The Influence of Fungicide Treatment on the Production and the Quality of Several Autumn Wheat Varieties

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ABSTRACT

The wheat production range from one year to another and is influenced by the climatic conditions, the cultivated variety and the presence of the pathogens which cause foliar and ear diseases. Also the quality of production (protein and gluten) is influenced by the pedological and climatic condition and diseases. The effect of the fungicide treatments in vegetation on the production and quality was studied in 2012-2013 at ARDS Turda, in the Phytopathology laboratory field. The study was conducted with five wheat varieties: Ariesan, Apullum, Turda 2000, Dumbrava and Andrada and the test variants were: no treatment (T0), one treatment, (T1) and two treatments (T2). The vegetation treatments have been carried out with the products Nativo (1l/ha) at the flag leaf appearance and Prosaro (1l/ha) at the end of the flowering. Since the *Fusarium* head blight, produced by different species of the genus *Fusarium*, is the most important disease in wheat crops and has a high impact on the quality and quantity of production, the percentage of diseased kernels was determined. The production was evaluated in kg/ha and the qualitative parameters were determined using the INSTALAB600 and AGRI CECK analyzer. Following the observations made and the statistical interpretation of data, we can say that applying vegetation treatments the percentage of diseased grains decreases compared to the control. The yield increases when treatment was applied. The gluten and the protein content recorded a slight decrease or increase, depending on the test variant; the ash content decreased when the treatments were applied on the vegetation period. The application of fungicide treatment on the vegetation is an important link in the wheat cultivation technology, ensuring the achievement quantitative and qualitative higher production.

Keywords: *fungicide, quality, yield, wheat*

INTRODUCTION

The winter wheat crops are affected by many diseases that cause significant quantitative and qualitative damages, damaging the food, feed and seed culture.

Wheat production varies from year to year, influenced by the climatic conditions, the variety grown and the presence of pathogens causing foliar and ear diseases. Production quality (protein and gluten) is influenced by the pedological

environment, climatic conditions but also by the diseases.

From the many diseases present in wheat culture, *Fusarium* ear blight, is responsible for reducing the production of wheat and also contributes to it is decrease.

Along with the seed treatment, fungicide treatments on vegetation helps to control pathogens like *Fusarium* spp., with the condition

that fungicides are applied in the BBCH 61- BBCH 65 stage.

MATERIALS AND METHODS

The study of fungicide treatments in vegetation on the quantity and quality of winter wheat production was achieved in 2012-2013 at ARDS Turda, in the Phytopathology laboratory. As biological material there have been used five wheat varieties: Ariesan, Apullum Turda 2000, Dumbrava and Andrada. Test variants were: no treatment (T0), a treatment (T1), and two treatments (T2) (Tab. 1). Treatments were carried out on Nativo (1 l / ha), (pebuconazol 200 g / l + trifloxystrobin 100 g / l) at the flag leaf emergence and Prosaro (1 l / ha) (prothioconazole 125 g / l + tebuconazole 125 g / l) (Hershman and Johnson, 2009 Welugo and Klein, 2013), at the end of flowering. Since *Fusarium* head blight produced by different species of the *Fusarium* genus, is the most important disease in wheat crop with a major impact on the quality and quantity of production, it was determined the percentage of diseased kernels (%). Production was measured in kg / ha. The quality parameters were determined using INSTALAB 600 and AGRI CHEK analyzer. Data obtained from the observation were processed using POLIFACT.

RESULTS AND DISCUSSIONS

The climatic conditions influence of the growing and developing of plants but also the emergence and evolution of pathogens. The year 2012, due to the temperatures recorded was a very warm year. The lack of water in the soil, combined with the lack of rainfall in late 2011 led to the emergence of wheat only in the spring of 2012.

Tab. 1. List of the field plot variants

Variant signification	Treatment
T0	control variant with seed treatment
T1	seed treatment and one vegetation treatment
T2	seed treatment and two vegetation treatments

(Source: The meteorological station Turda (longitudinal: 23° 47'; latitudinal 46°35'; altitudinal 427 m)

Even though the year 2012 was not normal in terms of climatic conditions, the varieties studied behaved well, being stable in terms of production and high capacity to adapt to different environmental conditions. In terms of temperatures, the year 2013 was a hot year, with temperatures that were slightly above the average of 55 years (Fig. 1).

(Source: The meteorological station Turda (longitudinal: 23° 47'; latitudinal 46°35'; altitudinal 427 m)

The years 2012 and 2013 are characterized as normal in terms of rainfall. Rainfall in April, May and June (Fig. 2) in the two experimental years, have influenced the emergence and development of the pathogens.

In order to determine the influence of the vegetation treatments on the quantity and quality production of winter wheat varieties the percentage of diseased kernels was determined for the varieties studied in the two years of experimentation.

The climatic conditions of the two experimental years of experimentation have

Fig. 1. The temperatures at ARDS Turda 2012-2013

Fig. 2. The rainfall regime at ARDS Turda 2012-2013

influenced the emergence and the manifestation of the diseases. In 2013, the average percentage of diseased kernels in all varieties studied in all experimental variants was higher, with a positive significant difference compared to the control (Tab. 2).

Regarding the influence of the number of vegetation treatments on the percentage of the diseased kernels we can say that by applying one or two treatments the percentage of attacked kernels was lower regardless of the number of treatments, recording negative significant differences compared to the control, on which no treatment was applied (Tab. 3).

Between the averages percentage of diseased kernels of all the variants, there were differences, but they were not statistically assured (Tab. 3). However we notice that the variety Dumbrava recorded the lowest percentage of diseased kernels (15.78%) and the variety Appulum, recorded the highest percentage of kernels attacked by *Fusarium* spp. (19.51%).

The application of the fungicide treatments on vegetation, contributes alongside with the agrotechnical measures (crop rotation, sowing period, balanced fertilization, cultivation of resistant varieties) at the obtaining of high yields.

Tab. 2. The influence of the climatic condition on the diseased kernels 2012 – 2013

No.	Year	Diseased kernels %	% to control	The difference to control	The significance of the difference
1.	2012	12.69	100.0	0.00	Control
2.	2013	22.93	180.7	10.24	*
LDS (p 5%)			6.01		
LDS(p 1%)			13.88		
LDS (p 0.1%)			44.18		

Tab. 3. The influence of the number of treatments on the diseased kernels 2012 – 2013

No.	Number of treatments	Diseased kernels %	% to control	The difference to control	The significance of the difference
1.	T0	24.86	100.0	0.00	Control
2.	T1	17.32	69.7	-7.54	000
3.	T2	11.25	45.3	-13.61	000
LDS (p 5%)			1.95		
LDS (p 1%)			2.60		
LDS (p 0.1%)			3.42		

Tab. 4 The behavior of the five varieties on *Fusarium* spp., attack 2012 - 2013

No.	Varieties	Diseased kernels %	% to control	The difference to control	The significance of the difference
1.	ARIESAN	17.88	100.0	0.00	Control
2.	APULLUM	19.51	109.1	1.62	-
3.	TURDA 2000	17.31	96.8	-0.57	-
4.	DUMBRAVA	15.78	88.2	-2.11	-
5.	ANDRADA	18.58	103.9	0.70	-
LDS(p 5%)			3.01		
LDS (p 1%)			4.14		
LDS (p 0.1%)			5.71		

In the experimental conditions of the ARDS Turda, applying the vegetation treatments have lead to the increasing of the production with yields between 414 and 1404 kg / ha in 2012 (Tab 4). In 2013, the yields were slightly lower, with the exception of the Andrada and Dumbrava varieties, production increased ranging from 21 to 1119 kg / ha, aspect that was correlated with higher percentage of sick kernels this year.

In the two years of experiments, Dumbrava variety has achieved the highest yields. In year 2012, the differences of production compared to the control were statistically assured. In 2013 the application of two treatments on vegetation leads to a higher production, with the positive significant difference to the control (Tab. 5).

Yield increases were registered at the Appulum and Turda 2000 varieties, in 2012, by applying

Tab. 5. The influence of the climatic conditions and the number of treatments on the production

No.	Year	Cultivars	Number of treatments	Yield kg/ha	% to control	The difference to control	The significance of the difference
1.	2012	ARIESAN	T0	7816	100.0	0.00	Control
2.			T1	8264	105.7	448	-
3.			T2	8339	106.7	523	-
4.		APULLUM	T0	7002	100.0	0.00	Control
5.			T1	7517	107.4	516	-
6.			T2	8243	117.7	1241	**
7.		TURDA 2000	T0	7309	100.0	0.00	Control
8.			T1	8063	110.3	754	-
9.			T2	8313	113.7	1004	*
10.		DUMBRAVA	T0	7487	100.0	0.00	Control
11.			T1	8777	117.2	1290	**
12.			T2	8891	118.8	1404	***
13.		ANDRADA	T0	7677	100.0	0.00	Control
14.			T1	8091	105.4	414	-
15.			T2	8342	108.7	665	-
16.		ARIESAN	T0	7830	100.0	0.00	Control
17.			T1	7851	100.3	21	-
18.			T2	7936	101.4	106	-
19.		APULLUM	T0	7427	100.0	0.00	Control
20.			T1	7582	102.1	155	-
21.			T2	7656	103.1	229	-
22.		TURDA 2000	T0	7560	100.0	0.00	Control
23.			T1	7614	100.7	54	-
24.			T2	7754	102.6	194	-
25.	DUMBRAVA	T0	7985	100.0	0.00	Control	
26.		T1	8447	105.8	462	-	
27.		T2	9184	115.0	1199	**	
28.	ANDRADA	T0	7666	100.0	0.00	Control.	
29.		T1	8512	111.0	846	*	
30.		T2	8626	112.5	960	*	
LDS (p 5%)				802.24			
LDS (p 1%)				1072.31			
LDS (p 0.1%)				1409.88			

two treatments on vegetation, and in 2013 the Andrada variety yields was higher in variants with one and two vegetation treatments, the difference compared with control being significantly positive (Tab. 5).

As regards its quality - protein, gluten and ash - they can be influenced by the infection with *Fusarium* spp.

The protein content can increase, decrease or remain constant at the *Fusarium* attack. Boyacioğlu and Hettiarachchy in 1995 have seen an increase in protein content after infection with *Fusarium* spp. Other authors (Dexter et al. in 1997, Gartner et al., in 2008), have observed a slight decrease in the protein content and Marie Kreuzberger, in 2011, stated that the *Fusarium* infections did not affect the protein content. The environmental conditions (year x location) the preceding crop and the cultivar type might influence the protein content.

Following the analyzes of the wheat samples from those five wheat varieties, it can be seen that

in the variant where no treatments were applied, the protein content is higher in both experimental years, correlated with the reduced production from all varieties, in this version, but with a high percentage of attacked kernels. The application of treatment leads to a slight decrease in the protein content in the single-treatment variant and increased slightly after the application of the second treatment, the protein content did not exceed the untreated variant (Fig. 3).

Due to the positive correlation that exists between protein and gluten content in our samples we could noticed that in the case of the variant without treatments, in all varieties taken under study, in both experimental years, the amount of gluten is higher. It was observed a slight decrease or even the same values when applying the vegetation treatments (Fig. 4).

The ash content in the flour obtained from infected grains with *Fusarium*, increase as was studied by Marie Kreuzberger, 2011). Ludmila Papoušková et al (2011) also noted an increase in ash content in the flour obtained from wheat infected with *Fusarium*.

The ash content is higher in the variant without vegetation treatment correlated with a higher percentage of diseased kernels. The application of vegetation treatments leads to the decreasing of the ash content in flour obtained from the studied varieties (Fig. 5).

To highlight the influence of the fungicide vegetation treatments on the quantity and quality of production, we have calculated the average yields per hectare in the two experimental years and the average amount of protein per hectare for all the varieties.

It can be seen in Tab. 6 that the highest amount of protein per hectare was obtained in

Fig. 3. The protein content in 2012-2013

Fig. 4. The gluten content in 2012-2013

Fig. 5. The ashes content in 2012-2013

Tab 6. The protein content (kg/ha) in 2012-2013

No.	Cultivars	Number of treatments	Yield average 2012-2013 (kg/ha)	Protein average content 2012-2013 (%)	Protein average content (kg /ha)
1.	ARIESAN	T0	7823	12.2	962
2.		T1	8056	11.9	959
3.		T2	8138	12.1	981
4.	APULLUM	T0	7215	12.5	898
5.		T1	7550	11.9	899
6.		T2	7950	11.9	946
7.	TURDA 2000	T0	7435	12.7	944
8.		T1	7839	12.0	941
9.		T2	8034	12.2	980
10.	DUMBRAVA	T0	7736	11.3	874
11.		T1	8612	10.4	891
12.		T2	9037	10.3	931
13.	ANDRADA	T0	7667	11.3	867
14.		T1	8301	11.1	921
15.		T2	8484	11.2	950

the variant where applied two treatments in vegetation, although in this variant the protein content was slightly lower than in the untreated variant. In some varieties (Ariesan and Turda 2000) the variant without vegetation treatments have achieved high amounts of protein, but it should be noted that in this variant the percentage of the kernels damaged by *Fusarium* spp. was the highest, aspect that leads to higher ash content and a lower quality of flour.

CONCLUSION

The climatic conditions influenced the percentage of attacked kernels by *Fusarium* spp., in 2013 the percentage of diseased kernels was higher in all studied varieties, compared to 2012;

The number of vegetation treatments influenced the percentage of diseased kernels; by applying a single treatment or two treatments on vegetation the percentage of diseased kernels decreased very significantly compared with the untreated control variant;

In the experimental conditions from the ARDS Turda, applying of vegetation treatments has led to increased yields between 21 and 1404 kg / ha, depending on the number of treated, applied;

The application of vegetation treatments leads to a slight decrease in the protein percentage in a

single treatment variant and to a slight increase after the application of two treatments, values that did not exceed the protein content recorded in the untreated control;

In case of applying vegetation treatments the amount of gluten recorded a slight decrease compared to the amount of gluten obtained from the control;

The ash content was higher in the variant without vegetation treatment correlated with a higher percentage of diseased kernels; the application of treatments in vegetation decreased the ash content;

The highest amount of protein per hectare was obtained in the variant where two treatments were applied on vegetation and it can be said that the application of the two treatments on vegetation contributes to a higher production in terms of quantity and quality.

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