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What Makes Tomato Leaves Twist or Curl?

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If the leaves on your vegetable plants are twisted or curled, the problem could be environmental, chemical, or biological. Sometimes all the leaves on a plant are twisted or curled; sometimes only new growth has symptoms while older leaves are normal. Damage may start moderately then quickly begin to affect new growth. Damage to tomato and other vegetable plants may have one or a combination of causes (Figs. 1-5).

There are five primary reasons that tomato leaves twist or curl:

- Wind damage
- Herbicide drift
- Herbicide residue
- Broad mite
- Tomato viruses

Wind damage

High winds, blowing dust and low humidity can damage the leaves and stems on tomato plants. Heat and low moisture can cause the edges of the tomato leaves to die back, then twist and curl.

Hot dry weather may also cause a symptom called physiological leaf roll. This is a self-defense response, where leaves and leaflets curl slightly to prevent further water loss (Fig. 6).

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Figure 1. Twisted tomato leaves

Figure 2. Severely twisted tomato leaves

Figure 3. Curling leaves on a bean plant

Figure 4. Curling leaves on an eggplant

Figure 5. Curling leaves on a pepper plant

Figure 6. Moderate physiological leaf roll

Mild leaf roll generally does not lower yields or quality, though severe symptoms may cause flowers to drop and fewer fruit to set.

These symptoms may look like damage from other causes, but if wind damage is the only problem, plant health will generally normalize once weather conditions improve.

Herbicide drift

Crops and pastures are often treated with herbicides to prevent or eliminate weeds, and drifting spray can damage tomato plants. Up to 84 percent of the cotton acreage in Texas is sprayed with broad-spectrum herbicides. They are also used on cereal and grain crops. The problem is that wind speeds as low as 5 mph can move these herbicides up to a mile.

Many home gardens are close enough to cotton and corn fields for drifting 2,4-D, dicamba, or other hormone-type herbicides to cause serious damage. Tomato plants are extremely sensitive to these herbicides: they can be injured by concentrations as low as 0.1 ppm. If only a little of the herbicide reaches the tomato plants, they can recover, but yield will definitely suffer (Fig. 7).

Figure 7. Dicamba injury to tomato leaves

In addition to commercial applications, herbicides from home gardeners or their neighbors can drift onto sensitive tomatoes or other vegetables. Weed killers for lawns and landscapes often contain broad-spectrum herbicides such as glyphosate and the growth-regulators such as 2,4-D and dicamba. Examples are Ortho Weed-B-Gon and Fertilome Weed FreeZone. Tomatoes are very sensitive to these herbicides even when applied at extremely low rates. Though the plants may look healthy, drift from these products can reduce the number and the quality of the fruit.

There is no remedy for leaves that are already injured by 2,4-D. If new growth continues to show injury symptoms, harvest any salvageable fruits and pull up the plants.

If new shoot growth is normal, and there is still at least 4 to 6 weeks left in the growing season, the plants may be able to outgrow the injury. New buds and leaves should begin growing within about a week. If not, pull the affected plants and replant.

To minimize herbicide drift following these steps:

- always read and follow the herbicide label instructions
- avoid spraying when wind speed is more than 5 mph
- avoid spraying when wind is blowing toward sensitive crops
- use a hooded sprayer when applying post-emergence herbicides near growing plants
- reduce spray pressure so droplet size is larger and less likely to move with the winds
- reduce the speed of the spray application to avoid movement in the circulating air
- ensure that the dosage applied is correct
- use the correct spray nozzles/tips for the chemical to be applied
- use drift reducing spray additives if available
- wash out all previous herbicide from inside the spray tank

Herbicide residue

Vegetables can be damaged by herbicides left in mulch or compost made with hay or manure from fields that have been sprayed with Grazon, GrazonNext, or GrazonNext HL. The active ingredient in these products is aminopyralid which persists for 18 months on treated hay and hay products. It also persists in the manure of animals that eat Grazon-treated hay. Grazon products are commonly used in pastures because they kill about 100 difficult broadleaf weeds .

The GrazonNext label states that any plant matter collected from fields sprayed with aminopyralid may not be used in compost or where vegetables are to be grown (Fig. 8). The label also states that the "applicator must provide the land manager with a copy of instructions regarding uses of forage from areas treated with aminopyralid."

Anyone who sells hay, silage, haylage, green chop, or bedding material that was treated

IMPORTANT USE PRECAUTIONS AND RESTRICTIONS TO PREVENT INJURY TO DESIRABLE PLANTS

- It is mandatory to follow the "***Use Precautions and Restrictions***" section of this product label.
- Manure and urine from animals consuming treated grass or forage may contain enough amnopyralid to cause injury to sensitive brodleaf plants.
- The Applicator must provide the land manager with a copy of the Dow AgroSciences Stewardship instructions regarding uses of forage from areas treated with aminopyralid.
- A printable version of the stewardship instructions can be found at www.aminopyralidstewardshipinstructions.com

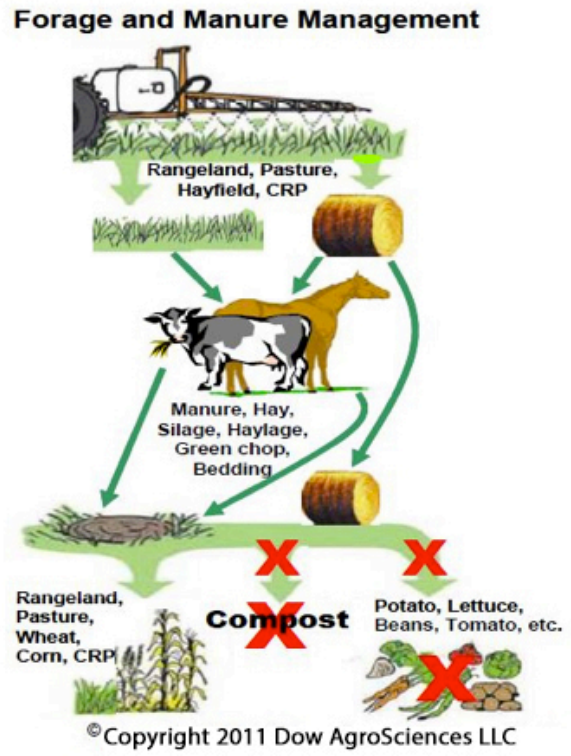

Figure 8. Precautions for aminopyralid use. (Source: GrazonNext HL label. Full label is found at http://www.cdms.net/LDat/ldA6K005.pdf)

with aminopyralid, is responsible for alerting the buyer that it was treated and must not to be used in composting or were vegetables are grown. Buyers must also ask whether aminopyralid was used on the source forage within the last 18 months.

Additional restrictions in hay and manure use:

- Do not use aminopyralid-treated plant residues, including hay or straw from areas treated within the preceding 18 months, in compost, mulch or mushroom spawn.
- In compost, mulch, or mushroom spawn, do not use manure from animals that have eaten forage or hay from treated areas within the previous 3 days.
- Do not plant broadleaf crops (including soybeans, sunflower, tobacco, **vegetables,** field beans, peanuts, and **potatoes**) in fields treated in the previous year with manure from animals that have grazed forage or eaten hay harvested from aminopyralid-treated areas until an adequately sensitive field bioassay is conducted to determine that the amount of aminopyralid residues in the soil will not injure the crop to be planted.
- To promote herbicide decomposition, burn the plant residues or evenly incorporate them in the soil. Aminopyralid breaks down faster in the plant residues and manure when the soil is warm and moist. Irrigation can speed up the process.

Broad mite damage

Broad mites (*Polyphagotarsonemus latus*) affect many plant families, including tomato, pepper, eggplant, potato, cotton, and citrus. It also attacks ornamentals such as dahlia, zinnia, chrysanthemum, pittosporum, and schefflera that are grown under shade cloth.

Broad mites avoid light and feed on young leaves and flowers. As they feed, they inject toxins that severely twist and distort the leavers. The damage may resemble other types of damage on tomato plants. In Texas, broad mites damage seedlings grown in greenhouses or under shade cloth. Severe broad mite infestations can make the underside of leaves and fruit look bronzed or russetted.

These mites are invisible to the human eye and can be overlooked even under a magnifying glass. They are usually discovered only after plant injury is noticeable. Broad mites are 0.10 to 0.30 millimeters long (Fig. 9), have oval bodies, and can be translucent to pale brown or yellow.

If you cannot see the broad mites readily, look for the eggs, which are white, oval-shaped and have ridges or bumps. This mite's eggs are distinct—they look like Christmas ornaments (Fig. 9). Eggs develop into adults in about 4 to 6 days in hot weather and 7 to 10 days in cool weather.

Figure 9. Broadmites and broadmite eggs

Broad mite populations come and go rapidly depending on food, weather, and light. Infestations are often sporadic and fluctuate from year to year. Broad mites may infest your tomato plants via transplants from greenhouses or the legs and antennae of whiteflies.

Before treating the plants, make sure that broad mites are the problem. Entomologists with the Texas A&M AgriLife Extension Service can diagnose leaf samples for you (http://plantclinic.tamu.edu). If broad mite damage is severe, pull up the plants and dispose of them.

Moderately affected plants can be treated with sulfur-based miticides. However, be sure that the tomato cultivar is tolerant of sulfur before applying it. Do not treat tomatoes when temperatures are higher than 90o F or when the plants are water stressed—the miticide can

damage the plant under these conditions. The plants will likely need additional applications to avoid further damage. Other products known to control mites in general include Horticultural Oils and Insecticidal Soaps. You can alternate these treatments with predatory mites that attack and consume broad mites. Predatory mites are most effective if used before the broad mites get firmly established. Predatory mites are sold by many companies specializing in organic products (Grow Organic, Arbico Organic, Benemites are a few examples)

Tomato viruses

Hundreds of viruses can cause leaf curling and stunting in tomatoes. Though initial virus symptoms can be confused with a phenoxy-based herbicide damage, the disease often progresses to include yellow-green mosaic patterns on the leaves (Fig 10).

Figure 10. Mosaic patterns on tomato leaves

Viruses in the geminivirus group are most often the culprit for virus-based leaf twisting in tomatoes. In Texas, the most common virus encountered is the tomato yellow leaf curl virus.

Geminiviruses spread to tomatoes and other plants exclusively by the sweet potato or silverleaf whitefly (Bemisia tabaci). To reduce the spread of this virus, manage whitefly populations with insecticidal oils and soaps.

This group also includes other viruses:

- the tomato yellow leaf curl virus
- chino del tomato virus
- tomato leaf crumple virus
- pepper huasteco virus
- potato yellow mosaic virus
- Sinaloa tomato leaf curl virus
- Texas pepper virus
- tomato yellow mosaic virus
- tomato yellow streak virus

New tomato varieties have been developed that resist tomato yellow leaf curl. However, these varieties are still susceptible to other virus diseases. As with any tomato leaf damage, you must identify the cause before making any management decisions. To confirm tomato yellow leaf curl virus, submit plant samples to the Texas Plant Disease Diagnostic Laboratory (http://plantclinic.tamu.edu). Pull up and dispose of diseased plants.

Summary

They key to solving the problem of twisted or curled leaves is to identify the source or sources of the problem. Wind damage will resolve once conditions improve. Mites and viruses can be identified by laboratory analysis. Damage caused by herbicide drift or residue in mulch and compost is the most difficult to identify. Regardless of the cause, curled or twisted leaves on tomatoes or other vegetables are a sign that you may need to take action to save your crop.

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