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INFLUENCE OF THE PRODUCT FURIA ON THE MORPHOLOGICAL CHARACTERISTICS OF PLANTS AND FRUITS OF LONG PEPPER GROWN IN SOLARIUM

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Keywords: Capsicum annuum L., fulvic acids, Romanian varieties.

ABSTRACT

Furia is a product of plant origin, easily assimilated by cultivated plants. It is composed of organic nitrogen, organic carbon of plant origin, potassium oxide and fulvic acid. The experiment performed in a cold solarium had as objective the influence of this product on the main morphological characteristics of long pepper plants and fruits. The results obtained showed a positive influence of the product on the growth in height of pepper plants, the increase in fruit length and diameter and the increase in the average number of fruits per plant. The biofertilizer is accredited for use in organic horticulture.

INTRODUCTION

Pepper *(Capsicum annuum L.)* is among the most popular and preferred vegetable species crops in the world but also in Romania. This species, in our country, at the level of 2018 had a national production of 229,662 t with an average per ha of 12,775 kg. (http://statistici.insse.ro). The interest for this species is growing due to the high profit in general, and especially the nutritional value very important for human health (Dinu et al., 2018; Sun et al., 2017; Dinu et al., 2013; El-Hifn and El-Sayed, 2011).

It is known that chemical fertilizers increase the yield of horticultural crops, because plants use these nutrients directly, but these fertilizers also produce undesirable effects on the horticultural ecosystem such as: soil and microbial flora degradation, groundwater contamination and air pollution (Chaudhry et al., 2009); Kaur et al., 2008). Consumers and horticultural producers have become more aware of how vegetables are produced and whether food poses a risk to human health in terms of pesticide residues. Unlike conventional production systems where plant nutrition is based on the use of synthetic and well-balanced fertilizers for plant absorption using soil analysis (Popescu and Dinu, 2019) organic horticulture is based on an agro-integrated system that uses organic fertilizer (Dorais, 2007). Organic fertilization has been shown to improve soil physical characteristics and nutrient retention in greenhouse soils (Scotti et al., 2016; Willekens et al., 2014).

The use of humic fertilizers to increase plant growth and yields has been the subject of many research studies over time. Humic substances can be characterized as humic acids, fulvic acids and humus based on water solubility depending on pH (Hartz and Bottoms, 2010). The effects of humic substances on the physicochemical properties of the soil include stabilization of soil structure (Hartz and Bottoms, 2010) and increased cation exchange. Chen and Aviad, (1990) found that optimizing root growth has been attributed to improved soil structure, stimulation of soil microflora, and auxin-like effects. Humic and fulvic acids play an important role in soil fertility and plant nutrition. Soils rich in humic substances or

fertilized with them influence the growth of plants, making them more stress tolerant, healthier, lead to high yields and superior nutritional quality of the harvest (Pettit, 2004).

It is also known that foliar application of humic acids has a rapid impact on the supply of plants according to their requirements. The use of humic acid spray on the leaves of tomato plants is one of the modern methods used to improve plant growth and productivity, due to their direct role in increasing the content of chlorophyll, lycopene, essential enzymes involved in organizing metabolic events or activating antioxidants (Dinu et al., 2015). Therefore, a higher resistance of plants to stress conditions is obtained (Cerdána et al., 2009), as well as a higher productivity in such conditions (Hounsome et al., 2008). Serna et al. (2012) found that spraying pepper plants with a mixture of amino acids led to an increase in the efficiency of photosynthesis and thus to a very good vegetative growth. Sarojnee et al. (2009) and Korkmaz et al. (2012) found that the use of amino acids, also in a pepper crop, led to a pronounced increase in plant height, number of arms and dry weight of shoots, especially after 50 days of treatment, compared to untreated plants.

The aim of this study was to observe the effect of Furia fertilizer, an organic fertilizer based on fulvic acids on the morphological characteristics of plants and fruits of long pepper grown in solarium.

MATERIAL AND METHOD

The study was conducted in a cold solarium, and the experience was bifactorial: the factor "**a"** was represented by technology, having two graduations: a1-V1 - the classic technology of pepper cultivation in solariums and a2-V2 - foliar fertilization supplement with the FURIA product, in a concentration of 0.25%, and the factor "**b**" was represented by the long pepper varieties: b1-Bogdan, b2-Lung de Ișalnița, b3-Lung românesc, b4- Doljan, b5-Cosmin, b6-Fermier, b7- Kaprima F1. 3 treatments were applied at intervals of 15 days (Table 1). The observations consisted of biometric determinations on pepper plants and fruits. The biometric determinations concerned the height of the stem (cm), the height of the plant (cm), the length of the fruit (cm), the diameter of the fruit (cm), measured at the base of the fruit, the average weight of the fruit and the number of fruits per plant. In order to highlight the effectiveness of foliar fertilizer, the comparison of the results was made against the witness.

RESULTS AND DISCUSSIONS

From the data recorded and compared to the witness, it was observed that the FURIA foliar fertilizer had, in most cases, a positive effect on the main morphological characteristics analyzed for the pepper varieties studied.

The height of the stem, measured from the root to the first branch, varied from 18.0 cm (Cosmin) to 29.8 cm (Fermier), for non-fertilized variants and from 21.6 cm also at Cosmin to 33.4 cm at Lung de Ișalnița, for the variants fertilized with Furia. There is a variation of growth, between genotypes in both non-fertilized and fertilized variants, which demonstrates the influence of the cultivar on this growth character (Figure 1). However, it is observed that the same unfertilized cultivar had higher values than the fertilized one, this being explained by the effect of the fertilizer which determined a decrease of the distance between the nodes. The cultivars that were influenced by the fertilizer were: Bogdan, Doljan, Fermier and Kaprima F1. Fury fertilizer increased the height of long pepper stalks, claims also made by Sarojnee et al., 2009 and Korkmaz et al., 2012.

The height of the plant showed higher values in most foliar fertilized varieties, compared to the witness, except for the hybrid Kaprima F1, with a negative difference of 4 cm compared to the control (Figure 2). These data are in agreement with those obtained by Chooneea et al., (2009) on tomatoes or Talat and Youssef (2002) on Ocimus basilicum.

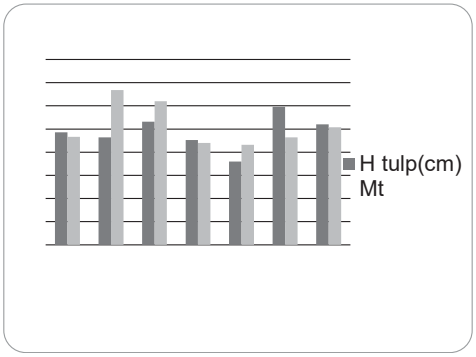

Fig. 1. The height of the stem of long pepper cultivars

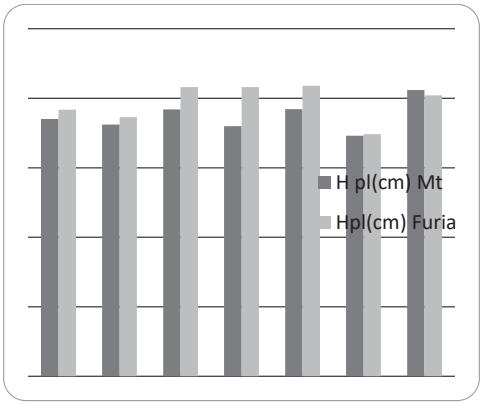

Fig. 2. Average height of long pepper plants / cultivar

The Doljan cultivar registered the largest difference in plant height growth compared to the witness variant (+ 28 cm), followed by Cosmin (+16.8 cm) and Lung românesc (+16 cm). There is no positive correlation between stem growth and plant growth.

The influence of fertilizer on the morphological characteristics of long pepper fruits.

The length of the fruit does not show significant differences between the two technological variants (Figure 3). The average length of the fruits from the non-fertilized variants varied from 15 cm at Fermier to 18.4 cm at Doljan, and at the variants fertilized with Furia from 15.3 cm at Fermier at 20.2 cm at Lung românesc. The foliar treatment positively influenced the fruit length in the cultivars Lung românesc (+2 cm), Cosmin (+1.7 cm), Lung de Șalnița (+1 cm) and Fermier (+0.3 cm), compared to the non-fertilized variants. Chooneea et al., (2009) conducted a study on peppers with foliar fertilizers based on humic acids and found that the fertilizer caused an increase in the length and diameter of the fruits. The diameter of the fruit, measured at the base of the fruit, does not show significant differences between the two technological variants, in the vast majority of cases, only Lung de Șalnița has a positive difference of 1 cm from the control (Figure 4). The diameter of the fruit had values between 3.6 cm at Lung de Șalnița and 7.3 cm at Kaprima F1 at the unfertilized witness and between 4.1 cm at Doljan and 7.2 cm Kaprima F1. It can be said that the fertilizer caused the fruit to deform.

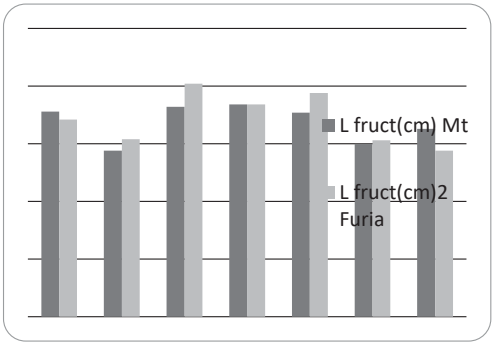

Fig. 3. Average length of fruit / cultivar

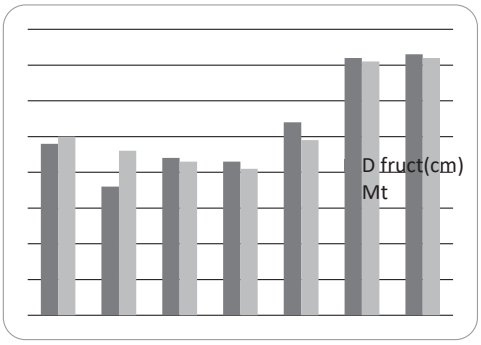

Fig. 4. Average diameter of fruit / cultivar

Regarding the average weight of the fruit, it registered values by a few grams lower in the variant that benefited from foliar treatment, compared to the unfertilized control (Figure 5), except for the cultivars Cosmin (+22 g), Lung de Ișalnița (+13 g), Lung Românesc (+4 g). Fertilizer application was not effective for all cultivars in terms of average fruit weight, a statement also supported by Hartz and Bottoms (2010) in a tomato crop.

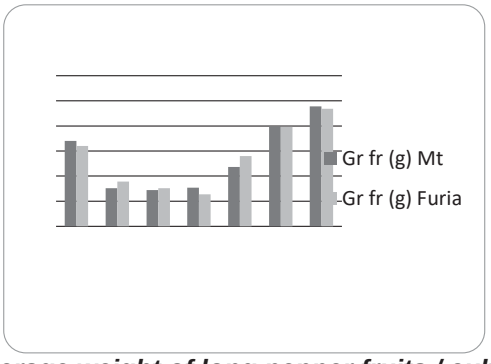

Fig. 5. Average weight of long pepper fruits / cultivar

The number of fruits per plant, a character that influences the productive capacity of a pepper cultivar, has increased in the case of additional application of Furia foliar fertilizer, for all pepper cultivars studied. There was a significant variation from 17 fruits / plant at Fermier to 39 fruits / plant at Lung Românesc in the non-fertilized variants and from 18 fruits / plant at Fermier at 48 fruits / plant at Lung Românesc, at the fertilized variants (Figure 6).

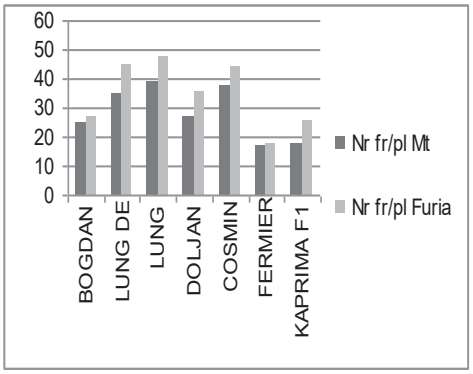

Fig. 6. Average number of fruits / plant / cultivar

The increase of the average number of fruits / plant was also observed by Serna, et al., (2012) in a culture of bell pepper grown in a greenhouse and foliar fertilized with biostimulators. The difference from the witness is one fruit / plant at the farmer Farmer at 10 fruits / plant at the Lung de Iṣalniṭa cultivar. A higher number of fruits per plant were recorded in cultivars in which the average weight of the fruit showed lower values.

CONCLUSIONS

Application of the biostimulator Furia in a long pepper crop grown in a cold solarium caused a significant increase in plant height, fruit length and diameter, as well as the average number of fruits / plant.

The results of this research support the application of biostimulators based on fulvic acids, to stimulate plant growth and increase the marketable yield of long pepper fruits, with minimal risks harmful to the environment and farm workers.

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Table 1

Long pepper cultivars studied

VARIETY	PROVENANCE variety	FRUIT COLOR AT MATURITY	
		technicalities	physiological
BOGDAN	SCDL Ișalnița	Yellowish green	Red
LUNG DE IȘALNIȚA	SCDL Ișalnița	Dark green	Dark red
LUNG ROMÂNESC	SCDL Ișalnița	Yellow-greenish	Red
DOLJAN	SCDL Ișalnița	Yellow-greenish	Orange
COSMIN	ICDLF Vidra	Dark green	Dark red
FERMIER	SC Mefim Agro SRL	Dark green	Dark red
KAPRIMA F1	Holland Farming	Dark green	Dark red

DEFINITION OF CLIMATIC AND OENOCLIMATE TRAITS FOR THE VINE CULTURE IN THE JIDVEI WINE-GROWING CENTER

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Key words: eco-climate factors, vineyards, Jidvei wine-growing region, growing season

ABSTRACT

The position of the Jidvei wine-growing center in climatic terms is favorable to its geographical location, 45°57' and 46°32' north latitude, 23°52' and 24°48' east longitude, at an altitude of 379 m, where the vine cultivation fulfills the best economic conditions. The summary of this work, from 2010 to 2020, shows that the Jidvei wine-growing center is part of the wine-growing zone A1 (Teodorescu Stt., and its collaborators, 1987), which has specific climatic characteristics for the production of only high quality white and aromatic wines, and in very favorable years also red quality wines. The raifall, insolation and temperature are in normal and favorable parameters for viticulture. The values of the heliothermal index (Ihr=1,83), the hydrothermal coefficient (CH=1,41) and the bioclimatic wine index (Ibcv=5,07) show that they are within the optimal values for viticulture in Romania. The index of oenological fitness (IAOe=4220,51) shows that the most favorable conditions for high-quality white and aromatic wines have been achieved in this wine-growing center and that, in some years, favorable average conditions for red quality wines have been achieved. There are enough arguments that define the qualities of climate friendliness and oenological favoritism in the Jidvei wine center.

INTRODUCTION

Oprea Stefan., 1995, classifies the eco-climatic factors defining the specific climatic conditions for each wine-growing area into absolutely necessary factors, those which manifest themselves within moderate accepted limits and critical factors, those which have a negative influence on the holding of vines, ripening and the chemical composition of grapes (Giugea Nicolae., 2001): "Climatic factors are the first ones that restrict the economic, profitable culture of vineyards".This study allowed the use of literature, scientific works and doctoral studies in the Târnave area and other similar areas with tradition for the vine culture, with current conceps. They have been brought to the foreground, data that have been recorded and then analyzed defining the climatic characteristics of the Jidvei wine-growing region. Representative is knowledge of the value of climatic indices defining the climatic favorable characteristics which are important for the definition of the Jidva wine-growing area and the variety microzoning. The Jidvei wine-growing center shall be situated in the Târnave' Plateau, between 45°57' and 46°32' north latitude and 23°52' and 24°48' east longitude, at an altitude of 379 m, with moderate continental temperate climate, with suitable warm summers, harsh and wet winters, with long autumn and predominant serenine, influenced by the western air masses. The Carpathian arc protects the region from cold currents in the north-east and east." The study was carried out at SC.Jidvei S.R.L Company, with the wine centers: Șona, Jidvei, Feisa-Tătârlaua Tăuni-Făget și Cenade.

MATERIAL AND METHOD

The climatic factors recorded in the period 2010 to 2020 were calculated by mathematical formulae and expressed mathematically as average values or sum. The 1986-2020 climatic factors shall be mathematically expressed as multi-annual average values. The interaction of two or more eco-climatic factors shall be expressed and measured by means of synthetic indices. In binary ratios, temperature-to-light interaction is expressed by the heliothermal index (Ihr) (Branas J, 1946) and temperature-to-humidity interaction by hydrothermal coefficient (CH) (Selenianov G.T., 1936). In tertiary ratios, the temperature-to-humidity interaction is expressed by the bioclimatic index (I.b.v.) (Constantinescu G., 1964), and the index of oenological aptitude (I.A.O.E) (Teodorescu C.St., 1977)/

RESULTS AND DISCUSSIONS

The work shows the evolution of some of the eco-climatic factors recorded in the Jidvei wine center in 2010-2020, which are necessary for the assessment of climate favoritism, and of the synthetic climatic indices for the assessment of oenological favoritism.

Vineyards has high requirements in relation to the moisture in the soil and the humidity in the atmosphere.

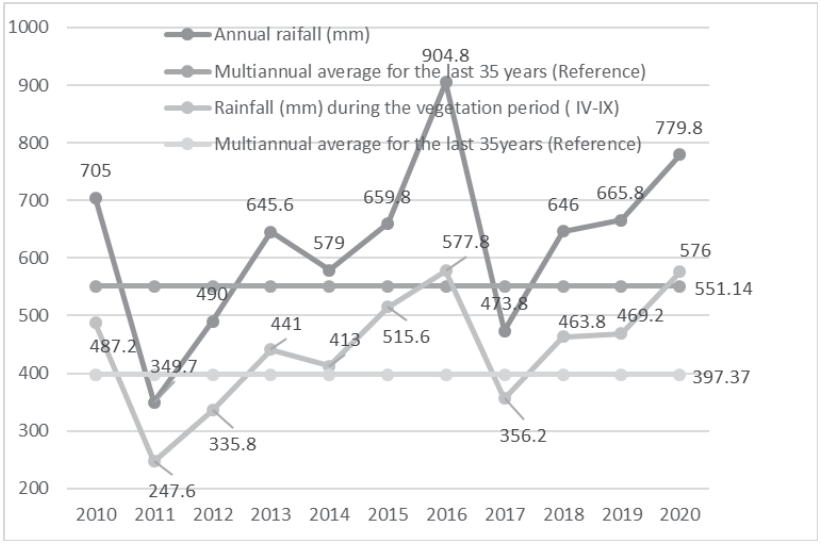

Fig. 1 Evolution of precipitation in the Jidvei wine center (2010-2020)

The multiannual period 1986-2020 is 551,14 mm. Normal, the average of the period 2010 to 2020, is 627,21 mm. The year 2016 was an excessively rainy year (904,8 mm), and 2011 was over-dry (349,7 mm). The total distribution of rainfall over the whole period of the year is quite rich, and their excess over some years 2016 (904 mm) creates difficulties in such a cool environment. Of the total rain falls (627,21 mm) annually, during the growing season 2/3 (443,93 mm) were recorded and during the rest period 1/3 (183,28 mm), The lowest value of the annual average during the growing season (1 IV-30 IX), was in 2011, (247,6 mm) and the highest value in 2016, (577,8 mm). The maximum monthly rainfall was recorded in June, (119,53 mm). Since August (57,19 mm), there have been significant drops in rainfall until September (42,98 mm), October (47,31 mm), which are important for good ripening of grapes, and soil heating.(10,51 annual average).

The vine is pretentious to light, the crop has maximum output in sunny places and exhibition. (Oprea Stt.,1995). The average value of the global solation, important in the appreciation of the real light resources, 2010-2020, summed (Σig=1859,0 hours), with variations of the solar intensity recorded (Σig=2119,8 hours) in 2012 and (Σig=1732 hours) in 2016.

The sum of the hours of effective sunlight, entered (Σir=1269,37 hours). Is also important, two thirds in the warm period of the year 1269,37 hours and one third (589,63 hours) in the cold period of the year of the total (Σig) 1859,0 hours. The maximum sunshine was recorded in July, with a monthly average distribution (Σir=2676,19 hours). August, (2011), was the most sunny, (Σir=269,5 hours). In December (2017), the lowest values were recorded (Σir=35,1 hours).

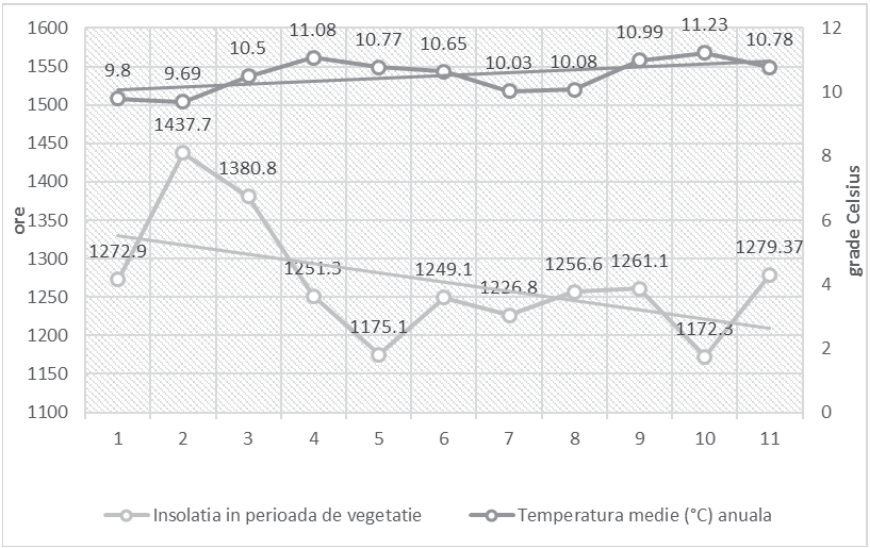

Fig. 2 Evolution of the actual temperature and insolation in the Jidvei wine center (2010-2020)

The temperature evolution over the interval shows a periodic fluctuation, with a tendency to increase and decrease slightly, but the evolution of the light shows an irregular movement, at the beginning and end of the interval with sudden increases (2011), sharp drops (2014), (2019). The air temperature is a decision factor for the spread of vines. The multi-annual temperature value, the average of the period (1986-2020), was 9,76 C with values (9,7 °C) close to (1995-2007) (Ioia.,2009) and 9,05 °C of the period (1972-2004) Corbean., 2011. The annual temperature value, the average of the period (2010-2020), is 10,51 °C, important to support the annual life cycle of vines. Values similar to the average were mentioned by other authors, 10,4 °C in the period (1995-2007) Ioia., 2009 and 10,06 °C (1999-2010) Corbean., 2011. Compared to normal 10,5 °C in 2019, it was a warm year (11,23 °C recorded). The same can be said for 2013, (11,08 °C). The coolest years from average were considered 2011 (9,69 °C) and 2010 (9,78 °C).

The growing season in question is 183 days, corresponding to the average value between 170-215 days in the vineyards of Tînave after(Ioia., 2009, Călugăr., 2011, Corbean., 2011, Hashegan., 2014).

4. The evolution of temperature during the growing season (1 IV-30 IX) in the period 2010-2020, is of great importance in the production of the heat balance for the growing crop. The average annual temperatures from April to September is 17,68 °C, multi-annual

average, 1986-2020 (16.85 °C). The highest value was recorded in 2012 (19,25 °C) and the lowest value 2014 (16,78 °C).

5. Annual average temperature (17,68 °C), and monthly average temperatures 11,62 °C (April), 15,87 °C (May), 19,79 °C (June), 21,11 °C (July), 21,31 °C (August), 16,37 °C (September), achieved during the growing season (1 IV-30 IX), contributes to the evolution of physiological processes that are very intense, depending on the phenophase and to obtain qualitative yields.

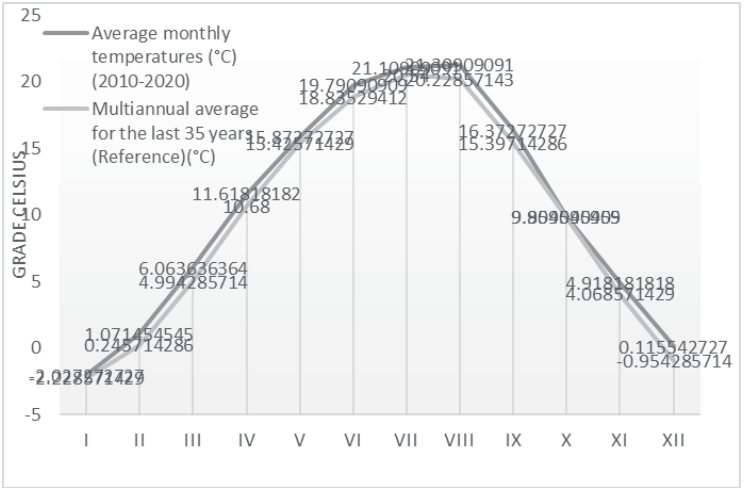

Fig. 3 Temperature evolution during the growing season in the Jidvei wine center (2010-2020)

6. The sum of the temperatures or the heat balance determines the direction of production and the variety assortment in the wine-growing area, (Oprea,1995). During the growing season, the average of the period (2010-2020), the sum of the temperature degrees as follows 3145,06 °C (Σta°C) and 1440,52 °C (Σtu°C) were estimated. The values were close to the values of the period 1994-2006, obtained by (Ioia, 2009), of those obtained by Baciu, Giugea., Popescu., and Șimon., 2020. from other vineyards in Transylvania, (Turda).