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MINI REVIEW

Prediction of barley rust's detrimental impact

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Research focused on understanding the dynamics of distribution and progression of spring barley rust. The disease exhibited varying levels of dissemination, ranging from 21.75% to 30.0% throughout the study period, coupled with intensities fluctuating between 13.25% and 19.0%. The impact of the disease on the structural aspects of the spring barley yield was observed, demonstrating a strong correlation (r=0.973, r=0.980, and r=0.973). Additionally, predictive models for estimating crop yield losses due to rust were formulated, enabling the anticipation of potential spring barley harvest reductions resulting from the disease.

Keywords: Spring barley, Rust, Close correlation, Plant protection.

Introduction

Spring barley holds the fourth position worldwide in terms of cultivation area, and secures the second spot in Europe among cereal crops. In Ukraine, it stands as the second most cultivated cereal after wheat, owing to its nutritional, fodder, and industrial significance, robust yields, adaptability to environmental conditions, and effective agrotechnical practices. Its multifaceted utility for food, fodder, and brewing industries underscores its pivotal role in the country's grain equilibrium. The composition of barley grain, with 12% protein, 64.6% devoid of nitrogenous compounds, 5.5% fiber, 2.1% fat, 13% water, and 2.8% ash, further highlights its nutritional value (Clifford, B.C., 1985).

Ukraine annually dedicates 3-4 million hectares to spring barley cultivation, along with 400–500 thousand hectares for winter barley. Effective disease control necessitates a comprehensive approach, combining organizational, economic, agronomic, and chemical interventions. The scientific management of chemicals emerges as a key strategy to mitigate environmental contamination from pesticide residues while safeguarding barley against diseases (Stubbs, R.W., 1985).

In recent times, the significance of plant diseases has grown due to their adverse impact on agricultural yield, product quality, and subsequent economic losses. Among these, rust stands out as a prominent culprit, affecting plants across the growth cycle, particularly manifesting on barley leaves. The causal agent of this ailment is the Puccinia hordenia Lawrow fungus. Rust inflicts substantial reductions in yield and impairs winter and drought resilience. The most severe damage occurs when the disease emerges during spring, leading to premature crop maturation and significant yield deficits, especially under conditions of inadequate soil moisture. Rust-induced losses range from 20-35% almost annually, and in epiphytic years, yield plunges from 25-30 to 5-6 c/ha. Severe infections result in exceptionally thin grain that is susceptible to wastage. The central Ukrainian regions experience rust epiphytes roughly every other year, while Western Ukraine encounters them less frequently (once in 3-4 years) (Qi, X., et al., 1998).

Literature Review

From 2017 to 2019, a series of experimental investigations were conducted both within the laboratory at the Department of Phytopathology, named in honor of V.F. Peresypkin, and within the phyto-section situated in the fields of the agronomic research station at the National University of Life and Environmental Sciences of Ukraine. These studies centered on the Avatar variety of barley and adhered to the established protocol (Dinh, H.X., et al., 2020).

Seeds were planted at the recommended intervals for the specific geographical zone, reaching a depth of 4-6 cm. Seed quality was assessed following established guidelines, and the sowing process was carried out manually. The individual plot size measured 4 m2, and the seeding rate was set at 4.0 million seeds per hectare. The experimental setup was replicated four times. Systematic placement of the experimental plot scheme was adopted. Rust disease variations in grain crops were taken into consideration during the grain's milk ripeness stage. Rust types were recorded using a specialized scale developed for this purpose, incorporating the composite scale. To monitor rust diseases across fields spanning up to 100 hectares, 20 samples of 10 stems each were collected, with an additional two samples taken for every additional 100 hectares. The assessment encompassed both disease spread (expressed as the percentage of affected plants or their components) and disease intensity (Steffenson, B.J., 1992).

Discussion

To assess the prevalence of spring barley rust, comprehensive field surveys were carried out within the premises of NULES of Ukraine's "Agronomic Research Station" situated in the Vasylkiv district of the Kyiv region spanning the years 2017 to 2019. Rust distribution was observed consistently throughout the entirety of the growth cycle. Initial indications of the ailment emerged during the flag leaf formation phase of the spring barley plants. The observed spread of the disease amounted to 13.0% in 2017, increased to 18.5% in 2018, and decreased to 11.0% in 2019. Correspondingly, disease intensity values were recorded as 5.5%, 9.5%, and 3.5% for the respective years. Throughout the milk-wax ripeness stage of spring barley, disease propagation manifested at rates of 25.0% in 2017, escalating to 30.0% in 2018, and then subsiding to 21.75% in 2019. Concurrently, disease advancement exhibited intensities of 16.0%, 19.0%, and 13.25% in the respective years. Spring barley rust constitutes a perilous affliction, underscoring the crucial necessity to investigate its prevalence and deleterious effects for the formulation of protective strategies. A meticulous analysis of the plant's structure revealed a substantial impact of the pathogen on the growth and development of spring barley. As the extent of infestation increased, discernible reductions were observed in biometric indicators. Our investigations demonstrated a notable deceleration in the growth and development of spring barley plants as the severity of their infestation heightened. Notably, under vigorous disease progression, plant height diminished by 9.5-15.0 cm compared to healthy specimens (Vales, M.I., et al., 2005).

Conclusion

Within the examined region, rust displays extensive prevalence throughout the spring barley's growth cycle, encompassing 11.0% to 18.5% of plants during the flag leaf formation phase and expanding to a range of 21.75% to 30.0% during the milk-wax ripeness period. Our investigations revealed a variation in its development intensity, ranging from 3.5% to 19.0%, contingent on the growth stage. Notably, we observed a notable influence of the pathogen on the growth and developmental trajectories of spring barley plants. As the infestation degree heightened, discernible reductions were registered in various biometric indicators. Specifically, under intensive lesions (score 0), both plant weight and the weight of 1000 seeds diminished by 0.61 and 6.8 grams, respectively, constituting 67.9% and 77.6% of the corresponding values from unaffected plants.

Correlations emerged between the extent of rust-induced damage and parameters such as seed weight per plant and weight of 1000 seeds, ear length, and seed count per plant. Regression equations were formulated, enabling the quantification of indicator decrement based on disease progression during the flag leaf formation phase.

References

Clifford, B.C. (1985). Barley leaf rust. In Diseases, Distribution, Epidemiology and Control, pp:173-205.

Stubbs, R.W. (1985). Stripe rust. In Diseases, Distribution, Epidemiology and Control, pp:61-101.

Qi, X., Niks, R.E., Stam, P., Lindhout, P. (1998). Identification of QTLs for partial resistance to leaf rust (Puccinia hordei) in barley. Theoretical and Applied Genetics, 96:1205-1215.

Dinh, H.X., Singh, D., Periyannan, S., Park, R.F., Pourkheirandish, M. (2020). Molecular genetics of leaf rust resistance in wheat and barley. Theoretical and Applied Genetics, 133:2035-2050.

Steffenson, B.J. (1992). Analysis of durable resistance to stem rust in barley. Euphytica, 63:153-167.

Vales, M.I., Schön, C.C., Capettini, F., Chen, X.M., Corey, A.E., Mather, D.E., Hayes, P.M. (2005). Effect of population size on the estimation of QTL: A test using resistance to barley stripe rust. Theoretical and Applied Genetics, 111:1260-1270.

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