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What is causing the blistering on my leaves?

Edema (oedema) and intumescence are physiological disorders that cause outward blistering and bumpy growth to form on leaves, petioles, and sometimes stems. Recent weather conditions in Michigan are suspected to have caused an increase in reports of edema. Michigan had a week of sunny, warm, spring-like weather followed by a cold snap where highs were in the low 40's and much of western Michigan experienced record snowfalls (2-8"). At this point in the season (Week 16) most greenhouses were full and some growers were watering more heavily in the sunny week prior to the cloudy, cold weekend.

Edema is thought to be related to an imbalance of water, where plants uptake water more quickly than tissues can transpire it, causing cells to burst. It is typically observed on the *lower* side of leaves, usually on the tissue *between* the veins of the leaf. Intumescence is more related to low UV radiation inside greenhouses, and develops on the *top and/or bottom* of the leaves and often *along* leaf veins. Both are physiological disorders and do not 'spread' over time.



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Edema on the underside of a geranium leaf; the blisters between veins. Photo: Sandra Jensen, Cornell University, Bugwood.org.



Intumescences present along the veins of the leaves of sweet potato vine. Photos: Anonymous.

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***Albugo* spp.**

Blisters or pustules on foliage of some crops can be a symptom of disease.

***Albugo* spp.** infects foliage causing what is commonly referred to as white blister rust. This is a bit of a misnomer, the pathogen is not a true rust fungus, but instead is more closely related to the downy mildew pathogens. There are several different species of *Albugo* that occur in the U.S., each species has a specific host range. For example, one species infects *Cleome*, while another infects several different *Brassica* species. Some susceptible greenhouse grown include *Amaranthus*, *Artemisia* (wormwood), *Iberis*, *Ipomea* (sweet potato vine), *Lobularia* (sweet alyssum), and *Portulaca*. Perhaps the most commonly infected plants are cruciferous vegetables.

Albugo spp. and downy mildew pathogens have some similarities in their life cycles. They are obligate pathogens, meaning that they require live host tissue for growth. They also greatly depend on water; these pathogens produce zoospores which are capable of swimming through free standing moisture (including on the leaf surface). Cool wet conditions are reported to promote infection and subsequent disease development. *Albugo* produces mycelium which grows within the plant tissue and forms raised wart-like growths. Sporangia, which are reproductive structures of the pathogen, are formed inside these growths.

How can you verify which issue you have?

Knowing your host is a good starting point. For example, ivy geranium has a tendency to develop edema but is not a host for the pathogens that cause white blister rust. *Ipomea* (sweet potato vine) is susceptible to both edema and *Albugo*.



Intumescences present along the veins of the leaves of sweet potato vine and tomato. Photo: Heidi Lindberg.



Blistering on the stem of a tomato. Photo: Heidi Lindberg.



Albugo on spinach (*Spinacia oleracea*). Photo: Paul Bachi, University of Kentucky Research and Education Center, Bugwood.org



White wart-like growths on the undersurface of Cleome foliage, caused by *Albugo* spp. Photo: Jan Byrne, MSU Diagnostic Services

The structures formed by *Albugo* and other white blister rust pathogens are small, in most cases they cannot be seen with the naked eye. When in doubt consider sending a plant sample to diagnostic lab. In the lab, cross sections of tissue can be viewed under a microscope to look for sporangia and other structures formed by *Albugo* and similar pathogens.

While there may be differences between edema or intumescences technically, the practical management strategies are similar. Both edema and intumescences are physiological disorders and do not ‘spread’ from one plant to another. Management strategies include:

1. reducing humidity in the greenhouse by increasing ventilation and/or operating horizontal air flow fans
2. watering highly-susceptible crops (such as ivy geranium, sweet potato vine, and tomato) carefully by not underwatering to cause plant stress, or overwatering to the point of water-logging the growing media
3. increasing the plant spacing to improve air flow, and
4. grouping crops that have similar watering needs to help avoid watering extremes.

However, if the environmental conditions *do improve* (higher light levels, more air flow, more venting), and the new growth on the plants develops blisters, it could indicate the presence of a pathogen. To try to prevent or minimize oedema/intumescence from occurring in the future, avoid having a wet growing substrate if conditions are expected to rapidly change from warm and sunny conditions to cold and cloudy conditions.

For more information, check out e-GRO Edible Alert 4.05

“[Edema of Greenhouse Tomatoes](#),” Alert 8.16, “[Intumescence on Black-eyed Susan vine](#),” and Alert 6.12 “[Ornamental Sweetpotato Intumescence: A Physiological Disorder](#).”

References: Farr, D.F., & Rossman, A.Y. Fungal Databases, U.S. National Fungus Collections, ARS, USDA. Retrieved May 1, 2019, from <https://nt.ars-grin.gov/fungalDATABASES/>

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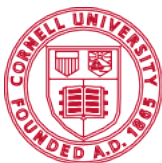
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