

THE INFLUENCE OF TREATMENTS WITH VARIOUS PHYTOSANITARY PRODUCTS (FUNGICIDES) ON THE ATTACK OF SOME PHYTOPATHOGENIC FUNGI ON BARLEY HARVEST, TEPEE VARIETY, IN 2024 PEDOCLIMATIC CONDITIONS OF THE EASTERN BARAGAN

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Abstract

This study aims at monitoring the dynamics of the occurrence and evolution of the attack of some pathogens to barley, among which we mention: mildew (*Blumeria graminis* f.sp. *hordei*), leaf stripe and spotting of the leaves produced by fungi of *Pyrenophora* genus and barley's rust (*Puccinia hordei*). Also, the influence of applying these fungicides on the harvest, as well as of the number of treatments/ha as compared to the untreated control variant, has been monitored. For this study, an experiment with 5 treatment variants was created (4 variants with phytosanitary treatment, plus a control variant not treated), being used the following phytosanitary products: ORTIVA TOP (200 g/l azoxystrobin+ 125 g/l difenoconazole) and MYSTIC GOLD (tebuconazole 250 g/l). The treatment variants were the following: V1- ORTIVA TOP 0.5 L/HA – 1 treatment applied at straw's extension + 1 treatment applied at barley grain filling, V2 – ORTIVA TOP 0.5 L/HA – treatment applied at ear release phase, V3- MYSTIC GOLD 1.0 L/HA - treatment applied at straw's extension + 1 treatment applied at barley grain filling, V4 - MYSTIC GOLD 1.0 L/HA - treatment applied at ear release phase and V5 – Control variant not treated. The experiment was placed in Latin square, the 5 variants being placed in 5 repetitions. The year 2024 was a year with a relatively wet spring and early summer. The climatic conditions were favorable to the attacks of barley-specific pathogens. The experiment was not irrigated, being established after corn. Among the pathogens followed, attacks produced by fungi of *Pyrenophora* sp. genus were observed, fungi producing in barley diseases known as spotting and leaf stripes. This led to obtaining a relatively different yield for the variants studied. Between the untreated control variant and some of the variants that were treated with fungicides, there were significant yield differences in the climatic conditions of 2024. The variant's yields were: V1- 7.951 to/ha, V2– 8.047 to/ha, V3-8.058 to/ha, V4–8.211 to/ha and V5–7.221 to/ha.

Keywords: *Pyrenophora*, *Blumeria*, Latin square experimental design

Hordeum vulgare barley is attacked by many pathogenic agents, such as: mildew - *Blumeria graminis* f.sp. *hordei*, leaf stripe, various spotting - *Pyrenophora* sp, rust - *Puccinia hordei* (Iacob Viorica, Hatman, M., Ulea, E., Puiu, I. 1998). The first half of 2024 was favorable for obtaining good barley yields. Average temperatures were slightly higher than the same period in 2023. For example, in February, the average temperature was 7°C, rainfall totaled 11 l/m² and the average relative humidity was 70%. In March, the average temperature was 8.5°C, average relative humidity was 72% and rainfall totaled 30 l/m². In April, the average temperature was 14.5°C, rainfall totaled 41 l/m² and the average relative humidity was 56%. In May, the average temperature recorded was 17°C, rainfall totaled 37 l/m² and the average relative humidity was 57.5%. Barley emergence in the fall of 2023 was relatively good. The winter between 2023 and

2024 was relatively warm, like the previous winter, which allowed the plants not to freeze, barley being a species more sensitive to cold than wheat. The rainfall that fell between February and May in 2024 was relatively equal to that of the previous year. This led to a good barley production compared to the production obtained in the previous year. Among the pathogens that appeared, we mention the fungus *Pyrenophora* sp. which produces, in barley, diseases known under different names: stripe, spotting, etc. This pathogen attacks barley crops every year, at attack intensities that vary from one year to another.

Other pathogens, specific to barley, had a reduced presence - for example, mildew - *Blumeria graminis* f.sp. *hordei* or even very low, practically accidental presence – for example, rust - *Puccinia hordei*.

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Figure1 Attack of *Pyrenophora* sp. Fungi on the date of 4th April 2024 (original).



Figure 2 Aspects from the experimental field (original)

Table 1

The results of the experiment with fungicide products (4 variants of treatment + 1 untreated control variant) in what concerns the attack (D.A. %) of *Pyrenophora* sp. fungus on barley ("flag" leaf and the next leaf). The observations were performed on the date of 20th May 2024

Variant	The "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-ORTIVA TOP 0.5 L/HA at straw extension + 1 treatment at grain filling	14.40	18.00	**	44.3	22.54	*
V2-ORTIVA TOP 0.5 L/HA at ear release phase	15.54	16.86	**	38.6	28.24	*
V3-MYSTIC GOLD 1.0 L/HA at straw extension + 1 treatment at grain filling phase	14.18	18.22	**	32.56	34.28	*
V4-MYSTIC GOLD 1.0 L/HA at ear release phase	14.84	17.56	**	38.54	28.30	*
V5- Untreated control variant	32.40	-	-	66.84	-	-

LD D.A.% for the „flag” leaf

LD 5% =11.66%

LD 1% =16.06%

LD D.A.% for the second leaf:

LD 5% =21.35%

LD 1% =29.40%

Table 2

The results of the experiment with fungicide products (4 variants of treatment + untreated control variant) in what concerns the yield (t/ha) obtained at the treated variants as compared to the untreated control variant

Variant	Prod. (to/ha)	Difference against mt (to/ha)	Significance
V1 - ORTIVA TOP 0.5 L/HA at straw extension + 1 treatment at grain filling	7.951	0.730	*
V2 - ORTIVA TOP 0.5 L/HA at ear release phase	8.047	0.826	*
V3 - MYSTIC GOLD 1.0 L/HA at straw extension + 1 treatment at grain filling	8.058	0.837	*
V4 - MYSTIC GOLD 1.0 L/HA at ear release phase	8.211	0.990	*
V5 - Untreated control variant	7.221	-	-

LD 5% = 0.6784 to/ha

LD 1% = 0.9344 to/ha

MATERIAL AND METHOD

An experiment with 5 study variants was designed for carrying out the observations. This experiment included 4 phytosanitary treatment variants (fungicidal products, their combinations, no. of treatments) and an untreated control variant. The experiment variants were as follows (tab.1):

- V1 - ORTIVA TOP 0.5 L/HA at straw extension + 1 treatment at grain filling
- V2 - ORTIVA TOP 0.5 L/HA at ear release phase
- V3 - MYSTIC GOLD 1.0 L/HA at straw extension + 1 treatment at grain filling
- V4 - MYSTIC GOLD 1.0 L/HA at ear release phase
- V5 - Untreated control variant

The experiment was set up in a Latin square. The 5 variants were set up in 5 repetitions. Each experimental plot had an area of 15 m² (5 x 3 m). The total number of experimental plots was 25. The area of an experimental variant was 15 m² x 5 repetitions = 75m². The total area of the experiment was 75 m² x 5 = 375 m². The treatments were performed manually, with a "Vermorel" type of equipment. Weed control was carried out using the Mustang herbicide (6.25 g/l florasulam + 300 g/l 2.4-D EHE acid) at a dosage of 0.5 l/ha applied, separately, with Vermorel. The experiment has monitored the effectiveness of the above-mentioned phytosanitary products in relation to their price, as well as the efficiency and, respectively, the profitability of applying one or two phytosanitary treatments, during the barley vegetation period.

The evaluation of the attack's frequency (F%), of the attack's intensity (I%) and respectively, of the degree of attack (D.A.%) was done separately, on each and every experimental plot, analyzing 10 plants/experimental plot. Their 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 ear's yield at strawy cereals, had been assessed. The

phytosanitary analyses of the plant's samples were done with the help of the stereomicroscope and 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* fungus in the samples analyzed, fungus which produces barley's leaf stripe and spotting.

In order to assess the yield of each variant under study, barley grain samples from each experimental plot, 5 samples / plot, had been analyzed by sampling. Each sample comprised 20 plants, so, from each experimental plot, 100 plants were taken over, from which the yield was manually weighted. The demarcation of each sample was performed with a metric frame with the area of 0.25 m² (0.5/0.5m). The average of the experimental plot samples had served for calculating the yield of each and every experimental plot. The statistic interpretation had been done with the help of the limit differences (LD %) (Săulescu N).

TEPEE variety was used. This is a new variety of barley for beer, traded by Soufflet French Company. The variety is early.

Assessing the pest attack can be done with the help of the following 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 for performing the observations. In the case of our observations regarding the foliar diseases, the number of attacked plant organs from the total of observed plant organs (leaves) had been taken into

consideration, establishing thus the frequency of the attack expressed in percentages %. In case of blights, the number of attacked ears reported to the total number of observed ears had been used. The frequency was calculated with the help of the $F\% = nx100/N$ formula.

- Attack intensity represents the degree or percentage where a plant or an organ of the plant is attacked and how much from the area of the plant or of the organ analyzed (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 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 summarizing the data, the attack intensity had been determined with the following formula:

$$I\% = \frac{\sum (i \times f)}{N}$$

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 our experiment, grades from 1 to 6 had been separately awarded to the “flag” leaf and to the next leaf situated below it.

- The Degree of Attack is the expression of the attack severity's extension on the crop or of the total number of plants for which we are making the observations. D.A.'s value expression is given by the ratio:

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

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 a crop's yield.

RESULTS AND DISCUSSIONS

The 2023–2024 agricultural year was a relatively favorable year for barley cultivation. It should be emphasized that barley (*Hordeum vulgare*) is a species much more sensitive to disease attack and wintering than wheat. The months of February, March, April and May of 2024 were relatively favorable in terms of precipitation. These months were warmer than the similar period in 2023. In the fall of 2023, sufficient precipitation fell for barley to germinate in optimal conditions. The winter of 2023-2024 was warmer than the average of previous years

Regarding the dynamics of the appearance of pathogen attacks on barley, we mention the following aspects:

– *Pyrenophora* sp affected barley in 2024 to a relatively similar extent compared to 2023. The degree of attack (D.A.%) was at the V5-untreated control variant of 32.4%, at the “flag” leaf on 20th May 2024.

If we analyze the data in table 1, we note that the degree of attack of the *Pyrenophora* sp fungus was differentiated as follows:

-V1 determined a degree of attack of the *Pyrenophora* sp. fungus of 14.40% on the “flag” leaf and of 44.3% on the second leaf, therefore lower by 18.00% and, respectively, by 22.54% compared to the untreated control variant (V5).

-V2 determined a degree of attack of the *Pyrenophora* sp. fungus of 15.54% on the “flag” leaf and of 38.6% on the second leaf, therefore lower by 16.86% and, respectively, by 28.24% compared to the untreated control variant (V5).

-V3 determined a degree of attack of the *Pyrenophora* sp. fungus of 14.18% on the “flag” leaf and of 32.56% on the second leaf, therefore lower by 18.22% and, respectively, by 34.28% compared to the untreated control variant (V5).

-V4 determined a degree of attack of the *Pyrenophora* sp. fungus of 14.84% on the “flag” leaf and of 38.54% on the second leaf, therefore lower by 17.56% and respectively by 38.54% compared to the untreated control variant (V5).

-V5 (untreated control variant) determined a degree of attack of the *Pyrenophora* sp. fungus of 32.4% on the “flag” leaf and of 66.84% on the second leaf.

From the analysis of table 2, the yield differences compared to the untreated control variant V5 can be observed as follow:\

-V1 achieved a yield of 7.951 to/ha, respectively with 0.730 to/ha higher than the untreated control (V5).

-V2 achieved a yield of 8.047 to/ha, respectively with 0.826 to/ha lower than the untreated control (V5).

-V3 achieved a yield of 8.058 to/ha, respectively with 0.837 to/ha higher than the untreated control (V5).

-V4 achieved a yield of 8.211 to/ha, respectively with 0.990 to/ha higher than the untreated control (V5).

-V5 the untreated control variant achieved a production of 7.221 to/ha.

CONCLUSIONS

The observations made in the spring of 2024 on the barley crop, under the pedoclimatic conditions of the Eastern Bărăgan, led to the following conclusions and recommendations:

1. The attack of the *Pyrenophora* sp. fungus, which produces diseases known by popular names as leaf stripe, spotting, made its presence felt in 2024. The attack of this fungus was, this year, relatively similar to that of 2023 and began relatively early. This was caused by: the relatively high amount of precipitation, the average temperatures and the relatively high average air humidity, recorded in the first 5 months of 2024.

2. The treated variants achieved the following differences in yield and profit, compared to the untreated control variant:

– V1-0.730 to/ha, amounting to 657 lei (131.4 €)

– V2-0.826 to/ha, amounting to 743 lei (148.6 €)

– V3-0.837 to/ha, amounting to 753 lei (150.6 €)

– V4-0.990 to/ha, amounting to 891 lei (178.2 €)

3. The Tepee beer barley variety proved, in the climatic conditions of the spring of 2024, to be relatively resistant to the attack of phytopathogenic fungi from the *Pyrenophora* and *Blumeria* genera. V5 (untreated control variant) achieved a relatively good yeild (7.221 to/ha), in the climatic conditions of 2024, which were favorable to attacks by phytopathogenic fungi from the mentioned genera

4. The experiment was located on a plot that was cultivated with sunflower the previous year.

As a result, the inoculum reserve of the *Pyrenophora* sp fungus remaining in the soil from the previous year was practically zero. Under these conditions, we consider that the general condition of the vegetation of the crop where the experiment was located was very good also due to the sunflower that preceded the barley. The crop received large quantities of fertilizers to counteract the fact that sunflower is a large consumer of nutrients.

5. The price of barley, in mid-2024, is approximately 0.90 lei (approx. €0.18)/kg (Cereal Exchange, May 2025).

6. The yields obtained in the studied variants were significantly higher than those achieved by the untreated control variant (V5) which achieved 7.221 to/ha.

7. Regarding the costs/ha of some plant protection products, they vary, in 2024 as follows:

– Ortiva Top costs approximately 320 lei/l – approximately 64 €/l. A single treatment with 0.5 l/ha (160 lei/ha–32 €/ha) was applied to V2. 2 treatments with 0.5 l/ha were applied to V1, i.e. a total of 1 l/ha (320 lei/ha – 64 €/ha).

– Mystic Gold costs 110 lei/l – 22 €/l. 1 l/ha (110 lei/ha – 22 €/ha) was applied to V4. In V3, 2 treatments with 1l/ha were applied, i.e. 220 lei/ha – 44 €/ha, i.e., a total of 2 l/ha.

8. From the analysis of the economic profitability of the production increase, in the climatic conditions of 2024, which was rainier and somewhat warmer in the first 5 months, compared to 2023, all variants proved to be profitable. The achieved yield increases covered the cost of the phytosanitary product relatively well, even if we add the other related expenses (labor costs, for example). However, we emphasize the very good profitability of applying a single treatment with 1l/ha Mystic Gold, which achieved a yeild increase of 0.990 to/ha (891 lei-178.2€/ha) with a cost of only 110 lei -22€/ha.

9. The Ortiva Top product is not approved for barley, in this experiment it is used exclusively for experimental purposes. It is approved for numerous vegetable species (tomatoes, peppers, eggplants, cucumbers, zucchini, onions, carrots) as well as for raspberries, at a dosage of 1l/ha for the prevention and control of specific pathogens such as the phytopathogenic fungi genera: *Alternaria*, *Colletotrichum*, *Cladosporium*, *Peronospora*, *Botrytis*, *Phytophthora*, etc. It is a relatively expensive product. In barley, in the climatic conditions of the first half of 2024, it proved relatively effective at a dosage of only 0.5 l/ha applied in a single treatment in the booting phase. Of course, it remains at the discretion of the manufacturer (Syngenta Company) whether it

wishes to extend its approval, in Romania, to barley as well. However, the Mystic Gold product proved to be more cost-effective in phytosanitary protection than the Ortiva Top product. We emphasize the fact that this is the first test of the Ortiva Top product on barley, in the pedoclimatic conditions where the experiment was carried out.

10. Barley grown after sunflower, even in the conditions of a year more favorable to the attack of specific pathogens, behaves relatively well in terms of the general phytosanitary condition. Of course, larger amounts of fertilizers must be applied when barley follows sunflower.

11. The Tepee barley variety presented, under conditions of 0 phytosanitary treatments, a relatively good tolerance to the attack of specific pathogens of barley. We emphasize that the first half of 2024 was very favorable to the attack of specific pathogens of barley.

12. The average exchange rate leu/€, in the months: April, May and June of 2025 was of 5.0626 lei/1€, according to the website of the National Bank of Romania.

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