SOME CONSIDERATIONS ON THE FROST BEHAVIOUR AND THE FLOWER ORGANOGENESIS OF FOUR LOCAL POPULATIONS OF PLUM CULTIVARS FROM BUZĂU COUNTY

CÂTEVA OBSERVAȚII ASUPRA REZISTENȚEI LA ÎNGHEȚ ŞI A PROCESULUI DE ORGANOGENEZĂ FLORALĂ A PATRU POPULAȚII LOCALE DE PRUN DIN JUDEȚUL BUZĂU

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Abstract: *Four local populations of Prunus domestica from Buzau - Pătârlagele city were analysed to evaluate the resistance to frost as well as the organogenesis process. To evaluate the frost resistance of the flower buds two moments were chosen - late February and first decade of April. In the first determination, more than 50% of the analysed buds showed different kinds of damage on flower components, while at the second determination most of the buds remaining on the branch were viable. The evaluation of the flower organogenesis process carried out at the end of February revealed differences in the stage of carpel development, while the rest of the floral organs were formed in all four populations.*
Key words: *Prunus domestica*, local cultivar populations, frost damage, flower organogenesis

Rezumat: *Patru populații locale de Prunus domestica din județul Buzău – oraş Pătârlagele au fost analizate din punct de vedere al rezistenței la îngheț şi al proceselor de organogeneză florală. Cele două momente alese pentru determinarea rezistenței la îngheț au fost sfârşitul lunii februarie şi sfârşitul lunii martie. În cazul primei determinări peste 50% din mugurii analizați au prezentat leziuni datorate înghețului, în timp ce la a doua determinare majoritatea mugurilor rămaşi pe ramură erau viabili.Evaluarea procesului de organogeneză florală, efectuat la sfârşitul lunii februarie, a evidențiat diferențe în stadiul de dezvoltare al gineceului, în timp ce restul organelor florale erau formate la toate cele patru populații.*
Cuvinte cheie: *Prunus domestica*, populații locale, rezistență la îngheț, organogenezăflorală

INTRODUCTION

The plum resistance to the frost as well as the viability of flower buds are negatively affected by the changes in thermic regime and the fluctuating temperatures especially, occurred during the dormancy in winter (Neumüller, 2011; Duchovskis *et al.,* 2007).

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Genotype, in addition to climatic conditions affects the plum's behaviour towards chill (Cosmulescu *et al.,* 2010; Neumüller, 2011).

As specie, depending on varieties, Prunus domestica can withstand a minimum temperature up to -31^{o}C, - 32^{o}C, if there is a gradually decrease, or up to -22^{o}C if there is an abrupt temperature decrease (Voiculescu, 1999).

Flower biology, starting with the bud stage carrying on with flowering stages, reflected both the influence of temperature during winter and soil moisture during the growing season (Butac, 2003).

The inadequacy at low temperatures of varieties chosen for a particular area can influence the differentiation of flower buds, leading to low harvests (Oukabli *et. al*., 2003).

Understanding the behaviour of the of local varieties, old cultivars and landraces to the temperature can become an important source for improving the response of new plum varieties to frost damages (Paunovic, 1988).

In this paper is discussed the response of flower buds to the changes of the temperature during the dormancy and their organogenesis for four local cultivar populations from Pătârlagele – Buzău County.

MATERIAL AND METHOD

The study was conducted in Pătârlagele, a town located in the north western part of Buzău County, at 45 ° 19 'north latitude and 26 ° 21' east longitude. The city is located in the Pătâragele Basin of the Subcarpathian area, on the Buzău River, at an altitude of approximately 400 meters, with hills - the dominant landscape of the area. The average of the annual temperature is 10,9^{0}C, with + 25^{0}; + 26^{0} C in summer and - 2^{0},-4^{0} C in winter.

From the local plum orchards four populations were chosen, named T1, T2, T3 and T4; T1, T3 and T4 populations are in independent plantations, while the T2 population is planted together with other local varieties. T2, T3, T4 populations are on sites with northern exposure, while the T1 population is on a land with southern exposure.

To determine the resistance to coldness of the flower buds, they were collected in two-stage during dormancy. The buds were examined using the stereomicroscope Leica S8APO.The damage scale was established based on the proportion of the affected flower parts, with brown colour.

The progress of the floral organogenesis process was observedon paraffin wax embedded plant material (floral buds). The vegetal material was processed according to a method described in Şerbănescu-Jitariu *et.al.*, 1983 and analysed with a Leica DM 1000LED microscope.

RESULTS AND DISCUSSIONS

The response of flower buds to coldness

The first assessment of flower buds' responses to coldness was carried out during their dormancy, on February 10, 2018.

Air temperature during the day, from the first 10 days of January until the determination date, had recorded generally positive values, higher than the

average of the period (4 ° C), as follows: up to in mid-January, daily temperatures were higher than the average with 1-8 ° C; 4 days had temperatures equal to or below 0 ° C in the middle of the month; after this period the air temperature was positive, sometimes higher than the month average up to 11-12 ° C.

At this assessment over 50% of the collected buds showed some or all flower components of brown colours to all four populations. The most of these buds have fallen.

Second assessment was conducted at the end of the dormancy period, on 2 April 2018. The flower buds were sampled from branches near those used for the first evaluation.

Air temperature decreased at the end of February and early March, but no lower of -10 ° C values were recorded during the day, as follows: at the end of February and in the first days of March, the values were negative, between - 8 ° C and -1 ° C; during March, positive values were recorded, excepting 5 days at the end of the month when these were negative but not lower than -10 ° C; at the end of March and in the early days of April air temperature values were positive.

The number of affected buds at the level of each population was much lower than to the previous determination (tab. 1):

Table 1

Results of the flower buds' assessment on 2.04.2018

Population	Total number of buds	Damaged buds	Viable buds	% viable buds
T1	50	3	47	94
T2	50	3	47	94
T3	50	4	46	92
T4	50	2	48	96

T1 population: 47 out of the 50 analysed buds were viable. The affected buds showed lesions at the perianth and carpel level or they were entirely damaged (fig. 1a).

T2 population: like at the T1 population, 47 out of the 50 analysed buds were viable. The affected buds showed different damages at all flower components (fig.1b).

T3 population: 46 buds from the total of 50 analysed were viable. Different lesions were observed to all flower components (fig.1c).

T4 population: only two buds were affected out of a total of 50 observed, the highest percentage of viability at this population (96%) was recorded; lesions were observed both at the flower components and cataphylls (fig.1d).

First assessment revealed that during dormancy a removal of the flower buds could take place if there were a surplus.

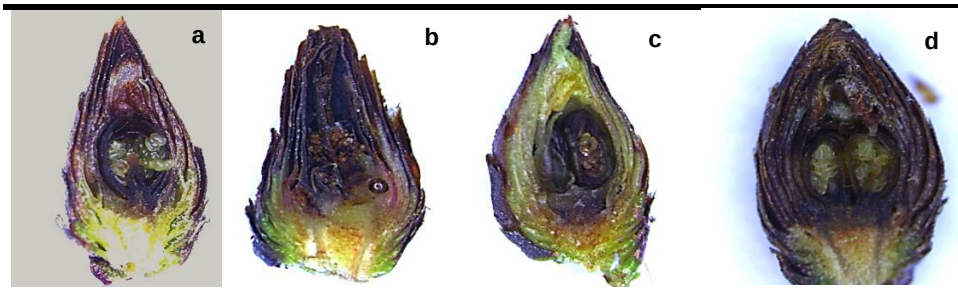

Fig. 1 Different types of frost damages on floral buds: a. T1 – cataphylls, perianth and carpel injured; b. T2 – damage of the whole flower; c. T3 – damage of the whole flower; d. T4 – cataphylls, perianth, carpel injured

Oscillating air temperature recorded in January, February and March did not affect the viability of flower buds, in any of the four populations, as long as temperatures did not reach the minimum value of plum resistance, as we have seen at the second assessment.

The small differences observed between the four cultivars related to frost resistance indicate a good adaptation to the local conditions, their selection being in accordance with the particularities of the climate in the area of Pătârlagele.

Floral development (Organogenesis)

In February, towards the end of dormancy (the moment of buds' collection) the main flower parts - the perianth, stamens, and carpel were differentiating.

A single flower is differentiate in the buds of the T1 cultivar population; the perianth elements and the anthers are well featured (fig. 2a); at the level of the anthers the pollen grain formation is finished, the anthers becoming unilocular (fig.2a); in the wall of the anther only the epidermis and endothecium are evident and pollen grains can be observed in the anther locules (Fig. 2b); in the ovule the process of forming the embryo sac is initiated (fig.2c).

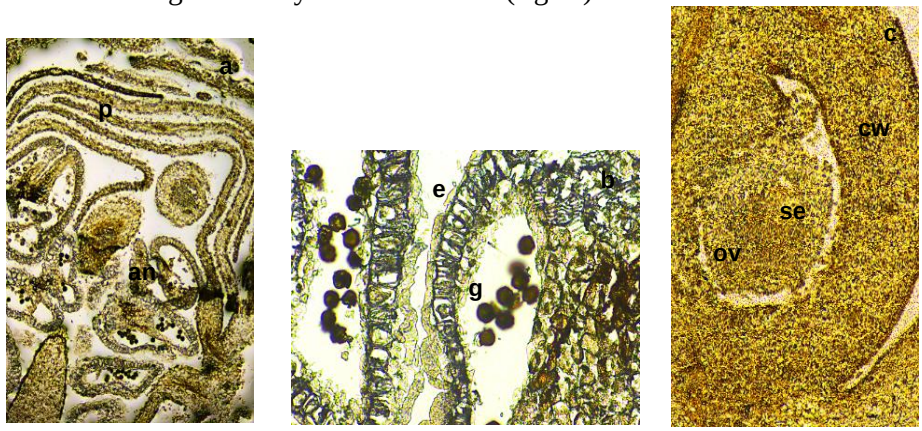

Fig. 2 Organogenesis in the floral buds of T1 population: a. the perianth elements (p) and unilocular anthers (an); b. the anther (e= endothecium; g = pollen grains; c. the carpel (c.w. = carpel wall; ov = ovule; se = embrio sac)

A single flower is discerned in sections through the buds of the T2 population; the elements of the perianth and the unilocular anthers with the pollen grains are also distinguished; the absence of the carpel in some buds can be notice (fig.3a).

One or two flowers can be observed in the buds of the T3 population; the anthers are at the same stage as the populations described above (fig.3b); the carpel with a long style is noticed also (fig.3c).

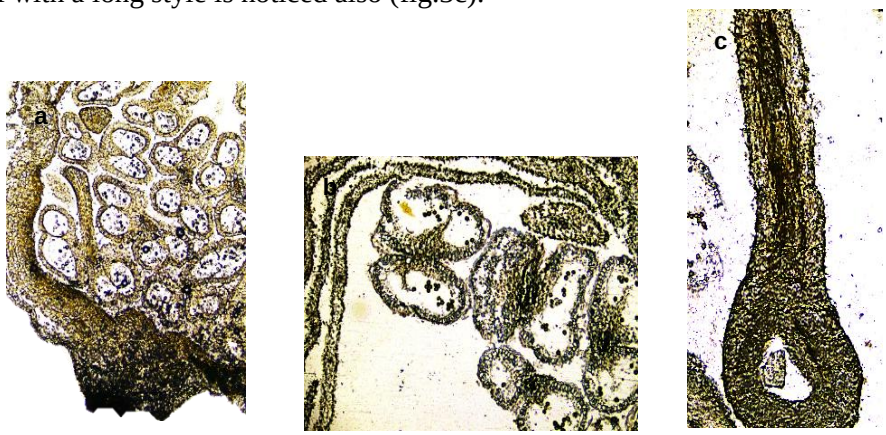

Fig. 3 Organogenesis in the floral buds of T2 and T3 population: a. T2 – the anthers with pollen grains; carpel is avorted; b. T3 – the perianth and the anthers with pollen grains; c. T3 – the carpel with a long style

Two flowers are observed usually in flower buds of the T4 population (fig. 11); the pollen grains are formed in anthers (12); the short style carpel (fig. 13) has an ovule in a primordial stage of development (fig. 11).

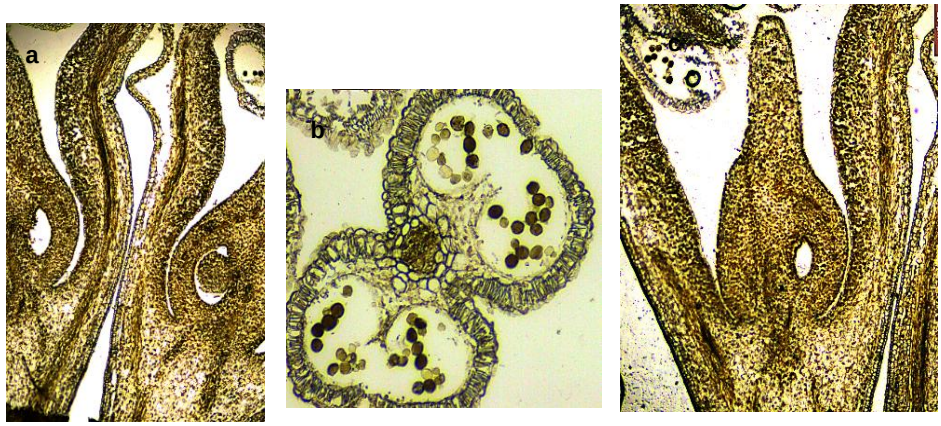

Fig. 4 Organogenesis in the floral buds of T4 population: a. – two flowers into a bud; b. the anther and the pollen grains; c. the carpel with a short style

The examination of the flower buds' sections emphasized the stage of floral organogenesis process to each population.

Toward the end of dormancy in all four cases the elements of the perianth and the pollen grains are already formed; differences are found in the stage of the carpel formation for each population.

Although in the literature it is specified that the ovule remains in the primordial stage during the dormancy to Prunus species (Mănescu et al., 1975), to the T1 population was found that the differentiation of the embryonic sac is initiate during this period. This population belongs to early varieties group, the fruits being mature in the second decade of August.

CONCLUSIONS

1. During dormancy a removal of flower buds could take place if they were produced in excess.

2. There is a well adaptation to the local conditions from Pătârlagele (Buzău County) for all four observed population.

3. Carpels are in different stages of development depending on the cultivars and the moment of fruit formation

4. The perianth elements and pollen grains are already formed at the end of dormancy to all four populations.

5. The carpels are in different stages of development depending on the cultivars and the moment of fruit formation.

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