FUNGAL LOAD ASSESSMENT OF WHEAT KERNELS UNDER THE ACTION OF SOME PHYTOSANITARY PRODUCTS

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Abstract

The quality of the wheat seeds determine the production and quality of the grains final agricultural product. Crop losses due to fungal contamination represent a significant problem for many cereals all over the world. Especially for cereals like wheat, at wich for example different toxigenic *Fusarium* spp. are frequently found as contaminants. Thus, in order to obtain the production of crops free from fungal infections it is necessary a permanent evaluation of the seeds before and after harvest but especially before sowing, even if it is mandatory the treatment of the seeds. Tested material was represented by kernels of Miranda wheat variety to which were applied a number of 14 variant treatments. Therefore, identified fungi genera on Miranda wheat variety kernels were *Alternaria, Aspergillus, Fusarium, Penicillium*, and *Rhizopus*. The incidence and percentage of the identified micromycetes was different for each treatment variant that was applied to the kernels.

Key words: fungi, wheat, treatment, kernel

Seed healthy testing is vital to have good germination, healthy seedlings and plant population. Early identification of unhealthy seeds is important for timely management of diseases control. The objective of seed testing is to identify the quality of material seeds that can be sown in the field, which ultimately results in production of healthy food, healthy seed crops, and improved yields in terms of quality and quantity.

The wheat crop is considered one of the most important worldwide in the world. Wheat plants are susceptible to a variety of diseases throughout the growth season and storage period, resulting in a drop in productivity and grain quality. One of the significant risks associated with cereal is consumption in the presence of mycotoxins produced by the development of fungi (Richard J. L. and Payne J. A., 2003).

Fungicides and insecticides, polymers and micronutrients can improve the agronomic performance of crops through seed treatment. The use of polymers improves seed adhesion, distribution, and coloration without impairing its quality and performance (Bays *et al.,* 2007).

MATERIAL AND METHOD

The study were conducted on "Ion Ionescu de la Brad" Iasi University of Life Sciences (IULS), Plant Protection Department.

The investigations carried out focused on testing the biological efficacy of fungicidal treatments on the autumn wheat variety/genotype Miranda, provided from a single location, harvested in 2023, on which were applied a number of 12 variant treatments and untreated. For the effective determination of the efficacy of the products, 8 fungicides, 1 insecticide, and 1 biostimulator were studied, constituting 13 treatments.

Evidence of the effectiveness of treatments applied to the seed or conducted analyses in 2 control variants, the first uncleaned and the second cleaned 5 minute with KOH 10%.

The data were processed using the ARMdata (Agriculture Research Management). The function for efficacy determining had the following form:

$$E.b.\% = \frac{I.m. - I.e.}{I.m.} * 100, were:$$

E.b. – biological efficacy.
I. m. – Intensity of the disease in untreated.
I. m. – Intensity of the disease in treatment (Dospehov, B.A.1979).

The function for frecvency analysis had the following form (Naqvi *et al*., 2013):

$$PF\% = \frac{.No.of\ seeds\ on\ which\ \ fungus\ appears}{Total\ number\ of\ seeds} * 100$$

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The treatments were: Difend[2], Redingo 100FS[3], Bariton Super[4], Redigo Pro 170FS[5], Difend Extra[6], Orius 6WG[7], Celest Extra[8], Orius 6WG + Signal 300ES[9], Rancona[10], Rancona + Signal 300ES[11], Ympact + Redigo 100FS[12] and Ympact + Redigo Pro 170FS[13] (table 1). The treatment were applied with laboratory seed treated Hege 11. The fungicides products have different active substances difenoconazole, protioconazol, tebuconazole, fludioxonil and ipconazole. Insecticide is cipermetrin and biostimulator composition is Cu, Mn, Mo, and Zn (table 1).

To determinate the percenatge (%) of seed infected the moist chamber method was used. (Mathur S. B, Kongsdal O., 2003). Each sample of 300 seeds was put on filter paper, moistened with distilled water, incubated at 22°C for 7 days (Hatman M. *et al,* 1986). After that, the micromycetes identification was done based on microscopic preparations that were analyzed under the optical microscope. The fungal load determination from the surface of the seeds was based on the showed morphological characteristics and some specialized scientific guides (Ellis M. B., Ellis P. J., 1985).

Table 1

Experimental schema regarding the testing of the effectiveness of seed treatment products

Nr. Treat.	Product	Composition s.a	Dose u.m.
1	UNTREATED	-	-
1	UNTREATED STERIL	-	-
2	DIFEND	*30 g/l difenoconazol*	2,00 l/t
3	REDIGO 100 FS	*100 g/l protioconazol*	1,00 l/t
4	BARITON SUPER 97,5 FS	*37.5 g/l fludioxonil*	1,00 l/t
		50 g/l protioconazol	
		10 g/l tebuconazol	
5	REDIGO PRO 170 FS	*150 g/l protioconazol*	0,50 l/t
		20 g/l tebuconazol	
6	DIDEND EXTRA	*25 g/l difenoconazol*	2,00 l/t
		25 g/l fludioxonil	
7	ORIUS 6 WG	*60 g/l tebuconazol*	0,15 l/t
8	CELEST EXTRA	*25 g/l fludioxonil*	1,50 l/t
		25 g/l difenoconazol	
9	ORIUS 6 WG + SIGNAL 300 ES	*60 g/l tebuconazol*	0,15 l/t
		300 g/l cipermetrin	2,00 l/t
10	RANCONA	*15 g/l ipconazol*	1,00 l/t
11	RANCONA + SIGNAL 300 ES	*15 g/l ipconazol*	1,00 l/t
		300 g/l cipermetrin	2,00 l/t
12	YMPACT + REDIGO 100 FS	*5,782 % Cu, Mn, Mo, Zn*	10,00 l/t
		100 g/l protioconazol	1,00 l/t
13	YMPACT + REDIGO PRO 170 FS	*150 g/l protioconazol*	0,50 l/t
		20 g/l tebuconazol	
		5,782 % Cu, Mn, Mo, Zn	10,00 l/t

RESULTS AND DISCUSSIONS

Each treatment variant was analyzed separately and were isolated from the seeds of 12 treatment including untreated. Following the observations and identification of micromycetes made, the next genus of fungi were determined: *Aspergillus, Penicillium, Fusarium, Alternaria,* and *Rhizopus* (table 2).

According to untreated treatment, high values were identified by genus *Alternaria* by 21,00%. Medium values on genus *Penicillium* by 8,00%, *Rhizopus* by 6,33%, and *Aspergillus* by 5,00%. The lowest value was recorded in the genus *Fusarium* by 1,67% (table 2).

Alternaria genus is not harmful for wheat seed because it does not greatly harm the germination (Morar O.A., 2009). It was identified by the large conidia, oval or ellipsoidal in shape,

their color varying from light brown to dark brown, multicellular, with longitudinal, transverse, and sometimes oblique septa. They were identified in all samples, the highest value being recorded in the untreated sample, by 21,00%, while the value of the treated samples differs with 20,67% and 11,67% respectively.

The *Aspergillus* genus was identified with a frequency range of 5,00% on the untreated and 4,33% on the sterilized untreated. The fungi of the genus *Penicillium* are commonly found in grain storage and develop aflatoxins, ochratoxins, and patuline. This fungus forms conidiophores from digitally branching hyphae, with large verticies resembling a skeleton hand. The value on the fungus frequency was recorded at 8,00%. High levels of seed infection can significantly reduce seed germination

Fusarium produces a number of mycotoxins of diverse chemical structures. The infections can start in the field and develop even in grain deposits. It produces mycotoxins classified into two chemical classes: trichothecenes and zearalenone. Among trichothecenes, we mention vomitoxin (deoxynivalenol / DON) toxic in the diet of humans and animals. The mycelium of the genus *Fusarium* fungi has been identified only on untreated sample 1,67%.

The most common species of the genus *Rhizopus* in cereals contaminated by aflatoxin are *Rhizopus nigricans* and *Rhizopus stolonifer*. *Rhizopus* sp. was identified and the highest percentage 6,33%

High levels of seed infection with fungi from the genera *Aspergillus, Fusarium*, and *Penicillium* can significantly reduce seed germination.

According to treatments applied to seed, comparing to the control, we observe a reduction of biological frequency in the case of all agents.

We encounter a high frequency in the case of 2 treatments, Rancona[10] 15,33% with 4 species of fungi, and Difend[2] 13,33% with 3 species. The highest frequency is attributed to the genus *Alternaria,* Rancona[10] 8,67% and Difend[2] 9,33% and medium frequency on *Aspergillus*, and *Penicillium* fungi. It also evident from the result that treatment with one active substance have a higher biological frequency of fungi development. This may be due to the widespread use of applied products and the beginning of the emergence of resistant strains.

Table 2

Biological frequency (%) of phytopathogenic agents

Nr. Treat	Product	Biological frequency (%)					Average frequency %
		Aspergillus	*Penicillium*	*Alternaria*	*Fusarium*	*Rhizopus*	
1	UNTREATED	5,00	8,00	21,00	1,67	6,33	42,00
1	UNTREATED STERIL	4,33	2,33	18,33	1,33	3,33	29,67
2	DIFEND	1,67	2,33	9,33	0,00	0,00	13,33
3	REDIGO 100 FS	2,33	1,33	2,33	0,00	0,00	6,00
4	BARITON SUPER 97,5 FS	1,67	0,67	0,33	0,00	0,00	2,67
5	REDIGO PRO 170 FS	1,67	1,00	1,33	0,00	0,00	4,00
6	DIFEND EXTRA	1,67	1,67	0,00	0,00	0,00	3,33
7	ORIUS 6 WG	1,33	0,33	1,33	0,00	0,00	3,00
8	CELEST EXTRA	1,67	1,33	1,67	0,00	0,00	4,67
9	ORIUS 6 WG + SIGNAL 300 ES	0,33	1,00	3,67	0,00	0,00	5,00
10	RANCONA	2,00	2,33	8,67	0,00	2,33	15,33
11	RANCONA + SIGNAL 300 ES	1,33	4,33	2,33	0,00	0,00	8,00
12	YMPACT + REDIGO 100 FS	0,67	0,00	1,00	0,00	4,67	6,33
13	YMPACT + REDIGO PRO 170 FS	0,67	0,00	1,00	0,00	0,67	2,33

Table 3

Efficacy (%) of seed tretament on phytopathogenic agents

Nr. Treat	Product	Efficacy %					Average efficacy%
		Aspergillus	*Penicillium*	*Alternaria*	*Fusarium*	*Rhizopus*	
1	UNTREATED	-	-	-	-	-	-
1	UNTREATED STERIL	-	-	-	-	-	-
2	DIFEND	66,67	70,83	55,56	100,00	100,00	68,25
3	REDIGO 100 FS	53,33	83,33	88,89	100,00	100,00	85,71
4	BARITON SUPER 97,5 FS	66,67	91,67	98,41	100,00	100,00	93,65
5	REDIGO PRO 170 FS	66,67	87,50	93,65	100,00	100,00	90,48
6	DIFEND EXTRA	66,67	79,17	100,00	100,00	100,00	92,06
7	ORIUS 6 WG	73,33	95,83	93,65	100,00	100,00	92,86
8	CELEST EXTRA	66,67	83,33	92,06	100,00	100,00	88,89
9	ORIUS 6 WG + SIGNAL 300 ES	93,33	87,50	82,54	100,00	100,00	88,10
10	RANCONA	60,00	70,83	58,73	100,00	63,14	63,49
11	RANCONA + SIGNAL 300 ES	73,33	45,83	88,89	100,00	100,00	80,95
12	YMPACT + REDIGO 100 FS	86,67	100,00	95,24	100,00	26,28	84,92
13	YMPACT + REDIGO PRO 170 FS	86,67	100,00	95,24	100,00	89,47	94,44

Reporting on the biological frequency of the agents, the highest efficacy is recorded by the micromycetes *Alternaria* followed by *Penicillium* and *Aspergillus*.

CONCLUSIONS

Poor management of seeds can lead to rapid degradation, resulting in reduced germination and nutritional value. During storage, wheat seeds are subjected to different fungi. The most common are *Penicillium* and *Aspergillus*, but because of climatic influence occurring during the vegetable period, also *Alternaria, Fusarium* and *Rhizopus* can appear. From an agronomic perspective, the most important are temperature, water, interaction with insects, harvest time and storage conditions.

The high frequency was recorded at treatment Rancona[10] 15,33% and Difend[2] 13,33% The highest frequency is attributed to the genus *Alternaria* 8,67%[10] – 9,33%[2] and medium frequency on *Aspergillus*, and *Penicillium* fungi.

The analyses performed show the health status of the wheat seeds intended for sowing as well as the importance of using phytosanitary products.

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