

THE INFLUENCE OF TREATMENTS WITH VARIOUS PHYTOSANITARY PRODUCTS (FUNGICIDES) ON THE ATTACK OF SOME PHYTOPATHOGENIC FUNGI ON WHEAT HARVEST - PITAR ROMANIAN VARIETY - IN 2019 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 Romanian wheat variety, Pitar. Among these, we mention: *Puccinia recondita* f. sp. *tritici* (sin. *Puccinia triticina*) which produces wheat's brown rust and *Septoria* spp. 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, 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: FALCON PRO (prothioconazole 53 g/l + tebuconazole 148 g/l + spiroxamine 224 g/l), MYSTIC 250 EC (tebuconazole 250 g/l) and CAPALO (fenpropimorph 200g/l, epoxiconazole 62.5 g/l, metraphenon 75g/l). The treatment variants were the following: V1 - MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at spike's releasing (17.05.2019); V2 - MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019), V3 - FALCON PRO 0.6 L/HA, 1 treatment applied at spike's releasing (17.05.2019), V4 - FALCON PRO 0.6 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019), V5 - CAPALO 1.0 L/HA, 1 treatment applied at spike's releasing (17.05.2019), V6 - CAPALO 1.0 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019), V7 - Untreated control variant. The experiment was placed in Latin square, the 7 variants being placed in 7 repetitions. 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 *Septoria* sp. variety producing leaf's brown rust (septoriosis) and from *Blumeria* (*Erysiphe*) variety, producing wheat's mildew, was rare. 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. The harvests of the treated variants were as follows: (V1 – 6989 kg/ha, V2 - 6688 kg/ha, V3 - 6536 kg/ha, V4 - 6828 kg/ha, V5 - 6875 kg/ha, V6 - 6582 kg/ha and V7 (control variant not treated) - 6301 kg/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 spike's burn *Giberella zae*, *Giberella avenacea* (Iacob Viorica *et al.*, 1998). The first half of the year 2019 was favorable to wheat, in what concerns the climatic conditions. Rainfalls in large quantities had been registered in this period and the average temperatures had been favorable to wheat. For example, in April, the average temperature registered was 10.4°C and the rainfalls amounted in total to 60.01 l/m². In May, the average temperature registered was 17.7°C and

the rainfalls amounted in total to 100.6 l/m². In June, the average registered temperature was 22.9°C and the rainfalls totaled up to 96.8 l/m². Accordingly, the conditions for the attack of some pathogenic agents specific to wheat were more favorable as compared to previous years. In these conditions, *Puccinia recondita* f. sp. *tritici* fungus (*figure 1*), producing wheat's brown rust (Velichi E., 2012) made known its presence in 2019, in a larger extent as compared to previous years. During vegetation period, this pathogenic agent formed uredospores. In the climatic conditions of the year 2019, teliospores of *Puccinia recondita* f. sp. *tritici* fungus had not been observed during the vegetation period. The other pathogenic agents

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mentioned, dangerous for wheat crop, were signaled sporadically in the climatic conditions of the year 2019. We underline that, as compared to previous years, the attack of *Giberella* spp. fungi

producing diseases known under the name of fusarioses (*Fusarium* spp.) was signaled sporadically.

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 19th June 2019

Variant	"Flag" leaf			The second leaf		
	D.A%	Difference as compared to the control variant	Significance	D.A%	Difference as compared to the control variant	Significance
V1-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at spike's release (17.05.2019)	1.47	3.43	**	2.87	2.37	**
V2-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019)	1.91	2.99	**	2.54	2.70	**
V3-FALCON PRO 0.6 L/HA, 1 treatment applied at spike's release (17.05.2019)	1.49	3.41	**	2.85	2.39	**
V4-FALCON PRO 0.6 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019)	2.01	2.89	**	3.07	2.17	**
V5-CAPALO 1,0 L/HA, 1 treatment applied at spike's release (17.05.2019)	1.96	2.94	**	3.07	2.17	**
V6-CAPALO 1,0 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019)	1.29	3.61	**	2.44	2.80	**
V7-Untreated control variant	4.90	-	-	5.24	-	-

LD D.A. % for "flag" leaf

LD D.A. % for the second leaf

LD 5% = 0.04%

LD 5% = 0.61%

LD 1% = 0.22%

LD 1% = 0.82%

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

Variant	Harvest (t/ha)	Difference as compared to the control variant (t/ha)	Significance
V1-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at spike's release (17.05.2019)	6989	688	**
V2-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at straw's extension (27.04.2019)+1 treatment applied at kernel's filling (8.06.2019)	6688	387	**
V3-FALCON PRO 0.6 L/HA, 1 treatment applied at spike's release (17.05.2019)	6536	235	Not significant
V4-FALCON PRO 0.6 L/HA, 1 treatment applied at straw's extension (27.04.2019)+1 treatment applied at kernel's filling (8.06.2019)	6828	527	**
V5-CAPALO 1.0 L/HA, 1 treatment applied at straw's extension (17.05.2019)	6875	574	**
V6-CAPALO 1.0 L/HA, 1 treatment applied at straw's extension (27.04.2019) +1 treatment applied at kernel's filling (8.06.2019)	6582	281	*
V7-Untreated control variant	6301	-	-

LD 5% = 246 kg /ha LD 1% = 330 kg/ha

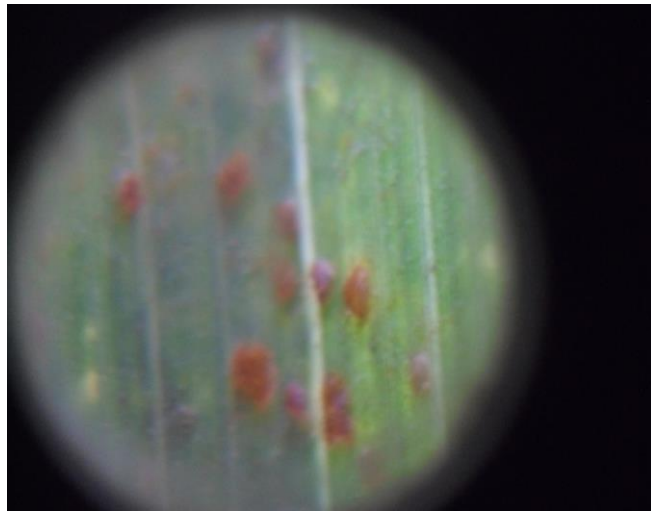


Figure 1 *Puccinia recondita f. sp. tritici* - uredospores (original)



Figure 2 Aspects from the experimental field (original)

MATERIAL AND METHOD

1 experiment with 7 study variants each (figure 2) 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-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at spike's release (17.05.2019);

-V2-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019);

-V3-FALCON PRO 0.6 L/HA, 1 treatment applied at spike's release (17.05.2019);

-V4-FALCON PRO 0.6 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019);

-V5-CAPALO 1.0 L/HA, 1 treatment applied at spike's release (17.05.2019);

-V6-CAPALO 1.0 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019);

- 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 Granstar Super 50 SG herbicide in a dosage of 0.04 l/ha applied, separately, with the 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, as well as the efficiency and respectively, the profitability of applying one or two phytosanitary treatments during the wheat's vegetation period in the climatic conditions of the year 2019.

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 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. However, in 2019, as compared to previous year, the attack of Giberella fungi which produce diseases known under the name of fusariosis to wheat was signaled sporadically.

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., 1967).

The used variety, Pitar, is a Romanian variety of wheat created by the National Agricultural Research and Development Institute Fundulea (I.N.C.D.A. Fundulea). It was registered in 2015. The variety is early-flowering. It is resistant to brown rust *Puccinia recondita f.sp. tritici* and to wheat’s mildew (*Blumeria graminis f. sp. tritici*) and average resistant to septoriosis (*Septoria* sp) and to yellow rust (*Puccinia striiformis*). It has an average resistance level to spike’s fusariosis (*Fusarium* spp.) (I.N.C.D.A. Fundulea 2019).

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 $F\% = nx100/N$.

- Attack’s intensity 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 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 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 the production of a crop.

RESULTS AND DISCUSSIONS

The 2018 – 2019 agricultural year was more 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

2019, rainfalls in large quantities had been registered, and the average temperatures had been favorable to wheat. For example, in April, the average temperature registered was 10.4°C, and the rainfalls summed up to only 60.0 l/m². In May, the average temperature registered was 17.7 °C and the rainfalls summed up to 100.6 l/m². In June, the average temperature registered was 22.9°C and the rainfalls summed up to 96.8 l/m². However, we underline that the autumn of 2018 was droughty. The first rainfalls useful to wheat's emergence had occurred late, in the second decade of November. Due to this, the plants emerged late, and their density in the spring was reduced. At harvesting, the density of the spikes / m² was more reduced than the previous years, being of approximately 410-420 spikes/m². This fact leads to obtaining a smaller production per ha (6400-6500 kg/ha) as compared to previous years, when the harvests 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 2019 was *Puccinia recondita* f.sp. *tritici* fungus producing the wheat's brown rust. Attacks of the fungi variety like *Septoria* sp. producing septoriosi to wheat and *Blumeria* sp. producing diseases known as mildews occurred sporadically. Attacks of the fungi from *Giberella* sp. variety producing diseases known under the name of fusarioses (*Fusarium* sp.) had been also sporadically observed in 2019, 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-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at spike's release (17.05.2019) had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 1.47% to "flag" leaf, and 2.87% to the second leaf, although smaller by 3.43% and respectively by 2.37% as compared to the untreated control variant (V7).

- V2-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at straw's extension (27.04.2019) +1 treatment applied at kernel's filling (8.06.2019), had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 1.91% to the "flag" leaf and 2.54% to the second leaf, so smaller by 2.99% and respectively by 2.70% as compared to the untreated control variant (V7).

- V3-FALCON PRO 0.6 L/HA, 1 treatment applied at spike's release (17.05.2019) had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 1.49% to "flag" leaf and 2.85% to the second leaf, so smaller by 3.41%

and respectively by 2.39% as compared to the untreated control variant (V7).

- V4-FALCON PRO 0.6 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019) had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 2.01% to the "flag" leaf and 3.07% to the second leaf, so smaller by 2.89% and respectively by 2.17% as compared to the untreated control variant (V7).

- V5-CAPALO 1.0 L/HA, 1 treatment applied at spike's release (17.05.2019) had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 1.96% to the "flag" leaf and 3.07% to the second leaf, so smaller by 2.94% and respectively by 2.17% as compared to the untreated control variant (V7).

- V6-CAPALO 1.0 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019) had determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* de 1.29% to the "flag" leaf and 2.44% to the second leaf, so smaller by 3.61% and respectively by 2.80% as compared to the untreated control variant (V7).

- V7 - The untreated control variety presented a degree of attack of *Puccinia recondita* f.sp. *tritici* fungus of 4.90% to the "flag" leaf and 5.24 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 harvest differences as compared to untreated control variant V7 can be also observed, as follows:

- V1-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at spike's release (17.05.2019) had achieved a harvest of 6989 kg/ha, so larger by 688 kg/ha than that of the untreated control variant.

- V2-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019) had achieved a harvest of 6688 kg/ha, so larger by 387 kg/ha than that of the untreated control variant.

- V3-FALCON PRO 0.6 L/HA, 1 treatment applied at spike's release (17.05.2019) had achieved a harvest of 6536 kg/ha, so larger by 235 kg/ha than that of the untreated control variant. We underline that this harvest increment, as compared to the untreated control variant, is not statistically assured.

- V4-FALCON PRO 0.6 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019) had achieved a harvest of 6828 kg/ha, so larger by 527 kg/ha than that of the untreated control variant.

- V5-CAPALO 1.0 L/HA, 1 treatment applied at spike's release (17.05.2019) had achieved a harvest of 6875 kg/ha, so larger by 574 kg/ha than that of the untreated control variant.

- V6-CAPALO 1.0 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019) had achieved a harvest of 6852 kg/ha, so larger by 281 kg/ha than that of the untreated control variant.

- V7-The untreated control variant had achieved a harvest of 6301 kg/ha.

The harvest differences as compared to the untreated control variant are statistically assured by it, being distinctly significant (**) in V1, V2, V4 and V5 and significant in (*) V6. The harvest increment of variant V3, as compared to the control variant (+235 kg/ha), is not statistically assured.

CONCLUSIONS

The 2018 – 2019 agricultural year had been relatively favourable to the wheat harvest. The fall was very poor in rainfalls. The spring and the beginning of the summer were rich in rainfalls, compensating to a certain extent the droughty autumn.

The observations made in the spring of the year 2019 on the wheat experiment – Pitar variety, have led to the following conclusions and recommendations:

1. The attacks of the pathogenic agents were more reduced than in the previous years, even though there had been conditions favourable to their attacks. Among them, the only pathogenic agent which made its presence known was *Puccinia recondita* f.sp. *tritici* fungus which produces the disease known under the name "brown rust" to wheat.

2. For a reliable protection of the wheat crop, in case of using Pitar variety, we recommend in the years with droughty springs the performance of a single treatment with fungicide products, which can contain a single active substance, such as, for example, MYSTIC 250 EC in homologated dosage of 0.5 l/ha. In case the density of plants is reduced, we also recommend the application of a single treatment, even in the years with rainy and cooler springs. In the conditions where a price of approximately 0.75-0.8 lei/ kg of wheat is foreseen in 2020 (Agrointeligenta 2020), the selection of the fungicide product is especially important from the point of view of the price. For example, FALCON PRO costs, in the year 2019, approximately 180 lei/l and 0.6-0.8 l/ha is applied. So the cost is

approximately of 117 lei/ha/treatment. CAPALO fungicide cost in 2019 approximately 190 lei/l and 1 l/ha is applied, so the cost per ha/treatment is 190 lei. Mystic 250 EC fungicide cost approximately 104 lei/l, 0.5 l/ha is applied, so the cost per ha/treatment is approximately of 52 lei.

The harvest increments as compared to the untreated control variant (V7) were the following:

- V1-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at spike's release (17.05.2019) was 688 kg/ha, amounting to 550.4 lei. This variant proved to be the most profitable in the climatic conditions of the year 2019, using Pitar variety.

- V2-MYSTIC 250 EC 0.5 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019) was 387 kg/ha, amounting to 309.6 lei/ha.

- V3-FALCON PRO 0.6 L/HA, 1 treatment applied at spike's release (17.05.2019) was 235 kg/ha, amounting to 188 lei/ha.

- V4-FALCON PRO 0.6 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019) was 528 kg/ha, amounting to 422 lei/ha.

- V5-CAPALO 1.0 L/HA, 1 treatment applied at spike's release (17.05.2019) was 574 kg/ha, amounting to 459 de lei/ha.

- V6-CAPALO 1.0 L/HA, 1 treatment applied at straw's extension (27.04.2019) + 1 treatment applied at kernel's filling (8.06.2019) was 281 kg/ha, amounting to 224.8 lei/ha.

The Romanian wheat variety, Pitar, had a very good behavior in what concerns the attack of the pathogenic agents specific to wheat, in the climatic conditions of the year 2019.

The exchange rate Lei/€ for the first 7 months of the year 2020 was 4.8180 lei/1 €, according to the website of the National Bank of Romania.

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