**Project AgriScan : Smart Leaf Disease Detection System**

**1. Late Blight**

**History:**

Late blight, caused by Phytophthora infestans, was infamous during the Irish Potato Famine of the 1840s. It's a routine threat in cool, wet conditions, attacking tomatoes and potatoes globally.

**Causes:**

The disease excels at cool (15–21°C), moist conditions. It spreads rapidly by way of airborne spores, rain, contaminated equipment, or plant residues. Poor crop rotation and compact, poorly ventilated crops provide it with ample opportunity to spread.

**Symptoms:**

Early watery, pale green or brown spots on leaves typically at the edges. With wetness, becoming larger and bearing a thin white powdery coating. It also attacks stems and fruits, leaving dark greasy blisters; in severe infestations, whole plants will wilt and rot.

**Pesticides Used:**

Growers rely on fungicides like chlorothalonil, mancozeb, and metalaxyl. It is important to rotate these to stay in front of resistance; preventive spraying is best.

**Prevention:**

* Grow resistant varieties where available.
* Crop rotation; do not grow tomatoes and potatoes in the same soil year after year.
* Remove all plant trash after harvest to cut the pathogen's life cycle.
* Grow plants spaced apart to provide airflow, reducing leaf wetness time.
* Watch local weather and treat with preventives when disease conditions are optimal.

**Economic Impact:**

During epidemic conditions, late blight can destroy yields—losses may total 70% or more. Continuous fungicide treatments add cost, and saleable crops reduce farmer incomes, stressing supply chains

**2. Early Blight**

**History:**

Early blight, induced by Alternaria solani, is well known to growers around the globe. It infects tomatoes and potatoes, typically occurring following periods of heat and rain.

**Causes:**

* Warm damp weather suits this fungus.
* Spores may occur in infected soil, plant debris, and seed.
* Densely stocked fields and aged, stressed plants are more vulnerable.

**Symptoms:**

Brown spots on leaves with typical "bull's-eye" rings—usually appearing on lower leaves. The fungus climbs to stems and fruit, with collar rot and cracking occurring, leaves yellowing and dead from the bottom up.

**Pesticides Used:**

* Chlorothalonil, mancozeb, and copper fungicides are usually applied.
* Following a spray schedule prevents blight.

**Prevention:**

* Seed and transplant plant disease-free.
* Crop rotation of tomatoes with dissimilar crops.
* Keep fields clean by removing old leaves and debris.
* Space and prune for air circulation.
* Use fungicides preventatively if conditions justify.

**Economic Impact:**

Untreated early blight results in high yield loss, with the loss of leaves hindering fruit growth. It means added cost of production and less marketable crop.

Reduced leaf area limits fruit growth, leading to smaller and fewer tomatoes.

The disease increases production costs due to the need for additional disease management efforts. Lower fruit quality and quantity result in less marketable produce, affecting farm income.

**3. Septoria Leaf Spot**

**History:**

Originally detected because of its unique symptoms, Septoria leaf spot is caused by Septoria lycopersici. It's one of the frequent garden and commercial field stopovers by gardeners in rainy periods

**Causes:**

* Fungus prefers rainy, wet weather.
* Spores are spread through water splashes, contaminated tools, and old plant residues.

**Symptoms:**

You’ll spot tiny (1–4mm), circular spots with dark edges and grayish centers, often packed together on older leaves. These accumulate, turning leaves yellow, brown, and ultimately dead. Fruit almost never gets infected.

**Pesticides Used:**

Fungicides like chlorothalonil and mancozeb are useful defenses, sprayed in cycles during outbreaks.

**Prevention:**

* Remove old leaves and flush out debris.
* Rotate crops regularly.
* Space out plants and stake them up for airflow.
* Start fungicide sprays at the first sign of trouble.

**Economic Impact:**

Severe infection leads to unnecessary leaf shedding and less fruit yield. Fungicide costs and wasted crops tighten profits. Loss of leaves directly leads to lower fruit yield and poorer crop quality. Farmers incur higher costs due to frequent fungicide applications needed to control the disease. Wasted crops and increased input expenses significantly reduce overall farm profitability.

**4. Tomato Yellow Leaf Curl Virus (TYLCV)**

**History:**

TYLCV initially appeared in the Middle East but spread throughout the world, especially in warm weather regions where whiteflies are plentiful.

**Causes:**

* The virus is conveyed and spread by whiteflies.
* It likes hot weather and travels freely between tomatoes and nearby weeds.

**Symptoms:**

Symptoms are yellowing and curling of young leaves, dwarfing, and low fruit set. Plant vigor is severely reduced.

**Pesticides Used:**

Whitefly-insecticidal control using chemicals like imidacloprid is common. Viral infection cannot be cured; the vector is managed.

**Prevention:**

* Plant resistant varieties.
* Kill whiteflies with insecticides and sticky traps.
* Weed crops to remove alternate virus hosts.
* Use reflective mulches to repel whiteflies.
* Economic Impact:
* Yield can collapse, particularly in the most seriously affected instances. Losses can exceed 50%, and expenditures rise for insect control and poorer-quality fruit.

**Economic Impact**

TYLCV can cause yield losses up to 100%, severely reducing tomato quantity and quality.

Managing the disease requires costly insecticides and resistant varieties, increasing production expenses. Annual economic losses amount to millions due to reduced harvests and higher input costs.

**5. Bacterial Spot**

**History:**

Bacterial spot is caused by several Xanthomonas species and affects tomatoes and peppers worldwide, especially during hot, humid periods.

**Causes:**

* Wasted on water, contaminated tools, seeds, and even the hands of workers.
* Excessive rain and overhead irrigation promote disease skips.

**Symptoms:**

Leaves have dark, oily marks, and these may coalesce and cause leaf drop. Fruits have raised, scabby marks, making tomatoes unsaleable.

**Pesticides Used:**

Copper sprays are used, with variable success. Resistance can develop, reducing control.

**Prevention:**

* Use certified, healthy seed.
* Water below and operate on dry ground.
* Use crop rotation and dispose of diseased material.
* Grow resistant varieties where available.

**Economic Impact**

Severe damage leads to leaf drop and blemished fruit, cutting yields and increasing control costs. Crop rejection due to fruit spot can also affect profits seriously. Blemished fruit lowers market value and increases costs for disease control measures. Crop rejection due to visible fruit spots results in substantial financial losses for farmers.

**6. Target Spot**

**History:**Target spot, caused by the fungus *Corynespora cassiicola*, was first identified in tropical and subtropical regions. It affects crops like cotton, soybean, tomato, and cucumber, leading to significant yield losses.

**Causes:**The disease thrives in warm (25–30°C), humid conditions, spreading via spores carried by wind, water, or contaminated tools. Poor field sanitation and dense planting exacerbate outbreaks.

**Symptoms:**Early signs include small, circular, brown spots with concentric rings (target-like appearance) on leaves. Severe infections cause defoliation, reduced photosynthesis, and crop loss.

**Pesticides Used:**Fungicides like chlorothalonil, mancozeb, and azoxystrobin are effective. Resistance management is crucial due to fungicide tolerance in some strains.

**Prevention:**Use resistant crop varieties.  
Ensure proper spacing for air circulation.  
Rotate crops to break the disease cycle.  
Remove infected plant debris to reduce spore load.  
Apply fungicides preventively during high-risk periods.

**Economic Impact:**Target spot can reduce yields by 30–50%, severely affecting farmers' incomes. In cotton, yield losses may reach 50%, while soybean farmers face up to 30% losses. Increased pesticide costs and reduced crop quality further strain profitability.

**7. Tomato Mosaic Virus**

**History & Cause:**  
Tomato Mosaic Virus (ToMV) is a highly contagious plant pathogen belonging to the *Tobamovirus* genus. First identified in the early 20th century, it affects tomatoes and other solanaceous crops (e.g., peppers, potatoes, and eggplants). The virus spreads through:

* Mechanical transmission (tools, hands, contaminated equipment).
* Infected seeds or transplants.
* Contact with infected plant debris**.**

**Symptoms:**

* Leaf mottling (yellow and green mosaic patterns).
* Leaf curling, distortion, and stunted growth.
* Fruit discoloration, uneven ripening, and reduced yield.
* Necrotic streaks in severe cases.

**Prevention & Control:**

* Use certified virus-free seeds and seedlings.
* Sanitize tools (bleach or disinfectants).
* Remove and destroy infected plants immediately.
* Avoid smoking near plants (tobacco can carry ToMV).
* Rotate crops to reduce soil contamination.
* Resistant varieties (e.g., 'Tomato Hybrid 6203').

**Economic Impact:**

* Yield losses can reach 20–50%, depending on infection timing.
* Market rejection of deformed or discolored fruits reduces profits.
* Increased costs for disease management (sanitation, resistant seeds).

ToMV remains a persistent threat to tomato farmers, emphasizing the need for strict hygiene and preventive measures.

**8. Leaf Mold**

**History:**Leaf mold, caused by the fungus *Passalora fulva* (formerly *Fulvia fulva*), was first identified in the mid-19th century in Europe. It became a significant problem as greenhouse tomato cultivation expanded, providing the ideal warm, humid conditions for the pathogen. The disease spreads globally through contaminated seeds, transplants, and infected plant debris, becoming particularly destructive in controlled environments where air circulation is limited.

**Cause & Favorable Conditions:**Leaf mold thrives under:

* High humidity (>85%) and moderate temperatures (20–24°C).
* Poor air circulation (common in greenhouses and densely planted fields).
* Prolonged leaf wetness (from overhead irrigation or condensation).

**Symptoms:**Early stage: Pale yellow or light green patches on upper leaf surfaces.  
Advanced stage: Olive-green to brown velvety fungal growth on the undersides of leaves.  
Severe infections: Leaves curl, turn brown, and die prematurely, leading to defoliation.  
Secondary effects: Reduced fruit size, yield, and quality due to weakened plants.

**Prevention & Control Measures:**

* **Cultural Controls:**
  + Improve greenhouse ventilation and reduce humidity.
  + Use drip irrigation instead of overhead watering.
  + Space plants adequately to enhance air movement.
  + Remove and destroy infected plant debris.
* **Chemical Controls:**
  + Apply fungicides like chlorothalonil, mancozeb, or copper-based sprays preventively.
  + Use biofungicides (*Bacillus subtilis*) for organic production.
* **Resistant Varieties:** Plant cultivars such as 'Legend F1' and 'Starbuck F1', which show tolerance to *P. fulva*.

**Economic Impact:**

* **Yield Losses:** Severe infections can reduce tomato yields by 30–50% due to defoliation and poor fruit development.
* **Increased Costs:** Farmers spend more on fungicides, greenhouse modifications (dehumidifiers, fans), and labor for disease management.
* **Market Rejection:** Infected fruits may be downgraded or rejected in markets, leading to financial losses.

**9. SPIDERMITES:**

**History:**Spider mites (especially *Tetranychus urticae*) have been damaging crops for centuries. Their impact grew severely with modern agriculture due to pesticide overuse killing their natural predators and climate change creating ideal hot, dry conditions for their spread.

**Why This Condition Occurs:**Thrives in hot (25-30°C), dry weather  
Spreads through wind, tools, clothing  
Pesticide resistance makes control difficult  
Drought-stressed plants are more vulnerable

**Symptoms:  
Early stage:** Tiny yellow/white spots on leaves, slight webbing  
**Severe stage:** Bronze leaves, heavy webbing, leaf drop  
**Result:** 30-50% yield loss, poor fruit quality

**Prevention & Control:  
Cultural:** Remove weeds, increase humidity  
**Biological:** Use predatory mites (*Phytoseiulus persimilis*) **Chemical:** Rotate miticides (abamectin, spiromesifen)

**Pesticides Used:**Abamectin  
Spiromesifen  
Bifenazate  
Neem oil (organic option)

**Economic Impact:**

**Yield loss:** 30-50% (up to 100% in greenhouses) **Control costs:** Rs. 4000-17000/acre **Long-term:** Pesticide resistance increases expenses

**10. POWDERY HILDEW**

**History**Powdery mildew (caused by fungi like *Podosphaera* and *Erysiphe* species) has affected plants since ancient times. It became a major agricultural concern with the expansion of monoculture farming and greenhouse cultivation, where warm, humid conditions favor its spread.

**Why This Condition Occurs**Thrives in moderate temperatures (25-37°C) with high humidity.  
Spreads via wind, contaminated tools, and infected plant debris.  
Poor air circulation and dense planting increase risk  
Overhead watering promotes spore germination

**Symptoms:  
Early stage:** White, powdery spots on leaves and stems **Advanced stage:** Yellowing leaves, stunted growth, reduced yields  
**Severe cases:** Premature leaf drop, fruit deformities

**Prevention & Control:  
Cultural:** Prune for airflow, avoid overhead watering, remove infected plants  
**Biological:** Apply *Bacillus subtilis* or milk sprays (organic options)  
**Chemical:** Use sulfur, potassium bicarbonate, or fungicides (myclobutanil, trifloxystrobin)

**Pesticides Used:**Sulfur (preventive)  
Potassium bicarbonate (curative)  
Myclobutanil  
Trifloxystrobin

**Economic Impact:**

**Yield loss:** 10-50% depending on crop and timing of infection **Control costs:** Rs 1800-86000/acre for fungicides **Additional costs:** Labor for pruning and sanitation