RESISTANCE REACTION OF SOME WINTER WHEAT GENOTIPES TO THE ATTACK OFF *FUSARIUM GRAMINEARUM* L. SCHW. IN THE CLIMATIC CONDITIONS OF BANAT PLAIN

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Abstract: *Fusarium graminearum Schw. is responsible for the occurrence of the fusarium disease that is unique due to its capacity of plants infection in all the vegetation stages. The economic importance of the disease is determined by the fact that the fungus is producing some dangerous mycotoxins that are contaminating the food and feed products, these substances being heat-proof. The fungus is affecting also the wheat yield from quantitative and qualitative point of view.The climatic conditions from the last years have been favourable for the development of the Fusarium graminearum pathogen; the disease was present in the wheat crops with different attack frequencies and intensities. In this research was analysed the response of some winter wheat varieties originated from Romania, Austria, France and Hungary to the attack of Fusarium graminearum having the purpose to set the resistance reaction. The 16 winter wheat varieties from the experimental field have reacted different to the Fusarium graminearum attack. Resistance reaction manifested by these varieties in 2012 year was set by a quantitative assessing method. The quantitative assessing methods have at the background the setting of the virulence of the pathogen.Thus, the attack frequency (F%) has varied between 2.063% and 15.206% and intensity (I%) or virulence of the pathogen at kernel was comprised between the relative values 16.666% and 73.666%, after Miedaner (1986) scale. The resistance of the varieties to the attack of Fusarium graminearum is variable and in general is influenced by the climatic conditions. There isn't any variety resistant to fusarium. In the climatic conditions of 2010, the analysed genotypes have manifested a variable resistance reaction, framing it in five reaction classes: medium resistant – MR (varieties Josef, Soissons, Glosa, Arlequin, Karolinum, Petur and Feny, sensitive – S (varietie Rusija), very sensitive (varieties Andalou, Azimut – control,and Kalango), reduce sensitive (varieties Apache and Beches) and resistant (varieties Dropia, Antonius and Renan). The infection with Fusarium graminearum in the experimental field was natural. The variance analysis show that the differences in comparison with control variety Azimut (highly sensitive to fusariose) are insignificant in most of the monitored genotypes in 2010, in the conditions that Azimut control variety was the most attacked from the comparative plots. Only the variety Dropia and Antonius have registered negative significant differences in comparison with the control. In the variety Dropia the fungus has showed the lowest attack frequency and intensity (F% = 2.063% and I% / 16.666%).*

Key words**:** *genotypes, wheat, resistance, Fusarium, virulence, intensity.*

INTRODUCTION

Wheat kernel fusariose is produced by the fungus *Fusarium graminearum* Schw., dominant species on the Romanian territory and in other European, Asian, American countries too (J. C. SUTTON, 1982; Y. Z. WANG, 1996). At worldwide level the specialists are affirming that the fusariose spreading is due to the climatic changes determined by the global warming but also to the no-tillage technologies (R. P. SHING *et al*., 1995).

The desease has distructive features in wheat in the areas with hot and wet climate, representing a serious threat both for production as quantity and quantity, the pathogen responsible for the appearance of the disease being mycotoxins producer. The most prevalent mycotoxins are deoxyvalenol (DON) and nivalenol (NIV) able to produce serous affections in humans and animals (R. P. SHING *et al*., 1995).

In the last years in Banat region, the fungus can produce infections in wheat, mainly due to the favourable conditions to the pathogeny and to the inoculus source from the soil, many farmers practicing the monoculture.

In this study the resistance of the wheat varieties to the attack of the fungus *Fusarium graminearum* Schw. Has been evaluated in conditions of natural infection the climatic conditions from the spring of 2010 during the flowering period have been favourable to the realisation of the infection and to the development of the pathogen. After J. C. ZADOKS (1969), the resistance of the plants to the attack of this pathogen can be presented and in this case none disease symptom appears or is missing and the plants are affected. None cultivate wheat variety does presents immunity to *Fusarium sp.* The resistance of the wheat varieties to *Fusarium sp*. is variable and influenced by the environmental conditions. From this point of view CIMMYT has started a programme for the increase of the resistance to *Fusarium sp.* 20 years ago.

The assessed comparative crop comprised 16 varieties of winter wheat, from those 14 originating from abroad (Hungary, France and Austria) and two Romanian varieties. The presence of the foreign varieties in great number in the comparative plots is due to the fact that those are intense cultivated in Banat region, instead of the Romanian varieties, their testing being necessary mainly to the resistance to the pathogens.

MATERIAL AND METHODS

The biological material used was represented by 16 winter wheat varieties. The experimental plots were set in the perimeter of the Didactic Station of Banat's University of Agricultural Sciences and Veterinary Medicine from Timisoara, after the randomized blocks method with three replicates for every variety. The size of a plot was 7m long and 1m width.

The observations regarding the attack of the fungus *Fusarium graminearum* Schw. have been realised at the end of May, beginning of June on the background of natural infection. The attack frequency was set with the help of the metrical frame (50 cm x 50 cm), considering the relative number of the attacked plants in report with the total number of analysed plants or organs. The incidence average (F%) and the severity (I%) can be expressed as proportion or percentage. The marks for the attack severity have been given on a 0 – 9 scale (described by T. MIEDANER, 1986). The attack degree (GA%) has been calculated after the classical formula (F% x I%/100).

The relative resistance of the winter wheat varieties to the infection with *Fusarium graminearum* was calculated after the formula recommended by J. C. ZADOKS (1972b), there being compared the infection degree of the tested material with the one of the variety that manifests the greater sensitivity [RES = 1 - DIS(T)/DIS (S)]. Thus, the relative resistance of a variety varies from 0 (highly sensitive) to 1 (completely resistant). Between the two values the plant show an intermediate reaction named "partial" resistance.

The climatic data (rainfalls amount, temperatures, and air relative humidity) have been collected from the Phytosanitary Unit of Timis County. The statistical analysis of the results has been realised with the programme Microsoft Excel.

RESULTS AND DISCUSSIONS

All the winter wheat varieties from the experience have presented disease symptoms produced by the fungus *Fusarium graminearum* Schw.. The presence of the fusariose is usually associated with a great amount of inoculum and favourable meteorological conditions, mainly during the flowering period, because the sensitivity of the plants to infection is maximal at this stage. The climate from the analysed period (April – June 2010) has been characterised by deviations from the multiyear average of the rainfall and temperatures. Thus, the rainfalls registered have been passed over the normal value with more than 50 mm/m^2 (May and June) and the average temperatures have been much higher in comparison with the multiyear average. The relative humidity from this period hasn't passed over the value 86%. There can be mentioned that the climatic conditions have been favourable to the realisation of natural infections. The rainfalls have an important role in the spreading of the spores with the wind. The conidia are hydrophyllic and are spreading most of the time with the rain drops (D. W. PARRY *et al*., 1994; T. DIEHL, 1984).

The frequency of the kernels attacked has values comprised between 2.063 (variety Dopria) nand 15.206 (Andalou variety). The differences in comparison with the control Azimut have been highly significant negative (varieties Dropia and Antonius), distinctly significant negative in Renan variety and negative significantly in the varieties Josef, Soissons, Glosa, Arlequin and Karolinum. The other varieties the differences in comparison with the control have been insignificant (Beches, Kalango, Apache, Petur, Feny, Rusija, Andalou) – Table 1.

Table 1

Variance analysis regarding the attack frequency of the attack of the fungus *Fusarium graminearum* Schw. in a comparative experimental trial with winter wheat in Timisoara in 2010

No.	Variety	F%	Difference in comparison with:		Significance in comparison with::	
			control	Average	control	Average
1	Azimut (control)	12.922	-	3.967	-	-
2	Dropia	2.063	- 10.859	- 6.892	000***	0
3	Becheş	13.983	1.061	5.028	-	-
4	Renan	5.776	- 7.146	- 3.179	00**	-
5	Antonius	2.806	- 10.116	- 6.149	000	0
6	Josef	7.071	- 5.851	- 1.884	0*	-
7	Soissons	7.353	- 5.569	- 1.602	0	-
8	Glosa	6.930	- 5.992	- 2.025	0	-
9	Kalango	13.971	1.049	5.016	-	-
10	Arlequin	6.333	- 6.589	- 2.622	0	-
11	Karolinum	7.463	- 5.459	- 1.492	0	-
12	Apache	12.123	- 0.799	3.168	-	-
13	Petur	7.935	- 4.987	- 1.02	-	-
14	Feny	9.773	- 3.149	0.818	-	-
15	Rusija	11.575	- 1.347	2.62	-	-
16	Andalou	15.206	2.284	6.251	-	0
	Media exp.	**8.955**				

LSD 5% = 5.217; LSD 1% = 7.033; LSD 0.1% = 9.335; *significantly negative; **distinctly significant negative; ***highly significant negative.

Table 2

The variance analysis regarding the attack intensity of the fungus *Fusarium graminearum* Schw. to a comparative winter wheat crop in Timisoara in 2010

No.	variety	D pl./m^2	I% (kernel)	Difference in comparison with:		Significance in comparison with::	
				control	Average	control	Average
1	Azimut (martor)	755	73.666	-	20.583	-	-
2	Dropia	588	16.666	- 57.00	- 36.417	00**	-
3	Becheş	647	46.666	- 27.00	- 6.417	-	-
4	Renan	809	38.333	- 35.333	- 14.75	-	-
5	Antonius	721	28.333	- 45.333	- 24.75	0*	-
6	Josef	811	55.00	- 18.666	1.917	-	-
7	Soissons	876	50.00	- 23.666	- 3.083	-	-
8	Glosa	719	51.666	- 22.00	- 1.417	-	-
9	Kalango	665	70.00	- 3.666	16.917	-	-
10	Arlequin	860	55.00	- 18.666	1.917	-	-
11	Karolinum	601	58.666	- 15.00	5.583	-	-
12	Apache	696	53.333	- 20.333	0.25	-	-
13	Petur	651	58.333	- 15.333	5.25	-	-
14	Feny	673	55.00	- 18.666	1.917	-	-
15	Rusija	591	68.333	- 5.333	15.25	-	-
16	Andalou	572	70.333	- 3.333	17.25	-	-
			53.083				
DL 5% = 39.123; DL 1% = 52.740; DL 0.1% = 70.00; *significantly negative; **distinctly significant negative							

The severity of the attack has oscillated between 16.666% in Dropia variety and 73.666% in Azimut variety (control). The statistical analysis shows that the differences in comparison with the control are distinctively significant negative in Dropia variety, significantly negative in the variety Antonius and insignificant in the other varieties from the experience (Renan, Becheş, Josef, Soissons, Glosa, Kalango, Arlequin, Karolinum, Apache, Petur, Feny, Rusija, and Andalou) – Table 2.

The attack degree (GA%) or the infection degree of the winter wheat varieties with *Fusarium graminearum* in 2010 has evidenced the variety Dropia with the lowest value (0.43%) and the variety Andalou with the greater value (10.694%). In the case of Andalou variety the value is explained by the great frequency of the attacked spikes (15.206%) in comparison with Azimut with 12.922% (Table 3).

The differences in comparison with the experience average are insignificant both in the case of the incidence (F%) of the attacked spokes and of the virulence on the kernel (I%). Exception represents the varieties Dropia and Antonius where the differences in comparison with the experience average are significantly negative in the case of the attack incidence (table 1 and Table 2).

The main objective of the present study was the evaluation of the winter wheat varieties from the point of view of the resistance to *Fusarium graminearum* in 2010, year favourable to the infections.

The relative resistance to *Fusarium* (RRF) of the monitores varieties was different. Three varieties from the experience were acted as resistant (R) to *Fusarium graminearum* (Dropia, Renan and Antonius); the varieties Josef, Soissons, Glosa, Arlequin, Karolinum, Petur and Feny have manifested medium reaction (MR); Beches, Rusija and Apache were acted as sensitive (S); highly sensitive were the varieties Azimut (control), Kalango and Andalou. The Andalou variety is highlighted by the greatest sensitivity (RES = 0) and the variety Dropia with the highest resistance (RES = 0.97) – Table 3.

Table 3

The comportment of some winter wheat varieties to the attack of the fungus *Fusarium graminearum* Schw. in Timisoara in 2010

No.	Variety	F%	I% (kernel)	GA%	RRF (relative resistance to *F. graminearum*)	The comportment of the variety to the *F. graminearum* attack
1	Azimut (martor)	12.922	73.666	9.519	0.11	FS
2	Dropia	2.063	16.666	0.343	0.97	R
3	Becheş	13.983	46.666	6.525	0.39	SR
4	Renan	5.776	38.333	2.214	0.8	R
5	Antonius	2.806	28.333	0.795	0.93	R
6	Josef	7.071	55.00	3.889	0.64	MR
7	Soissons	7.353	50.00	3.676	0.66	MR
8	Glosa	6.930	51.666	3.580	0.67	MR
9	Kalango	13.971	70.00	9.779	0.09	FS
10	Arlequin	6.333	55.00	3.483	0.68	MR
11	Karolinum	7.463	58.666	4.378	0.6	MR
12	Apache	12.123	53.333	6.465	0.4	SR
13	Petur	7.935	58.333	4.628	0.57	MR
14	Feny	9.773	55.00	5.375	0.50	MR
15	Rusija	11.575	68.333	7.909	0.26	S
16	Andalou	15.206	70.333	10.694	0	FS
	Media/exp.	**8.955**	**53.083**	**5.203**		
Notă: FS – highly sensitive; R – resistant; SR – reduced sensitivity; MR – medium resistant; S – sensitive						

There can be noticed the different resistance reaction of the monitored wheat varieties to the attack of the fungus *Fusarium graminearum*.

The winter wheat genotypes cultivated doesn't present resistance genes to the *Fusarium sp*. There exist difference among genotypes regarding the frequency and the intensity of the attack. The comportment of the wheat genotypes to *Fusarium sp.* is highly influenced by the climaric conditions, mainly to the abundant rainfalls and high temperatures (N. CEAPOIU, FLOARE NEGULESCU, 1983). For the obtaining of some real results the wheat varieties must to be tested for a greater number of years.

Comparisng the resistance of the varieties tested in field with the resistance described by their authors, we observe that the results obtained are in accordance with them. Exception does the variety Arlequin that is presented by the authors as resistant to fusarium, acting as medium resistance in the comparative trial. The two Romanian varieties had different resistance reactions: Glosa variety had manifested a medium resistance and Dropia has been the most resistant variety from the trial. Dropia variety has presented resistance against other pathogens too, e.g. to *Blumeria graminis*, *Puccinia recondita* (OTILIA COTUNA, 2006a). The variety Apache, a highly productive variety has manifested low sensitivity to the pathogen, even its authors are affirming that it is a variety resistant to fusariose.

After MIEDANER T. (1997) the testing of the resistance to *Fusarium* can be done both in natural and artificial infection conditions. The testing of the wheat genotypes in natural conditions is efficient only in the areas where the disease appears regularly. The climatic conditions from the last years in Banat area have allowed us to do the testing in conditions of natural infection.

CONCLUSIONS

1. The variety Dropia has manifested the greatest resistance to *Fusarium sp.* (RRF = 0.97) on a 0 – 1 scale. It is recommended to be used as germplasm for the obtaining of

new varieties. Our recommendation is based on the fact that this variety was tested in the field from SCDA Lovrin for many years from the point of view of the comportment to the attack of the pathogens specific for wheat and it has acted as resistant and medium resistant.

2. The greatest sensitivity was determined in the varieties Azimut (control), Andalou and Kalango.

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