# THE INFLUENCE OF TREATMENTS WITH DIFFERENT PHYTOSANITARY PRODUCTS (FUNGICIDES) ON THE ATTACK OF SOME PHYTOPATHOGENIC FUNGI AND ON BARLEY HARVEST – SALMANDRE VARIETY - IN 2018 PEDOCLIMATIC CONDITIONS OF THE EASTERN BARAGAN

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**Abstract**

Barley is attacked during the vegetation period by many pathogenic agents. One of these pathogenic agents, *Pyrenophora graminea* fungus producing the barley's leaf stripe (Velichi E. 2012) appeared in the Eastern Baragan area in 2018. An experiment took place in 2018, where 4 products of phytosanitary usage were used, as follows: ACANTO PLUS (picoxistrobin 200g/l + cyproconazole 80 g/l), MYSTIC 250 EC (tebuconazole 250 g/l) and FALCON 460 EC (triadimenole 43 g/l + tebuconazole 167 g/l + spiroxamine 250 g/l). This experiment consisted in 7 variants (6 variants with phytosanitary treatments in different combinations of products, plus one control variant not treated). The experiment was placed in Latin square. The 7 variants were placed in 7 repetitions. Among the pathogenic agents monitored, the greatest attacks were produced by *Pyrenphora graminea* fungus, which produces the tearing of barley's leaves. The first two leaves below the spike were analyzed for this. The observations showed that the degree of attack (D.A %) of the disease (barley's leaf stripe) was more reduced at all 6 variants of treatment than that of the control variant, V7. The harvests of the treated variants (V1 … V6) were higher than the harvest of the untreated control variant, V7. The harvests of treatment variants were significantly higher than the harvest of the untreated control variant (statistical assurance, LD 5%), except for V1, where the harvest increment has no statistical assurance. In what concerns the economic efficiency, like in the study performed in the year 2016, the fungicide product MYSTIC 250 EC 0.5 l/ha has proved to be the most efficient from price point of view.

**Key words**: *Pyrenophora,* cyproconazole, Latin square

*Hordeum vulgare* barley is under attack of many pathogenic agents, such as: mildew - *Blumeria graminis* f.sp. *hordei*, leaf stripe - *Pyrenophora graminea*, leaf blotch - *Rhynchosporium secalis*, rust - *Puccinia hordei* (Iacob V. *et al*, 1998). The first half of the year 2018 was very good for barley, even if, starting from April, it had been very droughty. The winter was very rich in rainfalls and also the month of March. Among the pathogenic agents which appeared, we mention *Pyrenophora graminea* fungus which produces the disease called leaf stripe at barley. This pathogenic agent attacks the barley crops each year, at attack intensities which vary each and every year. The other pathogenic agents mentioned had occurred sporadically in the year 2018 at barley's experiment.

## MATERIAL AND METHOD

For performing the observations, an experiment with 7 study variants was conceived. This experiment comprised 6 variants of phytosanitary treatment (fungicide products, their combinations, number of treatments) and a control variant not treated. The variants of the experiment were the following (tab.1):

- V1 ACANTO PLUS 0.5 L/HA 1 treatment applied at spike's release - blooming (1.05.2018);
- V2 ACANTO PLUS 0.5 L/HA 1 treatment applied at "bellows" phase (11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018);
- V3 FALCON 460 EC – 0.7 L/HA 1 treatment applied at spike's release - blooming (1.05.2018);
- V4 FALCON 460 EC - 0,7 L/HA 1 treatment applied at "bellows" phase (11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018);
- V5 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's release - blooming (1.05.2018);
- V6 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at "bellows" phase (11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05. 2018);
- V7 Untreated control variant.

We mention that FALCON 460 EC product is homologated for barley in a dosage of 0.6 l/ha. For

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wheat, it is homologated in a dosage of 0.6 l/ha for a complex of foliar diseases and 0.7 l/ha when there is high pressure of infection at blooming and there is a high risk of attack of the fungi from *Fusarium* sp. variety. The dosage of 0.7 l/ha was used for our experiment at barley in order to observe the efficiency of this slightly increased dosage at this variety.

The experiment was placed in randomized blocks. These 7 variants were placed in 7 repetitions. Each experimental parcel had an area of 15 $m^2$ (5 x 3m). The total number of experimental parcels was of 49. The area of an experimental variant was of 15 $m^2$ x 7 repetitions =105 $m^2$. The total area of the experiment was of 105 $m^2$ x 7 = 735 $m^2$. The treatments were executed manually, with a machine of "vermorel" type. "Trend" adjuvant product was added in the irrigation solution, in concentration of 0.03%. Weeds control was done with the help of Rival Star 75 GD herbicide, in a dosage of 15 g/ha. The experiment had as purpose establishing the efficiency of the mentioned phytosanitary products, reported to their price, as well as the efficiency and respectively the lucrativeness of applying one or two phytosanitary treatments during the barley's vegetation period.

The evaluation of the attack's frequency (F%), of the intensity of the attack (I%) and respectively, of the degree of attack (D.A.%) was done separately, on each and every experimental parcel, analyzing 10 plants / experimental parcel. To them it was assessed the degree of affectation (the intensity of the attack I %) of the last 2 leaves, especially of the "flag" leaf, which has the biggest contribution to the production of a spike at cereals. The phytosanitary analyses of the plants samples were done with the help of the stereomicroscope and of the optic microscope at Brăila Phytosanitary Office's laboratory – Phytosanitary National Authority, institution subordinated to the Ministry of Agriculture and Rural Development. These analyses had revealed the presence of *Pyrenophora graminea* fungus in the samples analyzed, which produces the barley's leaf stripe.

In order to assess the harvest of each variant under study, there had been analysed on a percentage sample basis kernel samples from each experimental parcel, 5 samples / parcel. Each sample comprised 10 plants, so, from each experimental plot, 50 plants were taken over, from which the harvest was manually weighted. The demarcation of each sample was performed with a metric frame with the area of 0.25 $m^2$ (0.5/0.5m). The average of the experimental parcel samples had served for calculating the production of each and every experimental parcel. The statistic interpretation had been done with the help of the limit differences (LD %) (Săulescu N).

The variety used was Salamandre. This is a French variety of barley for beer, produced by Soufflet Company. The variety is forward and has a good production potential. Also, this variety is tolerant at barley's main diseases **(**Soufflet. Agro Romania 2019).

Assessing the attack of a damaging agent can be done with the help of values (Prognosis and Warning Methods, 1980):

- Attack frequency (F %);
- Attack intensity (I %);
- Degree of attack (D.A %).

- Attack frequency represents the relative value of the number of plants or organs of the plant under attack (n) reported to the number of plants or organs observed (N). The value of the frequency is established through direct observations on a number of plants or organs, according to the case and to the conditions, existing different methods of collecting the samples and of performing the observations. In the case of our observations regarding the foliar diseases, there had been taken into consideration the number of organs of plants attacked from the total of organs of plants observed (leaves), establishing thus the frequency of the attack expressed in percentages %. In case of blights, it had been used the number of spikes attacked, reported to the total number of spikes observed. The frequency was calculated with the help of the formula F%= nx100/N.
- Attack intensity represents the degree or percentage in which a plant or an organ of the plant is attacked and how much from the area of the plant or of the organ analysed (leaf, fruit) is covered by the disease under study.

The assessment of the area attacked had been done with the naked eye or with the magnifying glass, assessing the percentage occupied by spots or burns caused by the pathogenic agent. The damage percentage can be recorded or grades can be awarded for each plant or organ attacked by the disease or/and by the pest. Grades usage can ease up greatly data summarizing. It can be used a scale with 6 degrees of intensity, as follows:

- Grade 0 no attack
- Grade 1 attack 1 – 3%
- Grade 2 attack 3 – 10%
- Grade 3 attack 11 – 25%
- Grade 4 attack 26 – 50%
- Grade 5 attack 51 – 75%
- Grade 6 attack 76 – 100%

After summarizing the data, the attack intensity had been determined with the following formula:

$$I\% = \frac{\Sigma (i \times f)}{n}$$

Where:

I% - Attack intensity (in %);

i – The intensity according to the grade awarded to the organ or plant attacked;

f – The number of cases (plants, organs) attacked;

n – The number of plants attacked.

In the case of our experiment, grades from 1 to 6 had been awarded, separately, to "flag" leaf and to the next leaf situated below it.

- The attack degree is the expression of the extension of the gravity of the attack on the crop or on the total number of plants for which we are making the observations. The value expression of DA is given by the relation:

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

In most of the 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.

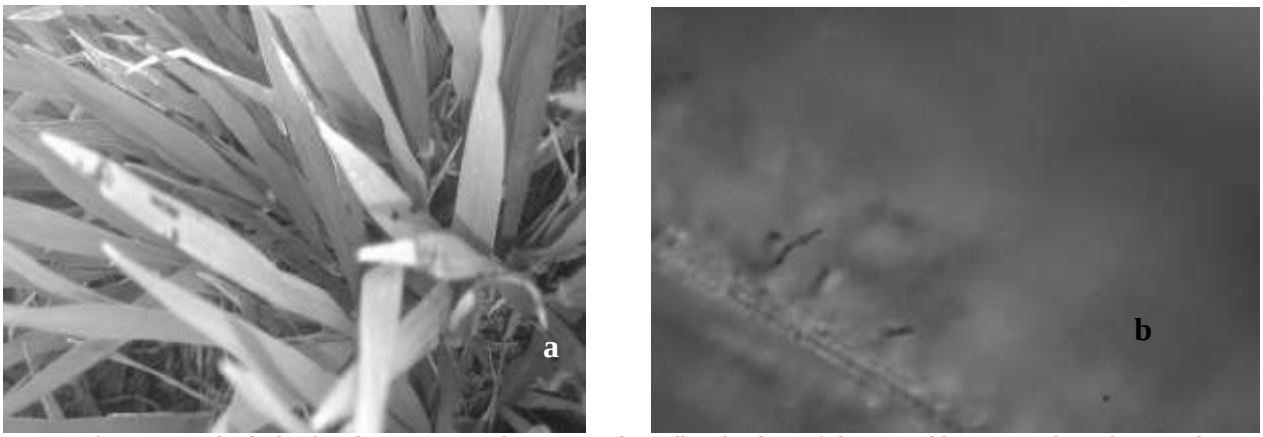


Figure 1 **Barley's leaf stripe, *Pyrenophora graminea* (beginning of the attack) a – attack on leaves, b – conidia (original)**

Table 1

**The results of the experiment with fungicide products (6 variants of treatment + untreated control variant) in what concerns the attack (D.A. %) of *Pyrenophora graminea* fungus at barley ("flag" leaf and the next leaf). The observations were performed on the date of May 22nd 2018**

| | "flag" leaf | | | The second leaf | | |
|---|---|---|---|---|---|---|
| Variant | D.A% | Difference as compared to control variant | Significance | D.A% | Difference as compared to control variant | Significance |
| **V1** ACANTO PLUS 0.5 L/HA 1 treatment applied at spike's release - blooming (1.05.2018) | 6.4 | 21.8 | *** | 33.2 | 55.0 | *** |
| **V2** ACANTO PLUS 0.5 L/HA 1 treatment applied at "bellows" phase(11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018) | 0.9 | 27.3 | *** | 21.5 | 66.7 | *** |
| **V3** FALCON 460 EC - 0.7 L/HA 1 treatment applied at spike's release - blooming (1.05.2018**)** | 7.8 | 20.4 | *** | 54.1 | 34.1 | *** |
| **V4** FALCON 460 EC - 0.7 L/HA 1 treatment applied at "bellows" phase(11.04.2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018) | 5.6 | 22.6 | *** | 59.3 | 28.9 | ** |
| **V5** MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's release - blooming (1.05.2018); | 14.7 | 13.5 | * | 77.9 | 10.3 | Not significant |
| **V6** MYSTIC 250 EC 0.5 L/HA 1 treatment applied at "bellows" phase (11.04.2018)+1 treatment applied at the beginning of kernel's filling (10.05.2018) | 11.5 | 16.7 | ** | 84.3 | 3.9 | Not significant |
| **V7** -Untreated control variant. | 28.2 | - | - | 88.2 | - | - |

LD D.A.% for "flag" leaf
LD 5% = 10.27%
LD 1% = 13.78%
LD 0.1% = 18.16%

LD D.A.% for the second leaf:
LD 5% = 17.47%
LD 1% = 23.41%
LD 0.1% = 30.90%

Figure 2 **Aspects from the experiment field in the phase of occurrence of the spike (original)**

Table 2

**The results of the experiment with fungicide products (6 variants of treatment + untreated control variant) in what concerns the harvest (t/ha) obtained at the variants treated as compared to the untreated control variant**

| Variant | Harvest (t/ha) | Difference as compared to the control variant (t/ha) | Significance |
|---|---|---|---|
| **V1** ACANTO PLUS 0.5 L/HA 1 treatment applied at spike's release - blooming (1.05.2018) | 7.688 | 0.323 | Not significant |
| **V2** ACANTO PLUS 0.5 L/HA 1 treatment applied at "bellows" phase (11.04.2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018) | 7.789 | 0.424 | * |
| **V3** FALCON 460 EC - 0.7 L/HA 1 treatment applied at spike's release - blooming (1.05.2018) | 7.911 | 0.546 | ** |
| **V4** FALCON 460 EC - 0.7 L/HA 1 treatment applied at "bellows" phase(11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018) | 7.769 | 0.404 | * |
| **V5** MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's release - blooming (1.05.2018); | 7.870 | 0.505 | ** |
| **V6** MYSTIC 250 EC 0.5 L/HA 1 treatment applied at "bellows" phase (11.04.2018)+1 treatment applied at the beginning of kernel's filling (10.05.2018) | 7.728 | 0.363 | * |
| **V7** Untreated control variant. | 7.365 | - | - |

LD 5% =0.343 t/ha
LD 1% = 0.469 t/ha
LD 0.1% = 0.606 t/ha

## RESULTS AND DISCUSSIONS

The agricultural year 2018 – 2019 was a slightly difficult year for barley crop from the point of view of the attacks of the pathogenic agents specific to this cultivated variety. It must be underlined the very important fact that barley (*Hordeum vulgare*) is a variety more sensible to the attack of the diseases than wheat. April and May months were hotter and very poor in rainfalls. In these months, only 1.5 l/m$^2$ rainfalls were recorded in April and 25.4 m/m$^2$ rainfalls were recorded in May. The average temperatures registered were 15° C in April and 18.5°C in May.

In what concerns the dynamic of the occurrence of the pathogenic attacks at barley, we mention the following aspects:

– *Pyrenophora graminea* had affected the barley in a smaller extent than in the previous years. However, it was necessary to apply phytosanitary treatments. The degree of attack

(D.A. %) was of 28.2% at variant V7 - untreated control sample, on the date of 22nd May 2018, at "flag" leaf. It must be underlined the fact that this pathogen had proven to be the most dangerous pathogenic agent of barley, like in the previous years.

– *Rhyncosporium secalis* (leaf scald) and *Blumeria* (*Erysiphe*) graminis f. sp. *Hordei (mildew)* had not significantly affected the barley in the spring of the year 2018 (D.A. < 0.5%).
– Barley's rust (*Puccinia hordei*) has not affected significantly the barley (D.A. < 1.0%).

If we analyse the data from Table 1, we observe that the degree of attack of the fungus *Pyrenophora graminea* was differentiated as follows:

- V1 ACANTO PLUS 0.5 L/HA 1 treatment applied at spike's release (01.05.2018) had determined a degree of attack of *Pyrenophora graminis* fungus of 6.4% at the flag leaf and of 33.2% at the second leaf, so lower by 21.8% and respectively, by 55.0% as compared to the untreated control variant (V7).
- V2 ACANTO PLUS 0.5 L/HA 1 treatment applied at "bellows" phase (11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018) had determined a degree of attack of *Pyrenophora graminea* fungus of 0.9% at the flag leaf and of 21.5% at the second leaf, so lower by 66.7%, and respectively by 27.3% as compared to the untreated control variant (V7).
- V3 FALCON 460 EC – 0.7 L/HA 1 treatment applied at spike's release - blooming (1.05. 2018) had determined a degree of attack of *Pyrenophora graminea* fungus of 7.8% at the flag leaf and of 54.1% at the second leaf, so lower by 20.4% and respectively by 34.1% as compared to the untreated control variant (V7).
- V4 FALCON 460 EC – 0.7 L/HA 1 treatment applied at "bellows" phase (11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05. 2018) had determined a degree of attack of *Pyrenophora graminis* fungus of 5.6% at the flag leaf and of 59.3% at the second leaf, so lower by 22.6% and respectively by 28.9% as compared to the untreated control variant (V7).
- V5 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's release - blooming (1.05.2018) had determined a degree of attack of *Pyrenophora graminis* fungus of 14.7% at flag leaf and of 77.9% at the second leaf, so lower by 13.5% and respectively by 10.3% as compared to the untreated control variant (V7).
- V6 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at "bellows" phase (11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018) had determined a degree of attack of *Pyrenophora graminis* fungus of 11.5% at flag leaf and of 84.3% at the second leaf, so lower by 16.7% and respectively by 3.9% as compared to the untreated control variant (V7).
- V7 Untreated control variant was affected by *Pyrenophora graminis* at values of the degree of attack (D.A.%) of 28.2% at the flag leaf and of 88.2% at the second leaf.

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

- V1 ACANTO PLUS 0.5 L/HA treatment applied at spike's release (01.05.2018) has achieved a harvest of 7.688 t/ha, respectively an increment of 0.323 t/ha as compared to the untreated control variant (V7).
- V2 ACANTO PLUS 0.5 L/HA 1 treatment applied at "bellows" phase (11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018) has achieved a harvest of 7.789 t/ha, respectively an increment of 0.424 t/ha as compared to the untreated control variant (V7).
- V3 FALCON 460 EC – 0.7 L/HA 1 treatment applied at spike's release - blooming (1.05.2018) has achieved a harvest of 7.911 t/ha respectively an increment of 0.546 t/ha as compared to the untreated control variant (V7).
- V4 FALCON 460 EC – 0.7 L/HA 1 treatment applied at "bellows" phase (11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018) has achieved a harvest of 7.769 t/ha respectively an increment of 0.404 t/ha as compared to the untreated control variant (V7).
- V5 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at spike's release - blooming (1.05. 2018) has achieved a harvest of 7.870 t/ha respectively an increment of 0.505 t/ha as compared to the untreated control variant (V7).
- V6 MYSTIC 250 EC 0.5 L/HA 1 treatment applied at "bellows" phase (11.04 2018) + 1 treatment applied at the beginning of kernel's filling (10.05.2018) had achieved a harvest of 7.728t/ha, respectively an increment of 0.363 t/ha as compared to the untreated control variant (V7).

- V7 Untreated control variant had achieved a harvest of 7.365 to/ha.

The harvest differences presented statistical assurance at V3 and V5, distinctly significant (**) and significant at V2, V4 and V6 (*). The harvest increment achieved by V1 (0.323 t/ha) has no statistical assurance, minimally accepted by the experimental technique and must not be taken into consideration.

## CONCLUSIONS

The observations performed in the spring of the year 2018 on the barley crop, in the pedoclimatic conditions of the Eastern Baragan had led to the following conditions and recommendations:

1. The most dangerous pathogenic agent of barley had proven to be in 2018 the *Pyrenophora graminea* fungus which produces the disease under the popular name of "leaf stripe". However, the attack of this fungus was more reduced that that of the previous years. The harvest differences between the treated variants and untreated control variant were quite small (maximum 0.546 t/ha at V3).

2. Insignificant attacks of the fungus which attack the foliage, respectively *Blumeria graminis* f.sp. *hordei*- barley's mildew, *Puccinia hordei*- barley's rust and *Rhynchosporium secalis* - brown leaf blotch had been observed.

3. For a secure protection against the attack of the pathogenic agents specific to barley, it is recommended the application, in the difficult years (rainy and chilly), of 2 phytosanitary treatments with fungicides homologated products for barley from the triazoles group, such as: FALCON 460 EC (triadimenole 43 g/l + tebuconazole 167 g/l + spiroxamine 250 g/l) in dosage of 0.7 l/ha and MYSTIC 250 EC (tebuconazole 250 g/l). The first treatment is recommended to be applied in the bellows phase and the second at the beginning of kernel's filling phase. The application of one single treatment in the difficult years is not recommended, because barley is a more sensitive variety than wheat to the attack of specific pathogenic agents.

4. In the years with droughty springs, unfavourable to the attack of the disease, like 2018, one single treatment can be applied at barley's blooming. In the conditions where in 2019 it is foreseen a price of 0.75 lei/kg of barley for beer, the increments of 0.424 t/ha and 0.404 achieved by the variants V2 and V4 (two phytosanitary treatments) are not justified from economic point of view. For example, the price of a liter of FALCON 460 EC is approx. 160 lei/l and is applied in dosages of 0.6 – 0.7 l/ha. One liter of MYSTIC 250 EC costs approx. 120 lei, in the conditions in which 0.5 l/ha is applied for one treatment. ACANTO PLUS product cannot be traded and used in Romania starting with December 2018. The limit date for storage and usage of this product, based on picoxistrobin, was 30.11.2018 according to the Regulation (EU) no. 1455/2017. The harvest increments offered by the variants V3 and V5 to which one single treatment was applied were 0.546 t/ha and respectively 0.505 t/ha. These two variants proved to be the most efficient from economic point of view.

5. Salamandre beer barley variety proved to be quite resistant to the diseases specific to barley, in conditions of 0 treatments with fungicides (V7). This variety achieved a very good harvest (7.365 t/ha) in 2018.

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

## REFERENCES

**Iacob V., Hatman M., Ulea E., Puiu, I**., **1998** – "Ion Ionescu de la Brad" Publishing House, *Agricultural phytopathology*, p. 37-39.

**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. 151 - 153.

******* *Romanian National Bank 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)

********Soufflet Agro Romania*, 2019 (web page).