Defying Tomato Disorders & Diseases

Disorders VS Diseases – Important Distinctions

Disorders
- Disorders are physiological issues caused by plant stresses related to abiotic (non-living) factors such as temperature, water, sunlight, nutritional imbalances, herbicide/chemical use, soil salts, soil conditions, pH, etc.
- Disorders are rarely fatal to a plant but often affect fruit production and can influence physical growth.
- Disorders are preventable and avoidable with proper cultural care and adjustments.

Diseases
- Diseases are caused by pathogens, biotic (living) factors in combination with environmental conditions.
- Numerous organisms like fungi, bacteria, nematodes, virus that can lead to infections resulting in adverse and negative growth symptoms or eventual death of the plant.
- Once plants become infected by disease there is no cure. Only the symptoms can be managed.
- Prevention is the most critical factor to limit disease infections.
  Disease management = Proactive steps to avoid or reduce disease potential. (i.e. Prevention)
  Disease control = Reactive steps to mitigate symptoms or limit disease progression. (i.e. Treatments)

Common Disorders (Not diseases)
Leaf roll, Blossom end rot, Cracking/Splitting, Yellow shoulder, Cat facing, Hard center cores, Poor fruit set.

Leaf roll/curl

Causes: Plant stress, heat, drought, nutritional imbalances, temperature fluctuations, herbicide damage or plants pruned during dry soil conditions, excess moisture during hot/humid growing conditions.

NOTE: Viral infections can produce leaf curling, but with additional symptoms. (TMV, ToMV, TYLCV)

Symptoms: Leaf curling or rolling. The type, season and direction of leaf curling helps narrow down what the main cause really is.
- Physical plant stress typically affects older leaves first, but not always, moving from low to higher on the plant or from the bottom up, which is also how many diseases infect tomato plants, but no leaf spotting, yellowing or necrotic tissue symptoms.
- Stress induced curling is typically lengthwise from the margins inward toward the center vein, and commonly upward cupping leaves.
- From abiotic causes, the leaves develop a thick, leathery texture, can become brittle, but the leaves hold their normal green color.
- Herbicide damage looks freakishly distorted, curled, clubbed, or balled with proliferation mainly on the new growth or near the ends of stems. On tomatoes, the leaf color typically remains normal green or slightly silvery-green.
- Viral infections (vectored by insects or tools) can stunt, curl leaves but discolored or mottle patterned foliage usually occurs.

Management: Prevention via proper cultural care.
- Maintain proper and stable cultural conditions to avoid plant stress.
- Plant tomatoes in well-drained, healthy soil with pH of 6.0-6.5.
- Maintain consistent watering, apply mulch around plants, limit nitrogen fertilizer applications, avoid pruning ind. types during high temperatures.
  o Choose determinate tomato varieties with viral disease resistance.
  o Follow proper IPM methods to prevent insects, and only use clean, sterile tools.
  o Avoid garden products with 2,4-D, glyphosate, dicamba, or other chemicals near veg. gardens.

Cracking & Blossom end rot (BER)

Causes: Inconsistent watering or rapid changes in soil moisture, which can be exacerbated by a lack of available calcium.

Symptoms: Splitting & Cracking = Linear cracks typically from the tops down or latitudinally partially around the fruits, usually near the top (stem end).
Blossom end rot = A brown, rotten circle patch at the bottom (flower end) of the fruits.
Management Steps: Prevention via proper varietal choice and proper cultural care are the best avoidance measures.

- Choose crack-resistant varieties. (Determinate varieties are less susceptible than Indeterminate types)
- Water consistently and keep soil evenly moist, especially early in the season while fruits are transitioning from green to ripe.
- Water prior to forecasted rain events, especially if conditions are dry leading up to rainy conditions. (T-storms)
- Fertilize consistently with tomato specific food w/added calcium.
- Avoid over-fertilization & read product ingredients. What are you applying & why? Who uses Epsom salts?
- Maintain proper soil pH range 6.0 to 6.5.
- If cracks or splits develop, fruits should be harvested asap, since fissures quickly lead to secondary fungal infections. With BER, rotted portions can be cut out and the healthy parts used.

Yellow/Green Shoulder

Cause: The main factors leading to yellow/green shoulder disorder are low potassium, sun exposure combined with high temperatures, and elevated pH or alkaline soil. Note: this is not a simple lack of ripening. This is a physiological disorder with specific symptoms and causes.

Symptoms: Yellow, green to orange areas primarily at top (stem end) of fruits that fail to ripen. No foliage distress.

Management Steps: Prevention via variety choice and provide proper cultural care or adjustments.

- Plant less susceptible cultivars. While any tomato variety can suffer from this disorder, heirloom types, and varieties with sparse foliage tend to be more prone to this disorder.
- In general, hybrid varieties listed as “good for canning” or w/higher acid are typically less susceptible.
- Avoid re-planting varieties that have experienced yellow shoulder for at least 1-2 yrs.
- Amend soil w/organic matter to boost beneficial microbes, test for & maintain proper pH.
- Fertilize with a complete, tomato specific food including adequate K (potassium). Have a soil test done once every 3-5 years, but also when disorders keep occurring, even though all other prevention measures are followed, and abiotic factors have been successfully mitigated.

Other tomato disorders - Catfacing, Hard center cores, Poor fruit set, small fruits, etc.

- All of these disorders occur due to abiotic issues – weather conditions; heat, drought, excess moisture, etc., nutrient imbalances, pollination issues, variety, planting time, which means all can be prevented or avoided.

Understanding Diseases – What they are, how they work & spread.

Plant disease triangle: Plant host X Conducive conditions X Pathogen = Plant Disease.

The best management & control measures = Exclusion, prevention, and resistance. (Eradication is another)

Soil-borne: Fusarium wilt, Verticillium wilt, Pythium, Nematodes, etc.

No current effective cure or treatment options for SB diseases. Chemical or solarization are frustratingly non-effective, especially in N climates and are very cost prohibitive. Planting resistant varieties is best preventative protection.

Air-borne & direct contact:

*Alternarria solani* (EB), *Septoria lycopersici* leaf spot (SLS), *Stemphylium sp.* - Gray leaf spot (GLS), *Phytophthora infestans* (LB), *Botrytis cinerea* – Gray mold, *Oidium neolycopersici* - Powdery mildew, etc.

Types of diseases

- **Bacterial**
  - Most often vectored by insects, but wind, rain or mechanical transmission is possible through natural openings or wounds on plants.
  - Microscopic bacteria overwinter on plant debris or inside insects.
  - Little to no controls once infection occurs.
  - Once positively identified via pathology testing, remove, and destroy infected plants.
o Preventing insect feeding and buying from certified sources are the best control measures.

- **Fungal** *(By far, the most destructive tomato/vegetable diseases are fungal or fungal-like.)*
  - Most often spread by wind, rain, direct contact, or insects. (Some are soil-borne)
  - Effective controls are – exclusion, prevention, and resistance like proper sanitation, ideal cultural practices, and crop rotations.
  - Planting resistant varieties is a critical step.
  - Applications of the right fungicide, at the right time, in the right amounts is beneficial.

- **Viruses/Viroid**
  - Least common diseases in home gardens, although they get a lot of attention.
  - Viruses are intracellular nucleic acids restricted to a particular host plant.
  - On tomatoes, primarily vectored by insects (aphids, leafhoppers, mites, whitefly, nematodes)
  - Once positively identified, remove & destroy infected plants.
  - Plant resistant varieties (know the codes) and prevent insects feeding.
  - Practice proper sanitation – clean & sanitize pruners & cutting tools.

**Know the Codes**

Tomato breeders utilize a logical, universal coding system for quick gardener reference for high disease resistance. Extension service professionals can help you determine what diseases are common in your area. Then research varieties with the corresponding disease resistance codes. (IPPC codes use pathogen genus & species for codes)

- **V** = Verticillium wilt
- **F** = Fusarium wilt (The number of Fs indicate races 1, 2, or 3 resistance F, FF or FFF)
- **N** = Nematodes
- **T** = Tobacco mosaic virus (TMV)
- **ToMV** = Tomato mosaic virus
- **A** = Alternaria stem canker
- **GLS** = Gray leaf spot. *(Sometimes listed as (St) for Stemphylium sp., genus of the causing pathogen)*
- **TSWV** = Tomato spotted wilt virus
- **BS** = Bacterial speck
- **EB** = Early blight
- **LB** = Late blight
- **YLCV** = Yellow leaf curl virus

**Not all are represented here, but these are the 12 most common.**

- **HR** = High resistance. Only those plants that prove high resistance are assigned corresponding disease code.
- **IR/ir** = Intermediate resistance. Intermediate resistances are mentioned in the variety descriptions, or as (ir:) w/code.

**NOTE:** High resistance does not mean plants are immune to a disease, only that they show better protection from existing threat of disease-causing pathogens when exposure and conditions are conducive to that disease.

- *Too many environmental and cultural variables exist to protect plants 100% from disease pathogens. Management and control measures still need to be employed to help prevent diseases.*

**Fungal disease symptoms can be numerous, but most have similar infection habits. Therefore, prevention & treatments are similar, so an exact disease diagnosis is not critically important for taking management steps.**

- A common symptom is leaf spotting. Spots can be purple, brown, tan or tan with white centers that drop out.
- Leaves turn yellow then develop necrotic tissue, with spots gaining in size, often leaving behind concentric rings and having a visible yellow halo between green healthy tissue and show dying, necrotic tissue.
- Spots often congeal to form larger leaf lesions & destroy the entire leaves.
- Most fungal infections start low on the plants and move upward as they progress.
  - An exception is Late blight (LB), which starts low then quickly jumps to upper parts of the plant. LB infections form water-soaked spots that morph quickly to tan or brown with no yellow halo between green and necrotic tissue. With LB, plants succumb to the disease seemingly overnight, which is extreme compared to other fungal infections. (Most are symbiotic parasites that do not want to kill their host)
However: LB is highly weather dependent. Infections are rarely severe every year. Misdiagnosis is common. During many growing seasons Late blight is of little to no concern because of its dependence on conducive weather conditions. LB infections start in southern states and migrate north with the warming weather. (Visit USABlight.com hosted by NC State)

Preventing Diseases on Tomato Plants = 6 Easy Steps

1. Choose varieties with HR to local potential diseases.
   a. Even varieties with IR are usually enough to prevent major seasonal disasters.

2. Rotate where tomato plants are grown every season.
   a. Most fungi & FLO are cumulative. This is why rotation is so help at preventing fungi population buildups.

3. Practice proper plant spacing.
   a. Plant fewer plants, leaving enough room to walk between them without brushing foliage.
   b. Prune indeterminate plants properly to remove vigorous, unproductive crowded growth. Do it early.

4. Sanitation, sanitation, sanitation.
   a. Pick infected leaves off ASAP. Then wash your hands or change gloves.
   b. Pick up fallen leaves and debris. Then go wash your hands, change gloves.
   c. Clean and disinfect tools after every use.
   d. Lift low hanging foliage. Keep 12-inches between ground and lowest leaves.
   e. Avoid using dirty, used soil, and never transfer soil from one spot to another.
   f. Keep adjacent areas free from weeds and debris, unless utilizing trapping crops.
   g. If/when plants become increasingly infected, remove them entirely, clean up thoroughly after them.

5. Keep plants healthy.
   a. Do proper fertilization.
   b. Apply water consistently and use proper spacing & caging.
   c. The healthier the plants are the more natural disease defenses they have.

6. Follow 3-Rs for fungicide use.
   a. Apply the right fungicide, at the right time, in the right amounts. (Read & follow product instructions!)

Fungicides 101 - Efficacy of any fungicide increases when combined with proper sanitation, appropriate plant spacing, proper care, watering and recommended pruning with caging.

- Topical fungicides are preventative, not curative.
  o Once an infection occurs, managing the symptoms & reducing potential negative effects is the goal.
  o Most seasons, some amount of disease infection is inevitable. Some infections are tolerable, but do continual scouting, and take the proper steps to slow or limit disease spread.
  o Utilize mineral-based (sulfur or copper) or bio fungicides early in the season, then switch to a broad-spectrum synthetic product later in the season as pressures increase due to summer moisture, humidity, heat and insect populations.

**IMPORTANT:** Fungi cannot develop resistance to mineral-based or bio-fungicides like they can with synthetic fungicides. Fungi are most elastic in spring. When synthetic fungicides are applied, fungi can mutate and become more resistant to synthetic chemicals.

- Rotating products may be necessary year to year depending on the environment, weather, and amount or level of past disease pressures.

**NOTE:** Neem oil provides low to no efficacy against most fungal diseases like Early or Late blight. It can help prevent the spread of PM if applied just prior to outbreak, but that’s really it.

Tomato varieties with good disease resistances:

<table>
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<tr>
<th>Item #</th>
<th>Var. Name</th>
<th>No. days</th>
<th>Habit</th>
<th>Class</th>
<th>Disease Resistance Code</th>
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<tbody>
<tr>
<td>033</td>
<td>Amelia VR Hyb.</td>
<td>75</td>
<td>Det.</td>
<td>(slicer)</td>
<td>V, F1-3, N, GLS, TSWV</td>
</tr>
<tr>
<td>066</td>
<td>Bella Rosa Hyb.</td>
<td>75</td>
<td>Det.</td>
<td>(slicer)</td>
<td>V, F1-2, A, GLS (ir: TSWV)</td>
</tr>
<tr>
<td>070</td>
<td>Bellatrix Hyb.</td>
<td>70</td>
<td>Det.</td>
<td>(sm. Slicer)</td>
<td>F1-2, TMV, LB, ToMV</td>
</tr>
<tr>
<td>076</td>
<td>Bellerose Hyb.</td>
<td>75</td>
<td>Ind.</td>
<td>(bfstk)</td>
<td>V, F1-2, N, TSWV, TYLCV</td>
</tr>
</tbody>
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