COMPARATIVE STUDY OF THE FUNGUS *SEPTORIA FRAGARIAE* BEHAVIOR IN POPULATIONS OF THE SPECIES *FRAGARIA VESCA* AND *FRAGARIA MOSCHATA*

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Abstract. *Fragaria vesca and Fragaria moschata are best known as generic popular name of wilde strawberries, although there are obvious anatomical differences between the two species. Starting from the existence of both species in populations quite well fixed in the area of the Anina mountains and the Cheile Nerei area, we made observations on the pathogens presents in those populations in the period between 2018-2021. Thus, we learn that one of the most common pathogens in the area mentioned before was Septoria fragariae. Taking in consideration that this pathogenic fungus is also one of the most damaging pathogens in strawberry plantations, we conducted a study of its incidence in the populations of the two species of wild strawberries. For this evaluation, during the whole time interval, the attack parameters of the pathogen Septoria fragariae were measured, the data being presented compared to the two species, Fragaria vesca and Fragaria moschata in four locations where both species were found. We did this in order not to have differences in climatic conditions and thus to avoid possible differences in the manifestation of the pathogen. As a general assessment, the results indicate some differences in the years more favorable to the manifestation of the pathogen both between species and between the populations of the two species of Fragaria sp.* If in the case of attack frequency the results were not so conclusive, the intensity of fungus attack point out clearly that the populations from Lake Marghitas and Marila have significant behavior differences.

Keywords*: Fragaria vesca, Fragaria moschata, Septoria fragariae*

INTRODUCTION

Fragaria vesca and *Fragaria moschata* known as wild strawberrys are two very well know species on the area where the survey for the present paper was performed (SCHRÖTT L., 1972,1973,). This species is from the same genus as common strawberries (*Fragaria anannasa)* and for this reason they have the same diseases and pests. Also fungus *Septoria fragariae* (MUTHUMARY J ,1999; VERKLEY GJM , 1998), as anamorph stage of *Micosphaerella fragariae* (JØRSTAD I .,1965; KUIJPERS A. ET. AL. 2002; MAAS, J. L. 1998) is very well known and described by a large number of researchers (DOCEA E., SEVERIN V., 1990; CONSTANTINESCU O ,1984; CROUS P.W. ET AL, 2000, 2001;).

There are a lot of ways to use strawberries, from fresh fruit consumption to sophisticated culinary delights and never the less so called green pharmaceutical products (TĂMAȘ M., ET. AL., 2007). Wild strawberries are also known for their sweet and very fragrant fruits and could be used as ornamental plants on some modern arrangement of landscape architecture. Mainly this are the reasons why we consider that knowing the infectious pressure of the pathogens from *F. vesca* and *moschata* is very important for evaluation the strategy of diseases protection on the areas where are cultivated both common and wild strawberries (DĂNEȚ CARMEN ELENA, 2008).

One last reason for such evaluation of a disease like *Mycosphaerella fragariae* is the idea of organic crops of strawberries very intense circulated in the area where the present study take place and this is a continuation from another study (MOȚ CERASELA, ET.AL, 2018). Infact we test the incidence of conidial stage of the pathogen which is *Septoria fragariae*, because

this stage is presemt on the plants leaves during summer month on the field. The reasons are almost the same but we have a larger base of discussions.

MATERIAL AND METHODS

On present paper there are data regarding the fungus *Septoria fragariae* infectious pressure measured as attack frequency and intensity on the wild species *Fragaria vesca* and *Fragaria moschata* on the mountain regions from South Western part of Romania. Row data were collected from representative populations of the two species and which we found close one to the other on some certain locations on the research area. Taken from north to south part of the research area these populations named after the most known geographical location, are: Lake Marghitaș, Marila, Beiului Valey and Sasca. Data for the present paper are from the period 2018-2021. As method of collecting data and calculations we take in consideration for each repeat from result data table an average of ten readings performed in each month from the period between June and September (ELZINGA C.L., ET. AL, 1998) .

Calculation method was for experiences with three factors, first factor was the experimental year with four graduations (2018-2021), second factor was the populations with four graduations (Sasca, Beiului Valley, Marila and Lake Marghitas) and the third factor was genus *Fragaria* species (*F. vesca* and *F. moschata*).

As it is very well known the weather conditions have a very high influence over relations between *Septoria fragariae* parasite relation with *Fragaria sp.*. plants. For present paper we toke in consideration the weather conditions from city of Oravita which is approximately on the middle of the observation area. Distance between Oravita and the extreme border on north and south of the observation area re below 20 km.

Comparation between temperature distribution over the four years, and the multiannual temperature average, as it is in figurre 1, show at first sight that most part of the months, in all four years, had much higher monthly averages than the multiannual average. This is a prove of an obvious and aggressive climate warming with a high influence on fungus pathogen life cycle.

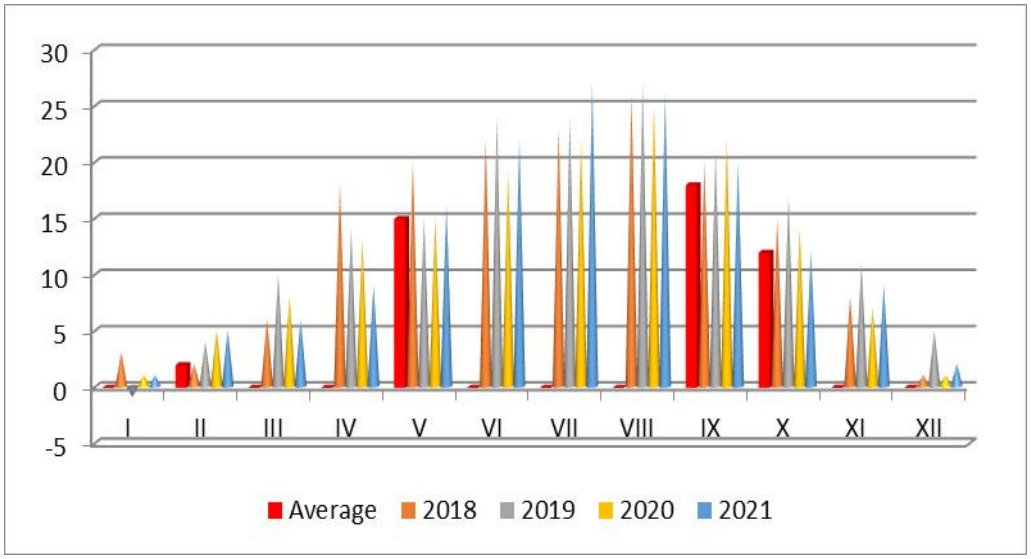

Fig. 1. Temperatures monthly averages evolution between 2018-2021 compared with 50 years average on the area of interest

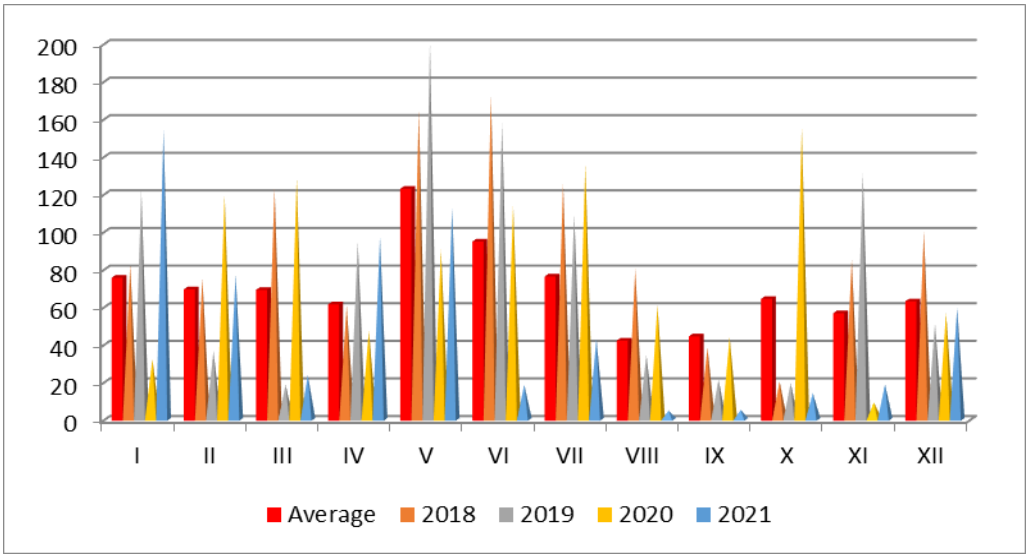

Fig. 2. Monthly rainfall amount evolution between 2018-2021 compared with 50 years average on the area of interest

If we analyze the evolution of the rain water amount (figure 2), as they are from meteorologic survey (https://www.worldweatheronline.com) it is relatively clear that there are some obvious differences between the four years. Thus, during the vegetation period the highest amount of precipitation was recorded during the period April - July in 2018 and 2019. Between August and November the monthly amount of water from rain decreases progressively, reaching that in October and November the precipitation amounts are very low. The differences in the monthly precipitation amounts compared to the multiannual average show that during the vegetation period in all four years the precipitation amounts exceeded the multiannual average.

From the point of view of the pathogen's relationship with those two species of wild raspberry plants, the best climatic conditions were in 2018 and 2019 due to the relatively large amounts of water from rainfall during the growing season. The most unfavorable were those of 2021 due to the low amounts of rainfall recorded throughout the period from April to November.

RESULTS AND DISCUSSIONS

In the four years since the pathogens were tested for the two species of the genus *Fragaria*, the fungus *Septoria fragariae* was present in all four populations. The dynamics of the incidence was variable and was very much influenced by climatic factors, and among them a decisive role was played by rainwater.

Rainfall distribution over time, the volume of water and especially the duration of rainfall play a key role in the development of the pathogen and its dissemination, which we also recorded through the results of the scans and the dynamics of frequency and intensity of attack pathogen *Septoria fragariae*.

The results on the frequency of attack show that on all two species of the genus Fragaria there are differences in the manifestation of the pathogen in the four locations but these differences are relatively small, the climatic differences being too small for the pathogen to show too large differences in behavior. . Thus, from a satistical point of view, only the populations near Sasca registered a lower frequency of attack than the witness with a

significantly negative difference. On the other hand, it can be said with certainty that the number of plants infected with the fungus *Septoria fragariae* was lower in the species *Fragaria moschata*, the frequency of attack having a value located at a significantly negative difference from the control.

Table 1

Evolution of fungus *Septoria fragariae* attack frequency on *F. vesca* and *F. moschata* between 2018-2021

Nr. crt	Factor A Populația	Factor B Species	Factor C - Year				Averages of factor A	Difference	Significance
			2018	2019	2020	2021			
1	Sasca	*Fragaria vesca*	11.7	16.7	10.0	6.7	10.8	-1.6	o
		Fragaria moschata	13.3	15.0	8.3	5.0			
2	Beiului Valley	*Fragaria vesca*	16.7	20.0	13.3	8.3	12.5	0.1	-
		Fragaria moschata	10.0	15.0	10.0	6.7			
3	Lake Marghitaș	*Fragaria vesca*	13.3	21.7	15.0	10.0	13.3	0.9	-
		Fragaria moschata	11.7	15.0	11.7	8.3			
4	Marila	*Fragaria vesca*	16.7	20.0	13.3	5.0	13.0	0.6	-
		Fragaria moschata	15.0	20.0	11.7	2.3			
5	Populations average	*Fragaria vesca*	14.6	19.6	12.9	7.5	12.4	Control	-
		Fragaria moschata	12.5	16.3	10.4	5.6			

DL 5%= 1.1 DL 1%= 1.8 DL 0,1%= 2.7

Factor B Species	*Fragaria vesca*	*Fragaria moschata*	Species average
Averages	13.6	11.2	12.4
Differences	1.2	-1.2	Control
Significance	x	o	-

DL 5%= 0.8 DL 1%= 1.6 DL 0,1%= 2.4

Factor C Year	2018	2019	2020	2021	Years Average
Averages	13.5	17.9	11.7	6.5	12.4
Differences	1.1	5.5	-0.8	-5.9	Control
Significance	-	xx	-	oo	-

DL 5%= 2.4 DL 1%= 4.6 DL 0,1%= 6.3

The dependence of the pathogen on climatic factors is demonstrated by the data on the frequency of attack over the four years. Thus, the highest frequency of attack on all two species and four populations was recorded in 2019, the year in which the highest monthly values of the amount of rainwater were recorded in April-September. The lowest value of the attack frequency was recorded in 2021, the year in which the lowest amounts of precipitation were in the same interval April-September.

The intensity of attack of leaf septorosis in the two species of the genus Fragaria (Table 2) had the same tendency as that of the frequency of attack but the values had more pronounced differences. Thus, the populations of *Fragaria vesca* and *Fragaria moschata*

around Lake Marghitaș recorded a statistically significant attack intensity at a distinctly significant difference from the control. The lowest average of the intensity of the attack was the one registered in the populations of the two species of the genus *Fragariae* in the Marila area, this average where situated from a statistical point of view of a significantly negative difference compared to the control.

Table 2

Evolution of fungus *Septoria fragariae* attack intensity on *F. vesca* and *F. moschata* between 2018-2021

Nr. crt	Factor A Populația	Factor B Species	Factor C - Year				Averages of factor A	Difference	Significance
			2018	2019	2020	2021			
1	Sasca	Fragaria vesca	6.7	11.7	5.0	2.3	7.8	-0.5	-
		Fragaria moschata	8.3	13.3	8.3	6.7			
2	Beiului Valley	Fragaria vesca	8.3	10.0	3.7	2.3	7.8	-0.4	-
		Fragaria moschata	10.0	16.7	6.7	5.0			
3	Lake Marghitaș	Fragaria vesca	6.7	15.0	6.7	5.0	10.2	1.9	xx
		Fragaria moschata	11.7	18.3	10.0	8.3			
4	Marila	Fragaria vesca	5.0	13.3	3.7	2.3	7.2	-1.1	o
		Fragaria moschata	6.7	15.0	6.7	5.0			
5	Populations average	Fragaria vesca	6.7	12.5	4.8	3.0	8.3	Control	-
		Fragaria *moschata*	9.2	15.8	7.9	6.3			

DL 5%=0.6 DL 1%= 1.4 DL 0,1%= 2.8

Factor B Species	*Fragaria vesca*	*Fragaria moschata*	Species average
Averages	6.7	9.8	8.3
Differences	-1.5	1.5	Control
Significance	o	x	-

DL 5%=0.8 DL 1%= 1.7 DL 0,1%= 3.2

Factor C Year	2018	2019	2020	2021	Years Average
Averages	7.9	14.2	6.3	4.6	8.3
Differences	-0.3	5.9	-1.9	-3.6	Control
Significance	-	xx	-	o	-

DL 5%= 2.4 DL 1%= 4.6 DL 0,1%= 6.7

Regarding the difference between the two species, it can be seen that in the case of the intensity of the attack, the highest value, statistically significant, was recorded in the case of the species *Fragaria moschata*. Thus, it can be seen that in the case of the intensity of the attack, the situation is exactly the opposite than in the case of the frequency of the attack.

Among the four years, the highest values of attack intensity were recorded in 2019 and the lowest in 2021. This emphasizes once again the fact that water from precipitation has a decisive role in the manifestation of the pathogen.

CONCLUSIONS

1. Both *Fragaria vesca* and *Fragaria moschata* are susceptible to Septoria fragariae infections, the difference being that in Fragaria vesca the pathogen is more virulent while in Fragaria moschata, if the number of plants is lower, the aggressiveness with the manifestation of the attack of the pathogen is greater.
2. The pathogen shows higher parameters of attack in the years with summers in which more precipitations are registered, as it was the year 2019 compared to the years 2020 and 2021.
3. Among the populations, the highest values of virulence and aggression of the pathogen were recorded in the populations of the two species located around Lake Marghhitaș, where the pathogen most likely benefited from humid air currents due to the proximity of the lake. The other populations recorded variations in the attack parameters depending on the amount of water that actually fell from precipitation, even if the average area is the same.

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