RESEARCHES ON THE COMPORTMENT OF SOME FOREIGN WINTER WHEAT TO THE ATTACK OF THE PATHOGEN *DRECHSLERA TRITICI REPENTIS* (DIED.) SHOEMAKER

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Abstract: *Wheat tan spot produced by Drechslera tritici repentis (Died.) Shoemaker fungus is a foliar disease spread in many areas of the world where wheat is cultivated; having great economic importance due to loses that can be produced at great attack intensities. This pathogen is present in Romania by about 15 years. In Banat region was first reported in 2007, with the suspicion that the fungus was present already before in wheat crops. The harvest loses produced by this pathogen are in direct relationship with the inoculum amount, the resistance of the cultivated variety, with the climatic conditions and with the wheat plants phenophase at the moment of the infections. In 2011 there have been monitored 13 winter wheat varieties, respectively 11 varieties of common wheat (Apache, Kalango, Azimut, Soissons, Renan, Karolinum, Esperia, Bilancia, Centauro, Sagittario and Alcione) and 2 varieties of durum wheat (Normanno and Maestrale). The climatic conditions from the spring of 2011 have influenced positively the pathogeny of Drechslera tritici repentis (Died.) Shoemaker fungus. The virulence of the pathogen was comprised between 45% and 75%. The most sensitive variety from the trial was Apache (control), where the attack intensity was 75%. The attack severity in the Italian varieties was between 48.33% (Esperia) and 66.66% (Normanno and Centauro). The lowest virulence from the trial was registered in the variety Kalango (I% = 45%). Due to the favourable climatic conditions, the infection has been spread to the flag leaf too. The flag leaf was affected in proportion of 15% (Maestrale and Bilancia varieties) and 33.33% (variety Apache). At the moment when the infection reaches the flag leaf the grains are susceptible to the infection. The evolution of Drechslera tritici repentis (Died.) Shoemaker fungus was assessed by the use of AUDPC (area under the disease progress curve). The greatest values of AUDPC have been registered in the varieties Centauro (1370.56), Renan (1359.84), Apache (1333.28), Normanno (1306.56), and the lowest values in the varieties Kalango (917.28), Azimut (954.56) and Esperia (959.84). The values of AUDPC are strongly correlated with the values of intensity registered in the trial field.*

Key words**:** *wheat tan spot, Drechslera tritici repentis (Died.) Shoemaker, AUDPC, winter wheat, severity.*

INTRODUCTION

Every year wheat is attacked by leaf pathogens (*Blumeria graminis* (D.C.) Speer – powdery mildew, *Septoria nodorum* – nodes and glume blotch, *Septoria tritici* – leaf blotch, *Puccinia recondita* Rob. et Desm.– brown rust, *Drechslera tritici repentis* (Died.) Shoem. – wheat tan spot). The ascomycetae *Pyrenophora tritici – repentis* (Died.) Drechsler (the sexuate form of the fungus) with the conidian form *Drechslera tritici - repentis* (Died.) Shoemaker has appeared by about 15 years and the phytopathologists correlate the fungus presence with the climatic changes from the last years. *Pyrenophora tritici – repentis* (PTR) is a necro-trophic fungus that produces the wheat tan spot, disease with great economic importance at global level (M. V. WEISE, 1987; E. D. DE WOLF *et al*., 1998).

This fungus produces one or a combination of toxins in host – selective (*HSTs*) necessary for the realisation of the infection. The two toxins produced, *Ptr ToxA* (*ToxA*) and *Ptr ToxB* (*ToxB*) are proteins that are producing two types of symptoms: necrotic spots, respectively chlorotic spots (IOVANNA PANDELOVA *et al*., 2012). The same authors are

supporting the hypothesis that the necro-trophic fungi are exploiting the defense responses of the plant with the purpose of inducing the cells death having as beckground the idea that the perception of the host selective toxins leads to the activation of the defence reactions.

The most numerous races of PTR are producing frequently necrosis symptoms, associating it with *ToxA* or *Ptr necrosis toxin* (L. M. CIUFFETTI *et al*., 1998; G. M. BALLANCE *et al*., 1989; H. ZHANG *et al*., 1997). The necrosis symptom is associated with *ToxB* (J. P. MARTINEZ *et al*., 2001; S. E. STRELKOV *et al*., 1999).

In the last years, the virulence of the fungus has increased due to the wheat cultivation in more intensive systems than in past due to the great demand of food but also to the insufficient surfaces of arable land. Thus, the increased incidence of this fungus is mainly correlated with the wheat cultivation in "no tillage" crop system and in monoculture (S. NAGARAJAN, J. KUMAR, 1998; M. GINKEL, S. RAJARAM, 1998).

The harvest loses caused by this fungus are in direct relationship with the inoculus amount, with the climate conditions, the resistance of the cultivated variety and the phenophase of the wheat at the moment of the infection (E. DUVEILLER, L. GILCHRIST, 1994; T. D. MURRAY *et al*., 2009).

In this study are presented the results obtained in 2011, when there were monitored 13 winter wheat varieties, respectively 11 varieties of common wheat (Apache, Kalango, Azimut, Soissons, Renan, Karolinum, Esperia, Bilancia, Centauro, Sagittario and Alcione) and two varieties of durum wheat (Normanno and Maestrale). The behaviour of the winter wheat varieties to the attack of *Drechslera tritici repentis* (Died.) Shoemaker has been evaluated with AUDPC method (area under the disease progress curve).

In Banat region, the infections produced by this fungus starts at the beginning of April, depending by the climatic conditions and is manifested in generally by necrosis. The fungus is very aggressive, the infection is getting expanding fast, being difficult to control it even there are applied fungicides.

MATERIAL AND METHODS

The comportment of the winter wheat to the attack of the fungus *Drechslera tritici – repentis* (Died.) Schoemaker, has been studied in a field plot set in the Didactic Station of the Banat's University of Agricultural Sciences and Veterinary Medicine from Timişoara during October 2010 – June 2011. The biologic material used is represented by 13 foreign winter wheat varieties (originating from France, Spain, Italy and Austria) and two varieties of durum wheat. During this period there have been registered the climatic data registered at the Meteorological Station of the Phytosanitary Direction from Timişoara. The experimental field has been set after the method of the randomized blocks with three replicates. The size of a plot has been 7 m x 1 m (7 m^2).

The attack frequency has been set with a metric frame (50 cm x 50 cm), taking in account the relative value of the attacked plants' number in report with the total number of the analysed plants or organs. The first registration regarding the virulence has been made on 9th May 2011. The evaluation of the attack intensity has been done visually in four stages at every 10 days among the observations. The severity of the attack has been appreciated on 0 – 9 scale (SAARI *et* PRESCOTT, 1975), where a unit represents 10% from the surface of the plants affected by pathogen.

The area under the disease progress curve (AUDPC) has been calculated using the Shaner and Finney (1977):

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

where: Yi = the disease level ti; t(i+1) - ti = the time in days between two secquential registrations of the disease.

The AUDPC gives the quantitative measure of the epidemic development and the disease intensity and can be used in the appreciaiton of the attack evolution.

The data have been analysed with the variance analysis.

RESULTS AND DISCUSSIONS

Wheat tan spot (PTR) is an extremely severe disease when is applied the monoculture and there where the farmers are applying "no tillage" technologies, due to the great amounts of organic matter that are remaining at the soil surface and are carrying the fructifications of the fungus responsible for the appearance of the disease (ERIK DE WOLF, 2008).

In the climatic conditions of Banat region the fungus is manifesting a great agressivity (reaching even 100% plants with symptoms) and the virulence reaches 80% in some situations, especially in the case of the sensitive varieties.

The development of *Drechslera tritici-repentis* (DTR) has been monitored in 2011 in 13 foreign winter wheat varieties there being analysed mainly their comportment to the attack of the pathogen. The varieties selected for this comparative trial are for common wheat (11) and durum wheat (2). From the total 13 analysed wheat varieties (Apache, Esperia, Bilancia, Normanno, Centauro, Sagittario, Alcione, Maestrale, Azimut, Renan, Karolinum, Kalango, Soissons) 7 are from Italy produced by *Societa Produttori Sementi S.p.A. Bologna* (Esperia, Bilancia, Normanno, Centauro, Sagittario, Alcione, Maestrale). The Italian varieties are highly productive and are manifesting a good resistance to pathogens. The first visible symptoms have appeared at the end of April on the basal leaves. The observations were done in four stages. The first observation was realised at 9th May 2011 and the last on 10 June 2011. The evaluation of the attack intensity was realised visually at every 10 days. The virulence of the fungus on the flag leaf vas registered at the last observation.

The average daily temperatures registered have favoured the pathogen biology. The average temperatures registered during the analysis period were comprised between 13.1 ^{o}C (April) and 22.04 ^{o}C (June) and the maxim ones between 20.4 ^{o}C (April) and 29.8 ^{o}C (June). The mycelium and the spores are germinating at a wide temperature interval (5 – 35 ^{o}C), from here resulting the great virulence of the fungus. The maturation of the perithecia (sexuate fructifications) takes place in the temperature interval of 5 – 20 ^{o}C, the optimum being comprised between 15 – 18^{0}C (WRIGHT and SUTTON, 1990). The pathogeny of *Drechslera tritici – repentis* is optimal at temperature comprised between 20 – 28 ^{o}C. Regarding the rainfall amount there were registered differences in comparison with the annuale average, thus in April there was registered a rainfall defficit of 23,6 mm and in May an excess of 12.9 mm in comparison with the average. Both temperatures and rainfalls have been favourable to the development of the fungus *Pyrenophora tritici - repentis* (PTR), the attack intensity in the comparative trials reaching to 75% in the control Apache variety (Table 1).

The typical symptom with that the fungus has manifested in field has necrosis, thus the necrosis is one of the symptoms produced by many races of PTR and it is associated with the production of the PTR toxA and ToxA. Recent researches show that ToxA has been detected in the cytoplasm and chloroplasts of the cells sensitive to ToxA, and the gene responsible for the induction the necrosis was found in cytoplasm. These results suggest an intracellular presence for ToxA (V. A. MANNING, L. M. CIUFFETTI, 2005; V. A. MANNING *et al*., 2008; J. D. FARIS *et al*., 2012).

Table 1

The dynamics of the intensity attack of the fungus *Drechslera tritici – repentis* in winter wheat in 2011

No.	Variety	Attack intensity (I%) at:				I% attack on flag leaf	AUDPC
		09.05.2011	19.05.2011	29.05.2011	10.06.2011	10.06.2011	
1	Apache (martor)	8.33	18.66	37.00	75.00	33.33	1333.28
2	Esperia	11.66	24.33	34.33	48.33	26.66	959.84
3	Bilancia	14.33	28.33	40.00	53.66	15.00	1087.84
4	Normanno (durum)	15.00	30.00	39.00	66.66	21.66	1306.56
5	Centauro	19.00	28.33	39.33	66.66	30.00	1370.56
6	Sagittario	15.00	34.33	40.00	59.33	23.33	1189.28
7	Alcione	17.33	31.00	44.00	62.33	25.00	1274.56
8	Maestrale (durum)	20.00	26.00	37.66	57.33	15.00	1237.28
9	Azimut	10.33	21.33	28.33	49.33	20.00	954.56
10	Renan	23.33	37.00	42.66	61.66	30.00	1359.84
11	Karolinum	14.33	26.00	35.00	55.00	21.00	1109.28
12	Kalango	12.33	25.33	31.00	45.00	18.33	917.28
13	Soissons	14.00	21.00	27.33	49.00	16.00	1008.00
Average		14.997	27.049	36.587	57.637	22.716	1162.2

In 2011 the amplitude of the virulence (I%) of the attack of the fungus *Drechslera tritici repentis* in the monitored varieties of winter wheat was comprised between 45% (Kalango variety) and 75% (Apache variety, control). The control Apache variety was chose because it presents a greater sensitivity to the attack of this pathogen (Table 1). The flag leaf was affected by the pathogen with 15% (Bilancia variety) and 33.33% (Apache). When the flag leaf is attacked, the danger of grains infection is great. The average of the virulence of the attack per trial was comprised between 14,997% at the first registration and 57,637% at the last observation data. The average severity of the attack at flag leaf for the entire comparative trial was 22.716% (Table 1).

The evaluation of the virulence of the pathogen was realised with the AUDPC method. For the calculation of the area under the disease progress curve are necessary repeated evaluations of the disease incidence. If the evaluation period is well defined, sometimes can be used at least two evaluations to offer most of the pieces of information resulted from the calculations of AUDPC (M. J. JEGER, S. L. H. VILJANEN – ROLLINSON, 2000). Thus, in the calculation AUDPC are introduced all the data from the appearance of the pathogen in crop till to the end of the epidermis, there being added the number of the days among the observations. The progress of the disease for the 13 varieties analysed as AUDPC values is presented in Table 1.

The average value of AUDPC was 1162.2. The lowest level of AUDPC was determined in Kalango variety respectivelly 917.28, and the highest in the Centauro (1370,56). Some varieties had AUDPC values greater than 1300, respectivelly Renano and Normanno varieties. There was noticed that from the point of view of the AUDPC, the most attacked variety Centauro, not the control Apache. This was happened because the attack intensity at the first observation was greater in the case of Centauro (19%) in comparison with Apache that has been attacked with an intensity of 8.33%.

Table 2

The area under the disease progress curve (AUDPC) in a comparative trial of winter wheat attacked by *Drechslera tritici – repentis* fungus in 2011

No.	Variety	AUDPC	Diferența față de:		Significance of the difference in comparison with:	
			control	Average	control	average
1	Apache (martor)	1333.28	-	171.12	-	-
2	Esperia	959.84	-373.44	-202.32	00	-
3	Bilancia	1087.84	-245.44	-74.32	-	-
4	Normanno (durum)	1306.56	-26.72	144.4	-	-
5	Centauro	1370.56	37.28	208.4	-	-
6	Sagittario	1189.28	-144.00	27.12	-	-
7	Alcione	1274.56	-58.72	112.4	-	-
8	Maestrale (durum)	1237.28	-96.00	75.12	-	-
9	Azimut	954.56	-378.72	-207.6	00	-
10	Renan	1359.84	26.56	197.68	-	-
11	Karolinum	1109.28	-224.00	-52.88	-	-
12	Kalango	917.28	-416.00	-244.88	00	-
13	Soissons	1008.00	-325.28	-154.16	0	-
	Average	1162.166				
LSD 5% = 251.391; LSD 1% = 341.697; LSD 0.1% = 457.630						

The statistical analysis of AUDPC values shows that the differences in comparison with the control have been significantly negative for the variety Soissons (Table 2). In comparison with the experience average the differences are insignificant from statistical point of view. The great values of AUDPC are in close relationship with the virulence values registered in the comparative trial. The agressivity of the fungus was maximal in 2011. The primary infections are injuring the young plants being able to affect the harvest (K. H. WRIGHT *et* J. C. SUTTON, 1990). In the conditions of the climate from Banatului Plain the fungus *Pyrenophora tritici – repentis* (PTR) appears early in crops, sometimes even at the beginning of April, than advancing rapidly at the leaves from the upper levels, mainly during the maturation of the grain (R. G. REES şi G. J. PLATZ, 1983). All the varieties from the comparative trial have manifested increased sensitivity to the attack of the fungus, mostly the Italian ones. The 13 monitored varieties are highly productive and often cultivate in Banatului Plain, but they are manifesting high sensitivity to this pathogen of the cereals, there being necessary to apply treatments for the disease control.

CONCLUSIONS

1. The great values of AUDPC for the 13 analysed winter wheat varieties are evidencing the great virulence of the pathogen *Drechslera tritici-repentis* in 2011;
2. The variance analysis shows negative differences of the AUDPC values for the varieties Esperia, Azimut and Kalango; the differences are insignificant in comparison with the average of the experience;
3. None varieties has manifested resistance for the attack of the *Pyrenophora tritici repentis* fungus for the climatic conditions of the spring of 2011, with strong alternances among the rainy days, cool and dry.

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