Scientific Papers, USAMV Bucharest, Series A, Vol. LII, 2009, ISSN 1222-5339

APRICOT ADAPTABILITY UNDER THE ROMANIAN CLIMATIC CONDITIONS

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Keywords: *apricot, fenotypes, climatic changes*

Abstract

Research on the adaptability of 665 apricot phenotypes from seven geographic areas, preserved in the genetic collections, 9000 hybrids and 35 variety created in Romania, have shown that, out of 27 seven years (1981-2007), seven years were unfavourable to apricot growing (of which four years were successive in the first decade of this century). Over the past four years, the short frost periods (-7^0C), sometimes lasting for only several hours, following longer warm periods at the end of February ($+12^0C$, $+20^0C$), affected the apricot phenotypes in their early budding or flowering stage. The damage resulted was 90-100% . The consequences of the climatic changes are significant with respect to the biological transformation of the fruiting and vegetative organs and, further on correlated to the biology of the most frequent pathogens, pests and predators in Romania.

INTRODUCTION

As a result of anthropic activities, the concentration in the most important greenhouse gases has increased in the last century, exceeding their natural replacement capacity either by "adsorption" on the Earth's surface or chemical reactions in the atmosphere.

In a first phase, climatic changes in general consist of increased annual average temperatures (1-2°C, i.e. 3.9-4.4°C in Southern Romania, according to Marica Adriana, 2000, [7] and decreased/increased annual rainfalls (5-20%, with variations from 47% to 81% in Sourthern Romania).

Under these conditions, the tendecy for aridization would intensify in the rainfall deficitary areas growing agricultural crops, resulting in less distinct differences between winter and spring, and "shortened" springs rapidly turning into summer.

The main objective of the paper "Apricot adaptability under the Romanian climatic conditions" is to sum up our 27-year research (1981-2007) on the biology of apricot adaptability to the climatic conditions of two Romanian areas: Campia Vlasiei (the Vlasia Plain) from the Romanian Plains, and the Valul lui Traian area on the Black Sea Coast, the Dobrudja area.

MATERIAL AND METHODS

The evaluation was focused on the impact of temperature fluctuations and climatic accidents on the apricot fruition phenopases and the eventual damage caused by the destruction of the flower organs, monitored over a period of 27 years (1981-2007).

Also, the evaluation was aimed at identifying the biology of the pathogen *Monilinia laxa*, the main pest that attacks the apricot during flowering and leaf growth.

The biological material used over the 27 years consisted in 665 apricot phenotypes preserved in the genetic collections, 9000 hybrids and 35 variety created in Romania.

RESULTS AND DISCUSSION

Areas delimited for apricot growing in Romania

Two areas were delimited for the apricot-tree growing in Romania a long time ago: the former is a 15 km strip of land along the Black Sea Coast, and the latter is a 4-5 km enclave along the Danube, where the rate of flower-bud damage is extremely low, i.e. 8-9 years of normal development (no loss) out of 10.

Getting farther from the two favourable micro-areas toward the Romanian Plain, the risk of losing flower buds or damage to full-flowering flowers is increasing as four out of 15 years are unfavourable to apricot growing, which consequently leads to reduced production [2].

Reduction is strictly correlated to the biological traits of the varieties that still exists in the plantations, as well as to their ecological plasticity.

One of our concerns is crop extension of some phenotypes of higher ecological plasticity allowing the eventual extension of the growing areas, together with the identification of the risk-free or minimum-risk areas and micro-areas under the present climatic changes.

Climatic characteristics of the areas growing the apricot phenotypes under study

Research was focused on two areas where apricot phenotypes were located, i.e. the Bucharest Plain and the Dobrudja area situated between the Danube and Black Sea.

As subdivision of the Romanian Plain, the largest plain area in Romania, **the Bucharest Plain and, implicitly, the Vlasia Plain** borders the Danube on the East and South, and the Getic Plateau, Sub-Carpathians, and the Moldavian Plateau on the North (figure 1).

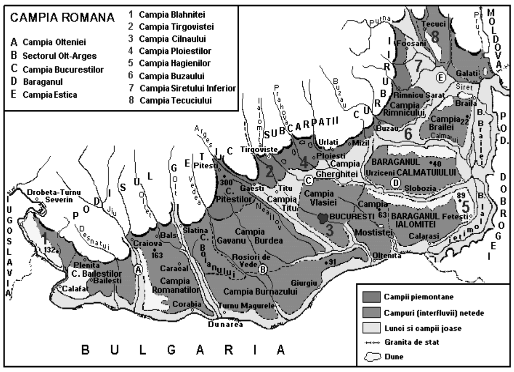

Fig. 1. Bucharest Plain location within the Romanian Plains

The Romanian Plain is marked by three types of influences: sub-Mediterranean in the Oltenia Plain (autumn rainfalls and mild winters), transition from oceanic and sub-Mediterranean influences to aridity in the central area (reduced rainfalls in the East and higher temperatures in winter), and aridity in Baragan (strong continentality, cold winters, warm even hot summers recently and drought) [7].

In the **Dobrudja area,** the main favourable area for apricot growing, the climatic factors are affected by the influence of the air currents between the Danube and the Black Sea, following the existent ground water sources, the influence of the lack of water upon the trees (both natural water-from rainfalls, and artificial-from irrigations), and particulalrly the regional and global climate change under the influence of the anthropogenic factor. Together with southern Banat and Oltenia, Dobrudja is considered a highly deserted area in Europe.

Flowering phases of apricot phenotypes over 28 years (1980-2008)

Passing through the fruit organ phenophases of the tree is the phenotypical externalization of some genetic codes, highly influenced by the environmental conditions reflecting the climatic particularities of every year [2, 4, 3]. The adaptability of all apricot phenophases studied in the two areas was reflected by their dependency on satisfying the needs of coldness and removing the dormance state on the one hand, and satisfying the needs of warmth in order to start vegetation (over the biological threshold of +6.5ºC). The research carried out over the 28 years on the numerous apricot phenotypes did not point out differences longer than 4-5 days in the beginning of the flowering phase, i.e. between “the earliest” and “the latest”.

No significant differences were recorded between the two areas with respect to the month when flowering began, either March or April, in any of the phenotypes under study; however, in Dobrudja, it always occurred 10-12 days earlier.

Nevertheless, high differences occurred between the years, resulting from extremely variable climatic conditions. The table 1 shows the years when flowering in both areas started earlier in March.

Table 1

The years when flowering in both areas started earlier in March

Area	1980-1989	1990-1999	2000-2008
Bucharest and Dobrudja*	1981, 1983	1995*	2000*, 2001, 2002, 2004, 2007, 2008

Over the 27 years of study, one and the same phenotype recorded differences of even 45 days in the beginning of flowering, and even differences from one year to another, irrespective of the phenotype.

The photosynthesis-respiration balance, both during the intensive growth of the shootlets and fruit, 15 May-15 June, and during the inactive phase (quiescence), pointed to the normal metabolism of the accumulated organic matter available for the vital activities, which reflected the physiological adaptation of the phenotypes selected as genitors, as well as their descendants, in the areas under study, i.e. the Romanian Plain and Dobrogea.

The genetical studies led to the following results: Genetic transgressions and cytoplasmic heredity were involved for the blooming time of apricot descendants $F_{1.}$

Behaviour under conditions of frost and wintering

There are numerous elements illustrating the resistance or susceptibility of the collection-preserved apricot-tree phenotypes, genitors and descendants in relation to low winter temperatures and fluctuating temperatures recorded at the end of winter and in spring time. Out of these elements, the determinations referred to: the free and bound water content and the carbon hydrate content, both in the dormant and vegetation stages, cryosusceptibility of malate dehydrogenase and peroxydase in the buds that were naturally exposed to frost during winter, and the percentage of dead flower buds.

The results from the genetic research data refer to the-heterosis of the content in carbon hydrates, free water and bound water present in the early shoots, expected in descendants F_1,-transgressive heredity, revealed for the frost resistance traits of descendants F_1,- correlation between the peroxidase cryoresistance of the genitors and the frost resistance of descendants $F_{1.}$

Damage caused by climatic accidents to the apricot flower organs

The seasons and years that recorded deviations from the normal situation, i.e. the flower organs of the apricot were damaged, were: the winters of 1982–1983, 1984–1985, 1986–1987 and springs of 1995*, 2000* (in Dobrudja*), 2001, 2002, 2005, 2007, and for some varieties – 2008.

If for 15 years (1981-1995), the climatic conditions of the springs posed no danger for the destruction of the flowering buds in the debudding or flower button phase, flowers before or after fecundation, or young fruit, the second period of time - 12 years (1995-2007) - recorded low-temperature springs in 1995, 2001, 2002, 2007, that is, precisely when apricot was fully flowering, which resulted in 95-100% damage.

The overall perspective on the years 1981-2008 shows that, out of the 7 years of climatic accidents, 4 years belong to the latter period, i.e. 33% risk factors, whereas the other 3 belong to the former period, i.e. 20% risk factors.

Consequences of climatic change upon the attack of the pathogen
Monilinia laxa (Aderhol et Ruhl., Honey et Whetzel). The pathogen *Monilinia laxa* hibernates as a resistant mycelium on various organs on the tree crown or soil surface, forming conidias at 10ºC. The minimum temperature (biological threshold) of development is around 4°C; thus the fungus has found favourable conditions of development every year when winter was mild and temperatures higher than the biological threshold were recorded. The incubation of the disease was 3-5 days, and even 8-10 days when drought occurred. Moniliasis was much influenced by the rainfalls occurring during the flowering phase, and inhibited when the apricot flowers were destroyed (table 2).

Table 2

Incubation of the *Monilinia laxa*

Monilinia laxa	**2006**	**2007**	**2008**
Identification	Beginning of April	Beginning of May	7-10 April
Offshoot incidence (%)	75	< 10	25

CONCLUSIONS

1. The last 7 years of the 18 years under analysis (2000-2008) have been enlightening for drawing conclusions on the dramatic climatic changes and significant damage caused by the risk factors.
2. Apricot flower organs are affected by every degree of negative temperature, even short termed (of hours, not days) that occurs in spring as a result of the continental climate specific to the Bucharest Plain and desertification of the Dobrudja area, as well as the cold fronts coming from the Arctic area.

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