

THE INFLUENCE OF TREATMENTS WITH VARIOUS PHYTOSANITARY PRODUCTS (FUNGICIDES) ON THE ATTACK OF SOME PHYTOPATHOGENIC FUNGI ON WHEAT HARVEST – GLOSA VARIETY - IN 2024 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 (septorioses). The influence of applying some fungicides on the harvest, as compared to the untreated control variant, has been monitored. One experiment with 7 variants (6 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: CYDELI TOP (125 g/l difenoconazole, 15 g/l cyflufenamid), EVALIA (250g/l azoxystrobin) and MYSTIC GOLD (250 g/l tebuconazole). The treatment variants were the following: V1 – CYDELI TOP 0.5 L/HA - treatment applied at straw's extension + 1 treatment at the filling of a wheat grain, V2--CYDELI TOP -0.5 L/HA - treatment applied in booting phase, V3 - EVALIA 1.0 L/HA - treatment applied at straw's extension + 1 treatment at the filling of a wheat grain; V4 - EVALIA 1.0 L/HA - treatment applied in booting phase, V5 - MYSTIC GOLD 1.0 L/HA - treatment applied at straw's extension + 1 treatment at the filling of a wheat grain, V6- MYSTIC GOLD 1.0 L/HA - treatment applied in booting phase and V7 - Control variant not treated. The experiment was placed in Latin square, the 7 variants being placed in 7 repetitions. The year 2024 was a year with a relatively wet spring and early summer for the area where the experiment was performed. The experiment was established after corn. The climatic conditions were favorable to the attacks of some wheat pathogens, especially those of *Septoria* sp. genus. The yields of the variants were as follows: V1 – 8.565 to/ha, V2 – 8.421 to/ha, V3- 8.579 to/ha, V4 – 8.351 to/ha, V5 8.584 to/ha, V6 – 8.345 to/ha and V7 (control variant not treated) – 7.587 to/ha.

Keywords: *Puccinia*, *Septoria*, latin square experimental design

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 (septorioses) - *Septoria tritici*, *Septoria nodorum*, stem's fusariosis and ear's rot *Giberella zeae*, *Giberella avenacea* (Iacob Viorica, Hatman, M., Ulea, E., Puiu, I. 1998).

The first half of 2024 was, for wheat, relatively favorable in terms of climatic conditions, somehow similar to the first half of 2023. Average temperatures were slightly higher than the same period in 2023. In February, the average temperature was 7°C, rainfall totaled 11 l/m² and the average relative humidity of the air was 70%. In March, the average temperature was 8.5°C, the average relative humidity of the air was 72% and rainfall totaled 30 l/m². In April, the average temperature was 14.5°C, rainfall totaled 41 l/m² and the average relative humidity of the air was 56%. In May, the average temperature recorded

was 17°C, rainfall totaled 37 l/m² and the average relative humidity of the air was 57.5%. In June, the average temperature recorded was 25°C, rainfall totaled 42 l/m² and the average relative air humidity was 48.7%. Under these conditions, the presence of the *Septoria* sp. fungus, which causes, in wheat, diseases known as brown leaf spots (septorioses), made itself felt. The phytopathogenic fungus *Puccinia recondita* f. sp. tritici showed a weaker presence than the previously mentioned one. The attack of fungi of the genus *Gibberella* was practically absent, probably due to the fact that June came with high temperatures and an air humidity of only 48%.

The experiment received a watering amounting to 800m² in May 2024, to complete the amount of water coming from rainfall. This watering contributed substantially to achieving a good wheat yield, especially since the month of June proved to be poorer in precipitation than April and May of 2023.

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Table 1

The results of the experiment with fungicide products (6 variants of treatment + 1 untreated control variant) in what concerns the attack (D.A.%) of *Septoria* sp. fungus ("flag" leaf and the next leaf). The observations had been made on 17th June 2024

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-CYDELI TOP 0.5 L/HA, 1 treatment applied at straw's extension + 1 treatment applied at wheat grain filling	19.20	29.72	**	66.07	24.63	**
V2--CYDELI TOP 0.5 L/HA, 1 treatment applied in booting phase	16.56	32.36	**	70.07	20.63	**
V3--EVALIA 1.0 L/HA, 1 treatment applied at straw's extension + 1 treatment applied at wheat grain filling	16.30	32.62	**	61.43	29.27	**
V4-EVALIA 1.0 L/HA, 1 treatment applied in booting phase	20.61	28.31	**	64.80	25.90	**
V5-MYSTIC GOLD 1.0 L/HA, 1 treatment applied at straw's extension +1 treatment applied at wheat grain filling	19.49	29.43	**	70.30	20.40	**
V6-MYSTIC GOLD 1.0 L/HA, 1 treatment applied in booting phase	19.64	29.28	**	66.36	24.34	**
V7- Untreated control variant	48.92	-		90.70		

LD D.A. % for the "flag" leaf

LD 5% = 7.73%

LD 1% = 10.40%

LD D.A. % for the second leaf

LD 5% = 12.52%

LD 1% = 16.90%

Table 2

The results of the experiment with fungicide products (6 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-CYDELI TOP 0.5 L/HA, 1 treatment applied at straw's extension +1 treatment applied at wheat grain filling	8,5650	0.978	**
V2-CYDELI TOP -0.5 L/HA, 1 treatment applied in booting phase	8,4210	0.834	**
V3-EVALIA 1.0 L/HA, 1 treatment applied at straw's extension +1 treatment applied at wheat grain filling	8,5790	0.992	**
V4--EVALIA 1.0 L/HA, 1 treatment applied in booting phase	8,3510	0.764	**
V5-MYSTIC GOLD 1.0 L/HA, 1 treatment applied at straw's extension +1 treatment applied at wheat grain filling	8,5840	0.997	**
V6-MYSTIC GOLD 1.0 L/HA, 1 treatment applied in booting phase	8,3450	0.758	**
V7- Untreated control variant	7,5870	-	-

LD 5% = 0.4284 to/ha

LD 1% = 0.5775 to/ha

Figure 1 Pycnidia of the *Septoria* sp. fungus (original).

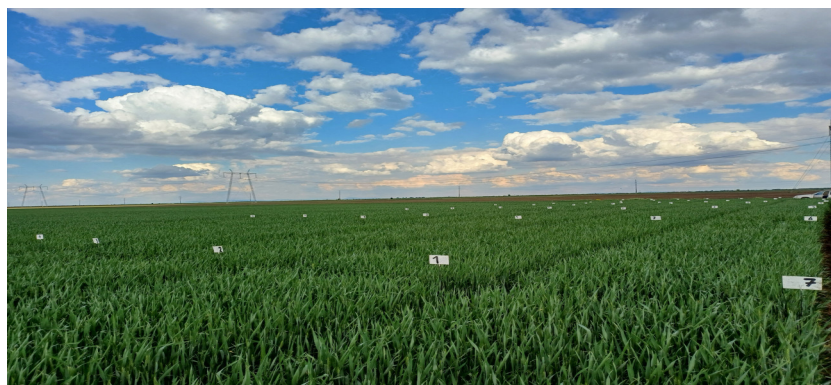


Figure 2 - Aspects from the experimental field (original).

MATERIAL AND METHOD

One experiment with 7 study variants had been conceived for performing the observations. This experiment comprised 6 phytosanitary treatment variants (fungicide products containing various active substances) and one untreated control variant. The variants of the experiment were the following:

- V1: CYDELI TOP 0.5 L/HA, 1 treatment applied at straw's extension + 1 treatment applied at wheat grain filling;
- V2: CYDELI TOP 0.5 L/HA, 1 treatment applied in booting phase;
- V3: EVALIA 1.0 L/HA, 1 treatment applied at straw's extension + 1 treatment applied at wheat grain filling;
- V4: EVALIA 1.0 L/HA, 1 treatment applied in booting phase;
- V5: MYSTIC GOLD 1.0 L/HA, 1 treatment applied at straw's extension + 1 treatment applied at wheat grain filling;
- V6: MYSTIC GOLD 1.0 L/HA, 1 treatment applied in booting phase;
- V7: untreated control sample.

The experiment was placed in Latin square; the 7 variants were placed in 7 repetitions. Each experimental plot had an area of 12 m² (6 x 2m). The total number of experimental plots was 49. The surface of an experimental variant was of 12 m² x 7 repetitions = 84 m². The total area of the experiment was of 84 m² x 7 = 588 m².

The treatments had been performed manually, with a "Vermorel" 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 0.6 l / ha applied, separately, with the Vermorel. The experiment has monitored the effectiveness of the above-mentioned phytosanitary 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 taken into account that the spring of 2024 was relatively rainy

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 *Septoria* sp. fungus which produces in wheat the disease known as septoriosi. Other pathogenic agents specific to wheat (*Blumeria* sp. *Puccinia* sp.) were signaled in the climatic conditions of the first half of the year 2024, but in a smaller percentage.

For assessing the yield of each variant under study, samples of wheat grains from each experimental plot, 5 samples each / plot, had been analyzed by spot check. Each sample contained 20 plants, so 100 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).

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 blights (*Ustilago* sp), 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 $F\% = nx100/N$.

- 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 affection 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 yield level.

RESULTS AND DISCUSSIONS

The first half of 2024 was more favorable to the onset of the attack of the wheat-specific pathogen complex. February, March, April and May months had relatively similar rainfall compared to 2023. In the autumn of 2023, there was relatively sufficient rainfall. Under these conditions, the plants emerged in time to successfully survive the winter of 2023-2024. This winter was relatively warmer than the average of previous years. The crop was irrigated in the spring of 2024 with 800 m² of water per ha.

Regarding the dynamics of the occurrence of pathogen attacks on wheat, we mention that the pathogen that appeared in the experiment in 2024 was the *Septoria* sp. fungus which produces wheat septorios. Besides *Septoria* sp., symptoms produced by *Puccinia recondita* f. sp. *tritici* were also accidentally observed.

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

-V1 determined a degree of attack (D.A.%) of the *Septoria* sp fungus % on the “flag” leaf of 19.20% and 66.07% on the second leaf, therefore lower by 29.72% and respectively by 24.63% compared to the untreated control variant (V7).

-V2 determined a degree of attack (D.A.%) of the *Septoria* sp fungus of 16.56% on the “flag” leaf and 70.07% on the second leaf, therefore lower by 32.36% and respectively by 20.63% compared to the untreated control variant (V7).

-V3 determined a degree of attack (D.A.%) of the *Septoria* sp fungus. of 16.30% on the “flag” leaf and 61.43% on the second leaf, therefore lower by 32.62% and respectively by 29.27% compared to the untreated control variant (V7).

-V4 determined a degree of attack (D.A.%) of the fungus *Septoria* sp of 20.61% on the “flag” leaf and 64.80% on the second leaf, therefore lower by 28.31% and respectively by 25.90% compared to the untreated control variant (V7).

-V5 presented a degree of attack (D.A.%) of the fungus *Septoria* sp. of 19.49% on the “flag” leaf and 70.30% on the second leaf, therefore lower by 29.43% and respectively by 20.40% compared to the untreated control variant (V7).

-V6 presented a degree of attack (D.A.%) of the fungus *Septoria* sp. of 19.64% on the “flag” leaf and 66.36% on the second leaf, therefore lower by 29.28% and respectively by 24.34% compared to the untreated control variant (V7).

-V7 The untreated control presented a degree of attack (D.A.%) of the fungus *Septoria* sp. of 48.92% on the “standard” leaf and 90.70% on the second leaf

All differences in terms of attack degree (D.A.%) are statistically assured, according to table 1.

From the analysis of table 2, the yield differences compared to the untreated control V7 can also be observed as follows:

-V1 achieved a yield of 8.5650 to/ha, therefore with 0.978 to/ha lower than the control variant.

-V2 achieved a yield of 8.4210 to/ha, therefore with 0.834 to/ha higher than the control variant.

-V3 achieved a yield of 8.5790 to/ha, therefore with 0.992 to/ha higher than the control variant.

-V4 achieved a yield of 8.3510 to/ha, therefore with 0.764 to/ha lower than the control variant.

-V5 achieved a yield of 8.5840 to/ha, therefore with 0.997 to/ha lower than the control variant.

-V6 achieved a yield of 8.3450 to/ha, therefore with 0.758 to/ha higher than the control variant.

-V7: The untreated control variant achieved a yield of 7.5870 to/ha.

CONCLUSIONS

The observations made in the summer of 2024 on the experiment with the Romanian wheat-variety Glosa, led to the following conclusions and recommendations:

1. The attacks of some pathogens were relatively high in 2024. Among them, *Septoria* sp appeared mainly, which causes in wheat diseases known as septoriosiis. The degree of attack of this phytopathogenic fungus, both on the flag leaf and on the second leaf, had significantly higher values compared to the untreated control.

2. For good protection of the wheat crop, when using the Romanian variety Glosa, we recommend performing, especially in years with moderately humid and cool springs, a single treatment with fungicidal products, applied in the booting - flowering phase of the wheat plants.

3. During the years with springs with rainfall, higher atmospheric humidity and lower temperatures, we recommend performing two treatments with plant protection products with fungicidal effect.

4. The prices of products (2025) with fungicidal effect used in 2024 are as follows:

- Cidely Top costs approximately 270 lei/ha, i.e. approximately 54 €/l. Applying 0.5 l/ha means 135 lei/ha (27 €/l/ha)
- Evalia costs approximately 240 lei /ha, i.e. 48 €/l/ha. Applying 1 l/ha means 240/lei/ha (47.34 €/l/ha).
- Mystic Gold costs approximately 110 lei/l (22 €/l/ha). Applying 1 l/ha means 110/lei/ha (22 €/l/ha).

In variant V1, 2 treatments with the product Cydeli Top 0.5 l/ha were applied, meaning the total cost of the phytosanitary product/ha was 270 lei/ha (55 €/ha)

In variant V2, 1 treatment with the product Cydeli Top 0.5 l/ha was applied, meaning the total cost of the phytosanitary product/ha was 135 lei/ha (27 €/ha).

In variant V3, 2 treatments with the product Evalia 1l/ha were applied, meaning the total cost of the Evalia fungicide product was 480 lei/ha (96 €/ha)

In variant V4, 1 treatment with the product Evalia 1l/ha was applied, meaning the total cost of the fungicide product/ha was 240 lei/ha (48 €/ha).

In variant V5, 2 treatments with the Mystic Gold product 1l/ha were applied, meaning the total cost of the fungicide product was lei/ha 220 lei /ha (44€/ha).

In variant V6, 1 treatment with the Mystic Gold product 1l/ha was applied, meaning the total cost of the fungicide product/ha was 110 lei/ha (22€/ha).

The yield differences, expressed in value (lei) compared to the untreated control (V7), were the following:

-V1: The yield difference was 0.978 to/ha, amounting to 782 lei/ha (156.4 €/ha);

-V2: The yield difference was 0.834 to/ha, amounting 667 lei/ha lei/ha (133.4€/ha);

-V3: The yield difference was 0.992 to/ha, amounting 794 lei/ha (158.8€/ha);

-V4: The yield difference was 0.764 to/ha, amounting 611 lei/ha (122.2€/ha);

-V5: The yield difference was 0.997 t/ha, amounting 798 lei/ha (159.6€/ha);

-V6: The yield difference was 0.758 t/ha, amounting 606 lei/ha (121.2€/ha);

-V7 The yield of the untreated control was 7.587 t/ha.

We emphasize that all variants presented statistical assurance.

5. From the analysis of economic profitability, in the climatic conditions of 2024, all variants with treatment achieved economically profitable yields, of course, some of them offering a better economic output. Under these conditions, we recommend, in years with relatively wet and cool springs, performing a single treatment, in the booting -flowering vegetation phase of the wheat, with a treatment with a more efficient fungicidal product, such as two of those used in this experiment: Cydeli Top (125 g/l difenoconazole, 15 g/l cyflufenamid) – if it will also be approved for wheat in Romania, and Evalia (250 g/l azoxystrobin). In the years with springs where precipitation falls above the multi-annual average of the area and temperatures are lower than usual, we recommend performing two treatments with more efficient fungicidal products.

6. In the years with dry and warm winters and springs, a single treatment with cheaper fungicidal products such as those based only on tebuconazole can be applied to wheat. Here we mention: ARMADA (250 g/l tebuconazole) at a dosage of 0.5 l/ha, ORIUS 25 EW (SALVATOR 25 EW - the second commercial name) 0.5 l/ha, MYSTIC GOLD -1.0 l/ha according to the Pest-Expert website of the National Phytosanitary Authority, a structure subordinated to the Ministry of Agriculture and Rural Development of Romania.

7. The Cydeli Top product is not approved for wheat, being used in this experiment exclusively for experimental purposes. It is approved for some vegetable species (tomatoes, peppers, eggplants, cucumbers, and zucchini) as well as for strawberries at a dosage of 1l/ha for the prevention and control of specific pathogens such as the genera of phytopathogenic fungi: *Alternaria*, *Colletotrichum*, *Cladosporium*, etc. It is a relatively expensive product. In wheat, under the climatic conditions of the first half of 2024, it proved effective at a dosage of only 0.5 l/ha applied in a single treatment in the booting stage. Of course, it remains at the discretion of the manufacturer (Syngenta Company) whether it wishes to extend its approval in Romania to wheat.

8. The price of wheat, quoted for export, was, in Romania, on 13th August 2025, approximately 0.8 lei/kg - approximately 160€/to (Cereal Exchange 2025).

9. The average exchange rate leu/€, in the months of April, May and June of 2025, was 5.0626 lei/€1, according to the website of the National Bank of Romania.

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