

I. RESURSE GENETICE, AMELIORAREA SPECIILOR POMICOLE GENETIC RESOURCES, BREEDING OF DECIDUOUS FRUIT TREES SPECIES

EVALUAREA RESISTENȚEI LA GER A FONDULUI DE GERMOPLASMĂ DE MUR (*RUBUS SP.*) DE LA ICDP PITEȘTI

EVALUATION OF THE BLACKBERRY GERMOPLASM (*RUBUS SPP.*) FROST RESISTANCE AT THE RESEARCH INSTITUTE FOR FRUIT GROWING PITEȘTI

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Abstract

The study concerns the evaluation of damage caused by strong frosts in the winter 2009-2010 to the blackberry plants in the experimental field of the RIFG Pitesti-Mărăcineni. There were taken under study 42 blackberry genotypes of the Institute collection, 11 selections originated from 6 hybrid combinations made in 2000 and 350 hybrids resulted from the 15 hybrid combinations, made in 2002. The objective of the work was to evaluate and identify genotypes with genetic resistance to negative temperatures extremely severe (-24.4°C in air and -25.5°C on snow surface) knowing that the threshold resistance of the thornfree blackberry is the minimum temperature -14°C ...-15°C and of the thorny ones -17°C ...-18°C. The goal was to introduce the most resistant genotypes as basic genitors in the breeding program for the improving the frost resistance of the varieties and to promote them in culture. The evaluation was done on the stems, buds and shoots of plants in the bud-break and growth of fruiting shoots phenophases. It was found that the most varieties, selections and hybrids with semierect and erect habit were strongly damaged, with some exceptions that will be presented below, while the least affected were those with creeping habit and stems bent to the ground soil. Of all the genotypes Wilson Early variety, selections ARK 613 and ARK 609, 2 / 21 and hybrids : N x A-T 12, H -N1, H T4-R3, N x H-2/11 și N x H 2/T 13 were found to have high degree resistance to the extremely frosts of the 2009-2010 winter.

Keywords: variety, selection, hybrid, minimum temperature, damaged canes

Cuvinte cheie: varietate, selecție, hybrid, temperatură minimă, tulpini înghețate

1. Introduction.

Resistance to low temperatures is a feature blackberry varieties need and a major limiting factor for blackberry crop in northern Europe, North America, and in Romania, too. In Romania, this crop finds difficult to place in commercial culture, being more extensive in the garden or in covered spaces. Blackberry bush is affected by strong frosts in some winters, when fruit yield may be destroyed partially or total. Resistance to cold is one of the most complex traits, having beyond genetic determinism and an important physiological component (carbohydrate content of stems and buds, the bound water, etc..) closely correlated with environmental factors (Palonen P. et al., 2002, Danek J. et al., 2004). In terms of our country is estimated that the limit of blackberry bush resistance is a minimum temperature of -17°C ...-18°C, for thorny varieties and -12 .. -15°C, for those thornless. The effect of low temperature is manifested by freezing the stem and buds, so that the current yield is compromised in whole or in part, without being affected the issuance of new canes from base of canes or from roots. Erect growing varieties are most exposed to low temperatures, while port creeping varieties are protected by snow (in winter when it exists).The Institute is supported by self-improvement blackberry varieties which aims mainly to improve resistance to frost, fruit quality and early maturing (Mladin P. et al., 2009).

In the spring 2010, after a winter with excessively low absolute minimum temperatures that were close to an absolute minimum (-24.4 ° C) for our area, was made a full assessment of the biological material existing at the Institute, including collection of varieties, selections and hybrids in field trials to identify those genotypes that have survived the severity of winter 2009-2010. These should be recommended for culture and for their inclusion as basic genitors in the breeding program.

2. Material and method

The biological material studied consisted of the followings : a) 42 cultivars and selections in the blackberry collection of the Institute (thornfree and thorny genotypes, with erect, semi-erect and creeping

habit); b) 11 selections in the micro-trial, originated from six hybrid combinations ; and c) 376 hybrids in the selection field, obtained from 15 crossing combinations. In the collection and microtrial each genotype was represented by 5 plants and the hybrids by individual plants. Plants were tracked throughout the growing season, and in those whose canes have survived, determinations were made on fruit quality and production. Data were analyzed by Duncan test.

3. Results and discussions

Preparing of the blackberry plants for dormant entry was made in a weather characterized by low intensity light, high temperatures and humidity that means unfavorable conditions for the accumulation and storage of carbohydrates in the stem and bud tissues. Warm and weak sunny period in October continued in November, passing then to the winter months when there were two periods of very low temperatures: first, on 21 and 22 December 2009 and the Second, on 25 and 26 January. In December, after a first half of the month with high medium and minimum temperatures, minimum temperatures suddenly dropped on 21 at -20°C outside the house (at 8 o'clock woundat -18°C weather in the shelter (Figure 1).

And in January 2010 the temperatures were similar. After a first half of warmer than normal, since 21 January, temperatures dropped sharply and remained at this level for 8 days (Figure 2).

The lowest value was reported on January 25 and 26 when the outside temperature fell to -23.9°C weather shelter $^{\circ}\text{C}$. On December 26, of snow surface temperature fell to -25.5°C , $0,7^{\circ}\text{C}$ lower than the station record (1969-2010) on January 1993 -24.8°C .

A) Results on frost resistance blackberry genotypes from the collection

From Table 1, one can see that group of genotypes with erect and semi-erect port none survived to the excessively low temperatures during the winter, all of which canes entirely frozen, except for their base protected by snow. An interesting phenomenon was observed in selections POL- 97 524 and POL- 97 464, which canes stretch over 1.8 to 2.0 m height. The buds over this height of the canes has at the first control were viable and have turned in growth, but after that they died, because the wood of the canes been entirely destroyed. The phenomenon is explained by the thermal difference from the soil ground, where was recorded the lowest temperature (-25.5°C) and air (-23.9°C), at the height of 1.8 to 2.0 m. This phenomenon has been observed in other genotypes (Felix and Ores) with higher canes than 2 m. Interestingly from this point was the selection of POL 97563 that presented viable buds below 2 m height, but they also died after turning in growing. This proves that buds unlike canes had some resistance to these extremely low temperatures, turning in vegetation from its own reserves. Of thornfree creeping varieties that took advantage of its foliage and cover with a layer of snow, Waldo variety performed best, with about 70% viable canes.

Under the same conditions, Adrienne, Loganberry and Helen var. were entirely affected. The ARK group hybrid selections: ARK 609, 615 and 556 / 1, were less affected by frost. These plants formed a roof of leaves and snow over canopy. It was also noted Wilson Early variety with good natural resistance to the excessively low temperatures, confirming once again its value as a genitor of character for the improving the resistance to very low temperature of the blackberry (already used in hybridization, personal communication). Creeping varieties were strongly affected, except Kotata variety, followed by variety Ollalie.

B) Results on frost resistance of the selections in blackberry trial. In this group only four selections had viable canes (20 to 100 %), of which only the selection of E 2 / 21 was evident by the fact that has natural resistance (having erect stems fully exposed to low temperatures), the other three selections having their canes lying on the ground (Table 2). Resistance of E 2 / 21 selections can be appreciated as an attribute spontaneously occurred since it comes from two with low resistance genitors, Arapaho and Lock Ness.

C) Results on frost resistance of the hybrid progenies

The assessment of 39 individuals coming from the combination Navaho x Adrienne resulted us three individuals being selected (Table 3). The hybrid N x AT 12 was noted by a natural resistance to extreme temperatures, while having thin and vertical canes The other two individuals had their canes fallen to the soil ground. From the combination Navaho x Helen, the hybrid H-2/11 noted, 50% stems affected. Besides those mentioned above were also highlighted hybrids H-H-T4-R3 and H-N1 with erect and thin stems.

4. Conclusions

Unusually low minimum temperatures of winter 2009-2010 strongly affected the blackberry plants. Out the 403 genotypes a number of eight resistant genotypes were found. Of these the most resistant was Wilson's Early variety, the selection E 2 / 21 and the hybrids: N x AT 12, H-N1, H-T4-R3 and N x H-2/11 resulted from the breeding program of the RIFG Pitești. Some resistance shows ARK 556 / 1 and ARK 609 coming from Fayetteville, Arkansas. In some genotypes generative buds showed some

resistance to extreme cold versus wood of the canes. E 2 / 21 by a previous evaluation is high quality and good in yield (Mladin P. et al., 2009), so this represents a valuable promising selection. The above mentioned hybrids: N x AT 12, H-N1, H-T4-R3 and N x H-2/11 are recommended to be evaluated in field trial, for the other agronomic traits characteristics. Wilson Early variety is an useful genitor in crosses for the improving of the frost resistance. Valuable parents for the resistance to sever frost could be the above mentioned hybrids and E 2/21 selection, too.

5. References

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Tables and figures

Table 1. Damage degree by low temperatures of blackberry genotypes from the collection of the RIFG Pitești (winter 2009-2010)

No.	Thornynnes and habit	Number of canes / bush	Number of apparently healthy canes	Frozen canes %	Number of canes with viable buds on the tops (over 2 m) *
Thornfree genotypes , erect and semi-erect habit					
1	Arapaho	6,0	0 n	100 a	0
2	Black Satin	8,3	0 n	100 a	0
3	Chester Thornless	7,4	0 n	100 a	0
4	Hull Thornless	6,6	0 n	100 a	0
5	Loch Ness	5,5	0 n	100 a	0
6	Loch Tay	4,6	0 n	100 a	0
7	Navaho	7,2	0 n	100 a	0
8	Thornfree	6,5	0 n	100 a	0
9	Thornless Evergreen	7,2	0 n	100 a	0
10	Triple Crown	5,6	0 n	100 a	0
11	POL-97524	4,4	4,4 c	100 a	4,4
12	POL-97464	6,4	6,4	100 a	6,4
13	M1-C	6,2	0 n	100 a	0
14	M2-C	5,6	0 n	100 a	0
Thorny genotypes, erect and semi-erect habit					
15	Adrienne	5,5	0,5 kl	90,9 fg	
16	Helen	5,7	0,5 lm	91,2 def	
17	Waldo	6,1	4,3 lm	29,5 k	
18	Loganberry	4,5	0 n	100 a	
Thorny genotypes, erect and semi-erect habit					
19	ARK 530	6,5	1,2 hi	81,5 h	0
20	ARK 537	6,7	1,7 g	74,6 i	0
21	ARK 556/1	5,4	4,2 b	22,2 l	0
22	ARK 593	5,2	0,3 lm	94,2 bcd	0
23	ARK 609	4,5	3,5 e	22,2 l	0
24	ARK 613	4,6	3,8 d	17,4m	0
25	ARK 615	4,5	0,3 lm	93,3 a	0
26	ARK 629	5,5	0,2 n	96,4 ab	0
27	ARK 745	6,6	1,3 h	80,3 h	0
28	Comanche	7,3	0,7 k	90,4 ef	0
29	Darrow	6,7	0,1 n	98,5 a	0
30	Wilson's Early	8,3	6, 6 a	20,5 lm	0
31	Felix	3,5	0,2	94,3 bcd	2,0
32	Ores	3,8	0,2	94,7 bc	1,0
33	97563	2,6	0,6 k	76,9 i	1,7
34	Dar-8	4,7	1,2 hi	74,5 i	0
35	Dar-24	5,6	1,0 j	82,1 h	0
Thorny genotypes, creeping habit					
36	Tayberry	5,5	0 n	100 a	
37	Tummelberry	6,8	1,3 h	80,9 h	
38	Bedford Giant	7,5	0,6 k	92,0 cde	
39	Kotata	8,9	6,4 a	28,0 k	
40	Olallie	7,7	2,4 f	68,8 j	
41	Silvan	6,8	1,0 j	85,3 g	

Table 2. Damage degree of the blackberry selections by low temperatures in the winter of 2009-2010 at the RIFG Pitești

No	Selection	Genetic origin	Number of canes	Frozen canes		Healthy canes	Observations
				No.	%	%	
1	E 1/8	Navaho x Adrienne	5	5 ab	100 a	0 d	
2	E 1/21	Navaho x Adrienne	5	5 ab	100 a	0 d	
3	E 1/32	Navaho x L. Ness	4	4 ab	100 a	0 d	
4	E 2/1	Navaho x L. Ness	3	0 c	0 d	100 a	Canes fallen on the soil
5	E 2/13	Navaho x Hellen	3	3 b	100	0 d	
6	E 2/21	L. Ness x Arapaho	6	3 b	50 c	50 b	Thin and erect canes
7	E 3/12	L. Ness x Arapaho	5	4 ab	80 b	20 c	Canes fallen on the soil
8	E 3/17	L. Ness x Navaho	5	4 ab	80 b	20 c	Canes fallen on the soil
9	E 5/5	Arapaho x L. Ness	6	6 a	100 a	0 d	
10	E 5/6	Arapaho x L. Ness	5	5 ab	100 a	0 d	
11	E 4/32	Arapaho x L. Ness	4	4 ab	100 a	0 d	

Table 3. Damage degree of blackberry hybrids by excessively low temperatures of 2009-2010 winter

No.	Hybrid family / number of individuals	Individual hybrid	Total number of canes	Of which			Observations
				Frozen canes		Healthy canes	
				Number	%	%	
1	Navaho x Adrienne/39	N x A-T 1	6	3 b	50 b	50 e	Fallen canes on soil
2		N x A-T 4	5	2 b	40 c	60 d	Fallen canes on soil
3		N x A-T 12	5	0 d	0 f	100 a	Thin canes
4	Navaho x Lock Ness /57	N x LN-2/1	2	0 d	0 f	100 a	Fallen canes on soil
5		N x LN-2/7	5	2 b	40 c	60 d	Fallen canes on soil
6	Navaho x Helen/25	N x H-2/11	6	3 a	50 b	50 e	Erect canes
7		N x H- 2/T 13	6	3 a	50 b	50 e	Fallen canes on soil
8		N x H - 2/T14	5	0 d	0 f	100 a	Fallen canes on the soil
9	Arapaho x Triple Crown/32	H -T4-R3	6	2 b	33,3 d	66,7 c	Erect canes
10	Triple Crown x Loch Ness/27	H -N1	5	1 c	20 e	80 b	Erect canes
11	ARK 609 x Darrow3/31	H t-16	5	3,2 a	64 a	36 f	Fallen canes on soil

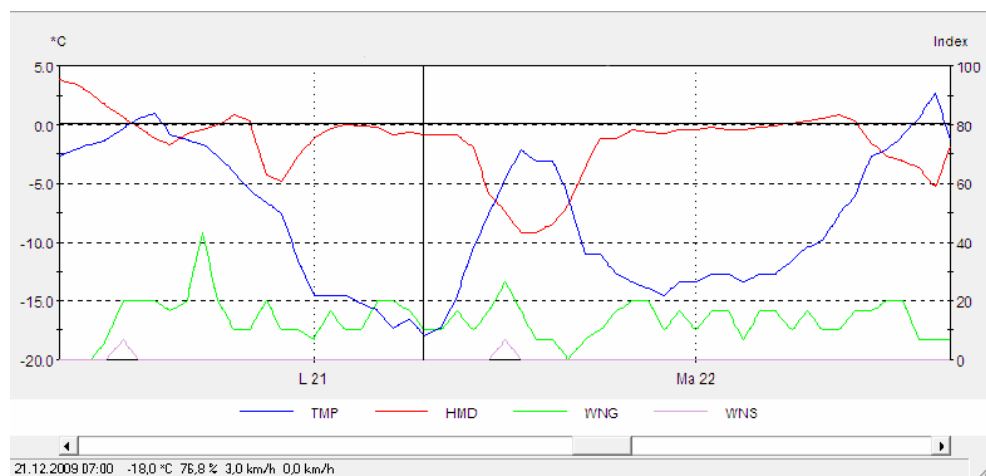


Figure 1. The evolution of air temperature, air humidity and wind speed on 21 and 22 December 2009 (Mărăcineni, Argeş)

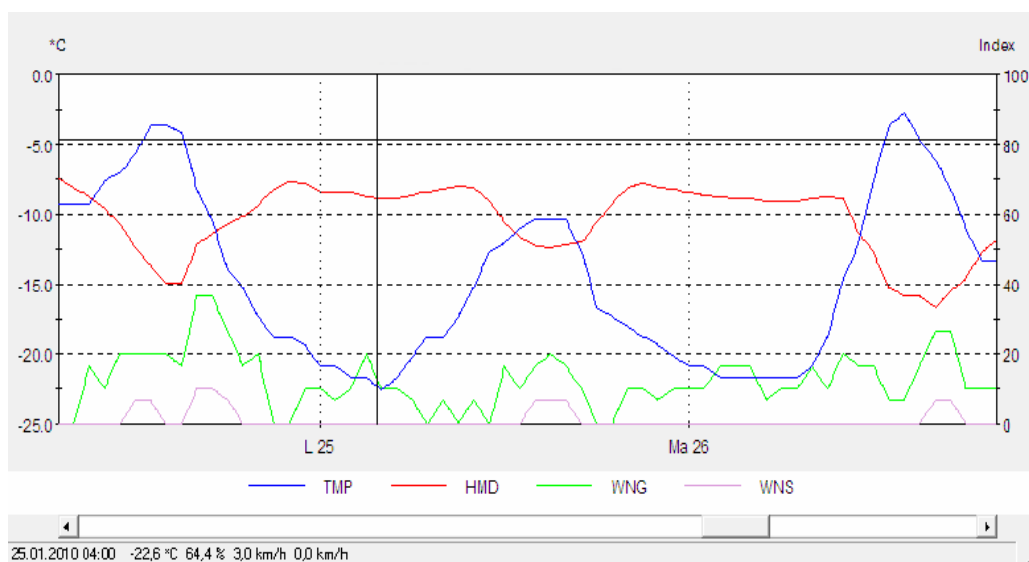


Figure 2. The evolution of air temperature, air humidity and wind speed on 25 and 26 January 2010 (Mărăcineni, Argeş).