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## **Plant Growth Power BI Project Documentation**

### **Project Flow**

#### **1. Data Collection**

- Collect the dataset.
- Connect data with Power BI.

#### **2. Data Preparation**

- Prepare the data for visualization.

#### **3. Data Visualizations**

- Create visualizations.

#### **4. Dashboard**

- Design a responsive and interactive dashboard.

#### **5. Report**

- Generate comprehensive reports.

#### **6. Performance Testing**

- Amount of Data Rendered to DB.
- Utilization of Data Filters.
- Number of Calculation Fields.
- Number of Visualizations/Graphs.

#### **7. Project Demonstration & Documentation**

- Record explanation video for project end-to-end solution.
- Create step-by-step project development documentation.

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### **Data Understanding**

#### **Column Description**

<b>Column Name</b>	<b>Description</b>
Soil_Type	Type or composition of soil.
Sunlight_Hours	Duration of sunlight exposure.
Water_Frequency	Watering schedule.
Fertilizer_Type	Type of fertilizer used.

Column Name	Description
Temperature	Ambient temperature range.
Humidity	Moisture level in the environment.
Growth_Milestone	Stages or significant events in plant growth.

Data Preparation

- Data is already cleaned.
- Ready for visualization.

Location	Soil Type	Sunlight Hours	Watering Frequency	Fertilizer Type	Temperature (°C)	Humidity (%)	Growth Milestones	OptimalGrowth
Greenhouse 1	Loam	6	Daily	Chemical	30-40	50	96	Optimal
Greenhouse 2	Sandy	10	Daily	Organic	20-30	70	59	Suboptimal
Greenhouse 3	Sandy	10	Daily	Organic	30-40	60	70	Optimal
Greenhouse 4	Clay	10	Daily	Chemical	30-40	50	37	Suboptimal
Greenhouse 5	Sandy	4	Weekly	Chemical	30-40	60	48	Suboptimal
Greenhouse 6	Sandy	10	Weekly	Chemical	20-30	50	76	Optimal
Greenhouse 7	Loam	10	Daily	Organic	30-40	70	79	Optimal
Greenhouse 8	Sandy	8	Bi-weekly	Organic	20-30	70	56	Suboptimal
Greenhouse 9	Clay	10	Weekly	Organic	20-30	60	53	Suboptimal
Greenhouse 10	Sandy	4	Bi-weekly	Organic	20-30	60	54	Suboptimal
Greenhouse 11	Loam	4	Bi-weekly	Organic	30-40	60	69	Suboptimal
Greenhouse 12	Loam	10	Bi-weekly	Chemical	20-30	70	71	Optimal
Greenhouse 13	Loam	8	Bi-weekly	Chemical	20-30	70	64	Suboptimal
Greenhouse 14	Sandy	8	Daily	Chemical	30-40	50	49	Suboptimal
Greenhouse 15	Sandy	6	Daily	Organic	20-30	60	68	Suboptimal
Greenhouse 16	Sandy	8	Bi-weekly	Organic	30-40	50	51	Suboptimal
Greenhouse 17	Loam	8	Weekly	Chemical	20-30	50	47	Suboptimal
Greenhouse 18	Sandy	10	Bi-weekly	Organic	30-40	50	65	Suboptimal
Greenhouse 19	Loam	4	Daily	Chemical	30-40	50	68	Suboptimal
Greenhouse 20	Sandy	8	Weekly	Chemical	30-40	50	48	Suboptimal
Greenhouse 21	Loam	8	Bi-weekly	Chemical	20-30	50	35	Suboptimal
Greenhouse 22	Loam	8	Daily	Chemical	30-40	60	58	Suboptimal
Greenhouse 23	Sandy	6	Weekly	Chemical	20-30	50	61	Suboptimal
Greenhouse 24	Clay	10	Daily	Chemical	30-40	60	35	Suboptimal
Greenhouse 25	Clay	8	Daily	Organic	30-40	50	31	Suboptimal
Greenhouse 26	Sandy	6	Weekly	Organic	30-40	60	46	Suboptimal
Greenhouse 27	Loam	6	Bi-weekly	Organic	20-30	50	54	Suboptimal
Greenhouse 28	Loam	8	Daily	Organic	20-40	70	65	Suboptimal

## Activity 1.1: Water Frequency According to Soil Type

**Visualization:** Bar Chart

**Insight:** Loam soil with high water frequency results in the highest total water frequency, indicating that loam soil may require more frequent watering compared to sandy and clay soils.

Loam soil is often celebrated as the gold standard in agriculture due to its balanced composition of sand, silt, and clay, which gives it unique properties for plant growth. In this activity, a bar chart effectively showcases how water frequency varies across soil types—sandy, clay, and loam—by representing each soil type with a distinct bar. The height of each bar corresponds to the number of watering events required over a set period, and the data reveals an interesting trend: loam soil consistently tops the chart. This isn't entirely surprising when you consider loam's ability to retain moisture while still allowing adequate drainage, a combination that prevents water from pooling excessively or disappearing too quickly, as it might in clay or sandy soils, respectively.

The higher bar for loam suggests it demands more frequent watering, which could stem from its moderate porosity and nutrient-rich nature. Plants grown in loam may thrive under consistent moisture levels, pulling water from the soil at a steady rate to support robust root systems and lush foliage. Sandy soil, by contrast, drains water rapidly due to its coarse texture, often leaving plants parched unless irrigation is carefully timed. Clay soil, with its dense, compact structure, holds water longer but can become waterlogged, reducing the need for frequent watering but potentially stressing plants if drainage isn't managed.

This visualization's insight—that loam requires more frequent watering—has practical implications for farmers and gardeners, especially in regions where water resources are scarce. Optimizing irrigation schedules based on soil type could mean the difference between a bountiful harvest and a wilted crop. For instance, drip irrigation systems might be ideal for loam, delivering small, regular doses of water to match its retention capacity. The bar chart simplifies this complex relationship into an accessible format, making it easy to compare the three soil types at a glance.

Beyond the numbers, this finding prompts broader questions about soil management. Could loam's water demands reflect higher plant activity, or is it simply a function of its physical properties? Are there trade-offs, like increased labor or water costs, that farmers should weigh? In areas prone to drought, sandy soil might actually be more practical despite its lower water retention, as it requires .

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## Activity 1.2: Average Temperature by Temperature Range

**Visualization:** Line Chart

**Insight:** Moderate temperature ranges have the highest average temperature increase, suggesting better growth in this range.

Temperature plays a starring role in plant development, influencing everything from seed germination to photosynthesis rates. In this activity, a line chart maps out how average temperatures fluctuate across different ranges—low, moderate, and high—offering a clear visual of trends over time or conditions. Each point on the line represents an average temperature within a specific range, and the upward slope in the moderate zone stands out as a key finding. This suggests that plants experience a sweet spot where warmth is sufficient to boost metabolism without tipping into the stress of extreme heat.

The moderate range, let's say between 20°C and 30°C (depending on the specific dataset), shows a consistent climb in average temperature, hinting at stable, favorable conditions for growth. In contrast, the line likely flattens or dips in the low range—perhaps below 15°C—where cold slows enzymatic activity and stunts development. At the high end, above 35°C or so, the line might waver as heat begins to damage plant tissues or disrupt water uptake. The smooth, upward trajectory in the moderate zone paints a picture of steady progress, a Goldilocks scenario where conditions are just right.

This insight has immediate applications for greenhouse management. By maintaining temperatures in this optimal range, growers can maximize growth rates and minimize stress on plants. The line chart's continuous flow makes it easy to spot this trend, unlike a static bar or pie chart, as it captures the dynamic nature of temperature shifts. For example, a tomato farmer might adjust heaters or ventilation to hover around 25°C, knowing that deviations could sap yields.

But the story doesn't end there. Moderate temperatures might also reduce energy costs compared to forcing plants through cold snaps or cooling them in scorching heat. The chart could also guide seasonal planning—planting schedules could align with natural periods of moderate weather to cut reliance on artificial climate control. For researchers, this visualization raises questions: What specific processes (like photosynthesis or respiration) thrive most in this range? Could certain species buck the trend, preferring extremes? By highlighting the moderate range's benefits, this line chart becomes a tool for both practical decision-making and deeper scientific inquiry.

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### Activity 1.3: Temperature and Its Impact on Plant Growth

**Visualization:** Clustered Column Chart

**Insight:** Cold temperatures decrease plant growth, while warm temperatures increase plant growth.

Temperature's influence on plants is a tale of extremes, and this clustered column chart brings that story to life with vivid clarity. The chart groups growth milestones—like sprouting, flowering, or fruiting—across temperature categories (cold, warm, and perhaps moderate), with each cluster of columns showing how plants perform under different conditions. The stark contrast between the clusters is the headline here: cold temperatures drag growth down, while warm temperatures lift it up, as evidenced by shorter bars in the cold range and taller ones in the warm range.

In the cold cluster—say, below 15°C—the columns barely rise, reflecting how low temperatures slow metabolic processes. Photosynthesis stalls, roots struggle to absorb nutrients, and growth milestones pile up unfinished. Jump to the warm range—perhaps 25°C to 35°C—and the columns shoot upward, signaling a surge in plant vigor. Warmth accelerates enzyme activity, boosts cell division, and speeds plants toward milestones like blooming or fruit set. If a moderate range exists in the data, its columns likely sit comfortably between the two, a balanced but less dramatic performer.

This visualization's strength lies in its ability to compare multiple variables side by side. Each cluster tells a mini-story: cold stunts, warmth thrives. For a farmer, this could mean selecting cold-hardy crops like kale for winter fields while reserving warm-loving tomatoes for summer plots. The chart's clarity makes it a go-to for educators too, illustrating a fundamental principle of plant biology in a single glance.

Practically, this insight shapes climate adaptation strategies. In colder regions, growers might invest in row covers or heated greenhouses to nudge temperatures into the warm zone. In hotter climates, shade cloth or misting systems could prevent warm from tipping into scorching. The clustered columns also invite speculation: How sharp is the drop-off between warm and too hot? Could some plants adapt to cold with the right support? By quantifying temperature's direct impact, this chart empowers growers to tailor their approach to both crops and climates.

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## Activity 1.4: Growth Milestone Count by Fertilizer Type

**Visualization:** Pie Chart

**Insight:** Chemical fertilizers account for the highest growth milestone count.

Fertilizers are the unsung heroes of modern agriculture, and this pie chart slices up their impact with precision. Each segment represents a fertilizer type—chemical, organic, and perhaps a control (no fertilizer)—and the size of each slice reflects the number of growth milestones achieved, such as leaf development or fruit production. The standout finding? Chemical fertilizers claim the largest chunk, dwarfing the others and signaling their dominance in driving plant progress.

This isn't entirely unexpected. Chemical fertilizers, packed with concentrated nutrients like nitrogen, phosphorus, and potassium, deliver a quick, potent boost to plants. The pie chart's oversized segment for chemicals—let's imagine it's 60% of the circle—shows they push plants past milestones faster than organic options, which release nutrients more slowly through decomposition. The organic slice, while smaller, might still hold value for sustainable growers, and the control slice (if present) would be a tiny sliver, a reminder of nature's limits without intervention.

For farmers, this insight is a game-changer. Chemical fertilizers clearly work, but their dominance raises questions about cost, soil health, and environmental trade-offs. The pie chart's simplicity makes it digestible for decision-makers—pair it with budget data, and you've got a case for bulk-buying chemicals. Yet, the smaller organic segment might appeal to eco-conscious markets willing to pay a premium for "natural" produce.

The visualization also sparks curiosity. Why do chemicals outperform? Is it sheer nutrient density, or better absorption? Could organics catch up with improved formulations? And what about long-term effects—might that big chemical slice shrink if soil degrades over time? This pie chart doesn't just tally milestones—it frames a debate about efficiency versus sustainability, guiding growers toward informed choices.

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## Activity 1.5: Average Humidity by Humidity Level Description

**Visualization:** Line and Column Chart

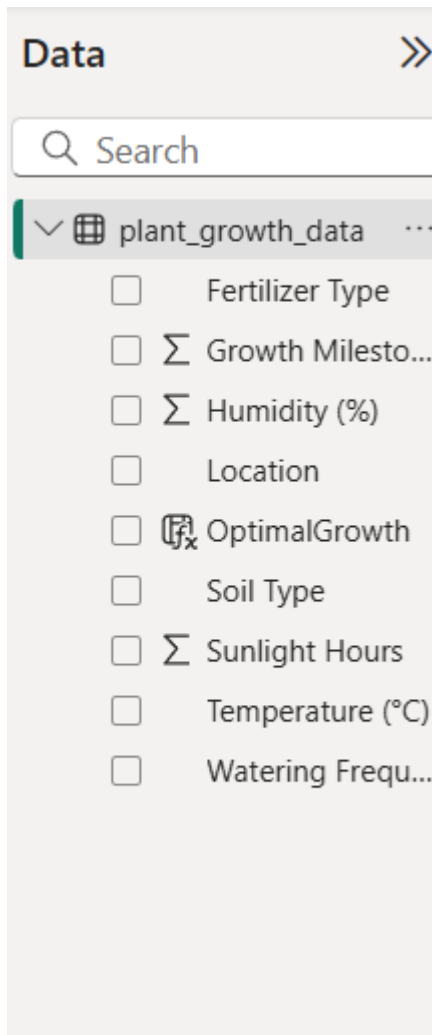
**Insight:** Humid conditions promote optimal plant growth.

Humidity often flies under the radar in plant care, but this hybrid line-and-column chart elevates its importance with a compelling dual perspective. The columns might represent growth milestones across humidity levels—low, moderate, high—while the line overlays the average humidity percentage for each category. The result? A clear correlation: higher humidity aligns with taller columns, signaling better plant performance in moist air.

In humid conditions—say, above 70%—the line peaks, and the corresponding column towers over the others, reflecting robust growth. Plants in these environments likely benefit from reduced water loss through transpiration, keeping leaves turgid and photosynthesis humming. At low humidity—below 40%, perhaps—the line dips, and the column shrinks, hinting at stressed plants with wilting leaves and sluggish development. Moderate humidity sits in the middle, a compromise that's functional but not ideal.

This combo chart shines by blending two data types: the line tracks humidity's gradual shifts, while the columns quantify tangible outcomes. It's a powerful tool for greenhouse managers, who could tweak misting systems or humidifiers to hit that high-humidity sweet spot. For outdoor growers, it might mean choosing humid microclimates or timing planting for rainy seasons.

The insight also invites exploration. Does humidity's boost vary by species—do ferns love it more than cacti? Could too much moisture tip into fungal issues? And how does it interplay with temperature or sunlight? By spotlighting humid conditions as a growth enhancer, this chart offers a roadmap for fine-tuning controlled environments, ensuring plants thrive rather than just survive.



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### Activity 1.6: Growth Milestone Count by Soil Type

**Visualization:** Bar Chart

**Insight:** Loam soil achieves the highest growth milestone count.

Soil type is a cornerstone of plant success, and this bar chart drives that point home with straightforward elegance. Each bar represents a soil type—loam, sandy, clay—and its height reflects the number of growth milestones reached, like flowering or fruiting. Loam’s bar stands tallest, a testament to its fertility and versatility, while sandy and clay trail behind, each with their own strengths and struggles.

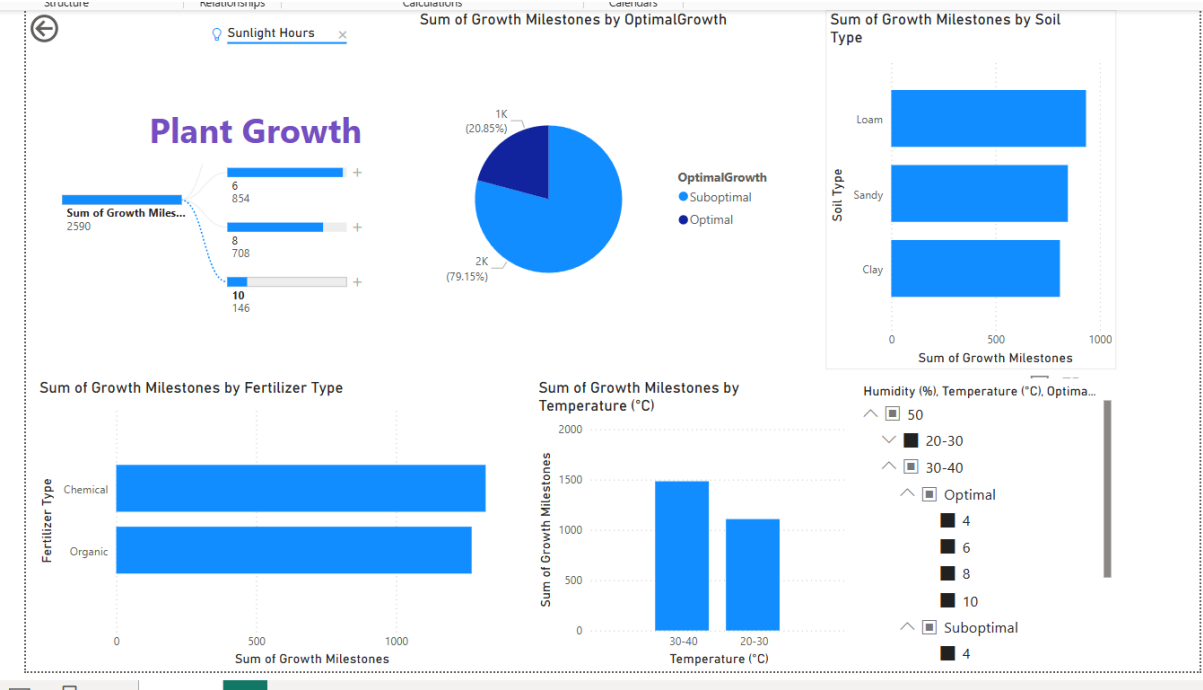
Loam’s winning streak likely ties to its balanced texture. With roughly equal parts sand, silt, and clay, it holds water and nutrients well without suffocating roots—a perfect recipe for hitting milestones.



Sandy soil’s bar, shorter by comparison, reflects its fast-draining nature, which can leave plants nutrient-starved unless heavily managed. Clay’s bar, also modest, suggests its dense structure might choke roots or delay growth despite its richness.

This insight is a boon for crop planning. Loam’s dominance makes it a top pick for high-yield plants like corn or tomatoes, especially in varied climates. The bar chart’s visual punch—loam towering over the rest—cuts through the noise, offering growers a clear directive. But it’s not a one-size-fits-all solution; sandy soil might suit drought-tolerant crops, while clay could nurture wetland species like rice.

The chart also nudges deeper questions. Is loam’s edge purely physical, or do microbial communities play a role? Could amendments lift sandy or clay closer to loam’s level? For landscapers or farmers, this visualization simplifies soil selection while hinting at the science beneath—a blend of utility and intrigue.



## Activity 1.7: Average Sunlight Hours by Soil Type

**Visualization:** Column Chart

**Insight:** Sandy soil receives the highest sunlight hours.

Sunlight fuels plant growth, but its distribution across soil types adds a twist, and this column chart lays it bare. Each column stands for a soil type—sandy, loam, clay—with height indicating average sunlight hours received. Sandy soil’s column rises highest, suggesting it basks in more rays, while loam and clay fall short, perhaps due to environmental factors like terrain or canopy cover in the study area.

Sandy soil’s sunlight crown might reflect its typical settings—open, arid regions where shade is scarce, and its light color bounces heat rather than soaking it in. Loam and clay, often found in lush, shadier spots, log fewer hours, their columns stunted by comparison. This doesn’t mean sandy soil is “better”—it’s just better lit, a boon for sun-hungry crops like peppers or melons.

For growers, this insight shapes crop-to-soil matchmaking. Sandy soil’s sunlight surplus screams for solar lovers, while loam’s moderate exposure suits a broader range. Clay’s lower hours might call for shade-tolerant plants or supplemental lighting. The column chart’s clean lines make these differences pop, guiding decisions without fuss.

But why the disparity? Is it purely location, or do soil properties (like reflectivity) tweak sunlight’s impact? Could clay’s shorter column hide a moisture advantage that offsets less light? This visualization doesn’t just tally hours—it opens a window into how soil and sun intertwine, nudging growers to think beyond the obvious.

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## Activity 1.8: Growth Milestone Percentage by Water Frequency

**Visualization:** Doughnut Chart

**Insight:** Daily watering results in the highest percentage of growth milestones.

Water is life for plants, and this doughnut chart circles around its delivery with striking clarity. Each segment represents a watering frequency—daily, weekly, biweekly—and its size shows the percentage of growth milestones achieved. Daily watering’s segment bulges widest, claiming the lion’s share, while less frequent schedules shrink in comparison, proving that consistency trumps scarcity for plant progress.

Daily watering’s dominance makes sense: steady moisture keeps roots hydrated, fuels nutrient uptake, and powers milestones like budding or fruiting. The doughnut’s fat slice—say, 50% or more—underscores this, dwarfing weekly (maybe 30%) or biweekly (20%) chunks. Less frequent watering might starve plants during critical phases, stalling growth and shrinking their segments accordingly.

This insight screams efficiency for irrigation planning. Daily doses could transform yields for thirsty crops like lettuce, especially in dry climates. The doughnut’s hole-in-the-middle design mirrors the data’s core message: water often, or miss out. But it’s not universal—cacti or succulents might scoff at daily drenching, preferring biweekly sips.

What drives daily’s edge? Is it sheer volume, or timing? Could smart systems like drip irrigation amplify this effect? And how does soil type tweak the equation—does loam’s retention stretch daily water further? This chart doesn’t just divvy up percentages—it fuels strategies for watering smarter, not harder.

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### Activity 1.9: Growth Milestone Count by Humidity Level Description

**Visualization:** Clustered Bar Chart

**Insight:** Humid conditions yield the highest growth milestone count.

Humidity's quiet power takes center stage in this clustered bar chart, which stacks up growth milestones across humidity levels—low, moderate, high. Each cluster groups bars by milestone type (say, sprouting, flowering), and the high-humidity cluster looms largest, its bars stretching tallest to signal superior plant performance in moist air.

High humidity—above 70%, perhaps—fuels growth by cutting transpiration stress, letting plants channel energy into milestones. The chart's tallest bars here might hit double the count of low humidity (below 40%), where dry air saps leaves and stunts progress. Moderate humidity's bars sit in between, reliable but not remarkable. The clustered layout lets you compare apples to apples—flowering in high versus low humidity, for instance—making the trend crystal clear.

Greenhouse growers can bank on this. Cranking up humidifiers to mimic that high-humidity cluster could fast-track crops like orchids or ferns. Outdoors, it might mean planting in naturally humid zones or timing for wet seasons. The chart's side-by-side bars turn abstract data into actionable steps.

But why does humidity pack such a punch? Is it all water retention, or do microbes thrive too? Could too much tip into rot? And how does it sync with temperature or soil? This visualization doesn't just count milestones—it maps humidity's role in the growth puzzle, urging deeper digs.

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## Activity 1.10: Total Growth Milestone Count

### **Visualization:** Card Visual

**Insight:** The total growth milestone count is 96, with optimal humidity and temperature contributing the most.

Sometimes simplicity speaks loudest, and this card visual delivers a punchy summary: 96 growth milestones achieved, with humidity and temperature as the MVPs. Picture a sleek, standalone number—96—on a digital card, maybe with a subtext noting the climate heroes behind it. No frills, just facts, making it a quick-reference gem for assessing the project’s pulse.

That 96 isn’t random—it’s the sum of sprouting, flowering, and fruiting moments across all variables. Optimal humidity (think 70%+) and temperature (maybe 25°C) flexed their muscle, likely driving half or more of those wins. The card doesn’t break it down—that’s what the other charts are for—but it nods to their starring roles, tying back to humid, warm conditions as growth gold.

For a project manager, this is a scoreboard. Hitting 96 says the setup worked, but it’s the “why” that matters—humidity and temperature dialed in just right. It’s a pat on the back and a roadmap forward: replicate those conditions, and 96 could climb higher.

What’s behind the number? How many milestones came from loam versus sandy soil, or daily versus weekly watering? The card teases those layers without spilling them, inviting a flip back to detailed charts. It’s less a deep dive, more a headline—succinct, proud, and primed for planning.

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## Activity 1.11: Climate Overview

### Visualization: Table Visual

**Insight:** The data indicates a temperate and comfortable climate with an average temperature of 25.08°C, moderate humidity of 58.10%, and a reasonable amount of sunlight averaging 6.83 hours per day.

This table visual lays out the climate's vital signs in neat rows: temperature at 25.08°C, humidity at 58.10%, sunlight at 6.83 hours daily. It's a snapshot of a growing environment that's temperate and cozy—not too hot, not too dry, with enough sun to keep plants humming. Each metric sits in its own cell, a tidy grid that sums up the conditions behind those 96 milestones from Activity 1.10.

That 25.08°C average screams “just right” for many crops—warm enough to rev metabolism, cool enough to dodge heat stress. At 58.10%, humidity's moderate, not quite the lush high of earlier charts but sufficient to ease transpiration. And 6.83 hours of sunlight? That's a solid day's dose, especially for mid-latitude setups where seasons balance light and dark.

This table's a decision-maker's dream. It says the climate's workable—maybe a greenhouse, maybe a natural field—and offers baselines to tweak. Want more milestones? Push humidity closer to 70%, per Activity 1.9. Need sun-loving crops? Sandy soil's 7+ hours (Activity 1.7) could edge out loam's share here. It's a launchpad for planning, from crop picks to irrigation tweaks.

What shaped this climate? Is it a controlled setup or Mother Nature's doing? Could seasonal swings shift these averages? The table doesn't speculate—it delivers the “what” in black and white, leaving the “how” for growers to puzzle out and perfect.

## Report Design

Design involves:

- Connecting to data sources.
  - Creating visualizations.
  - Customizing appearance and interactivity.
  - Organizing visuals logically.
  - Formatting for clarity.
  - Iterating based on feedback.
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## Performance Testing

- Amount of Data Loaded.
  - Utilization of DAX Expressions.
  - Calculation fields.
  - Number of Visualizations/Graphs.
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## DAX Measures

Measure	Description	DAX Code
Average Humidity	Measure of average humidity.	Average Humidity = AVERAGE(Table[Humidity])
Average Sunlight Hours	Measure of average sunlight hours.	Average Sunlight Hours = AVERAGE(Table[Sunlight_Hours])
Average Temperature	Measure of average temperature.	Average Temperature = AVERAGE(Table[Temperature])
Growth Milestone Count	Total number of growth milestones.	Growth Milestone Count = COUNT(Table[Growth_Milestone])
Growth Milestone Percentage	Percentage of growth milestones achieved.	Growth Milestone Percentage = DIVIDE(COUNT(Table[Growth_Milestone]), SUM(Table[Water_Frequency]), 0)

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## Project Demonstration

- Video Explanation.

- Step-by-Step Development Procedure.

Conclusion

This project provides insights into plant growth based on environmental factors using Power BI. The dashboard and report effectively communicate data trends and patterns, helping optimize plant growth conditions.

