

Predicting Plant Growth Stages with Environmental and Management Data Using Power BI

Introduction:

Plant growth prediction is an essential part of precision agriculture, helping farmers optimize resources, increase yield, and manage risks. This project leverages Power BI to analyze environmental and management data to predict plant growth stages effectively. The primary objective is to identify key factors such as temperature, humidity, soil type, and fertilizer usage that influence different growth stages of plants. By visualizing trends and patterns, this analysis helps in making data-driven decisions for improved crop production.

Power BI is used to integrate data from multiple sources, clean and preprocess it, and create dynamic dashboards to analyze the relationships between various factors affecting plant growth. This report presents a structured workflow starting from data collection to visualization, performance testing, and final insights.

Project Flow:

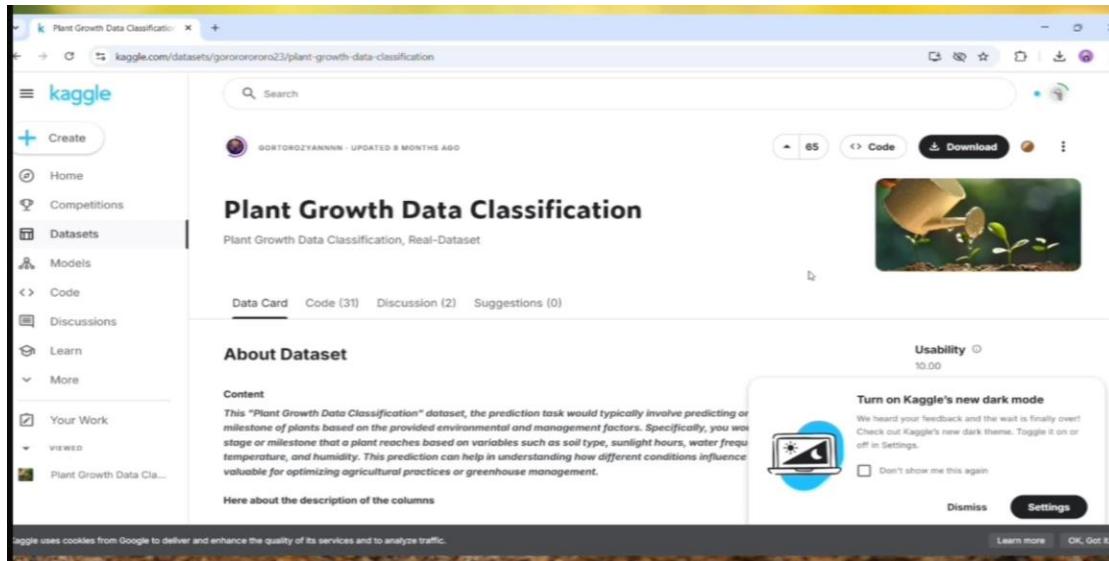
The project consists of the following key milestones:

- Milestone 1: Data Collection & Extraction from Database
- Milestone 2: Data Preparation
- Milestone 3: Data Visualization
- Milestone 4: Dashboard Design
- Milestone 5: Report Creation
- Milestone 6: Performance Testing

Milestone 1: Data Collection & Extraction

The dataset for this analysis consists of environmental and agricultural data collected from multiple sources. These datasets include climate parameters, soil characteristics, and plant growth observations.

- - Climate Data: Temperature, humidity, sunlight hours.
- - Soil Data: Soil type, moisture content, and nutrient levels.
- - Plant Growth Stages: Recorded observations of different plant growth phases.
- - We have taken the Dataset from Kaggle.



Milestone 2: Data Preparation:

Data preparation involves cleaning, transforming, and structuring the raw data for analysis. This includes handling missing values, normalizing numerical attributes, and encoding categorical variables.

 A screenshot of a Power BI Desktop window displaying a data table. The table has columns for 'Growth_Milestone', 'Water_Frequency_Numeric', 'Temperature_Range', 'Humidity_Range', 'Humidity_Level_Description', 'Temperature_Range_Description', and 'Growth_Milestone_Description'. The data is organized into rows, with the first row highlighted. The 'Humidity_Range' column is selected, and a filter is applied: 'Humidity_Range <= 40, "Low"; [Humidity] >= 40 && [Humidity] <= 60, "Moderate"; [Humidity] >= 60, "High"'. The 'Data' pane on the right shows a list of fields, including 'plant_growth_data', 'Average_Humidity', 'Average_Sunlight_Hours', 'Average_Temperature', 'Fertilizer_Type', 'Growth_Milestone', 'Growth_Milestone_Count', 'Growth_Milestone_Description', 'Growth_Milestone_Percentage', 'Humidity', 'Humidity_Level_Description', 'Humidity_Range', 'Plant_Growth_Category', 'Soil_Type', 'Sunlight_Hours', 'Temperature', 'Temperature_Range_Description', 'Water_Frequency', and 'Water_Frequency_Numeric'.

Milestone 3: Data Visualization

Power BI was used to create insightful visualizations that help in understanding the relationship between different environmental and management factors and plant growth stages.

- Line Charts: Track temperature and soil moisture changes over time.
- Bar Charts: Compare plant growth stages under different conditions.

- Heatmaps: Show correlations between environmental factors and growth patterns.

Extracted Graphs and Tables:

Soil_Type	High	Moderate	Total
<input type="checkbox"/> sandy	49	59	108
weekly	15	30	45
daily	22	13	35
bi-weekly	12	16	28
<input type="checkbox"/> loam	55	63	118
weekly	18	24	42
daily	11	9	20
bi-weekly	26	30	56
<input type="checkbox"/> clay	79	66	145
weekly	48	42	90
daily	13	6	19
bi-weekly	18	18	36
Total	183	188	371

This visualization provides a summary of key environmental factors, including average sunlight hours (6.83), humidity (58.10), and temperature (25.08). These metrics are crucial in determining the ideal conditions for plant growth.

Key influencers Top segments



What influences Temperature to ?

When...

....the average of
Temperature decreases by

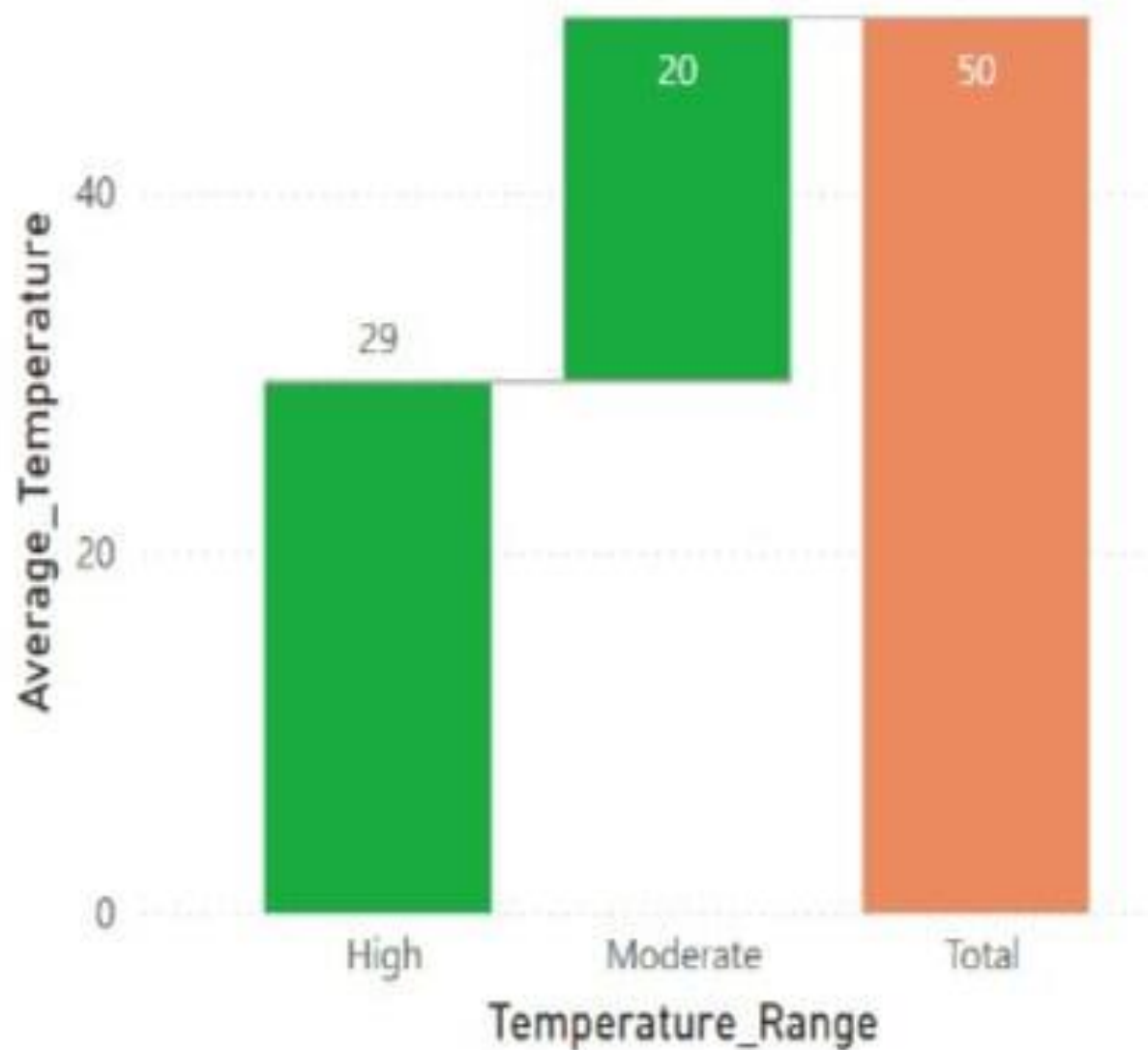
Temperature_Range_Descr...
is Cold



The Power BI dashboard displays multiple insights, including the effect of soil type, fertilizer type, and climate variables on plant growth. It allows users to interact with the data and explore different scenarios.

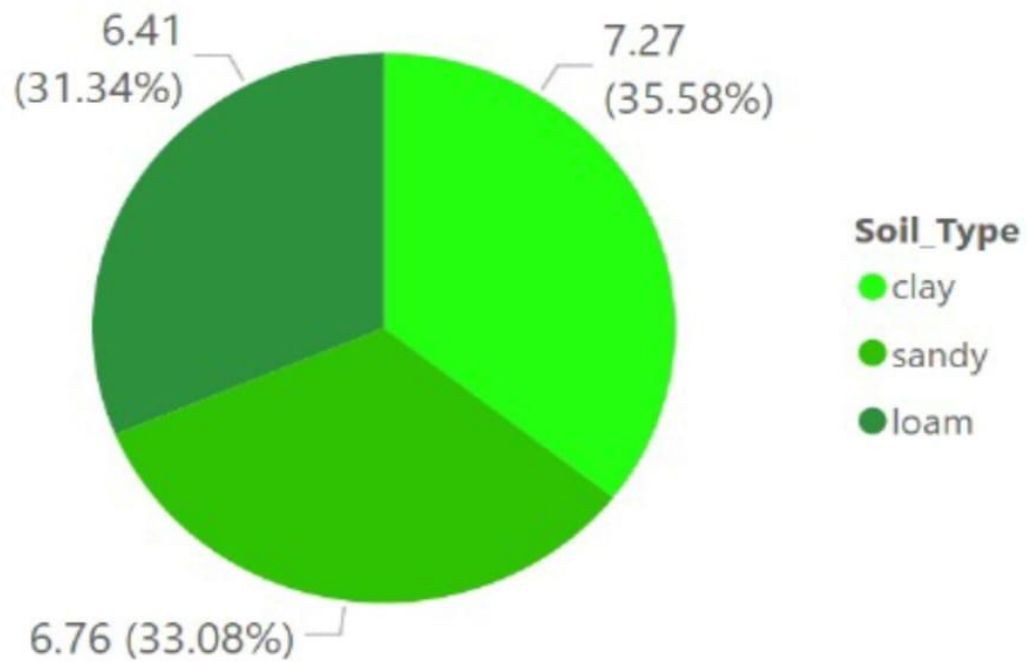
Average_Temperature by Temperature_Range

● Increase ● Decrease ● Total



This graph highlights the relationship between soil type and plant growth. It shows how different soil compositions influence plant development and which types are best suited for optimal growth.

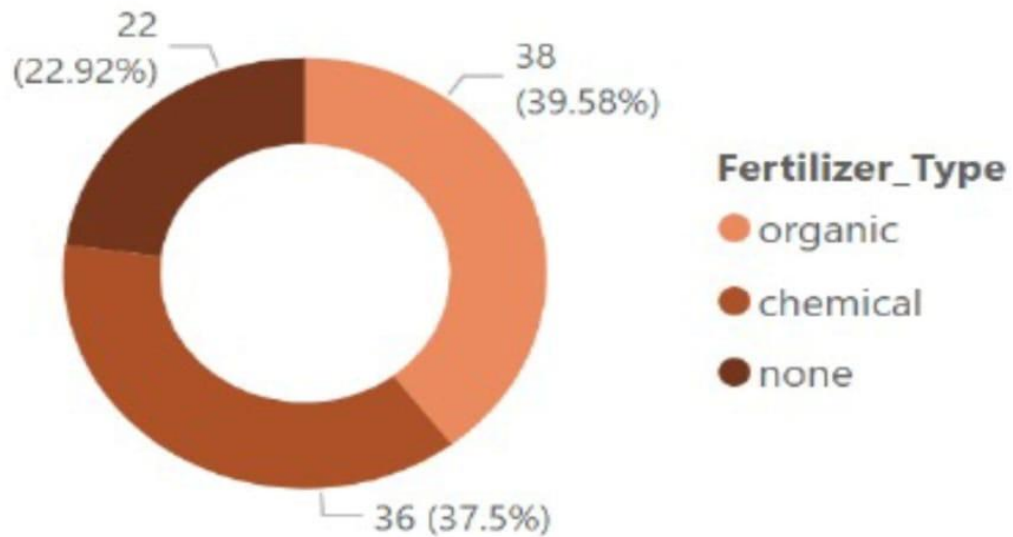
Average_Sunlight_Hours by Soil_Type



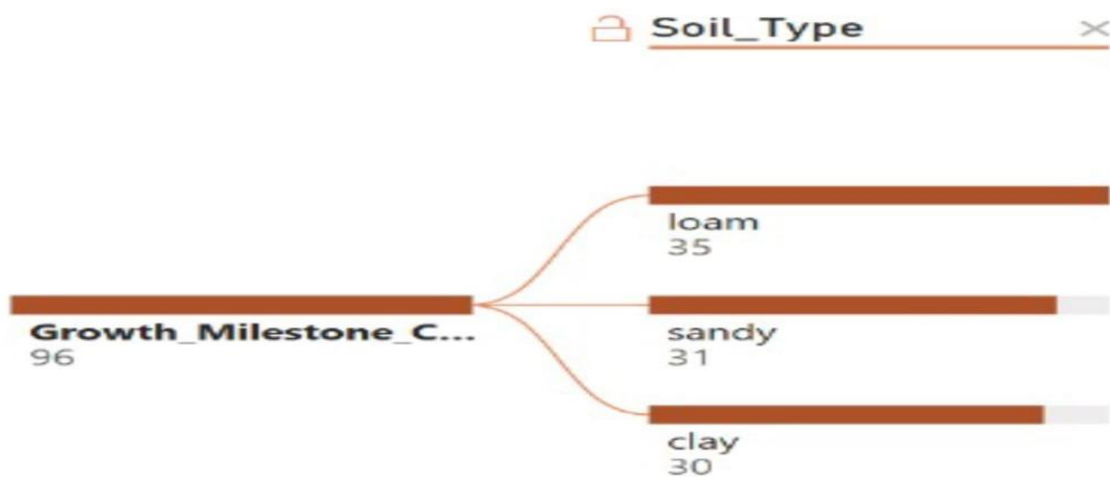
Growth_Milestone_Count

A donut chart representing the distribution of fertilizer usage. The chart helps compare the effectiveness of organic versus chemical fertilizers and their impact on plant health.

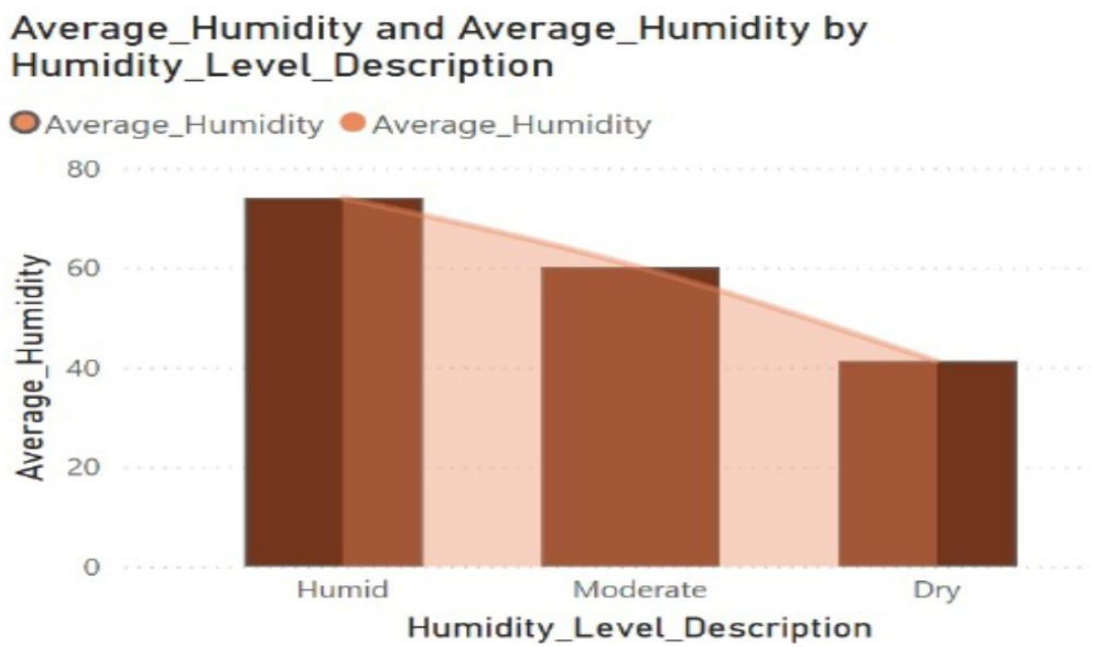
Growth_Milestone_Count by Fertilizer_Type



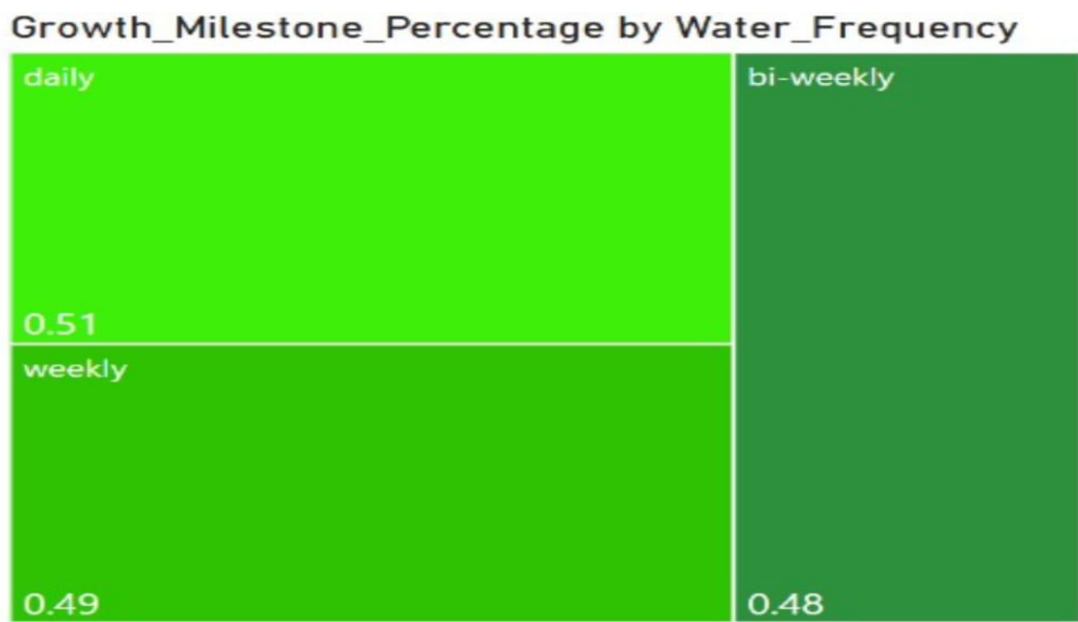
This bar chart visualizes the relationship between humidity levels and plant growth. The analysis highlights how humidity affects water retention in soil and the overall health of plants.



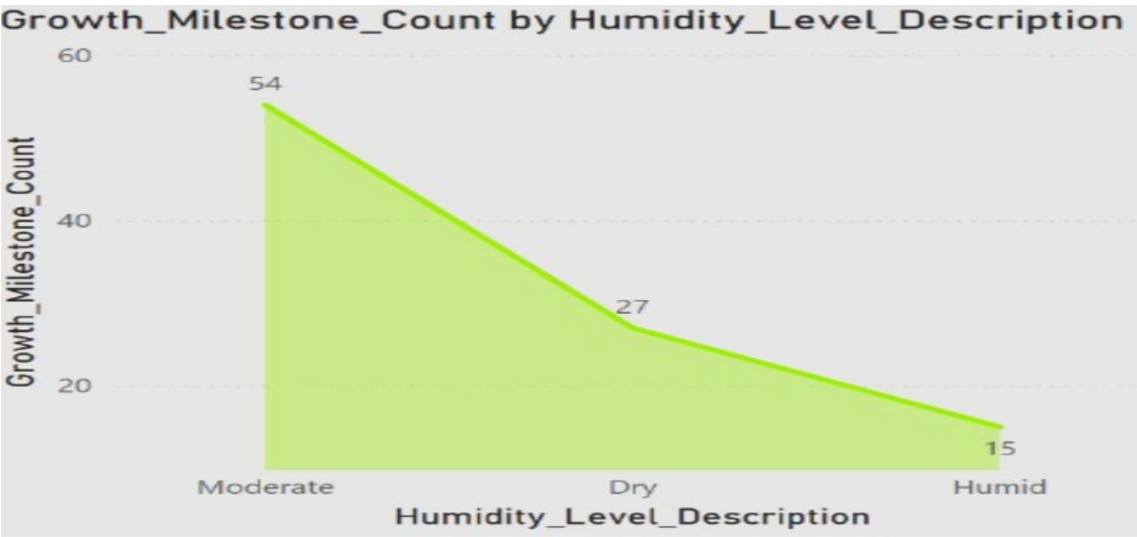
A key influencer analysis showing how temperature fluctuations impact plant growth. The chart identifies critical temperature ranges that result in optimal growth conditions.



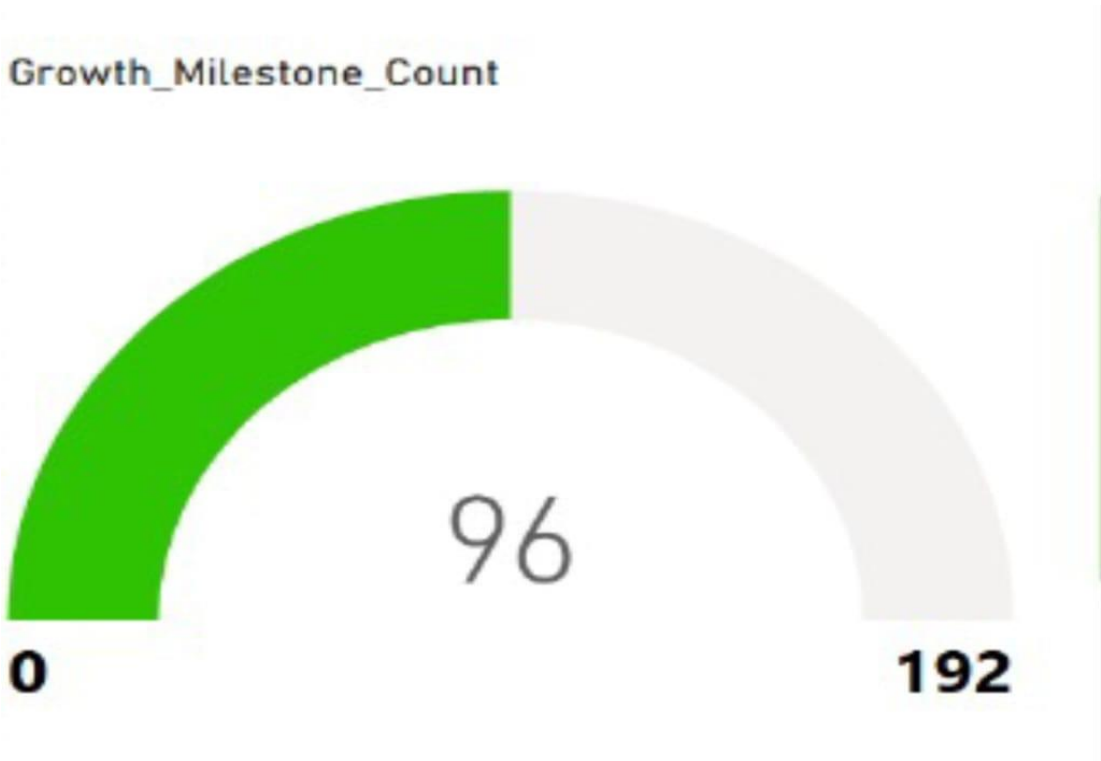
A scatter plot depicting temperature distributions across different soil types. It provides insights into how soil composition affects temperature retention and influences plant metabolism.



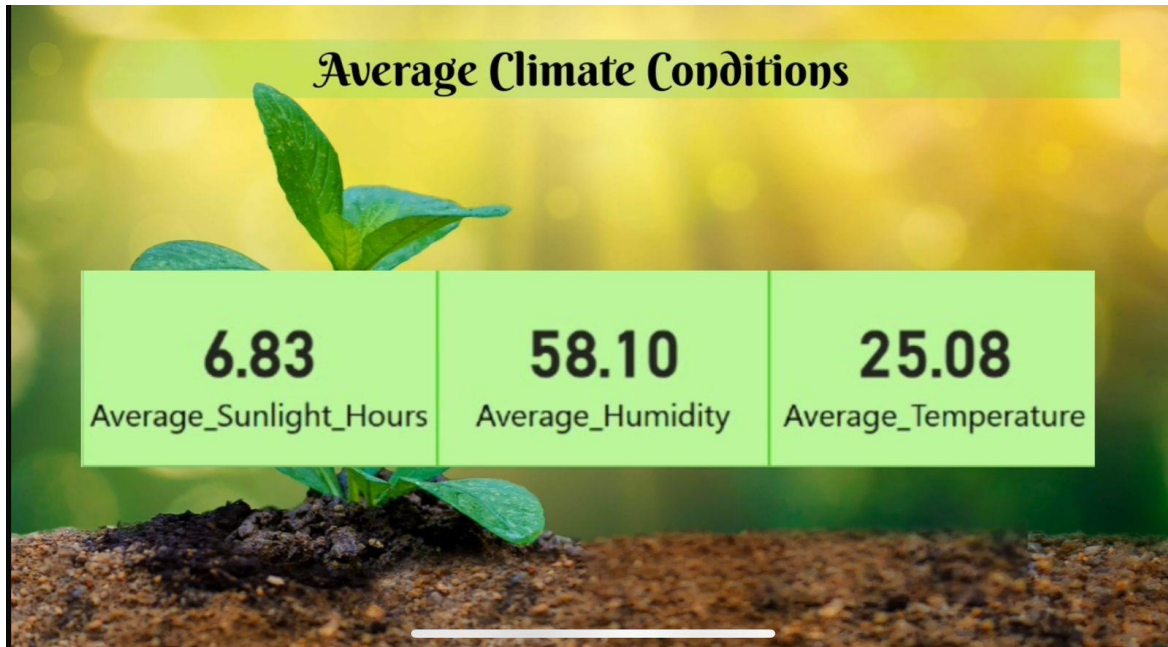
A breakdown of plant growth trends influenced by various environmental factors. It helps in understanding which conditions contribute to accelerated or delayed growth stages.



A graphical representation of seasonal humidity and temperature variations. Understanding these patterns helps in optimizing planting schedules and resource allocation.

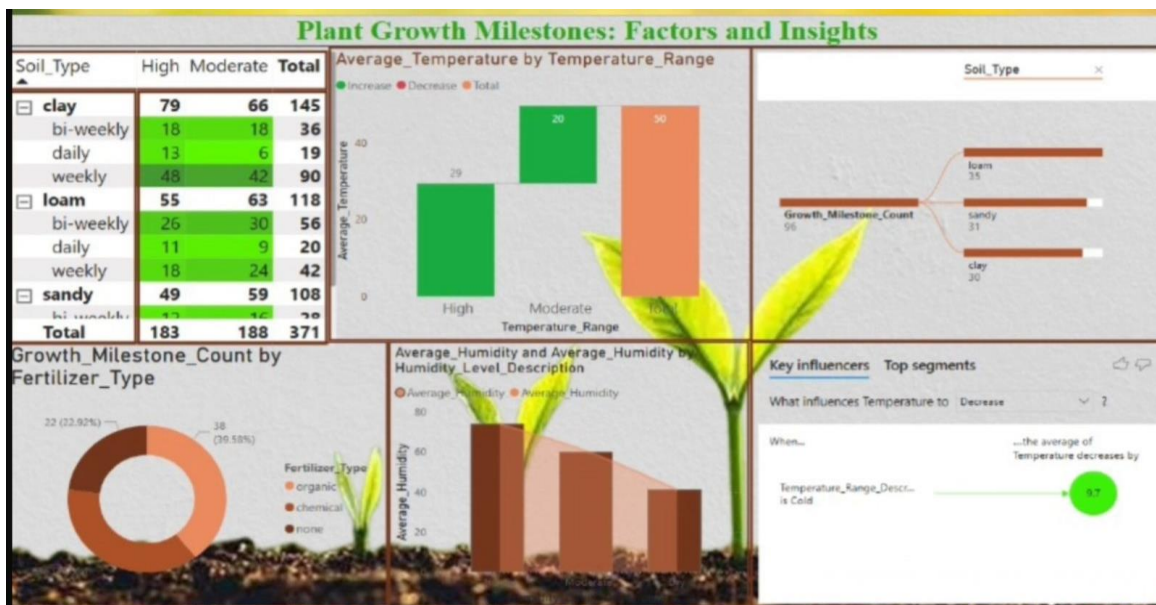


This visualization focuses on plant growth milestones and their dependencies on external factors such as soil type, weather conditions, and fertilizer application.



Milestone 4: Dashboard

A Power BI dashboard was designed to provide an interactive platform for users to explore different plant growth scenarios. The dashboard includes multiple filters and data views for detailed analysis.



Milestone 5: Report Creation

A detailed report summarizing key insights from the analysis was generated. The report highlights major trends, data-driven recommendations, and areas for further research.

Milestone 6: Performance Testing

Performance testing was conducted to ensure that the Power BI dashboards and visualizations were optimized for speed and accuracy. This included testing data refresh rates, visualization responsiveness, and accuracy of trend predictions.

Conclusion:

The Power BI project successfully demonstrates how data visualization and predictive analytics can assist in monitoring and forecasting plant growth stages. The insights derived from this study help in optimizing agricultural practices, improving yield, and managing environmental risks. Future enhancements could include integrating IoT-based real-time data collection and AI-driven predictive modeling for greater accuracy.