EVALUATION OF *BLUMERIA GRAMINIS* (D.C.) SPEER PATHOGEN IN SEVERAL WINTER WHEAT VARIETIES

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Abstract. *Etiologic agent responsible for the powdery mildew disease in winter wheat is the fungus Blumeria graminis (D.C.) Speer. Powdery mildew is one of the main wheat diseases, present in all cultivation areas and it produces quantitative and qualitative yield losses by the shrinking of the grains. This fungus is present in every year in the wheat crops in Banat Plain, and is manifesting with different attack intensities depending by the climatic conditions. The evaluation of the fungus attack was realised on six wheat varieties: Apache, Azimut, Kalango, Karolinum, Soissons and Renan. The experimental field was placed within the perimeter of the Didactic Farm of Banat`s University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania,, from Timisoara. Intensity of the fungus attack was monitored as dynamics during two experimental years (2012 and 2013) during March – Aprilie period. There were realised observations in dynamics at every 10 in 10 days and from 12 to in 12 days. The attack of Blumeria graminis was evaluated by the calculation of AUDPC (area under the disease progress curve). The average value of AUDPC calculated for the two experimental years was comprised between 671.34 in Apache variety and 114.08 in Renan variety. The results obtained during the two experimental years shows the uniformity of the pathogen virulence, due to the climatic conditions very similar, both from point of view of the average temperatures registered and the rainfalls. Thus, the amplitude of the attack of Blumeria graminis fungus was comprised between 25.33 % (variety Renan) and 60.76% in 2012 is framing in the interval 20.78% (Renan) and 60.88% (Apache). According with the obtained results we can affirm that the most sensitive variety from the experimental plots was Apache ant the most resistant to powdery mildew was Renan. The other varieties from the research were tolerated well the pathogen, and the registered intensity was comprised between 40% and 50% in both experimental years.*

Key words: *AUDPC, Blumeria graminis, powdery mildew, wheat, virulence, variety*.

INTRODUCTION

Powdery mildew is a disease that locates on all the aerial parts of wheat plants. It starts with chlorotic or yellowish spots on the basal leaves. The first symptoms are small patches, white – the mycelia or the fungus body, isolated or confluent that during time are extending to the leaves sheaths, on stems and then on spike. Meanwhile the mycelia colours turns in dark yellow and the lesions are becoming dusty that means that the fungus has fructified anamorphic (asexuate) through conidiophores with conidia. The anamorphic sporogenesis appears as a fine white powder from where comes the common name of powdery mildew. When starts the wheat plants maturation mycelia patches are becoming gray and then light brown and there appear black dots visible with naked eye – perithecia or cleisthotecia

with asci and ascospores – telemorphic sporogenesis or the yellowis-red phase. Beneath the mycelia cover the plant tissues are brown, necrotic or death (M. HATMAN *et al*., 1989; EUGENIA ELIADE, 1990; P. E. LIPPS, 1996; T. BAICU, TATIANA SEŞAN, 1996; GH. POPESCU, 1998, 2005).

Regarding the internal changes (biochemical and functional) that takes place in the leaves attacked by *Blumeria graminis*, A. L. KLECAN *et al*. (1986) have observed the decrease of the fructose content and the enrichment of the cells with fructose 2-6 biphosphate, an metabolite that stresses the plants. During the night the content in this metabolite is the same, both in the diseased leaves and the healthy ones. During the day the content in fructose 2-6 biphosphate of the diseased leaves increases a lot (10%) in the second day after the infection and till to 150% in the 15th day in the detriment of fructose. From the hydrocarbonated substances of the plant, the fungus *Blumeria graminis f. sp. tritici* take only the glucose instead of sucrose (M. MANNERS, J. L. GAY, 1983).

F. T. LAST (1962) – cited by EUGENIA ELIADE (1990) notices that due to the mycelium cover that develops on leaves and on stem take place a decrease of the chlorophyll amount, respectively less organic matter in the caryopses that will lead to the formation of shrunken seeds with negative influence on processing of the grains and on germination.

The manifesting on the plants exterior specific to *Blumeria graminis f. sp. tritici* fungus become severe, respectively has epidemic features if the environmental conditions are favourable to the pathogen, and if the cultivated wheat varieties are sensitive, or if there are present virulent races of the fungus (J. M. PRESCOTT *et al.*, 1986; GH. POPESCU, 1998; SUZANE BISSONETTE, 2002). The capacity of *Blumeria graminis f. sp. tritici* fungus to attack wheat plants and to determinate the powdery mildew disease is due to the pathogenic features respectively virulence, aggressiveness, nutrition mode and production of enzymes and toxins.

In Romania the disease is in full ascension, manifesting (in the years with climatic conditions favourable for its development) with high frequency and intensity (EUGENIA ELIADE, 1990) is affected. In and determinates significant harvest loses when the flag leaf of the wheat plant. In Banat Plain powdery mildew is present in every year in wheat crops with different attack intensities depending by the climatic conditions.

The evaluation of the powdery mildew attack was effectuated on several foreign winter wheat varieties cultivated in the perimeter Didactic Station of Banat`s University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania,, from Timisoara and they have been monitored during two years (2012 – 2013) with the purpose to bring useful pieces of information regarding their comportment in the case of the natural infection with *Blumeria graminis* in the climatic conditions from the area.

MATERIAL AND METHOD

The experience was placed on the area of of Banat`s University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania,, from Timisoara during 2012 – 2013. For this period there were used the climatic data registered at the Meteorological Station Timişoara, and the six winter wheat foreign varieties.

The observations regarding the frequency and intensity of the fungus *Blumeria graminis f. sp. tritici* attack were realised at every 10 days there being monitored the attack dynamics during the interval April – June 2012 and 2013. The final evaluation was realise by the calculation of AUDPC (area under the disease progress curve) that show the quantitative measure of the epidemic development and the disease intensity that can be used in the

appreciation of the attack evolution (REYNOLDS *et* NEHER, 1997). AUDPC was calculated using the Shaner *et* Finney (1977) formula:

$AUDPC = \Sigma [\{Yi + Y (i + 1)/2 \times (t(i+1) - ti)]$ where:

Yi = the level of the disease at the moment ti;

t(i+1) - ti = time in days between two sequential observations of the disease.

The data have been processes statistically with variance analysis method.

RESULTS AND DISCUSSIONS

The ascomycota fungus *Blumeria graminis f. sp. tritici* is able sometimes to produce harvest loses comparable with other foliar diseases due to the biotrophic nutrition of the mycelia that are covering the leaves, their sheaths, stems and sometimes their spikes. The harvest loses are producing to the sensitive varieties when the interaction wheat – fungus is ending with the partial diminishing of the photosynthetic area of the leaves that is correlated with the low tiller formation, lower spikes, respectively with less grains or and with low quality. The loses of the yield are becoming great when the mentioned diminishing is total, the phenomenon that produces plants fading this fact leading to the compromising of the harvest because the spikes remain captive in the flag leaf sheath, or if the spikes emerge from the flag leaf sheath they are covered with the fungal mycelia (GH. POPESCU, 1998; W. M. BROWN JR., 2001; SUZANNE BISSONNETTE, 2002; E. J. PARTRIDGE, 1997).

The morpho-pathology of the interaction among *Triticum aestivum – Blumeria graminis f. sp. tritici* was studied in six winter wheat varieties sensitive to the attack of this fungus, respectively Azimut, Apache, Kalango, Karolinum, Soissons and Renan cultivated in the soil and climate conditions from Timişoara. The attack intensity was registered at every 10 days. The results obtained are presented in Table 1.

Table 1

Synthesis of the results regarding the evaluation of the attack of the fungus *Blumeria graminis f. sp. tritici*

Variety	**AUDPC (area under the disease progress curve)**			**I % (intensity)**	
	2012	2013	Media	2012	2013
Apache	730.35	612.33	**671.34**	60.76	60.88
Azimut	492.86	570.72	531.79	50.66	55.33
Kalango	317.12	355.39	336.25	45.66	50.66
Karolinum	334.03	389.39	361.71	48.66	45.33
Soissons	342.09	357.27	349.68	40.00	40.00
Renan	132.84	95.32	**114.08**	25.33	20.78

Analyzing the results obtained during the two experimental years there was noticed their uniformity due to the very similar climatic conditions both from the point of view of the average registered temperatures and rainfall amount. The rainfall regime registered during the interval of April – June 2012 and 2013 was characterised both by positive and negative deviations to the multiannual average values. The total rainfall amounts registered during the months April, May, June 2012 was 184.5 mm and in 2013 during the same period it was 170.6. The differences between the two years aren't great from the point of view of the rainfall amount. The average monthly temperatures from the two years of research are very similar, without major differences. In conclusion, the climate during April – June 2012 and 2013 can be characterised by deviations to the multiannual average of the temperatures and rainfall amounts.

The amplitude of the attack of the fungus *Blumeria graminis* was situated between 25.33% (variety Renan) and 60.76% (Apache variety) in 2012. In 2013 the attack intensity is sensitively different in comparison with the year 2012 and is framing between 20.78% (Renan) and 60.88% Apache.

The *Blumeria graminis* attack registered in the experimental plots was evaluated by the calculation of AUDPC. The average value of AUDPC calculated for the two experimental years was situated between 671.34 in variety Apache and 114.08 in variety Renan (Table 1). The quantitative appreciation obtained by the analysis of AUDPC is in close relationship with the virulence of the fungus. According with the obtained results we can affirm that the most sensitive variety from the experience was Apache and the most resistant to this pathogen was Renan. The other varieties from the experience have tolerated well the pathogen and the registered intensity was oscillated between 40 and 50% in both experimental years (Table 1).

Table 2

The statistical analysis of the attack intensity of *Blumeria graminis f. sp. tritici*

Variety	Experimental year 2012			Experimental year 2013		
	Attack intensity %	Difference in comparison with the control	Statistical signification	Attack intensity %	Difference in comparison with the control	Statistical signification
Azimut	**50,66**	-	-	**55,33**	-	-
Apache	60,76	10,1	***	60,88	5,55	-
Kalango	45,66	-5	0	50,66	-4,67	-
Karolinum	48,66	-2	-	45,33	-10	00
Soissons	40,00	-10,66	000	40,00	-15,33	000
Renan	25,33	-25,33	000	20,78	-34,55	000
2012 - LSD 5% - 3,616; LSD 1% - 5,140; LSD 0,1% - 7,442 2013 - LDS 5% - 5,936; LSD 1% - 8,439; LSD 0,1% - 12,219 dif.> 5% positive significant* dif. < 5% negatively signigicant^0						

The statistical analysis of the research results from 2012 show that the difference in comparison with the control Azimut (I% = 50.66) are significantly positive in the case of variety Appache. In the case of the variety Karolinum the difference in comparison with the control is insignificant and in the other varieties the differences are significantly negative in comparison with the control. The Renan variety was proved to be the most resistant in the experience both in 2012 and in 2013.

In 2013 the situation is a little bit different. Variety Apache remains the most attacked variety in the experience but the difference in comparison with the control Azimut is insisgnificant because the pathogen was manifested with attack intensities relatively similar. The winter wheat variety Apache was attacked with a virulence of 60.88% and the variety Azimut with 55.33%. The difference in the case of the variety Kalango is also insignificant (50.66%). In the other varieties from the experience the significations are negative (Table 2).

We can affirm that due to the similar climatic conditions of the two years (period during April – June 2012 and 2013) the attack intensities of the fungus *Blumeria graminis* were very similar. The most attacked variety was Apache and the most resistant was the variety Renan.

The implication of the two climatic factors (temperature and rainfall amount) in the pathogeny of the fungus *Blumeria graminis* is incontestable. Thus, the average temperature

from the interval $13,2^0$C in April and $20,3^0$C in June have influenced positively the development of the powdery mildew together with the factor rainfall amount. The climatic parameters analysed were implied in the same measure in the spread of the fungus, this being a pathogen that can develop in a great interval of temperature, rainfalls and humidity.

CONCLUSIONS

The obtained results obtained during the two experimental years show the uniformity of the fungus virulence, due to the climatic conditions very similar, both from the point of view of the average temperatures registered and the rainfalls amount. The evaluation of *Blumeria graminis* fungus attack with AUDPC formula is in close relationship with the fungus virulence and allows the quantitative evaluations of the epidemic development and the intensity of the disease. The six monitored have tolerated well the pathogen. The variety Renan is evidenced by the low virulence registered (25.33%) in comparison with the other varieties from the experience in that the virulence has oscilated between 40 and 60%.

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