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Issue Article

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WHEAT LOAF VOLUME, GLUTEN QUALITY, AND DOUGH CHARACTERISTICS AS A RESULT OF VARYING N LEVELS AND THE USE OF FUNGICIDES TO TREAT LEAF RUST DISEASE

Abstract: *Wheat, a vital food source, is known for its flexibility, output potential, and unique viscoelastic qualities. The balance between glutenins and gliadins is crucial for dough tenacity, extensibility, strength, and elasticity. Post-anthesis environmental factors, such as water availability, temperature, and atmospheric CO_2 concentration, impact wheat quality. Nitrogen (N) fertilizer increases the amount of gliadin and glutenin storage proteins and overall protein content. However, there is a lack of knowledge regarding the impact of foliar diseases and their interaction with fungicides and N fertilizer applications on dough rheological properties and gluten quality. Leaf rust, caused by Puccini triticina Eriks., is a significant biotic hazard in wheat-growing regions, affecting grain protein content and overall nitrogen concentration.*

Key words: *fungicide, rust disease, control, nitrogen, balance, Puccini triticina*.

Language: *English*

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Introduction

One of the most vital food sources on the planet is wheat (Triticum aestivum L.). The flexibility of this crop, its great output potential, and particularly the distinctive viscoelastic qualities granted by gluten-which are the reason why wheat is used universally for a wide variety of products-are all crucial to its success. Gliadins, which give dough its viscosity and extensibility, and glutenins, which give dough its strength and elasticity, make up the majority of gluten. Gluten tenacity, gluten extensibility, gluten strength, dough development time, dough stability, and loaf volume are all rheological characteristics that are determined by the precise balance between these gluten fractions and the total protein content.

A balanced glutenin/gliadin ratio is crucial to ensuring greater volumes, especially for loaf volume, since the dough needs to be both sufficiently extensible to respond to gas pressure created during fermentation and sturdy enough to resist collapsing.

From immediately after anthesis until the completion of grain-filling, gluten fractions build up. Gliadins are said to accumulate before glutenins do throughout the grain-filling stage. Therefore, any factor that shortens the grain-filling phase or impacts it differently may lower the overall protein concentration and alter the protein composition, changing the functional qualities of the dough.

In this regard, a number of studies have documented the impact of post-anthesis environmental factors on the quality of wheat, including water availability, temperature, and atmospheric CO_2 concentration.

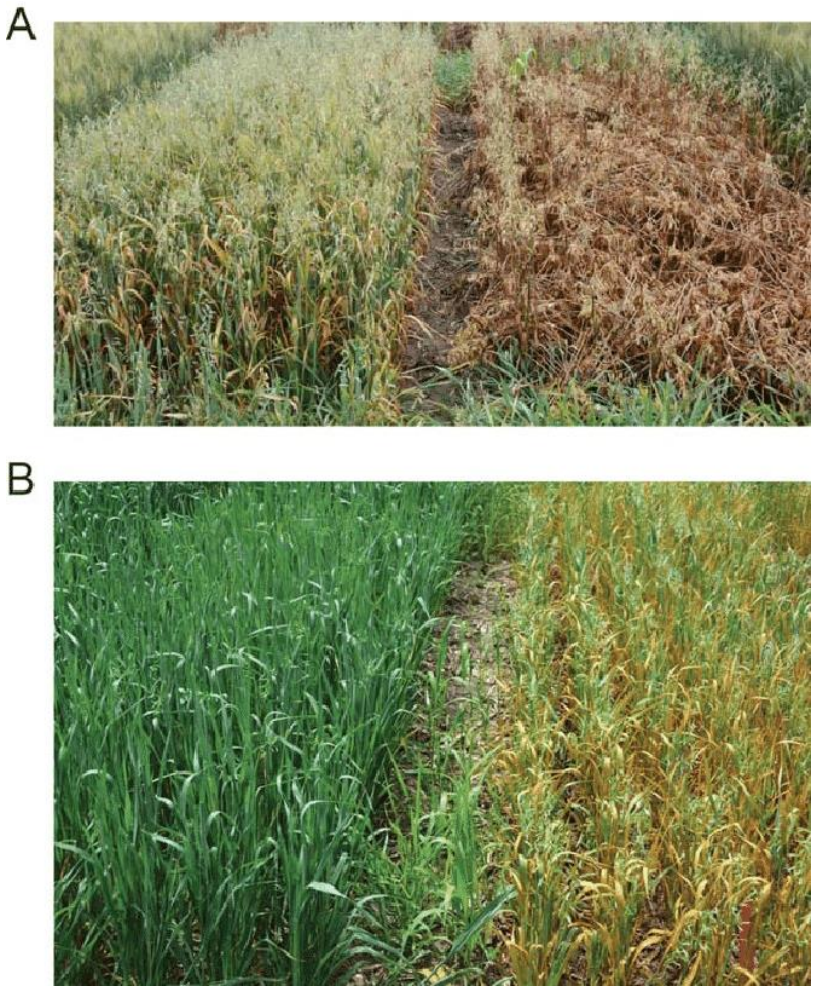

Fig. 1 Crown rust management strategies. (A) Effect of fungicide treatment in an oat field. Right section of the field depicts damage of the pathogen in the absence of fungicide treatment on a susceptible variety, in contrast with the left side of the field that was treated with fungicide. (B) Effect of genetic resistance in the field.

On the other hand, it is well known that the application of nitrogen (N) fertilizer generally increases the amount of gliadin and glutenin storage proteins as well as the overall protein content. There is, however, a general lack of knowledge regarding the impact of foliar diseases and their interaction with fungicides and N fertilizer applications on dough rheological properties and gluten quality, despite the fact that considerable research effort has been put into improving our understanding of abiotic stresses and single management factors like N nutrition on wheat quality.

In many wheat-growing regions of the world, the Puccina triticina Eriks.-caused leaf rust is a significant biotic hazard. Both N and carbon buildup in the grain are decreased by the pathogen, but overall, N concentration is adversely affected more. Despite widespread reports of decreased grain protein content (GPC), nothing is known about how leaf rust affects the protein composition, gluten content, loaf volume, and rheological qualities as measured by alveogram and farinogram parameters.

One theory is that the disease could change the protein composition and rheological qualities by causing early leaf senescence and shortening the grain-filling period. The maintenance of the canopy's green-leaf-area duration (GLAD) by the use of foliar fungicides for disease management may stop this change. Additionally, recently introduced fungicides have been discovered to have additional advantageous physiological benefits that are not mediated by pathogen control.

Accordingly, succinate dehydrogenase inhibitors (SDHIs) fungicides were found to cause physiological alterations in plants, including an extension of GLAD, a decrease in leaf surface temperature, and an increase in PSII's maximal photochemical efficiency. Due to these modifications, treatment with SDHIs fungicides demonstrated better yields in comparison to untreated controls, while

possible effects on wheat quality have not yet been examined.

However, N application can result in noticeably higher disease incidence and lesion area when biotrophic organisms such mildews and rusts are present. Therefore, the negative impacts linked to a promoted more severe leaf rust could offset the direct and favorable influence on the quality of N nutrition. The efficiency of foliar fungicide sprays may potentially be impacted by N fertilization.

The complex attribute of wheat quality is impacted by management, environmental, and genetic variables. Few research have examined the impact of leaf rust and its interactions with management measures like N fertilization and fungicide sprays on dough rheological qualities, despite the fact that some of their potential effects have just been identified. Additionally, the majority of the research was conducted under conditions of naturally occurring infections, making it challenging to determine how foliar illnesses brought on by pathogens with distinct nutritional habits affect the balance of N and starch.

Last but not least, the literature that is currently available mainly focuses on the impact of foliar diseases and fungicides on grain yield and GPC without taking other crucial breadmaking traits into account or was done using traditional active ingredients like triazoles and strobilurins, so the impact of new fungicide active ingredients like carboxamides are unknown. The goal of this study was to investigate the effects of the leaf rust disease, its control with a triple-mixture fungicide containing the SDHI fluxapyroxad, and the interaction of both factors with N fertilization on wheat breadmaking quality, including GPC, wet gluten content, loaf volume, and dough rheological properties. This was done due to the lack of information in the existing literature.

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