Bacterial spot on pepper and tomato
Xanthomonas campestris pv. vesicatoria

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Xanthomonas campestris pv. campestris (Xcv) is a seedborne bacterium causing bacterial spot in pepper and tomato. The pathogen has been frequently found in Indonesia, although a clear relation with seed borne infections was never established. Xcv has been redistributed recently in three species, viz. *Xanthomonas axonopodis* pv. *vesicatoria*, *Xanthomonas vesicatoria* and *Xanthomonas gardnerii*. Most strains within a species are strictly host specific, although some strains can infect both tomato and pepper. It is unknown which species are present in Indonesia. In this leaflet the old name (Xcv) will be used.

Symptoms and damage

Symptoms can appear on leaves, fruits, stems and petioles.

On leaves

- Initially small, yellow-green circular lesions with yellowish halo which appear as a water-soaked border under wet conditions (Fig. 1). They are most visible on the underside of the leaflets. Infected plants in seed beds usually have lesions along the edges of first leaves
- Spots become brown and sunken (Fig. 2). The center of the lesions dries and breaks resulting in leave holes (shot hole appearance). As disease progress, spots may coalesce, giving a blight appearance. Edges and tips may die and appear ragged.
- Severe infections may result in defoliation and sunscald, in particular for pepper (Fig. 3)
- Cotyledons are very susceptible, lesions are initially small, sunken and silvery. They later become darker in color.

On fruits

- Initially a black stippling appears causing superficial lesions with a diameter of ca. 1 mm.
- Spots can develop further further, giving lesions with a diameter of ca. 3 mm. They are raised, scabby areas giving fruits a warty appearance (Fig. 4, 5)
- Fungi and pectolytic bacteria may enter these spots causing fruit rot.

Disease expression is favored by humid (> 80% RH) and warm conditions (20-35 ^{o}C), in particular when nights are warm (24-28 ^{o}C) and when

temperatures fluctuate. The pathogen is very infectious. It rapidly spreads throughout a field during rainy weather. Spread in plant beds and green houses and during planting operations is especially serious. Plant growth, fruit yield and quality can be reduced. Spotting of stems and pods will result in unmarketable fruit. In the USA, fruit losses to peppers have approached 100%, and to tomato 50%.

Survival and dissemination

- Xcv can survive in crop residues in or on soil (ca. 6 months), but not free in soil.
- Xcv survives for long periods in seed (≥ 16 year).
  (Seed is the major sorurce of long distance dessimination)
- Xcv has been found on solanaceous weeds
- Xcv can be disseminated by rain or during overhead irrigation
- Cotyledon leaves commonly become contaminated as they emerge from an infested seedcoat.
- Xcv penetrates leaves via stomata or wounds, fruits via wounds caused by insects or mechanical injury.
- Within and between fields Xcv is disseminated by water splashes, aerosols, cultivation practices causing mechanical damage

Prevention and cure

Cultural practices

- Produce seed in arid or semi-arid areas or in the dry season
- Use certified pathogen-free seed and disease-free transplants
- If not available, disinfect seed with sodium hypochlorite (30 min, 1%) or acetic acid (24 h, 0.8%, 21 ^{o}C) or hydrochloride (5-10 h, 5%) (ca 1 liter per 100 gram). Prepare a fresh solution for each batch of seed).Seeds may also be disinfected with hot water (30 min, 51 ^{o}C). Wash seed with water, immediately upon treatment and dry thoroughly. These treatments may affect germination
- Avoid the use of overhead irrigation; drip irrigation is preferred. If used, allow crops to dry quickly
- Avoid working around plants when the foliage is wet
- Destroy solanaceous weeds, or other plants that can serve as a host (Xcv can survive on solanaceous weeds)
- Strive to maintain a balanced fertility. A high fertility results in excessive foliage, low fruit set and an increase in disease severity.
- Carry out adequate sanition in greenhouses used for transplant production. Clean equipment and tools with a disinfectant, wash hands, remove seeds and plant debris. After crop production, disinfect walls, benches etc.
- Destroy or removed diseased tomato plants and crop debris. Compost debris well (deep plowing) and don’t use it on tomato.
- Practice crop rotation (tomato or pepper only every 3-4 years)

- Use tolerant cultivars (none of the cultivars is resistant to all races/species)

Chemical control

- A fixed-copper fungicide (e.g. Kocide 2000 and Mankocide (Griffin Corp.)may be used, although this will only slow down the disease en can easily result in copper resistance.
- Control of bacterial spot was also found with Actigard (CGA-245704) Ciba Crop Protection), a compound inducing resistance in plants.

Comment [JvdW1]: allowed in Indonesia?

Pictures

Fig. 1. Initial spots on lower leaves with a water soaked border around spots

Fig. 2. Mature leaf spots on pepper

Fig. 3. Defoliation resulting in sunscald of sweet pepper

Fig. 4. Angular spots on tomato fruits

Fig. 5. Angular spots on sweet pepper fruits

Source pictures:
http://www.apsnet.org/education;
http://www.ces.ncsu.edu
http://www.extension.iastate.edu