Major seed-borne diseases in Indonesia

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Lay-out

- Conclusions from the survey
- Management of major seed-borne pathogens

Major fungal diseases on hot pepper

Field Pathogen	%	Seed Pathogen
Alternaria	4 – 10	
Colletotrichum	0 – 4	*Colletotrichum*
		Fusarium oxysporum
		Aspergillus
Cercospora	13 – 22	
Culvularia	30	
Choanephora	10-20	
Rhizoctonia	22	

Major bacterial diseases on pepper

Field		Seed	
Pathogen	%	Pathogen	%
Xanthomonas	?	Xanthomonas	17
Ralstonia	3		

Major viral diseases on pepper

Field		Seed	
Pathogen	%	Pathogen	%
Mosaic viruses	3 – 35	ToMV	4
		CMV	18 – 71
Curly Yellow Gemini	2		
Kerupuk (CPSV)	8		

Major fungal diseases on tomato

Field		Seed	
Pathogen	%	Pathogen	%
Alternaria	25 – 50	*Alternaria*	?
Fusarium	0 – 22	*Fusarium*	?
Sclerotium	0- 2	*Colletotrichum*	?
Phytophthora	1 – 38	*Aspergillus*	?
Cladosporium	0 – 16		

Major bacterial diseases on tomato

Field		Seed	
Pathogen	%	Pathogen	%
Xanthomonas	?	Xanthomonas	33
Clavibacter	?		
Ralstonia	2		

Major viral diseases on tomato

Field		Seed	
Pathogen	%	Pathogen	%
Mosaic viruses	3.5 – 56	TMV	5 – 90
		ToMV	8 – 65
		CMV	1 – 20
Curly Yellow Gemini	2 – 54		

Conclusions tomato and pepper

- Fungi: no relation between seed infections and symptoms found in field
- Bacteria: possible relation between seed infections and field symptoms for *Xanthomonas vesicatoria*
- Viruses: clear relation between seed infections and field symptoms for mosaic viruses

Major fungal and bacterial diseases on shallot

Field		Bulbs	
Pathogen	%	Pathogen	%
Alternaria	6 – 13	*Alternaria*	1
Fusarium oxysporum	1 – 5	*Fusarium oxysporum*	1
Aspergillus	0 – 1	*Aspergillus*	0 – 1
Fusarium nivale	0 – 2		
Stemphylium	0 – 22		
Sclerotium	2		
		Erwinia	2

Major viral diseases on shallot

Field		Bulbs	
Pathogen	%	Pathogen	%
Mosaic symptoms	15 – 56	OYDV	8 – 10
Curly symptoms	0 – 5	SYSV	12 – 15
		Mixtures	24 – 50

Conclusion shallot

- Moderate relation between bulb infections and field symptoms for fungal and viral pathogens

Management of major seed-borne bacteria and fungi

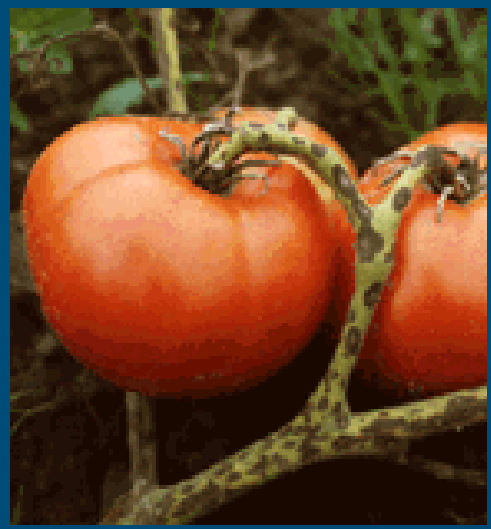
- Tomato
  - *Alternaria solani* - early blight
  - *Xanthomonas axonopodis* pv. *vesicatoria* - bacterial spot
  - Tomato Mosaic Virus
  - Tobacco Mosaic Virus
  - Cucumber mosaic *cucumovirus*
- Pepper pathogens
  - *Colletotrichum capsici* - pepper (anthracnose)
  - *Xanthomonas axonopodis* pv. *vesicatoria* - bacterial spot
  - Tomato Mosaic Virus
  - Tobacco Mosaic Virus
  - Cucumber mosaic *cucumovirus*

Host-pathogen combinations

- Shallot
  - *Alternaria porri* - neck rot
  - (Erwinia – soft rot)
  - Onion yellow dwarf *Potyvirus*
  - Shallot Yellow Stripe Virus

Alternaria solani – tomato (early blight)

Symptoms


Leaves: brown circular or irregular spots with concentric circles and a chlorotic halo

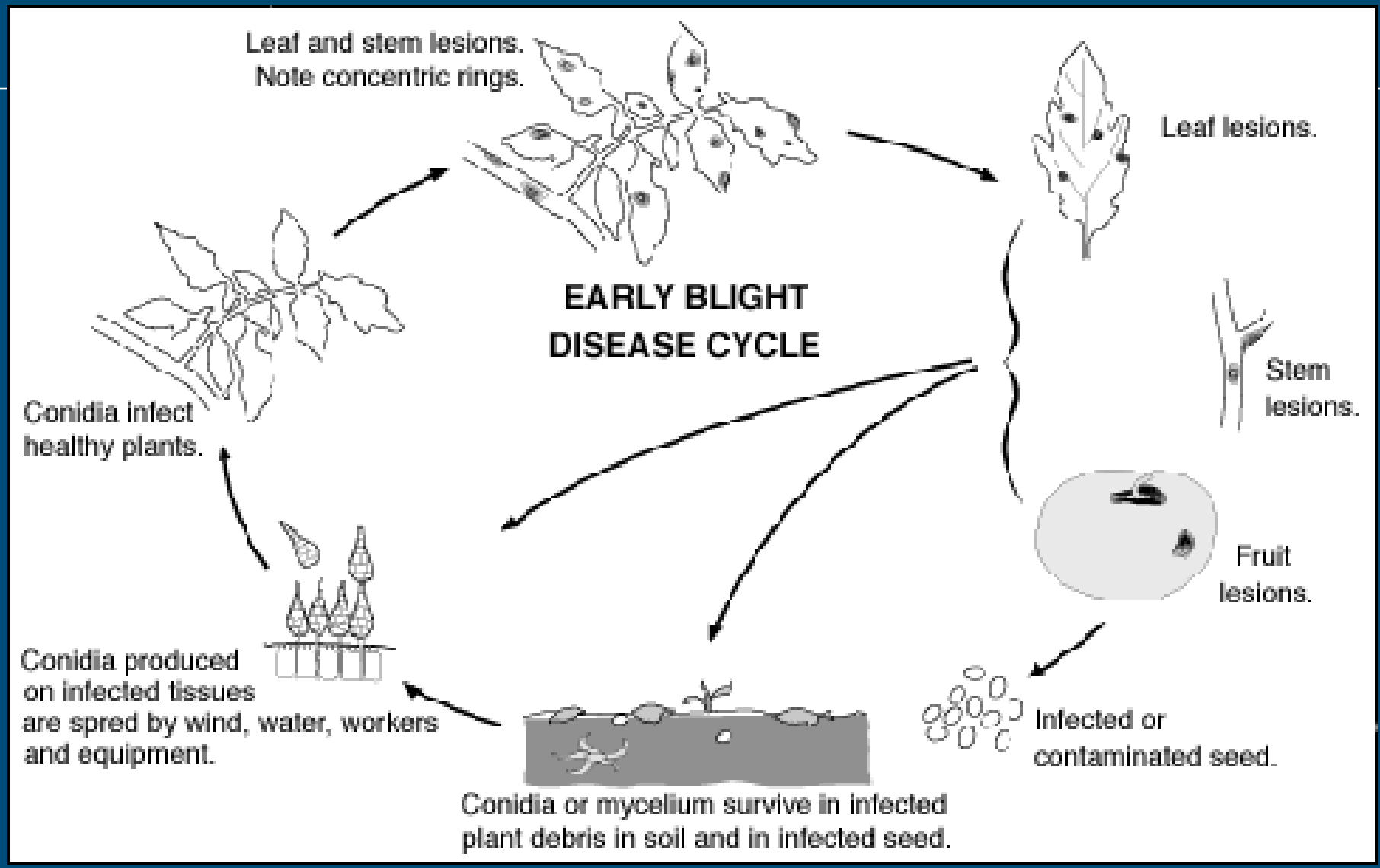
Progressing disease:

Stems: dark brown circular spots

Fruits:dark brown round depressions with concentric rings

Epidemiological features

- hosts: solanaceous plants
- survival: soil, infested crops, weed residues
- transmission: wind, insects, workers, farm equipment
- Site of infection: conidia on leaves, stems and fruits during warm wet periods
- Inducive conditions: heavy fruit load, nematode attack, low nitrogen fertility, mild to high temperature (24 – 29 ^{o}C), rainfall, alternating dry and wet periods
- Damage: yield loss (early leaf fall)


Leaf and stem lesions.
Note concentric rings.
Leaf lesions.
EARLY BLIGHT
DISEASE CYCLE
Stem
lesions.
Conidia infect
healthy plants.
Fruit
lesions.
Conidia produced
on infected tissues
are spred by wind, water, workers
and equipment.
Infected or
contaminated seed.
Conidia or mycelium survive in infected
plant debris in soil and in infected seed.

Cropping measures

- Use of certified seed
- Plant resistant varieties
- Planting in dry season
- Crop rotation (3 yrs)
- Removal of debris of former solanaceous crops
- Use of wind breaks (trees, hedges, fodder grasses)
- Do not use overhead irrigation
- Increase of organic matter (nitrogen fixing legumes)
  - increase nitrogen content, reduce nematodes

Control with fungicides

- Upon detection of symptoms: apply protectant fungicides:
  - carbamates
  - clorotalonil
  - cuprics
    (7 days intervals at cool and damp weather,
    10 days intervals at dry conditions)

Anthracnose on pepper caused by *Colletotrichum sp.*

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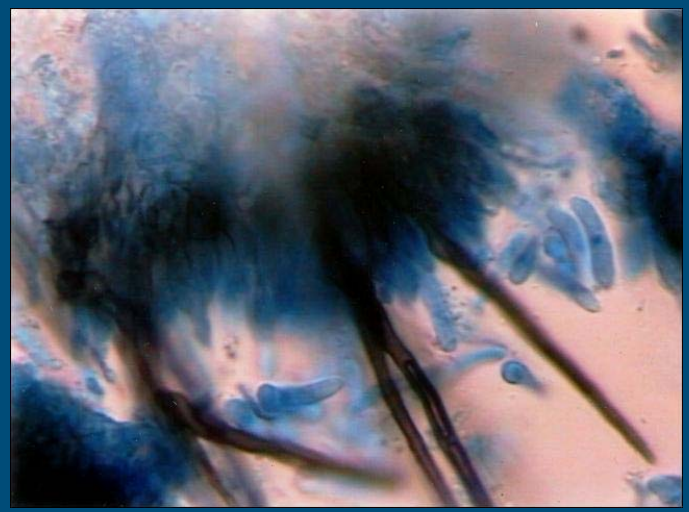
Pathogen

- *Colletotrichum capsici, C. gloeosporioides* and *C. coccodes*
- Ascomycete producing perithecia (sexual) and acervuli (asexual)
- spore morphology:

Pathogen



Spores and black spines in salmon colored acervuli on pepper

Spores under a light microscope

http://www.affrc.go.jp; http://edis.ifas.ufl.edu

Symptoms

- On all parts in any stage
  (fruit infections economically most relevant)
- Initially:
  - water soaked, slightly sunken lesions, soft and tan
- Later:
  - lesions brown - black
  - concentric rings of salmon colored fungal fruiting bodies (acervuli) releasing wet gelatious spores with numerous black spines

Symptoms

Sweet pepper infected with *Colletotrichum*

Mature pepper fruit with multiple lesions

Salmon colored spore masses in concentric rings

http://edis.ifas.ufl.edu

Epidemiological features

- Survival: in seeds, plant debris and alternative hosts (solanaceous weeds)
- Dissemination: via rain splashes
- Factors favouring disease development: optimal temperature 27 °C and rainy weather conditions

Control

- Use certified, pathogen-free seed
- Eliminate weeds and plant debris
- Drainage of soil
- Crop rotation (> 2 years)
- Resistant varieties (only present in chili pepper)
- Avoid wounding (e.g. by insects)

Bacterial spot on pepper and tomato

Pathogen

- *Xanthomonas campestris* pv. *vesicatoria* (old name)
  - *X. axonopodis* pv. *vesicatoria* (Group A and C)
  - *X. vesicatoria* (Group B)
  - *X. gardneri* (Group D)

  Group A and B most widely distributed
  Group A – D: tomato strains
  Group A: predominantly pepper strains
  Group C: no pepper strains
  (some strains can infect both hosts)

Symptoms on leaves

- Numerous angular spots
  - first water soaked (old leaves) or yellow green (young leaves)
  - later brownish red necrotic spots (0.25 – 0.5 cm)
- Deformed leaves
- Margins rimmed with necrotic tissue

http://www.apsnet.org/education; http://www.ces.ncsu.edu

Symptoms on leaves

Defoliation….

…resulting in sunscald

http://www.apsnet.org/education/

Symptoms on fruits

- Numerous angular spots
  - first small, blister like irregular
  - later brown with warty appearance (0.5 cm)
  - Even symptoms on peduncle

http://www.apsnet.org/education; http://www.ces.ncsu.edu

Survival and spread

- Survival:
  - in plant debris (ca. 1 year)
  - in seed (many years)
  - as epiphytes on non-host plants (solanaceaous plants!)
- Spread:
  - by water movement during rainy weather (splashing rain drops), overhead irrigation, touching and handling wet plants
  - bacteria enter through stomato and hydathodes (leaf wet period very important)

Control

- Pathogen free seed
- Avoid overhead irrigation

- Plantlets in sterilized potting medium
- Crop rotation (2 – 3 years period)
- Seed treatment (e.g. sodium hypochlorite, acetic acid)
- Spraying with copper or streptomycin (marginal effects + resistance)

Alternaria porri - shallot

Symptoms

- Initally whitish sunken lesions
- Later oval brown lesions surrounded by a yellow halo
- Lesions can coalesce and girdle leaves and stems

Epidemiological features

- Conidia are spread by air, rain splashes and tools
- Germination can occur when tissue is covered by a water film for > 2 h
- A new generation of conidia can be produced every 5 days in warm, moist weather
- Optimum growth temperature 26 ^{o}C
- Fungus maintains in infected plant debris in soil for longer than 1 year

Control

- Use certified pathogen-free bulbs or seed and disease-free plantlets of a resistant cultivar
- Grow in well-drained soil
- Drip irrigation is preferred above overhead
- Lower density of transplanted crops
- Treat seed with hot water or fungicide
- Eradicate weeds (in particular Allium species)
- Control insects
- Balance fertility (low nitrogen, high potassium/calcium)
- Eliminate cull piles
- Practice crop rotation (once every 4 years)
- Chemicals: dithiocarbamates, mancozeb, iprodione etc.