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RESEARCH REGARDING EFFICACY OF FENPICOXAMID TREATMENT IN THE CONTROL OF SOME PATHOGENS IN WINTER WHEAT

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Abstract

The aim of our research was to evaluate the performance of a new active ingredient, fenpicoxamid, from picolinamide group, in control of wheat pathogens. Trials were carried out in experimental fields located in Buzău county, with foreign wheat genotype and in Neamț county with Romanian wheat genotype. In both experimental fields was detected attack by Septoria spp. that causes wheat septoria, Puccinia recondita, pathogen responsible for brown rust, and Blumeria graminis, powdery mildew pathogen. The control scheme included treatments with a.i. from SDHI, Strobilurins, Triazoles, Picolinamides and their mixtures. Treatment with 50 g/l fenpicoxamid + 100 g/l prothioconazole performed the best with the highest efficacy in control of pathogens monitored in the experimental fields. Efficacy in septoria control was over 90% in both locations. Efficacy in control of brown rust was 89.6% in Buzau experimental field and 90.1% in Neamț experimental field and control of powdery mildew was 78.8% in Buzău county while in Neamț county was 83.1%.

***Key words**: wheat, agent pathogen, treatment, fenpicoxamid, efficacy.*

INTRODUCTION

Wheat is one of the most cultivated and important cereal crops in the world. In 2024 at European level, also in Romania, wheat occupied the largest cultivated area, as shown in Figure 1. *Plant production for field crops in 2024 (provisional data)*. (n.d.). *INNSE. Retrieved from https://insse.ro/cms/sites/default/files/com_presa/com_pdf/prod_veg_r24.pdf.* However, wheat production faces significant challenges due to numerous fungal pathogens that can drastically reduce yields. The pathogens *Zymoseptoria tritici* (leaf septoria), *Puccinia recondita* (brown rust), and *Blumeria graminis* f. sp. *tritici* (wheat powdery mildew) are among the most destructive for wheat crops, causing substantial production losses globally. Leaf septoria frequently occurs in wheat crops in temperate regions and causes losses considered a major issue for wheat cultivation (Fones & Gurr, 2015). Also, brown rust or leaf rust is a fungal disease with high incidence, resulting in significant damage (Chaudhari & Chaudhari, 2013). Powdery mildew causes losses during severe attacks, affecting leaf area and yield (El Shamy et al., 2012; Costamilan, 2005). Efficient disease management is crucial for maintaining high wheat yields and ensuring food security. Controlling these pathogens, which have a major impact on plant health and wheat production, requires measures including development and cultivation of resistant varieties and integrated diseases management. The use of synthetic chemicals remains a necessary measure (Esmail & Draz, 2017). Traditionally, fungicides have been the primary method of control, utilizing substances from various chemical groups that target the pathogens. However, the development of resistance to certain fungicides has become a significant concern in integrated diseases management (IPM). *Wheat and barley disease management guide. (n.d.). AHDB cereals & oilseeds. Retrieved from https://projectblue.blob.core.windows.net/media/Default/Imported%20Publication%20Docs/AHDB%20Cereals%20&%20Oilseeds/Disease/Wheat%20and%20barley%20disease%20management%20guide%20(2024).pdf.*

Global efforts to discover and use new fungicide active ingredients for controlling foliar diseases in cereals have been successful with the development of fenpicoxamid (Inatreq active), a new fungicide from picolinamides group, which has shown the potential to control a wide range of fungal pathogens. In this study, we evaluated the efficacy of fenpicoxamid in combination with prothioconazole in managing wheat diseases caused by *Zymoseptoria tritici*, *Puccinia recondita*, and *Blumeria graminis* f. sp. *tritici.* The results of this study will provide valuable information on the role of fenpicoxamid in the sustainable management of wheat diseases.

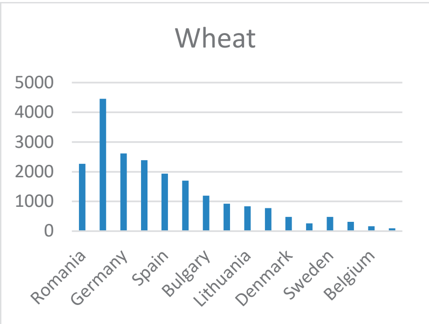

Figure 1. Wheat cultivated area in Romania and in some EU member states in 2024 (thousands of ha)

MATERIALS AND METHODS

Field trials were conducted in Dulbanu, Buzău County (foreign wheat genotype - Anapurna variety) and Zănești, Neamț County (Romanian wheat genotype - Glosa variety) during 2023/ 2024 growing season. Both locations were selected based on their historical vulnerability to *Septoria* spp., *Puccinia recondita*, and *Blumeria graminis*. The test fields were designed in randomized blocks with four replications per treatment, and a minimum plot size of 3 x 10 m. The fungicides tested included SDHIs, strobilurins, triazoles, picolinamides (fenpicoxamid), and their mixtures. Fenpicoxamid was applied at a rate of 1.5 L/ha (50 g/L fenpicoxamid + 100 g/L prothioconazole) as the treatment of interest. Table 1 shows the details of treatment applications at the two trial locations.
All treatments were applied according to trial protocol and following EPPO guidelines. Fungicides were applied using a hand sprayer calibrated for uniform coverage of each plot. The treatments were applied at BBCH45 wheat growth stage in accordance with fungicide labels and trial protocol to ensure optimal timing for pathogens control.

Table 1. List of treatments in the protocol and details of application

Trt. No.	Treatment name	Dose rate L/ha	Solution volume	Crop stage
1	Fenpicoxamid 50 g/l + Prothioconazole 100 g/l	1.5	200 l/ha	BBCH45
2	Bezovindiflupir 75 g/l + Prothioconazole 150 g/l	1.0	200 l/ha	BBCH45
3	Bixafen 75 g/l + Prothioconazole 150 g/l	1.0	200 l/ha	BBCH45
4	Fluxapiroxad 75 g/l+ Prothioconazole 150 g/l	1.0	200 l/ha	BBCH45
5	Azoxistrobin 250 g/l + Prothioconazole 250 g/l	0.8 +0.6	200 l/ha	BBCH45
6	Untreated	-	-	-

In Dulbanu, Buzău County, the treatments were applied on April 29, 2025, at 14:30. The application conditions were good, with an air temperature of 20°C, wind speed of 12 km/h, and air humidity of 52%. In Zănești, Neamț County, the treatments were applied on May 10, 2025, at 11:25. The application conditions were also good, with an air temperature of 19°C, wind speed of 9 km/h, and air humidity of 56%. After preparing the spraying solution for each treatment, we analyzed the treatments physically (miscibility, stability, sedimentation). All treatments were safe for the crop, with uniform distribution in the solution volume, without sedimentation. Immediately after application, we observed the coverage power of each treatment, where the treatment with fenpicoxamid and prothioconazole stood out for its excellent leaf coverage, due to the innovative IQ4 formulation. *Drip by drip: Delivering durable protection against fungal diseases. (n.d.). Corteva Agriscience. Retrieved from https://www.corteva.com/products-and-services/inatreq/Drip-by-drip-Delivering-durable-protection-against-fungal-diseases.html.* To determine the efficacy (E%)

of each treatment in the protocol at each location, a phytosanitary check (assessments) was conducted before application, as well as after application at 7 days, 14 days, and 28 days, identifying the pathogens present in the crop, and calculating the attack frequency (F%) and intensity (I%) to determine the severity of the attack. The following formulas were used:

- **F** = (n x N) / 100 (%), where: F = attack frequency, n = number of affected plants, N = total number of observed plants;
- **I (%)** = Σ(i x f) / n, where: I = intensity, i = attack percentage, f = number of plants with that percentage, n = total number of plants with the disease;
- **GA%** = F% x I% / 100.
- Based on the attack severity data, the efficacy of the treatments in the protocol was calculated using Abbott’s formula: **E (%)** = [(Gam - Gav) / Gam] x 100, where:
  - Gam = attack severity of the untreated control;
  - Gav = attack severity of the treated variant.

RESULTS AND DISCUSSIONS

The 2023-2024 agricultural year was characterized by particularly significant climatic challenges, which greatly affected the development of crops and agricultural production. Extreme climatic factors, such as prolonged droughts, insufficient or irregularly distributed rainfall, and unusually high temperatures, put pressure on agricultural activities, necessitating the adoption of adaptive measures and efficient technologies to manage these difficult conditions. Even under these circumstances, the need for fungicide treatments in wheat cultivation arose. As shown in the graphs below (Figures 3, 4), the evolution of temperatures and precipitation in the test locations led us to apply the treatments before heading. *Historical weather data. (n.d.). Granular Link. (n.d.). Retrieved from https://link.granular.ag/map/farms/11423/fields* .These climatic conditions directly impacted the decisions regarding the timing of treatments, as the correct management of the application timing can significantly contribute to the effective control of pathogens and maximize crop yields.

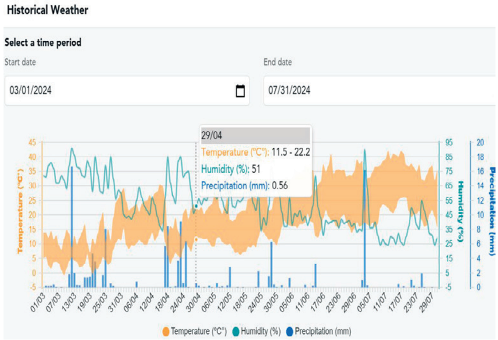

Figure 2. Evolution of temperatures and precipitation from March to July 2024 in Dulbanu location

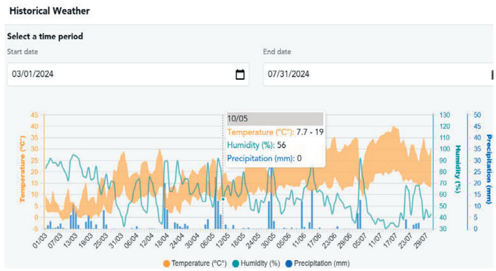

Figure 3. Evolution of temperatures and precipitation from March to July 2024 in Zănești location

The treatment with 50 g/L fenpicoxamid + 100 g/L prothioconazole provided significant control over all the monitored pathogens in both Buzău and Neamț counties. The data show a high efficacy against the pathogen *Zymoseptoria tritici* (wheat septoria), *Puccinia recondita* (brown rust), and *Blumeria graminis* f. sp. *tritici* (wheat powdery mildew), with disease attack reductions of over 80%.

- Efficacy against *Zymoseptoria tritici* (wheat septoria)
  The combined treatment significantly reduced the severity of septoria in both counties, with an overall efficacy of 91.2% (Figure 4) in Buzău and 92.3% (Figure 5) in Neamț. These results demonstrate the robust protective activity of the fenpicoxamid-prothioconazole combination, which performed better than most of other treatments evaluated in the study.

- Efficacy against *Puccinia recondita* (brown rust**)**
  The treatment was also highly effective in controlling brown rust, showing disease severity reduction rates of 89.6% (Figure 6)

in Buzău and 90.1% (Figure 7) in Neamț. This suggests that fenpicoxamid has broad-spectrum activity, providing consistent control across different wheat genotypes.

- **Efficacy** against *Blumeria graminis* f. sp. *tritici* (wheat powdery mildew)
  Although the combined treatment was somewhat less effective against wheat powdery mildew, it still provided a solid reduction in disease incidence. The efficacy rates were 78.8% (Figure 8) in Buzău and 83.1% (Figure 9) in Neamț, indicating that fenpicoxamid is a valuable tool for managing this pathogen.

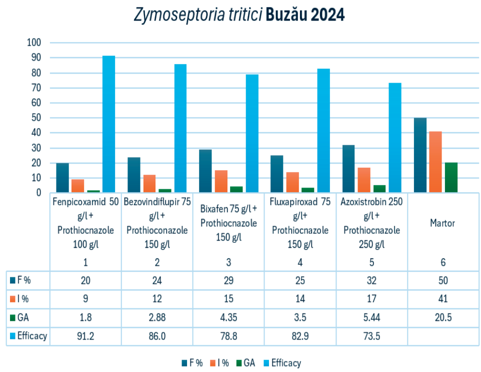

Figure 4. Efficacy of treatments in controlling *Zymoseptoria tritici* in Dulbanu, Buzău

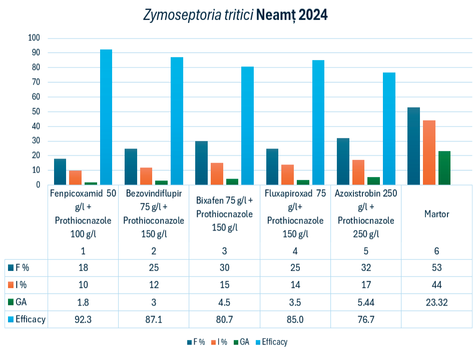

Figure 5. Efficacy of treatments in controlling *Zymoseptoria tritici* in Zănești, Neamț

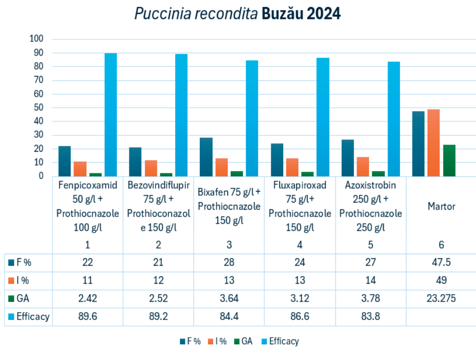

Figure 6. Efficacy of treatments in controlling *Puccinia recondita* in Dulbanu, Buzău

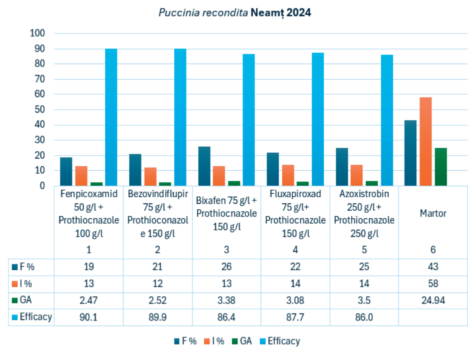

Figure 7. Efficacy of treatments in controlling *Puccinia recondita* in Zănești, Neamț

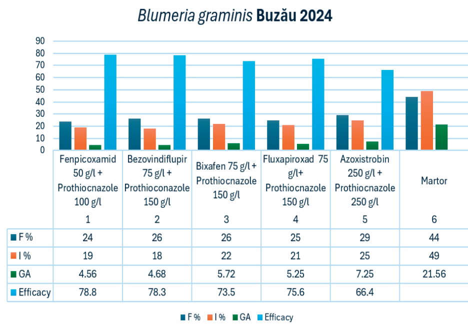

Figure 8. Efficacy of treatments in controlling *Blumeria graminis* in Dulbanu, Buzău

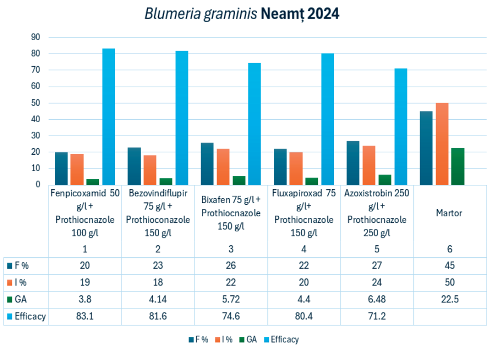

Figure 9. Efficacy of treatments in controlling *Blumeria graminis* in Zănești, Neamț

Research on the efficacy of treatments in controlling pathogens is a constant concern for establishing phytosanitary interventions and integrating them into plant integrated pest management schemes (Toth and Cristea, 2020; Chiriac and Cristea, 2021), as well as for wheat cultivation (Iosub et al., 2022). Iosub et al. (2022) determined the efficacy values of some molecules recommended for controlling wheat pathogens, including powdery mildew, brown rust, and septoria, ranging between 90% and 73%.

CONCLUSIONS

In conclusion, the novel mode of action of fenpicoxamid combined with the complementary and synergistic activity of the mixture partner, prothioconazole, demonstrated exceptional efficacy in controlling the pathogens present at the test locations, particularly *Zymoseptoria tritici* and *Puccinia recondita*, with a control efficacy of over 90%. The fungicidal action against *Blumeria graminis* ranged from 78.8% to 83.1%, within the standards of the fungicide market, thus providing an acceptable alternative as a control tool and preventing the development of cross-resistance. These results suggest that fenpicoxamid could be a valuable addition to fungicide management programs, especially for integrated pest management (IPM) strategies in wheat production. Further studies are needed to explore the long-term effects of this combination and its role in managing fungicide resistance.

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