2024-25 HIVE Summer Internship Project

Blackspot Disease Risk Dashboard for Field Peas: Real-Time Spatial and Temporal Visualization

46SAE_EECMS_DiseaseRiskDashboard

Primary Academic Supervisor
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Project Background

Blackspot disease is one of the most destructive diseases affecting field peas which cause significant yield losses and impacting the livelihoods of growers. With global demand for sustainable and efficient agriculture on the rise, farmers need reliable, real-time data to manage crop diseases more effectively. Every year, The Department of Primary Industries and Regional Development (DPIRD) issues a national disease risk forecast for blackspot disease, providing essential guidance to growers on when and where to plant crops to minimize the risk of infection. However, current communication methods, such as weekly SMS updates and web-based forecasts, limit the ability of growers to interpret and act on this critical information for their specific locations.

In response to this challenge, there is an increasing need for a dynamic, interactive dashboard that will allow farmers to not only receive timely disease risk updates but also to visualize and query real-time data for their specific circumstances. By presenting the risk levels visually, farmers can make informed, location-specific decisions based on a combination of spatial risk models (assessing proximity to previous crop fields) and temporal risk models (based on current weather conditions). The goal is to provide growers with a simple but powerful tool that integrates both temporal and spatial data into a data-driven decision-making intuitive platform.

In a rapidly changing agricultural landscape, this project will harness cutting-edge data visualization technologies to empower growers. By providing them with an automated dashboard capable of integrating weather forecasts, disease history, and spatial risk data, this solution will contribute to more sustainable crop management. As agriculture moves towards precision farming and data-driven decisions, the Blackspot

Dashboard will help growers stay ahead of potential outbreaks, reduce crop losses, and ensure a more efficient planting strategy.

Project Description, Expected Outputs, Possible Stretch Goals

The goal of this project is to develop a real-time, interactive dashboard that provides growers with actionable insights into the risk of blackspot disease in field peas. The dashboard will integrate both temporal and spatial risk models developed by DPIRD, offering a holistic view of disease risk based on weather conditions and crop proximity.

1. Temporal Risk Model:

The temporal model uses current weather observations to estimate the risk of spore production and disease development at specific locations. This model provides weekly updates to help growers make time-sensitive decisions about sowing. Visualizing this data will involve plotting risk scores and advisories (e.g., “sow now” or “delay sowing”) for various locations.

2. Spatial Risk Model:

The spatial risk model assesses the risk of blackspot infection based on proximity to previous field pea crops. This model produces a polygon-based map showing areas of high, medium, and low disease risk. The combination of these risk models will offer growers a more comprehensive assessment of their field conditions.

3. Expected Outputs:

o Temporal Risk Dashboard: An interactive dashboard where users can query the current risk level for specific locations based on weather data. Users can see disease risk ratings (0-100) and recommendations (e.g., sowing advice) displayed spatially for around 50 locations.

o Spatial Risk Map: A visual display of spatial disease risk, showing polygons that classify cropping regions by risk level (high, medium, low, not assessed).

o Risk Surface Interpolation: An interpolation of temporal data to create a gridded risk surface, offering a continuous risk assessment across regions.

o Combined Risk Assessment: An integrated view combining both spatial and temporal models, giving growers a single risk rating for their location, simplifying decision-making.

4. Possible Stretch Goals:

o Automation of Data Collection and Model Updates: Automating the data feed from weather stations and historical

Links to background reading and any relevant recent work in the field

1. DPIRD - Blackspot Disease Forecast (https://www.agric.wa.gov.au/field-peas/blackspot-field-peas-disease-forecast)
Provides details on blackspot disease forecasting and the importance of managing disease risks in field peas.
2. Blackspot Risk Model in Field Peas (https://agriculture.vic.gov.au/biosecurity/plant-diseases/grain-pulses-and-cereal-diseases/blackspot-of-field-peas)
Explores the temporal and spatial risk models used for predicting blackspot disease and their role in decision-making for growers.
3. Spatial Models in Agriculture: Techniques and Applications (https://www.sciencedirect.com/science/article/pii/S0308521X15000239)
Discusses the use of spatial modelling and GIS technology in agriculture, relevant to developing risk assessment tools like the blackspot dashboard.

What type of visualisation will the student develop or produce?

The student will develop an interactive dashboard that visually represents temporal risk data (weekly weather-based risk updates) and spatial risk data (polygon maps showing areas of varying disease risk). The dashboard will include queryable features, enabling users to select specific locations and view both current and forecasted disease risks with advisory recommendations.

How will the visualisation contribute to your research outcomes?

The visualization will combine complex spatial and temporal data into a user-friendly platform, enabling better decision-making for growers. By automating and visually presenting the risk assessments, the research will contribute to improved disease management strategies, enhancing field pea production efficiency and minimizing the impact of blackspot disease across cropping regions.

If the project is successful, where would you consider publishing the results?

If the project is successful, the results could be considered for publication in the following Q1 journals and conferences related to agriculture technology, data visualization, and disease modelling such as Computers and Electronics in Agriculture, Agricultural Systems, International Conference on Precision Agriculture (ICPA)

Draft Project Timeline:

Week 1

• Nov 11: Full-day HIVE induction, familiarizing the student with HIVE's visualization and research tools. • Nov 12: Area and project induction with the primary supervisor to review project goals, timeline, and deliverables. • Begin literature review on blackspot disease, disease risk modelling, and relevant data visualization techniques. • Develop a detailed project plan with input from HIVE and the academic team.

Week 2

• Data Collection and Processing: Begin gathering relevant spatial and temporal risk data (weather data, crop history, etc.) from DPIRD public dataset. • Start cleaning and preparing data for integration into the dashboard, ensuring it is compatible with

Week 3

• Implement temporal risk model visualizations: Create the framework to display real-time temporal blackspot disease risks across various regions. • Develop queryable features in the dashboard, allowing users to search for specific locations and view detailed risk assessments. • Continue refining data integration and model automation.

Week 4

• Spatial Risk Model Visualization: Begin visualizing the spatial blackspot risk using polygon maps that display disease risk ratings (high, medium, low). • Overlay the temporal and spatial models to allow a combined risk assessment feature for users. • Test the early-stage visualization and dashboard components.

Week 5

• Data Interpolation and Automation: Implement data interpolation techniques to create a gridded risk surface across regions based on the collected data. • Automate the process for weekly data updates from weather and crop data sources. • Refine the dashb

Week 6

• First Testing Phase: Test the dashboard prototype with sample data and real user scenarios, ensuring data accuracy and system functionality. • Gather feedback from the project supervisors and HIVE team on initial functionality and areas for improvement.

Week 7

• Refine the visualization components based on user feedback from the first testing phase. • Implement any additional data sources (e.g., environmental data for long-term disease risk). • Optimize the dashboard performance to handle real-time data updates

Week 8

• Continue working on dashboard improvements based on second-round testing. • Refine the AI-driven predictive analytics for future disease risk forecasting. • Begin preparing final documentation detailing the development process, data integration, and key insights.

Week 9

• Focus on report writing and preparing for the final project presentation. • Create visual and functional summaries of the dashboard for the presentation. • Test the final product to ensure it meets project objectives and functions smoothly in real-time.

Week 10

• Jan 31st: Final presentation at the HIVE Internship Showcase to demonstrate the fully operational dashboard. • Submit the final report, including a detailed explanation of the system, data sources, challenges faced, and potential future developments.

<u>Student Experience and Supervision:</u>

How often will you meet with the student over the 10-week period?

Once per week, if needed twice.

Your work desk location and the location of student desk

My Office: Building 314, Room 332B, | Student desk could be at HIVE Staff Office: Building 201, Room 212| Bentley Campus, or Online

<u>Student Attributes:</u>

Please indicate any preference for student's academic discipline or field of study

Computer Science, Data Science

What competencies are required to start this project

Beginner - 2D image and/or video software (e.g. Adobe Suite, Sony Vegas)
Beginner - 3D modelling software (e.g. Blender, 3ds Max)
Beginner - Unity Programming (C# coding, animation syntax, debugging, problem-solving)
Intermediate - Data structures, analytics, statistical modelling
Beginner - Experience with GIS software

Do you have any other student attributes you think are important to the project?

No