

SEPTORIA PLANTAGINIS A CONSTANT PRESENCE ON PLANTAGO SP. IN SOUTHWESTERN PART OF ROMANIA

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Abstract. *On the last two years, one of the targets of our research work from the area of Nera river basin was to determine the diseases of plantains (Plantago sp.) species from Nera river basin. Also, it is an attempt to see the dynamics of those pathogens. It is our duty to show from the very beginning that this paper contain data of just two years of research and this is the reason why data statistic interpretation could suffer dramatic changes in the near future, after we bring more observations data for statistic analyze. Regarding to the work method, all observation data were collected during vegetation period of years 2017 and 2022. In this paper there are presented only averages of data collected during the time period mentioned previously. Our observations consist from three separate operations: first operation was to determine the areas with representative populations of Plantago sp., second to determine the density of those populations and third operation was to see if those plants are affected of some pathogens and forth operation was to evaluate the attack parameters of each pathogen. The novelty is relatively high because this work provides important data for both agricultural practices especially for breeding process and also for local environment protection authorities. Taking in consideration that Plantago sp. plants are used on a relatively large scale for some pharmaceutical and cosmetic industry, it is important to know the infection pressure of the plants pathogens from natural environment. From this point of view, we appreciate that the plants from wild flora are considered to be a consistent source for diseases resistance genes in the plant breeding process. Limits of the research are that data from the research are just from two years and greatly influenced by local climatic and soil factors. Results point out the small variation of attack degree between different populations and between the years of the observations time period*

Keywords: *Plantago sp., wild flora, Sphaceloma plantaginis-lanceolatae*

INTRODUCTION

P *Plantago sp.* is known in the world, including in Romania, as plants used for medicinal purposes (DAVID GH. BORCEAN A, IMBREA F., 2003). Plants conditioned in different forms are used in the treatment of various diseases of the skin, of the organs of the digestive system, of the circulatory system, for blood pressure and even wounds and inflammations (TURGUMBAYEVA A. ET. AL., 2022).

This is because the leaves of plants of the genus *Plantago* contain different amounts of biologically active substances and natural components such as essential oils, minerals and amino acids in addition to polysaccharides and lipids. Due to this rich and varied chemical composition, the plants of the genus *Plantago* have many uses. Thus, in the pharmaceutical field, the leaves of *Plantago sp.* they are even used directly, being applied externally on wounds, boils or on the site of insect or even snake bites (PIERONI ET. AL., 2004; DE NATALE ET. AL., 2007; TITA ET. AL., 2009). Extracts are also used as expectorants, emollients, anti-inflammatory, astringent, antimicrobial or to treat conditions such as bronchitis, laryngeal and tracheal conditions and even diarrhea (FONS F., GARGADENNEC A., RAPIOR S., 2008; NEVES J., MATOS C., MOUTINHO C., QUEIROZ G., GOMES L., 2009).

However, species of the genus *Plantago* are considered in some areas of the world as potentially dangerous weeds because they spread quickly and are very persistent on the ground. (MONTGOMERY F. H., SWITZER C. M., 1967; HAWTORN W. R. 1973.)

Pathogenic fungi which are developing on *Plantago sp.* tissues, produce damage on the area with secretory cells. This will lead to a number of chemical composition modifications

of the biologically active substances (Zechini et al. 1995). From literature it is well known that some of the fungi occurring on ribwort plants found in the United States include some pathogens with facultative character of parasitism as there are *Cercospora plantaginis*, *Septoria plantaginis* and *Phyllosticta plantaginis* (FARR ET AL. 1995). All these three pathogens are the cause of different types of spots on the ribwort leaves. The main effect of these three pathogens is to reduce the quality and the amount of the *Plantago sp.* harvest and yet we know that there are certain programs of *Plantago sp.* breeding (Ross M. D., 1970)

MATERIAL AND METHODS

Present paper start from the basic idea that it is constantly necessary to know how much are some pathogens present in the natural habitat because this is the way to have an idea about the pressure of those pathogens on some plant species with special interest. This time it is about plants of fungus *Septoria plantaginis* which is constantly present on the plants of *Plantago sp.*. This pathogen was also signaled to be also constantly present on other zones of Romania (Mitrea R., Fodor A.M., 2021)

The most present species of the genera *Plantago* are *Plantago major* and *Plantago lanceolata* constantly present in habitats over the world (BASSETT, I. I. 1973.; CONNERS L L. 1967) and both species have large populations on the spontaneous flora on the southwestern part of Romania. The observations for present paper were carried out on three locations situated on the mountain region of the area and we define the population by the nearby location, as there are Population of Caraşova, Population of Anina and Population of Sasca (figure 1).

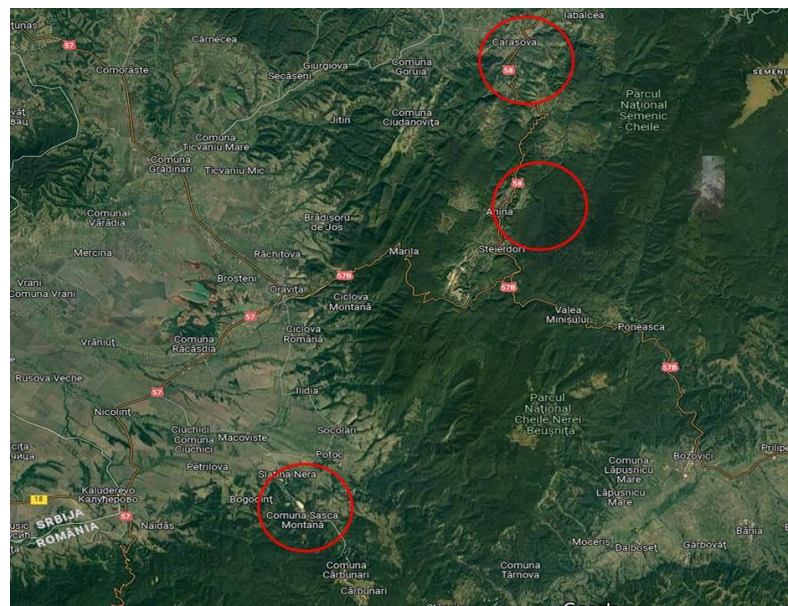


Figure 1. Space distribution of *Plantago sp.* populations token under surveillance between 2020 and 2022

Main observations performed on the field were concerning about the pathogen attack parameters: frequency and intensity of attack. On the base of these two parameters, it was

calculated the degree of attack. To be sure about sustainability of the data, there are plant leaf samples which were harvested on the field and studied on microscope in the laboratory to confirm that there are no mistakes about the pathogen and the attack parameters which were read in the field.

The three repetitions represent the three times in each year when readings were taken of the frequency and intensity of *Septoria plantaginis* attack. In order to have as accurate data as possible regarding the presence and aggressiveness of the pathogen and also the behavior of species of the genus *Plantago*, the three readings were carried out in June, August and September.

Climatic conditions throughout the evaluation period were very uneven. If we are looking at temperature evolution, the worst temperatures were in 2021 when almost all monthly average temperatures were with approximately 1°C lower than those from 2022. But in general it is clear that during all three years the temperature was favorable for both, plants of *Plantago sp.* and for the pathogen *Septoria plantaginis*. This could be one good reason why this relation of parasitism is continuous for such long time.

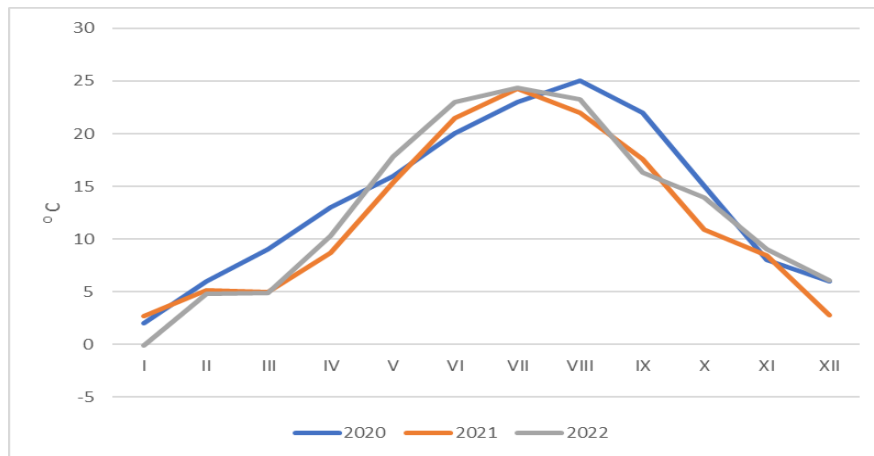


Figure 2. Monthly average temperature in the research area between 2020-2023

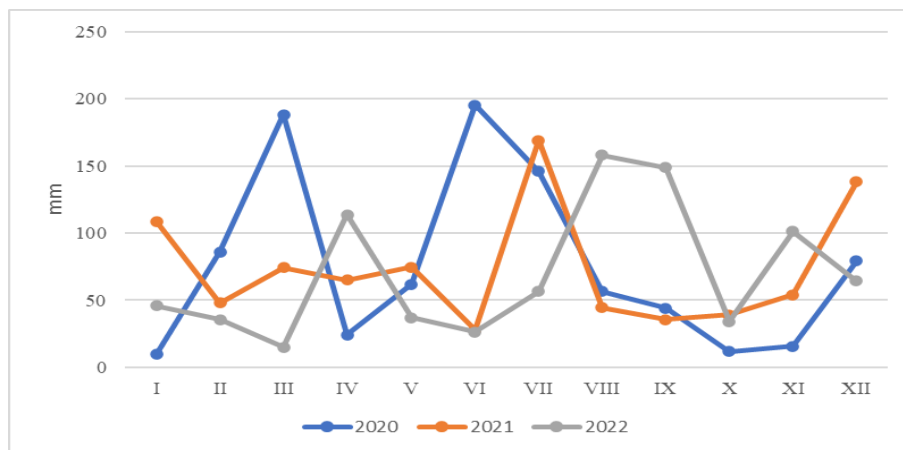


Figure 3. Monthly amount of water from the rain in the research area between 2020-2023

Looking at the rainfall distribution during the analyze period it is obvious that almost any parasitic fungus will have problems in establishing parasitic relations with their host plants. This is due the alternation of month with good amount of water rain and moth when the rains are so poor that it is a problem even with host plant survival. So from the rain distribution point of view the best year is 2022 because of the rains between July and October, when in 2020 and 2021 we have poor rain amount specially in July and August.

RESULTS AND DISCUSSIONS

The observations regarding the attack frequency of septoriossis on the leaves of *Plantago sp.* shows that pathogen attack occurred in all three populations. The number of plants infected during the three years in all three populations is around 30% (table 1) which means that the plants of the *Plantago* species present in the field have a natural tolerance. However, this tolerance is influenced by the climatic conditions of the year.

The figures regarding the evolution of attack frequency show that the largest number of infected plants was in the Anina population, while the lowest number of infected plants was in the Caraşova population. In the population of Sasca, there was an increasing evolution of attack frequency in each of the three years, being advantaged by the influence of increased air humidity, especially in the morning, a fact due to the presence near the Nera River. However, it can be seen that the year 2020 followed the same trend as the other populated ones because the supply of atmospheric moisture could not replace the lack of water from precipitation.

Table 1

Fungus *Septoria plantaginis* attack frequency on observed populations

Factor A - populations	Factor B - year	Repetition 1	Repetition 2	Repetition 3	Average of factor A	Differences	Significance
Population of Sasca	2020	15	25	40	30,6	0,9	-
	2021	20	25	45			
	2022	20	30	55			
Population of Anina	2020	20	20	45	31,1	1,5	-
	2021	25	20	50			
	2022	20	30	50			
Population of Caraşova	2020	15	20	30	27,2	-2,4	o
	2021	25	25	35			
	2022	20	30	45			
Populations averages	2020	16,7	21,7	38,3	29,6	Control	-
	2021	23,3	23,3	43,3			
	2022	20,0	30,0	50,0			

DL 5% = 2.2 , DL 1% = 4.3 , DL 0.1% = 6.8

Table 2

Fungus *Septoria plantaginis* attack frequency between 2020-2022

Factor B - year	2020	2021	2022	Average
Averages	25,6	30,0	33,3	29,6
Differences	-4,1	0,4	3,7	Control
Significance	o	-	*	-

DL 5% = 3,6 , DL 1% = 5.3 , DL 0.1% = 8,7

The intensity of the attack, in the present case, is the one that really shows the aggressiveness of the pathogen towards the plants and thus defines the direct loss produced by that pathogen closer to reality. This is because the pathogen affects the leaves, which are the main crop of plantain plants. The results of the three years of monitoring show practically an equality from this point of view between the three populations, the maximum difference compared to the average of the region (experimental control) being 0.9% in the population of Anina (table 3). The differences of the populations from the control are below the significance limit. All the data and the results of the statistical analysis indicate a good tolerance of the plants to the pathogen and therefore a limited loss of about 20% of the leaf blade during the entire vegetation period.

Table 3

Fungus *Septoria plantaginis* attack intensity on observed populations

Factor A - populations	Factor B - year	Repetition 1	Repetition 2	Repetition 3	Average of factor A	Differences	Significance
Population of Sasca	2020	10	10	25	19,4	-0,7	-
	2021	15	20	25			
	2022	20	25	25			
Population of Anina	2020	15	10	25	21,1	0,9	-
	2021	10	20	35			
	2022	20	25	30			
Population of Caraşova	2020	15	10	20	20,0	-0,2	-
	2021	20	20	25			
	2022	20	25	25			
Populations averages	2020	13,3	10,0	23,3	20,2	Control	-
	2021	15,0	20,0	28,3			
	2022	20,0	25,0	26,7			

DL 5% = 2,1, DL 1% = 4,6, DL 0.1% = 5,3

Table 4

Fungus *Septoria plantaginis* attack intensity between 2020-2022

Factor B - year	2020	2021	2022	Average
Averages	15,6	21,1	23,9	20,2
Differences	-4,6	0,9	3,7	Control
Significance	o	-	*	-

DL 5% = 2,6, DL 1% = 5,3, DL 0.1% = 8,7

Being plants from the spontaneous flora, the plant tolerance can be improved by breeding. The evolution of the attack intensity of the pathogen in the three years (table 4) has an average variability, due exclusively to the different amounts of water from the precipitation. The highest average of the attack intensity on the three populations was recorded in 2022, the year with the most precipitation, especially between August and September. The lowest average of the attack intensity of the *Septoria plantaginis* fungus was in 2020, the year in which the beginning of the vegetative season was characterized by a lack of precipitation in April and in August and the September-October interval were characterized by a lack

progressive precipitation. All this was also highlighted by the statistical calculation that shows significant differences between the years 2020 and 2022 compared to the control.

The degree of attack (table 5) stands out primarily by relatively low values, due practically to the low values of the frequency and intensity of the attack on the basis of which they were calculated. The data of the degree of attack resulting from the statistical calculation show that the differences between the three populations are very small, being below the significance limit.

Table 5

Fungus *Septoria plantaginis* attack degree on observed populations

Factor A - populations	Factor B - year	Repetition 1	Repetition 2	Repetition 3	Average of factor A	Differences	Significance
Population of Sasca	2020	1,5	2,5	10,0	6,5	-0,1	-
	2021	3,0	5,0	11,3			
	2022	4,0	7,5	13,8			
Population of Anina	2020	3,0	2,0	11,3	7,4	0,9	-
	2021	2,5	4,0	17,5			
	2022	4,0	7,5	15,0			
Population of Caraşova	2020	2,3	2,0	6,0	5,8	-0,8	-
	2021	5,0	5,0	8,8			
	2022	4,0	7,5	11,3			
Populations averages	2020	2,3	2,2	9,1	6,6	Control	-
	2021	3,5	4,7	12,5			
	2022	4,0	7,5	13,3			

DL 5% = 1,2, DL 1% = 3,4, DL 0.1% = 5,2

Table 6

Fungus *Septoria plantaginis* attack degree between 2020-2022

Factor B - year	2020	2021	2022	Average
Averages	4,5	6,9	8,3	6,6
Differences	-2,1	0,3	1,7	Control
Significance	-	-	-	-

DL 5% = 2,6, DL 1% = 5,3, DL 0.1% = 8,7

Also, the combination of attack frequency and attack intensity leads to a leveling of the two indicators values and shows that the attack of the pathogen is in reality easily absorbed by the plants' tolerance towards it. With regard to the results regarding the three experimental years (table 6), a difference below the significance limit can also be observed here, which also shows in this case that the differences are relatively small between the three years, the variation in the aggressiveness and virulence of the pathogen being a limited one but very easily influenced especially by the amounts of rainwater.

Regarding the aspects in the field highlighted in the photos in figure 4, the necrosis produced by the *Septoria plantaginis* fungus can be observed relatively easily on the leaves of the *Plantago sp.*



Figure 4. Aspects from field and laboratory with leaves of *Plantago lanceolata* infected with *Septoria plantaginis*

CONCLUSIONS

The number of plants infected during the three years in all three populations is around 30 %, which means that the plants of the *Plantago* sp. present in the field have a good natural level of tolerance

All the data and the results of the statistical analysis regarding attack intensity of the pathogen *Septoria plantaginis* indicate a good tolerance of the plants to the pathogen and therefore it is a limited loss of about 20% of the leaf blade during the entire vegetation period.

The combination of attack frequency and attack intensity leads to a leveling of the two indicators values and shows that the attack of the pathogen is in reality easily absorbed by the plants' tolerance towards it.

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