Scientific Papers. Series B, Horticulture. Vol. LXI, 2017
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

THE EFFECT OF CERTAIN CLIMATIC PARAMETERS ON THE APRICOT TREE

Cristina MOALE[1], Adrian ASĂNICĂ[2]

[1]Research Station for Fruit Growing Constanta, 25 Pepinierei Street, Valu lui Traian, Romania
[2]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd., District 1, Romania

Corresponding author email: moalecristina@yahoo.com

Abstract

The pedo-climatic conditions in the South-Eastern part of Dobrogea are favourable to the culture of the apricot tree; this species that loves warm weather has always found good conditions for growing and yielding in the South-Eastern part of Romania, and especially in Dobrogea. In this period, 6 Romanian and foreign apricot tree cultivars were studied at RSFG Constanta: 'Harcot', 'Auraş', 'Goldrich', 'Dacia', 'Fortuna' and 'Hungarian C.M.B'. Branch samples were harvested from these 6 cultivars with different ripening periods three days after the frost and they were analysed. This paper presents the manner in which certain apricot tree cultivars reacted to frost in the winter of 2012, 2013 and 2014, as well as the effect of the hail on July 11th, 2014 on the apricot production. The greatest losses caused by the frost were registered in the winter of 2012 as far as the fructiferous buds are concerned: 94% at 'Fortuna', 83% at 'Auraş', 82% at 'Goldrich' and 'Dacia', 77% at 'Harcot' and 65% at 'Hungarian C.M.B.'. The losses caused by the hail on July 11th, 2014 affected the production of the 'Dacia' cultivar by 40% and of the 'Hungarian C.M.B.' by 30%. The climatic changes that have been registered throughout the past 10 years have negatively influenced the culture of the apricot tree and the effects have been classified according to the cultivar and its biology, as well as to the topographic placement of the allotments. The studies that have been carried out, together with the obtained results demonstrate the importance of choosing the cultivar assortment taking into account the favourability of the area, as well as the importance of installing anti-hail nets when setting up fruit-growing plantations.

Key words: *climate change, Prunus armeniaca* L., *resistance to temperature variations.*

INTRODUCTION

The apricot tree is one of the most valuable fruit-growing species, due to the fact that is precocious, its production is quite significant and the fruits are very appreciated for their organoleptic qualities; are demanded by the market, both for fresh and processing, being capitalised at convenient prices.

The apricot tree has higher requirements concerning the heat, the temperature being the limitative factor in terms of extending the specie. The trees burst after a period of 7-10 days with temperatures above the biological threshold (6.5 °C), while flowering and fruit setting occur if the temperature is at least 10-12 °C (Hoza, 2000).

The studies which were carried out over a period of several years by researchers in the agro-meteorological field consider Dobrogea, as well as the entire south-eastern part of Romania, to belong to the most favourability area for the apricot tree culture (Roman, 1992).

Previous researches have revealed that the impact of climatic changes upon fruit-growing species can already be felt. For instance, by the end of the 90's, the flowering of the trees in Germany occurred several days earlier (Chmielewschi et al., 2004 and 2005). The vegetative season in Europe became longer by 10 days in the past 10 years (Chmielewschi and Rotzer, 2002). Due to the early flowering of the trees, in certain regions of Europe there was noticed an increase in the risk of damage caused by late frosts (Anconelli et al., 2004; Sunley et al., 2006; Legave and Clauzel, 2006; Legave et al., 2008; Chitu et al., 2004 and 2008) or by the disorders in the pollination and fruit setting processes (Zavalloni et al., 2006).

The Black Sea Coast is situated in the area with the largest average annual sums of day length on the country's territory, sums which surpasses 2250-2300 hours (Păltineanu et al., 2000).

Action to adapt to climate changes through an appropriate management of structure, rotation and technology of fruit crops require knowledge of regional and local characteristics of present and future climate and of assessment the associated risks. In the latest 50 years, according to the studies of the National Meteorology Administration (Bojariu, et al., 2015), the monthly average of air temperature exclusively presents growth trends, statistically significant over the whole Romania, during spring and summer. There are also rising trends of air temperature in the winter, for the central and north-eastern part of the country, but the percentage of stations showing significant trends is lower (Birsan and Dumitrescu, 2014). A gradual downward trend was also noted in the intensity of cold stress generated by minimum air temperatures below -15°C in the winter months, from 26 units of the "cold" in the 1961 to 1970 decade, to a range between 12 and 21 of "cold" units in the last four decades (1971-2010).

Chitu et al. (2015) found that between 1985-2014, the highest growth rate of both from all the months had been recorded in November, the trend (+1.3 °C in ten years for maximum and 0.94 °C for minimum) being statistically insured. It was also noted that if in the west and center part of the country, winters were becoming milder (temperature increase with more than 1.5 °C per decade, even if the trend is not statistically assured). In the eastern and especially in the southern part of Romania in the last 30 years, lower temperatures by 0.1 to 0.8 °C were recorded.

Changes in the year 2007, the whole Europe and implicit Romania will be confronted in future with a process of global warming, characterized by increasing of temperatures with -0.5 - 1.5 °C for the period 2020 – 2029 and with -2 – 5 °C for the period 2029 – 2099. In the period 2090-2099 Romania will confront with pronounced drought during the time of summer. Researches from many countries, in the frame of climatic research methodology have the approached aspects regarding climatic changes effects on growth and development of some fruit tree species (Chmielewski and Rotzer et al., 2002; Olensen 2002; Sunley et al.2006, Chitu et al., 2010; Sumedrea et al., 2009). Climatic changes occurred also in Romania, they have determined meteorological phenomena, which are manifesting with augmented amplitude and intense frequency (severe drought, intense flooding, tornados, hail).

Throughout the entire world, the research concerning the apricot tree has among its main objectives the relationship between the climatic conditions and the apricot tree culture. In our country, this relationship has been studied by numerous authors: Burloi (1957), Bordeianu et al. (1961), Cojean (1961), Mănescu et al. (1975), Topor (1987, 2002, 2009), Stancu et al. (1989), Roman et al. (1992) and so on. The results obtained by all these studies corresponded to a certain period of time and to a certain assortment of cultivars which represented the material. As concerns the new apricot tree cultivars, the obtained results are correlated with the evolution of the main climatic elements recorded in the past ten years.

This paper deals with the manner in which frost and hail influenced the fruit production of certain apricot tree cultivars from Dobrogea in the years 2012, 2013 and 2014.

That is why each area promotes a specific assortment of cultivars, although some of the latter might be common for all the areas (Topor, 1995).

MATERIALS AND METHODS

The biological material utilised consisted of 6 apricot tree cultivars and represented 3 ripening groups:

- extra early: ‘Fortuna’, ‘Auraş’;
- early: ‘Harcot’, ‘Goldrich’;
- medium: ‘Dacia’, ‘Hungarian C.M.B.’

Upon comparing the ripening period of the fruit we can observe that the ‘Fortuna’ and ‘Auraş’ ripened in the period between the 16th and the 30th of June, the ‘Harcot’ and ‘Goldrich’ cultivars ripened in the period between the 20th of June and the 10th of July, whereas the period for the ‘Dacia’ and ‘Hungarian C.M.B.’ cultivars ripened in the period between the 7th and the 20th of July.

The studied cultivars are new and were created at RSFG Constanta: 'Fortuna' and 'Auraş', as well as the apricot tree cultivars introduced in the zonal and national assortment: 'Harcot', 'Goldrich', 'Dacia' and 'Hungarian C.M.B.'

The trees were planted at a distance of 5 m between rows and 4 m between trees within the row (500 trees/ha).

The canopy shape is a Veronese vase and the trees were planted in 2003.

The applied culture technology is the one specific to the apricot tree: pruning, phytosanitary treatments, soil works, irrigation, harvesting, conditioning and capitalisation of the fruit.

Due to climatic changes over the past few years, the resistance of apricot trees seems to have become very different from one year to another. However, there are other factors involved as well, such as the topographic position of the orchard lot in which the apricot trees are planted (in the case of the studied cultivars the land was the same – a plateau), the alternation between minimum and maximum temperatures during winter, which renders the trees less resistant and last but not least, the severity of climatic accidents. The numbers of studied buds in the three years are shown in Figure 1.

The observations and determinations were carried out in the plots where there are some of the promoted apricot tree cultivars. Branch samples from the 6 cultivars were collected and analysed. The degree of differentiation of the flowering buds was relatively good. As concerns the soil where the plantation is placed, it is a calcareous chernozem (CZKa), with a loamy texture and a low alkaline pH (8.2) on its entire profile.

In addition, the overall climatic conditions were favourable to the growth and fructification of the trees, with exception of the years 2012-2014, when a very strong frost was registered in both January and February, leading to the loss of some of the floriferous buds, while the hail on July 11th, 2014 affected the production of the 'Dacia' and 'Hungarian C.M.B.' cultivars. With regard to these cultivars we observed the main fructification phenophases: the beginning of the blossoming, upon the appearance of the pink button; the beginning of the flowering, upon the appearance of the first open flowers; the ending of the flowering, when most of the flowers have lost their petals.

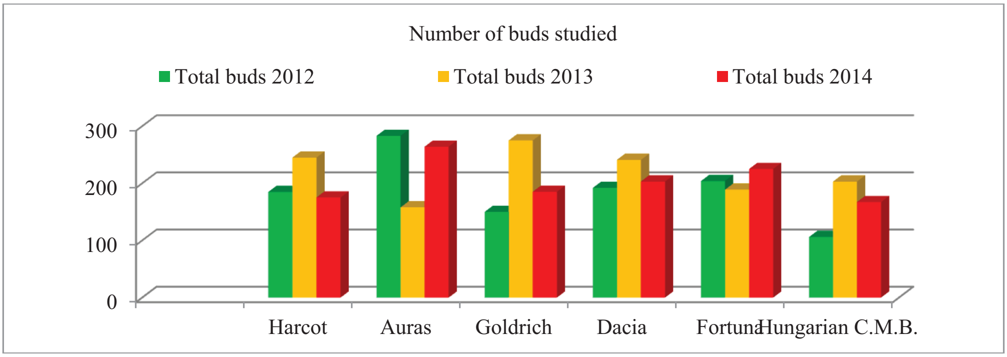


Figure 1. The number of studied buds per cultivar in the years 2012, 2013, 2014.

The duration of the flowering phenophase at a certain cultivar can vary according to the action of the maximum temperatures during the day and the intensity of the wind, correlated with the degree of differentiation of the trees (i.e. the amount of flowers per tree). The intensity of the flowering was graded on scale from 0 to 5, 0 being used when the cultivars displays no flowers at all, while 5 is used when the cultivar displays a plethora of flowers. The hardening of the core was determined by means of piercing it with a needle at regular intervals, usually 2 days. The process was carried out progressively, in the same day for all the observed cultivars. The harvesting maturity is largely influenced by a series of climatic and agro-technical factors, such as: temperature, drought, quantity of fruit per tree, shape of the head, density of the trees etc. The observations and determinations were carried out 3-5 days after the climatic accidents recorded in 2012, 2013 and 2014, respectively and the production was assessed after the hail occurrence on July 11th, 2014. The hail, with a dimension of approximately 5-20 mm, seriously damaged the fruit production of some of the apricot tree cultivars, more exactly those who had not been harvested until July 11th, 2014. The climatic data were recorded with the aid of an automatic meteorological station (the WatchDog type) and were processed as daily averages. We noticed that the resistance of apricot tree cultivars differs from one year to the next because of the climatic changes that have occurred during the past few years and it depends on the gravity of climatic accidents. The minimum and maximum temperatures during winter alternate and together with the gravity of climatic accidents lead to the weakening of the trees.

The behaviour of apricot tree cultivars towards the attack of the pathogen agents - 1) *Stigmina carpophila* (Lév.) M.B. Ellis, 2) *Cytospora cincta* Sacc andi 3) *Monilinia laxa* (Aderhol et Ruhl.) - was studied under conditions of natural infections, according to the test created by Crossa Raynaud (1968).

The evaluation technique consisted in writing down the frequency of the attacked organs and the intensity with which the symptoms manifested themselves and these two aspects were utilised in assessing the behaviour of the cultivars.

The field observations were centred on the calculation of the pathogens' frequency (F %) and intensity (I) on different tree organs such as: leaves, flowers, shoots, branches and fruits. For the intensity of the diseases marks were granted on a scale from 0 to 4.

Depending on the frequency and intensity of the disease, the studied cultivars and hybrids were categorised into 4 classes and 8 groups of resistance according to the following scale (Table 1).

F.A.= cultivars without attack (F%= 0 and I= 0)
T= tolerant cultivars (F%= 0.1-5% and I= 0 $^{\underline{\pm}}$ +)
S.A.= weakly attacked cultivars (F%= 5.1% - 10% and I= +)
M.A.= moderately resistant cultivars (F%= 10.1% - 25% and I= +)
S=sensitive cultivars (F%=25.1–50% and I=+ $^{\underline{2}}$ 4)
F.S.= highly sensitive cultivars (F%= 50.1% - 100%, I= + $^{\underline{4}}$ 4)

Table 1. Cultivar categorisation into classes and groups of resistance

Resistance class	Resistance group	Frequency (F%)	Intensity (I%)
1= tolerant (T)	1	0	0
2= medium resistance (MR)	2	0.1-11.0	+
	3	11.1-25.0	+
3= sensitive (S)	4	25.1-34.0	+ $^{\underline{\pm}}$ 2
	5	34.1-50.0	+ $^{\underline{1}}$ 2
4= very sensitive (VS)	6	50.1-59.0	+ $^{\underline{2}}$ 3
	7	59.1-75.0	+ $^{\underline{3}}$ 3
	8	75.1-100	+ $^{\underline{4}}$ 4

RESULTS AND DISCUSSION

The triggering of the main fructification phenophases in the years 2012-2014 occurred between rather wide limits, according to the characteristics of the cultivar and the climatic characteristics of the studied years.

In the period 2012-2014 the blossoming of the floriferous buds of the apricot trees occurred between the following limits: between 08.03 and 14.03 for the 'Fortuna' cultivar, between 11.03 and 27.03 at the 'Auraş' cultivar, between 15.03 and 27.03 at the 'Harcot' cultivar, between 24.03 and 29.03 at the 'Goldrich' cultivar, between 13.03 and 28.03 at the 'Dacia' cultivar, between 24.03 and 29.03 at the 'Hungarian C.M.B.' cultivar. Calendaristically the blossoming at the apricot tree occurred between 08.03 and 29.03 (21 days) in the studied years 2012-2014 (Table 2).

Table 2. The main stagers of fructification and apricot in the 2012-2014 period

No.	Cultivar	Year	The swelling of the flowering buds	The flowering			Inten-sity	The hardening of the stone	Harvesting maturity
				Beginning	Ending	Duration (days)			
1	Fortuna	2012	08.03	18.03	05.04	17	1	04.06	14.06
		2013	14.03	16.03	01.04	15	1	10.06	27.06
		2014	12.03	21.03	02.04	11	1	07.06	25.06
		Limits	08.03-14.03	16.03-21.03	01.04-06.04	11-17	1	04.06-10.06	14.06-25.06
2	Auraș	2012	11.03	22.03	06.04	14	2	04.06	12.06
		2013	27.03	28.03	10.04	12	3	08.06	17.06
		2014	22.03	17.03	03.04	16	4	10.06	29.06
		Limits	11.03-27.03	17.03-28.03	03.04-10.04	12-16	2-4	04.06-10.06	12.06-29.06
3	Harcot	2012	15.03	25.03	10.04	15	2	02.06	18.07
		2013	29.03	28.03	16.04	18	2	08.06	16.07
		2014	26.03	20.03	03.04	13	4	08.06	27.07
		Limits	15.03-27.03	20.03-28.03	03.04-16.04	13-18	2-4	02.06-08.06	16.07-27.07
4	Goldrich	2012	26.03	04.04	17.04	13	2	06.06	13.07
		2013	29.03	09.04	23.04	14	2	10.06	18.07
		2014	24.03	20.04	28.04	8	2	08.06	16.07
		Limits	24.03-29.03	04.04-20.04	10.04-28.04	8-14	2	06.06-10.06	13.07-18.07
5	Dacia	2012	22.03	05.04	20.04	15	3	08.06	03.07
		2013	28.03	11.04	19.04	8	3	10.06	02.07
		2014	13.03	20.04	30.04	10	4	07.06	12.07
		Limits	13.03-28.03	05.04-20.04	19.04-30.04	8-15	2-4	07.06-10.06	02.07-12.07
6	Hungarian C.M.B.	2012	24.03	05.04	18.04	13	4	07.06	17.07
		2013	29.03	09.04	16.04	7	3	09.06	15.07
		2014	25.03	18.04	27.04	9	4	10.06	19.07
		Limits	24.03-29.03	05.04-18.04	16.04-27.04	7-13	3-4	07.06-10.06	15.07-19.07

The beginning of the flowering. For all the studied cultivars the beginning of the flowering in the period 2012-2014 was recorded; however, the cultivars entered this phenophases at different times, albeit not necessarily significant (a few days from one cultivar to the next), so that mutual pollination was fully ensured. The limits for this phenophase were 16.03 and 20.04.

The ending of the flowering. In the studied period 2012-2014 the ending of the flowering occurred between 01.04 and 06.04 for the 'Fortuna' cultivar, between 03.04 and 10.04 for the 'Auraș' cultivar, between 03.04 and 16.04 for the 'Harcot' cultivar, between 10.04 and 28.04 for the 'Goldrich' cultivar, between 19.04 and 30.04 for the 'Dacia' cultivar, between 16.04 and 27.04 for the 'Hungarian C.M.B.' cultivar. The dates were recorded as the days when the flowers lost their last petals. The duration of the flowering at the peach tree (average for the three studied years) expressed in number of days varied between 7 days (the 'Hungarian C.M.B.' cultivar in 2013) and 18 days (the 'Harcot' cultivar in 2013).

The intensity of the flowering. In 2012, 2013 and 2014 the following cultivars displayed a weak intensity of the flowering: 'Fortuna' - 1 (2012, 2013 and 2014), 'Auraș' - 2 (2012), 'Harcot' - 2 (2012, 2013) and 'Goldrich' - 2 (2012, 2013 and 2014).

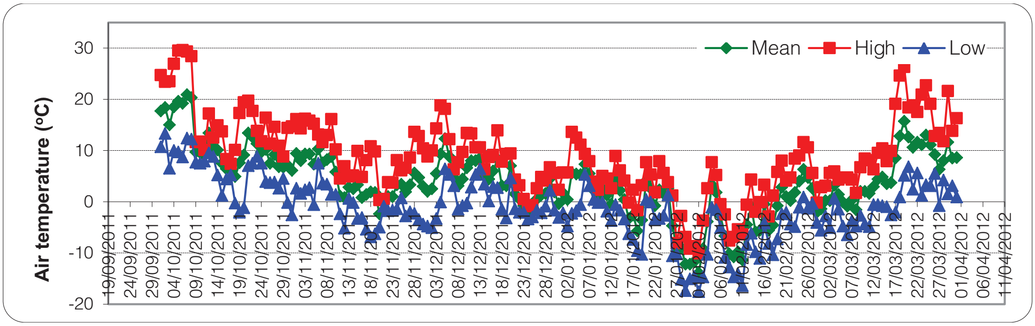
The hardening of the core. This phenophase occurred in the first half of the month of June (between 2th and 10th) in the years 2012, 2013 and 2014.

The harvesting maturity. Each ripening period has large variation limits from one year to another, depending on how the climatic factors determine the type of vegetation in a specific year: early, late or extra late. The harvesting maturity of the fruit had as variation limits the 14th of June and the 27th of July.

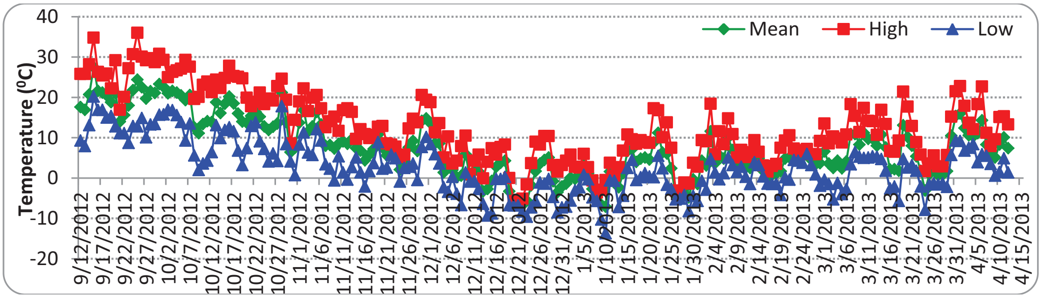
As we can notice in figure 2a, January 2012 was the coldest month, during which 9 days recorded daily average temperatures ranging from -10.2 °C and -17.6 °C. These values, together with those that were extremely varied in February (7 days with daily average temperatures of -10.4 and -16.4 °C) and eight consecutive days of hoarfrost, the ice on the branches caused the loss of 65% - 94% of the floriferous buds at the studied cultivars.

Figure 2b. reveals the fact that the coldest month in the period September 2012 - April 2013 was January 2013, when the recorded values were -13.7 °C (January 10th, 2013). These values did not significantly influence the loss of floriferous buds at the apricot tree cultivars (local observations).

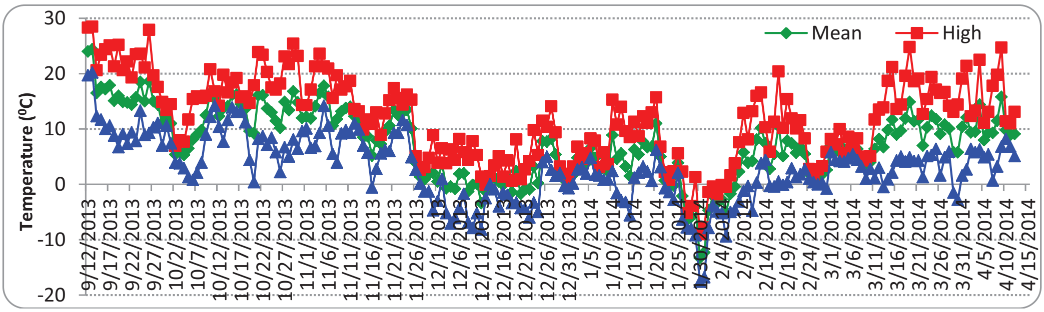
In the period October 2013 - March 2014 (Figure 2c.) the lowest temperature was recorded in January: -17.6 °C (January 30th, 2014); another day when the recorded temperature was low (-9.4 °C) was February 5th, 2014. The low temperatures recorded during this period affected the 'Goldrich' cultivar (67%) and the 'Fortuna' cultivar (90%).



2 a



2b



2c

Figure 2. Air temperature (°C) in the cold period October 2011 – March 2012 (a), October 2012 – March 2013 (b) and October 2013 – March 2014 (c) at Valu lui Traian, Constanţa

The observations were carried out with the aim of assessing the losses of floriferous buds because of temperature variations during winter and the low temperatures during the day.

Thus, for the 'Harcot' cultivar the losses recorded for 2012 were of approximately 77%, 58% for 2013 and 42% for 2014, there being difference from one cultivar to another. The winter frost caused losses for the 'Goldrich' cultivar of 82% in 2012, 69% in 2013 and 67% in 2014. For the 'Dacia' cultivar, the losses were of 82% in 2012, 63% in 2013 and 28% in 2014. The 'Auraş' cultivar recorded losses of 83% in 2012, 65% in 2013 and 24% in 2014. For the 'Fortuna' cultivar, the losses were of 94% in 2012, 92% in 2013 and 90% in 2014. The 'Hungarian C.M.B.' cultivar recorded losses of 65% in 2012, 54% in 2013 and 15% in 2014 (Figure 3).

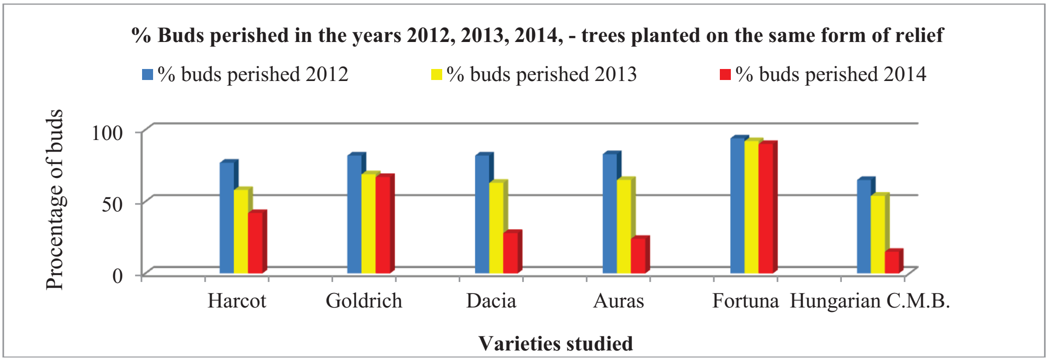


Figure 3. Procentage of apricot tree flowering buds perished due to frosts during the winter of 2012, 2013 and 2014 at Valu lui Traian, Constanta

We must bear in mind the fact that the losses caused by the winter frost of 2012, together with those caused by hoarfrosts and late frosts were very severe, taking also into account the surface of the Station's orchards cultivated with this cultivar. These losses were also caused by the warm period before the frost – in the first three weeks of January 2012 the average temperature of the air was positive, of approximately 5 °C.

A good resistance to frost during the winter of the three studied years was displayed by the apricot cultivar, with the following percentages: 'Hungarian C.M.B.'- 45%, (Figure 4).

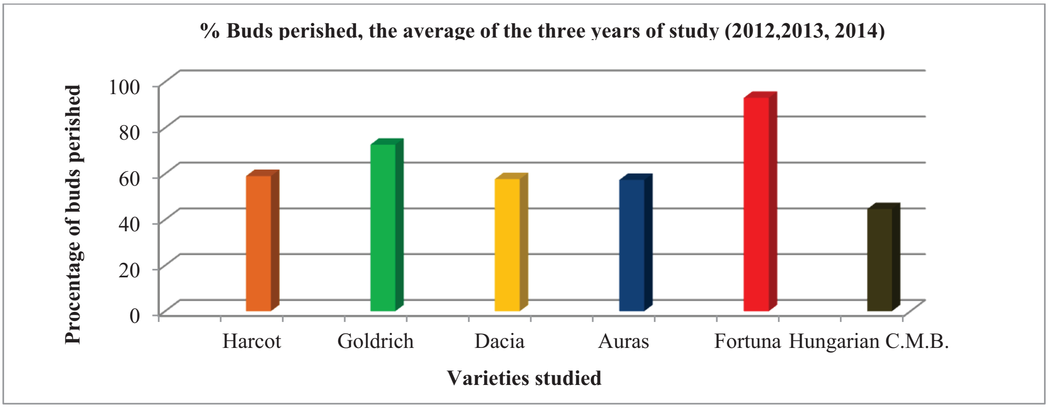


Figure 4. Procentage of apricot tree flowering buds perished because of frosts (average over the three years), Valu lui Traian

In these conditions, the 'Auraş', 'Dacia' and 'Harcot' cultivars were more than 50% damaged. The climatic accidents recorded in January and February 2012 (sudden temperatures of -16.4 °C, minimum temperature during the day) and 8 days of hoarfrost caused the damaging of the production for the early cultivars 'Fortuna' and 'Goldrich'.

At R.S.F.G. Constanta, in the second week of June 2014, more exactly on July 11th, the amount of precipitations was accompanied for 10 minutes by hail, which affected 40% of the fruit production for the 'Dacia' cultivar (the fruit were just beginning to ripe) and 30% for the 'Hungarian C.M.B.' cultivar (Figure 5). The hail bruised the fruit, the shoots and the stems, thus creating a good environment for future infections and diseases. The bruises on the fruit, despite some of them becoming scars, diminished the commercial aspect and the quality of the production.

Figure 5. The 'Dacia' cultivar affected by the hail on July 11th, 2014 (full maturity)

Table 3, presents the relative sensitivity of 6 cultivars from the demonstrative plot created within the laboratory responsible with improving the apricot tree concerning the attack of the pathogens *Stigmina carpophila*, *Cytospora cincta* and *Monilinia laxa*, under natural conditions of infection. The analysis of the data in this table highlights a variation in the apricot tree cultivars' behaviour towards a pathogen or another.

Table 3. The behaviour of apricot tree cultivars towards the attack of the main pathogens in the period 2012-2014

No.	Cultivar	Year	Intensity of attack (note)			
			Stigmina carpophila	*Cytospora cincta*	*Monilinia laxa*	*Monilinia fructigena*
a. Cultivars planted in 2003						
1.	Harcot	2012	FA	T	T	T
		2013	FA	T	T	T
		2014	FA	T	T	T
2.	Auraș	2012	T	FA	FA	FA
		2013	T	FA	FA	FA
		2014	T	FA	FA	FA
3.	Goldrich	2012	FA	S	T	T
		2013	FA	SA	T	T
		2014	FA	SA	T	T
4.	Dacia	2012	FA	S	SA	SA
		2013	FA	SA	SA	SA
		2014	FA	SA	S	S
5.	Fortuna	2012	SA	FA	FA	FA
		2013	SA	FA	FA	FA
		2014	SA	FA	FA	FA
6.	Hungarian C.M.B.	2012	FA	T	SA	SA
		2013	FA	T	SA	SA
		2014	FA	T	S	S

According to the intensity (I) of the attack the studied cultivars were classified as follows (Table 3): *Stigmina carpophila* in 6 resistance classes: **cultivars without attack (F.A.)** – 4 cultivars belong to this class, where the intensity (I) of the attack was 0: 'Harcot', 'Goldrich', 'Dacia' and 'Hungarian C.M.B.', during all three studied years (2012, 2013 and 2014). The 'Auraș' cultivar was not attacked by *Stigmina carpophila*; **tolerant cultivars (T)** – 'Auraș' in all three studied years; **weakly**

attacked (S.A) - 'Fortuna' (in 2012, 2013 and 2014.

The *Stigmina carpophila* fungus survives from one year to the next in buds, in cracks in the bark and in wounds, which facilitates the occurrence of infections in early spring, at temperatures above 8 °C and an atmospheric humidity of over 80%. Temperatures over 30°C stop the evolution of the disease.

By correlating the frequency of the attack (F%) of *Cytospora cincta* Sacc with its intensity (I), the studied cultivars were categorised as follows: **cultivars without attack (F.A.) -** both the frequency (F%) and the Intensity (I) were 0; there are 2 cultivars in this class: 'Auraș', and 'Fortuna', in all three studied years; **tolerant cultivars (T)** – 'Harcot' and 'Hungarian C.M.B.'. in the studied years 2012, 2013 and 2014; **weakly attacked (S.A)** – 'Goldrich' and 'Dacia' were weakly attacked in 2013 and 2014; **sensitive (S)** – 'Goldrich' and 'Dacia'. None of the studied cultivars could be categorised into the classes **moderately resistant (M.A.)** and **highly sensitive (F.S.).**

The disease caused by the *Cytospora cincta* Sacc fungus manifested itself through the sudden drying of the branches. The affected trees seemed to be suffering in full summer the leaves wilted, becoming yellowish-green and the drying of the branches occurred from the tip towards the base.

As far as the attack of the *Monilinia laxa* and *Monilinia fructigena* fungi is concerned (Aderh et Ruhl) Honey, the disease manifested itself on all aerial organs during spring, through the wilting of the flowers and the drying of the vegetative buds and shoots.

The strong attack of the *Monilinia laxa* fungus occurs when the maximum phase of pathogenicity or the fungus is corroborated with the maximum phase of receptivity of the trees (the flowering phase), directly conditioned by temperature and humidity. This explains why the intensity of the attack on the same cultivar varies from one year to another, remaining, though, within the limits of the minimal, medium or maximal attack levels. Certain factors favour the attack of the *Monilinia*, among which: the biological reserve of the pathogen from one year to the next, given the fact that the fungus winte rs as a mycelium within the branches, at the base of the flowering buds, or in mummified fruit that are still on the branches; the atmospheric humidity and the air temperature during the flowering; the genetic resistance of the cultivars.

By correlating the frequency of the attack (F %) with its intensity (I), the studied cultivars were categorised as follows: **cultivars without attack (F.A.)** – 2 cultivars, for which both the frequency (F%) and the intensity (I) were 0: 'Auraș' and 'Fortuna', in all three studied years; **tolerant cultivars (T)** - 2 cultivars: 'Harcot' and 'Goldrich', in 2012, 2013 and 2014; **weakly attacked (S.A)**: 'Dacia' and 'Hungarian C.M.B.' in 2012 and 2013; **sensitive (S)** – 'Dacia' and 'Hungarian C.M.B.' in 2014. None of the studied cultivars could be categorised into the classes **moderately resistant (M.A.)** and **highly sensitive (F.S.)**.

Most studied cultivars manifested an increased resistance towards the attack of the pathogen agent *Monilinia laxa*, with the exception of 'Dacia' and 'Hungarian C.M.B.' cultivars, which were sensitive in 2014. These cultivars were affected by the hail that occurred on July 11th, 2014, which facilitated the development of moniliasis especially at cultivars that were in full harvesting maturity.

CONCLUSIONS

The greatest yield losses were recorded for the 'Fortuna' cultivar in 2012 – 94% in 2013 - 92% and 90% in 2014.

The lower losses during the three studied years were recorded by 'Hungarian C.M.B'.

The hail from July 11th, 2014, which lasted for only 10 minutes, affected the 'Dacia' cultivar (40%) and the 'Hungarian C.M.B.' cultivar (30%) and therefore we recommend the orchards to be covered with anti-hail nets.

As far as the attack of the *Stigmina carpophila* (Lév.) M.B. Ellis fungus is concerned, the following cultivars: 'Harcot', 'Goldrich', 'Dacia' and 'Hungarian C.M.B.' – proved to be tolerant in all three studied years (2013-2015).

Concerning the attacks of the *Cytospora cincta* fungus, both the sensitivity and the resistance towards the pathogen are exclusively connected to the soil.

The sensitive cultivars were 'Goldrich' and 'Dacia' in 2012, while the resistant ones, without attack were 'Auraş' and 'Fortuna' (2013, 2014, 2015).

Most studied cultivars manifested an increased resistance towards the attack of the pathogen agent *Monilinia laxa*, with the exception of 'Dacia' and 'Hungarian C.M.B.' cultivars, which were sensitive in 2014. These cultivars were affected by the hail that occurred on July 11th, 2014, which facilitated the development of moniliasis especially at cultivars that were in full harvesting maturity.

REFERENCES

Anconelli S. Antolini G. Facini O. Giorgiadis T.Merletto V. Nardino M. Palara U. Pasquali A.Pratizzoli W. Reggitori G.Rossi F. Sellini A. Linoni F, 2004: Previsione e difesa dalle gelate tardive – Risultati finali del progetto DISGELO. CRPV Diegaro di Cesena (FO). Natiziario tecnico N.70. ISSN 1125-7342. 64. pp.

Bordeanu, T., Tranavski, I., Radu, I.F. 1961. Study on Winter Rest and Biological Threshold of Apricot Flower Buds. Studies and research of Biology. Plant Biology Series no. 4 (XIII).

Burloi Niculina. 1957. Behavior apricot buds in the Bucharest. Communications of the Romanian Academy no. 9, vol. VII, Bucharest

Birsan, M.V., Dumitrescu, A., 2014. ROCADA: Romanian daily gridded climatic dataset (1961-2013) V1.0. National Meteorological Administration, Bucharest Romania, doi: 10.1594/PANGAEA.833627.

Bojariu, R., Bîrsan, V.M., Cică, R., Velea, L., Burcea, S., Dumitrescu, A., Dascălu, S.I., Gothard, M., Dobrinescu, A., Cărbunaru, F., Marin, L., 2015. Climatical changes - from physical bases to risks and adaptation. Printech Publishing House, Bucharest, ISBN 978-606-23-0363-1, 200 pp.

Chitu E., M. Butac, S. Ancu and V.Chitu 2004. Effects of low temperatures in 2004 on the buds viability of some fruit species grown in Maracineni area. Annals of the University of Craiova. Vol. IX (XLV), ISSN 1435-1275: 115-122.

Chiţu E., D. Sumedrea, Cr. Pătineanu, 2008. Phenological and climatic simulation of late frost damage in plum orchard under the conditions of climate changes foreseen for România. Acta Horticulturae (ISHS) 803:139-146.

Chitu, E., Giosanu D., Mateescu E., 2015. The Variability of Seasonal and Annual Extreme Temperature Trends of the Latest Three Decades in Romania. Agriculture and Agricultural Science Procedia. Volume 6, 2015, doi:10.1016/j.aaspro.2015.08.113, pages 429-437.

Chiţu, E., Elena Mateescu, Andreea Petcu, Ioan Surdu, Dorin Sumedrea, Tănăsescu Nicolae, Cristian Păltineanu, Viorica Chiţu, Paulina Mladin, Mihail Coman, Mădălina Butac, Victor Gubandru, 2010. Methods of estimating climatic favorability for tree culture in Romania. The Publishing House INVEL Multimedia, CNCSIS accredited, ISBN 978-973-1886-52-7.

Chmielewski F.M., Muller A., Kuchler W., 2005. Possible impacts of climate change on natural vegetation in Saxony (Germany). Int. J. Biometeorol, 50:96-104.

Chmielewski F.M., Rotzer T 2002. Annual and spatial variability of the begenning of growing season in Europe in relation to air temperature changes. Clim. Res. 19(1), 257-264.

Chmielewski F.M., Muller A., Bruns E., 2004. Climate changes and trends in phenology of fruit trees and field crop in Germany, 1961-2000, Agricultural and Forest Meteorology 121 (1-2), 69-78.

Cojean Natalia. 1961. Rezistenţa la îngheţ a mugurilor floriferi de cais în legătură cu etapele de creştere şi de dezvoltare. Studii şi cercetări de Biologie. Seria Biologie vegetală nr.1.

Crossa-Raynaud, P.H. (1969). Evaluating Rezistance to *Monilinia laxa* (Aderh&Ruhl) Honey of varieties and hybrids of apricots and almonds using mean growth rate of cankers on young branches as criterion of susceptibility. J. Amer. Soc. Hort. Sci. 94, 282-284.

Hoza D., 2000. Pomologie. Ed.Prahova, Ploieşti, pp: 286, ISBN 973-99268-3-5.

Legave, J.M. and Clazel G., 2006. Long-term evolution of flowering time in apricot cultivars grown in southern France: wich future imtacts of global warming? Acta Horticulturae, 714: 47-50.

Legave, J.M., Farrera, I., Almeras, T. and Calleja, M, 2008. Selecting models of apple flowering time and understading how global warming has had an impact on this trait. Journal of Horticultural Science & Biotechnology, 83:76-84.

Olensen, J.O., Bindi, M., 2002. Consequences of climate change for European agricultural productivity, land use and policy. European Journal of Agronomy, 16, 239–262.

Mănescu Creola, Baciu Elena And Cosmin Silvia, 1975. Controlul biologic în pomicultură. Ed. Ceres, Bucureşti.

Paltineanu, Cr., Mihailescu, I.F. & Seceleanu, I. (2000A). Dobrogea, condiţiile pedoclimatice, consumul si necesarul apei de irigatie ale principalele culturi agricole. Editura Ex Ponto, Constanta, 258pp.

Roman Ana Maria, Cusursuz Beatrice, Cociu V., Elena Topor, S.A. 1992. Studiul agrometeorologic al mecanismelor exogene ce controlează înflorirea unor specii prunoidee din Romania. Eucarpia, Angers, Franta.

Stancu, T., Balan Viorica, Ivascu Antonia, Cociu, V.,1989. Resistance to frost and wintering of some apricots varieties with different geographical origin, under Romanian plain conditions. Acta Horticulturae, nr. 239.

Sunley, R.J., Atkinson, C.J. and Jones, H.G., 2006. Chill unit models and recent changes in the occurrence of winter chill and soring frost in the United Kingdom. Jurnal of Horticulturae. Science & Biotechnology, 81: 949-958.

Sumedrea D., Tănăsescu N., Chițu E., Moiceanu D., Marin Fl., Cr., 2009. Present and perspectives in Romanian fruit growing technologies under actual global climatic changes. Scientific Papers of the Research Institute for Fruit Growing Pitesti, Vol. XXV, ISSN 1584-2231, Editura INVEL Multimedia, București: 51-86.

Topor Elena, 1995. Cercetări privind îmbunătățirea sortimentului de cais în Dobrogea. Teză de doctorat ASAS București.

Topor Elena, 1987. Modificările continutului in hidrati de carbon în funcţie de perioada de vegetaţie a 11 soiuri de cais. Vol. Omagial, S.C.D.P. Constanta.

Topor Elena, 2002. Cercetari privind relaţia dintre condiţiile climatice si fructificarea caisului. Lucr. St. Vol.1 . Seria Horticultura, Ed. Ion Ionescu de la Brad Iasi.

Topor Elena, 2009. Cercetari privind influenţa schimbarilor climatice asupra culturii caisului în Dobrogea. Lucrările Simpozionului Mediul si Agricultura în regiunile aride –prima editie. ISBN 978-973-7681-68-3.(223)

Zavalloni, C., Andersen, J.A., Flore, J.A., Black, J.R. and Beedy, T.L., 2006. The pileus project: climate impacts on sour cherry production in the great lakes region in past and projected future time frames. Acta Horticulturae, 707: 101-108.

EX·TERRA·AVRVM