OCCURRENCE AND FREQUENCY OF POWDERY MILDEW (*BLUMERIA GRAMINIS* F.SP. *TRITICI*) OF WINTER WHEAT IN NORD-EAST OF ROMANIA, BETWEEN 2015-2018

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Abstract

Wheat crop are damaged by numerous pathogens, which can produce important yields losses. *Blumeria graminis* (DC.) E.O. Speer f.sp. *tritici* Em. Marchal, anamorph *Oidium monilioides* Link. is an important pathogen present annually in wheat fields, and yield losses attributed to this disease range from 13% to 34%, when the degree of infestation is low, but in the cases when the pressure of infection is high the losses can be over 50%, reaching even the total production compromise.
The paper presented the behavior of 35 winter wheat cultivars, represented by Romanian varieties: 11368G1, 11424G1, 11838G8, Boema, Glosa, Izvor, Litera, Miranda FDL, Otilia, Pajura, Pitar, Semnal, Unitar, Ursita, Vestitor, Voevod, Voinic, Zamolxe, Zina, Zamfira, respectively from A.R.D.S. Turda: Andrada, Codru, Dumbrava, T.19-10, T.42-05, T.55-01, T.62-01, T.95-12, T.109-12, T.118-11, T.123-11, T.124-11, T.143-11, T.150-11 and Bezostaia 1 (control variant) based on the dates obtained in three years of field trials (2015-2018), performing at Didactic Station Iasi - Ezăreni Farm. The winter wheat varieties exhibited a wide variability over the studied pathogen, during the study period, variability determined by the characteristics of the agricultural year and by each winter wheat variety.

Key words: *Blumeria graminis*, Powdery mildew, winter wheat, Yield, Diseases

Angiosperms, almost belonging to the dicotyledons, with one notable exception, the cereals and grasses group (monocotyledons) are attacked by a group of fungus (the *Erysipahles*) which produce diseases know as *powdery mildews*. In this order, is only one family, the *Erysiphaceae*, and the species grouped here cause symptoms on plants which can be easy recognized because of conidia produced in abundance on the surfaces of infected host plants. The term "powdery mildews" is often also applied to the organisms causing this types of diseases (Ridout C.L., 2009; Webster J. *et al*, 2007).

Powdery mildew (*Blumeria graminis* (DC.) E.O. Speer f.sp. *tritici* Em. Marchal, anamorph *Oidium monilioides* Link.) (www.speciesfungorum.org) of wheat (*Triticum aestivum* L.) is one most damaging diseases of wheat in the world (Alam *et al*, 2011; Xu X. *et al*, 2018; Bennett F.G.A., 1984), being a problematic disease primarily in the northern hemisphere (Cowger C. *et al*, 2012).

Yield losses attributed to this disease range from 13% to 34%, when the degree of infestation is low, but in the cases when the pressure of infection is high the losses can be over 50%, reaching even the total production compromise (Mwale *et al*., 2014).

Before to the *Green Revolution* the powdery mildew of wheat was economically damaging only in cold climates, maritime or semi-continental climates, but in recent decades powdery mildew of wheat has become an important disease in warm and dry climates due to intensive agricultural practices, high dose of fertilizers use in agriculture and cultivation of semi dwarf varieties (Cowger C. *et al*, 2012; Bennett F.G.A., 1984).

In Romania, powdery mildew of wheat is an important disease, being observed annually in wheat fields at different frequencies and intensities. Yield losses estimated to be produced by this disease have broad limits ranging from 3-4%, in years of low attack, at values of 20-25% in years of high attack, and even over 40% when attack of pathogen is very high (Cotuna *et al*, 2007; Nagy Elena *et al*, 2008).

MATERIAL AND METHOD

Between 2015 and 2018 the occurrence and frequency of wheat powdery mildew (*Blumeria graminis* f.sp. *tritici*) was studied.

A total number of 35 winter wheat cultivars, represented by romanian varieties (from N.A.R.D.I. Fundulea: 11368G1, 11424G1, 11838G8, Boema, Glosa, Izvor, Litera, Miranda FDL, Otilia, Pajura, Pitar, Semnal, Unitar, Ursita, Vestitor, Voevod, Voinic, Zamolxe, Zina, Zamfira, respectively from A.R.D.S. Turda: Andrada, Codru, Dumbrava, T.19-

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10, T.42-05, T.55-01, T.62-01, T.95-12, T.109-12, T.118-11, T.123-11, T.124-11, T.143-11, T.150-11), as well by the old Russian variety Bezostaia 1, used as a long-term control variant in comparative crops, were the biological materials used in the study.

The experience was placed in the experimental field of the Iasi Didactic Station, the "Ezăreni" farm, being organized according to the randomized block diagram, in three replicates, each wheat cultivar representing an experimental variant.

In the experience, the specific technology of wheat cultivation was applied; no treatments against pathogens were performed.

The observations to identify the presence of pathogens were conducted between March-June 2016, 2017 and 2018.

In order to determine Frequency (F%), Intensity (I%) and to calculate the degree of attack (DA%), were made observation with metric frame (50X50 cm) in each variant of the 3 replications.

To determine the Intensity of attack (I%) was use the F.A.O. scale rate, with 9 attack classes.

Univariate Analysis of Variance was used for statistical interpretation (IBM SPSS Statistics 20) and the charts were made with Microsoft Office tools.

RESULTS AND DISCUSSIONS

Under the climatic conditions of the three agricultural years studied (2015-2018), following the observations made on the 35 winter wheat cultivars, the presence of *Blumeria graminis* (DC.) E.O. Speer f.sp. *tritici* Em. Marchal, anamorph *Oidium monilioides* Link. was observed with different values of frequency and severity of attack.

In the first year of study (*table 1*) the presence of the pathogen was observed in case of 23 cultivars.

Table 1

Powdery mildew of wheat – degree of attack in 2015-2016 agricultural year

No.	Winter wheat varieties	Degree of attack%	Min %	Max %	%	Difference from Mt. (%)	Means
1	Bezostaia 1 (Mt.)	3.75±0.78	2.23	4.81	100.00	0.00	
2	11368 G1	0.34±0.10	0.15	0.50	9.16	-3.41	***
3	11424 G1	0.98±0.58	0.29	2.13	26.08	-2.77	**
4	11838 G8	2.96±1.22	0.90	5.11	79.01	-0.79	*
5	Andrada	3.45±0.35	2.75	3.80	91.90	-0.30	NS
6	Boema	2.56±0.99	0.77	4.19	68.32	-1.19	NS
7	Codru	1.02±0.17	0.77	1.36	27.21	-2.73	**
8	**Dumbrava**	**0.00±0.00**	**0.00**	**0.00**	**0.00**	**-3.75**	***
9	Glosa	2.35±0.97	0.76	4.12	62.74	-1.40	NS
10	Izvor	1.44±0.45	0.94	2.34	38.42	-2.31	**
11	Litera	0.41±0.26	0.13	0.92	10.86	-3.34	***
12	Miranda FDL	3.80±0.93	1.99	1.99	101.26	0.05	NS
13	Otilia	1.21±0.78	0.30	2.76	32.21	-2.54	**
14	Pajura	0.56±0.11	0.41	0.77	15.01	-3.19	***
15	Pitar	0.99±0.97	0.00	2.92	26.40	-2.76	**
16	Semnal	2.15±0.40	1.36	2.56	57.38	-1.60	NS
17	T.123-11	1.44±0.67	0.31	2.64	38.43	-2.31	**
18	T.124-11	0.52±0.21	0.10	0.74	13.82	-3.23	***
19	T.150-11	0.64±0.26	0.17	1.08	17.04	-3.11	***
20	T.19-10	0.39±0.08	0.27	0.55	10.47	-3.36	***
21	T.42-05	3.66±0.48	2.84	4.51	97.73	-0.09	NS
22	T.55-01	1.57±0.57	0.47	2.39	41.87	-2.18	*
23	T.62-01	2.68±0.24	2.22	3.00	71.42	-1.07	NS
24	**Unitar**	**0.00±0.00**	**0.00**	**0.00**	**0.00**	**-3.75**	***
25	Ursita	0.01±0.01	0.00	0.03	0.24	-3.74	***

The highest DA(%) value was observed in the Bezostaia 1 winter wheat cultivar, which is also the control variant of experience. Between Bezostaia 1 and the other winter wheat varieties there were differences regarding the degree of attack (DA(%)) but just in case of 17 varieties the differences were ensured statistically. In this agricultural year the pathogen was not present in Dumbrava and Unitar winter wheat cultivars, and in Ursita, the pathogen was present with a low DA(%), the difference from control variant being very significant (***). Very significat differences was recorded and in case of 11368G1, Litera, Pajura, T.124-11, T.150-11, T.19-10 cultivars.

Table 2

Powdery mildew of wheat – degree of attack in 2016-2017 agricultural year

No.	Winter wheat varieties	Degree of attack%	Min %	Max %	%	Difference from Mt. (%)	Means
1	Bezostaia 1 (Mt.)	3.84±0.51	3.31	4.85	100.00	0.00	
2	11424 G1	1.14±0.11	0.97	1.34	29.64	-2.70	***
3	Andrada	4.16±0.74	2.72	5.19	108.35	0.32	NS
4	Codru	3.11±0.27	2.59	3.51	80.99	-0.73	NS
5	Dumbrava	1.66±0.19	1.41	2.02	43.25	-2.18	**
6	Glosa	3.30±0.13	3.06	3.50	86.05	-0.54	NS
7	Izvor	3.20±0.20	2.80	3.46	83.40	-0.64	NS
8	Litera	2.77±0.06	2.70	2.90	72.24	-1.07	NS
9	Miranda FDL	1.88±0.29	1.35	2.35	48.87	-1.96	**
10	Otilia	1.24±0.42	0.39	1.67	32.18	-2.60	***
11	Pajura	1.24±0.38	0.49	1.72	32.25	-2.60	***
12	Pitar	0.52±0.05	0.46	0.61	13.56	-3.32	***
13	Semnal	3.05±0.30	2.71	3.64	79.35	-0.79	NS
14	T.109-12	1.09±0.46	0.59	2.01	28.27	-2.75	***
15	T.118-11	3.24±0.26	2.83	3.71	84.38	-0.60	NS
16	T.123-11	1.33±0.88	0.37	3.07	34.52	-2.51	**
17	T.124-11	0.91±0.51	0.31	1.92	23.71	-2.93	***
18	T.143-11	0.94±0.28	0.53	1.48	24.38	-2.90	***
19	T.19-10	3.03±0.44	2.18	3.65	78.84	-0.81	NS
20	T.95-12	2.68±0.60	1.48	3.37	69.82	-1.16	NS
21	Unitar	1.32±0.41	0.54	1.91	34.25	-2.52	**
22	Ursita	0.72±0.18	0.48	1.09	18.82	-3.12	***
23	Vestitor	3.45±0.24	3.00	3.83	89.78	-0.39	NS
24	Voevod	2.83±1.11	0.76	4.57	73.65	-1.01	NS
25	Voinic	3.59±1.03	1.64	5.17	93.51	-0.25	NS

In the second year of observation the pathogen was noticed in all winter wheat varieties (*table 2*). Andrada cultivar recorded the highest DA(%) of powdery mildew, but the difference was not statistically ensured from control variety, which recorded 3.84±0.51%. The lowest severity of attack was recorded in Pitar cultivar, 0.52±0.05%. In case of 12 winter wheat varieties the differences were statistically ensured.

Table 3

Powdery mildew of wheat – degree of attack in 2017-2018 agricultural year

No.	Winter wheat varieties	Degree of attack%	Min %	Max %	%	Difference from Mt. (%)	Means
1	Bezostaia 1 (Mt.)	3.69±1.02	1.95	5.49	100.00	0.00	
2	11424 G1	0.74±0.20	0.39	1.07	20.19	-2.95	**
3	Andrada	2.18±0.85	0.62	3.56	59.04	-1.51	NS
4	Codru	1.77±0.32	1.39	2.41	48.08	-1.92	*
5	Dumbrava	0.48±0.22	0.12	0.89	12.92	-3.21	**
6	Glosa	3.48±0.64	2.51	4.69	94.19	-0.21	NS
7	Izvor	3.96±1.02	2.27	5.79	107.43	0.27	NS
8	Miranda FDL	4.00±1.28	1.68	6.11	108.28	0.31	NS
9	Otilia	1.61±0.73	0.65	3.05	43.52	-2.08	*
10	Pajura	3.84±0.14	3.57	4.03	104.11	0.15	NS
11	Pitar	0.81±0.26	0.34	1.23	21.88	-2.88	**
12	Semnal	3.04±0.54	2.09	3.96	82.32	-0.65	NS
13	T.109-12	1.30±0.74	0.49	2.78	35.27	-2.39	*
14	T.118-11	1.75±0.40	1.11	2.49	47.31	-1.94	*
15	T.123-11	1.46±0.38	1.07	2.22	39.62	-2.23	*
16	T.124-11	1.41±0.13	1.19	1.63	38.21	-2.28	*
17	T.143-11	0.49±0.29	0.13	1.05	13.17	-3.20	**
18	T.19-10	2.29±0.71	1.21	3.63	62.16	-1.40	NS
19	T.95-12	3.51±0.60	2.32	4.28	95.10	-0.18	NS
20	Unitar	1.49±0.58	0.34	2.14	40.26	-2.20	*
21	Ursita	0.58±0.14	0.33	0.82	15.79	-3.11	**
22	Voinic	3.19±0.31	2.67	3.73	86.55	-0.50	NS
23	Zamfira	1.47±1.08	0.37	3.63	39.81	-2.22	*
24	Zamolxe	2.66±0.62	1.69	3.82	71.97	-1.03	NS
25	Zina	1.38±0.50	0.69	2.35	37.40	-2.31	*

In the last year of study (2017-2918) the pathogen was present in all winter wheat varieties with values of the degree of attack between 0.48±0.22% (Dumbrava variety) and 4.00±1.28 (Miranda FDL variety). The control variant recorded 3.69±1.02%, values versus which statistical differences were noticed only for 11424G1, Codru, Dumbrava, Otilia, T.109-12, T.118-11, T.123-11, T.124-11, T.143-11, Unitar, Ursita, Zamfira, Zina winter wheat variety.

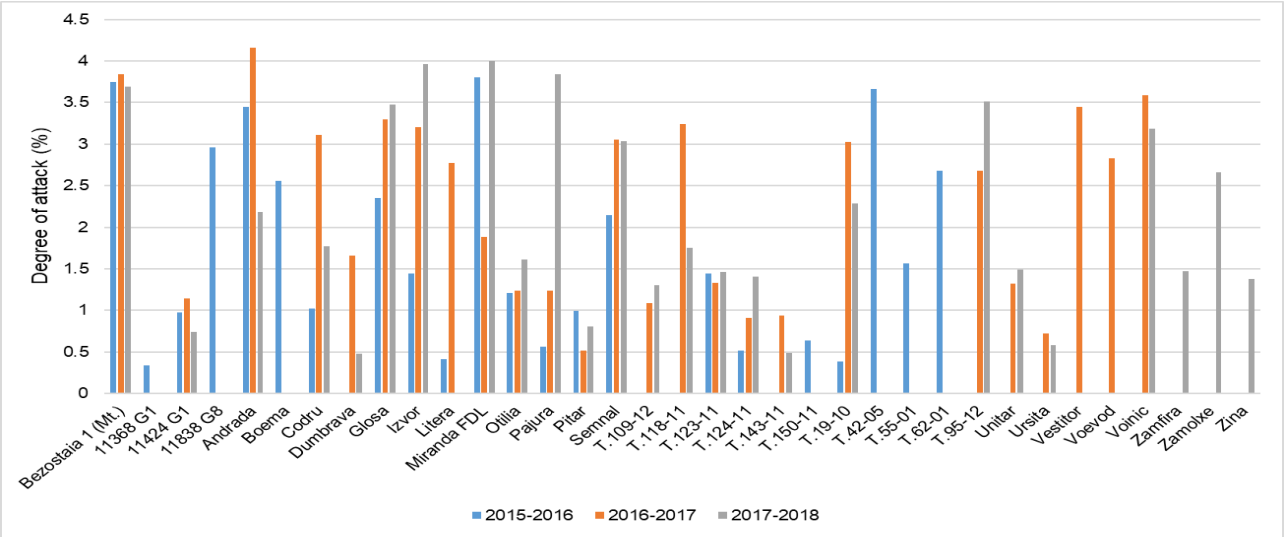

Figure 1 **Powdery mildew of wheat, DA (%) values between 2015-2018**

Analyzing the presence of *Blumeria graminis* (DC.) E.O. Speer f.sp. *tritici* Em. Marchal during the study period (*figure 1*) ca be observed that in the second year of observation (2016-2017), de presence of pathogen was higher compared to the other two years of observation. This situation can be explained by the fact that in this year the climatic conditions were favorable for the development of the pathogen. Analysis of climatic conditions and their influence on yields and diseases development for the studied period ca is presented in a paper published previously (Gafencu A.M. *et al*, 2018).

CONCLUSIONS

Powdery mildew (*Blumeria graminis* f.sp. *trtitici*) is a pathogen that appears annually in wheat fields and can cause yield losses if diseases control measures are not applied.

Using resistant cultivars is beneficial because it avoids the use of expensive chemical (fungicide).

The results of this study show that the new winter wheat cultivars may be a good measure for controlling de pathogen. 11424G1, T.124-11 winter wheat lines, which are tested to introduced for cultivation show a good manifestation of the behavior against the pathogen.

REFERENCES

Alam M.A., Mandal M.S.N., Wang C., Ji W., 2013 – *Chromosomal location and SSR markers of a powdery mildew resistance gene in common wheat line N0308*. Afric. J. Micro. Res. 7(6) 477-482.

Bennet F.G.A., 1984 – *Resistance to powdery mildew in wheat: a review of its use in agriculture and breeding programmes*. Plant Pathology. Vol. 33, 279-300.

Cotuna Otilia, Popescu G., Grozea Ioana, 2007 – *Fungicide applying effect on Blumeria graminis f.sp. tritici and winter wheat yield, with different reaction for powdery mildew*. Research Journal of Agricultural Science, Vol. 39, Nr. 1., pp. 445-448.

Cowger C., Miranda L., Griffey C., Hall M., Murphy J.P., Maxwell J., 2012 – *Wheat Powdery Mildew*. In: Disease Resistance in Wheat, edited by Indu Sharma. ISBN 13: 978-1-84593-818-5.

Gafencu A.M., Florea Andreea-Mihaela, Lipșa F.D., Ulea E., 2018 – *Impact of climatic conditions on yield and plant diseases of winter wheat in north-eastern Romania*. Lucr. Șt. Seria Agronomie, Vol. 61, Nr. 1, pp. 157-162.

Mwale V.M., Chilembwe E.H.C., Uluko H.C., 2014 – *Wheat powdery mildew (Blumeria graminis f.sp. tritici): Damadge effects and genetic resistance developed in wheat (Triticum aestivum)*. International Research Journal of Plant Science, Vol. 5(1)., pp. 1-16. ISSN: 2141-5447.

Nagy Elena, Nagy D.C., 2008 – *Influența tratamentelor cu fungicide asupra producției și calității la câteva soiuri de grâu*. Anale I.N.C.D.A. Fundulea, Vol. LXXVI, pp. 147-154

Ridout C.J., 2009 – *Profiles in Pathogenesis and Mutualism: Powdery Mildews*. Plant Relationships, 2nd Edition. The Mycota V., H Deising (edt.). Pp. 51-68.

Webster J., Weber R.W.S., 2007 – *Introduction to Fungi*. Third Edition. Cambridge University Press. ISBN-13 978-0-521-80739-5

Xu X., Jing F., Jieru F., Zhiyong L., Qiang L., Yilin Z., Zhanhong M., 2018 – *Identification of the resistance gene to powdery mildew in Chinese wheat landrace Baiyouyantiao.* Journal of Interactive Agriculture, Vol. 17, No. 1, pp. 37-45.

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