

THE INFLUENCE OF TREATMENTS WITH VARIOUS PHYTOSANITARY PRODUCTS (FUNGICIDES) ON THE ATTACK OF SOME PHYTOPATHOGENIC FUNGI ON WHEAT HARVEST – GLOSA VARIETY - IN 2021 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 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: NATIVO PRO 325 SL (prothioconazole 175 g/l + trifloxystrobin 150 g/l), EVALIA (azoxystrobin 250 g/l), EVOLUS (prochloraz 320 g/l, + tebuconazole 160 g/l, + proquinazid 40 g/l). The treatment variants were the following: V1 – NATIVO PRO 325 SL 0.70 L/HA, 1 treatment applied at straw's extension (22nd April 2021) + 1 treatment applied at the beginning of kernel's filling (7th June 2021), V2 – EVALIA 1.00 L/HA, 1 treatment applied at straw's extension (22nd April 2021) + 1 treatment applied at the beginning of kernel's filling (7th June 2021), V3 – EVOLUS 0.75 L/HA 1 treatment applied at straw's extension (22nd April 2021), 1 treatment applied at the beginning of kernel's filling (7th June 2021), V4 – NATIVO PRO 325 SL 0.70 L/HA, 1 treatment applied at earing – blooming (23rd May 2021), V5 - EVALIA 1.00 L/HA 1 treatment applied at earing – blooming (23rd May 2021), V6 - EVOLUS 0.75 L/HA 1 treatment applied at earing – blooming (23rd May 2021), V7 – untreated control variant. The experiment was placed in Latin square; the 7 variants being placed in 7 repetitions. The year 2021 was rainy in May and June. This has led to obtaining very good wheat yields, but also to the appearance of pathogens' attacks (e.g. *Septoria* sp) which prefer such weather conditions. Among the pathogens monitored, the highest attacks had been produced by fungi of the *Septoria* sp. genus which produce, in wheat, diseases known as septoriosis. *Puccinia recondita* f.sp. *tritici* producing brown rust in wheat, has generated less attacks. The fungi attack of the *Blumeria (Erysiphe)* genus producing mildew was sporadic. For this study, the first two leaves located under the ear has been analyzed. These observations has led to the conclusion that all of the 6 treatment variants showed degrees of attack (D.A%) of *Septoria* sp. fungi, but the attack was lower than in the untreated control variant. The yields of the variants were as follows: V1: 7.259 to/ha, V2: 7.327 to/ha, V3: 7.344 to/ha, V4: 7.310 to/ha, V5: 7.225 to/ha, V6: 7.174 to/ha and V7: 6.919 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 burn *Giberella zeae*, *Giberella avenacea* (Iacob Viorica, Hatman, M., Ulea, E., Puiu, I. 1998). The first half of the year 2021 was very favorable to wheat, in what concerns the climatic conditions. Rainfalls in sufficient quantities had been registered in this period and the average temperatures had been situated at values almost near to the normal of the period for this date. In March, the average temperature registered was 6°C and the rainfalls

amounted in total to 32.5 l/m², as compared to the previous year when they were of only 1.4l/m². In April, the average temperature was 10.9°C and the rainfalls amounted in total to 44.5 l/m². In May, the average temperature registered was 17°C and the rainfalls amounted in total to 32.5 l/m. In June, the average registered temperature was 20.2°C and the rainfalls totaled up to 88 l/m². In these conditions, *Puccinia recondita* f. sp. *tritici* fungus, producing wheat's brown rust (E. Velichi 2012) made known its presence in 2021, in a smaller extent as compared to previous years. Instead, the favorable weather conditions – relatively low average temperatures, accompanied by rainfalls, have determined the occurrence of

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phytopathogenic fungi of *Septoria* sp. (figure 1) producing, in wheat, diseases known as septoriosis. Even if favorable conditions occurred,

no attacks from fungi of *Giberella* sp. genus producing diseases known as fusariosis, have been observed.

Table 1

The results of the experiment (the first treatment applied at straw's extension, the second at kernel's filling) 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 4th June 2021

| 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 325 SL 0.70 L/HA 1 treatment applied at straw's extension (22 nd April 2021) + 1 treatment applied at the beginning of kernel's filling (07.06 2021) | 10.23 | 44.54 | ** | 61.94 | 31.63 | ** |
| V2 - EVALIA 1.00 L./HA 1 treatment applied at straw's extension (22 nd April 2021) + 1 treatment applied at the beginning of kernel's filling (07.06 2021) | 21.24 | 33.53 | ** | 82.54 | 11.03 | Not significant |
| V3 - EVOLUS 0.75 L/HA treatment applied at straw's extension (22 nd April 2021) + 1 treatment applied at the beginning of kernel's filling (07.06 2021) | 20.48 | 34.29 | ** | 77.40 | 16.17 | Not significant |
| V4 - NATIVO PRO 325 SL 0.70 L/HA 1 treatment applied at earing – blooming (23 rd May 2021) | 20.74 | 34.03 | ** | 83.21 | 10.36 | Not significant |
| V5 - EVALIA 1.00 L./HA 1 treatment applied at earing – blooming (23 rd May 2021) | 20.21 | 34.56 | ** | 86.42 | 7.15 | Not significant |
| V6 - EVOLUS 0.75 L/HA 1 treatment applied at earing – blooming (23 rd May 2021) | 19.35 | 35.42 | ** | 88.21 | 5.36 | Not significant |
| V7 - Untreated control variant | 54.77 | - | - | 93.57 | - | - |

LD D.A. % for "flag" leaf

LD 5%= 17.43%

LD 1%= 23.36%

LD D.A. % for the second leaf

LD 5%=17.19%

LD 1%=23.04%

Table 2

The results of the experiment (the first treatment applied at straw's extension, the second at kernel' filling) 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 --NATIVO PRO 325 SL 0.70 L/HA 1 treatment applied at straw's extension (22 nd April 2021) + 1 treatment applied at the beginning of kernel's filling (07.06 2021) | 7.259 | 0.340 | ** |
| V2 - EVALIA 1.00 L/HA 1 treatment applied at straw's extension (22 nd April 2021) + 1 treatment applied at the beginning of kernel's filling (07.06 2021) | 7.327 | 0.408 | ** |
| V3 - EVOLUS 0.75 L/HA 1 treatment applied at straw's extension (22 nd April 2021) + 1 treatment applied at the beginning of kernel's filling (07.06 2021) | 7.344 | 0.425 | ** |
| V4 - NATIVO PRO 325 SL 0.70 L/HA 1 treatment applied at earing – blooming (23 rd May 2021) | 7.310 | 0.391 | ** |
| V5 - EVALIA 1.00 L/HA 1 treatment applied at earing – blooming (23 rd May 2021) | 7.225 | 0.306 | * |
| V6 - EVOLUS 0.75 L/HA 1 treatment applied at earing – blooming (23 rd May 2021) | 7.174 | 0.255 | * |
| V7 - Untreated control variant | 6.919 | - | - |

LD 5% = 0.242 to/ha, LD 1% = 0.327 to/ha

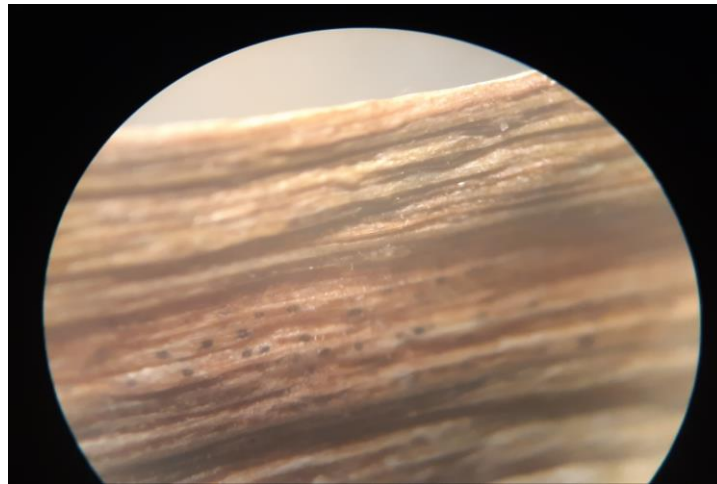


Figure 1 *Septoria sp* (pycnidia)



Figure 2 - Aspects from the experimental field (original)

MATERIAL AND METHOD

1 experiment with 7 study variants each 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 NATIVO PRO 325 SL 0.70 L/HA 1 treatment applied at straw's extension (22nd April 2021) + 1 treatment applied at the beginning of kernel's filling (07.06 2021);

- V2 EVALIA 1.00 L/HA 1 treatment applied at straw's extension (22nd April 2021) + 1 treatment applied at the beginning of kernel's filling (07.06 2021);

- V3 EVOLUS 0.75 L/HA 1 treatment applied at straw's extension (22nd April 2021) + 1 treatment applied at the beginning of kernel's filling (07.06 2021);

- V4 NATIVO PRO 325 SL 0.70 L/HA 1 treatment applied at earing – blooming (23rd May 2021);

- V5 EVALIA 1.00 L/HA 1 treatment applied at earing – blooming (23rd May 2021);

- V6 EVOLUS 0.75 L/HA 1 treatment applied at earing – blooming (23rd May 2021);

- V7- Untreated control variant

The experiment was placed in Latin square; the 7 variants were placed in 7 repetitions. Each experimental plot had an area of 15 m² (5 x 3m). The total number of experimental plots was 49. The surface of an experimental variant was of 15 m² x 7 repetitions = 105 m². The total area of the experiment was of 105 m² x 7 = 735 m². The treatments had been performed manually, with a "Vermorel" type of equipment. "Trend" adjuvant product, in concentration of 0.03%, was added to the spraying solution. Weeds were fought against with the help of Mustang herbicide (6.25 g/l florasulam + 300 g/l acid 2,4-D EHE) in a dosage of 0.5 l/ha separately applied with Vermorel. An insecticide (Faster 10 CE – 0.15 l/ha) product was also added to the herbicide solution for fighting against cereals' bugs - *Eurygaster sp*. The purpose of the experiment had been the efficiency of the mentioned phytosanitary products, as reported to

their price. Also, the efficiency and profitability in applying only one phytosanitary treatment with a product with fungicide effect or two phytosanitary treatments with one product with fungicide effect during wheat's vegetation period was observed. It was taken into consideration the fact that the spring and first summer month of 2021 were 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 stereomicroscope 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 the presence of *Septoria* sp. fungus which produces wheat's brown leaf spotting (septoriosis) in the analyzed samples (fig.1). Other pathogenic agents specific to wheat were signaled in a smaller percentage.

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).

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 $F\% = nx100/N$.

- 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 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 2020–2021 agricultural year was a year favorable to the attack of the complex of wheat specific pathogens as compared to previous years. Relatively high quantities of rainfalls had been registered in the spring of 2021, and the average temperatures were moderate. For example, in March, the rainfalls totaled to 32.5 l/m². In April,

the average recorded temperature was 10.9°C, and rainfalls totaled 44.5 l/m². In May, the average recorded temperature was 17°C and rainfalls totaled 32.5 l/m². June was very rainy (88 l/m²). In the autumn of 2021, sufficient rainfalls have fallen, which have led to an optimum emergence of plants. Accordingly, the plants have emerged on time, their density at harvesting being of approximately 595 ears/m².

In what concerns the dynamics of the occurrence of pathogens to wheat, we mention that the pathogenic agent which occurred in the experiment in the year 2021 was *Septoria* sp. fungus producing the wheat's brown leaf spotting. Attacks of *Blumeria graminis* f.sp. *tritici* producing the disease known as mildew occurred sporadically. It is interesting that in 2021, even if favorable weather conditions had occurred, no attacks of *Giberella* sp. producing diseases known under the name of fusarioses (*Fusarium* sp.) had been observed.

When analyzing the data from Table 1, we observe that the degree of attack of the pathogens under monitoring, on each variant of treatment, is the following:

-V1 NATIVO PRO 325 SL 0.70 L/HA 1 treatment applied at straw's extension (22nd April 2021)+1 treatment applied at the beginning of kernel's filling (07.06 2021), has determined a degree of attack (D.A.%) of *Septoria* sp. fungus of 10.23 % at the "flag" leaf and 61.94 % at the second leaf, so smaller by 44.54% and respectively by 31.63% as compared to the untreated control variant (V7).

-V2 EVALIA 1.00 L./HA 1 treatment applied at straw's extension (22nd April 2021)+1 treatment applied at the beginning of kernel's filling (07.06 2021), has determined a degree of attack (D.A.%) of *Septoria* sp. fungus of 21.24% at the "flag" leaf and 82.54% at the second leaf, so smaller by 33.53% and respectively by 11.03% as compared to the untreated control variant (V7).

-V3 EVOLUS 0.75 L/HA treatment applied at straw's extension (22nd April 2021)+1 treatment applied at the beginning of kernel's filling (07.06.2021), has determined a degree of attack (D.A.%) of *Septoria* sp. fungus of 20.48% at the "flag" leaf and 77.40% at the second leaf, so smaller by 34.29% and respectively by 16.17% as compared to the untreated control variant (V7).

-V4 NATIVO PRO 325 SL 0.70 L/HA 1 treatment applied at earing – blooming (23rd May 2021) has determined a degree of attack (D.A.%) of *Septoria* sp. fungus of 20.74% at the "flag" leaf and 83.21% at the second leaf, so smaller by 34.03% and respectively by 10.36% as compared to the untreated control variant (V7).

-V5 EVALIA 1.00 L/HA treatment applied at earing – blooming (23rd May 2021) has determined a degree of attack (D.A.%) of *Septoria* sp. fungus of 20.21% at the "flag" leaf and 86.42% at the second leaf, so smaller by 34.56% and respectively by 7.15% as compared to the untreated control variant (V7).

-V6 EVOLUS 0.75 L/HA treatment applied at earing – blooming (23rd May 2021) has determined a degree of attack (D.A.%) of *Septoria* sp. fungus of 19.35% at the "flag" leaf and 88.21% at the second leaf, so smaller by 35.42% and respectively by 5.36% as compared to the untreated control variant (V7).

-V7 control variant presented a degree of attack of *Septoria* sp. fungus of 54.77% at the "flag" leaf and 93.57% at the second leaf.

All differences in what concerns the degree of attack (D.A. %) are statistically assured, according to Table 1.

Out of the analysis of Table 2, the production differences as compared to untreated control variant V7 can be also observed, as follows:

-V1 NATIVO PRO 325 SL 0.70 L/HA 1 treatment applied at straw's extension (22nd April 2021) + 1 treatment applied at the beginning of kernel's filling (07.06.2021), has achieved a yield of 7.259 to/ha so by 0.340 to/ha higher than that of the control variant.

-V2 EVALIA 1.00 L./HA 1 treatment applied at straw's extension (22nd April 2021)+1 treatment applied at the beginning of kernel's filling (07.06.2021), has achieved a yield of 7.327 to/ha, so by 0.408 to/ha higher than that of the control variant.

-V3 EVOLUS 0.75 L/HA 1 treatment applied at straw's extension (22nd April 2021)+1 treatment applied at the beginning of kernel's filling (07.06 2021), has achieved a yield of 7.344 to/ha, so by 0.425 to/ha higher than that of the control variant.

-V4 NATIVO PRO 325 SL 0.70 L/HA 1 treatment applied at earing – blooming (23rd May 2021) has achieved a yield of 7.310 to/ha, so by 0.391 to/ha higher than that of the control variant.

-V5 EVALIA 1.00 L./HA 1 treatment applied at earing – blooming (23rd May 2021) has achieved a yield of 7.225 to/ha, so by 0.306to/ha higher than that of the control variant.

-V6 EVOLUS 0.75 L/HA 1 treatment applied at earing – blooming (23rd May 2021) has achieved a yield of 7.174 to/ha, so by 0.255 to/ha higher than that of the control variant.

-V7 untreated control variant achieved a yield of 6.919 to/ha

The yield increase of the treated variants, compared to the untreated control variant (V7), presents statistical assurance.

CONCLUSIONS

The observation performed in the summer of 2021 on the experiment with wheat - Glosa Romanian variety, have led to the following conclusions and recommendations:

1-The attacks of the pathogenic agents were higher than in the previous years. Among them, we mention *Septoria* sp. pathogen which produces diseases known as septorioses to wheat.

2-For a reliable protection of the wheat crop, in case of using Romanian Glosa variety, we recommend, even in the years with rainy springs, the performance of one single treatment with fungicide products, such as the ones used in the present experiment. It seems that the performance of only one treatment in the earing – blooming phase is very efficient from economic point of view.

3-The prices of the products (2022) with fungicide effect used in 2021 are the following: NATIVO - PRO 35 SL 185 lei/l (37.4 €), 0.7 l/ha were applied, i.e. 129.5 lei/ha (26.2 €/ha), EVALIA – 267 lei/l (54 €), 1 l/ha were applied, i.e. 267 lei /ha (54 €/ha), EVOLUS- 200 lei/l (40.4 €/ha), 0.75 l/ha were applied, i.e. 150 lei/ha (30.3 €/ha).

The yield increase, expressed value wise (lei) as compared to the untreated control variant (V7), was the following:

- For V1, it was 0.340 to/ha, in amount of 578 lei/ha (116.8 €);
- For V2, it was 0.408 to/ha, in amount of lei/ha 693.6 lei/ha (140.2 €);
- For V3, it was 0.425 to/ha, in amount of 722.5 lei/ha (146.1 €);

- For V4, it was 0.391 to/ha, in amount of 664.7 lei/ha (134.4 €);
- For V5, it was 0.306 to/ha, in amount of 520 lei/ha (105.14 €);
- For V6, it was 0.255 to/ha, in amount of 433.5 lei/ha (87.7 €).

From the economic profitability analysis, it seems that, in the climatic conditions of 2021, the V4 NATIVO PRO 35 SL variant proved to be the most profitable – a single treatment with 0.7 l / ha applied in the wheat's earing – blooming phase. A yield increase of 134.4 €/ha was obtained at 26.2 €/ha invested.

The approximate average price of wheat was 1700 lei/to (343 €/to) in Romania as of 9th August, 2022, according to the Agri Portal website

The leu/€exchange rate, for the first 6 months of 2022, was 4.9455 lei/1€, according to the National Bank of Romania's website.

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