

The effect of ecological conditions on the germination of pollen, fecundation and yield of some grapevine cultivars in Skopje region, Republic of Macedonia

Influence des facteurs écologiques sur la germination du pollen, la fécondation et le rendement de certains cépages de la région de Skopje, République de Macédoine

Biljana KORUNOSKA¹, Zvonimir BOŽINOVIĆ², Srebra ILIĆ-POPOVA², Elizabeta ANGELOVA²

¹Institut of Agriculture, Aleksandar Makedonski bb, 1000 Skopje, Republic of Macedonia,

²Faculty for Agricultural Sciences and Food, Aleksandar Makedonski bb, 1000 Skopje, Republic of Macedonia

*Corresponding author: markovskabiljana@yahoo.com tel. +389 2 2658 604; fax +389 2 2621 434;

Summary

The ecological conditions (climatic factors and soil) during the whole year, and especially before flowering and during the time of flowering, have a great influence on the functional ability of pollen, the pollination, the fecundation and the yielding potential of the cultivars of grapevine.

During the period of time 2003-2005, researches have been conducted about the percentage of germination of pollen, the percentage of self-pollination and cross-pollination and the yielding potential of certain cultivars of grapevine in R. Macedonia, more precisely in Skopje area of vineyards.

The following cultivars of grapevines were examined: Vranec, Dattier, Italia and two different varieties of Drenok (Drenok red and Drenok black). They had different resistance to the winter low temperatures and the spring late frosts, which had a certain influence on the fecundation.

The examined cultivars of grapevine are mainly characterized with good germination of pollen and they are with a good degree of fecundation in optimal climatic conditions, excepting the varieties of Drenok (Drenok red and Drenok black). The obtained results of the examined elements are of a great importance for further yield and quality of the grape of the examined cultivars.

Key words: ecological conditions, germination of pollen, pollination, fecundation, yielding potential

Introduction

The obtained results of the examination of the germination of pollen and the degree of fecundation of the cultivars of grapevine are very important for obtaining certain review of the future crops and quality of the grape. Pollen with a good functionality (germination) is the main precondition for successful covering with dust and fecundation of the grapevine blooms, and with that for getting bunches of grapes, which are well fecundated, and are with a high quality.

The cultivars of grapevines - Vranec, Dattier and Italia, which are taken for examination in this study, regarding the fecundation, in the district of their growing, they have shown a great adaptability. They have morphological and hermaphroditic bloom, fertile pollen and a possibility for self-pollination (autogamy). It is important for those cultivars the degree of fecundation to be known, especially the degree of self-pollination (auto-fertility) as a significant element for planning and growing clear grapevines and performing hybridisation.

Two different varieties of Drenok (Drenok red and Drenok black) have morphological hermaphroditic and functionality female bloom, sterile pollen and a possibility for cross-pollination (xenogamy). They to have need of other cultivars for cross-pollination.

The germination of pollen and the degree of fecundation depend on the climatic conditions, microclimate, specification of the cultivars of grapevines, the soil, scientific farming methods, genetic predisposition etc. The climatic conditions have a significant influence on the percentage of the fecundation, and differences and variations appear, both in the years the researches have been

conducted for the same cultivar of grapevine, and on the cultivars that are determined only as self-pollinated or only as cross-pollinated.

Material and Methods

The researches were conducted during the period 2003-2005 in the grapevine plantations of JNU Institute of Agriculture, Skopje. The following cultivars of grapevines were examined: Vranec, Dattier and Italia (they had morphological and functional hermaphroditic flower and had a regular and well fecundation) and two different varieties of Drenok - Drenok red and Drenok black (they had morphological hermaphroditic and functional female flower and sterile pollen). They had different resistance to the winter low temperatures and the spring late frosts, which had a certain influence on the fecundation.

The germination of the pollen was examined *in vitro*, with planting pollen grains in fertile base of 15% saccharose solution, in a preparation hanging drop and with keeping it in a thermostat on a temperature of 21°C. After that the germinated pollen grains were counted and photographed under a microscope.

For determination of the effect of covering with dust in conditions of isolation a choice of bunches of flowers immediately prior flowering was made, they were marked, the flowers were reduced and counted and were isolated with cellophane bags and tied. After the fecundation the cellophane bags were opened so that the bunches of grape could grow. After the veraisson the fecundated grains were counted. For establishing the effect of free covering with dust, bunches of flowers were chosen that would serve for making comparison with the previously isolated bunches of flowers and those were marked and in some cases reduced. The flowers prior flowering were also counted, and after the veraisson the fecundated grains, the rest of the flowers and the unfecundated grains were counted and the percentage was calculated.

Element	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	IV- X	I - XII
Year 2003														
T	2,7	-0,5	6,9	10,6	20,2	23,8	25,2	26,2	17,7	12,6	8,4	1,9	19,5	13,0
mm	113,0	16,3	1,7	31,6	93,0	62,3	2,3	11,5	21,3	91,1	25,9	27,1	313,1	497,1
Year 2004														
T	0,4	4,0	8,2	13,5	15,3	21,3	24,1	23,0	18,8	15,1	6,6	3,3	18,7	12,8
mm	43,1	25,6	40,0	43,9	54,6	55,2	61,4	16,1	63,0	27,2	63,2	38,4	321,4	531,7
Year 2005														
T	1,8	0,2	7,2	12,6	18	20,9	24,1	22,1	19,1	12,7	5,1	3,1	18,5	12,2
mm	44,0	22,8	39,0	22,7	72,4	38,4	36,9	73,3	34,2	50,1	39,3	101,6	328,0	574,7

Table 1 Climatic conditions in Skopje area of vineyards, during the period of 2003-2005 year

For the climatic conditions, we may say that the most important elements are the temperature and the rain. In Table 1 the following is presented the average monthly air temperature (T) and the rain in mm.

It can be noticed from the Table 1, that during the period of time from March to June, when the phenophases buds burst and flowering took place, the climatic elements were within optimal border. But in February, in three years, it can be noticed that the temperature fell up to – 0,5°C in 2003 and up to 0,2°C in 2005, that especially in 2003 it had certain negative influence upon the fecundation. The

low winter temperatures (from $-0,5^{\circ}\text{C}$ in February 2003 to $3,3^{\circ}\text{C}$ in December 2004) hadn't negative influence on the grapevines for frozen and that not reflected on the fecundation during the period of time 2003-2005. In three years in May and June, during the time of fecundation, the temperature, rain, moisture, the wind and insolation were optimal. The rain (from 113,0 mm in January 2003 to 1,7 mm in March 2003) was favourable for germination and fecundation. Data from the Department of Hydro-Meteorological Matters in Skopje were used for the climatic conditions.

The soil is maintained at colluvium-delluvium with alluvium young soils and they are favourable for breeding (propagate) on grapevine.

Results and Discussion

The examination of the germination of pollen in the cultivars of grapevine is an important feature for a successfully performed fecundation. Germination of the pollen grains in the pollen tubes depends on several factors: biological features of the cultivar (density, health condition, age, and nourishment), ecological conditions, the method of growing etc. The cultivars can be characterized with good, medium, poor and very poor germination or no germination of the pollen as at auto-sterile cultivars.

In Table 2 it can be noticed that the examined cultivars – Vranec, Dattier and Italia, show a good average of germination of pollen, although it can be noticed that the germination is few decreased in 2005 because of little variation on temperatures, and that gives a distinction between the three years during which the research was conducted. So the coefficient of variation (CV%) was low. The highest percentage of germination was observed at the cultivar Vranec i.e. 71,04% and CV=1,85%, and the lowest percentage was observed at the cultivar Dattier i.e. 57,35% and CV=7,96%. The cultivar Italia had a medium germination of the pollen.

Two different varieties of Drenok - Drenok red and Drenok black hadn't germination of pollen because they had sterile pollen and the abnormality of the reductional division (meiosis) in the microsporogenesis.

On photographs 1 and 2 the beginning of germination of pollen at both cultivars is shown.

In Table 3 the results of the examination of the percentage of fecundation in cases of covering with dust in isolated conditions and in conditions of free covering with dust (normal conditions).

The cultivar Vranec is characterized with highest average of the percentage of self-pollination that is 29,99% and CV=16,46%, and the cultivar Italia with the lowest average that is 21,55% and CV=6,28%. The CV is high as a result of the temperature variations in the three years. The cultivar Vranec is characterized with the highest average of the percentage of cross-pollination that is 67,58% and CV 4,33%, and the cultivar Italia with the lowest average of the percentage of cross pollination that is 65,09% and CV=4,02%. The CV at the cross-pollination is a little bit lower.

The varieties - Drenok red and Drenok black are characterized with 0,00% of self-pollination, Drenok black is characterized with 51,15% average of cross-pollination (CV= 3,86%) and Drenok red is characterized with 48,19% average of cross-pollination (CV= 2,94%). Drenok red and Drenok black have morphological hermaphroditic and functionality female flower, sterile pollen and exceptionally a possibility for cross-pollination (xenogamy).

The degree of fecundation depends on several factors: fertility of the pollen, specification of the cultivar, ecological conditions, genetic factors, microclimate in the isolated bags, the method of growing etc.

Making analysis of the results of the performed fecundation at all examined cultivars, it can be noticed that there are distinctions between the three years in which the researches were conducted that was conditioned by the climatic conditions. In 2005 the percentage of fecundation was smaller. The least differences between the three years and the least CV% of germination of pollen was observed at the cultivar Vranec, and concerning the degree of fecundation it was the least at the cultivar Drenok red, which showed as less variable.

In the examined cultivars - Vranec, Dattier and Italia, the percentage of cross-pollination is significantly higher in comparison with the self-pollination. These cultivars are bipolar, auto-fertile (they can fecundate themselves) and the self-pollination should be more present. But although the cross-pollination is more present, it is not in the real sense of the word, and it remains among the units of one cultivar. Anyway it is better when the fecundation is performed with pollen by another unit (grapevine), and not within the frames of one flower only. The lower percentage of self-pollination is

also caused by the influence of the unfavourable conditions (microclimate) by isolating in bags, but it can be corrected by creating more favorable conditions, similar to those in the open-air. The varieties - Drenok red and Drenok black to have need of other cultivars for cross-pollination.

The obtained results are in accordance with the results obtained by several authors (Alleweldt 1992, Bronner 1997, Galet 1993, Meyerowitz 1994, Staudt 1982, Torregrosa 1995).

Cultivars	Year	Pollen germination %	CV %
VRANEC	2003	72,30	1,85
	2004	71,15	
	2005	69,68	
	2003/2005	71,04	
DATTIER	2003	62,60	7,96
	2004	55,12	
	2005	54,33	
	2003/2005	57,35	
ITALIA	2003	62,14	7,38
	2004	56,05	
	2005	54,00	
	2003/2005	57,40	
Varieties			
DRENOK RED	2003	0,00	----
	2004	0,00	
	2005	0,00	
	2003/2005	0,00	
DRENOK BLACK	2003	0,00	----
	2004	0,00	
	2005	0,00	
	2003/2005	0,00	

Table 2 Percentage of pollen germination

Cultivars	Year	Isolated conditions (Autogamy) %	CV %	Normal conditions (Xenogamy) %	CV %
VRANEC	2003	35,55	16,46	70,75	4,33
	2004	28,30		67,00	
	2005	26,12		64,98	
	2003/2005	29,99		67,58	
DATTIER	2003	24,75	10,35	68,15	3,56
	2004	22,60		65,87	
	2005	20,10		63,46	
	2003/2005	22,48		65,83	
ITALIA	2003	22,68	6,28	68,00	4,02
	2004	21,91		64,35	
	2005	20,05		62,92	
	2003/2005	21,55		65,09	
Varieties					
DRENOK RED	2003	0,00	----	49,38	2,94
	2004	0,00		48,57	
	2005	0,00		46,62	
	2003/2005	0,00		48,19	
DRENOK BLACK	2003	0,00	----	52,60	3,86
	2004	0,00		51,95	
	2005	0,00		48,90	
	2003/2005	0,00		51,15	

Table 3 Percentage of fecundation in cases of covering with dust in isolated conditions (self-pollination) and in normal conditions (cross-pollination)

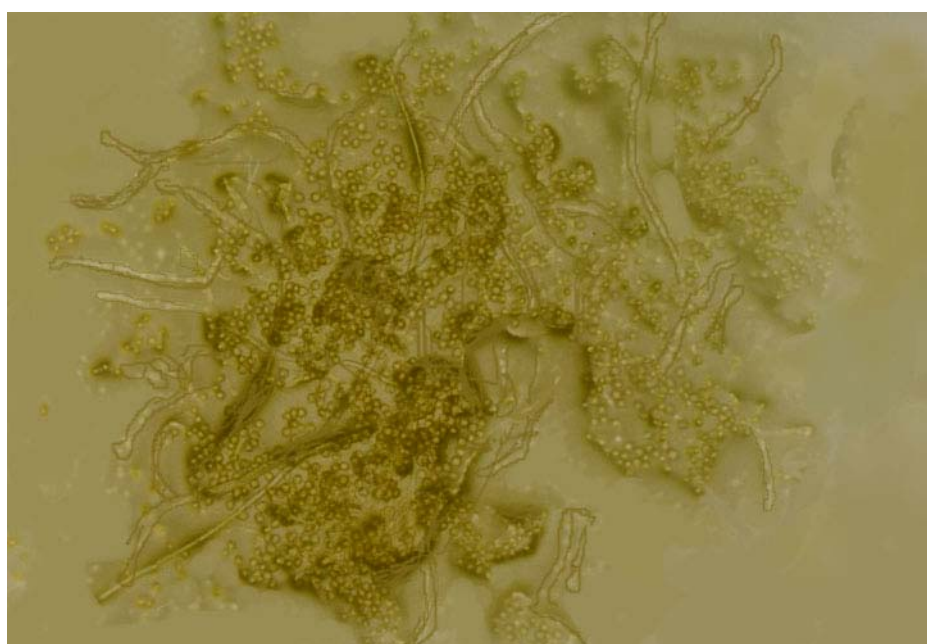


Figure 1 Beginning of pollen germination at Italia cultivar

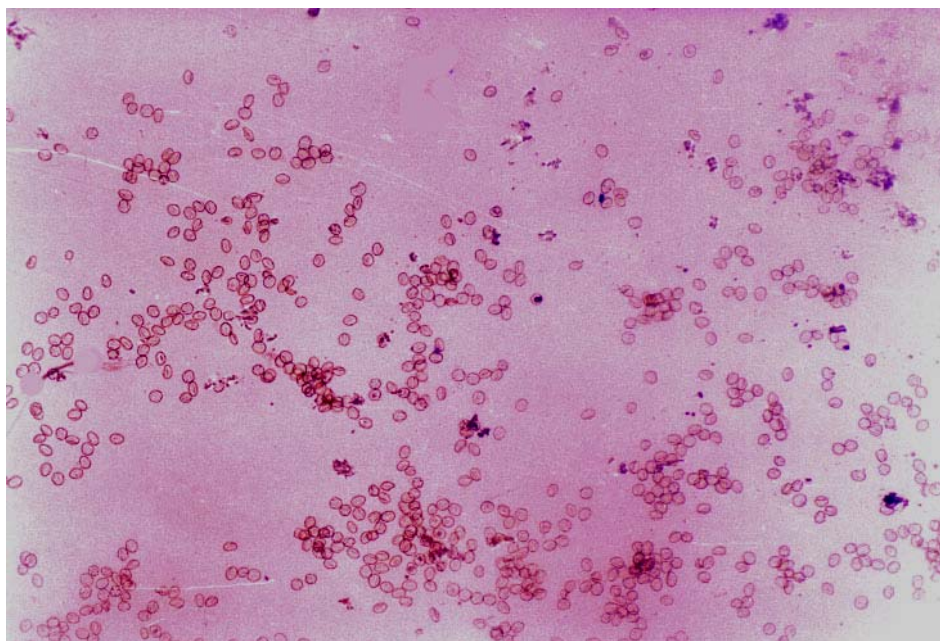


Figure 2 Sterile pollen at Drenok black varietie

Conclusion

On the basis of the conducted researches the following conclusions can be presented:

1. For ecological conditions within the period when the researches were conducted can be presented; there was a presence of insignificant low winter temperatures during January and February 2003-2005, and there wasn't a presence of spring lower temperature in April, which had certain positive influence on the germination of the pollen and the fecundation. The rain (from 113,0 mm in January 2003 to 1,7 mm in March 2003) was favourable for germination and fecundation. The soil is favourable for breeding (propagate) on grapevine.
2. During the months of May and June in three years, when the fecundation was going on, the temperatures, rain, the moisture of the air, the wind and the insolation were optimal and favourable.
3. The following cultivars were examined: Vranec, Dattier and Italia. The cultivar Vranec showed the highest percentage and the cultivar Dattier the lowest percentage of germination of pollen. The cultivar Vranec was observed as the least variable concerning that characteristic in three years of research. Two different varieties of Drenok - Drenok red and Drenok black hadn't germination of pollen because they had sterile pollen and the abnormality of the reductional division (meiosis) in the microsporogenesis.
4. The cultivar Vranec had the highest degree of self-pollinated and cross-pollinated fecundation, and the cultivar Italia had the lowest degree of fecundation. The cultivar Drenok red was the least variable concerning that characteristic in three years of research. The varieties - Drenok red and Drenok black are characterized with 0,00% of self-pollination, because have morphological hermaphroditic and functionality female flower, sterile pollen and exceptionally a possibility for cross-pollination (xenogamy) and they to have need of other cultivars for cross-pollination.
5. According to the degree of fecundation all cultivars showed a lower percentage of self-pollination (and 0,00% self-pollination), and a higher percentage of cross-pollination. In a greater part that represents a cultivar characteristic, and in a smaller part an influence of the micro-conditions on the environment. The obtained results in 2005 are somewhat poorer for the two examined parameters at all cultivars, which is a result of the climatic factors. The results of the research in the paper are very

important for further yield, quality of the grape on the cultivars, science and practical work and will be used for further selection of grapevine.

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