

EXTREME HEAT IN THE GARDEN

EFFECT OF HEAT STRESS ON PLANTS

- Most plants grow best in temperature range 15C – 32C.
- When temperatures are above 32C, plant growth is slowed; some plants begin to show signs of stress. Pollen may be sterilized so that fruit does not set.
- Above 40C many plants will survive but will show different signs of heat stress dependent on plant type, maturity of the plant, and factors that often come with high temperatures, such as drought or wind.
- In dry soil, heat injury occurs at lower temperatures than it would for well-watered plants.
- Photosynthesis drops off rapidly above 34C. At 46C plant tissue dies.

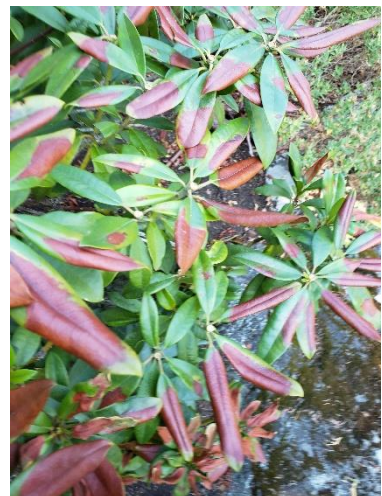
The plants most likely to die from extreme heat are germinating seeds and small seedlings, because their roots are close to the hot surface. The leaves of young plants are prone to being burned but any kind and age of vegetable can experience heat injury if it gets hot enough, especially if the soil is allowed to get dry.

SIGNS OF HEAT STRESS IN PLANTS:

1. Sunscald

Direct heat injury, called sunscald happens when temperatures are so high that plant tissue die. On leaves sunscald appears as light tan, brown, black or purple dead areas. The injury starts at the leaf tips and margins. The injury extends inward between leaf veins the longer the hot weather lasts.

From apples to tomatoes to melons, many fruits will scald in high temperatures, primarily on the side of the fruit most exposed to the sun. Sunscald looks different on varying fruit types and may appear as a watery area on the fruit, discoloration, blisters on the skin of the fruit, dried out fruit, or sunken, hardened areas on the fruit surface.



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Diagnosing sunscald vs plant disease: How can you tell which is which?

	Sunscald Symptoms	Disease Symptoms
Timing	Damage appears all at once, on the top leaves or side of a plant most exposed to the sun	Damage progresses over time, usually starting with oldest leaves and gradually spreading
Symptoms	Injury appears on parts of the leaf farthest from the veins, between the veins and on leaf tips and margins	Fungal leaf diseases typically grow in roughly circular patterns that can overlap leaf veins
Hosts	Shows up on a variety of unrelated plants growing in the same conditions	Pathogens have limited host ranges, usually infecting only one species or closely related species of plants
Weather	Appear after unusually hot weather, especially in dry and windy conditions	Many common leaf diseases spread in cool, wet conditions

2. Leaf rolling and cupping

Corn and tomatoes are among many plants that commonly roll their leaves or cup in response to heat. Leaf surface area is minimized, and stomata (microscopic openings in leaves that allow movement of moisture and gasses) close. Together, these reduce moisture loss in the plant.

3. Wilting

Wilting occurs when low moisture in the plant creates a lack of water pressure within the plant. Common in non-woody annuals and perennials, many plants will recover when temperatures drop. Potential for permanent damage increases with the length of time that a plant remains wilted. Plants that wilt during the hottest part of the day, and recover in the evening and early morning, are likely suffering from heat stress.

4. Dry leaf edges

A survival mechanism used by some plant types is that the outer margins of a leaf will dry up, but the leaf as a whole remains viable. This may be more common in large-leaved plants like squash and pumpkin, where there is more leaf surface area to “spare” and still maintain function. Dry leaf edges can appear similar to disease symptoms.



5. Ozone damage

When high temperatures are combined with poor air quality, ozone damage can result. Where air inversions are common, ozone damage to tomatoes has been observed when hot

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temperatures and wildfire smoke are present. Ozone damage can also be confused with a disease. In tomatoes, for instance, the dry brown spots in between leaf veins resemble bacterial leaf spot (the bacterial spots will have yellow “halos” that ozone damage does not). In cucumbers, squash, and pumpkin, ozone-damaged leaves become bleached and very dry-looking.

6. Blossom and fruit drop

Numerous ornamentals abort or drop buds and flowers after prolonged exposure to high temperatures. This allows the plant to conserve resources for parts of the plant necessary for survival. Blossom and fruit drop are common in peppers, squash, and cucumbers when high temperatures persist. Most plants will return to typical production after a heatwave is over.

7. Bolting

Bolting is the premature flowering of plants before they would typically be harvested. High temperatures induce bolting in cool-season vegetables. A heatwave will likely mean the end for many cool weather plants like cilantro, broccoli, cauliflower, lettuce, and spinach. It may be helpful to harvest these foods when a heatwave is predicted, for the best quality and flavor.

8. Blossom end rot

A common tomato problem associated with deficient calcium can become more problematic when sunscald is present. Consistent watering helps minimize blossom end rot. Avoid letting plants completely dry out between watering.

Growth Disorders from Heat and Drought Stress

Vegetables	Over C	Impact
Potatoes	27	Tubers do not form
Cabbage Family	27	Growth slows, heads are malformed or do not form
Leaf Mustard	15-19	Seed stalks form
Tomatoes	30-32	Flowers drop, fruit ripening is delayed, fruit has poor flavour
Peppers	24	Flowers drop (also occurs below 15C)
Beans	27	Flowers drop, pods distorted or not filled
Garlic	20	Poor bulb formation
Lettuce	25-33	Seeds will not germinate
Peas	35	Plants die if air temperature is over 35C long enough

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PREVENTION OF HIGH TEMPERATURE STRESS IN PLANTS

1. Pay attention to weather forecasts

The key to protecting plants is to act **before** a predicted heat wave hits.

2. Provide shade for vulnerable plants

- buy **horticultural shade cloth** (products that provide 30%-50% shade are ideal) available at garden centers to shelter particularly precious plants. This is usually light-colored, knitted fabric that is water permeable. Rig up some sort of frame and spread the cloth over. Try not to lay it directly on the plants so they have air circulation. The temperature under the shade cloth can be 10 degrees lower. Use shade cloth over cold frames, cloches and greenhouses.
- make **wooden latticework** covers (cedar lath panels are available at lumber yards). These options let in enough light that you can leave the shade material in place until the heat wave is over.
- use **opaque materials**, such as old bed sheets or any kind of lightweight fabric, but it would be best to **cover your plants in mid-morning and uncover them in late afternoon** so they have some photosynthesis time in the cooler parts of the day.
- **This is NOT the time to use floating row cover** (e.g., Remay), since it is designed to let in as much light as possible and to trap heat.
- Just remember that heat kills, while a period in the shade is merely inconvenient for plants....so use anything you can lay your hands on to cover plants for the short period it will be necessary to protect them.
- Be prepared for plants that are heavily shaded for long periods to “stretch” towards more light.

For newly sown beds

- cover these with burlap, opaque white plastic, old beach towels or bedsheets to prevent the soil from getting hot enough to kill germinating seeds. If you have some of those plastic lattice-work seedling trays, cover small seedlings with these, turned upside down.

For vegetables, fruit and flowers

- It is a good idea to **grow several cultivars** of each type of crop because there can be marked differences in how well each one handles adverse conditions. Sow winter crops **on a couple of different dates**.
- Look for disease resistant varieties of fruit, vegetables and flowers. Choose varieties of fruit trees that bloom as late as possible. Plant hardier, less delicate species.
- Plant native species that are adapted to dry summers.

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- In addition to any young plants, shading is needed for mature leafy greens, lettuce, peas and cabbage family crops (broccoli, cauliflower, cabbage). While broccoli and cabbage will be less stressed and will perform better if they are shaded, shading is essential for cauliflower, which is very sensitive to heat. If you have cauliflower heads close to harvest when a heat wave is predicted, **pick immediately** because the heads rapidly come apart and become strong flavoured in the heat. Also, harvest Chinese cabbage, radishes, lettuce, spinach before the heat causes bolting.

For plants in greenhouses or tunnels

- temperatures will be far too high without shading so cover the greenhouse with shade cloth. If that isn't possible, then shade the plants inside the greenhouse using any kind of shading fabric. Increase ventilation, including using high speed fans, if possible, to dump the heat.

For plants in pots

- To protect potted plants from heat, you can use many of the same plant **shade covers** as you would in your garden. Many containers can be moved. Place them under a porch or **in full shade** on exceptionally hot days.
- Containers tend to dry out faster and will **need more frequent watering** than your garden plants. Check your potted plants and hanging baskets every morning to ensure they are not dry.
- Stick your finger in the soil to see when it needs water. If the pots are small, pick them up; if they are light, water.

3. Increase Watering

- **the main defense plants have against high temperatures is water.** They cool themselves by allowing water to evaporate from their leaves. As the temperature rises, water evaporates faster and the whole plant gets thirstier.
- Know your **plants' roots**:
 - Shallowly rooted plants will dry out more quickly and will wilt faster.
 - Tap-rooted plants can draw water from deeper into the soil.
 - Young plants with less root development will need water more often than older, established plants with a large network of roots for drawing moisture from the soil.
 - Mature trees can suffer from heat and drought stress just like smaller plants but may not show symptoms of that stress until much later.
- **Water vegetables two to three times a week** during really hot weather.
- **Water early in morning.** Watering in the afternoon when the sun is high and temperatures are at their peak, means any water you give them at that time evaporates and does not benefit the plants.
- **Water plants deeply, at least to 6 inches down.** Plants are the best indicator of when they need water – they wilt. Watch your plants. If they begin to droop, it's time to get out the hose. Dig down in the soil 1 to 2 inches next to the plant to see if it needs

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moisture. Plants in sandy soil will need to be watered more often than those in clay soil, which retains water much more than sandy soil.

- **Wilted plants** should be watered as soon as is reasonable to minimize the time spent in a wilted state.
- **Use drip systems and soaker hoses** for the most efficient watering. They get the water right to the plant's roots and avoids excess evaporation.
- If you are watering by hand, **water close to the soil** under the plant.
- **Hanging baskets and containers will need to be watered more frequently** than plants in the ground. Be sure to check them often.
- **Water as much as possible** within the constraints of any local watering restrictions.
- **For additional water**, note that there is a lot of clean household water that can be collected and poured on garden plants, whether from the kitchen (veggie washing, dish rinsing, etc.) or the bathroom (collect shower water in a bucket while waiting for it to warm up enough to step in).

4. **Mulch Everything**

- to prevent soil temperatures from getting too high and to conserve moisture. You can use straw, compost, wood chips or whole dry leaves.
- Amend soil with organic material. Well-amended soil holds water better.
- Refer to the Clinic Reference Materials article on Mulching 101.

5. **Reduce competition from weeds**

- One activity to not postpone in the garden during a heatwave is weeding. Many weeds are better adapted to extremes than ornamental plants: weeds compete with garden plants for water and nutrients.

6. **Ground cover**

- To protect against future hot spells, plant ground cover plants this fall or coming spring when the time is right do so. Come next summer, you will have a nice mass of ground cover to help with erosion control, weed suppression ... that can help lessen the evaporation.

WHAT NOT TO DO IN A HEATWAVE - Avoid anything that can further stress the plants!

1. **Don't plant, re-pot or transplant**

Too-warm soil temperatures can kill young seedlings, or cause cankers where the stem meets the soil line. Transplanting is stressful to plants without the added issues caused by high temperatures. Postpone planting or transplanting until cooler temperatures arrive.

2. **Don't prune trees and shrubs**

Removal of leaves and branches means a new part of the canopy will be exposed to sunlight. In times of intense heat, this can lead to sunburn in leaves that were previously

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shaded. Trees and shrubs with sunburn in a portion of the canopy will likely recover but will be unattractive in the meantime. Stressed trees are more likely to attract damaging insects like wood-boring beetles.

3. **Wait to fertilize**

During periods of intense heat, inducing new growth is not ideal. Wait until a cooler period for this garden activity. Heavy watering during the heatwave would have flushed a lot of nutrients out of the soil. Wait at least a week after the heatwave to fertilize to help plants recover. A liquid fertilizer is more rapidly absorbed by plants.

4. **Don't apply chemicals**

Many treatments for plant disease and insect issues can damage plants when temperatures are consistently above 27C. Check the label of a product for specifics before applying. Some plant types such as conifers and succulents can be further damaged by any treatment—even soap or neem oil—applied during extreme heat.

5. **Avoid wetting plant leaves**

While misting leaves can provide humidity to cool the plant, it will also provide conditions that risk fungal growth.

6. **Disturb the soil as little as possible**

7. **Leaf removal**

If there is any green left on the foliage, just leave it be. Even if a leaf has some scorching, remaining green areas are still photosynthesizing and feeding the plant to help it grow. If you want to remove burned leaves, leave at least 70 percent of the foliage on the plant. There could be dormant buds on plants that can still re-foliate this year.

References:

1. Resilient Gardens 2016 - Climate Change, Stress Disorders, Pest Update. Linda A. Gilkeson, PhD, 2016 www.lindagilkeson.com Also Lindaslist@lists.resist.ca June 24/21
2. Oregon State University Extension Service, "Tips for Gardening in Extreme Heat", Erica Chernoh, Horticulturist, 2021