

Hands-on identification of vegetable diseases: Tomato

Theme: How to diagnose a specific disease from diseases or disorders with similar symptoms.

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Tomato



2014, FL (USDA-NASS, 2015)
33,000 acres harvested in FL, #1 in the U.S
(97,600 acres harvested in the U.S).

>\$437 million Farm Value, #1 in the U.S.
(\$1.1 billion Farm value in the U.S)

Tomato section discussion layout

- Scenario 1: **Wilts**
- Scenario 2: **Spots**
- Scenario 3: **Yellowing, stunting**
- Scenario 4: **Fruit damage**
- Scenario 5: **Canker**

Scenario 1a: That was a fine morning; Jennifer Bearden is visiting a tomato farm in Okaloosa county and notices the plant wilting. The grower needs to know what is the cause of wilting and a solution!



Possible reasons:

1. Bacterial wilt: **Bacterial (B)**
2. Tomato spotted wilt: **Viral (V)**
3. Fusarium wilt: **Fungal (F)**
4. Verticillium wilt: **F**
5. Southern blight: **F**
6. Sclerotinia blight: **F**
7. Bacterial pith necrosis: **B**
8. Root-knot: **Nematodes**
9. Lightning strike: **Abiotic (A)**
10. Lack of water: **Physiological (P)**
11. Excessive soil moisture: **P**



There is only one fungal disease that is known to cause a white fungal mycelial mat like growth on the collar region of the plant and the adjacent soil: **Southern blight** caused by *Sclerotium rolfsii*



Definitive confirmation of **Southern blight** is the mustard like structure known as sclerotia which is white, light brown, or dark brown in color. At later stages, you may only see sclerotia and not the mycelium.

If it is not southern blight, it may be **Sclerotinia blight** caused by *Sclerotinia sclerotiorum*



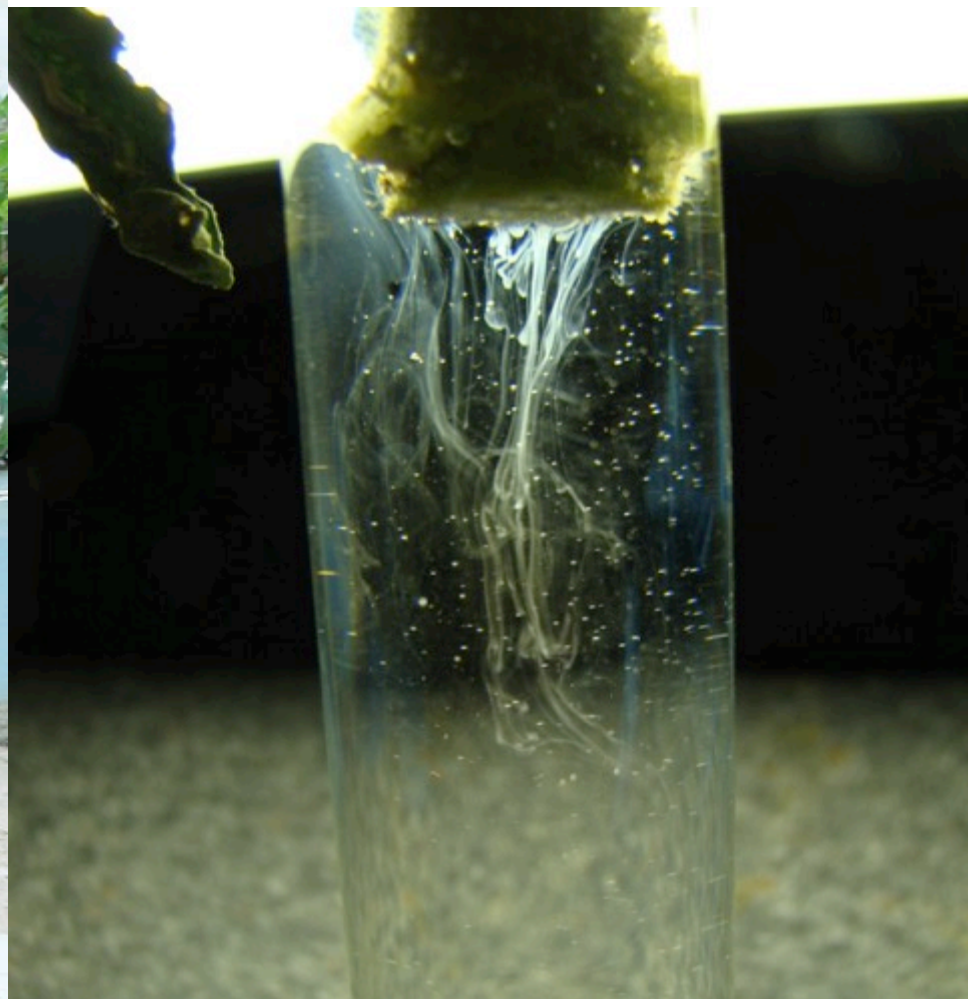
You may see white fungal growth on the blighted stem in case of Sclerotinia blight



Definitive confirmation of Sclerotinia blight: black fungal structures (sclerotia) can be seen inside the blighted stem with the white fungal growth.



If it is not sclerotinia blight, it may be **Bacterial wilt** caused by *Ralstonia solanacearum*



Bacterial streaming from cut section of the stem is a definitive confirmation of **Bacterial wilt**

If it is not bacterial wilt, may be it is **Fusarium wilt** caused by *F. oxysporum* f.sp. *lycopersici*, or **Verticillium wilt** caused by *V. dahliae*, and *V. albo-atrum*. All these diseases can cause vascular discoloration.



Wilting, and yellowing of the leaves may be most likely due to **Fusarium wilt**. Culturing in the lab required for confirmation.

Tomato Spotted Wilt is caused by a *Tospovirus* TSWV and is vectored by various thrips species



A combination of symptoms can provide a definitive confirmation.
Wilting, Curling and Purpling of leaves

Black/Purplish patterns on the leaves



Small purplish spots coalesce on leaves



Combination of symptoms can provide a definitive confirmation for TSWV: **Circular patterns on the fruit**



Various types of fruit symptoms associated with **Tomato Spotted Wilt**



Scenario 1b: A small producer in Jackson county encounters something unusual. A section of the field is completely wilted. He calls Matt Lollar to check his plot. The grower mentioned that he got a good 2 inches of rain yesterday after a long dry period. But he didn't reveal all the information.

Matt checking his plants found something different than normal wilt diseases. He notices vascular system collapse but had a unique ladder like appearance.

Based on the symptoms, Matt thought it could be

1. **Bacterial pith necrosis: B**
2. **Lightning strike: A**



The unique pattern of wilting (proceeding along a bed), and the ladder-like appearance was due to **lightning damage**. The grower confirmed that there was lightning the previous day.

Matt should have seen a complete collapse of the vascular system, necrotic pith, possibly fruit necrosis and plant yellowing if it was **Bacterial pith necrosis** caused by *Pseudomonas corrugata*.

Wilting of plants caused by **Bacterial pith necrosis**





Pseudomonas corrugata is a opportunistic bacteria that wilts sections of the the plants as it invades wounds on the stem; **in this case the wound is from tying injury!**



If none of the issues discussed before were found, check the roots. If you find root-galling, **root-knot nematodes** may be the cause of wilting and stunting of the plants

Production in fields with no history of the disease is an important management option for all soil-borne organisms.

	Disease	Management options
1	Bacterial wilt	a. Grafted plants with hybrid rootstocks, SAR inducer
2	Southern blight	a. Field fumigation
3	Sclerotinia blight	a. Field fumigation
4	Fusarium wilt (Races 1, 2 and 3 are known)	a. Resistant varieties b. Field fumigation c. Grafting with resistant rootstocks
5	Verticillium wilt (Races 1 and 2 known)	a. Resistant varieties b. Field fumigation c. Grafting with resistant rootstocks
6	Tomato Spotted Wilt (TSW)	a. Resistant varieties b. Reflective mulches c. Thrips pesticide management d. Kaolin e. SAR inducer
7	Bacterial pith necrosis	a. Avoid injury to the plants; tie the plants late in the day when they are dry and avoid tying during excessive moisture
8	Root-knot	a. Grafting, resistant varieties, Field fumigation

Scenario 2: Mark Maudlin gets a call from a tomato grower in Jackson county who has been noticing numerous spots on leaves. The grower would like to know the cause and how to manage it.

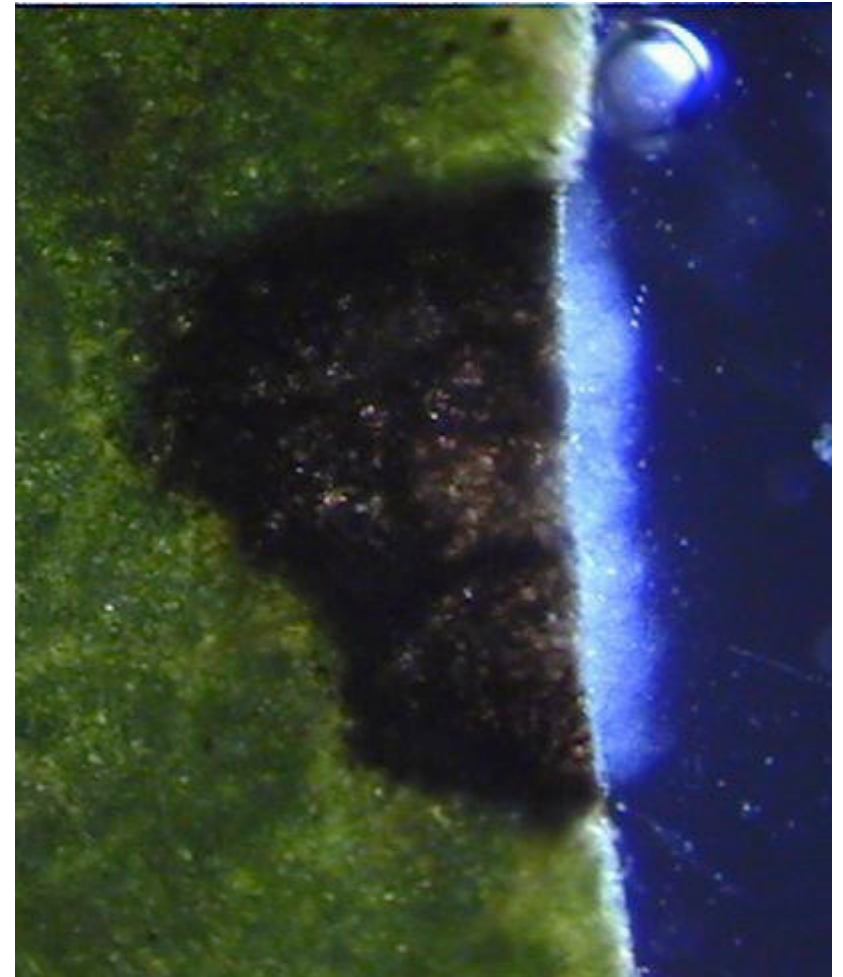
Possible reasons:

1. Bacterial spot: **B**
2. Bacterial speck: **B**
3. Syringae leaf spot: **B**
4. Target spot: **F**
5. Early blight: **F**
6. Spray damage: **P**
7. **TSW**



First step: Mark brings back a sample to the county office and conducts a **bacterial ooze test**

1. Bacterial spot: **B**
 2. Bacterial speck: **B**
 3. Syringae leaf spot: **B**
 4. Target spot: **F**
 5. Early blight: **F**
 6. Spray damage: **P**
 7. TSW
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If the bacterial ooze test is positive (+), the disease may be early stages of **bacterial spot** caused by *Xanthomonas perforans*





During late stages of **bacterial spot**; the central portion of the spots fall down, which is a good indicator that the disease may be bacterial spot.



Another good indicator of **bacterial spot** is the small **raised lesions** on the fruits.



If the disease symptoms doesn't look like bacterial spot it could be instead **Bacterial speck** caused by *Pseudomonas syringae* pv. *tomato*, **Syringae leaf spot** caused by *Pseudomonas syringae* pv. *syringae*. However, field diagnosis of these diseases can be difficult and samples may have to be send to a diagnostic lab for ID.

If Mark gets a negative **bacterial ooze test**, it could be a **fungus disease** causing the spots or it could be **TSW**. However, based on the lack of other characteristic symptoms, Mark thinks it is not TSW. It could be **Target spot** caused by *Corynespora cassicola*



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Symptoms on leaves (2, 3) are good indicators; on fruits (4, 5) are characteristic for **Target spot**. Lesions are sunken and will have cracks in the center compared to raised and no cracks for bacterial spot.

Symptoms of **Early blight** caused by *Alternaria solani*/*A. tomatophila* can be very similar to target spot leaf symptoms.



Black shoulder - *Alternaria alternata*



Stem lesions



The stem and fruit lesions are good indicators of **Black shoulder**.

Other **spots**, **molds** and **mildew**

1. **Septoria leaf spot**: *Septoria lycopersici*
2. **Gray leaf spot**: *Stemphyllium solani*
3. **Late blight**: *Phytophthora infestans*
4. **Phoma rot**: *Phoma destructiva*
5. **Cercospora leaf mold**: *Pseudocercospora fuligena*
6. **Gray mold**: *Botrytis cinerea*
7. **Leaf mold**: *Fulvia fulva*
8. **Powdery mildew** (*Levelillula, Oidium*)

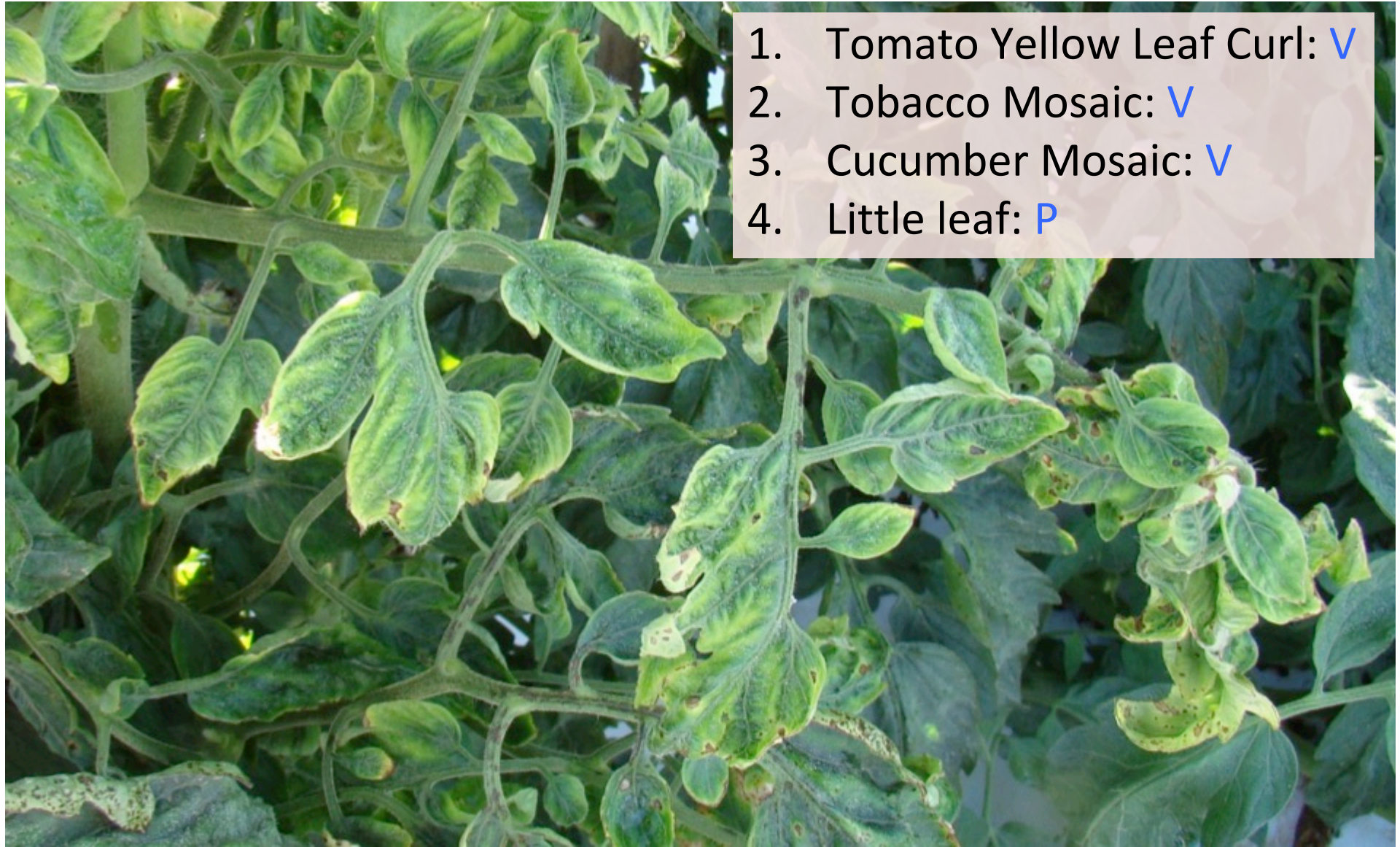
Spots and molds can be difficult for field diagnosis. If you are not sure, send the sample to a diagnostic clinic for a definitive ID.

Florida weather conditions are ideal for occurrence of foliar diseases. This necessitates the judicious use of protective and systemic fungicides and rotating fungicide chemistries for effective disease management

	Disease	Management options
1	Bacterial spot Bacterial speck Syringae leaf spot	a. SAR inducer b. Bacteriophage c. Copper hydroxide + Maneb/Mancozeb
2	Target spot	a. Fungicide application
3	Early blight/Black shoulder	a. Fungicide application
4	Septoria leaf spot Gray leaf spot Late blight Phoma rot Cercospora leaf mold Gray mold Leaf mold Powdery mildew	a. Fungicide application

Scenario 3: In the Fall of 2014, Keith Wynn noticed yellowing and stunting of plants in Hamilton county. Talking with other agents he short listed the **possible reasons**.

1. Tomato Yellow Leaf Curl: **V**
2. Tobacco Mosaic: **V**
3. Cucumber Mosaic: **V**
4. Little leaf: **P**





Yellowing, stunting, and presence of white flies under the leaves or in the field in high numbers is a strong indicator that the disease is ***Tomato Yellow Leaf Curl (TYLC)*** caused by a *Geminivirus* and vectored by white flies



Spider mite feeding can also cause leaf spots and severe yellowing of plants. Check under the leaves for mites.

Unique chlorotic pattern on the leaves between the veins may be due to **TMV**; a *Tobamovirus*, that is spread by mechanical transmission



Severe shoestring leaf symptoms can be due to TMV or CMV
(transmitted by aphids)



Phenoxy type (IAA) herbicide damage can also look similar to CMV symptoms



Interveinal chlorosis, inward curling of the leaf, distorted leaf, cracking of the fruit may be due to **little leaf** (cause not known)



Challenge question: A grower has tomatoes planted in a high tunnel in raised troughs that contain a mix of organic compost. Several weeks into the season the plants begin to exhibit leaf strapping and curling and growth rate nearly stops. He has a neighbor with a sod farm. He also has 2 acres of tomatoes that were just set outside that are not showing symptoms. **What is most likely reason based on the information provided above.**

- A. TMV transmitted within the high tunnel by workers**
- B. Herbicide drift from the neighboring farm**
- C. Herbicide carryover in the compost**

Management options

	Disease	Management options
1	Tomato Yellow Leaf Curl	a. Resistant varieties b. White fly management
2	Tobacco Mosaic	a. Greenhouse sanitation of pruning knives and equipments and worker sanitation.
3	Cucumber Mosaic	a. Aphid pesticide management

Scenario 4a: Forget diseases caused by plant pathogens, what about physiological issues causing fruit damage. David Nistler at Clay county extension office gets these questions all the time.

Blossom End Rot



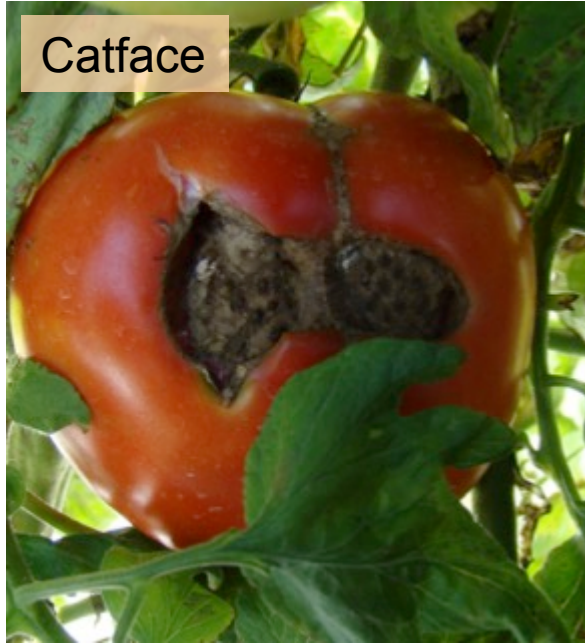
Possible reasons:

1. Blossom end rot: P
2. Zebra Stripe: P
3. Catface: P
4. Graywall: P
5. Pox and Gold Fleck: P
6. Little leaf: P

Zebra stripe



Catface



Pox and Fleck



Graywall

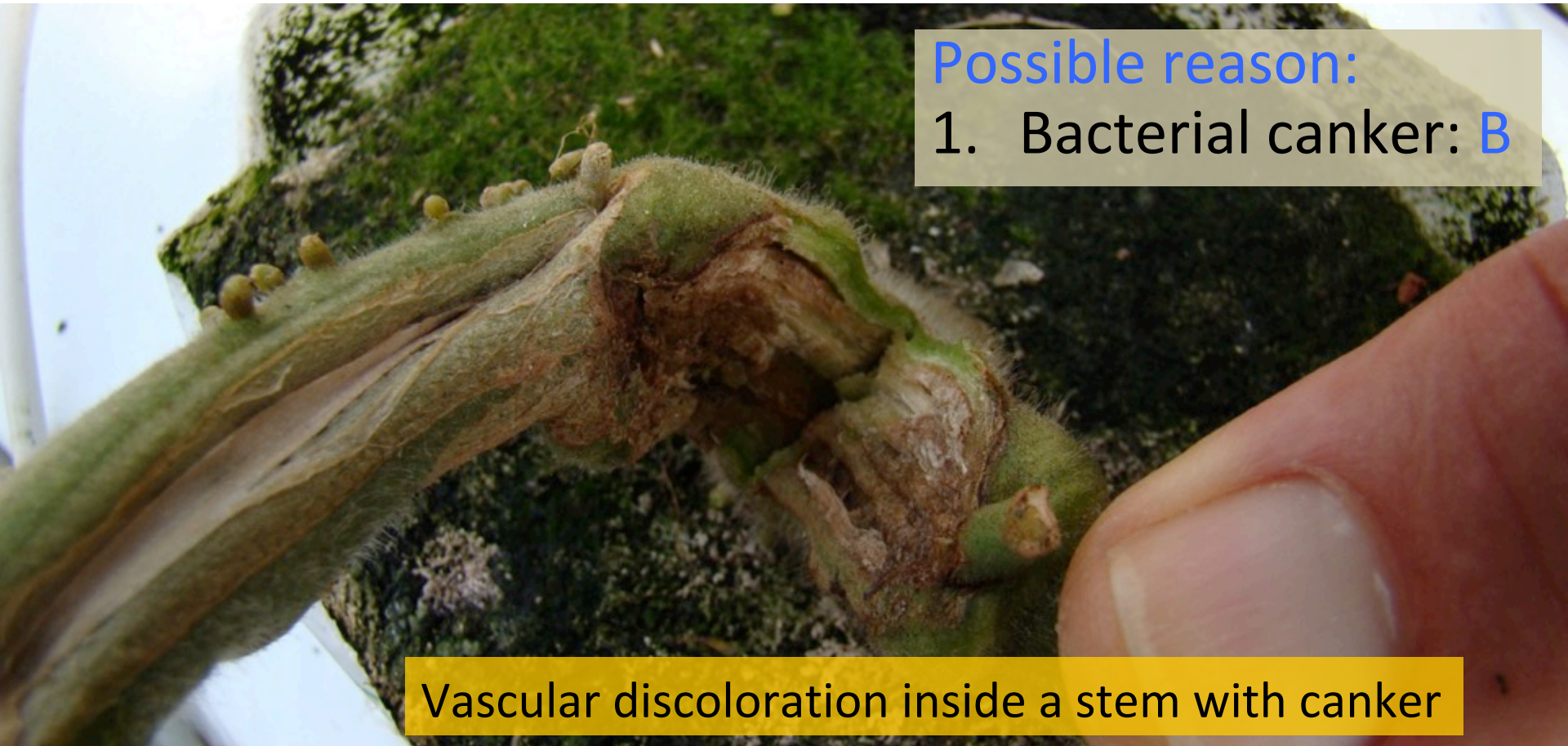


Gold fleck (thrips feeding or genetic)

Scenario 5: Blake Thaxton noticed cankers on stem, lesions on the fruits, blighting of leaves, and vascular discoloration during one of his regular visits to a greenhouse production at Santa rosa county. What could be the problem.

Possible reason:

1. Bacterial canker: **B**



Vascular discoloration inside a stem with canker

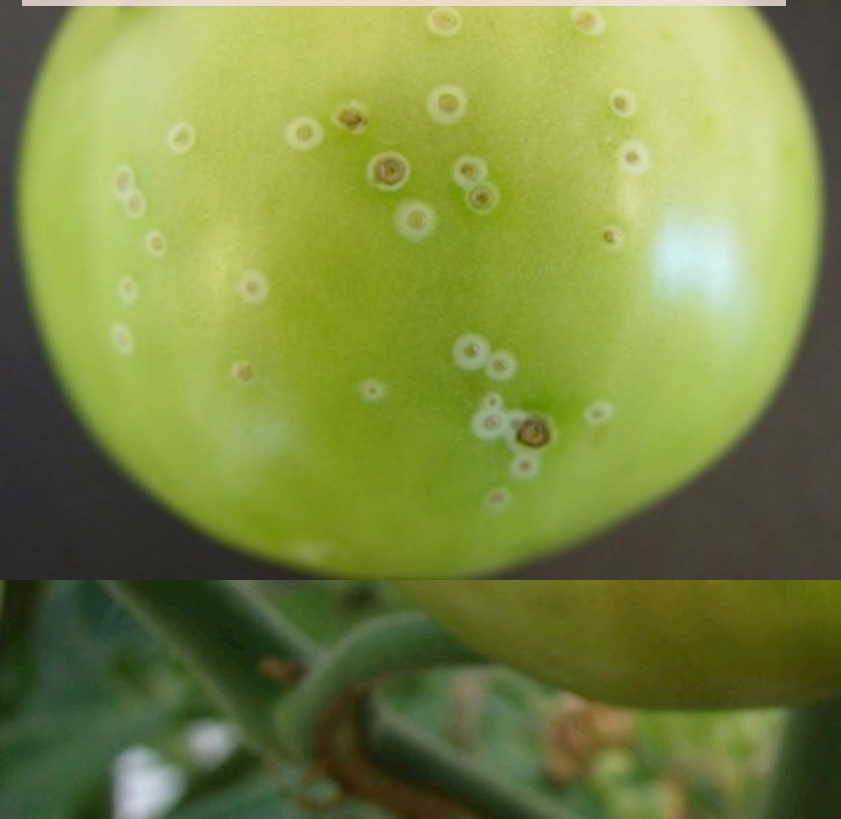
Wilting of the leaves and severe blight



Unilateral wilting of the leaves and severe blight



Bird's eye lesions on a fruit: Field production



	Disease	Management options
1	Bacterial canker	a. Seed sanitation b. Pruning knives and worker sanitation

Netting of the fruit: Greenhouse production



Combination of canker, vascular discoloration, blighting, unilateral wilting, bird's eye lesions/netting of fruits is a strong indicator that the disease may be **bacterial canker** caused by *Clavibacter michiganensis* subsp. *michiganensis*.

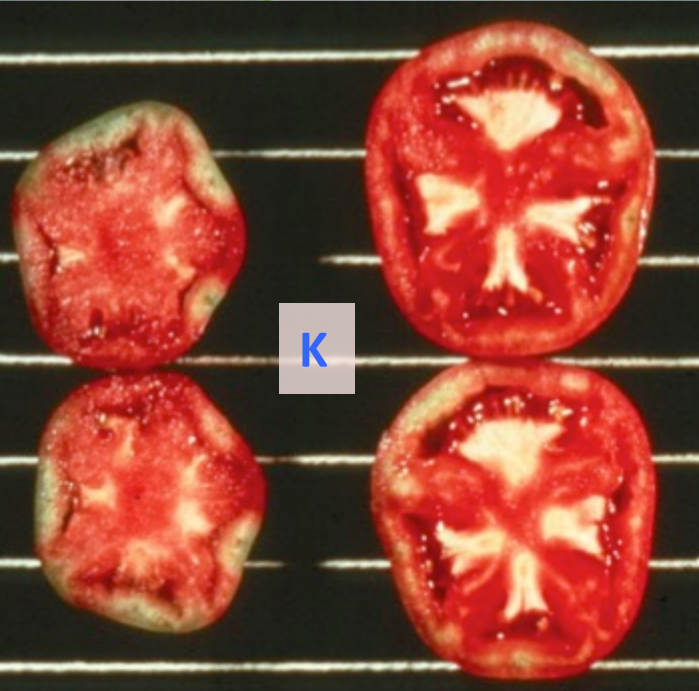


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Now, the key question is how symptoms of **nutrient deficiencies** are different than caused by plant diseases?



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- Field identification based on key symptoms caused by various pathogens can be an effective tool for rapid recommendations at the county level.
- However, if you are not sure, use diagnostic facilities at UF for definitive confirmation.

Contact for additional information

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