



Edema: A Physiological Disorder of Plant Grown Under Protected Conditions

Ganesh V. Chaudhari^{1*} and N. K. Hedau²

¹Scientist (Vegetable Science), ICAR-VPKAS, Almora (Uttarakhand)-263601, India

²Pr. Scientist (Vegetable Science), ICAR-VPKAS, Almora (Uttarakhand)-263601, India

Corresponding author*: Chaudhari.Ganesh@icar.gov.in

ABSTRACT

“Edema/Oedema” is not a pest/pathogen but a physiological disorder that develops when vegetable crops (*viz.*, bell pepper, hot pepper, tomato, eggplant, *etc.*) or other plants are grown under protected structures or potted indoor. Being a physiological disorder it is a non-infectious problem but ‘edema’ due to the symptoms it develops; possibly be mistaken as a pest/pathogen. The bewilderment in ‘edema’ identification thereby creates ambiguity for its management. Under such circumstances, ‘edema’ gets the time-opportunity to cause its characteristic cosmetic damage on the plant leaves and also proliferate further to make a yield penalty to the affected plants. Understanding ‘edema’ and its causes are therefore crucial for its timely-management.

INTRODUCTION

“Edema/Oedema” although common but lesser noted physiological disorder of vegetable crops (*viz.*, bell pepper, hot pepper, tomato, eggplant, *etc.*) and other plants that develop when they are grown under protected structures or potted indoor. The fact that ‘edema’ is not a pathogen/pest but a physiological disorder; makes it a non-infectious problem but its misidentification because of the crystal/blister growth symptoms similar to the gall/scale/pathogen creates confusion. The crystals/blisters develop primarily on the underside of leaves with corresponding yellow spots on the upper-side of leaves. The affected leaves generally turn yellow and fall-off from the plant. The corky spots develop resulting ‘edema’ symptoms mimic damage sometimes like spider mite/thrips, especially in peppers.

The confusion of its identification and thereby vagueness in its management provides ‘edema’ the required-time to make typical damage *viz.*, dropping of significant plant leaf-cover as well as development of badly distorted leaves leading to both cosmetic and yield penalty to the affected vegetable crops under protected structures / to the plants potted indoor. Understanding the ‘edema’; its causes are therefore very important for its timely-management.

Sagi and Rylski (1978) mentioned ‘edema/oedema’ on tomato plants when grown under controlled conditions of 23°C day and 13°C night temperatures, high relative humidity (80%), coupled with saturated irrigation conditions. Although they called it as a disease which also damages greenhouse-cultivated eggplants; pretty clearly they mentioned that edema development gets affected by various environmental factors favouring water accumulation in the leaves (due to excess soil moisture, high relative humidity). The ‘edema’ estimated to cause the cell walls to expand up to 8-10 times their normal size and the similar morphological disturbances were found by them when plants were sprayed with oil emulsions which by closing stomata prevent transpiration.

What explained by Sagi and Rylski (1978) was not just supported by different workers, but it was also identified that ‘edema’ is just a Physiological disorder. To quote a few; Lang and Tibbitts (1983) defined ‘oedema’ like ‘a watery swelling in plant organs or plant parts,’ consequent from water congestion in the plant tissue’ which seems just the half information about ‘edema’ and the remaining half further mentioned by Morrow and Tibbitts (1988) explaining that ‘oedema’ normally forms under conditions where excess water and high relative humidity hinders sufficient transpiration from the plant.

Studies on physiological disorders/ diseases/ pest categorized as well as separated enations, intumescences, tumors, galls, neoplasms, *etc.* from the ‘edema’ which is an ‘an abiotic damage’.

Identification: Typical Symptoms and Associated Causes

The causes of ‘edema’ under the protected conditions/ indoor potted plants are surplus soil moisture combined with warm soil, cool air temperature, cloudy weather, high humidity and poor air circulation; the plant roots absorb more water than it can be used by the plant and/or the plant can transpire under such an environment. The excess water accumulation in the plant, therefore, creates pressure and results in rupturing the cells, particularly of the lower-surface of younger leaves but also on the older leaves which leads to the development of whitish crystal-like growth on the lower-leaf side (Anonymous, 2020). Initially, near leaf-veins the crystals/blisters develop on the entire leaf on later stages. Although comparatively less; the whitish crystal-like growth also can be observed on the upper-leaf surface (Fig. 1.).

A single, crystal/blister usually about ‘mm’ diameter, frequently merge together to form a large affected area. The whitish crystals later become tan or brown-coloured, with a corky texture mostly seen on the leaf veins (Fig. 2. b & c). Severely affected older leaves of plants turn yellow and drop prematurely and the younger affected leaves become cup-shaped/deformed (Fig. 2. a & b) turn yellow and drop (McAvoy, 2020). At first, symptoms appear on the leaves but, flowers, fruit and stem of the plant can get affected on the extreme injury.

The slightly affected plant often recovers from ‘edema’ producing ‘edema-free’ new growth if the problem spotted timely and accordingly the environmental conditions inside the protected structure/around potted plants restored. However, the leaves of bell pepper in particular if affected will never recover; but, restoring the conditions suitably will bring-out new healthy leafy growth in bell-pepper.

Supplementation of calcium (Ca) in the root medium along with a suitable environment for ‘Ca’ uptake has also been suggested to strengthen the plant cell walls and thereby to stop the edema occurrence (Micheal, 1996); however, no research literature found this strategy as effective (Rud, 2009).

Avoiding Edema Occurance: (Madeiras, 2020)

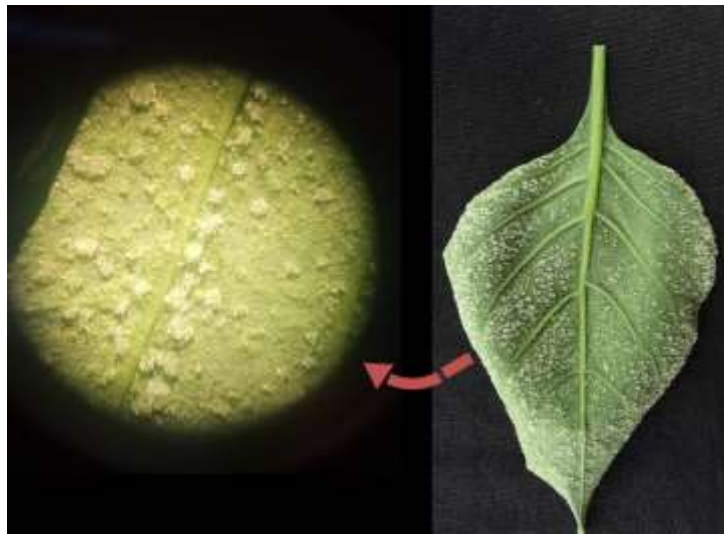
- Using a well-drained growing media inside protected structure/ for indoor pots
- Avoiding over-irrigation inside protected structures or over-watering to potted plants.
- Avoid irrigating/watering during cool, cloudy-humid weather conditions.
- Irrigate when the air-temperatures are rising or humidity is low.
- Adopt proper ‘plant-to-plant’ and ‘row-to-row’ spacing inside the protected structure
- Reduce humidity by proper ventilation/ air-circulation
- Varietal selection: Some varieties may be inherently more susceptible to edema and therefore select varieties suitable for protected structure is important



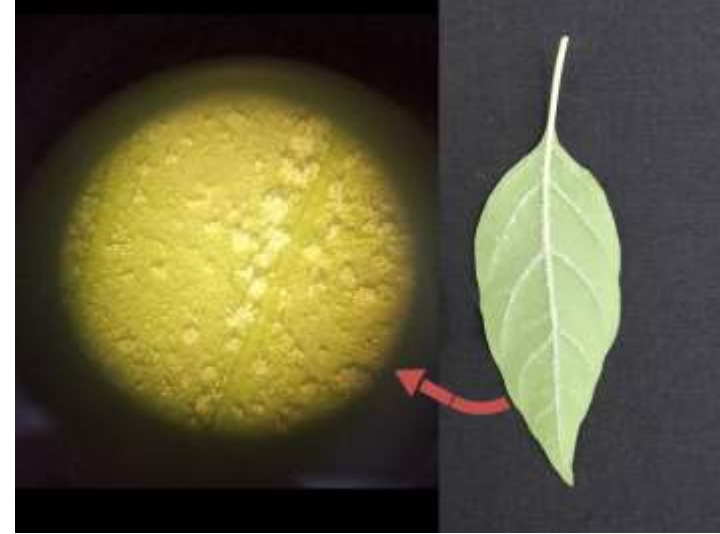
a. Edema / Oedema on Bell pepper leaves



b. Edema / Oedema on Hot pepper leaves



c. Close-up : characteristic whitish crystal-growth on dorsal-side of Bell pepper leaf



d. Close-up : characteristic whitish crystal-growth on dorsal-side of Hot pepper leaf

Fig: 1 Edema / Oedema on Peppers



a. Yellow spots and deformation of leaf with whitish crystal-like growth

b. Yellow spots and deformation of leaf with corky growth on leaf veins upon edema incidence

c. Tan/brown patches on lower-side of leaf alongwith whitish crystal-like growth

Fig: 2 Edema / Oedema symptoms on bell pepper leaves

Managing Edema Occurance: (Anonymous, 2020; Waterworth, 2020)

Edema stops when the environmental conditions inside the protected structure/around potted plants restored suitably but the spots already developed remain on the leaves giving a cosmetic penalty.

- If you spot 'edema' under the protected structures or potted indoor plants, first control the irrigation frequency and quantity; however, avoid plants to dry-out completely and irrigate in such situations when the sun is up.
- Make sure a well-drained condition at root-medium which can also mean shifting potted plant to a larger pot.
- High relative humidity helps 'edema' occurrence; therefore, restoring good air-circulation around plants inside protected structures/ around potted plants will help to reduce the humidity level. A proper crop-geometry inside polyhouse and spaced-placing of indoor pots will not only provide a good air-circulation but it will also allow better light interception.
- Make sure the temperature maintained inside protected structure is according to the crop need and not too low; in case, increase the temperature to a suitable level needs to be achieved.

CONCLUSION

"Edema/Oedema" is a physiological disorder of vegetable crops (*viz.*, bell pepper, hot pepper, tomato, eggplant, *etc.*) or plants that are grown under protected structures or potted indoor. The symptom 'edema' develop creates bafflement when it comes to its identification and thereby gaps in its essential management which barely prevents the cosmetic penalty and further the loss on the part of yield. The 'edema' can be tackled by following strategies like 'avoiding' its occurrence and 'managing' it timely through its 'early-identification' if at all it develops. Notably, the varietal difference for 'edema-sensitivity' provides a line for further study.

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