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Research Article

Efficacy of Systiva® Seed Treatment in Managing Tan Spot and Septoria Leaf Blotch in Winter Wheat

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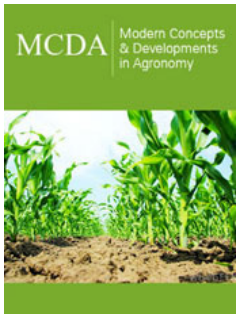

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Abstract

This study evaluates the efficacy of fluxapyroxad, a Succinate Dehydrogenase Inhibitor (SDHI), when applied as a seed treatment fungicide for the control of early-season foliar diseases in winter wheat. Fluxapyroxad, the active ingredient in Systiva®, inhibits mitochondrial respiration in fungal pathogens such as Pyrenophora tritici-repents and Zymoseptoria tritici, which are responsible for tan spot and Septoria leaf blotch, respectively. By targeting critical fungal processes (including spore germination and mycelial development), fluxapyroxad provides a preventative strategy during key wheat growth stages, particularly tillering. This study synthesizes recent findings and field data to demonstrate that seed treatment with Systiva® significantly reduces disease severity while enhancing crop vigor and yield. The results highlight the potential of fluxapyroxad-based seed treatments as a sustainable and effective component of integrated disease management programs in wheat production.

Keywords: Fluxapyroxad; SDHI fungicide; Tan spot; Septoria leaf blotch; Pyrenophora tritici-repents; Zymoseptoria tritici; Integrated disease management; Seed treatment

Introduction

This study evaluates the efficacy of fluxapyroxad as a seed treatment fungicide for the control of major foliar pathogens in wheat. The research aims to highlight its potential as a preventative and curative agent within integrated disease management strategies.

Fluxapyroxad-general

Fluxapyroxad is a pyrazole-4-carboxamide fungicide widely used for its broad-spectrum antifungal activity, high efficiency and low toxicity [1,2]. It is structurally related to boscalid and contains the difluoro methyl-substituted pyrazole acid building block and the biphenyl parts [3]. Fluxapyroxad acts as a Succinate Dehydrogenase Inhibitor (SDHI) [4-6] and has been found to have comparable efficacy to boscalid against various fungi [4]. Its mechanism of action involves inhibiting the SDH enzyme, disrupting the electron transport in the complex II-oxidation of succinic acid to fumarate in fungi, and disrupting cellular energy metabolism [7]. Furthermore, the fungicidal activities of fluxapyroxad, along with other Succinate Dehydrogenase Inhibitors (SDHIs), have been evaluated and it has been found to inhibit succinate dehydrogenase in complex II of the mitochondrial respiratory chain, leading to the inhibition of mycelial growth within the fungus target species [8].

Mode of action of fluxapyroxad against wheat pathogens

Fluxapyroxad functions as a Succinate Dehydrogenase Inhibitor (SDHI), targeting key wheat pathogens such as Pyrenophora tritici-repentis and Zymoseptoria tritici [9,10]. SDHIs interfere with various key fungal life functions, including spore germination, germ tube growth, appressoria formation and mycelium growth. Specifically, fluxapyroxad inhibits the

activity of succinate dehydrogenase, an essential enzyme within complex II of the mitochondrial respiratory chain. This disruption impairs the Tricarboxylic Acid (TCA) cycle and electron transport processes, ultimately leading to a breakdown in cellular energy metabolism and suppression of pathogen growth and development [11]. It is important to note that resistance to fluxapyroxad has been observed in some fungal pathogens, such as Botrytis cinerea. However, there is no cross-resistance between fluxapyroxad and other fungicides with different modes of action [12,13]. Our findings demonstrate that fluxapyroxad, when applied as a seed treatment fungicide, effectively disrupts the development of major wheat pathogens, including *P. tritici-repentis*, the causal agent of tan spot disease [14].

Fluxapyroxad and *Pyrenophora tritici-repentis*

Pyrenophora tritici-repentis is a fungal pathogen that causes tan spot disease in wheat. Tan spot disease, also known as yellow spot, yellow leaf spot, yellow leaf blotch, or helminthosporiosis, is a significant fungal disease that affects wheat crops worldwide [15,16]. The fungus overwinters on stubble and can cause increased incidence and yield loss if ideal conditions occur [17]. The disease is one of the most important fungal diseases of wheat and is found in all regions of the world where wheat and other susceptible host crops are cultivated. Fluxapyroxad has been studied for its effectiveness in managing tan spot disease in wheat. Research indicates that when used in conjunction with integrated agronomic practices (such as nitrogen fertilization and silicon soil amendments), fluxapyroxad significantly reduces disease severity [17]. As mentioned above, the use of fluxapyroxad as a seed treatment fungicide offers a proactive approach to suppressing *P. tritici-repentis*, thereby mitigating yield losses and enhancing crop resilience.

Fluxapyroxad as a seed treatment fungicide

Although fluxapyroxad is primarily applied as a foliar spray, its potential as a seed treatment fungicide has garnered increasing attention. Seed-applied fungicides, including fluxapyroxad, have demonstrated significant benefits in reducing disease severity and enhancing overall plant health and productivity. Studies have shown that seed treatments can improve early plant vigor, increase winter survival rates and boost grain yield by 25-50% [18]. Systiva®, a fluxapyroxad-based fungicide formulated for seed treatment, has proven effective in protecting wheat crops against a range of pathogens. Notably, its application has been associated with reduced infection rates of *P. tritici-repentis* and Zymoseptoria tritici during critical early growth stages (GS23-25 and GS30-31), contributing to improved crop establishment and disease suppression [14].

Objectives of this study

The primary objective of this study is to provide further evidence supporting the efficacy of Systiva® (a fluxapyroxad-based seed treatment fungicide) in reducing the incidence and severity of key foliar fungal diseases in wheat. Emphasis is placed on its effectiveness against *P. tritici-repentis*, the causal agent of tan spot disease, during the early growth stages of wheat development.

Materials and Methods

Field trials were conducted during the 2024-2025 growing season in the Larissa region of central Greece. Visual field measurements were employed to assess wheat tiller numbers and disease severity. The experiment was conducted in a 0.4-hectare field located in Larissa, central Greece, under minimum tillage conditions. A Randomized Complete Block Design (RCBD) was used, consisting of two treatments (Treated with Systiva® and Untreated -Control) and four replications. Each plot measured 10×4 meters, covering 160m^2 per treatment.

Methodology for tiller counting

Tiller density was assessed through direct visual field measurements following established agronomic protocols. In each experimental plot, tillers were counted along fixed-length rows-either three 1-meter rows or five 0.5-meter rows-depending on the season and plot layout. The total number of tillers within these measured segments was recorded and converted to tillers per square meter (tillers m^{-2}) using the known row spacing and sampling area. This method, as outlined by Scotford & Miller [19], provides a reliable estimate of tiller density, though it is labor-intensive and subject to variability due to sampling position. To minimize bias, sampling locations were randomly selected within each plot and measurements were conducted at consistent growth stages to ensure comparability across treatments.

Disease assessment

Visual disease assessment of wheat foliar pathogens was conducted by evaluating symptomatic plant tissues affected by *P. tritici-repentis* and Septoria species. Observers evaluated 8-10 plants every meter between two crop rows, estimating the percentage of leaf area exhibiting blotching, chlorosis, or necrosis. Disease severity was quantified using a Standard Area Diagram (SAD), which provided reference images corresponding to 1%, 5%, 25%, 50% and 75% leaf area infection. This visual scoring method enabled consistent and reproducible evaluations across treatments. Assessments were carried out at 40 evenly spaced sampling points along each treatment path, with intervals of 0.35 meters between sites. All evaluations were performed during the wheat tillering stage, in accordance with the methodology described by Vagelas et al. [14].

Statistics

To evaluate the impact of Systiva® seed treatment on wheat tiller count and foliar disease severity, an independent samples t-test was conducted using JASP statistical software. The dataset consisted of two treatment groups (treated with Systiva® and Untreated-Control) with corresponding measurements for tiller density and disease severity scores. Each observation was considered independent and preliminary diagnostics were conducted to validate the assumptions of parametric testing. Normality of the data distribution was assessed using the Shapiro-Wilk test, while homogeneity of variances between groups was evaluated via Levene's test. The t-test was applied to determine whether the mean differences in tiller count and disease severity between the

two groups were statistically significant. To further interpret the practical relevance of the findings, effect sizes were calculated using Cohen's d, accompanied by 95% confidence intervals to quantify the magnitude and precision of the observed effects.

Result

The results of the independent samples t-test revealed a statistically significant difference in both tiller count (Figure 1) and disease severity (Figure 2) between wheat plants treated with Systiva® and those in the untreated control group. Systiva®-treated plants exhibited a notably higher mean tiller density (Figure 1), alongside substantially lower disease severity scores (Figure 2). Specifically, the reduction in mean disease severity among the treated group underscores the fungicidal efficacy of fluxapyroxad in suppressing early-season infections caused by *P. tritici-repentis* and *Septoria spp*. These results demonstrate that seed treatment with Systiva® not only enhances early plant vigor but also provides effective protection against foliar fungal pathogens under field conditions.

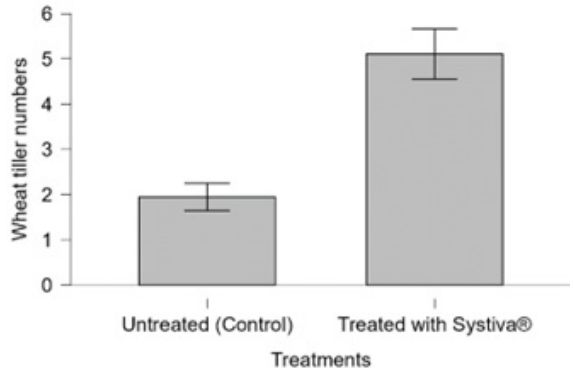

Figure 1: Number of wheat tillers in plants treated with Systiva® seed treatment fungicide compared to untreated controls.

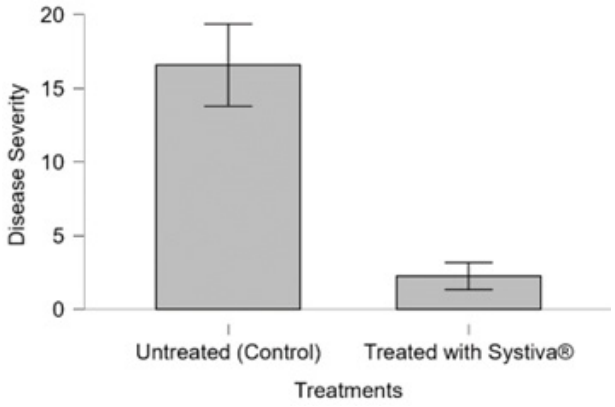

Figure 2: Disease severity in wheat plants treated with Systiva® seed treatment fungicide compared to untreated control plants.

Conclusion

This study provides compelling evidence that seed treatment with Systiva® significantly improves early-stage wheat performance by increasing tiller density and reducing the severity of foliar fungal diseases compared to untreated controls. Statistical analysis using independent samples t-tests confirmed that these differences were both statistically significant and agronomically meaningful, with large effect sizes underscoring the robustness of the treatment's efficacy. The results of this study reinforce the strategic value of fluxapyroxad-based seed treatments, such as Systiva®, within integrated disease management programs for wheat [14]. Specifically, Systiva® demonstrated effective suppression of early-season infections caused by *P. tritici-repentis* and *Septoria spp*., including *Z. tritici*, under natural field conditions. By enhancing plant vigor and suppressing pathogen pressure during critical developmental stages, Systiva® contributes to improved crop establishment and productivity under field conditions. Given the increasing disease risks associated with climate variability and residue-borne inoculum, further research is warranted to assess the long-term effectiveness of Systiva® across diverse agroecological zones and evolving pathogen populations. Such studies will help refine application strategies and ensure sustainable disease control in wheat production systems.

Future Suggestions

To expand upon the findings of this study, future research should explore the long-term efficacy of fluxapyroxad seed treatments across diverse agro-climatic zones and under varying pathogen pressures. Investigating the interaction between Systiva® and different wheat genotypes could reveal genotype-specific responses and optimize treatment recommendations. Additionally, integrating molecular diagnostics to monitor shifts in pathogen populations and resistance development would enhance early detection and inform adaptive management strategies. Comparative trials involving alternative fungicides and integrated disease control approaches (including crop rotation and resistant cultivars) could further validate the role of Systiva® within sustainable wheat production systems.

References

1. Wang W, Wang J, Wu F, Zhou H, Xu D, et al. (2021) Synthesis and biological activity of novel pyrazol-5-yl-benzamide derivatives as potential succinate dehydrogenase inhibitors. Journal of Agricultural and Food Chemistry 69(20): 5746-5754.
2. Li Z, Zhang X, Qin J, Tan Z, Han M, et al. (2019) Efficient and practical synthesis of 3′,4′,5′-trifluoro-[1,1′-biphenyl]-2-amine: A key intermediate of fluxapyroxad. Organic Process Research &Amp, Development 23(9): 1881-1886.
3. Devendar P, Qu R, Kang W, He B, Yang G (2018) Palladium-catalyzed cross-coupling reactions: A powerful tool for the synthesis of agrochemicals. Journal of Agricultural and Food Chemistry 66(34): 8914-8934.
4. Yang D, Zhao B, Fan Z, Yu B, Zhang N, et al. (2019) Synthesis and biological activity of novel succinate dehydrogenase inhibitor derivatives as potent fungicide candidates. Journal of Agricultural and Food Chemistry 67(47): 13185-13194.
5. Wang W, Wang J, Wu J, Jin M, Li J, et al. (2022) Rational design, synthesis and biological evaluation of fluorine- and chlorine-substituted pyrazol-5-yl-benzamide derivatives as potential succinate dehydrogenase inhibitors. Journal of Agricultural and Food Chemistry 70(24): 7566-7575.

6. Bouillaud F (2023) Inhibition of succinate dehydrogenase by pesticides (SDHIs) and energy metabolism. International Journal of Molecular Sciences 24(4): 4045.

7. Grishechkina LD, Podgornaya M, Dolzhenko V (2021) Difenoconazole-based fungicides for orchard protection. BIO Web of Conferences 34: 04004.

8. Zhao Y, Jiao F, Tang T, Wu S, Wang F, et al. (2023) Adverse effects and potential mechanisms of fluxapyroxad in xenopus laevis on carbohydrate and lipid metabolism.

9. Harvey IC, Craigie R, McCloy BL (2015) The control of tan spot of wheat (caused by Pyrenophora tritici-repentis): A possible emerging disease in New Zealand. New Zealand Plant Protection 68: 428-433.

10. Yao C, Meyer KG, Gallup CA, Bowling AJ, Hufnagl A, et al. (2021) Florylpicoxamid, a new Picolinamide fungicide with broad spectrum activity. Pest management science 77(10): 4483-4496.

11. Taher K, Graf S, Fakhfakh MM, Salah HB, Yahyaoui AH, et al. (2014) Sensitivity of Zymoseptoria tritici isolates from Tunisia to pyraclostrobin, fluxapyroxad, epoxiconazole, metconazole, prochloraz and tebuconazole. Journal of Phytopathology 162(7-8): 442-448.

12. Vicentini SN, Casado PS, Carvalho G, Moreira SI, Dorigan AF, et al. (2021) Monitoring of Brazilian wheat blast field populations reveals resistance to QoI, DMI and SDHI fungicides. Plant Pathology 71(2): 304-321.

13. Liu K, Wen Z, Ma Z, Shao W (2022) Biological and molecular characterizations of fluxapyroxad-resistant isolates of Botrytis cinerea. Phytopathology Research 4(2):

14. Vagelas I, Cavalaris C, Karapetsi L, Koukidis C, Servis D, et al. (2022) Protective effects of Systiva® seed treatment fungicide for the control of winter wheat foliar diseases caused at early stages due to climate change. Agronomy.

15. Schilder AC, Bergstrom GC (1994) Infection of wheat seed by Pyrenophora tritici-repentis. Botany 72(4): 510-519.

16. Kaneps J, Bankina B, Moročko-Bičevska I (2021) Virulence of Pyrenophora tritici-repentis: A minireview. Research for Rural Development.

17. Laribi M, Yahyaoui AH, Abdedayem W, Kouki H, Sassi K, et al. (2022) Characterization of mediterranean durum wheat for resistance to Pyrenophora tritici-repentis. Genes 13(2): 336.

18. Bugingo C, Ali S, Yabwalo D, Byamukama E (2025) Optimizing fungicide seed treatments for early foliar disease management in wheat under northern great plains conditions. Agronomy.

19. Scotford IM, Miller PC (2004) Estimating tiller density and leaf area index of winter wheat using spectral reflectance and ultrasonic sensing techniques. Biosystems Engineering 89(4): 395-408.