13.8	8.3	4.5
Mean maximum air temperature, T_{max} (°C)	18.1	23.6	29.7	30.9	32.0	27.3	4.7	7.9	13.7	19.3	12.4	8.4
Mean minimum air temperature, T_{min} (°C)	3.9	10.5	15.8	16.7	17.0	13.5	-3.8	-0.9	1.5	8.2	4.6	0.8
Precipitation, P (mm)	17.1	18.7	39.8	58.6	4.8	20.2	15.8	43.7	30.6	11.3	17.3	29.7
Reference evapotranspi-ration, PM-ET_0 (mm)	95.2	129.0	145.0	147.0	136.4	83.3	12.9	23.4	57.4	44.8	18.7	11.6
Water Deficit/Water Excess, WD/WE (mm)	-78.2	-110.0	-105.0	-88.2	-132	-63.0	2.2	20.3	-27.0	-33.5	-1.5	18.1

Soil water content (SWC) during in irrigation period

In 2019, the dynamics of soil water content (SWC) as a result of the four irrigation applications is shown in Figure 2a. It is noted that both in T1 and T2, the SWC values ranged from FC (field capacity) to MAD (management allowed deficit, mid-interval between FC and WP), except for the values from T2 treatment, last watering, which are found in the interval MAD and WP (wilting point), with values close to MAD. The SWC values in T3 were between MAD and WP, with values close to WP due to the dry year.

*Corresponding author, E-mail address: septarleinar71@gmail.com

Current Trends in Natural Sciences
Vol. 10, Issue 19, pp. 387-393, 2021
https://doi.org/10.47068/ctns.2021.v10i19.051
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

In 2020, following the application of the six waterings the dynamics of soil water content is illustrated in Figure 2b. Thus, in the irrigated treatments, the SWC values oscillated in the range between FC and MAD. But, at the last watering, the SWC values of T1 and T2 to approached MAD. In T3, SWC values were to half interval between MAD and WP, with values approaching to WP at the end of vegetation period.

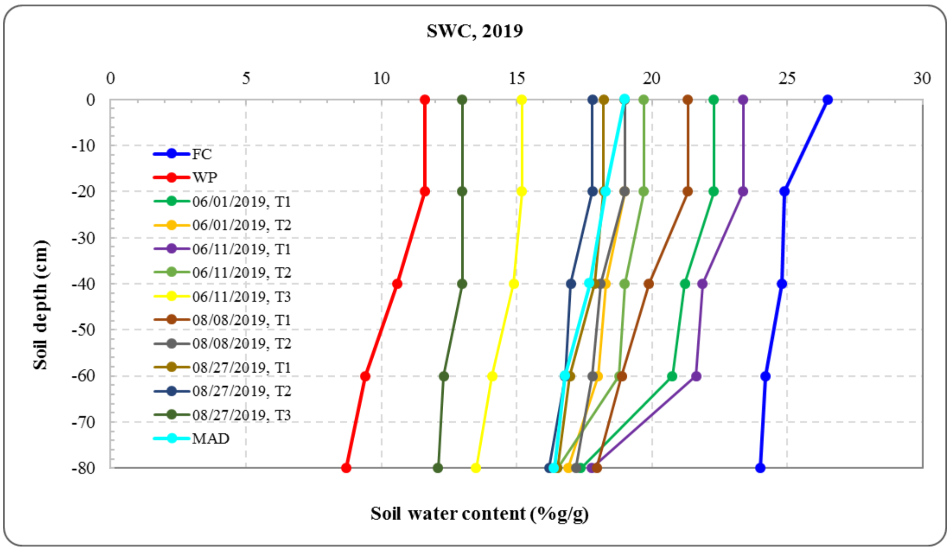

Figure 2a. Soil water content (SWC) profiles in the treatments studied Agigea village, Dobrogea, Romania-2019

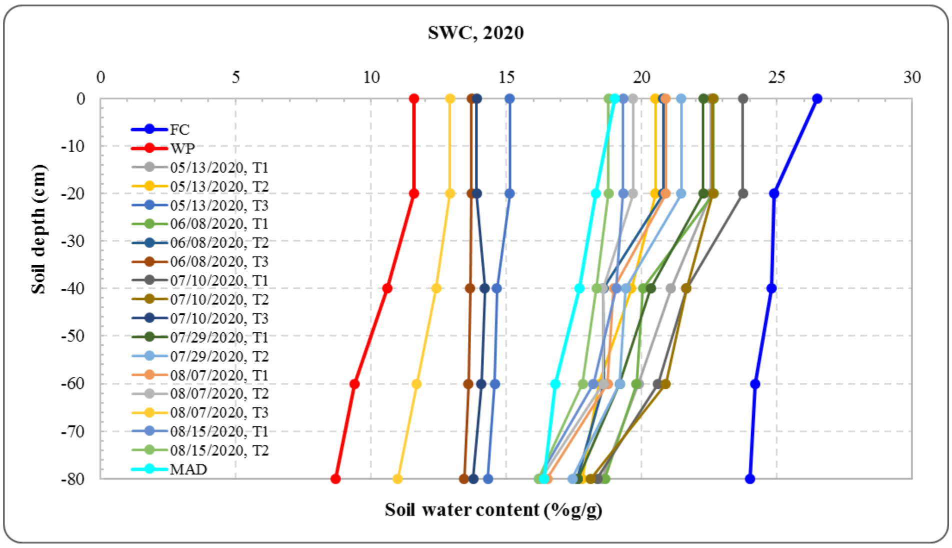

Figure 2b. Soil water content (SWC) profiles in the treatments studied Agigea village, Dobrogea, Romania-2020

Biometrical measurements and weight to apricot fruits

After harvesting, the fruits of experience has been subjected to biometrical measurements and fruits weithing. The values presented represent average values of the two years of study. Thus, apricots

*Corresponding author, E-mail address: septarleinar71@gmail.com

Current Trends in Natural Sciences
Vol. 10, Issue 19, pp. 387-393, 2021
https://doi.org/10.47068/ctns.2021.v10i19.051
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

had a longitudinal diameter of 31.8 mm to 68.6 mm. Fruits in the T1 treatment were much big, followed by the fruits from the T2 treatment. The smallest longitudinal diameter was found in T3 treatment. Figure 3 shows that there were significant differences between the treatments studied on fruit's longitudinal diameter, as indicated by different letters accoring to the probability (P) ≤ 0.05 according to Duncan`s multiple range test. As with fruit longitudinal diameter, the transversal diameter determined on the fruits of the studied treatments had the same trend. The highest value was obtained in T1 treatment, 53.4 mm and the lowest value in T3 treatment, 27.2 mm, respectively. Figure 4 shows significant differences, written with different letters, between the treatments studied regarding the fruits transversal diameter. The height of the fruits determined of the studied treatments had the same trend. The apricot fruits had a height of 32.1 mm to 65.1 mm. Figure 5 shows significant differences between the treatments studied regarding the fruits height. As with fruit biometrical characteristics, the fruit weight determined on the fruits of the studied treatments had the same trend. The highest value was obtained in T1 treatment, 96.5 g and the lowest value in T3 treatment, 29.5 g, respectively. Figure 6 shows significant differences between the treatments studied regarding the fruits weight.

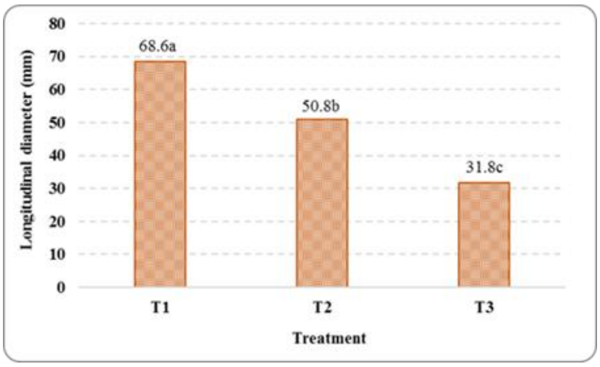

Figure 3. Longitudinal diameter (mm) of the apricot fruits, 2019-2020

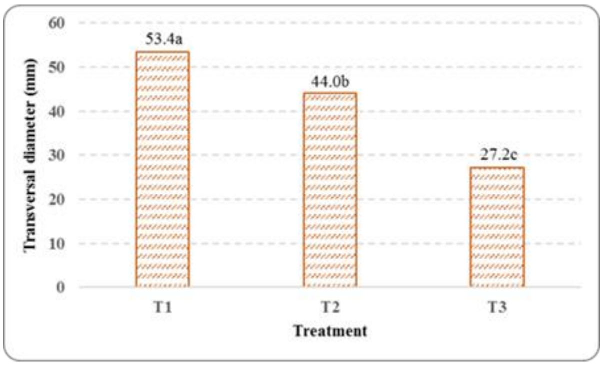

Figure 4. Transversal diameter (mm) of the apricot fruits, 2019-2020

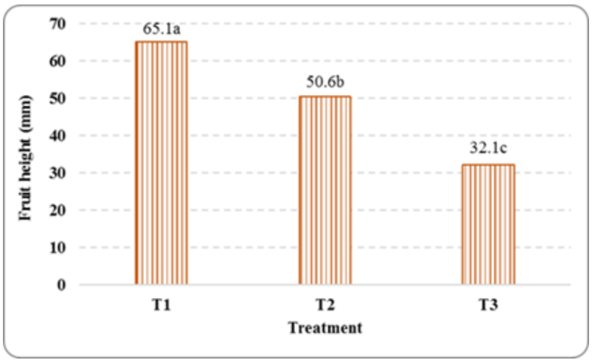

Figure 5. Fruit height (mm) of the apricot fruits, 2019-2020

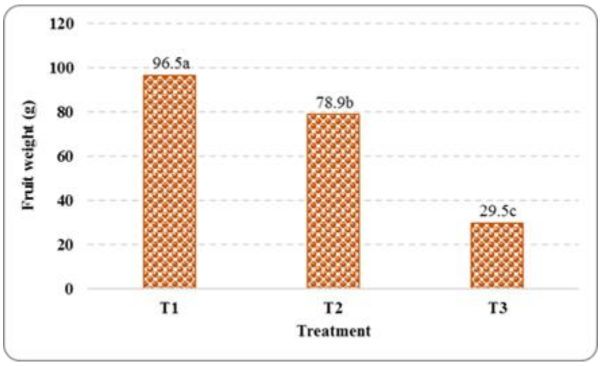

Figure 6. Fruit weight (g) of the apricot fruits, 2019-2020

4. CONCLUSIONS

Irrigation is the largest consumer on the planet. Deficit irrigation, by reducing water use, can aid in coping with situations where supply is restricted.

*Corresponding author, E-mail address: septarleinar71@gmail.com

In the irrigated treatments, T1 and T2, the SWC values oscillated in the range between FC and MAD, but, at the last watering, the SWC values of T1 and T2 to approached MAD.
The fruit biometrical characteristics was influenced by the irrigation regime, with the irrigated treatment with 100% AHI (T1) showing significantly (P <5%) higher differences versus T2 and T3.
As with fruit biometrical characteristics, the fruit weight determined on the fruits of the studied treatments had the same trend.
In the context of global warming, water saving is a major objective. Therefore, irrigation with hydric stress is an attractive alternative.
The study suggests that a moderate water stress can be profitable for enhancing key fruit quality characteristics.

5. ACKNOWLEDGEMENTS

This work was supported by a grant of the Romanian Ministery of Research and Innovation, CCCDI-UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0332"/Project 1 "Complex electronic system with intelligent algorithms for data processing used for monitoring the developing conditions of water and biocenotic stresses, for warning about their presence and preventing them in horticulture", within PNCDI III.

6. REFERENCES

Chalmers, D.J., Mitchell, P.D. & van Heek, L. (1981). Control of peach tree growth and productivity by regulated water supply, tree density and summer pruning. *Journal of the American Society of Horticultural Science*, 106, 307-12.
Fereres, E., Soriano, M. A. (2007). Deficit irrigation for reducing agricultural water use. Journal of Experimental Botany, 58 (2), 147–159.
Goldhamer, D.A., Salinas, M. (2000). Evaluation of regulated deficit irrigation on mature orange trees grown under high evaporative demand. In: Proceedings of the International Society of Citriculture, IX Congress, Orlando, 227-231.
Goldhamer, D.A., Beede, R.H. (2004). Regulated deficit irrigation effects on yield, nut quality and water-use efficiency of mature pistachio trees. Journal of Horticultural Science and Biotechnology, 79, 538-545.
Mitchell, P.D. and D.J. Chalmers. (1982). The effect of reduced water supply on peach tree growth and yield. J. Amer. Soc. Hort. Sci., 107, 853–856.
Paltineanu, C., and Howse, R.K. (1999). Installing suction samplers to collect nitrate-leaching and monitoring soil moisture and hydraulic potential during an infiltration experiment within swell-shrink soils. Stiinta sol, no. 2, vol XXXIII, 9-22.
Paltineanu C., Mihailescu, I.F., Seceleanu, I., Dragota, C., and Vasenciuc F. (2007). Using aridity indexes to describe some climate and soil features in Eastern Europe: a Romanian case study. Theoretical and applied climatology, Springer Velag Vienna, Volume 90, no. 3-4, 263-274.
Paltineanu, C., Septar, L., Moale, C., Oprita, A., and Lamureanu, G. (2011b). Peach Irrigation under soil water stress in the south-eastern part of Romania. Acta Horticulturae, 922, 195-202.
Paltineanu, C., Septar, L., and Chitu, E. (2016a). Temperature profile in apricot tree canopies under the soil and climate conditions of the Romanian Black Sea Coast. Int. J. Biometeorol., 60, 401-410.
Ruiz-Sánchez, M.C., Torrecillas, A., Pérez-Pastor, A., Domingo, R. (2000). Regulated deficit irrigation in apricot trees. Acta Horticulturae, 537, 759-766.
World Reference Base for Soil Resources (2006). A framework for international classification, correlation and communication. Food and Agriculture Organization of the United Nations, Rome, p. 145 http://epic.awi.de/35324/1/wsrr103e.pdf.

*Corresponding author, E-mail address: septarleinar71@gmail.com