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THE RELATION BETWEEN POLLEN FUNCTIONAL ABILITY AND FRUIT SET IN GRAPEVINE (*VITIS* SP.)

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In this paper, pollen functional ability of the cultivars Chardonnay, Smederevka and SV 12-375, used as the male parent, for pollination of the cultivar Bagrina, as the female parent, was investigated. Free pollination of the cultivar Bagrina was observed as well as controlled pollination. Satisfactory pollen germination *in vitro* was established for the cultivars SV 12-375 (76.65%) and Smederevka (66.08%), while the cultivar Chardonnay had low pollen germination (20.88%). An association between pollen functional ability of the pollinizers and fruit set degree was determined for the cultivar Bagrina. Cultivars SV 12-375 and Smederevka were suitable pollinizers for the cultivar Bagrina.

Key words: grapevine, cultivar, pollen functional ability, fruit set

INTRODUCTION

Bagrina cultivar is an old Balkan grapevine intended for high quality, white wine production. While it has a functional female flower, fruitfulness is irregular because the fruit set is low. That is why this cultivar should be cultured in vineyards in which other cultivars served as pollinizers (CINDRIĆ *et al.*, 1994).

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Cultivars with hermaphroditic flowers that produce enough pollen with good functional ability are recommended as suitable pollinizers in grapevine. The degree of pollen functional ability is a basic factor for successful fertilization, fruit set and high yield. Pollen functional ability means the ability of pollen to develop a pollen tube after it falls on the stigma of the pistil and complete the fertilization in a short time. It must keep this ability longer than the functional vitality of the embryo sac lasts. To determine pollen functional ability according to STANLEY and LINSKENS (1974), the acetocarmine staining method and *in vitro* germination can be used.

The aim of this work was to study pollen functional ability of the cultivars Chardonnay, Smederevka and SV 12-375, when used as pollinizers, and to determine the degree of fruit set of the cultivar Bagrina when used as the female parent.

MATERIAL AND METHODS

The cultivars Chardonnay, Smederevka and SV 12-375 were used as pollinizers and the cultivar Bagrina was used as the female parent.

Pollen functional ability of the pollinizers cultivars was determined by acetocarmine staining and germination method *in vitro*. For acetocarmine staining a two-factorial experiment was carried out in 4 repetitions under a totally random plan. Pollen germination *in vitro* was determined by sowing pollen grains in Petri dishes with artificial nutrient medium (0.7% agar-agar with 16%, 18% and 20% sucrose). Thus, the experimental design was three-factorial in 4 repetitions under a totally random plan.

The degree of fertilization of the cultivar Bagrina was established from the fruit set and fruit harvested from three controlled combinations of pollination and one open pollination. Three weeks after flowering, fruit set number was determined, and at full maturity the number of fruit harvested was determined. The experiment was carried out in a two-factorial design with 5 repetitions under a totally random plan.

The results obtained were subjected to analysis of variance and single testing by the LSD test at 0.05 and 0.01 probabilities.

RESULTS AND DISCUSSION

From the results shown in Table 1, it can be seen that the cultivar Smederevka (93.34%) had the highest average for colored pollen grains, while the cultivar Chardonnay had the lowest (78.38%) in both years.

Considering the two year average, the cultivar Chardonnay had the lowest pollen grain germination in 20% sucrose (18.71%), but the highest in 18% sucrose (22.62%). The lowest pollen grain germination in Smederevka cultivar was in 20% sucrose (58.11%), and the highest in 16% sucrose (72.35%). In contrast, cultivar SV 12-375 had the highest pollen grain germination in 20% sucrose (80.20%), and the lowest in 16% sucrose (71.79%). In 1994, on average for all sucrose concentrations, pollen grain germination varied from 23.41% (cv. Chardonnay) to 82.31%

(cv. SV 12-375), while in 1996 the range was 18.34% (cv. Chardonnay) to 70.99% (cv. SV 12-375). Thus, for all sucrose concentrations and both years of investigations, the lowest mean pollen grain germination was shown by cultivar Chardonnay

Table 1. Mean values of pollen functional ability for three grapevine cultivars

Cultivar	Year	Staining (%)	*In vitro* germination in different sucrose concentrations (%)			
			16%	18%	20%	Average
Chardonnay	1994	84.08	24.18	25.54	20.50	23.41
	1996	72.67	18.41	19.69	16.91	18.34
	Average	78.38	21.30	22.62	18.71	20.88
Smederevka	1994	93.32	80.11	75.05	77.25	77.47
	1996	93.35	64.59	60.53	38.97	54.70
	Average	93.34	72.35	67.79	58.11	66.08
SV 12-375	1994	84.37	79.17	82.89	84.88	82.31
	1996	95.61	64.41	73.04	75.53	70.99
	Average	89.99	71.79	77.97	80.20	76.65

(20.88%) and the highest by cultivar SV 12-375 (76.65%). Similar variation intervals of pollen grain germination were found by DAULTA and CHAUHAN (1987) in grapevine cultivars. Namely, pollen grain germination was 34.6% to 93.0%. A slightly lower variation interval (16.7% - 41.0%) was obtained by KIMURA *et al.* (1998) who examined pollen grain germination in 4 grapevine cultivars.

Table 2. Mean squares from analysis of variance and LSD values for pollen grain staining in three grapevine cultivars

Source of variation	df	MS	LSD	
			0.05	0.01
Cultivar (A)	2	349.56**	1.33	1.83
Year (B)	1	6.83	-	-
A x B	2	186.03**	1.88	2.58
Error	18	1.61	-	-

The results of analysis of variance, (Table 2) show that the variability of pollen grain coloring was influenced very significantly by cultivar and interaction between cultivar x year, while the differences between years was not significant. In Table 3 it can be seen that the variability of pollen grain germination was influenced very significantly by all examined factors and their interactions. This confirms the results of AVRAMOV (1956) who found significant variations of pollen grain germination of some grapevine cultivars associated with sucrose concentration, cultivar and year.

Table 3. Mean squares from analysis of variance and LSD values for in vitro pollen germination in three grapevine cultivars

Source of variation	df	MS	LSD	
			0.05	0.01
Cultivar (A)	2	7910.77**	0.83	1.12
Year (B)	1	1280.18**	0.68	0.91
Sucrose concentration (C)	2	31.17**	0.83	1.12
A x B	2	164.14**	1.19	1.58
A x C	4	99.26**	1.45	1.93
B x C	2	26.72**	1.19	1.58
A x B x C	4	49.89**	2.05	2.73
Error	54	2.10	-	-

In Table 4 it can be seen that overall for both years of investigation the highest fruit set and fruit harvested occurred after open pollination (51.43%; 36.94%). With controlled pollination, the lowest fruit set and fruit harvested was obtained with the combination of Bagrina x Chardonnay (29.32%; 15.93%). The highest fruit set was obtained from the combination of Bagrina x SV 12-375 (39.10%), and the most fruit harvested from the combination of Bagrina x Smederevka (23.90%). These results were similar to those of JINDAL and MAKHIJA (1986) who found from 19.46% to 69.67% fruit set after different combinations of pollination in grapevine.

Table 4. Mean values of fruit set and fruit harvested in the cultivar Bagrina with different combinations of pollination

Combination of pollination	Year	Fruit set (%)	Fruit harvested (%)
Open pollination	1994	59.81	41.14
	1996	43.04	32.74
	Average	51.43	36.94
Bagrina x Chardonnay	1994	27.40	11.78
	1996	31.23	20.08
	Average	29.32	15.93
Bagrina x Smederevka	1994	34.25	13.58
	1996	43.80	34.22
	Average	39.03	23.90
Bagrina x SV 12-375	1994	48.45	12.42
	1996	29.74	21.54
	Average	39.10	16.98

In Table 5 it can be seen that the variability of fruit set and fruit harvested was very significantly influenced by the combination of pollination, and signifi-

cantly by the interaction of pollination combination x year. In addition, a very significant influence of the year on the fruit harvested was established.

Table 5. Mean squares from analysis of variance and LSD values for fruit set and fruit harvested in the cultivar Bagrina with different combinations of pollination

Source of variation	df	Fruit set			Fruit harvested		
		MS	LSD		MS	LSD	
			0.05	0.01		0.05	0.01
Combination of pollination (A)	3	233.22**	6.25	8.40	436.45**	5.66	7.61
Year (B)	1	178.93	-	-	323.76**	4.62	6.22
A x B	3	152.61*	8.84	-	157.24*	8.10	-
Error	32	47.14	-	-	38.70	-	-

CONCLUSION

After examination of pollen functional ability of some pollinizer-cultivars and fruit set degree in the cultivar Bagrina pollinated in different combinations, the following can be concluded:

All the examined cultivars showed a high percentage of colored pollen grains.

Satisfactory pollen grain germination *in vitro* occurred for cultivars SV 12-375 and Smederevka, while very low pollen grain germination was found in the cultivar Chardonnay.

The highest fruit set and fruit harvested was obtained as a result of open pollination, while with controlled pollination the highest fruit set was obtained for the combination Bagrina x SV 12-375, and the highest fruit harvested in the combination of Bagrina x Smederevka.

Association between pollen functional ability of the pollinizer-cultivars and fruit set degree was established for the cultivar Bagrina. Cultivars SV 12-375 and Smederevka were suitable pollinizers for the cultivar Bagrina.

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REFERENCES

AVRAMOV L. (1956): Klijavost polena nekih sorti vinove loze. Arhiv za poljoprivredne nauke *23*, 22-36.

CINDRIĆ P., N. KORAĆ, and V. KOVAČ (1994): Sorte vinove loze. Prometej, Novi Sad.

DAULTA B.S. and K.S. CHAUHAN (1987): Pollination and *in vitro* pollen germination studies in grapes (*Vitis vinifera* L.). Haryana Journal of Horticultural Sciences *16*, 204-208.

JINDAL P.C. and M. MAKHIJA (1986): Effect of pollen parent on berry and seed in grapes. Seed Research *14*, 239-240.

KIMURA P.H., G. OKAMOTO, and K. HIRANO (1998): Artificial pollination in *Vitis coignetiae* Pulliat. Vitis *37*, 83-86.

STANLEY R.G. and H.F. LINSKENS (1974): Pollen-biology, biochemistry, management. Springer-Verlag, New York.

ODNOS FUNKCIONALNE SPOSOBNOSTI POLENA I STEPENA ZAMETANJA PLODOVA U VINOVE LOZE (*VITIS* SP.)

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Izvod

U ovom radu proučavana je funkcionalna sposobnost polena sorti Šardone, Smederevka i SV 12-375 koje su korišćene u svojstvu oca za oprašivanje sorte Bagrina koja je korišćena u svojstvu majke. Pored kontrolisanog oprašivanja praćeno je i slobodno oprašivanje sorte Bagrina. Funkcionalna sposobnost polena utvrđena je metodom bojenja acetokarminom i metodom *in vitro* naklijavanja. Stepen oplodnje ustanovljen je na osnovu broja zametnutih plodova i broja ubranih plodova. Sve ispitivane sorte pokazale su visok procenat obojenih polenovih zrna (preko 75,00%). Zadovoljavajuća klijavost polena *in vitro* utvrđena je kod sorti SV 12-375 (76,65%) i Smederevka (66,08%), dok je kod sorte Šardone utvrđena niska klijavost polena (20,88%). Najveći broj zametnutih plodova i broj ubranih plodova ustanovljen je kao rezultat slobodnog oprašivanja (51,43%; 36,94%). Od proučavanih kombinacija kontrolisanog oprašivanja najmanji broj zametnutih plodova i broj ubranih plodova imala je kombinacija Bagrina x Šardone (29,32%; 15,93%). Najveći broj zametnutih plodova dobijen je u kombinaciji Bagrina x SV 12-375 (39,10%), a najveći broj ubranih plodova dobijen je u kombinaciji Bagrina x Smederevka (23,90%). Ustanovljena je zavisnost između funkcionalne sposobnosti polena sorti oprašivača i stepena zametanja plodova sorte Bagrina. Dobri oprašivači za sortu Bagrina bile su sorte SV 12-375 i Smederevka.

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