

**ON THE BEHAVIOUR OF SOME WINTER WHEAT VARIETIES IN
BLUMERIA GRAMINIS F.SP.TRITICI (D.C.) SPEER THAT CAUSES
POWDERY MILDEW DISEASE**

**COMPORTAREA UNOR SOIURI DE GRÂU DE TOAMNĂ LA ATACUL
CIUPERCII BLUMERIA GRAMINIS F.SP. TRITICI (D.C.) SPEER CARE
CAUZEAZĂ BOALA NUMITĂ FĂINARE**

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Abstract: Observations realized during three years (2003-2005) on behaviour of 27 winter wheat varieties in case of *Blumeria graminis* (powdery mildew) attack allow us to affirm next: a) fungus attack is manifested with different intensity, in function of variety and general condition of experimental years (average virulence of the fungus is 26% in 2003, this increased at 43% in 2004 and decreased at 25% in 2005); b) from these 27 studied winter wheat varieties none presents immunity against powdery mildew, 18% are resistant and medium resistant for powdery mildew, and 64% are very sensitive; c) were resistant next varieties: Dor, Falnic, Gruia, Gloria and Bercsy (18%); medium resistant were: Ardeal, Fundulea 4, Holda, Dropia and Renan (18%); and 17 varieties were sensitive for powdery mildew: Flamura 85, Turda 95, Turda 2000, Bezostaia, Partizanka, G.K. Othalom, G.K. Gobe, Arieșan, Lovrin 34, Alex, Romulus, Boema, Crina, Delabrad, Farmec, Izvor, and Ciprian; d) it doesn't exist any immune for powdery mildew variety (Dor variety wasn't attacked in 2003 and 2004 until in 20 May, and during 2005); e) characterization of varieties used in production is: Dor, Falnic, Bercsy (resistant), Ardeal, Fundulea 4, Dropia and Renan (medium resistant) and Flamura 85, Turda 95, Turda 2000, Partizanka, G.K. Othalom, G.K. Gobe, Arieșan, Lovrin 34, Alex, Romulus, Boema, Crina, Delabrad, Izvor, Ciprian (sensitive).

Rezumat: Observațiile efectuate timp de 3 ani (2003 - 2005) asupra comportării celor 27 soiuri de grâu de toamnă față de atacul ciupercii *Blumeria graminis* (făinare) ne permit să spunem următoarele: a) atacul ciupercii s-a manifestat cu intensitate diferită, în funcție de soi și de condițiile anilor de experimentare (virulența medie a ciupercii a fost de 26% în anul 2003, s-a ridicat la 43% în anul 2004 și a scăzut în 2005 la 25%); b) din cele 27 de soiuri de grâu de toamnă cercetate, nici un soi de grâu nu prezintă imunitate față de făinare, sunt rezistente și mijlociu rezistente la făinare 18% și 64% sunt forme sensibile; c) s-au prezentat ca rezistente soiurile: Dor, Falnic, Gruia, Gloria și Bercsy (18%); soiurile Ardeal, Fundulea 4, Holda, Dropia și Renan au prezentat reacție de mijlociu rezistent (18%); s-au încadrat ca fiind sensibile un număr de 17 soiuri (64%) - Flamura 85, Turda 95, Turda 2000, Bezostaia, Partizanka, G. K. Othalom, G. K. Gobe, Arieșan, Lovrin 34, Alex, Romulus, Boema, Crina, Delabrad, Farmec, Izvor și Ciprian; d) nu există nici un soi imun la făinare (soiul Dor nu a fost atacat până în 20 mai în anii 2003, 2004 și de-a lungul anului 2005); e) caracterizarea soiurilor de grâu aflate în producție este următoarea: Dor, Falnic, Bercsy (rezistente), Ardeal, Fundulea 4, Dropia și Renan (mijlociu rezistente) iar din categoria celor sensibile se găsesc Flamura 85, Turda 95, Turda 2000, Partizanka, G. K. Othalom, G. K. Gobe, Arieșan, Lovrin 34, Alex, Romulus, Boema, Crina, Delabrad, Izvor, Ciprian (sensitive).

Key words: wheat, powdery mildew, resistance, immunity, sensitivity.

Cuvinte cheie: grâu, făinare, rezistență, toleranță, imunitate, sensibilitate.

INTRODUCTION

Production capacity, quality, behaviour in case of diseases, identification of resistance sources for resistance against infectious diseases are elements that characterize valuable

varieties of crop plants which are research objectives on national plan (E.Rădulescu, 1935; C. Sandu -Ville et. al. , 1963; C. Sandu-Ville, 1967; Floare Negulesc, N. N. Săulescu, Gh. Ittu, 1978, 1979; Drăcea A. E. et. al. , 1970, 1978; A. Moisuc et. al. , 1980; N. Ceapoiu et. al. , 1978, 1983; Gh. Popescu et al., 2000, 2005; Otilia Cotuna, Gh. Popescu, 2004, 2005a, 2005b) and international (E. E. Sari, J. M. Prescott, 1975; G. Shaner, R. E. Finney, 1977; F. Kokourek, L. Vechet, 1984; J. E. Parlevliet, 1988; S. Friederich, 1995 a, b; Iacob Viorica et al. , 1998; Nedialka Petrova et al. , 2000; P. Spetsov ,F. J. Zeller, 2000; Evert et al. , 2001; L. Vechet, 2003).

We are presenting the results obtained during 2003-2005 obtained at Lovrin having as purpose to contribute to the characterization of some Romanian and foreign winter wheat varieties concerning the resistance, tolerance and sensitivity reaction in the case of natural infection with *Blumeria graminis f.sp. tritici*.

MATERIAL AND STUDY METHOD

Biologic material is represented by 27 whiter wheat varieties from a comparative crop realized in S.C.D.A. Lovrin

Incidence average (F%), and severity and virulence average (I%) can be expressed with marks from 0 to 5 (a unit representing 20% from the surface of a plant attacked by fungus – N. Filadjic, T.B. Sutton, 1992), 0-9 scale (a unit represents 10% - C.L. Champbell, L.V. Madeen, 1990) or as percentage. Indifferent by the severity index type this is a discreet variable at plant level (as individual unit), but at group level average is a pseudo-continuous variable. Big differences can appear even is used the same scale, because the result is influenced by the size of analyzed sample (after N.Mc. Roberts et al., 2003), and in our conception depends also by the subject of the observation (Otilia Cotuna, Gh. Popescu, 2005).

We have considered intensity or fungus attack degree of the most sensitive variety in a year being 100%, and the values of the other varieties are reported as percentage to this variety. Marks as immune (I), resistant (R), medium resistant (MR) or tolerant (T) and sensitive (S) were accorded after I.C. Plant Protection Bucharest scale, modified by us in diseases crop rank resistance:

- infection absence – immune variety (I);
- infection (virulence) of 0.1-2 (or 1-20%) – resistant variety (R);
- infection between 2.1-4.0 (or 21-40%) – medium resistant or tolerant variety (MR; T);
- infection between 4.1-9.0 (or 41-100%) – sensitive variety (S);

Variance analysis is realized with the help of monofactorial analysis programme.

RESULTS AND DISCUSSIONS

Virulence or attack intensity expressed as percentage (0-9 scale) registered in these 27 winter wheat varieties during 2003-2005 period is presented in table 1, 2 and 3. Experimental year 2004 (table 2), through the realisation of the thermal and hydric optimal needs of the fungus is the year that decided the reaction type (immune –I; resistant – R; medium resistant or tolerant – MR, T; and sensitive – S) as the variety's mark. We have used as control variant Bezostaia variety, old winter wheat variety with great sensitivity for powdery mildew. There are also some old varieties that are not used for corps (Partizanka), but are maintained as standard of measures for new created wheat varieties (Ardeal, Dor, Boema, Delabrad, and others).

They noticed that there are differences in attack, in function of year and cultivated variety. In 2003, at last observation (9 July) from those five realised, fungus virulence vary among 10% for Dor variety and 82% for Bezostaia (control). Average virulence of the fungus

for winter wheat varieties is 26.1 (table 1). The other 19 winter wheat varieties have presented in this year an infection minus very distinctively significant. Signification in front of the attack average of the varieties shows infection pluses very distinctively significant in case of the extremely sensitive varieties as are Bezostaia, Arieşan, Boema, G.K. Gobe and Partizanka (table 1).

Table 1

Results concerning the behaviour of some winter wheat varieties in case of *Blumeria graminis* fungus attack during 2003

Nr. Crt	Variety	Attack intensity I%	Perct from control %	Difference (comparison with control)	Difference signification	Difference (comparison with average)	Difference signification
1	Bezostaia	82	100	-	-	56	***
2	Arieşan	40	48.78	-42	000	14	***
3	Ardeal	20	24.39	-62	000	-6	00
4	Alex	18	21.95	-64	000	-8	000
5	Bercsy	10	12.19	-72	000	-16	000
6	Boema	37	45.12	-45	000	11	***
7	Crina	24	29.26	-58	000	-2	-
8	Dropia	13	15.85	-69	000	-13	000
9	Delabrad	14	17.07	-68	000	-12	000
10	Dor	10	12.19	-72	000	-16	000
11	Fundulea 4	23	28.04	-59	000	-3	-
12	Flamura 85	24	29.26	-58	000	-2	-
13	G.K. Gobe	40	48.78	-42	000	14	***
14	G.K. Othalom	14	17.07	-68	000	-12	000
15	Lovrin 34	29	35.36	-53	000	3	-
16	Partizanka	62	75.60	-20	000	36	***
17	Renan	12	14.63	-70	000	-14	000
18	Romulus	14	17.07	-68	000	-12	000
19	Turda 95	12	14.63	-70	000	-14	000
20	Turda 2000	24	29.26	-58	000	-2	-
Experience average -26,1 %							

DL 5%=3.46%

DL 1%=4.62%

DL 0.1%=6.08%

During 2004 thermal and hydric needs are in optimal limits for *Blumeria graminis* fungus and for wheat. Variation limits of fungus virulence are similar with 2003 year, but coverage potential or parasitic potential of the fungus is higher in the other varieties (Arieşan has an anamorphic and telomorphic potential index of 40% in 2003 and 54% in 2004) (table 2), and in the case of average virulence difference is greater (42.6% in 2004, in comparison with 26.1% in 2003).

In this year variance analysis shows an infection minus very distinctively significant for all wheat varieties, in comparison with Bezostaia, (except Partizanka variety, very close as sensitivity with Bezostaia variety, that hasn't the limit difference provided statistically).

Table 2

Results concerning the behaviour of some winter wheat varieties in case of *Blumeria graminis* fungus attack during 2004

Nr. Crt	Variety	Attack intensity I%	Perct from control %	Difference (comparison with control)	Difference signification	Difference (comparison with average)	Difference signification	Reaction type
1	Bezostaia	80	100	-	-	37	***	S
2	Arieşan	54	67,5	-26	000	11	***	S
3	Ardeal	28	35	-52	000	-15	000	MR
4	Alex	44	55	-36	000	1	-	S
5	Boema	48	60	-32	000	5	*	S
6	Crina	44	55	-36	000	1	-	S
7	Ciprian	62	77,5	-18	000	19	***	S
8	Dropia	36	45	-44	000	-7	00	MR
9	Delabrad	56	70	-24	000	13	***	S
10	Dor	8	10	-72	000	-35	000	R
11	Fundulea 4	30	37,5	-50	000	-13	000	MR
12	Flamura 85	54	67,5	-26	000	11	***	S
13	Farmec	43	53,75	-37	000	0	-	S
14	Falnic	15	18,75	-65	000	-28	000	R
15	Gloria	12	15	-68	000	-31	000	R
16	Gruia	11	13,75	-69	000	-32	000	R
17	G.K. Othalom	43	53,75	-37	000	0	-	S
18	Lovrin 34	45	56,25	-35	000	2	-	S
19	Holda	22	27,5	-58	000	-21	000	MR
20	Izvor	64	80	-16	000	21	***	S
21	Partizanka	76	95	-4	-	33	***	S
22	Renan	24	30	-56	000	-19	000	MR
23	Romulus	43	53,75	-37	000	0	-	S
24	Turda 95	53	66,25	-27	000	10	***	S
25	Turda 2000	70	87,5	-10	000	27	***	S
Experience average=42,6%								
		DL 5%=4.52 %	DL 1%=6.03 %	DL0.1%=7.86				

26	Bercsy	10	12.19	-72	000	-16	000	R
27	G.K. Gobe	40	48.78	-42	000	14	***	S

DL5%=7.59% DL1%=10.12% DL0.1%=13.18

High percentages of fungus virulence in this experience year between 53-80% in case of some winter wheat varieties allowed us to establish correctly the reaction type or the mark of their behaviour in the case of powdery mildew infection. In this case studied varieties are characterized as follows:

- Dor, Falnic, Gloria, Gruia and Bercsy varieties are resistant (R) for powdery mildew;

- Ardeal, Fundulea 4, Holda, Dropia and Renan are medium resistant (MR);
- Bezostaia, Flamura 85, Turda 2000, Turda 95, Partizanka, G.K. Othalom, G.K. Gobe, Lovrin 34, Arieşan, Alex, Romulus, Boema, Crina, Delabrad, farmec, Izvor, Ciprian manifests sensitivity in powdery mildew. These varieties in case that fungus is not influenced favourable thermal and hydric presents tolerance, and even with a high pathologic load succeed to have good yields, when the pathogen tends to be epidemic with pandemic character these varieties must to be helped to close their production cycle with chemical treatments.

Table 3

Results concerning the behaviour of some winter wheat varieties in case of *Blumeria graminis* fungus attack during 2005

Nr. Crt	Variety	Attack intensity I%	Perct from control %	Difference (comparison with control)	Difference signification	Difference (comparison with average)	Difference signification
1	Bezostaia	50	100	-	-	25	***
2	Arieşan	35	70	-15	000	10	*
3	Ardeal	38	76	-12	00	13	**
4	Alex	30	60	-20	000	5	-
5	Boema	40	80	-10	0	15	***
6	Crina	25	50	-25	000	0	-
7	Ciprian	35	70	-15	000	10	*
8	Dropia	25	50	-25	000	0	-
9	Delabrad	40	80	-10	0	15	***
10	Dor	0	0	-50	000	-25	000
11	Fundulea 4	10	20	-40	000	-15	000
12	Flamura 85	15	30	-35	000	-10	0
13	Farmec	10	20	-40	000	-15	000
14	Falnic	10	20	-40	000	-15	000
15	Gloria	10	20	-40	000	-15	000
16	Gruia	15	30	-35	000	-10	0
17	G.K. Othalom	25	50	-25	000	0	-
18	Lovrin 34	25	50	-25	000	0	-
19	Holda	10	20	-40	000	-15	000
20	Izvor	50	100	0	-	25	***
21	Partizanka	40	80	-10	0	15	***
22	Renan	10	20	-40	000	-15	000
23	Romulus	15	30	-35	000	-10	0
24	Turda 95	25	50	-25	000	0	-
25	Turda 2000	30	60	-20	000	5	-
Experience average =25%							
DL5%=7.59% DL1%=10.12% DL0.1%=13.18%							

In 2005 *Blumeria graminis* fungus attack amplitude have values between 0% (Dor variety) and 50% (Bezostaia variety) (table 3). In this year the spring is humid and cold, and first powdery mildew spots, anamorphic and telemorphic, appeared in experimental trial in May, not in April as in 2003 and 2004.

In comparison with control variety (Bezostaia – 50% virulence), 32 varieties are statistically provided with infection minus, except Izvor variety statistically unprovided because of the virulence similar with control variant (50%).

In comparison with medium virulence of the fungus in the case of our trial, resistance reaction of Dor, Falnic, Gloria and Gruia varieties is constantly provided with infection minus. Medium resistance of Ardeal, Fundulea 4, Holda, Dropia and Renan is oscillating (infection plus distinctively significant, or infection minus very distinctively significant), and in the case of sensitive varieties Alex, Crina, G.K.Othalom, Lovrin 34, Turda 95, Turda 2000 isn't noticed a statistic guaranteed because is not passed the limit difference of 7.59%.

In our experiences Dor varieties haven't presented powdery mildew in this way: in 2003 until in 19 May (the third observation) until at the 5th notation when the anamorphic and telemorphic potential inoculus of the fungus becomes powerful and succeeded to colonise this variety on 9.33% (Otilia Cotuna, Gh. Popescu, 2005); in 2004 until in 20 May (also the third observation) also this variety has no infection, but in 30 May is colonised anamorphic and telemorphic on 7.33%; in 2005 fungus potential hasn't the necessary energy for infection. In fact in 2005 thermal and hydric needs of the *Blumeria* fungus weren't realised in optimal limits (very cold and humid weather), and in consequence anamorphic (IPa) and telemorphic (IPt) potential inoculus with his energy succeeded to colonize the sensitive varieties only at the half of the virulence from 2003 and 2004 (Otilia Cotuna, Gh. Popescu, 2005).

Major, minor and mixed resistance gene source is enough rich (Floare Negulescu *et al.*, 1978, 1979; Drăcea Aneta Elena, M. Goian, Gh. Popescu, 1978) from 325 varieties studied for 4 years have presented a constant resistance the next varieties: Atlas 50, A. 66, Blondeau, Coutiches, Koga II, Lo 1482, Pilote, Quanch, Rudest, Todd, Valdor, Momont, Wakeland, 84/1960 (Austria), 87/1960 (Austria); Drăcea Aneta Elena, M. Goian, Gh. Popescu, 1978 from 445 wheat varieties a constant resistance for 4 years presented the next varieties: Cama, Purdue 5396, TP 309 A, Sappo, TP 309 B (c), TP 310 A, TP 315/1, Zlatka; A. Moisuc, 1980 – next varieties: 62/139, Bruckner 6111, IBO 110, TP 114, TP 314; Otilia Cotuna, Gh. Popescu, 2005 – next varieties: Dor, Falnic, Gloria, Gruia and Bercsy.

Wheat varieties with resistance genes for powdery mildew introduced for crops, usually after some years are losing this feature, this effectiveness in disease control (N. Ceapoiu, Floare Negulescu, 1983; Otilia Cotuna, Gh. Popescu, 2005), in fact they become sensitive.

For cultivated wheat varieties that have lost their vertical, horizontal or mixed action, but are not productive Otilia Cotuna, Gh. Popescu (2005) are coming with next recommendations:

- their inbreeding must to be realised with the use of resistance sources identified until now;
- they must to be helped with chemical treatments (on seeds, for other diseases with products based on copper, fungicides that are not affecting the ecosphere, and in vegetation with sulphur that has the same qualities as the copper, or triazoles that are totally metabolised by the plants) for consumption or seed plots;
- imprinting of the tolerance through the respect of technological chain that creates the framework for unspecific genes for resistance to provide morphological, physiological and biochemical features to help the wheat to manifest partial resistance.

CONCLUSIONS

Observations realized during three years (2003-2005) on behaviour of 27 winter wheat varieties in case of *Blumeria graminis* (powdery mildew) attack allow us to affirm next:

a) fungus attack is manifested with different intensity, in function of variety and general condition of experimental years (average virulence of the fungus is 26% in 2003, this increased at 43% in 2004 and decreased at 25% in 2005);

b) from these 27 studied winter wheat varieties none presents immunity against powdery mildew, 18% are resistant and medium resistant for powdery mildew, and 64% are very sensitive;

c) were resistant next varieties: Dor, Falnic, Grăia, Gloria and Bercsy (18%); medium resistant were: Ardeal, Fundulea 4, Holda, Dropia and Renan (18%); and 17 varieties were sensitive for powdery mildew: Flamura 85, Turda 95, Turda 2000, Bezostăia, Partizanka, G.K. Othalom, G.K. Gobe, Arieșan, Lovrin 34, Alex, Romulus, Boema, Crina, Delabrad, Farmec, Izvor, and Ciprian;

d) it doesn't exist any immune for powdery mildew variety (Dor variety wasn't attacked in 2003 and 2004 until in 20 May, and during 2005);

e) characterization of varieties used in production is: Dor, Falnic, Bercsy (resistant), Ardeal, Fundulea 4, Dropia and Renan (medium resistant) and Flamura 85, Turda 95, Turda 2000, Partizanka, G.K. Othalom, G.K. Gobe, Arieșan, Lovrin 34, Alex, Romulus, Boema, Crina, Delabrad, Izvor, Ciprian (sensitive).

For wheat varieties that are cultivated but have lost their vertical, horizontal and mixed action, but are productive we are coming with next recommendations:

- their inbreeding must to be realised with the use of resistance sources identified until now;
- they must to be helped with chemical treatments (on seeds, for other diseases with products based on copper, fungicides that are not affecting the ecosystem, and in vegetation with sulphur that has the same qualities as the copper, or triazoles that are totally metabolised by the plants) for consumption or seed plots;
- imprinting of the tolerance through the respect of technological chain that creates the framework for unspecific genes for resistance to provide morphological, physiological and biochemical features to help the wheat to manifest partial resistance.

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