RESULTS CONCERNING THE ATTACK OF THE FUNGUS *USTILAGO MAYDIS* IN ALMAJULUI DEPRESSION

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Abstract: *Research aim was to test the tolerance of a range of maize hybrids to infectious pressure of the pathogen Ustilago maydis in climatic conditions from Timisoara Didactic Research Station. Stage of research is being characteristic for partial interpretation of experimental data after the first experimental year, in preparation the doctoral thesis. Experimental field was located in climatic conditions of Timisoara Didactic Research Station. Technology was the standard applied to this area. The experience was bifactorial. First factor was the hybrid grown with six graduations, provenance hybrids was Monsanto with different vegetation periods, (DKC 3511, DKC 4626, DKC 4964, DKC 4983, DKC 5783 and DKC 5170). Factor B was the amount of nitrogen applied to three graduations (N_0, N_{100} and N_{200}) all three doses were applied on a constant background elements of $P_{80}K_{80}$. The novelty is relatively high, work providing important data for agricultural practice from hybrids point of view for the experimental area. Achievements stage in this field. In this work were carried out research including one of authors, known as the reference and possible reactions of the pathogen depending on local biocoenosis factors. Limits of the research are that data from the fungus Ustilago maydis are just after two years of pathogen bonitation. Practical implications of the research consisted of playing a part of a complex study of strategy in the protection of maize reference experience. The originality of the work comes from the fact that data are relevant in view of uniformity of hybrid origin, these data are only part of the data submitted for interpretation in the preparation of the PhD thesis of the main author. Importance of the paper became from bringing in front of the specialists of one of the topics in the experiences of the author's doctoral preparing, to evaluate the accuracy of techniques addressed. The relevance of data, experimental results give an overview of pathogen behavior in relation to hybrids experienced by groups of precocity.*

Key words: *Ustilago maydis, plant tolerance, nitrogen amount*

INTRODUCTION

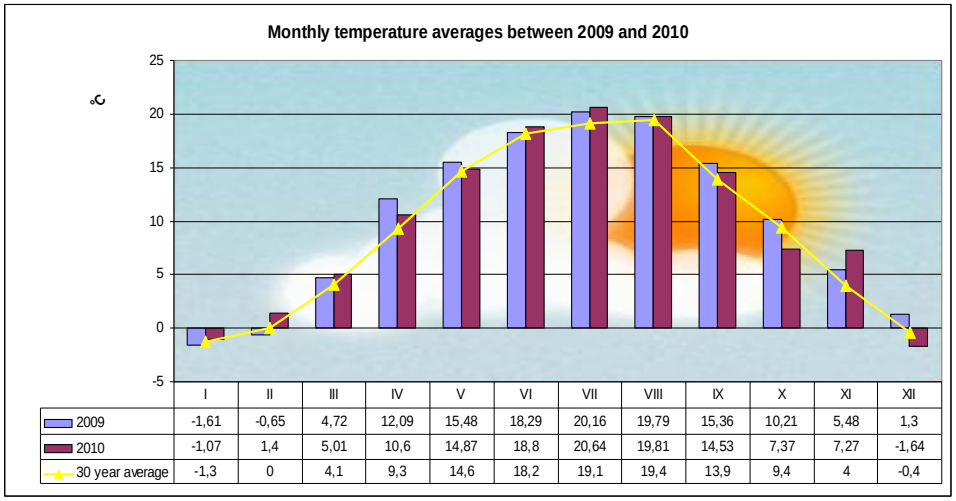
Between July and August of the years 2009 and 2010 there was carried out a number of observations in the maize experimental of field crops from Almaj Valley. It was very interesting to see the differences between hybrids to the attack of fungus *Ustilago maydis* and, the fact that it may be interesting as information's for other researchers and farmers is the reason of the present paper with experimental results from phd experiment year.

MATERIAL AND METHODS

Experimental conditions where those from the city region Bozovici from Almaj Valley. In the figures below are described temperature (figure 1) and rain (figure 2) between 2009 and 2010 the multiannual average for this two whether parameters available for the experimental field.

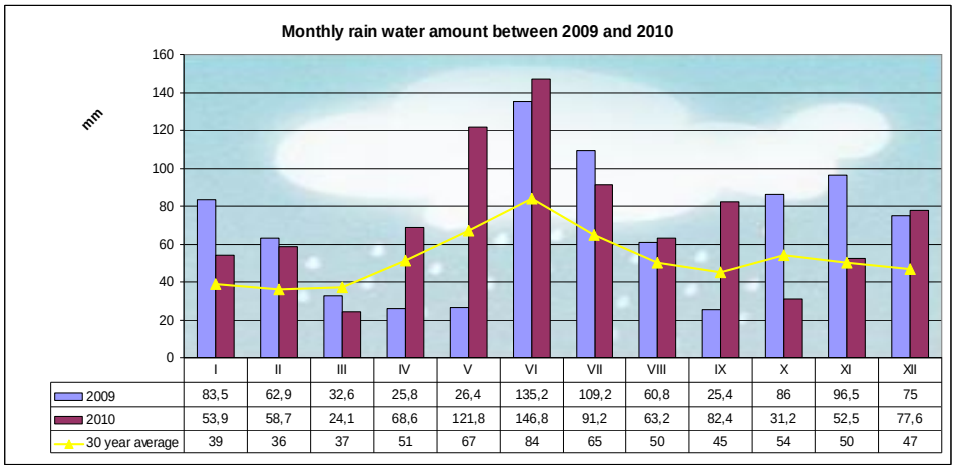
The purpose of this study was to see the behavior of a large assortment of hybrids to infection with common smut of maize (*Ustilago maydis*) under natural conditions from Almaj Valley. Over the field observations the frequency of attack, intensity of attack at corn cobs and on the base of those data it was calculated the attack degree as synthetic indicator performed statistic interpretation after the method for one factor experiments.

Biological material consist from the following hybrids DKC 3511, 4626 DKC, DKC 4964, DKC 4983, DKC 5783 and DKC 5170. Statistic calculations was done only for attack degree because it is a synthetic indicator of both, frequency and intensity of fungus *Ustilago maydis* attack. Method for statistic calculation and interpretation is the classic method for three factor experiences.



	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2009	-1,61	-0,65	4,72	12,09	15,48	18,29	20,16	19,79	15,36	10,21	5,48	1,3
2010	-1,07	1,4	5,01	10,6	14,87	18,8	20,64	19,81	14,53	7,37	7,27	-1,64
30 year average	-1,3	0	4,1	9,3	14,6	18,2	19,1	19,4	13,9	9,4	4	-0,4

Figure 1. Monthly temperature averages, compared with long term averages recorded at Bozovici Meteorological Station



	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2009	83,5	62,9	32,6	25,8	26,4	135,2	109,2	60,8	25,4	86	96,5	75
2010	53,9	58,7	24,1	68,6	121,8	146,8	91,2	63,2	82,4	31,2	52,5	77,6
30 year average	39	36	37	51	67	84	65	50	45	54	50	47

Figure 2. Monthly rainfall water amount, compared with long term averages recorded at Bozovici Meteorological Station

It was preferred as witness for results interpretation the experimental average because only on this way we can see the real tendency of maize hybrids behavior on fungus *Ustilago maydis* attack.

RESULTS AND DISCUSSIONS

The results of the observations concerning attack frequency and intensity from the field are in table 1. Based on these observations there was calculate the attack degree as synthetic indicator, figures of this parameter is also in table 1. Because the attack degree is a synthetic indicator of attack frequency and intensity of attack we will refer at it for statistic calculation.

Tabel 1.

Field readings for frequency and intensity and calculated attack degree of fungus *Ustilago maydis* between 2009 and 2010

Anul	Hibridul	Agrofondul	Frecvența (%)				Intensitatea (%)				Gradul de atac			
			R1	R2	R3	x	R1	R2	R3	x	R1	R2	R3	x
2009	DKC 3511	$N_{100}P_{80}K_{80}$	15	25	10	16,66	1	5	5	3,66	0,15	1,25	0,5	0,63
		$N_{150}P_{80}K_{80}$	20	15	35	23,33	15	10	5	10	3	1,5	1,75	2,08
		$N_{200}P_{80}K_{80}$	20	25	25	23,33	10	20	15	15	2	5	3,75	3,58
	DKC 4626	$N_{100}P_{80}K_{80}$	15	10	10	11,66	5	10	10	8,33	0,75	1	1	0,91
		$N_{150}P_{80}K_{80}$	10	15	5	10	15	5	15	11,66	1,5	0,75	0,75	1
		$N_{200}P_{80}K_{80}$	25	15	20	20	20	15	25	20	5	2,25	5	4,08
	DKC 4964	$N_{100}P_{80}K_{80}$	10	20	5	11,66	20	10	15	15	2	2	0,75	1,58
		$N_{150}P_{80}K_{80}$	15	25	20	20	10	20	25	18,33	1,5	5	5	3,83
		$N_{200}P_{80}K_{80}$	20	30	30	26,66	25	20	30	25	5	6	9	6,66
	DKC 4983	$N_{100}P_{80}K_{80}$	15	5	10	10	5	5	10	6,66	0,75	0,25	1	0,66
		$N_{150}P_{80}K_{80}$	25	10	10	15	20	10	10	13,33	5	1	1	2,33
		$N_{200}P_{80}K_{80}$	20	20	25	21,66	20	30	20	23,33	4	6	5	5
	DKC 5170	$N_{100}P_{80}K_{80}$	5	5	10	6,66	2	5	5	4	0,1	0,25	0,5	0,28
		$N_{150}P_{80}K_{80}$	30	20	20	23,33	5	15	10	10	1,5	3	2	2,16
		$N_{200}P_{80}K_{80}$	20	35	30	28,33	15	20	15	16,66	3	7	4,5	4,83
	DKC 5183	$N_{100}P_{80}K_{80}$	3	5	5	4,33	5	10	5	6,66	0,15	0,5	0,25	0,3
		$N_{150}P_{80}K_{80}$	25	10	20	18,33	20	10	15	15	5	1	3	3
		$N_{200}P_{80}K_{80}$	10	20	25	18,33	15	25	15	18,33	1,5	5	3,75	3,41
2010	DKC 3511	$N_{100}P_{80}K_{80}$	25	25	20	23,33	5	10	5	6,66	1,25	2,5	1	1,58
		$N_{150}P_{80}K_{80}$	35	20	25	26,66	15	10	15	13,33	5,25	2	3,75	3,66
		$N_{200}P_{80}K_{80}$	25	35	30	30	15	15	15	15	3,75	5,25	4,5	4,5
	DKC 4626	$N_{100}P_{80}K_{80}$	20	15	15	16,66	5	10	5	6,66	1	1,5	0,75	1,08
		$N_{150}P_{80}K_{80}$	20	20	15	18,33	15	10	15	13,33	3	2	2,25	2,41
		$N_{200}P_{80}K_{80}$	20	15	20	18,33	20	15	30	21,66	4	2,25	6	4,08
	DKC 4964	$N_{100}P_{80}K_{80}$	15	10	10	11,66	5	5	10	6,666	0,75	0,5	1	0,75
		$N_{150}P_{80}K_{80}$	15	20	20	18,33	15	15	12	14	2,25	3	2,4	2,55
		$N_{200}P_{80}K_{80}$	25	20	20	21,66	30	25	25	26,66	7,5	5	5	5,83
	DKC 4983	$N_{100}P_{80}K_{80}$	5	15	15	11,66	15	10	15	13,33	0,75	1,5	2,25	1,5
		$N_{150}P_{80}K_{80}$	10	20	15	15	25	20	15	20	2,5	4	2,25	2,91
		$N_{200}P_{80}K_{80}$	15	15	25	18,33	25	20	35	26,66	3,75	3	8,75	5,16
	DKC 5170	$N_{100}P_{80}K_{80}$	15	10	15	13,33	5	15	15	11,66	0,75	1,5	2,25	1,5
		$N_{150}P_{80}K_{80}$	15	15	15	15	15	10	20	15	2,25	1,5	3	2,25
		$N_{200}P_{80}K_{80}$	25	15	20	20	20	25	20	21,66	5	3,75	4	4,25
	DKC 5183	$N_{100}P_{80}K_{80}$	5	15	5	8,333	15	15	25	18,33	0,75	2,25	1,25	1,41
		$N_{150}P_{80}K_{80}$	20	15	25	20	25	15	15	18,33	5	2,25	3,75	3,66
		$N_{200}P_{80}K_{80}$	25	15	25	21,66	20	15	20	18,33	5	2,25	5	4,08
	Media hibrizilor	$N_{100}P_{80}K_{80}$	12,33	13,33	10,83	12,16	7,33	9,16	10,41	8,972	0,76	1,25	1,04	1,01
		$N_{150}P_{80}K_{80}$	20	17,08	18,75	18,61	16,25	12,5	14,33	14,36	3,14	2,25	2,575	2,65
		$N_{200}P_{80}K_{80}$	20,83	21,66	24,58	22,36	19,58	20,41	22,08	20,6	4,12	4,39	5,35	4,62

Differences between years 2009 and 2010 from the weather conditions point of view, consist from lower temperature averages and higher rain amount in 2010 than those from 2009. This rule has an exception for rain water amount in July when there was 40 mm of rain in 2009 and only 24,7 mm in 2010, but this rule exception did not influenced the *Ustilago maydis* attack parameters. It is a really obvious after bonitation figures from table 1, that in 2009 frequency and intensity of attack registered lower values, but this situation was corrected in 2010 when the rain amount during summer month, except July, raise the attack parameters. This evolution is reflected in the attack degree values trend. As it can be seen in table 2, the year 2010 was much more favorable for fungus *Ustilago maydis.* attack on maize cobs than year 2009, this was marked by statistic calculation with a very significant difference on attack degree analyze.

Hybrids has shown over the two years results, the real potential of their tolerance at

pathogen attack. This conclusion is bolded by the climate differences between 2009 and 2010. Under this conditions the results shown in table 2 point out that DKC 4626 is the most tolerant hybrid at *Ustilago maydis* attack, with a very significant negative difference to control, the experimental average for this factor. The next hybrids that we can consider tolerant to pathogen attack where DKC 5170 with a distinctly significant negative difference to control and 5183 with a significant negative difference to control.

Table 2

Statistic interpretation data for attack degree of fungus *Ustilago maydis between 2009-2010*

Factor A Year	Factor B Hibrid	Factor C- Fertilizers			Averages of Factor A	Differences	Signif
		N_{100} P_{80} K_{80}	N_{150} P_{80} K_{80}	N_{200} P_{80} K_{80}			
2009	DKC 3511	0,63	2,08	3,58	2,57	-0,19	000
	DKC 4626	0,91	1	4,08			
	DKC 4964	1,58	3,83	6,66			
	DKC 4983	0,66	2,33	5,0			
	DKC 5170	0,28	2,16	4,83			
	DKC 5183	0,3	3,0	3,41			
2010	DKC 3511	1,58	3,66	4,5	2,95	0,19	***
	DKC 4626	1,08	2,41	4,08			
	DKC 4964	0,75	2,55	5,83			
	DKC 4983	1,5	2,91	5,16			
	DKC 5170	1,5	2,25	4,25			
	DKC 5183	1,41	3,66	4,08			
Averages	DKC 3511	1,105	2,87	4,04	2,76	Control	
	DKC 4626	0,995	1,705	4,08			
	DKC 4964	1,165	3,19	6,245			
	DKC 4983	1,08	2,62	5,08			
	DKC 5170	0,89	2,205	4,54			
	DKC 5183	0,855	3,33	3,745			

DL 5% = 0,4 DL 1% = 0,6 DL 0,1% = 0,8

Factor B - Fertilizers	DKC 3511	DKC 4626	DKC 4964	DKC 4983	DKC 5170	DKC 5183	Average
Averages of Factor B	2,67	2,26	3,53	2,92	2,54	2,64	2,76
Differences	-0,09	-0,50	0,77	0,16	-0,21	-0,12	Control
Significance	-	000	***	*	00	0	-

DL 5% = 0,1 DL 1% = 0,2 DL 0,1% = 0,3

Factor C Fertilizers (kg/ha)	N_{100} P_{80} K_{80}	N_{150} P_{80} K_{80}	N_{200} P_{80} K_{80}	Average
Averages of Factor B	1,015	2,65	4,62	2,76
Differences	-1,74	-0,11	1,86	Control
Significance	000	-	***	-

DL 5% = 0,14 DL 1% = 0,18 DL 0,1% = 0,23

On the other side we can say that the hybrids DKC 4964 with a very significant difference to control prove to be very sensitive to *Ustilago maydis.* Also the hybrid DKC 4983 is sensible to pathogen attack because he registered a significant difference to control. As it can be seen, the results point out that on the modern hybrids the tolerance reaction at *Ustilago maydis* is not influenced by the precocity groups. This is proved by behavior of hybrids DKC 4626 and DKC 5170 which are from different precocity groups, but they have almost the same tolerance reaction at fungus *Ustilago maydis.*

Regarding at the hybrids behavior to different nitrogen amount, comparing with the the experimental average of this factor, the statistic results show that the increase of dosage at has as effect the increase of plants sensitivity to pathogen attack. The higher values of attack frequency and intensity was in the variants where there was applied the largest amount of nitrogen, 200 kg nitrogen per hectare, and as becomes from table 2 the attack degree of fungus *Ustilago maydis* has a very significant difference to control. Also from the table 2 figures, a dosage of only 100 kg/ha nitrogen has a very good effect on plants tolerance at fungus attack.

CONCLUSIONS

- The frequency and intensity of fungus *Ustilago maydis* attack have a very high variation on all hybrids, some of them as DKC 5170 and DKC 4626 prove to have relatively high tolerance to this fungus, even under conditions when the technology and natural factors stimulate the fungus attack.
- From the tested hybrids, DKC 4964(with a very significant differences to control) and DKC 4983(with significant differences to control) prove to be sensitive to *Ustilago maydis* attack.
- In both experimental years, there was an extension of the period of maximum sensitivity of plants (between period when stigmata are visible and the moment when kernels are in milk stage) to *Ustilago maydis* attack in the variants where was applied higher nitrogen amounts due to effect of nitrogen on plant phisiology.
- Regarding to the effect of nitrogen, it is very clear that the incresing of nitrogen dosage conduct to an increase of attack degree wich registry very significant negative value of difference on the nitrogen amount of 100 kg/ha and a very significant difference on the nitrogen amount of 200 kg/ ha. Because of this differences and the fact that at 150 kg/ha nitrogen, the difference to control is under the significance value, we can say that on this region, a moderate dosage of nitrogen between 100-150 kg/ha is useful for plants for increasing the yield with a good assing on pathoens threat.

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