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EVALUATION OF SOME SWEET CHERRY CULTIVARS TO WINTER FREEZE IN DIFFERENT AREAS OF ROMANIA

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Abstract

A very large number of sweet cherry cultivars grafted on different rootstocks was tested for freeze injuries in the winter of 2011/2012. The cultivars evaluated were Van, Celeste, Lapins, Kordia, Giant Red, Ferrovia, Early Red, Firm Red, Skeena, New Star, Regina grafted on PHLC rootstock in Istrita Nursery Station; Van and Stella on Prunus mahaleb L. in Moara Domneasca Didactic Farm; Ferrovia, Lapins, Celeste, Vega, Skeena, Early Red, New Star, Kordia, Mora di Vignola, Firm Red, Giant Red, Katalin, Ulster, Sam, B. Burlat, Boambe de Cotnari, Hedelfinger, Germersdorf, Van, Rivan, Regina, Giorgia grafted on PHLC, Colt, CAB6P, CAB11E and Prunus mahaleb L. in USAMV Bucharest Experimental Field. The wood hardness of the cultivars was assessed considering the branch types and the position in the crown. Frost hardiness results indicate a wide spectrum of cultivar resistance in terms of winter damages between 9.98% to 63.92% in Istrita region, 1.96% to 48.25% in Bucharest and Moara Domneasca area. The most affected by frost was Skeena at Istrita and Germersdorf in Bucharest.

Keywords**:** *sweet cherry, frost injuries, hardiness evaluation*

INTRODUCTION

The benefits of the sweet cherry (*Prunus avium* L.) consumption and fruit growing are well known worldwide [4]. Because of his importance, many producers are trying to adapt the new release cultivars [9] and rootstocks [1] in different regions in order to maximize the quality and yield of fruits [5].

A lot of remarkable sweet cherries varieties recently introduced coming from different breeding conditions [9] have abroad origin. In the new concept of european market and globalization, sweet cherry productions should come from cultivars more homogenous [2] with standard required quality.

Due to a lack of data regarding their performance in the traditional and non traditional Romanian cultivation area of sweet cherry, many of these cultivars could be affected by winter frosts and may register serious production losses in the unfavourable years. The climate changes problems should not be ignored in this case and might be a subject for further researches.

The temperature fluctuations in winter and the sudden amplitudes are the main cause for frost injuries [7] in the south-eastern part of Europe where the absolute minimum temperature is not the major factor involved for cherry. The effect of low temperatures is also expressed by cultivars according to genetic heritage [2] and rootstock used. For instance, Gisela 5 one of the most recommended and used dwarf rootstock for cherry is mentioned by some authors [8, 10] as hardier than Mazzard. Other authors [7] found that 'Burlat' grafted on Gisela 5 recorded much severe frost injuries than *P. mahaleb* L. seedlings or Weiroot rootstock series.

A research conducted on many sweet cherry cultivars from Fruit Genebank Dresden-Pilnitz show no correlation between frost and diseases resistance of the cultivars, so this issue must be approached separately [3].

MATERIAL AND METHOD

In order to evaluate the hardiness of some sweet cherry cultivars grafted on different rootstocks in the condition of 2011/2012 winter, three locations were choosed for test. The cultivars evaluated were Van, Celeste, Lapins, Kordia, Giant Red, Ferrovia, Early Red,

Firm Red, Skeena, New Star, Regina grafted on PHLC rootstock in Istrita Nursery Station; Van and Stella on *Prunus mahaleb* L. in Moara Domneasca Didactic Farm; Ferrovia, Lapins, Celeste, Vega, Skeena, Early Red, New Star, Kordia, Mora di Vignola, Firm Red, Giant Red, Katalin, Ulster, Sam, B. Burlat, Boambe de Cotnari, Hedelfinger, Germersdorf, Van, Rivan, Regina, Giorgia grafted on PHLC, Colt, CAB6P, CAB11E and *Prunus mahaleb* L. in USAMV Bucharest Experimental Field (photo 4).

The wood hardiness of the cultivars was assessed considering the branch types and the position in the crown. From each cultivar it were collected spur, medium and long branches, detached from first level and upper half of the crown (second level). At the end of January and in the first decade of February, it were analyzed 100 floral buds on each variant and it was calculated the percentages of losses. As statistical method it was used Duncan's multiple range test *($P \leq 0.05$)* where means followed by the same letter in the same column are not significantly different.

RESULTS AND DISCUSSIONS

In the last time, in Romania as in other European countries, the climate changes are more often mentioned when pay attention to very low temperatures in winter or very hot summers with long periods of dryness.

The winter of 2011/2012 is one of the hard winter examples, when low temperatures have persisted for many days and the wind blew harder.

In the Istrita condition (table 1), the highest degree of frozen flower buds was recorded by Skeena (63,92%). The biggest losses were counted in the bazal part of the crown and the most affected type of branch was the medium one (90,91%). In the upper part of the tree, the percentages of damages were under 50% for the medium and long branches.

Not all of cultivars react like Skeena. For instance, Kordia tolerate quite well the low temperatures and has numbered only 9,98% frost buds/tree.

Table 1. Floral buds losses due to 2011/2012 winter frost at some sweet cherry cultivars grown in Istrita, Buzau (%)

Cultivar	*I level (below)*				*II level (upper)*				*Mean per tree*
	Spurs	*Medium branches*	*Long branches*	*Average I level*	*Spurs*	*Medium branches*	*Long branches*	*Average II level*	
Van	68.29a	60.00d	57.30b	***61.87b***	22.95f	20.29de	44.93a	***29.39d***	***45.63b***
Celeste	7.73h	53.33e	14.04g	***25.03g***	1.56h	0	0.00	***0.52h***	***12.78g***
Lapins	42.18c	37.25g	32.31d	***37.25e***	6.21h	8f	10.09f	***8.10gh***	***22.67f***
Kordia	13.76g	9.92j	2.38i	***8.68j***	12.58g	7.31f	13.92e	***11.27g***	***9.98h***
Giant Red	28.92d	61.36c	28.33ef	***39.54d***	38.02c	18.46e	5.61g	***20.70f***	***30.12e***
Ferovia	20.83f	7.37j	11.43h	***13.21i***	27.78e	25.53c	43.30b	***32.20c***	***22.71f***
Early Red	28.48d	67.21b	29.79e	***41.83c***	3.85h	9.09f	10.37f	***7.77gh***	***24.80f***
Firm Red	43.33c	35.53h	27.42f	***35.43f***	43.33b	35.52b	27.42c	***35.43b***	***35.43c***
Skeena	65.52b	90.91a	77.55a	***77.99a***	58.57a	45.45a	45.52a	***49.85a***	***63.92a***
New Star	42.51c	40.58f	45.16c	***42.75c***	31.21d	21.84d	19.44d	***24.17e***	***33.46d***
Regina	26.72e	26.72i	15.38g	***22.94h***	6.77h	4.80f	7.89fg	***6.49h***	***14.72g***
Media	***35.30***	***44.56***	***31.01***	***36.96***	***22.98***	***17.84***	***20.77***	***20.54***	***28.75***

* means followed by the same letter in the same column are not significantly different.

With no significant differences, Lapins, Ferrovia and Early Red positioned in the "*under 30%*" group. According to Kolesnikov [6], cited by Budan S. [2], the sweet cherry production started to decrease only when the flowering buds were lost in a higher percentage than 30%. Other cultivars with a good resistance that recorded under 35% losses are Celeste, Regina, New Star and Giant Red.

The analyze of the frost injuries depending on branch type (fig. 1) is revealing the fact that the losses are linked with genetic information of the cultivar and with flowering bud formation on the fruit branches.

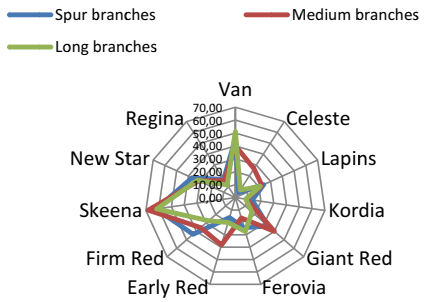

Fig. 1. The flower buds losses at some sweet cherry cultivars depending on branch type (Istrita, %)

Position in the crown of the flowering buds is another element involved in the total percentage of bud losses. As it could be observed in the figure 2, the first level (from the ground to half of the tree height) is much affected by cold temperatures.

For Celeste, even the total injuries are minor, the higher share of the frozen flower buds was remarked in the first level of the crown.

As a general comment, we observed that the cultivars appreciated together (mean values) indicate the inferior part of the crown with susceptibility to the cold injuries.

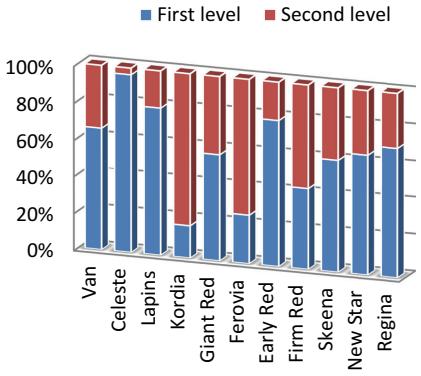

Fig. 2. The flowering bud losses degree at some sweet cherry cultivars depending on the position in the crown (Istrita, %)

In the experimental plot of USAMV Bucharest, the total frost buds percentage at cherry was smaller than in the Istrita Station field.

Excepting Germersdorf (48,25%), Giant Red (45,74%), Skeena (34,4%) and Lapins (35,07%), all the sweet cherry cultivars proved a good tolerance to cold winter temperatures.

The smallest percentages of flower buds destroyed by frost were noticed for Giorgia, Regina, Ulster, Rivan, Van, Mora di Vignola, Vega (table 2). The values did not exceed 10%.

Table 2. The flower buds losses by cold temperatures in the 2011/2012 winter of some sweet cherry cultivars in the experimental field of USAMV Bucharest (%)

Cultivar	*Spur*	*Medium branch*	*Long branch*	*Mean (tree)*
Ferrovia	26.92g	9.52ghij	16.67gh	***17.70h***
Lapins	43.55d	18.18f	43.48b	***35.07d***
Celeste	72.41b	7.69hij	15.00hi	***31.70e***
Vega	10.71i	12.50g	0.00	***7.74j***
Skeena	35.90f	61.11a	18.18fg	***38.40c***
Early Red	55.56c	12.82g	34.78c	***34.39d***
New Star	13.56i	20.51ef	4.17k	***12.75i***
Kordia	36.00f	10.81gh	25.00d	***23.94f***
Mora di Vignola	12.50i	10.00ghi	0.00	***7.50j***
Firm Red	39.13e	18.87f	2.38k	***20.13g***
Giant Red	87.50a	36.67b	13.04ij	***45.74b***
Katalin	8.89i	35.06c	31.03d	***25.00f***
Ulster	6.38i	0.00	7.14k	***4.51j***
Sam	19.81h	19.44f	11.11j	***16.79h***
Burlat	4.35i	4.76ij	20.00f	***9.70ij***
B de Cotnari	14.47i	24.53d	19.05fg	***19.35gh***
Hedelfinger	6.02i	22.22e	0.00	***9.42ij***
Germersdorf	12.99i	61.76a	70.00a	***48.25a***
Van	3.37i	17.65f	0.00	***7.01j***
Rivan	1.41i	5.41ij	11.54j	***6.12j***
Regina	2.70i	3.64j	0.00	***2.11j***
Giorgia	5.88i	0.00	0.00	***1.96j***
Media	***23.64***	***18.78***	***15.57***	***19,33***

** Duncan's multiple range test ($P \leq 0.05$)*

As in the Istrita case, the branch type influenced the number of frozen floral buds at the cherry trees in Bucharest. Bigger damages were observed for floral buds on the spur branches at Celeste, Early Red, Giant Red, Ferrovia and Kordia; on medium branches at Skeena, Vega, New Star, Katalin, Hedelfinger, Boambe de Cotnari and Van); on long branches at Ulster, Burlat, Germersdorf and Rivan (fig. 3).

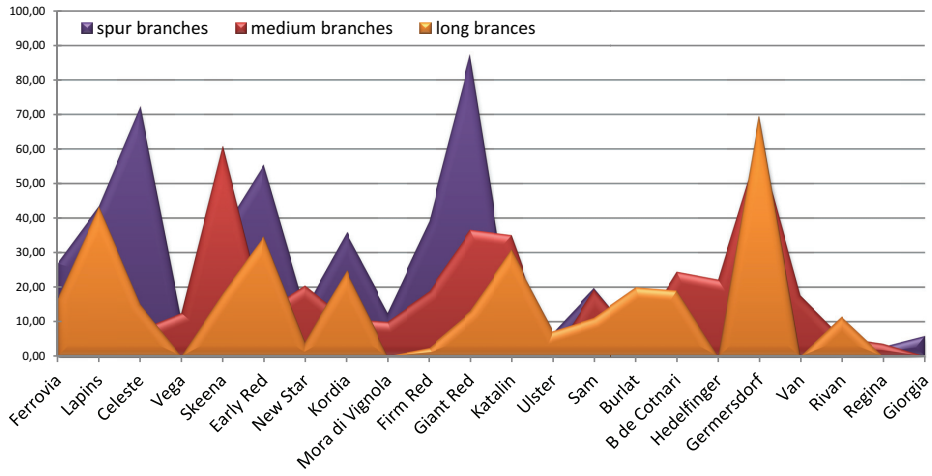

Fig. 3. Flower bud losses of some different sweet cherry cultivars in the USAMV Bucharest experimental field depending on branch type (%)

It is important to say that the age of the tree, genetic distribution and share of the branch type in the crown as well as the physiological and biochemical balance of the tree in the previous year, could lean towards a higher or lower percentage of buds lost due to low temperatures in the winter.

In the Didactic Farm of Moara Domneasca, the main cultivars have been affected by cold temperatures in the 2011/2012 winter too, but the bud losses did not overcome significantly the limit accepted as regular. Stella and Van recorded superior values of frozen flower buds on medium branches (table 3).

Table 3. The frost injuries degree of the flower buds in the winter of 2011/2012 at main sweet cherry cultivars in the Didactic Farm of Moara Domneasca (%)

Cultivar	*Spurs*	*Medium branch*	*Mean*
Stella	5.80a	12.00b	***8.90b***
Van	27.38b	34.25a	***30.81a***
Media	***16,59***	***23,12***	***19,86***

** Duncan's multiple range test ($P \leq 0.05$)*

Ensembling the average data regarding the floral buds losses due to the cold temperatures during the last winter in each of the studied areas (figure 4), we found that percentages of the cherry injuries are unable to compromise the yield of this year.

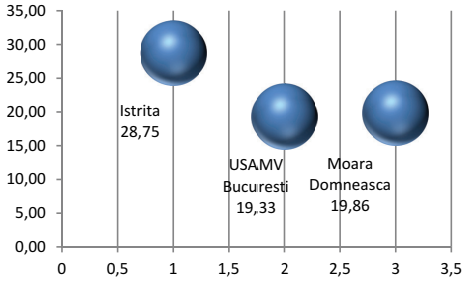

Fig. 4. The average percentages of affected flower buds in the three experimental centers: |Istrita Buza, USAMV Bucharest and Didactic Farm Moara Domneasca

Unfortunately, later in the Spring, the temperatures oscillations after bud burst and especially the lower temperature registered in the morning of April, 10 in Istrita Buzau region (-6^0C) destroyed all the flowers (photo 1,2,3) and fully compromise the cherry production in this year.

The other two centers haven't reported additional losses caused by the late spring frosts.

Photo 1. Browning of the floral organs due to negative temperatures occured in the morning of April, 10 in Istrita Buzau

Photo 2. Transversal sections reveal floral organ damage by frost (Moara Domneasca, 2012)

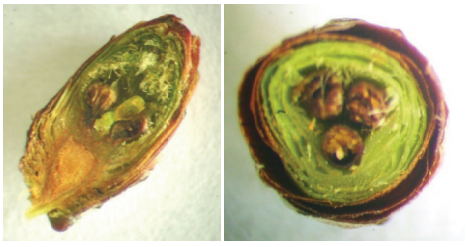

Photo 3. Frost damage at sweet chery fruiting buds - transversal and longitudinal section view

Photo 4. Sweet cherry experimental plot in high density system at USAMV Bucharest (2012)

CONCLUSIONS

The lasting low temperatures in the 2011/2012 winter produced frost damages at the floral buds of sweet cherry cultivars grown in Istrita, Bucharest and Moara Domneasca regions differentially.

9.98% to 63.92% of floral buds affected by frost was recorded in Istrita region and 1.96% to 48.25% in Bucharest and Moara Domneasca area.

The most affected by winter frost was Skeena (63,92%) at Istrita and Germersdorf (48,25%) in Bucharest.

Lower part of the crown was much exposed to the low temperatures and registered a higher percentage of floral buds losses, respectively with 28,5% more than the upper half of the crown.

Frost injuries depend on branch type. Floral bud losses are linked also with genetical heritage of the cultivar.

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