

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

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Abstract

This study evaluated the efficacy of fenpicoxamid, a novel picolinamide fungicide, for controlling major wheat foliar diseases under Romanian field conditions. Field trials were conducted during 2024/2025 growing season in Buzău and Neamț counties using Anapurna wheat variety. A standardized fungicide programme including SDHI, strobilurin, triazole, picolinamide, and their mixtures was applied across both locations. Disease pressure from *Zymoseptoria tritici*, *Puccinia recondita*, and *Blumeria graminis* was recorded during the season. The combination of fenpicoxamid + prothioconazole (50 g/L + 100 g/L) provided over 90% control of septoria tritici blotch (STB) at both sites. The efficacy against brown rust attack was 86.2% in Buzău location and 84.3% in Neamț location. Efficacy against powdery mildew was higher than 82% in both locations. The results demonstrated a high and constant efficacy under different pedoclimatic conditions. These conclusions confirm fenpicoxamid as an effective tool in integrated management of wheat diseases. Its performance supports its use in diverse production systems.

Key words: efficacy, fenpicoxamid, wheat, foliar diseases, field performance.

INTRODUCTION

Wheat remains one of the most extensively cultivated and strategically important cereal crops worldwide, playing a central role in global food security. At European level, including in Romania, according to Figure 1 and Figure 2 (INS-2026), wheat continued to occupy the largest share of arable land in 2024/2025 season, confirming its agronomic and economic importance within cropping systems.

Monitoring the evolution of cultivated areas and crop production of major crops in Romania represents a continuous concern for agricultural research (Toth and Cristea, 2018; Arghiroiu et al., 2015; Popescu et al., 2018).

Wheat production is increasingly challenged by a complex spectrum of foliar fungal pathogens that can severely reduce yield and grain quality. Among the most economically important diseases are septoria tritici blotch caused by *Zymoseptoria tritici*, leaf rust caused by *Puccinia recondita*, and powdery mildew caused by *Blumeria graminis* f. sp. *tritici*.

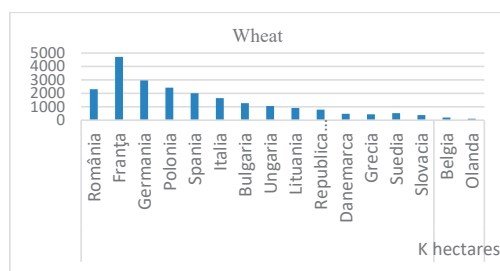


Figure 1. Wheat cultivated area in major European Union countries during the 2024/2025 season (INS - 2026)

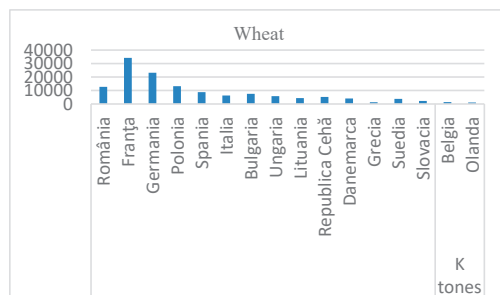


Figure 2. Wheat production in major European Union countries during the 2024/2025 season (INS - 2026)

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). These pathogens are widely distributed across temperate regions and are responsible for recurrent epidemics, leading to significant yield losses under favorable environmental conditions. In recent years, increased climatic variability, characterized by fluctuating temperatures and prolonged leaf wetness periods, has further enhanced disease pressure and unpredictability.

Effective disease management is therefore essential to sustain wheat productivity. Current strategies rely on an integrated disease management (IDM) framework, combining host resistance, agronomic practices, disease monitoring, and chemical control. However, the durability of these strategies is increasingly threatened by the evolution of pathogen resistance to key fungicide modes of action, particularly within widely used classes such as azoles (DMIs) and SDHIs (AHDB, 2026). The use of synthetic chemicals remains a necessary measure (Esmail & Draz, 2017). This challenge is further intensified by regulatory constraints at the European level, which have reduced the number of available active substances and emphasized the need for more sustainable plant protection solutions. In this context, the introduction of novel fungicide active ingredients with new modes of action is critical. Fenpicoxamid (Inatreq™ active), belonging to the picolinamide chemical group, represents a significant advancement in cereal disease control, offering a unique mode of action and high efficacy against major foliar pathogens, particularly *Zymoseptoria tritici*.

Its use in combination with established triazoles such as prothioconazole provides both curative and protective activity, while also contributing to resistance management strategies. The present study evaluates the efficacy of fenpicoxamid in combination with prothioconazole for the control of key wheat diseases caused by *Zymoseptoria tritici*,

Puccinia recondita, and *Blumeria graminis* f. sp. *tritici*. The findings aim to support the optimization of fungicide programs and to contribute to the development of sustainable disease management strategies in modern wheat production systems.

MATERIALS AND METHODS

Field trials were conducted in Dulbanu (Buzău County) and Zănești (Neamț County) using a foreign wheat genotype (the Anapurna variety) during the 2024-2025 growing season. Both locations were selected based on their historical vulnerability to *Zymoseptoria tritici*, *Puccinia recondita*, and *Blumeria graminis*. The experimental layout followed a randomized block design with four replications per treatment, as illustrated in Figure 3. The minimum size of each experimental plot was 3 × 10 m.

R1	V1	V2	V3	V4	V5	V6
R2	V6	V1	V2	V3	V4	V5
R3	V5	V6	V1	V2	V3	V4
R4	V4	V5	V6	V1	V2	V3

Figure 3. Trial map

The tested fungicides included succinate dehydrogenase inhibitors (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.

Table 1. Fungicide treatment protocol, application doses, solution volumes, and wheat growth stages at application

Trt. No.	Treatment name	Dose rate L/ha	Solution volume	Crop stage
V1	Fenpicoxamid 50 g/l + Prothioconazole 100 g/l	1.5	200 l/ha	BBCH 49
V2	Bezovindiflupir 75 g/l + Prothioconazole 150 g/l	1.0	200 l/ha	BBCH 49
V3	Bixafen 75 g/l + Prothioconazole 150 g/l	1.0	200 l/ha	BBCH 49
V4	Fluxapirroxad 75 g/l + Prothioconazole 150 g/l	1.0	200 l/ha	BBCH 49
V5	Azoxistrobin 250 g/l + Prothioconazole 250 g/l	0.8 +0.6	200 l/ha	BBCH 49
V6	Untreated	-	-	-

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 (Figure 4). The treatments were applied at BBCH 49 wheat growth stage in accordance with fungicide labels and trial protocol to ensure optimal timing for pathogens control.



Figure 4. Application of protocol in trial location

In Dulbanu (Buzău County), the treatments were applied on May 2, 2025, at 14:00 h. Application conditions were favorable, featuring an air temperature of 20°C, a wind speed of 8 km/h, and a relative humidity of 49%.

In Zănești (Neamț County) the treatments were applied on May 10, 2025, at 13:30 h. Application conditions were also favorable, with an air temperature of 17°C, a wind speed of 6 km/h, and a relative humidity of 56%.

After preparing the spraying solution for each treatment, their physical properties: miscibility, stability, and sedimentation, were analyzed.

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.

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:

- $F = (n \times N) / 100$ (%), where: F = attack frequency; n = number of affected plants; N = total number of observed plants;

- $I (\%) = \Sigma (i \times f) / n$, where: I = intensity; i = attack percentage; f = number of plants with that percentage; n = total number of plants with the disease;
- $GA\% = F\% \times I\% / 100$.

Based on the attack severity data, the efficacy of the treatments in the protocol was calculated using Abbott's formula:

$E (\%) = [(Gam - Gav) / Gam] \times 100$, where:

- Gam = attack severity of the untreated control;
- Gav = attack severity of the treated variant.

RESULTS AND DISCUSSIONS

The 2024-2025 growing season (March-July 2025) exhibited distinct agroclimatic patterns across the two experimental sites, Dulbanu (Buzău County) and Zănești (Neamț County), as evidenced by the Granular Link weather data (Figure 5 and Figure 6). In both locations, temperatures followed a progressive upward trend, increasing from approximately 5-10°C in early March to sustained values of 25-32°C during June-July, with occasional peaks exceeding 35°C.

Precipitation was unevenly distributed throughout the season, with notable differences between the two sites. Dulbanu experienced lower cumulative rainfall and longer dry intervals, particularly during April and early June, contributing to moderate drought stress. In contrast, Zănești recorded higher precipitation amounts, including a significant rainfall peak in the second half of May, which temporarily increased relative humidity and created favorable conditions for disease development.

A key observation from both locations was that May 2025 was characterized by lower-than-average temperatures combined with increased rainfall compared to normal seasonal conditions. This combination of cooler and wetter weather created optimal conditions for the development and spread of foliar pathogens, resulting in elevated disease pressure during a critical stage of wheat growth.

These environmental conditions directly influenced disease management decisions. In response to the identified infection risk window, fungicide treatments were applied according to the experimental protocol. The timing of these

applications was strategically aligned with pre-heading stages, ensuring effective protection of the crop and maximizing the efficacy of the treatments under the prevailing climatic conditions.

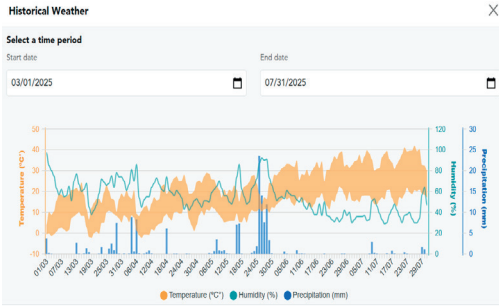


Figure 5. Evolution of temperatures and precipitation from March to July 2025 (Dulbanu, Buzău)

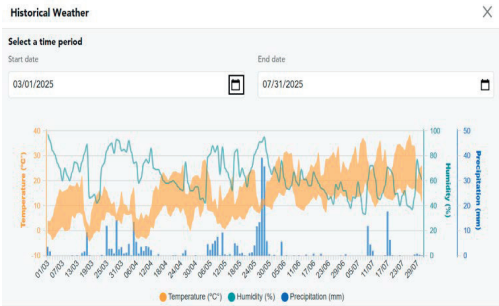


Figure 6. Evolution of temperatures and precipitation from March to July 2025 (Zănești, Neamț)

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 90.7% (Figure 7) in Buzău and 90.1% (Figure 8) 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.

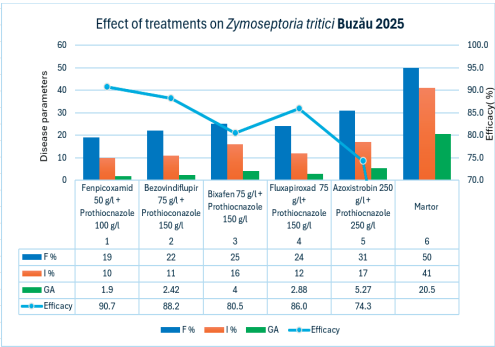


Figure 7. Efficacy of treatments in controlling *Zymoseptoria tritici* (Dulbanu, Buzău)

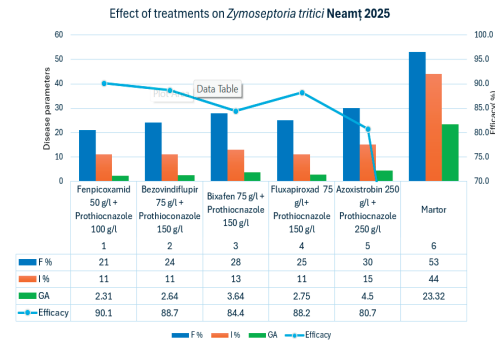


Figure 8. Efficacy of treatments in controlling *Zymoseptoria tritici* (Zănești, Neamț)

Efficacy against *Puccinia recondita* (brown rust)

The treatment was also highly effective in controlling brown rust, showing disease severity reduction rates of 86.2% (Figure 9) in Buzău and 84.3% (Figure 10) in Neamț. This suggests that fenpicoxamid has broad-spectrum activity, providing consistent control across different climate.

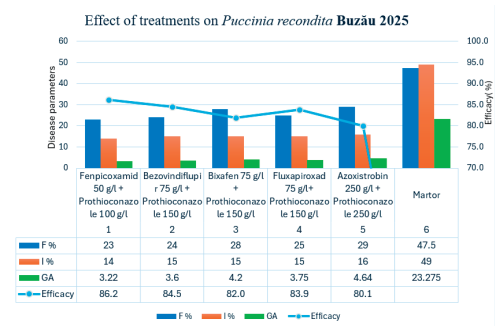


Figure 9. Efficacy of treatments in controlling *Puccinia recondita* (Dulbanu, Buzău)

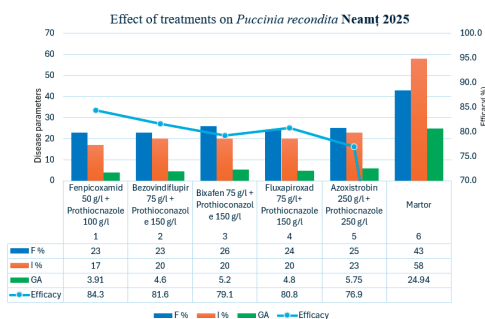


Figure 10. Efficacy of treatments in controlling *Puccinia recondita* (Zănești, Neamț)

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 82.7% (Figure 11) in Buzău and 82.4% (Figure 12) in Neamț, indicating that fenpicoxamid is a valuable tool for managing this pathogen.

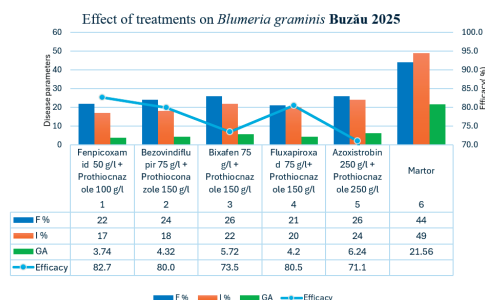


Figure 11. Efficacy of treatments in controlling *Blumeria graminis* (Dulbanu, Buzău)

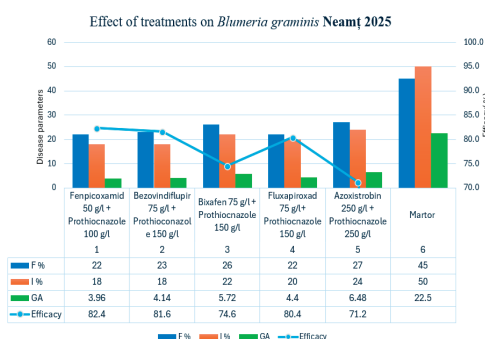


Figure 12. Efficacy of treatments in controlling *Blumeria graminis* (Zănești, Neamț)

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 82%.

CONCLUSIONS

The novel mode of action of fenpicoxamid, combined with the complementary and synergistic activity of its mixture partner, prothioconazole, demonstrated high efficacy in controlling key wheat pathogens across the experimental sites. In particular, control of *Zymoseptoria tritici* exceeded 90%, highlighting the strong performance of this combination under the prevailing environmental conditions. For *Puccinia recondita*, control efficacy ranged between 84.3% and 86.2%, while *Blumeria graminis* was effectively managed with control levels above 82% at both locations. These results are consistent with current fungicide performance standards and confirm the reliability of this mixture under variable disease pressure.

The use of fenpicoxamid in combination with prothioconazole provides not only effective disease control but also contributes to resistance management by introducing a novel mode of action, thereby reducing the risk of cross-resistance development.

Overall, these findings support the inclusion of this fungicide combination as a valuable component of integrated pest management (IPM) strategies in wheat production. However, further research is required to evaluate its long-term performance and its role in sustainable resistance management under diverse agroecological conditions.

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