

THE INFLUENCE OF TREATMENTS WITH VARIOUS PHYTOSANITARY PRODUCTS (FUNGICIDES) ON THE ATTACK OF SOME PHYTOPATHOGENIC FUNGI ON WHEAT – AIRBUS VARIETY, IN 2020 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 pathogenic agents to French wheat variety, Airbus. Among these, we mention: *Puccinia recondita* f. sp. *tritici* (sin. *Puccinia triticina*) (fig. 1) 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 production, as compared to the untreated control variant, was 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: EVOLUS (prochloraz 320 g/l, tebuconazole 160 g/l, proquinazid 40g/l), AMISTAR (azoxystrobin 250 g/l), FALCON PRO (prothioconazole 53 g/l, spiroxamine 224 g/l, tebuconazole 148 g/l), TOPSIN 500 SC (thiophanate-methyl 500 g/l), ORIUS 25 EW (250 g/l tebuconazole), DITHANE M 45 (mancozeb 80%). The treatment variants were the following: EVOLUS 0,75 L/HA - 1 treatment applied at spike's releasing - 23.05.2020, V2 - AMISTAR 0.75 L/HA - 1 treatment applied at spike's releasing - 23.05.2020, V3 - FALCON PRO 0.6 L/HA - 1 treatment applied at spike's releasing - 23.05.2020, V4 - ORIUS 25 EW 0.5 L/HA + TOPSIN 500 SC 1.0 L/HA - 1 treatment applied at spike's releasing - 23.05.2020, V5 - ORIUS 25 EW 0.5 L/HA 1 + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's releasing - 23.05.2020, V6 - TOPSIN 500 SC 1.0 L/HA + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's releasing - 23.05.2020, V7 - Untreated control variant. The experiment was placed in Latin square; the 7 variants being placed in 7 repetitions. The experiment was performed under irrigation conditions. The year 2020 was one of the driest years in the last 3 decades. Among the pathogenic agents under monitoring, *Puccinia recondita* f.sp. *tritici* fungus producing the brown rust had produced the greatest attacks. The attack of the fungi from *Blumeria* (*Erysiphe*) variety, producing wheat's mildew, was rare. No attacks of fungi from *Septoria* sp. variety producing leaf's brown rust (septoriosis) were observed. The first two leaves placed under the spike had been analyzed for the above. These observations had led to the conclusion that for all 6 treatment variants, the degree of attack (D.A. %) of *Puccinia recondita* f.sp. *tritici* fungus was more reduced than at the untreated control variant.

Key words: *Puccinia*, *Septoria*, 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 spike's burn *Giberella zeae*, *Giberella avenacea* (Jacob Viorica, Hatman, M., Ulea, E., Puiu, I. 1998). The first half of the year 2021 was sparsely favorable to wheat, in what concerns the climatic conditions. Rainfalls in small quantities had been registered in this period and the average temperatures had been higher than the usual for this date. For example, in March, the average temperature registered was 9.6°C and the rainfalls amounted in total to 1.6 l/m². In April, the average temperature was 12.08°C and the rainfalls amounted in total to 1.4

l/ha. In May, the average temperature registered was 17°C and the rainfalls amounted in total to 41 l/m². In June, the average registered temperature was 22.2°C and the rainfalls totaled up to 44 l/m². Accordingly, the conditions for the attack of some pathogenic agents specific to wheat were less favorable as compared to previous years. In these conditions, *Puccinia recondita* f. sp. *tritici* fungus, producing wheat's brown rust (E. Velichi 2012) made known its presence in 2020, in a larger extent as compared to previous years. During vegetation period, this pathogenic agent formed uredospores. In the climatic conditions of the year 2020, teliospores of *Puccinia recondita* f. sp. *tritici* had not been observed during the vegetation period. The other pathogenic agents mentioned, dangerous for wheat crop, were signaled

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sporadically in the climatic conditions of the year 2020. The attack of *Septoria* Fungi producing diseases known under the name of septoriosis was

not observed in the wheat experiment established in 2020.

Table 1

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 attack (D.A.%) of *Puccinia recondita* f. sp. *tritici* fungus ("flag" leaf and the next leaf). The observations had been made on 6th June 2020

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-EVOLUS 0.75 L/HA - 1 treatment applied at spike's release - 23.05.2020	5.74	22.29	**	27.44	43.13	**
V2-AMISTAR 0.75 L/HA - 1 treatment applied at spike's release - 23.05.2020	2.57	25.46	**	20.64	49.93	**
V3-FALCON PRO 0.6 L/HA - 1 treatment applied at spike's release - 23.05.2020	4.21	23.82	**	28.57	42.00	**
V4-ORIOUS 25 EW 0.5 L/HA + TOPSIN 500 SC 1,0 L/HA - 1 treatment applied at spike's release - 23.05.2020	7.37	20.66	**	25.27	45.30	**
V5-ORIOUS 25 EW 0.5 L/HA 1 + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's release - 23.05.2020	4.90	23.13	**	36.85	33.72	**
V6-TOPSIN 500 SC 1.0 L/HA + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's release - 23.05.2020	10.08	17.95	**	28.68	41.89	**
V7-Untreated control variant	28.03	-	-	70.57	-	-

LD D.A. % for "flag" leaf

LD 5%= 6.41%

LD 1%= 8.43%

LD D.A. % for the second leaf

LD 5%= 18.85%

LD 1%= 25.26%

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 production (t/ha) obtained at the treated variants, as compared to the untreated control variant

Variant	Prod. (t/ha)	Difference as compared to the control variant (t/ha)	Significance
V1-EVOLUS 0.75 L/HA - 1 treatment applied at spike's release - 23.05.2020	7.279	0.349	*
V2-AMISTAR 0.75 L/HA - 1 treatment applied at spike's release - 23.05.2020	7.462	0.532	**
V3-FALCON PRO 0.6 L/HA - 1 treatment applied at spike's release - 23.05.2020	7.588	0.658	**
V4-ORIOUS 25 EW 0.5 L/HA + TOPSIN 500 SC 1,0 L/HA - 1 treatment applied at spike's release -23.05.2020	7.448	0.518	**
V5-ORIOUS 25 EW 0.5 L/HA 1 + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's release -23.05.2020	7.266	0.336	*
V6-TOPSIN 500 SC 1.0 L/HA + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's release -23.05.2020	7.224	0.294	*
V7- Untreated control variant	6.930	-	-

LD 5% = 0.286 to/ ha

LD 1% = 0.383 to / ha



Figure 1 *Puccinia recondita f. sp. tritici* - uredospores (original)



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 (fig.2). 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-EVOLUS 0.75 L/HA - 1 treatment applied at spike's release - 23.05.2020;
- V2-AMISTAR 0.75 L/HA - 1 treatment applied at spike's release - 23.05.2020;
- V3-FALCON PRO 0.6 L/HA - 1 treatment applied at spike's release - 23.05.2020;
- V4-ORIOUS 25 EW 0.5 L/HA + TOPSIN 500 SC 1,0 L/HA - 1 treatment applied at spike's release - 23.05.2020;
- V5-ORIOUS 25 EW 0.5 L/HA 1 + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's release - 23.05.2020;
- V6-TOPSIN 500 SC 1.0 L/HA + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's release - 23.05.2020;
- V7-Untreated control variant.

The experiment was placed in Latin square, the 7 variants being 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 (6.25 g/l florasulam + 300 g/l acid 2,4-D EHE) herbicide 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, their efficiency and profitability in applying only one phytosanitary treatment or a mixture of two commercial products with fungicide effect. The application of one single treatment with fungicides was considered due to the fact that the year 2020 was particularly dry between March and May. For this reason, the infection pressure of pathogens was lower than in the previous year. However, the experience being established in irrigation conditions, the attack of these pathogens was present, in percentages that positively influenced the production of the treated variants compared to the untreated control variant. 2 irrigations were applied, each with 400 m³ of water / ha. The first irrigation was applied in mid-April, and the second at the end of May 2020.

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 affection (attack intensity, I%) of the last two leaves was assessed, especially of the “flag” leaf which has the greatest contribution to the spike’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 the presence of *Puccinia recondita f.sp. tritici* fungus which produces wheat’s brown rust in the analyzed samples. Other pathogenic agents specific to wheat were signaled totally sporadic.

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 harvest 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 harvest of each and every experimental parcel. The statistic interpretation was executed with the help of limit differences (LD %) (Săulescu N).

The used variety, Airbus, is a French variety created by Limagrain company, being registered in 2016. The variety is semi-early-flowering. It is resistant to brown rust *Puccinia recondita f.sp. tritici* and to wheat’s mildew (*Blumeria graminis f. sp. tritici*).

The assessment of the attack of pests 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 %).

Attack’s frequency 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 attacked wheat spikes, as reported to the total number of observed wheat spikes. The frequency is calculated with the formula $F\% = n \times 100 / N$.

The intensity of the attack represents the degree or percentage in which 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 value expression of DA is given by the relation:

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

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 2019 – 2020 agricultural year was less favorable to the occurrence of the attack of the complex of pathogens specific to wheat, as compared to the previous years. In the spring of 2020, rainfalls in very small quantities had been registered, and the average temperatures had been high. For example, in March, the average temperature registered was 9.6°C, the rainfalls summed up to only 1.6 l/m² and the humidity was 43%. In April, the average temperature registered was 12.8 °C and the rainfalls summed up to only 1.4 l/m² and the humidity was 36.8%. In May, the

average temperature registered was 17°C and the rainfalls summed up to 41 l/m², totally insufficient for covering the water deficit from the soil. However, we underline that the autumn of 2019 had sufficient rainfalls, leading to an optimum emergence of the plants. The first rainfalls useful to wheat's emergence had occurred on time, being of 28 l/m² in October. Accordingly, the plants emerged on time, and their density in the spring was at harvest of approximately 490 spikes/m². However, due to excessive drought, the productions obtained were somewhat smaller (approximately 7400 kg/ha) as compared to previous years, when the productions exceeded frequently 8000-8200 kg/ha.

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 2020 was *Puccinia recondita* f.sp. *tritici* fungus producing the wheat's brown rust. Attacks of *Blumeria graminis* f.sp. *tritici* producing the disease known as mildew occurred sporadically. No attacks of *Septoria* sp. variety producing diseases known as septorioses and of *Giberella* sp. producing diseases known under the name of fusarioses (*Fusarium* sp.) had been observed in 2020, as compared to previous years.

When analysing 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 - EVOLUS 0.75 L/HA - 1 treatment applied at spike's release -23.05.2020 had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* of 5.74% to the "flag" leaf and 27.44% to the second leaf, so smaller by 22.29% and respectively by 43.13% as compared to the untreated control variant (V7).

- V2 - AMISTAR 0.75 L/HA - 1 treatment applied at spike's release - 23.05.2020, had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* of 2.57% to the "flag" leaf and 20.64% to the second leaf, so smaller by 25.46% and respectively by 49.93% as compared to the untreated control variant (V7).

- V3 - FALCON PRO 0.6 L/HA - 1 treatment applied at spike's release - 23.05.2020, had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* of 4.21% to the "flag" leaf and 28.57% to the second leaf, so smaller by 23.82% and respectively by 42.00% as compared to the untreated control variant (V7).

- V4 - ORIUS 25 EW 0.5 L/HA + TOPSIN 500 SC 1.0 L/HA - 1 treatment applied at spike's release - 23.05.2020, had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* of

7.37% to the "flag" leaf and 25.27% to the second leaf, so smaller by 20.66% and respectively by 45.30% as compared to the untreated control variant (V7).

-V5 - ORIUS 25 EW 0.5 L/HA 1 + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's release -23.05.2020, had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* of 4.90% to the "flag" leaf and 36.85% to the second leaf, so smaller by 23.13% and respectively by 33.72% as compared to the untreated control variant (V7).

-V6 - TOPSIN 500 SC 1,0 L/HA + DITHANE M 45 2 KG/HA 1 treatment applied at spike's release -23.05.2020, had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* of 10.08% to the "flag" leaf and 28.68 to the second leaf, so smaller by 17.95% and respectively by 41.89% as compared to the untreated control variant (V7).

-V7 - control variant presented a degree of attack of *Puccinia recondita* f.sp. *tritici* of 28.03% to the "flag" leaf and 70.57% to 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- EVOLUS 0,75 L/HA - 1 treatment applied at spike's release -23.05.2020 - a production of 7.279 to/ha had been achieved, so larger by 0.349 to/ha than that of the control variant.

-V2 - AMISTAR 0.75 L/HA - 1 treatment applied at spike's release - 23.05.2020 - a production of 7.462 to/ha had been achieved, so larger by 0.532 to/ha than that of the control variant.

-V3 - FALCON PRO 0.6 L/HA - 1 treatment applied at spike's release - 23.05.2020 - a production of 7.588 to/ha had been achieved, so larger by 0.658 to/ha than that of the control variant.

-V4 - ORIUS 25 EW 0.5 L/HA + TOPSIN 500 SC 1.0 L/HA - 1 treatment applied at spike's release - 23.05.2020 - a production of 7.448 to/ha had been achieved, so larger by 0.518 to/ha than that of the control variant.

-V5 - ORIUS 25 EW 0.5 L/HA 1 + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's release - 23.05.2020 - a production of 7.266 to/ha had been achieved, so larger by 0.336 to/ha than that of the control variant.

-V6 - TOPSIN 500 SC 1.0 L/HA + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's release - 23.05.2020 - a production of 7.224 to/ha had been achieved, so larger by 0.294 to/ha than that of the control variant.

-V7 – untreated control variant achieved a production of 6.930 to/ha.

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

CONCLUSIONS

The observation performed in the summer of 2020 on the experiment with wheat - Airbus variety have led to the following conclusions and recommendations:

1. The attacks of the pathogenic agents were more reduced than in the previous years. Among them, the only pathogenic agent which made its presence known was *Puccinia recondita* f.sp. *tritici* which produces the disease known as “brown rust” to wheat.

2. For a reliable protection of the wheat crop, in case of using Airbus French variety, we recommend in the years with droughty springs the performance of one single treatment with fungicide products, such as, for example, FALCON PRO in homologated dosage of 0.6 l/ha. In the conditions where a price of approximately 0.9 lei/ kg of wheat is foreseen in 2021 (Agrointeligenta 2020), the selection of the fungicide product is especially important from the point of view of the price. For example, EVOLUS product costs in 2021 approximately 198 lei/l and in case 0.75 l/ha will be applied, the cost will be approximately 148 lei/ha. AMISTAR fungicide costs in 2021 approximately 350 lei/l and in case 0.75 l/ha will be applied, the cost per ha/treatment will be 262.5 lei/ha. FALCON PRO fungicide costs in 2021 approximately 170 lei/l and in case 0.6 l/ha will be applied, the cost per ha/treatment will be 102 lei/ha. ORIUS 25 EW fungicide costs approximately 80 lei/l, so in case 0.5 l/ha is applied, the costs per ha/treatment will be 40 lei, in case it will be applied alone. TOPSIN 500 SC fungicide costs 80 lei/l and in case 1 l/ha will be applied, the cost will be 80 lei/ha. DITHANE M 45 fungicide costs 40 lei/kg and in case 2 kg/ha will be applied, the cost will be 80 lei/ha.

The production increase as compared to the untreated control variant (V7) was the following:

- V1 - EVOLUS 0.75 L/HA - 1 treatment applied at spike's release - 23.05.2020, the increase was of 0.349 to/ha, amounting to 314.1 lei.

- V2 - AMISTAR 0.75 L/HA - 1 treatment applied at spike's release - 23.05.2020, the increase was of 0.532 to/ha amounting to 478.8 lei/ha.

- V3 - FALCON PRO 0.6 L/HA - 1 treatment applied at spike's release - 23.05.2020, the increase was of 0.658 to/ha, amounting to 592.2 lei/ha.

- V4 - ORIUS 25 EW 0.5 L/HA + TOPSIN 500 SC 1.0 L/HA - 1 treatment applied at spike's release - 23.05.2020, the increase was of 0.518 to/ha amounting to 466.2 lei/ha.

- V5 - ORIUS 25 EW 0.5 L/HA 1 + DITHANE M 45 2 KG/HA - 1 treatment applied at spike's release - 23.05.2020, the increase was of 0.336 to/ha amounting to 302.4 de lei/ha.

- V6 - TOPSIN 500 SC 1.0 L/HA + DITHANE M 45 2 KG/HA 1 treatment applied at spike's release - 23.05.2020, the increase was of 0.294 to/ha amounting to 264.6 lei/ha.

Following the value analysis, it is easily found that the most profitable variant, in terms of production increase, proved to be V3 FALCON PRO 0.6 L / HA, 1 treatment applied to the spike release. At 102 lei (20.8 €) spent per ha, a production increase of 592.2 lei / ha (120.75 € / ha) was obtained.

We emphasize that the experiment was carried out under irrigation conditions (2 irrigations of 400 m² / irrigation). The first irrigation was applied in April and the second at the end of May

The exchange rate Lei/€ for the first 7 months of the year 2021 was 4.9043 lei/1 €, according to the website of the National Bank of Romania.

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