POLLEN VIABILITY AND GERMINATION CAPACITY OF SWEET CHERRY CULTIVARS IN THE CLIMATE CONDITIONS OF ROMANIAN NORTHEASTERN AREA

VIABILITATEA POLENULUI ȘI CAPACITATEA DE GERMINARE A SOIURILOR DE CIREȘ ÎN CONDIȚIILE CLIMATICE DIN NORD-ESTUL ROMÂNIEI

CORNEANU Margareta[1], MINEAȚĂ Iulia[1]*, GOLACHE Iuliana Elena[1], SÎRBU Sorina[1], IUREA Elena[1], UNGUREANU I.V.[1]

*Corresponding author e-mail: iulia_mineata@yahoo.com

Abstract. *This study presents the germination capacity and the pollen viability of ten sweet cherry cultivars ('Regina', 'Kordia', 'Bucium', 'Cătălina', 'Cetățuia', 'George', 'Golia', 'Maria', 'Marina' and 'New Star') registered on climatic conditions and phenological evolution of 2021. The phenological stages followed from bud burst to the end of flowering, were between April 5th ('Regina') and May 4th ('New Star'), with an average value of 21.3 days. Determination of pollen viability recorded average percentage values of 64.3% and a germination capacity of 74.5% with a medium coefficient of variation (11.29%–respectively 15.86%). The significant differences among pollen viability and germination ability were recorded for all cultivars. The results showed that the sum of the degrees of active temperature during the flowering have important influence to obtain high percentage values of pollen viability and germination capacity.*

Key words: *Prunus avium L.*, pollen, germination, flowering stage, cultivars

Rezumat. *Acest studiu prezintă capacitatea de germinare și viabilitatea polenului a zece soiuri de cireș („Regina", „Kordia", „Bucium", „Cătălina", „Cetațuia", „George", „Golia", „Maria", „Marina" și „New Star") înregistrate în condițiile climatice și evoluția fenologică a anului 2021. Stadiile fenologice urmărite de la dezmugurit până la sfârșitul înfloritului s-au desfășurat între 5 aprilie („Regina") și 4 mai („New Star"), cu o perioadă medie de 21,3 zile. Determinarea viabilității polenului a înregistrat valori procentuale medii de 64,3% și o capacitate de germinare de 74,5%, cu un coeficient mediu de variație (11,29%, respectiv 15,86%). Rezultatele au arătat că suma gradelor de temperatură activă în timpul fenofazelor de înflorire a avut o influență importantă pentru a obține valori procentuale ridicate ale viabilității polenului și ale capacității de germinare.*

Cuvinte cheie: *Prunus avium L.*, polen, germinare, fenofazele înfloririi, soiuri

[1]Research and Development Station for Fruit Growing (RSFG) Iași

INTRODUCTION

Determination of functional quality pollen, acording to viability and germination capacity through the development of research methods, allow their monitoring of the fertility of the cherry cultivars. For fruit production, an important role is played by pollen morphology, pollen germination, pollen tube growth and the establishment of an adequate source of compatible and viable pollen (Thomson, 2004; Hedly *et al.*, 2004).

The most important factors that influence the percentage of viability and germination capacity of pollen of sweet cherry tree (*Prunus avium* L.) are according to Webster and Looney (1996) and Kozma *et al.*, (2003), high temperatures associated with drought, rainy weather during flowering and unstable weather, from hot to cold or wind affecting pollination; rootstock; soil fertility and lack of nitrogen; soil drought or water stress; and agro-technical management. Also, the diseases and pests have influence on the evolution of flowers and, later, fruits.

The determination of pollen viability aims to know the value of a cherry variety as a pollinator in interfering combinations and to assess the physiological state of the tree (Cociu and Oprea, 1989). The germination capacity of pollen on solid nutrient medium has a role in knowing the biological value of pollen used in hybridizations, assessing the biological value of pollen following the action of external factors: frost, mutagenic factors, fertilizers, herbicides, or pesticides (Cociu and Oprea, 1989).

Therefore, the knowledge of the viable pollen percentage and germination capacity are very important properties in choosing and selecting the appropriate pollen from an orchard (Brown *et al.*, 1996; Nyéki *et al.*, 2008). Also, morphological, physiological research methods and the degree in which they are affected by environmental factors can influence the prediction of hybrid formation (Davarynejad *et al.*, 2008).

Sweet cherry is self-incompatible so the purpose of this study was to compare results of pollen viability and germination capacity using pollen from different cultivars of sweet cherry during the condition of climate of the year 2021.

MATERIAL AND METHOD

A collection of sweet cherries formed the basis of the study of the work. The study was conducted on the pollen grains of ten sweet cherries cultivars ('Regina', 'Kordia', 'Bucium', 'Cătălina', 'Cetățuia', 'George', 'Golia', 'Maria', 'Marina' and 'New Star') were collected at full bloom in 2021. Trees grown in an experimental field in northeastern Romania at Research and Development Station for Fruit Growing (RSFG) Iași. Research material are located in plantation founded in 2011, trees were planted at 5 x 4 m distances and are grafted on *Prunus mahaleb* L. In general, the weather conditions durring the sweet cherry blossom period were at an average of 11.65^{o}C and the rainfall was 58.5mm (NMA RO, 2021).

The phenological observations followed the development of the phenophases of the growth and fruit organs by recording the data according to the landmark stages (Meier *et al.*, 1994): bud swelling, bud burst, beginning of flowering, end of flowering, fruit ripening. The determining factor for phenology stages is the heat, so that, for starting certain phenophases is necessary the cumulative sum of active temperatures (SAT), in the days when it is more than 5°C (Budan and Grădinaru, 2000). Based on the results obtained, was calculated the value of the coefficient of variation (S%), which indicates the degree of phenotypic variability depending on the environmental conditions (Leonte, 1997).

During the flowering period of the sweet cherry (April 2021), to determine the viability and germination capacity of the pollen, were harvested anthers from ballon staged flowers from each cultivar studied. The flowers were transferred in laboratory. Anthers were removed and places in Petri dishes in a dark place for 24-72 hours at room temperature for pollen release (Cociu and Oprea, 1989).

Pollen viability was estimated by using Cornoy`s solution (ethanol and glacial acetic acid 3:1) and carmine acetic 2-3 %. To determine pollen viability, pollen grains of each cultivar were observed on 10 slides under a light microscope (x10 magnifications) noting the number of viable ones and the number of sterile ones (Cociu and Oprea, 1989).

Pollen germination was determined in medium containing 15g sucrose + 1.5g agar + 0.01g boric acid and incubated at 22°C. After 6 hours the pollen germination was blocked by the addition of three drops of formaldehyde. The pollen tube growth was evaluated by reading 15 slides under a light microscope (x20 magnifications) (Cociu and Oprea, 1989).

The experimental data resulted were analyzed and interpreted statistically using the Duncan's multiple range test at $p<0.05$ signifiance and coefficient of variation.

RESULTS AND DISCUSSIONS

The phenophases from the start of vegetation, bud burst to the end of flowering are presented in table 1. The bud burst phenophase started the earliest in the 'Regina' cultivar, on April 5th, requiring a sum of 225.4°C until the end of flowering, at a difference of 16 days.

The longest number of days was recorded for the 'Kordia' cultivar, which needed 27 days and a sum of temperature 265.1°C. The sum of the necessary degrees from the phenophase of bud burst to end of flowering had an average value of 214.96°C, with a minimum of 192.8 °C and a maximum of 265.1°C. The coefficient of variation between these phenophases was 9.86%. On average, the duration of flowering phenophases of the cultivars studied has a value of 21.3 days.

The flowering period took approximately 16 and 27 days. The earliest blooming cultivar was 'Regina', while 'Kordia', 'Cetățuia' and 'Cătălina' was the latest blooming cultivars.

The difference is related to the specific requirements needed of the temperature of each species.

Table 1

Sum of active temperatures (sat) (⩾5°C) required for the beginning of sweet cherry phenophases (RSFG Iași, 2021)

Cultivar	53*	61*	69*	Duration to 53 to 69	Σ^{T}
	(data)	(data)	(data)	(days)	(℃)
Regina	05.04	17.04	30.04	16	225.4
Kordia	07.04	20.04	03.05	27	265.1
Bucium	13.04	22.04	01.05	19	192.8
Cătălina	08.04	20.04	30.04	23	209.9
Cetățuia	07.04	21.04	29.04	23	197.8
George	11.04	26.04	02.05	22	229.8
Golia	10.04	20.04	30.04	21	201.3
Maria	10.04	20.04	30.04	21	201.3
Marina	11.04	22.04	01.05	21	215.5
New Star	15.04	26.04	04.05	20	210.7
Min				16	192,80
Max				27	265,10
Average				21.30	214.96
STDEV				2.87	21.20
COVAR S%				13.47	9.86

*BBCH-Phenological growth stages (Meier *et al.*, 1994): 53 (bud burst); 61 (beginning of flowering: about 10% of flowers open); 69 (end of flowering).

In correlation with the meteorological characteristics of 2021, the cherry cultivars were also evaluated in terms of pollen viability and germination capacity both as a percentage and statistically interpreted of the average of the analyzed fields. The results are presented in table 2.

The percentage value of pollen viability varied between 60% for 'Bucium' cultivar and 77% for 'Kordia' cultivar with a medium coefficient of variation of 11.29%. The germination capacity of viable pollen has an average percentage value of 74.5%. The highest percentage values for the two pollen indices were recorded for the 'Kordia' (fig. 1) and 'Golia' (fig. 2) cultivars.

Data from microscopic readings to determine the viability and germination capacity of pollen were interpreted statistically. Thus, regarding the viability of the pollen, were registered significant differences between all the cultivars studied, the values varying from 10.2 for the 'Cătălina' cultivar to 39.6 for 'Kordia'.

In the analysis of the pollen germination capacity of the cherry cultivars studied, were registered significant differences between most cultivars. Insignificant differences were registered bettween the cultivars: 'Kordia', 'Cetățuia' and 'Maria'.

The viability and germinability of pollen are also influenced by environmental conditions and particularly temperature (Özcan, 2020).

Table 2

The viability and germination capacity of the pollen at sweet cherry tree
(RSFG Iasi – Romania, 2021; n=3)

Cultivar	Pollen viability		The capacity of germination	
	(%)	Average*	(%)	Average*
Regina	73.0	24.4^{b}	85.0	25.2^{de}
Kordia	77.0	39.6^{a}	86.0	35.4^{bcd}
Bucium	60.0	16.8^{cde}	55.0	63.2^{a}
Cătălina	57.0	10.2^{e}	60.0	16.8^{e}
Cetățuia	52.0	23.0^{bc}	70.0	35.4^{bcd}
George	65.0	19.0^{bcd}	80.0	26.6^{de}
Golia	62.0	16.0^{cde}	88.0	49.8^{ab}
Maria	65.0	16.2^{cde}	63.0	37.0^{bcd}
Marina	65.0	14.2^{de}	76.0	47.6^{abc}
New Star	67.0	12.4^{de}	82.0	30.0^{cde}
Average	64.3		74.5	
COVAR S%	11.29		15.86	

*Different letters indicate significant differences

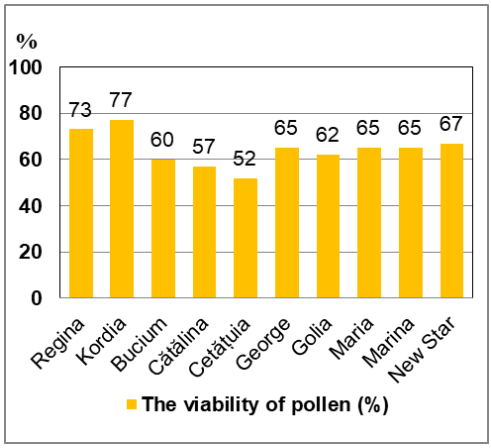

Fig. 1 The viability of pollen (%)

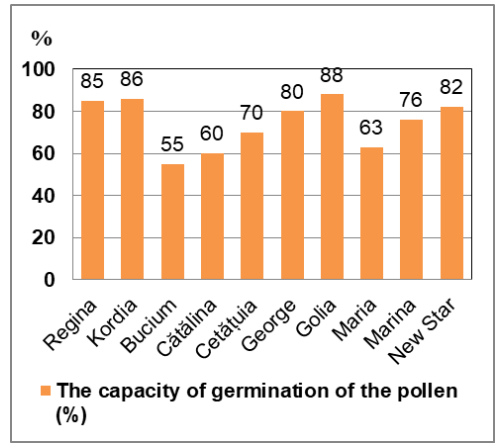

Fig. 2 The capacity of germination of the pollen (%)

CONCLUSIONS

1. Determining the viability and germination capacity of pollen grains of sweet cherry are the most important role in knowing the value of a cultivar as a pollinator in

planting schemes, appreciation of the physiological state of the tree in relation to the environmental conditions. Also, teasting the viability and germination of pollen the presence of genotype anomalies or diseases on gametes can be detected.

2. In the climatic conditions of 2021 the viability of sweet cherry pollen registered significant differences between all the cultivars studied, the values varying from 10.2 for the 'Cătălina' cultivar to 39.6 for 'Kordia'. In case of determining the germination capacity of pollen in solid nutrient medium were registered significant differences between most cultivars. Insignificant differences were registered bettween the cultivars: 'Kordia', 'Cetățuia' and 'Maria'. In this context, this study may provide useful informations for facilitating the evaluations of sweet cherry cultivars based on their pollen performance.

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