Evaluation of different sources of resistance for breeding powdery mildew resistant grapevine varieties

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Summary: The appearance of resistance to powdery mildew was investigated on seedling progenies of interspecific crossings. Hybrids of American and East-Asian wild species and one *Vitis vinifera* variety (Janjal kara) were used as source of resistance in the crossings. The resistance of foliage and of berries were tested in the field at the time of vintage. The degree of resistance was ranked into six classes.

In American and Asian hybrid derivatives there were few highly resistant progenies, but in the hybrids of *Janjal kara* variety more than 90 % of the progenies proved to be highly resistant to powdery mildew. According to the distribution of classes of resistance in the populations the resistance of American and Asian sources are mostly influenced by additive gene affects. The resistance of *Janjal kara* seemed to be mono or digenic.

No close correlation was found between the powdery mildew resistance of the foliage and that of the berries.

Introduction

The primary condition of efficient plant breeding is the knowledge of genetic variability, heritability of the intended character. In the case of perennial plants with a long life-cycle and requiring large space, reliable data are restricted to the heritability of very few characters. A number of controversial data have been published about the heritability of powdery mildew resistance of grapes as well.

The first publication *(Husfeld,* 1933) to give numerical data about the variability of the resistance to powdery mildew of hybrid populations did not attempt to set up a model of heritability.

On the basis of the examination of *V. amurensis* x *V. vinifera* hybrids the heritability of resistance to powdery mildew seemed to be a monogenic mechanism *(Filippenko* and *Shtin,* 1980).

Through the analysis of numerous hybrid populations, the coefficient of heritability in the narrow sense calculated for resistance to powdery mildew range from 0.31 to 0.51, which indicates that the resistance is mostly influenced by additive gene effects *(Eibach* et al., 1989).

The disease is controlled by 4 pairs of alleles, susceptibility being dominant and resistance recessive *(Honroe* et al., 1992).

The progenies produced either by selfing or crossing of *V. vinifera* varieties always contained a few resistant individuals, irrespective resistance ratings of the parental. On the other hand, the frequency of resistance in the progeny showed a positive correlation with the resistance of the parents. It is suggested, that the results indicate that "minor" resistance genes do exist in the cultivars of *V. vinifera* (Li,. 1993).

Significant correlation (r=0.54; 0.59) has been found between the powdery mildew resistance of the leaves and fruits. However, the degree of infection of the fruits could not be inferred from the degree of infection of the leaves at early stages of development *(Eibach,* 1994).

In the course of the present research we examined the variability of the resistance of leaves and fruits, as well as the correlation of leaf- and bunch-resistance, in hybrid-populations produced by crossing the same maternal parent to males with resistance at various degrees and of various sources.

Material and methods

The experiments were carried out Szigetcsép, Experimental Station of the Department of Genetics and Plant Breeding, University of Horticulture and Food Industry between 1992-94. We have evaluated 289 seedlings of 6 crosses.

The resistance of the leaves and berries were noted once a year – in September, when the fruits ripened, – on the field. The degree of resistance was expressed on a 6-grade scale (0–5). The grades were distinguished on the basis of the area covered by conidiophors and the extent of the damage of the leaf or berry. Class 0 means perfect health, 5 means totally covered by conidiophores and brown leaf or burst and dried berry.

Table 1 Parentages and number of genotypes of the studied families (crosses)

No.	Parentage	Genotypes
1.	S-11 x Moldova	81
2.	S-11 x Pölöskei muskotály	58
3.	S-11 x Janjal kara x	40
4.	S-11 x Dolores	39
5.	S-11 x 66-80-7	32
6.	S 11 x 66-80-18	39

x *V. vinifera*

Table 2 Parentages of the parental clones

Parental clones	Parentages
S-11	[(V. amurensis x V. vinifera)F_2 x Afuz Ali x] x Kocsis Irma x
Moldova	Guzal kara x X Seyve Villard 12.375
Pölöskei muskotály	[Seyve Villard 12.375 x Pearl of Csaba x] x [Gloria Hungariae x x Qeen Elisabeth x]
Dolores	(Nimrang x x V. amurensis) x Ghalan x
66-80-7	[(V. amurensis x V. vinifera)F_2 x Italia x] x Husayne x
66-80-18	[(V. amurensis x V. vinifera)F_2 x Italia x] x Husayne x

x *V. vinifera*

Table 3 Mean values of powdery mildew resistance of leaves

No.	Families	Leaves	Order
1.	S-11 x Moldova	1.17	2.
2.	S-11 x Pölöskei muskotály	1.68	3.
3.	S-11 x Janjal kara	0.55	1.
4.	S-11 x Dolores	1.93	5.
5.	S-11 x 66-80-7	2.32	6.
6.	S-11 x 66-80-18	1.74	4.

In 5 out of the 6 crosses the relative frequencies of resistance classes show normal distribution, which proves the effect of additive genes. In these populations, resistance is derived from the East-Asian *V. amurensis* species or from an American wild species through the Seyve-Villard 12.375 hybrid.

In the case of the 3rd combination - where the male parent was the Janjal kara *V. vinifera* variety - more than 90% of the progeny belonged to classes 0 or 1, meaning very high resistance. The distribution observed in this population suggests a mono- or digenic inheritance of resistance derived from the *V. vinifera* variety, Janjal kara.

On the grounds of the mean values of the populations *Table 3 and 4,* the level of resistance of the 1st and 3rd populations is higher significantly than that of all the rest.

Table 4 Significance values for resistance of leaves (P=0.05.)

Families	1.	2.	3.	4.	5.
1. S-11 x Moldova					
2. S-11 x Pölöskei muskotály	0.33 0.51*	SD x_1-x_2			
3. S-11 x Janjal kara	0.41 1.13*	0.41 0.62*			
4. S-11 x Dolores	0.39 0.76*	0.41 0.25	0.47 1.38*		
5. S-11 x 66-80-7	0.39 1.15*	0.41 0.64*	0.47 0.77*	0.47 0.39	
6. S-11 x 66-80-18	0.39 0.57*	0.41 0.06	0.47 0.19*	0.47 0.19	0.47 0.58*

*Significant at P=0.05.

The coefficient of heritability of resistance could not be calculated as we could not evaluate the resistance of the parents on the same spot of investigation. The mean values of resistance of the hybrid-populations were compared by analysis of variance. The correlations between the resistance of the leaves and of the berries to powdery mildew were examined by the χ^2 test *(Sváb* 1981).

Results and discussion

Resistance of leaves

As the maternal partner was identical in each cross, differences between the resistance of progeny populations are, consequently paternal effects. *(Fig. 1)*

However, the resistance of the 1st family higher than that of the 3rd .

Resistance of berries

The relative distribution of the classes of resistance on berries shows that berries suffered more than the leaves *(Fig. 2).*

The distribution of resistance classes regarding the berries in the 3rd population is different from the distribution in the other populations, which confirms the different heritability of the resistance in the Janjal kara variety.

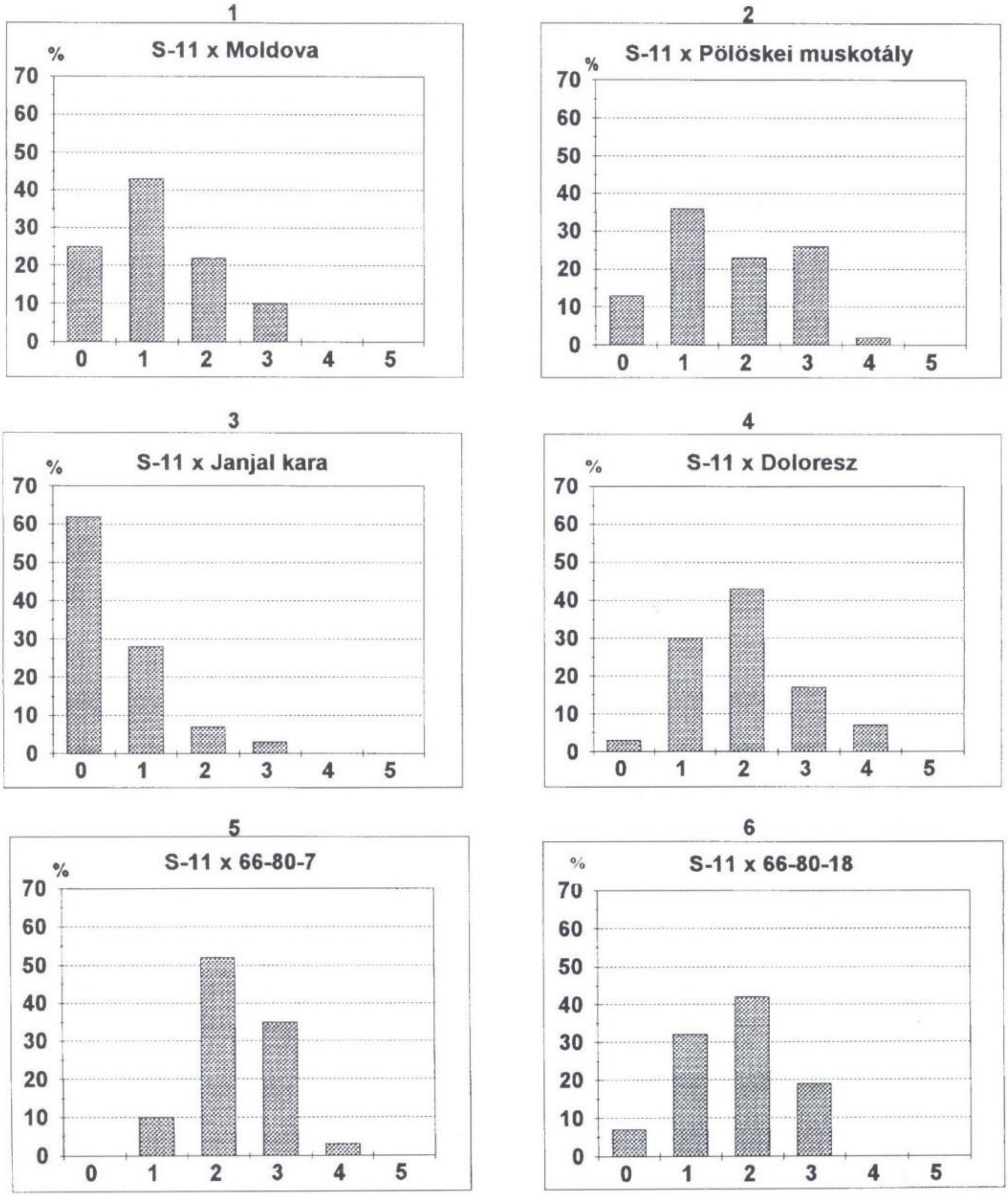

Fig. 1 Relative distribution of classes of resistance tested on leaves

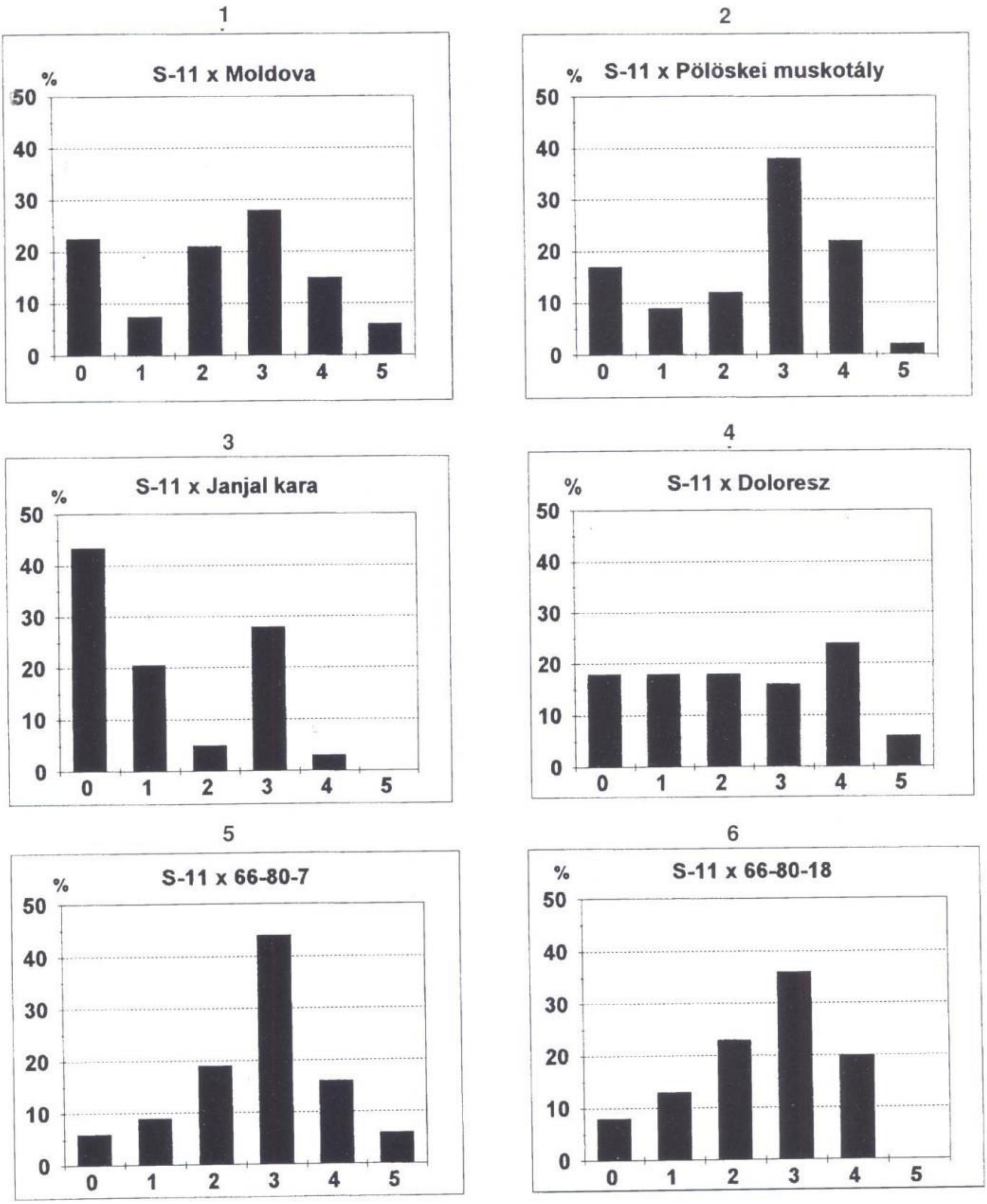

Fig. 2 Relative distribution of classes of resistance tested on berries

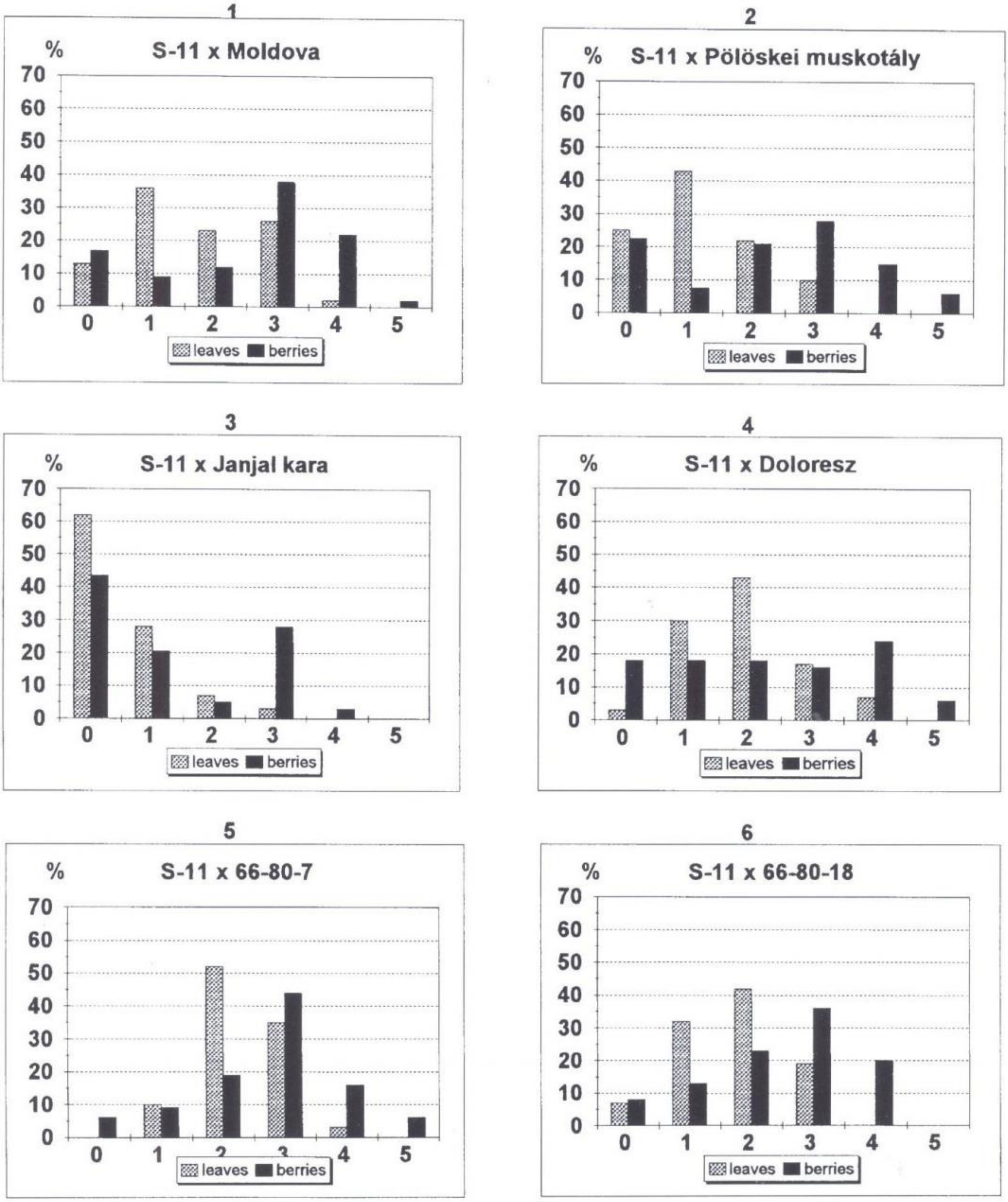

Fig. 3 Relative distribution of classes of resistance tested onleaves and berries

With regard to mean values of resistance shown in *Table 5*, the populations show a slightly different order from that one based on resistance of foliage. The 3rd population is significantly better than the others with regard to resistance of berries, too (*Table 6*), in spite of the fact that the rate of individuals with outstanding resistance is not as high as in the case of resistance of the foliage.

Table 5 Mean values of powdery mildew resistance of berries

No.	Families	Berries	Order
1.	S-11 x Moldova	2.24	2-3.
2.	S-11 x Pölöskei muskotály	2.45	4.
3.	S-11 x Janjal kara	1.26	1.
4.	S-11 x Dolores	2.24	2-3.
5.	S-11 x 66-80-7	2.72	6.
6.	S-11 x 66-80-18	2.49	5.

Table 6 Significance values for resistance of berroes (P=0.05.)

Families	1.	2.	3.	4.	5.
1. S-11 x Moldova					
2. S-11 x Pölöskei muskotály	0.49 0.21*	SD x_1-x_2			
3. S-11 x Janjal kara	0.55 1.98*	0.59 0.19*			
4. S-11 x Dolores	0.55 0.00*	0.59 0.21	0.63 1.98*		
5. S-11 x 66-80-7	0.59 1.48*	0.61 0.27*	0.67 0.46*	0.47 0.39	
6. S-11 x 66-80-18	0.55 0.25*	0.59 0.04	0.63 0.23*	0.47 0.19	0.67 0.23*

*Significant at P=0.05.

The correlation between the resistance of leaves and of berries

The mean values of resistance on the foliage and the berries- (*Table 3 and 5*) and the distribution of resistance classes (*Fig. 3*) displayed significant differences in the same populations. That is why we have examined the correlation of the two kinds of resistance.

The χ^2 trial proved the connection between the resistance of foliage and fruits to powdery mildew. However, the counted value of the contingency coefficient is r_k=0.21, which indicates loose correlation.

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