

THE INFLUENCE OF TREATMENTS WITH DIFFERENT PHYTOSANITARY PRODUCTS (FUNGICIDES) ON THE ATTACK OF SOME PHYTOPATHOGENIC FUNGI AND ON WHEAT HARVEST – APACHE VARIETY - IN 2018 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, Apache. Among these, 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 was monitored, as compared to the untreated control variant. 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 homologated phytosanitary products for wheat (according to PEST –EXPERT) were used, as follows: FALCON 460 EC (triadimenole 43 g/l + tebuconazole 167 g/l + spiroxamine 250 g/l), MYSTIC 250 EC (tebuconazole 250 g/l), BUMPER 250 EC (propiconazole 250 g/l), TOPSIN 500 SC (thyophanate-methyl 500 g/l). The treatment variants were the following: V1 - FALCON 460 EC 0.7 L/HA 1 treatment applied at spike's releasing (12.05.2018), V2 - FALCON 460 EC 0.7 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018), V3 - MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's releasing (12.05.2018), V4 - MYSTIC 250 EC 0.5 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018), V5 - BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0,75 l/ha 1 treatment applied at spike's releasing (12.05.2018), V6 - BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0,75 l/ha 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018) and 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 fungi of *Septoria* sp. variety producing the leaf's brown rust (septoriosis) and *Blumeria graminis* f.sp. *tritici* fungus, producing wheat's mildew, produced rare attacks. 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 the two diseases was more reduced than at the untreated control variant. The harvests of the treated variants were as follows: V1 - 8434 kg/ha, V2 - 8866 kg/ha, V3 - 8742 kg/ha, V4 - 9072 kg/ha, V5 - 8907 kg/ha, V6 - 8701 kg/ha and V7 (control variant not treated) - 8454 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 zeae*, *Giberella avenacea* (Iacob Viorica, Hatman M., Ulea E., Puiu I., 1998). The first half of the year 2018 was difficult for wheat, in what concerns the climatic conditions. Few rainfalls and high temperatures had been registered in this period. In the year 2018, April and May months were especially hot and droughty. For example, in April, the average temperature registered was 15°C and the rainfalls amounted in total to only

1.5 l/m². In May, the average temperature registered was 18.5°C and the rainfalls amounted in total to 25.4 l/m², relatively few for this month. Accordingly, the conditions for the attack of some pathogenic agents specific to wheat were less favorable as compared to previous years. However, *Puccinia recondita* f. sp. *tritici* fungus, producing wheat's brown rust (Velichi E., 2012) made known its presence. During vegetation period, this pathogenic agent formed uredospores and teliospores (figure 1). *Puccinia recondita* f. sp. *tritici* attacks the wheat crops every year, at relatively high attack intensities, even if the year is droughty in April and May. The other pathogenic agents mentioned dangerous for wheat

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crop were signaled rarely in the climatic conditions of the year 2018

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 cumulated attack (D.A.%) of *Puccinia recondita* f. sp. *tritici* fungus ("flag" leaf and the next leaf) (16th June, 2018)

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 FALCON 460 EC 0.7 L/HA 1 treatment applied at spike's release (12.05.2018)	0.85	29.19	***	3.91	38.18	***
-V2 FALCON 460 EC 0.7 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018)	5.58	24.46	***	10.62	31.47	***
-V3 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's release (12.05.2018).	2.35	27.69	***	11.01	31.08	***
-V4 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018)	10.31	19.13	***	11.04	31.05	***
-V5 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at spike's release (12.05.2018).	8.84	21.2	***	14.31	27.18	**
-V6 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018).	16.94	13.1	***	23.99	18.1	*
-V7 Untreated control variant	30.04	-	-	42.09	-	

LD D.A. % for "flag" leaf

LD 5%= 2.56

LD 1%= 3.42

LD D.A. % for the second leaf

LD 5%= 16.1

LD 1%= 21.36

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 all variants treated as compared to the untreated control variant (16th June, 2018)

Variant	Harvest (t/ha)	Difference as compared to the control variant (t/ha)	Significance
-V1 FALCON 460 EC 0.7 L/HA 1 treatment applied at spike's release (12.05.2018)	8.434	-0.020	Not significant
-V2 FALCON 460 EC 0.7 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018)	8.866	0.412	**
-V3 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's release (12.05.2018).	8.742	0.288	**
-V4 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018)	9.072	0.618	**
-V5 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at spike's release (12.05.2018).	8.907	0.453	**
-V6 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018).	8.701	0.347	*
-V7 Untreated control variant	8.454	-	-

LD 5% = 0.162 t/ha LD 1% = 0.217 t/ha

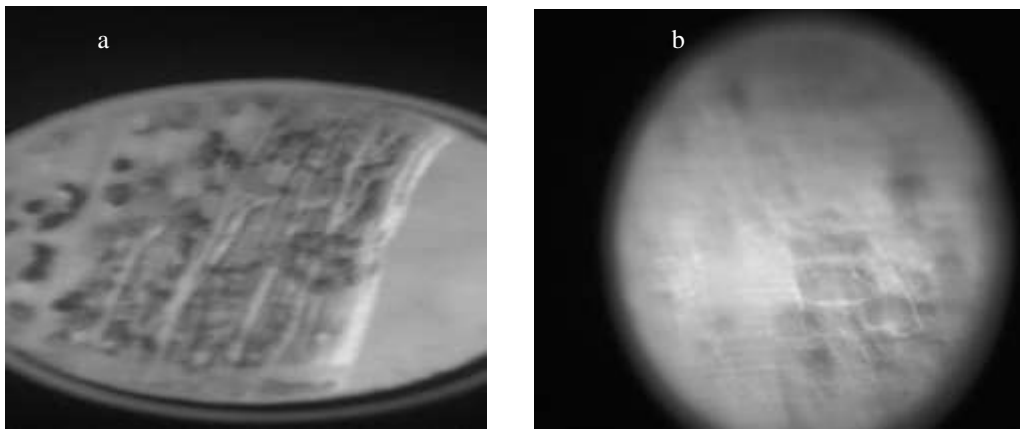


Figure 1 *Puccinia recondita* f. sp. *tritici* – bearings of teliospores (original) and b bearings of uredospores



Figure 2 Aspects from the experimental field (original)

MATERIAL AND METHOD

These experiments 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 FALCON 460 EC 0.7 L/HA 1 treatment applied at spike's release (12.05.2018).

-V2 FALCON 460 EC 0.7 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018).

-V3 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's release (12.05.2018).

-V4 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018).

-V5 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at spike's release (12.05.2018).

-V6 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018).

-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 was added, in concentration of 0.03%, in the spraying solution. Weeds were fought against with the help of Mustang herbicide in a dosage of 0.5 l/ha applied, separately, with the Vermorel. An insecticide product was also added (Karate Zeon – 0.15 l/ha) in 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.

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 in the analyzed samples, which produces wheat's brown rust. 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, Apache, is a French variety of wheat, produced by the company Limagrain. The variety is a semi-forward sort and presents a good tolerance to the attack of some pathogenic agents specific to wheat, such as: rust - *Puccinia* sp. and fusariosis - *Fusarium* sp. (LG. Romania 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 of 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 $F\% = n \times 100 / N$.

-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 diseases 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. There can be noted the affectation percentages, 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 – 3%
- Grade 2 attack between 3 – 10%
- Grade 3 attack between 11 – 25%
- Grade 4 attack between 26 – 50%
- Grade 5 attack between 51 – 75%
- Grade 6 attack between 76 – 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 2017 – 2018 agricultural year was less favourable to the occurrence of the attack of the complex of pathogens specific to wheat, as compared to the previous years. April and May months were hotter and with few rainfalls. During these months, only 1.5 l/m² rainfalls were registered in April and 25.4 l/m² rainfalls were registered in May. The average temperatures recorded were 15°C in April and 18.5°C in May.

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 2018 was *Puccinia recondita f.sp. tritici* fungus producing the wheat's

brown rust. Attacks of the fungi variety like *Septoria* sp. producing septoriososis at wheat were sporadic. No attacks of the following fungi were observed: *Blumeria (Erysiphe) graminis* f.sp. *tritici* producing wheat's mildew and those of *Giberella* sp. variety, producing wheat's fusariosis.

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 FALCON 460 EC 0.7 L/HA 1 treatment applied at spike's release (12.05.2018) determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 0.85% at "flag" leaf and of 3.91% at the second leaf, so lower by 29.19% and respectively by 38.18% as compared to untreated control variant (V7).

-V2 FALCON 460 EC 0.7 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018) determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 5.58% at "flag" leaf and 10.62% at the second leaf, so lower by 24.46% and respectively by 31.47% as compared to untreated control variant (V7).

-V3 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's release (12.05.2018) determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 2.35% to the "flag" leaf and of 11.01% at the second leaf, so lower by 37.69% and respectively by 31.08% as compared to untreated control variant (V7).

-V4 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018) determined a degree of attack (D.A. %) of *Puccinia recondita* f.sp. *tritici* fungus of 10.31% at the "flag" leaf and of 11.04% at the second leaf, so lower by 19.13% and respectively by 31.05% as compared to untreated control variant (V7).

-V5 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at spike's release (12.05.2018) determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 8.84 % at the "flag" leaf and 14.31% at the second leaf, so lower by 21.2% and respectively by 27.18% as compared to untreated control variant (V7).

-V6 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018) determined a degree of attack (D.A. %) of *Puccinia recondita* f.sp. *tritici* fungus of 16.94% at the "flag" leaf and 23.99% at the second leaf, so lower by 13.1% and respectively by 18.1% as compared to untreated control variant (V7).

-V7 Untreated control variant presented a degree of attack of *Puccinia recondita* f.sp. *tritici* fungus of 30.04% at "flag" leaf and 42.09% 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 harvest differences as compared to untreated control variant V7 can be also observed, as follows:

-V1 FALCON 460 EC 0.7 L/HA 1 treatment applied at spike's release (12.05.2018) had achieved a practically equal harvest (-0.020 t/ha) to the one of the untreated control variant, i.e. 8.434 t/ha as compared to 8.454 t/ha achieved by the control variant.

-V2 FALCON 460 EC 0.7 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018) had achieved a practically equal harvest 8.866 t/ha, so by 0.412 t/ha higher than that of the control variant.

-V3 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's release (12.05.2018) had achieved a harvest of 8.742 t/ha, so by 0.288 t/ha higher than that of the control variant.

-V4 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018) had achieved a harvest of 9.072 t/ha, so by 0.618 t/ha higher than that of the control variant.

-V5 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at spike's release (12.05.2018) had achieved a harvest of 8.907 t/ha, so by 0.453 t/ha higher than that of the control variant.

-V6 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at straw's extension (21.04.2018) + 1 treatment applied at kernel's filling (1.06.2018) had achieved a harvest of 8.701 t/ha, so by 0.347 t/ha higher than that of the control variant.

-V7 Untreated control variant had achieved a harvest of 8.454

Harvest differences: the crops are ensured statistically (**distinctly significant and *significant), except for V1, which achieved a harvest practically equal to the one of the control variant (-0.02 t/ha difference).

CONCLUSIONS

The 2017 – 2018 agricultural year had been favourable to the wheat harvest. 2017 – 2018 winter was rich in rainfalls. The spring was droughty, but the plants had achieved very good

harvests due to the large reserve of water remained in the soil since winter.

The observations made in the spring of the year 2018 on the wheat experiment – Apache 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* fungus which produces at wheat the disease known under the name “brown rust”.

2-For a reliable protection of the wheat crop, in case of using Apache variety, we recommend the application, in the years with droughty springs, of one single treatment with fungicide products containing only one single active substance, such as, for example, MYSTIC 250 EC in the homologated dosage of 0.5 l/ha. In the conditions when in the year 2019, a price of around 0.7 lei/ kg of wheat is foreseen, the selection of the fungicide product is especially important from price point of view. For example, the cost of the product FALCON 460 EC in the year 2019 is around 160 lei/l and 0.6 - 0.7 l/ha is applied. Accordingly, the approximate cost is 96-112 lei/ha/treatment. MYSTIC 250 EC fungicide costs in 2019 approximatively 120 lei/l and 0.5 l/ha is applied, so the cost per ha/treatment is 60 lei. BUMPER 250 EC fungicide costs around 130 lei/l. Topsin 500 SC fungicide costs around 63 lei/l. An approximate price / ha of 80 lei/ha results for the dosage used in the experiment.

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

-V1 FALCON 460 EC 0.7 L/HA 1 treatment applied at spike’s release was 0.02 t/ha. This variant does not offer conclusive results.

-V2 FALCON 460 EC 0.7 L/HA 1 treatment applied at straw’s extension +1 treatment applied at kernel’s filling was 0.412 t/ha, amounting to 288.4 lei/ha.

-V3 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike’s release was 0.288 t/ha amounting to 201.6 lei/ha.

-V4 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at straw’s extension +1 treatment applied at kernel’s filling was 0.618 t/ha, amounting to 463.5 lei/ha. This variant had proved to be the most profitable in the climatic conditions of the year 2018, as by using Apache variety, the profit offered by the harvest increment being 343 lei/ha.

-V5 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at spike’s release was 0.453 t/ha amounting to 317 lei/ha.

-V6 BUMPER 250 EC 0.25 l/ha + TOPSIN 500 SC 0.75 l/ha 1 treatment applied at straw’s extension + 1 treatment applied at kernel’s filling was 0.347 t/ha amounting to 242.9 lei/ha.

Apache wheat French variety had presented, in the climatic conditions of the year 2018, a good behavior in what concerns the attack of the pathogenic agents specific to wheat.

The exchange rate Leu/€ for the first 7 months of the year 2018 was 4.7396 lei/1€, according to the website of the Romanian National Bank.

REFERENCES

- Iacob Viorica, Hatman, M., Ulea, E., Puiu, I., *Agricultural phytopathology*, 1998 – “Ion Ionescu de la Brad” Publishing House, p. 16-18, 26-28, 31-33.
- Săulescu, N. 1967 - *Experiment field*, Agro– Sylvan Publishing House, Bucharest, p. 217, 311.
- Velichi, E. 2012 - *General and special phytopathology*, University Publishing House, Bucharest, p. 136-137.
- Romanian National Bank 2019 (web page)
- Limagrain Romania 2019 (web page).
- Methods of Prognosis and Warning, 1980 M.A.I.A., Bucharest, p. 7-9.
- Pest – Expert, Ministry of Agriculture and Rural Development, the National Phytosanitary Authority (web page)