EVALUATION OF SOME WHEAT VARIETIES BEHAVIOR TO INFECTION WITH *TILLETIA CARIES* (D.C.) TUL.

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Abstract

Common bunt caused by *Tilletia* genus species (*T. caries and T. foetida*) is one of the most damaging diseases of wheat. Recent climate change led to a series of changes in the lifecycle of pathogens, with repercussions on the intensity of the attack and to the manifestation period of the attack.

The paper presents results regarding the resistance of 24 wheat varieties, domestic or imported to the *Tiletia caries* attack. The trial was conducted at Ezareni Didactic Farm from Didactic Station of the University of Agricultural Sciences and Veterinary Medicine in Iasi, between 2011-2014 period. The experiment was designed by the block method in four repetitions.

Wheat kernels were artificially infected with spores of *Tilletia caries* and during the growing season determinations were made on the number of tillers, the plant height and the number of kernels per wheat ear for each variety. Different climatic conditions recorded during the 3 years and also the diversity of the studied cultivars led to differences between the infected varieties and the control.

Key words: common bunt, wheat, behaviour, artificial infection.

Wheat (*Triticum aestivum* L.) has a particular importance in human nutrition which is why this culture is extended on all continents. In Romania wheat crop cover around 2.35 million hectares, wich represent 25% of the total arable acreage and 40% of the total cereals acreage (Cociu Al. I. and Eliana Alionte, 2013). Among the pathogens that cause disease in wheat, fungal species that attacks the ear shows the highest value.

Wheat common bunt is a disease caused by two species of *Tilletia* (*Tilletia tritici* (Bjerk.) Wint. (syn. *T. caries* (DC) Tul) and *T. laevis* Kuhn (syn. *T. levis*, *T. foetida* (Wallr.) Liro, *T. foetens* (Berk. & Curt.) Schoert.) and can be transmitted through infected seed or spore contaminated soil (Mirjana Koprivica *et al*., 2009). Although there are now many fungicides for combating pathogens that attack wheat, given the large area that this plant is grown on and the additional expenses necessary for the treatments a permanent research regarding the resistance to the *Tilletia* sp. attack is required.

Acording to Fraga and Saulescu (2008) genetic resistance is the most convenient way of controlling the disease, as it reduces both costs and environmental impact. However, bunt has been known for its high ability to overcome resistance by new, more aggressive races, prompting continuous search for genetic diversity of resistance. Wheat varieties cultivated in our country have differentiated behavior to diseases especially in the context of climate change (Man S., 2012).

MATERIAL AND METHOD

Plant material

The biological material used is represented by a total of 24 varieties of wheat, 5 of them are indigenous varieties, the others being imported. Kernels were artificially infected with the teliospores of *Tilletia caries* (D.C.) Tul.. Subsequently, they were sown in the experience, located at Ezareni Didactic Farm from Didactic Station of the University of Agricultural Sciences and Veterinary Medicine in Iasi.

Artificial inoculation of wheat

In order to achieve the artificial infection of the 24 wheat plants 0.1 g spores of *Tilletia caries* (D.C.) Tul. were used for 250 healthy wheat caryopses. The samples were continuously mixed for 1 minute in Erlenmayer type flasks (Veronika Dumalasová şi P. Bartoš, 2010) after which they were sown according to the wheat technology culture.

Field management

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The experiment was performed in four repetitions block method, and the size of a parcel was 1.5 x 1.2 m with a total area of 1.8 m^2. On the surface of the plots 10 rows of wheat were planted at a distance of 12.5 cm between rows.

Statistical analysis

Biometric measurements on morphological characters (plant height, number of siblings and number of kernels) were performed in triplicate, for the results to be statistically processed. In order to check the significant differences between the infected variants and the control for each variety the t test for paired samples was used (Paired t test, alpha ≤ 0.05), and the statistically analysis were performed using the software SPSS 21.0.

RESULTS AND DISCUSSION

Weather characteristics during the 2011-2014

The averages trend on annual climatic conditions during the three years is shown graphically in figures 1-4. During the growing season of the 2011-2012 agricultural year, from September until August the following year, the highest temperature was registred in July, 25.5°C with a deviation of 4.2°C from the annual average.

In the crop year of 2012-2013 the average annual temperature recorded 10.40C value having a positive deviation of 0.9°C from the annual average. During the growing season, the highest temperatures were in the range from April to June with positive values from the annual average, except for July was negative deviation. The average annual temperature in crop year of 2013-2014 was 10.7°C with positive deviation from the annual average of 1.2 °C temperatures.

Analysing the annual average temperature it is observed that in 2013/2014 there were the higest temperatures with a great variation of the temperature throughout the year and the biggest difference between the maximum and minimum temperature (*figure 1*and *figure 2*).

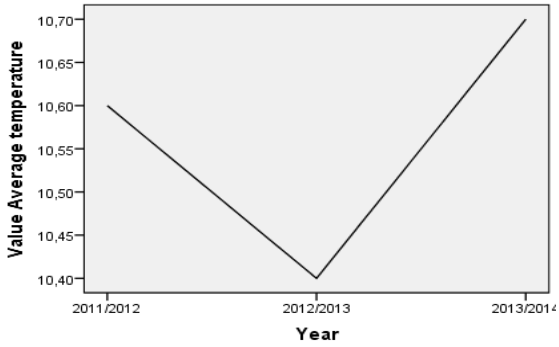

Figure 1 **Evolution of annual average temperature during 2011-2014 period (T°)**

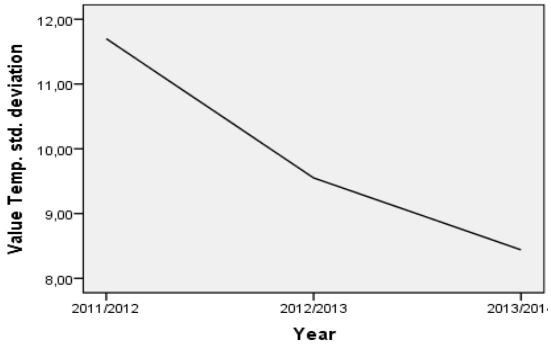

Figure 2 **Evolution of the square variation temperature average during 2011-2014 period (T°)**

The lowest annual average temperature amplitude variation from the annual average was recorded in the year of 2012-2013 (*figure 3*). Precipitations from the crop year of 2011-2012 recorded the lowest amount of rainfall, which means that this year was the driest of the three under study.

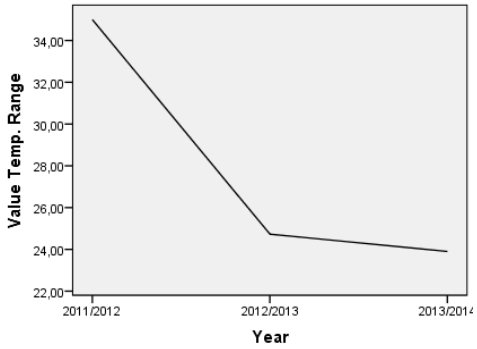

Figure 3 **Evolution of the amplitude temperature variation during 2011-2014 period (T°)**

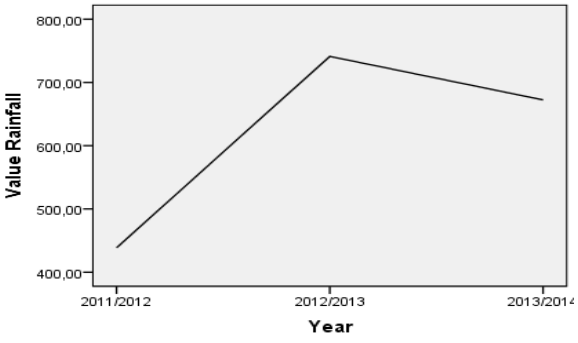

Figure 4 **Evolution of the annual rainfall amount during 2011-2014 (mm)**

The analysis of the climatic conditions indicates that the 2012-2013 crop year showed the average annual value closer to the multi-temperature and the annual rainfall were the highest (*figure 4*). The agricultural year of 2013-2014 could be considered favorable for wheat

crop in terms of climate, temperature variation amplitude was very small compared to the annual average and annual rainfall of 154.6 mm multi exceed the amount.

Morphological Parameters

Number of kernels per wheat ear is an important component of yield. Change in number of kernels per wheat ear drastically influences the final yield. According to Borojević (1963), number of kernels per wheat ear is a hereditary character of a variety that shows a large phenotypic variability.

Studies mention that the disease caused by the pathogen *Tilletia caries* (DC.) Tul inlfluence a number of morphological characteristics of the plants such as plant height, number of kernels per wheat ear and the degree of twinning (Dumalasova V, Bartos P, 2007). The number of kernels / wheat ear is the most important component of wheat production, thus reducing the number of kernels/ wheat ear can drastically affect the production (Rade Protić, Goran Todorović, Nada Protić, and Dušica Delic, 2012). According to Borojevic's research (1963), on the number of kernels/wheat ear there is a hereditary character of variety showing a very high phenotypic variability. In the international and national there have not been great amount of studies regarding the influence of *Tilletia caries* (DC.) Tul. on the number of wheat ear kernels to attacked plants. This morphological change was mentioned by Lucretia Dumitras (1991) on *Tilletia controversa* Khün in a paper were are described *Tilletia* species found in Romania.

Table 1

Grain number per spike of wheat varieties artificially inoculated with *Tilletia caries* (DC.) Tul. (2011/2012, 2012/2013 and 2013/2014)

Cultivar	Average no. of tillers - inoculated plants			Average no. of tillers – control			Difference (%)			t	df	Sig. (2-tailed)
	11/12	12/13	13/14	11/12	12/13	13/14	11/12	12/13	13/14			
Accor	3.9	4.1	3.7	3.6	3.1	2.6	0.2	1.0	1.1	2.898	2	.101
Andalou	3.3	4.1	3.6	2.6	3.2	2.6	0.6	0.9	1.0	7.774	2	.016*
Antonius	3.5	3.9	4.1	3.2	3.0	3.6	0.2	0.9	0.4	2.906	2	.101
Ariesan	3.5	3.8	3.2	3.2	2.8	3.2	0.3	0.9	0.0	1.486	2	.276
Arlequin	4.4	4.0	4.3	4.0	3.6	4.0	0.4	0.3	0.3	18.084	2	.003*
Arrezo	3.8	4.1	4.0	3.0	3.3	2.6	0.8	0.8	1.3	6.204	2	.025*
Bitop	3.1	4.0	3.0	2.5	3.4	2.4	0.5	0.5	0.5	48.497	2	.000*
Boema	3.3	4.0	3.3	3.1	3.2	2.7	0.2	0.7	0.6	3.418	2	.076
Capo	3.2	3.9	3.6	2.5	3.0	2.3	0.6	0.9	1.3	5.405	2	.033*
Crina	3.8	4.2	3.8	3.2	3.3	3.3	0.5	0.8	0.5	6.409	2	.023*
Dropia	3.4	3.6	3.9	3.0	3.0	2.6	0.4	0.6	1.2	3.122	2	.089
Exotic	3.8	3.8	3.8	3.1	3.0	3.0	0.7	0.8	0.8	18.538	2	.003*
Gk Kalasz	3.6	4.1	3.0	3.2	3.1	2.5	0.4	1.0	0.4	3.119	2	.089
Glosa	2.8	3.6	3.6	2.5	3.0	2.0	0.3	0.6	0.5	5.049	2	.037*
Gruia	3.7	3.6	4.0	3.2	3.0	3.2	0.5	0.6	0.7	9.131	2	.012*
Joseph	3.0	4.1	3.2	2.3	3.6	2.3	0.7	0.4	0.8	5.787	2	.029*
Kiskun gold	3.5	3.9	4.0	3.2	3.0	3.2	0.2	0.9	0.7	3.441	2	.075
Kiskun serina	3.3	4.1	3.4	2.4	3.4	2.3	0.8	0.7	1.1	8.500	2	.014*
Midas	3.1	4.1	3.8	2.6	3.5	2.4	0.5	0.6	1.4	2.976	2	.097
Potential	3.9	4.0	4.0	3.2	3.7	3.6	0.6	0.3	0.3	4.183	2	.053*
Primmo	3.9	3.9	4.1	3.0	3.2	3.3	0.9	0.7	0.7	16.798	2	.004*
Seconzar	3.5	5.0	3.6	3.0	3.6	3.0	0.5	1.3	0.6	3.269	2	.082
So 207	4.5	4.0	4.6	3.3	3.8	4.0	1.2	0.1	0.6	2.253	2	.153
Sorrial	3.6	4.3	3.3	3.3	3.5	2.7	0.3	0.8	0.5	3.833	2	.062

Table 2

Effect of *Tilletia caries* (DC.) Tul. on the number of tillers in 2011-2014 period

Paired Samples Test							
Cultivar			Paired Differences		t	df	Sig. (2-tailed)
			95% Confidence Interval of the Difference				
			Lower	Upper			
ACCOR	Pair 1	control - infected	-24.06001	43.40001	1.234	2	.343
ANDALOU	Pair 1	control - infected	-9.76662	12.73996	.568	2	.627
ANTONIUS	Pair 1	control - infected	-19.14867	17.50200	-.193	2	.865
ARIESAN	Pair 1	control - infected	-24.56598	33.24598	.646	2	.585
ARLEQUIN	Pair 1	control - infected	-16.89775	33.78442	1.434	2	.288
ARREZO	Pair 1	control - infected	-34.54029	29.24696	-.357	2	.755
BITOP	Pair 1	control - infected	-.23446	5.78112	3.967	2	.058
BOEMA	Pair 1	control - infected	-15.37282	20.40616	.605	2	.607
CAPO	Pair 1	control - infected	-27.83077	15.65743	-1.204	2	.352
CRINA	Pair 1	control - infected	-7.55793	18.20460	1.778	2	.217
DROPIA	Pair 1	control - infected	-18.25100	41.76433	1.686	2	.234
EXOTIC	Pair 1	control - infected	-8.50448	14.62448	1.138	2	.373
GK KALASZ	Pair 1	control - infected	-7.62075	11.00075	.781	2	.517
GLOSA	Pair 1	control - infected	-9.89115	24.91115	1.857	2	.204
GRUIA	Pair 1	control - infected	-1.58264	6.32930	2.581	2	.123
JOSEPH	Pair 1	control - infected	-16.16974	22.78307	.730	2	.541
KISKUN GOLD	Pair 1	control - infected	-18.24267	8.38934	-1.592	2	.252
KISKUN SERINA	Pair 1	control - infected	-13.25844	17.51177	.595	2	.612
MIDAS	Pair 1	control - infected	-6.09521	12.48855	1.480	2	.277
POTENTIAL	Pair 1	control - infected	-14.74249	19.74916	.625	2	.596
PRIMMO	Pair 1	control - infected	-10.38787	22.63454	1.596	2	.252
SECONZAR	Pair 1	control - infected	-8.38541	6.80541	-.448	2	.698
SO 207	Pair 1	control - infected	-29.43079	18.55079	-.976	2	.432
SORRIAL	Pair 1	control - infected	-16.92091	25.30757	.855	2	.483

*Note: *α=0,05 => Statistically significant differences* (5%)
*Note: *α=0,05=> Statistically significant differences (5%)*
*** 11/12, 12/13, 13/14 = Year of study*

Veronika Dumalasová and Bart (2007) in experiments on the artificial infection with *Tilletia caries* (DC.) Tul., conducted in 2005-2007 period have noticed a number of tillers increasing of 2.0% to 24.0%. The number of tillers increasing is a side effect of *Tilletia caries*, DC.) Tul. infection and this modification is signaled by other authors such as Fischer and Holton (1957).

In our research, the number of tillers ranged from 2.8 to 5 tillers/plant on the infected variants and 2-4 tillers/plant on the control. Even though the number of tillers was higher on the infected variants for all the cultivars, these differences are statistically insured only for Andalou, Arlequin, Arrezo, Bitop, Capo, Crina, Exotic, Glosa, Gruia, Joseph, Kiskun Serina and Potential varieties (*table 2*).

Significant differences regarding the plants height were noticed, between the infected variants and the control, only on five varieties. For the other varieties, however, this difference is insignificant, for a 5% risk. Although the plant height of all the cultivars from the control is higher than the infected plants the registred differences are statistically significant only for varieties Exotic, Joseph, Kiskun Gold, Midas and Potential (*table 3*).

Table 3

Effect of *Tilletia caries* (DC.) Tul. on the plant height in 2011-2014 period

Paired Samples Test												
Cultivar	Average plant.height – control (cm)			Average no. of tillers - inoculated plants (cm)			Difference (%)			t	df	Sig. (2-tailed)
	11/12	12/13	13/14	11/12	12/13	13/14	11/12	12/13	13/14			
Accor	54.50	62.50	53.20	50.50	53.96	51.50	0.07	0.14	0.03	2.362	2	.142
Andalou	50.42	58.92	58.20	47.51	60.46	46.60	0.06	-0.03	0.20	1.120	2	.379
Antonius	84.65	93.33	64.80	55.66	82.13	62.60	0.34	0.12	0.03	1.795	2	.214
Ariesan	60.01	83.25	67.40	59.03	59.03	59.03	0.02	0.18	0.18	2.198	2	.159
Arlequin	55.63	64.33	47.60	46.53	60.29	47.40	0.16	0.06	0.00	1.725	2	.227
Arrezo	55.45	65.50	59.40	50.48	57.25	58.40	0.09	0.13	0.02	2.261	2	.152
Bitop	68.31	74.00	59.40	55.58	72.75	59.20	0.19	0.02	0.00	1.178	2	.360
Boema	55.50	73.25	52.00	52.50	58.46	48.60	0.05	0.20	0.07	1.827	2	.209
Capo	68.08	75.75	60.40	53.30	57.67	59.26	0.22	0.24	0.02	2.186	2	.160
Crina	47.36	76.58	69.80	45.50	59.63	56.80	0.04	0.22	0.19	2.347	2	.143
Dropia	56.20	74.75	62.60	54.20	56.63	59.60	0.04	0.24	0.05	1.478	2	.278
Exotic	55.62	61.83	53.80	41.78	53.83	44.20	0.25	0.13	0.18	6.015	2	.027*
Gk kalasz	63.16	67.25	47.40	48.38	63.08	43.46	0.23	0.06	0.08	2.134	2	.166
Glosa	52.43	71.08	62.40	51.70	59.08	60.20	0.01	0.17	0.04	1.407	2	.295
Gruia	51.51	67.17	69.20	48.55	60.50	54.80	0.06	0.10	0.21	2.377	2	.141
Joseph	66.44	84.50	64.60	60.15	72.79	56.80	0.09	0.14	0.12	5.325	2	.034*
Kiskun gold	62.20	65.50	70.60	50.90	55.83	54.73	0.18	0.15	0.22	6.618	2	.022*
Kiskun serina	64.06	68.92	67.60	53.60	63.96	64.50	0.16	0.07	0.05	2.794	2	.108
Midas	63.53	78.92	63.20	51.93	69.08	57.80	0.18	0.12	0.09	4.850	2	.040*
Potential	60.12	74.17	58.00	48.88	66.00	48.40	0.19	0.11	0.17	10.903	2	.008*
Primmo	54.63	67.75	51.20	48.00	55.83	51.00	0.12	0.18	0.00	1.844	2	.206
Seconzar	99.80	104.33	102.00	71.85	99.92	77.80	0.28	0.04	0.24	2.582	2	.123
So 207	68.58	54.60	56.24	49.20	53.38	51.60	0.13	0.22	0.05	2.345	2	.144
Sorrial	56.04	59.67	47.40	45.20	56.00	46.20	0.19	0.06	0.03	1.811	2	.212

*Note: *α=0,05=> Statistically significant differences (5%)*

*** 11/12, 12/13, 13/14 = Year of study*

In general, given agricultural year 2011-2012 and 2013-2014 there was a downward trend on plant height attacked by *Tilletia caries* (DC.) Tul. to those from the control.

CONCLUSIONS

During the 3-years of study were observed statistically significant differences on a few side effects of *Tilletia caries* (DC.) Tul. attack such as the number of kernels/wheat ear, number of tillers and plant height.

Climate changes that involve high temperatures in the autumn and low rainfall adversely affect plant growth, favoring the fungi from the genus *Tilletia* and practically contribute to extending the sensitivity of the wheat plants that sometimes overstays the period with fungicidal coating solution .

For all the studied cultivars from the infected variant the number of kernels/wheat ear was greatest than the control but the results are not statistically ensured.

Observations reagarding the number of tillers confirm the results from the literature so the number of tillers was higher on the infected variant and varieties as Andalou, Arlequin, Arrezo, Bitop, Capo, Crina, Exotic, Glosa, Gruia, Joseph, Kiskun Serina and Potential had a statistical significance.

Regarding the plants height attacked by *Tilletia caries* (DC.) Tul. were also obtained data according to the literature particularly on Exotic, Joseph, Kiskun Gold, Midas and Potential varieties.

ACKNOWLEDGEMENTS

This paper was published under the frame of European Social Fund, Human Resources Development Operational Programme 2007-2013, project no. POSDRU/159/1.5/S/132765. Also with the the Funding research projects contract – no. 5529/25.04.2013, USAMV "Ion Ionescu de la Brad" from Iasi.

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