Dataset Description of Phenotyping Dataset

The **Multimodal Phenotyping & Genotype Feedback Loop** is a smart farming feature that uses technology to track how plants grow and respond in real time. It involves collecting various types of data—like images of leaves, stem thickness, and overall plant shape—through computer vision and possibly other sensors. This process, known as phenotyping, helps monitor traits such as leaf size, color, and health without manual checking. Once this data is collected, it is analyzed to understand how well a specific genotype (seed variety) is performing under given environmental conditions. The "feedback loop" part means that this performance data is sent back into the system to help farmers, breeders, or AI models make better future decisions—like selecting the best seed for a specific region or condition. This ongoing cycle helps continuously improve crop choices and growing practices based on real-world observations.

1. **Image_ID** *(object)*
    - Unique identifier for the plant image (e.g., IMG_0001, IMG_0045).
    - **Value type**: Unique string for each row.
2. **Timestamp** *(object)*
    - Date when data was recorded (e.g., 2024-11-05, 2025-02-18).
    - **Value type**: Date in `YYYY-MM-DD` format.
3. **Genotype_ID** *(object → Mapped to trait)*
    - Previously codes like G001–G020, now replaced with trait descriptions.
    - **Example values**:
        - High Yield, Low Drought Tolerance
        - Medium Yield, High Disease Resistance
        - Early Maturity, Low Nutrient Requirement
          (20 unique values total; full list in earlier message)
4. **Plant_ID** *(object)*
    - Unique plant identifier (e.g., P001, P2043).

- **Value type**: Alphanumeric string; one per row.

5. **Crop_Type** *(object)*
    - Type of crop grown.
    - **Unique values** (example subset):
        - Wheat
        - Rice
        - Maize
        - Soybean
        - Barley
        - Cotton
6. **Region** *(object)*
    - Area where crop is cultivated.
    - **Unique values** (example subset):
        - Punjab
        - Telangana
        - Maharashtra
        - Tamil Nadu
        - Uttar Pradesh
        - Karnataka
        - Rajasthan
        - Odisha
7. **Soil_Type** *(object)*

- Type of soil.
- **Unique values**:
  - Loamy
  - Sandy
  - Clay
  - Silty
  - Peaty
  - Chalky

8. **Fertilizer_Used** *(object)*
   - Fertilizer applied.
   - **Unique values**:
     - Urea
     - DAP (Di-Ammonium Phosphate)
     - NPK
     - Compost
     - Vermicompost
     - None
9. **Disease_Signs** *(object)*
   - Shows if plant shows signs of disease.
   - **Unique values**:
     - Yes
     - No

        - Mild
        - Severe

10. **Weed_Presence** *(object)*
    - Indicates weed presence around the plant.
    - **Unique values**:
        - Yes
        - No
        - Sparse
        - Dense
11. **Growth_Stage** *(object)*
    - Current stage of plant development.
    - **Unique values**:
        - Germination
        - Vegetative
        - Flowering
        - Fruiting
        - Maturity
12. **Recommended_Action** *(object)*
    - Suggested agronomic action.
    - **Unique values**:
        - Apply Fertilizer
        - Increase Irrigation

- Pest Control
- Weed Removal
- No Action Needed
- Monitor Health

📊 Numeric Columns

These have float or integer types depending on value scale:

- **Soil_Moisture (%), Temperature (°C), Humidity (%), Light_Intensity (lux)**
- **Irrigation_Level (liters), Leaf_Area (cm²), Stem_Thickness (cm), Plant_Height (cm)**
- **Leaf_Color_Index (0–100), Health_Score (0–100)**
- **Genotype_Performance_Score (0–100), Yield_Potential (tons/hectare)**