

THE INFLUENCE OF TREATMENTS WITH VARIOUS PHYTOSANITARY PRODUCTS (FUNGICIDES) ON THE ATTACK OF SOME PHYTOPATHOGENIC FUNGI ON WHEAT HARVEST – GLOSA VARIETY - IN 2022 PEDOCLIMATIC CONDITIONS OF THE EASTERN BARAGAN

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Abstract

This study aims at monitoring the dynamics of the occurrence and evolution of the attack of some pathogens to Glosa Romanian wheat variety, among which we mention: *Puccinia recondita* f. sp. *tritici* (sin. *Puccinia triticina*) which produces wheat's brown rust and *Septoria* sp. which produces wheat's brown leaf spotting (septoriosis). Also, the influence of applying these fungicides on the harvest, as compared to the untreated control variant, has been monitored. One experiment with 5 variants (4 variants with phytosanitary treatment, plus one control variant not treated) was taken into consideration for this study, for which the following phytosanitary products were used, as follows: NATIVO PRO 325 SL (prothioconazole 175 g/l + trifloxystrobin 150 g/l) and EVALIA (azoxystrobin 250 g/l). The treatment variants were the following: V1 – NATIVO PRO 0.6 l/ha, 1 treatment applied on 20th April + 1 treatment applied on 23rd May, V2 – EVALIA 1.00 l/ha, 1 treatment applied on 20th April + 1 treatment applied on 23rd May, V3 – NATIVO PRO 0.7 l/ha, 1 treatment applied on 13th May; V4 - EVALIA 1.00 l/ha, 1 treatment applied on 13th May and V5 – Untreated Control Variant. The experiment was placed in Latin square, the 5 variants being placed in 5 repetitions. The year 2022 was very dry, especially in March, April and May. The experiment received two waterings with norms of 800 m²/ha/watering in the spring of the year 2022. These waterings led to good wheat yields. We emphasize that the experiment also received, in the autumn of the year 2021, a sprout watering with a norm of 400 m²/ha. Even though three waterings were applied, the attacks of the pathogens that frequently cause foliar diseases in wheat were very low, even in the untreated control variant. This led to very uniform yields in the variants studied. Basically, there were no significant yield differences between the untreated control variant and the variants that were treated with fungicides. The yields of the variants were as follows: V1 – 9.914 to/ha, V2 – 10.668 to/ha, V3 – 10.376 to/ha, V4 – 9.649 to/ha, V5 (untreated control variant) – 10.200 to/ha.

Key words: *Puccinia* spp, *Septoria* spp, latin square

The wheat, *Triticum aestivum*, is attacked by many pathogenic agents, such as: mildew - *Blumeria graminis* f. sp. *tritici*, brown rust - *Puccinia recondita* f. sp. *tritici*, brown leaf spotting - *Septoria tritici*, *Septoria nodorum*, stem's fusariosis and ear's rot *Gibberella zeae*, *Gibberella avenacea* (Iacob Viorica, Hatman, M., Ulea, E., Puiu, I. 1998). The first half of the year 2022 was very unfavorable to wheat, in what concerns the climatic conditions. The year 2022 was one of the driest years in the last 10 years in the Baragan Plain area. During this period, rainfall in totally insufficient quantities was recorded. Average temperatures were higher than normal for this date. In January, the average temperature was 2.6°C and the rainfall totaled only 5.2 l/m². In February, the average temperature was 5.1°C and the rainfall totaled 10.5 l / m². In March, the average temperature was 4.1°C, the rainfall totaled only 8.5 l/m² and the average relative humidity of

the air was only 54%. In April, the average temperature recorded was 12.7°C, the rainfall totaled 30 l/m² and the average relative humidity of the air was only 50.7%. In May, the average temperature was 19.7°C, the rainfall totaled 21 l/m² and the average relative humidity of the air was 47%. In June, the average temperature recorded was 25.3°C, the rainfall totaled 14 l/m² and the average relative humidity of the air was low - 47.3%. Under these circumstances, the fungus *Puccinia recondita* f. sp. *tritici* that produces brown rust in wheat (Velichi E., 2012) made its presence known to a very small extent in 2022, compared to previous years. We emphasize that this phytopathogenic fungus has made its appearance even in very dry years - it is true that in the form of very weak attacks. These weather conditions, totally unfavorable for the first half of 2022, have led to the effective absence of attacks by pathogens that are usually present in this area.

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Among them we mention: *Blumeria graminis f. sp. tritici*, which produces wheat mildew, *Septoria sp.* which produces, in wheat, diseases known as septoriosis, *Gibberella spp.* which produces in wheat diseases known as fusariosis (*Fusarium sp.*).

We emphasize that the experiment was carried out under irrigation conditions, benefiting from three waterings. The first watering was applied in autumn with a norm of 400 m²/ha. The other two

waterings were applied in spring, with norms of 800 m²/ha/watering. The two waterings in the spring of 2022 were applied as follows: the first watering in the last week of April, the second in mid-May, exactly in the phases of maximum need of water for wheat. The three waterings applied during the growing season had a decisive role in obtaining very good wheat yields in the location where the experiment was established.

Table 1

The results of the experiment (the first treatment applied at straw's extension, the second at kernel's filling) with fungicide products (4 variants of treatment + 1 untreated control variant) in what concerns the attack (D.A.%) of *Puccinia recondita f. sp. tritici* fungus ("flag" leaf and the next leaf). The observations had been made on 9th June 2022

Variant	"Flag" leaf			Second leaf		
	D.A.%	Difference as compared to the control variant	Significance	D.A.%	Difference as compared to the control variant	Significance
V1 - NATIVO PRO 0.6 l/ha 1 treatment applied on 20 th April + 1 treatment applied on 23 rd May	0.06	11.38	**	9.52	20.9	**
V2 - EVALIA 1.00 l/ha 1 treatment applied on 20 th April + 1 treatment applied on 23 rd May	0.18	11.26	**	8.66	21.76	**
V3 - NATIVO PRO 0.7 l/ha 1 treatment applied on 13 th May	0.12	11.32	**	6.88	23.54	**
V4 - EVALIA 1.00 l/ha 1 treatment applied on 13 th May	0.12	11.32	**	9.28	21.14	**
V5 - Untreated control variant	11.44			30.42		

LD D.A. % for "flag" leaf

LD 5%= 0.954%

LD 1%= 1.314%

LD D.A. % for the second leaf

LD 5%=7.78%

LD 1%=10.72%

Table 2

The results of the experiment (the first treatment applied at straw's extension, the second at kernel' filling) with fungicide products (4 variants of treatment + 1 untreated control variant) in what concerns the yield (t/ha) obtained at the treated variants, as compared to the untreated control variant

Variant	Yield (t/ha)	Difference as compared to the control variant (t/ha)	Significance
V1 - NATIVO PRO 0.6 l/ha 1 treatment applied on 20 th April + 1 treatment applied on 23 rd May	9.914	-0.286	Not significant
V2 - EVALIA 1.00 l/ha 1 treatment applied on 20 th April + 1 treatment applied on 23 rd May	10.668	0.468	Not significant
V3 - NATIVO PRO 0.7 l/ha 1 treatment applied on 13 th May	10.376	0.176	Not significant
V4 - EVALIA 1.00 l/ha 1 treatment applied on 13 th May	9.649	-0.551	Not significant
V5 - Untreated control variant	10.200	-	

LD 5% = 0.806 t/ha

LD 1% = 1.050 t/ha



Figure 1 - Aspects from the experimental field (original)-the plants are in the ear's release phase



Figure 2 - Aspects from the experimental field (original)-the plants are in full maturity phase

MATERIAL AND METHOD

One experiment with 5 study variants each had been conceived for performing the observations. This experiment comprised 4 phytosanitary treatment variants (fungicide products containing various active substances) and one untreated control variant. The variants of the experiment were the following:

- V1 - NATIVO PRO 0.6 l/ha 1 treatment applied on 20th April + 1 treatment applied on 23rd May
- V2 - EVALIA 1.00 l/ha 1 treatment applied on 20th April + 1 treatment applied on 23rd May
- V3 - NATIVO PRO 0.7 l/ha 1 treatment applied on 13th May
- V4 - EVALIA 1.00 l/ha 1 treatment applied on 13th May
- V5 - Untreated control variant

The experiment was placed in Latin square; the 5 variants were placed in 5 repetitions. Each experimental plot had an area of 15 m² (5 x 3m). The total number of experimental plots was 25.

The surface of an experimental variant was of 15 m² x 5 repetitions = 75 m². The total area of the experiment was of 75 m² x 5 = 375 m². The treatments had been performed manually, with a manual sprayer type of equipment. Weed control was achieved with the help of Mustang herbicide (6.25 g/l florasulam + 300 g/l 2,4-D EHE acid) at a dosage of 0.5 l / ha applied, separately, with the vermored. The experiment has shown the effectiveness of these plant protection products in relation to their price. The efficiency and, respectively, the profitability of applying a single treatment to a product with a fungicidal effect or two phytosanitary treatments with a product with a fungicidal effect were also monitored during wheat's vegetation period. It was considered that the spring and the first summer month of 2022 were particularly dry.

The assessment of the attack's frequency (F %), of attack's intensity (I%) and respectively of the degree of attack (D.A.%) was done separately, on each and every experimental plot, being analyzed 10 plants / experimental plot. The degree of affectation (attack intensity, I%) of the last two leaves was assessed, especially of the "flag" leaf which has the greatest contribution to the ear's

production at strawy cereals. The phytosanitary analyses on the plants' samples had been done with the help of the stereo-microscope and of the optic microscope at the laboratory of Braila's Phytosanitary Office – National Phytosanitary Authority, institution subordinated to the Ministry of Agriculture and Rural Development. These analyses have revealed in the analyzed samples the presence of *Puccinia recondite f. sp.tritici* fungus which produces wheat's brown rust. Other pathogenic agents specific to wheat were not signaled in the climatic conditions of the first half of the year 2022.

For assessing the production of each variant under study, samples of kernels from each experimental plot, 5 samples each / plot, had been analyzed by spot check. Each sample contained 10 plants, so 50 plants had been taken from each experimental plot, for which the yield was weighted manually. The delimitation of each sample was done with a metric frame with an area of 0.25 m² (0.5/0.5m). The average of the samples from the experimental plots was used for calculating the yield of each experimental parcel. The statistic interpretation was executed with the help of limit differences (LD %) (Săulescu N., 1967).

The used variety, Glosa, is a Romanian variety created by the Fundulea National Agricultural Research & Development Institute. Glosa variety is an early variety. It has good resistance to falling, resistance to wintering, drought and heat and it has a good resistance at sprouting into ear. It has average resistance to brown rust and is resistant to mildew and to the actual strains of yellow rust (Fundulea Seeds Company, 2021).

The assessment of pest attack can be done with the help of the following values (Methods of Prognosis and Warning 1980):

- Frequency of attack (F %);
- Intensity of attack (I %);
- Degree of attack (D.A %).

- The frequency of attack represents the relative value of the number of plants or organs of the plant under attack (n) reported to the number of observed plants or organs (N). The value of the frequency is established by direct observation on a number of plants or organs, according to the case and to the conditions, existing different methods of sample taking and for performing the observations. In the case of our observations, for the foliar diseases, the number of attacked plant organs out of the total of observed plant organs (leaves) was taken into consideration, being thus established the attack's frequency expressed in percentages %. In the case of blight, it is used the number of wheat's attacked ears, as reported to the total number of observed ears. The frequency is calculated with the formula $F\% = \frac{n \times 100}{N}$.

- The intensity of the attack represents the degree or percentage whereby a plant or a plant's organ is attacked and how much from the surface

of the plant or of the organ analyzed (leaf, fruit) is covered by the disease under study.

- The assessment of the surface under attack is done with the naked eye or with the magnifying glass, assessing the percentage occupied by spots or burns caused by the pathogenic agent. The affectation percentages can be noted or grades can be given for each plant or organ attacked by the disease and/or by the pest. The usage of grades can make easier data summarization in a great extent. It can be used a scale with 6 degrees of intensity, as follows:

- Grade 0 no attack
- Grade 1 attack between 1 and 3%
- Grade 2 attack between 3 and 10%
- Grade 3 attack between 11 and 25%
- Grade 4 attack between 26 and 50%
- Grade 5 attack between 51 and 75%
- Grade 6 attack between 76 and 100%

After data's summarization, the attack's intensity is determined by the formula:

$$I\% = \frac{\sum (i \times f)}{n}$$

Where:

- I% – attack's intensity (in %);
- i – intensity according to the grade given to the organ or plant under attack;
- f – number of cases (plants, organs) attacked;
- n – number of plants attacked.

Grades from 1 to 6, separately, to the "flag" leaf and to the next leaf situated beneath it, had been awarded in our experiment.

The degree of attack is the expression of the extension of the severity of the attack onto the crop or onto the total number of plants on which we perform the observations. The following relation gives the value expression of D.A.:

$$D.A (\%) = \frac{F \times I}{100}$$

In most cases, there is a negative correlation between the degree of attack of a pathogenic agent or pest and the quantitative and/or qualitative level of production

RESULTS AND DISCUSSIONS

The agricultural year 2021–2022 was a totally unfavorable year for the occurrence of the attack of the wheat-specific pathogen complex compared to previous years. In January and February, including the spring of 2022, very little rainfall was recorded and average temperatures were very high. For example, in January, the rainfall totaled only 5.2 l/m² and the average temperature was 2.6°C, which is very high. In February, the average temperature recorded was 5.1°C and the rainfall totaled only 10.5 l / m². In

March, the average temperature recorded was 4.1°C, the rainfall totaled only 8.5 l / m². In April, the average temperature recorded was 12.7°C, the rainfall totaled 30 l/m². In May, the average temperature was 19.7°C and the rainfall totaled 21 l/m². June was very dry compared to previous years (only 14 l/m²). It should also be noted that the average air humidity had low values in the spring of 2022 and in June, that is: March 54%, April 50.7%, May 47%, June 47.3%. Relatively little rainfall fell in the fall of 2021. However, the plants sprouted on time, as the crop also benefited from a sprouting watering with a norm of 400 m².

Regarding the dynamics of the occurrence of pathogen attacks in wheat, we mention that the pathogen that appeared in the 2022 experiment was the *Puccinia recondita f. sp. tritici* fungus that produces brown rust in wheat, at degree of attack (D.A.%) values much lower compared to the previous year.

If we analyze the data of *table 1*, we notice that the degree of attack of the pathogens monitored, on each treatment variant, was as follows:

-V1 NATIVO PRO 0.6 l/ha 1 treatment on 20th April + 1 treatment on 23rd May resulted in a degree of attack (D.A.%) of the *Puccinia recondita f.sp. tritici* fungus of 0.06 % in the “flag” leaf, and of 9.52 % in the second leaf, thus lower by 11.38 % and by 20.9% respectively, compared to the untreated control variant (V5).

-V2 EVALIA 1.00 l/ha +1 treatment on 20th April + 1 treatment on 23rd May caused a degree of attack (D.A.%) of the *Puccinia recondita f.sp. tritici* fungus of 0.18% in the “flag” leaf, and of 8.66% in the second leaf, thus lower by 11.26% and by 21.76% respectively, compared to the untreated control variant (V5).

-V3 NATIVO PRO 0.7 l/ha 1 treatment on 13th May caused a degree of attack (D.A.%) of the *Puccinia recondita f.sp. tritici* fungus of 0.12% in the “flag” leaf, and of 6.88% in the second leaf, thus lower by 11.32% and by 23.54% respectively, compared to the untreated control variant (V5).

-V4 EVALIA 1.00 l/ha 1 treatment on 13th May determined a degree of attack (D.A.%) of the *Puccinia recondita f.sp. tritici* fungus of 0.12% in the “flag” leaf and of 9.28% in the second leaf, i.e. lower by 11.32% and by 21.14% respectively, compared to the untreated control variant (V5).

-V5 Untreated control variant showed a degree of attack (D.A.%) of the *Puccinia recondita f.sp. tritici* fungus of 11.44% in the “flag” leaf, and 30.42% in the second leaf

All differences regarding the degree of attack (D.A.%) are statistically assured according to *Table 1*.

By analyzing *Table 2*, we can also see the yield differences compared to the untreated control variant, V5, as follows:

-V1 achieved a yield of 9.914 to/ha, thus 0.286 to/ha lower than that of the control variant.

-V2 achieved a yield of 10.668 to/ha, thus 0.468 to/ha higher than that of the control variant.

-V3 achieved a yield of 10.376 to/ha, so 0.176 to/ha higher than the control variant.

-V4 achieved a yield of 9.649 to/ha, so 0.551 to/ha lower than the control variant.

-V5 The untreated control variant achieved a yield of 10,200 to/ha

The yield increases of the treated variants, versus the untreated control variant (V5), do not provide statistical assurance.

CONCLUSIONS

The observations made in the summer of 2022 on the experiment with Glosa Romanian wheat-variety led to the following conclusions and recommendations:

1. The attacks of some pathogens were much lower than in previous years. Of these, only *Puccinia recondita f.sp. tritici*, which produces, in wheat, the disease known as brown rust, appeared. The values of the degrees of attack of this phytopathogenic fungus, both in the „flag” leaf and in the second leaf were much lower compared to previous years.

2. For a good protection of the wheat crop, when using the Romanian variety Glosa, we recommend performing, especially in years with dry spring, a single treatment with fungicidal products.

3. We emphasize that, in the years with dry spring, the attack of pathogens that produce foliar diseases in wheat, causes very low attack degrees even when the crop is irrigated. In this case, the experiment received 3 waterings. The first was applied in autumn, for a good sprouting.

4. The prices of products (2023) with fungicidal effect used in 2022 are as follows:

- NATIVO PRO 35 SL 230 lei/l (46.62 €) 0.7 l/ha was applied to V3, i.e., 161 lei/ha (32.63 €/ha);

- EVALIA-270 lei/l (54.73 €) 1.0 l/ha was applied to V4, i.e., 270 lei/ha (54.73 €/ha).

- For the V1 variant, 2 treatments with NATIVO PRO 35 SL were applied (0.6 l / ha / treatment), i.e., a total of 1.2 l of phytosanitary product / ha - the cost was 270 le / ha (54.73 €).

- For the V2 variant, 2 treatments with EVALIA were applied (1.00 l / ha / treatment), i.e., a total of 2 l phytosanitary product / ha - the cost was 540 lei / ha (109.46 €).

The differences in yield, expressed in value (lei) compared to the untreated control variant (V5), were as follows:

-V1 was - 0.286 to/ha, amounting to 343 lei/ha (69.52 €);

-V2 was + 0.468 to/ha, amounting to 561.6 lei/ha (113.83 €);

-V3 was +0.176 to/ha, amounting to 211.2 lei/ha (42.81€);

-V4 was -0.551 to/ha, amounting to 661.2 lei/ha (134.02 €);

-V5 - The yield of the untreated control variant was 10,200 to/ha.

5. From the analysis of economic profitability, it seems, that in the climatic conditions of 2022, which was very dry and hot in the first half, the most profitable turned out to be V5– the untreated control variant. However, we do not recommend, even in very dry and hot years, the cultivation of wheat without applying any treatment, during vegetation, with a phytosanitary product with fungicidal action.

6. In years with dry and hot winters and springs, we recommend a single treatment with fungicidal products for wheat. During these years, cheaper products with fungicidal effect, approved in Romania, can be used, such as those based only on tebuconazole: ARMADA (250 g / l tebuconazole)

at a dosage of 0.5 l / ha, ORIUS 25 EW (SALVATOR 25 EW – a second trade name) 0.5 l / ha according to the Pest-Expert website of the National Phytosanitary Authority, structure subordinated to the Ministry of Agriculture and Rural Development of Romania.

The export-quoted wheat price was 1.2 lei/ton (247.25 €/to) in Romania on 22nd July 2023, according to the Agri Portal website.

The leu/€ exchange rate, for the first 6 months of 2023, was 4.9335 lei/1 €, according to the website of the National Bank of Romania.

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