

Agentic AI Hackathon: Building Intelligent Agents with IBM Granite and LangFlow

AgriAtwal

Intelligent AI System for Pest and Disease Risk Assessment.

Name of the team: AgriAtwal

Details of Team members

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Problem statement

Problem Statement 12: Intelligent AI System for Pest and Disease Risk Assessment.

The Challenge

Pest and disease outbreaks can rapidly impact crop yield if not identified early. Traditional monitoring methods rely on visual inspections and historical experience, which may not capture early risk conditions driven by weather and environmental changes. There is a need for an intelligent system that can analyze environmental and crop data to assess pest and disease risk proactively.

Environmental & Crop Data Analysis Agent

An agent that processes temperature, humidity, rainfall, crop type, and seasonal data into risk assessment summaries.

Pest & Disease Risk Detection Agent

An agent that identifies favorable conditions for pest and disease development using historical patterns and agronomic thresholds.

Risk Alert & Preventive Advisory Assistant

An agent that generates risk alerts and preventive care insights(assistive only, non-chemical recommendation).

Outcome

Improves early awareness of pest and disease risks, reducing crop loss, and unnecessary interventions.

Mandatory Tech Stack

Lang Flow using IBM Granite Model(Using RAG on integrated pest management (IPM) guidelines and agricultural extension resources.

Proposed solution

Our proposed solution is an **Intelligent AI-based Pest and Disease Risk Assessment System** that proactively analyzes environmental and crop data to identify early risk conditions for pest and disease outbreaks.

The system works through three logical stages:

- **Environmental & Crop Data Analysis** to evaluate weather conditions such as temperature, humidity, rainfall, crop type, and season.
- **Pest & Disease Risk Detection** to identify favorable conditions for pest and disease development using agronomic thresholds.
- **Risk Alert & Preventive Advisory** to generate farmer-friendly, non-chemical preventive recommendations based on Integrated Pest Management (IPM) guidelines.

By combining **real-time data analysis, AI reasoning, and agricultural knowledge**, the system helps farmers take **early preventive actions**, reducing crop loss and avoiding unnecessary interventions.

Need of project

- Pest and disease outbreaks significantly reduce crop yield and farmer income when not detected early.
- Traditional monitoring methods rely on manual field inspection and past experience, which are time-consuming and often reactive.
- Changing climate conditions such as temperature, humidity, and rainfall create unpredictable pest and disease risks.
- Farmers lack timely, data-driven risk alerts and preventive guidance based on real environmental conditions.
- There is a need for an intelligent AI system that continuously analyzes environmental and crop data to assess risks proactively.
- An AI-assisted, non-chemical advisory system based on IPM guidelines can help farmers take preventive action and reduce unnecessary interventions.

End user of project

Farmers & Growers

- Receive early warnings about pest and disease risks
- Make timely, informed decisions to protect crops
- Reduce crop losses through preventive, non-chemical measures

Agricultural Extension Officers

- Support farmers with AI-driven risk assessments
- Provide region-specific advisories based on environmental data
- Improve outreach and decision-making efficiency

Agronomists & Crop Consultants

- Analyze pest and disease risk trends across crops and seasons
- Recommend sustainable preventive practices using IPM guidelines

Agri-Tech Organizations & Startups

- Integrate the system into digital farming platforms
- Enhance precision agriculture and smart advisory services

Government & Agricultural Departments

- Monitor pest and disease risks at a regional level
- Support early intervention planning and food security initiatives

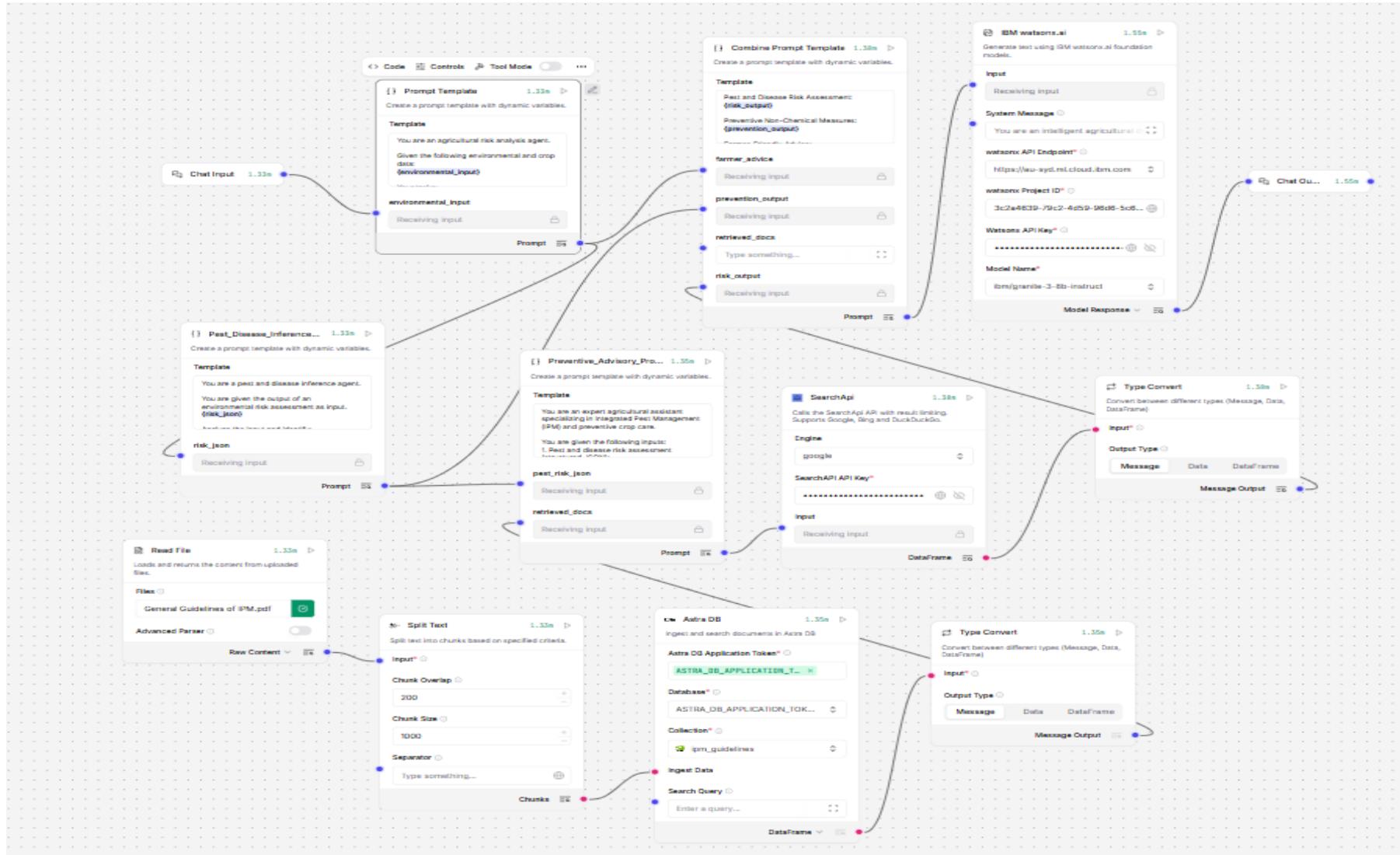
Technology Used

- **LangFlow** – For visual orchestration of multi-agent AI workflows
- **IBM watsonx.ai (Granite Model)** – Large Language Model used for reasoning, analysis, and advisory generation
- **Retrieval Augmented Generation (RAG)** – To enhance AI responses using IPM guidelines and agricultural extension resources
- **Astra DB (Vector Database)** – For storing and retrieving embedded IPM guideline document
- **Document Processing (PDF Upload & Split)** – For ingesting Integrated Pest Management guideline documents
- **Python** – For API integration and local execution
- **REST APIs** – To trigger and consume LangFlow workflows programmatically

Novelty and Uniqueness

- **Proactive Risk Assessment:** Unlike traditional visual inspection methods, the system predicts pest and disease risks before symptoms appear using environmental indicators.
- **Non-Chemical Focus:** Strictly promotes preventive, non-chemical solutions, aligning with sustainable agriculture practices.
- **Multi-Agent Intelligence:** Separates analysis, inference, and advisory into logical agents, improving clarity and accuracy.
- **RAG-Powered Advisory:** Uses official IPM guidelines to ensure recommendations are reliable and practical.
- **Farmer-Friendly Output:** Converts complex AI analysis into simple, actionable advice suitable for farmers.
- **Scalable & Extensible:** Can be adapted to different crops, regions, and climatic conditions.

Technical flow diagram - Architecture blueprint



Langflow component Used

- **Chat Input** – To receive environmental and crop data
- **Prompt Templates** – Environmental Risk Analysis Prompt
Pest & Disease Inference Prompt
Preventive Advisory Prompt
Final Advisory Combination Prompt
- **IBM watsonx.ai LLM Node (Granite Model)** – For analysis and natural language generation
- **File Upload Component** – To upload IPM guideline PDFs
- **Text Splitter** – To divide documents into manageable chunks
- **Embedding Component** – To convert IPM documents into vector embeddings
- **Astra DB Vector Store** – For storing and retrieving relevant agricultural knowledge
- **Type Converter** – To convert retrieved data into LLM-compatible format
- **Chat Output** – To display the final agricultural advisory

Input Screenshot 1



User

Temperature: 30

Humidity: 80

Rainfall: 90

Crop type: Tomato

Season: Summer

Input Screenshot 2



User

Temperature: 35

Humidity: 65

Rainfall: 60

Crop type: Cotton

Season: Kharif

Output Screenshot 1



AI ibm/granite-3-8b-instruct

Agricultural Risk Assessment Advisory for Cotton in Kharif Season

Environmental & Crop Data Analysis

- **Risk Score:** 75
- **Risk Level:** High
- **Reasoning:** The current environmental conditions (Temperature: 35°C, Humidity: 65%, Rainfall: 100mm) combined with the summer season create a favorable environment for pests and diseases. High temperatures and humidity levels can accelerate pest reproduction and disease spread, while excessive rainfall can lead to waterlogging and nutrient leaching, weakening the crop's defenses.
- **Risk Score:** 85
 - **Risk Level:** High
 - **Reasoning:** The combination of high temperatures, humidity, heavy rainfall during summer increases the risk of fungal diseases like Early/Late Blight and viral infections like TYLCV through vector transmission by insects. Waterlogging from excessive rainfall weakens plant roots, making them more susceptible to diseases.
- **Preventive Measures & Farmer Advice:**
 - **Crop Rotation:** Rotate crops annually to disrupt pest life cycles and reduce disease buildup in soil.
 - **Sanitation:** Remove infected plant debris regularly to prevent disease spread.
 - **Irrigation Management:** Ensure proper drainage to avoid waterlogging; use drip irrigation if possible to minimize leaf wetness.
 - **Resistant Varieties:** Plant disease-resistant tomato varieties if available for your region.
 - **Mulching:** Apply organic mulch around plants to conserve moisture, regulate soil temperature, and suppress weeds that harbor pests.
 - **Biological Control:** Encourage natural predators like ladybugs for aphid control or introduce beneficial nematodes for soil health improvement against certain pests and diseases.

- **Reasoning:** The current environmental conditions (Temperature: 30°C, Humidity: 80%, Rainfall: 90%) combined with the summer season create a favorable environment for pests and diseases. High temperatures and humidity levels can accelerate pest reproduction and disease spread, while excessive rainfall can lead to waterlogging and nutrient leaching, weakening the crop's defenses.

Pest & Disease Risk Detection

- **Likely Threats:** Early Blight (*Alternaria solani*), Late Blight (*Phytophthora infestans*), Tomato Yellow Leaf Curl Virus (TYLCV), and various insect pests like Aphids and Whiteflies.
- **Causes:** High temperatures and humidity promote the rapid growth of fungi causing Early Blight and Late Blight. TYLCV is transmitted by Whiteflies, which thrive in warm, humid conditions. Aphids are attracted to the sweet sap of tomato plants and can spread viruses like TYLCV. Excessive rainfall can cause waterlogging, leading to root rot diseases.
- **Crop Stress Indicators:** Wilting or yellowing leaves (Early/Late Blight), curling or yellowing leaves with silvery patches (TYLCV), stunted growth, reduced fruit set, or fruit deformation (insect damage).

Risk Alert & Preventive Advisory

- **Crop Rotation:** Rotate crops annually to disrupt pest life cycles and reduce disease buildup in soil.
- **Sanitation:** Remove infected plant debris regularly to prevent disease spread.
- **Irrigation Management:** Ensure proper drainage to avoid waterlogging; use drip irrigation if possible to minimize leaf wetness.
- **Resistant Varieties:** Plant disease-resistant tomato varieties if available for your region.
- **Mulching:** Apply organic mulch around plants to conserve moisture, regulate soil temperature, and suppress weeds that harbor pests.
- **Biological Control:** Encourage natural predators like ladybugs for aphid control or introduce beneficial nematodes for soil health improvement against certain pests and diseases.
- **Regular Monitoring:** Inspect plants weekly for early signs of stress or disease; act promptly upon detection by removing affected parts or applying organic treatments like neem oil or copper sprays as a last resort after exhausting other methods.

By implementing these non-chemical strategies, farmers can significantly reduce the risk of crop loss due to pests and diseases while maintaining sustainable practices that benefit long-term soil health and ecosystem balance.

Output Screenshot 2



AI ibm/granite-3-8b-instruct

Agricultural Risk Assessment Advisory for Tomato Crop in Summer

Environmental & Crop Data Analysis

- Risk Score: 85
- Risk Level: High
- Reasoning: The current environmental conditions (Temperature: 30°C, Humidity: 80%, Rainfall: 90%) combined with the summer season create a favorable environment for pests and diseases. High

curling leaves (Whiteflies), wilting or yellowing (Fusarium/Verticillium Wilt), and overall poor plant health.

Risk Alert & Preventive Advisory

- Risk Score: 75
 - Risk Level: High
- Reasoning: Given the high environmental risk score and identified threats, immediate preventive measures are crucial to protect your cotton crop from significant damage during the Kharif season.

Preventive Measures & Farmer Advice

- Implement Integrated Pest Management (IPM) practices tailored for cotton crops in hot and humid conditions:
 - Cultural Control: Regularly monitor fields for early signs of pests or diseases; remove infected plant debris promptly to reduce overwintering sites for pests; practice crop rotation to disrupt

- Reasoning: The current environmental conditions (Temperature: 35°C, Humidity: 65%, Rainfall: 60mm) and the Kharif season are conducive to pest and disease outbreaks in cotton crops. High temperatures and humidity can accelerate pest reproduction rates, while excessive rainfall can create favorable conditions for fungal diseases. These factors combined indicate a high risk for cotton crops.

Pest & Disease Risk Detection

- Likely Threats: Boll Worms, Whiteflies, Fusarium Wilt, and Verticillium Wilt.
 - *Boll Worms*: These pests feed on cotton bolls, causing significant damage to the crop yield.
 - *Whiteflies*: They suck sap from cotton plants, leading to reduced growth and potential transmission of viral diseases.
 - *Fusarium Wilt and Verticillium Wilt*: These soil-borne fungal diseases cause wilting and yellowing of leaves, eventually leading to plant death if left untreated.
- Environmental Causes: High temperatures and humidity promote rapid pest reproduction, while heavy rainfall increases the likelihood of fungal diseases spreading through water splashing onto plant surfaces.
- Crop Stress Indicators: Visible signs include damaged or missing bolls (Boll Worms), yellowing or

- Cultural Control: Regularly monitor fields for early signs of pests or diseases; remove infected plant debris promptly to reduce overwintering sites for pests; practice crop rotation to disrupt pest life cycles; maintain proper spacing between plants for better air circulation which reduces humidity around leaves.
- Biological Control: Encourage natural predators like ladybugs or lacewings that feed on whiteflies by providing habitat such as flowering companion plants near the field edges; introduce beneficial nematodes that attack boll worm larvae in soil.
- Physical Barriers: Use row covers or fine mesh netting over young plants to prevent adult whiteflies from laying eggs on them; install traps baited with pheromones to monitor boll worm populations without harmful chemicals.
- Resistant Varieties: Plant cotton varieties known for resistance against common pests like bollworms and diseases like Fusarium/Verticillium wilt where available in your region.

By following these non-chemical strategies, you can significantly reduce the impact of pests and diseases on your cotton crop during this high-risk period without resorting to harmful chemical treatments that could further stress your plants or contaminate your produce with residues unsuitable for organic markets if applicable. Regular monitoring is key – early detection allows timely intervention before infestations become severe enough to cause substantial yield losses.

Future Scope

➤ Real-Time Data Integration

Integrate IoT sensors, weather APIs, and satellite data for live pest and disease risk monitoring.

➤ Expanded Crop & Pest Coverage

Support more crop varieties, regional pests, and diseases using extended IPM and agricultural datasets.

➤ Predictive & Seasonal Forecasting

Use advanced AI models to predict outbreaks weeks in advance based on climate trends and historical patterns.

➤ Mobile & Multilingual Advisory System

Deliver risk alerts and preventive guidance through mobile apps in regional languages for wider farmer adoption.

➤ Image-Based Pest Detection

Combine image recognition from crop photos with environmental analysis for more accurate diagnosis.

➤ Personalized Farm-Level Recommendations

Provide customized advisories based on farm location, crop stage, and seasonal conditions.

➤ Government & Policy Support

Enable large-scale pest surveillance dashboards for agricultural departments and policymakers.

Git Hub Link

Github URL – <https://github.com/Dinavya/Agri-Agent.git>

References

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Thank You!

Thank you for your time and interest.