BLACK POINT INCIDENCE IN SOME WINTER WHEAT VARIETIES CULTIVATED IN NORTH-EASTERN ROMANIA

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Abstract

Black point is a common disease in all wheat growing regions of the world and is an important quality defect of the wheat kernel. Black point can be characterized by a dark brown to black discoloration of the pericarp and testa, primarily embryo sides of the grains. Wheat kernel black point disease is associated with many microorganisms, both fungi or bacteria, but those most usually responsable for these symptoms are species of the fungus *Alternaria alternata*, *Cochliobolus sativus*, *Fusarium graminearum*, *Aspergillus* spp., *Penicillium* spp.. This study was undertaken to investigate the incidence of black point on some winter wheat cultivars in the nord-est area of Romania. Twenty-eight (*Triticum aestivum* L.) winter wheat varieties were compared for reaction to black point in a 2-years field trials. There were individual varietal differences in black point incidence within each of the varieties.

Key words: winter wheat, Black point, disease, climatic conditions

Winter wheat (*Triticum aestivum* L.) is an important cereal crop in Romania. Every year the wheat covered area exceeds 2 million hectare threshold, having a key role for stability of economy and people's food requiremenet.

Wheat is a vulnerable crop to the attack of several pathogens. The diseases produce by these pathogens can be grouped into two categories: pre-harvest diseases and post harvest diseases (Kaur J., *et al*, 2018). In the first category are included diseases which ocure in the vegetation period. These diseases affect the plant tisues - being named foliar diseases, and distroing the photosynthetic apparatus of the plant, whereas have a negative influence on the quality of the grains. Most important foliar disease are the wheat rusts: brown rust (leaf rust of wheat), yellow rust (stripe rust), black rust (stem rust of wheat), powdery mildew, septoria leaf blight etc. Also in the vegetation period can be present diseases at the level of spike, most important diseases which can be found an the spike are the head scab of wheat and smuts. In the second categories are included diseases like ***black point***.

Black point is a term wich was used for the first time in 1913 by Bolley (quate by Culshaw *et al*, 1988). The term ***black point*** has been used since then to describe a grain wheat discolouration supposedly due to fungal invection.

Black point is characterized by different color changes which can vary from a brown to black discoloration, or sometimes these discoloration can be reedish, of the pericarp of the seed. These symptoms are not only distinguished due to the color but also the place where these symptoms are observerd on the seeds and the degree of discoloration (Fernandez M.R. *et al*, 2011; Toklu F. *et al*, 2008; Özer N., 2005; Fernandez M.R. *et al*, 2000).

Wheat kernel black point disease is associated with many microorganisms, both fungi or bacteria. More than 100 fungi species have been isolated from black pointed kernels but usually responsable for these symptoms are species of the fungus *Alternaria alternata*, *Cochliobolus sativus*, *Fusarium graminearum*, *Aspergillus* spp., *Penicillium* spp. (Kaur J. *et al*, 2018; Khani M. *et al*, 2018; El-Gremi *et al*, 2017; Fernandez M.R. *et al*, 2011; Toklu F. *et al*, 2008; Özer N., 2005; Fernandez M.R. *et al*, 2000; Culshaw F. *et al*, 1988; Conner R.L. *et al*, 1988; Wilson J.M., 1993.)

Other studies indicated that the environment conditions had a major impact on the incidence of black point. Black point can be the result of abiotic stress conditions cause by the high rainfall, high umidity and extremes of temperature during the early stage of kernels development and grain filling period (Toklu F. *et al*, 2008; Özer N., 2005; Clarke M.P. *et al*, 2004; Wang H. *et al*, 2002; Conner R.L., 1989).

This study was undertaken to compare the black point reaction of 28 winter wheat cultivars

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which are currently registered for cultivate or are tested in field trials to be registrered for growing in Romania and have a good potential for production.

MATERIAL AND METHOD

This study was conducted under field conditions from the Ezăreni Farm – Iasi Didactic Station which belongs to the "Ion Ionescu de la Brad" University of Agricultural Sciences and Veterinary Medicine during the vegetation seasons 2016-2017 and 2017-2018.

Wheat kernels from 28 varieties were used as research material for this study: 11424G1, Andrada, Bezostaia 1, Codru, Dumbrava, Glosa, Izvor, Litera, Miranda FDL, Otilia, Pajura, Pitar, Semnal, T.95-12, T.109-12, T.118-11, T.123-11, T.124-11, T.143-11, T.19-10, Unitar, Ursita, Vestitor, Voevod, Voinic, Zamfira, Zamolxe, Zina.

The incidence of black point for each cultivar was the mean percent number of seeds with black point symptoms (*figure 1*) – a brown to black, or a dark discoloration of three subsamples of 1000 kernels each.

Meteorological data (precipitation and air temperature) were recorded at meteorological stations on site.

The control variant was the cultivar Bezostaia 1, and every cultivar was comparing with them to highlight statistical differences. The statistical and graphical processing was done in the MS Excel program.

RESULTS AND DISCUSSIONS

Meteorological data during the early stage of kernel development and grain filling period at Ezăreni Farm presented in *table 1* indicate difference between climatic conditions characteristic for these two years of observation.

Table 1

Total rainfall (mm) and monthly minimum, maximum and mean temperatures (°C) in Iasi during the grain filling period in 2017 and 2018

Month	2017						2018					
	Temperature (°C)			Rainfall (mm)			Temperature (°C)			Rainfall (mm)		
	Mean	Min.	Max.	Monthly	Decade	mm	Mean	Min.	Max.	Monthly	Decade	mm
April	10.05	4.36	16.02	140.4	I	77.8 (4)*	15.43	7.89	22.32	18.0	I	0.6 (1)
					II	37.8 (5)					II	3.6 (2)
					III	24.8 (4)					III	13.8 (2)
May	16.07	9.20	22.42	72.8	I	0.0 (0)	18.67	10.85	25.82	16.8	I	8.8 (6)
					II	59.2 (3)					II	8.0 (2)
					III	13.6 (4)					III	0.0 (0)
June	21.11	14.19	27.53	71.6	I	17.6 (2)	20.78	15.09	27.19	216.0	I	6.0 (4)
					II	5.2 (1)					II	167.8 (7)
					III	48.8 (3)					III	42.2 (6)

*Number of days of rain in parenthesis

April and May was warmer in the second year of observation and in June the mean temperature recorded similar values.

Total rainfall (mm) recorded in 2017 the early stage of kernel development and grain filling period was 284.8 mm and in the second year total rainfall was 250.8 mm.

The amount of precipitation falling between April and June of these two years studied was quite similar.

Figure 1 **Black point symptoms in wheat kernels, discoloration located mainly on the germ end** (original)

The multiannual amount of precipitation of this period (April-June) is 167.9 mm, with 40.3 mm recorded in April, 52.5 mm recorded in May and 75.1 mm recorded in June. Comparing the precipitation values recorded in the studied years with the multiannual average, the spring period of both years can be considered more rainy.

An analysis broken down on months, and for each month the analysis over decade shows that rainfall distribution was uneven, with major variation from month to month and from decade to decade.

Following the monthly rainfall distribution it is noted that in the spring of 2017 the precipitations fell in each one of these three months was important, whereas in the spring of the second year in April and May the amount of precipitations was low, recorded values under 20 mm/month. In June 2018, a significant amount of rainfall (216 mm) fell, but they fell in the second half of the month, when the wheat crop was in an advanced stage of development, the kernels being already filled.

These differences in precipitation distribution influenced the incidence of black point attack on winter wheat kernels.

Tabel 2

The incidence of Black point on winther wheat in north-eastern Romania during 2016-17 to 2017-18

No.	Variety	Agricultural year 2016/2017						Agricultural year 2017/2018					
		Black point incidence (%)	Min.	Max.	Comparison with Mt. (%)	Difference to the Mt. (units)	Means	Black point incidence (%)	Min.	Max.	Comparison with Mt. (%)	Difference to the Mt. (units)	Means
1	11424G1	8.73±0.35	8.2	9.4	191.10	4.16	ooo	2.70±0.44	2.0	3.5	84.38	-0.50	ns
2	ANDRADA	12.13±0.69	11.3	13.5	265.50	7.56	ooo	2.70±0.46	1.9	3.5	84.38	-0.50	ns
3	CODRU	7.93±0.59	7.2	9.1	173.60	3.36	ooo	2.83±0.41	2.2	3.6	88.54	-0.37	ns
4	DUMBRAVA	10.13±0.61	9.0	11.1	221.74	5.56	ooo	4.87±0.67	4.1	6.2	152.08	1.67	ooo
5	GLOSA	12.27±0.49	11.4	13.1	268.42	7.7	ooo	3.30±0.25	2.8	3.6	103.13	0.10	ns
6	IZVOR	29.27±0.98	28.0	31.2	640.41	24.7	ooo	9.67±0.32	9.3	10.3	302.08	6.47	ooo
7	LITERA	21.37±1.37	19.2	23.9	467.54	16.8	ooo						
8	MIRANDA FDL	20.20±1.27	18.0	22.4	442.01	15.63	ooo	3.40±0.38	2.8	4.1	106.25	0.20	ns
9	OTILIA	12.53±0.65	11.3	13.5	274.25	7.96	ooo	5.60±0.55	5.0	6.7	175.00	2.40	ooo
10	PAJURA	25.83±1.53	23.1	28.4	565.28	21.26	ooo	7.70±0.25	7.4	8.2	240.63	4.50	ooo
11	PITAR	9.73±0.61	8.7	10.8	212.98	5.16	ooo	3.70±0.29	3.2	4.2	115.63	0.50	ns
12	SEMNAL	26.50±0.97	25.2	28.4	579.87	21.93	ooo	2.57±0.22	2.3	3.0	80.21	-0.63	ns
13	T.109-12	7.53±0.34	7.1	8.2	164.84	2.96	ooo	2.17±0.20	1.8	2.5	67.71	-1.03	*
14	T.118-11	9.03±1.56	7.0	12.1	197.67	4.46	ooo	3.73±0.62	2.5	4.5	116.67	0.53	ns
15	T.123-11	3.30±0.32	2.8	3.9	72.21	-1.27	**	3.27±0.15	3.0	3.5	102.08	0.07	ns
16	T.124-11	7.67±0.20	7.3	8.0	167.76	3.1	ooo	2.47±0.17	2.3	2.8	77.08	-0.73	ns
17	T.143-11	13.27±0.35	12.7	13.9	290.30	8.7	ooo	5.33±0.64	4.5	6.6	166.67	2.13	ooo
18	T.19-10	5.40±0.25	4.9	5.7	118.16	0.83	ns	11.63±0.18	11.3	11.9	363.54	8.43	ooo
19	T.95-12	5.93±0.03	5.9	6.0	129.83	1.36	oo	1.20±0.15	1.0	1.5	37.50	-2.00	***
20	UNITAR	23.10±0.21	22.7	23.4	505.47	18.53	ooo	2.90±0.10	2.8	3.1	90.63	-0.30	ns
21	URSITA	11.17±0.24	10.7	11.5	244.35	6.6	ooo	2.87±0.46	2.1	3.7	89.58	-0.33	ns
22	VESTITOR	5.97±0.30	5.4	6.4	130.56	1.4	oo						
23	VOEVOD	8.13±0.68	7.4	9.5	177.97	3.56	ooo						
24	VOINIC	24.03±0.85	22.7	25.6	525.89	19.46	ooo	4.77±0.38	4.2	5.5	148.96	1.57	ooo
25	ZAMFIRA							2.07±0.41	1.4	2.8	64.58	-1.13	**
26	ZAMOLXE							4.20±0.32	3.6	4.7	131.25	1.00	ooo
27	ZINA							2.93±0.17	2.6	3.1	91.67	-0.27	ns
28	**BEZOSTAIA 1**	**4.57±0.27**	**4.2**	**5.1**	**100.00**	**0.00**	**Mt.***	**3.20±0.30**	**2.6**	**3.5**	**100.00**	**0.00**	**Mt.**

*Mt.=control variant

DL 5% = 0.88%
DL 1% = 1.15%
DL 0.1% = 1.50%

DL 5% = 0.42%
DL 1% = 0.55%
DL 0.1% = 0.71%

Analizing the date presentend in table 2 is clear that the incidence of black point of winter wheat kernel is influenced by precipitation recorded in spring. The fact is easy highlight from the rainfall data given in table 1, which clearly indicates that withe the increase in amount of precipitations the incidence of black point also increased.

In the first year of observations, the incidence of black point attack reached high values, with a peak of 29.27±0.98% for the Izvor variety and a minimum of 3.30±0.32% for the winter wheat line T.123-11. In the case of the control variant, represented by the Bezostaia 1 winter wheat variety, the incidence of black point attack was 4.57±0.27%.

Statistically, in this year in case of 20 winter wheat varieties, the incidence of the black point attack was negative and distinctly significant, and in the case of 2 wheat varieties the difference was very significant (T.95-12, Vestitor). Only in the case of the T.123-11 winter wheat line the difference was positive, statistically being very significant.

In the second year of observations, the incidence of the black point attack in the case of control variant was 3.20±0.30%. The highest value of the incidence of black point attack was 11.63±0,18%, the value recorded for the T.19-10 winter wheat line. Statistically, this value was ensured, being negative and significantly difference from the control variant. Also, distinctly significant negative values were obtained for Dumbrava, Izvor, Otilia, Pajura and T.143-10 winter wheat varieties. Two winter wheat cultivars, Zamolxe and Zina, recorded very significant negative values.

In the case of 14 varieties, the incidence of black point attack recorded values that were not statistically assured.

In case of three varieties the difference from control variant was positive: T.109-12 wheat variety recorded significant difference, Zamfira wheat variety recorde very significant difference, and T.95-12 winter wheat line recorded significantly difference.

CONCLUSIONS

Incidence of black point disease of winter wheat varied with amount of rainfall recorded during the early stage of kernel development and grain filling period and seed maturation. Unpredictibility of wheater during the vegetation period of winter wheat crop and expecially in the later stages of crop growth will continue to be a major factor in the dowgranding to cereal producers.

From the results obtained it can be noted that black point incidence among winter wheat cultivars ranged between 1.20±0.15 to 29.27±0.98%, depending on the cultivars and agricultural years.

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