Hypergraph Models for Predicting Fusarium Head Blight Risk

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Fusarium Head Blight (FHB) is one of the most destructive diseases of wheat in the Canadian Prairies, causing yield loss, grain downgrading, and mycotoxin contamination. Accurate risk prediction can support management decisions such as wheat variety selection and fungicide application, but most existing tools rely on simple, weather-only models that do not capture the multi-way interactions underlying disease development.

This work applies Hypergraph Neural Networks (HMPNNs) to FHB risk prediction in Canadian wheat by modelling the Prairies as a multi-class hypergraph built on a sensory network of weather stations and historical FHB observations. Hyperedges link varieties, locations, years, and their associated environmental and historical signals, enabling structure-aware learning over spatial, temporal, and varietal relationships.

We evaluate two settings using data from the Canadian Grain Commission's Harvest Sample Program (1995–2024): region-level prediction with annual weather aggregation, and collection-center-level prediction with monthly aggregation aligned to the crop growth cycle. Across both settings, HMPNNs consistently outperform support vector machines, feed-forward neural networks, and transformer baselines, reducing root mean squared error by several percentage points. These results highlight the value of structural representations for forecasting FHB risk in practice.