

CGMMV/BFB Training Session

Colusa Industrial Park
April 22, 2014

2013 Yolo County Fields Affected with CGMMV (CDFA)



CGMMV Intro

- Common name = "white break mosaic"
- Other names: Cucumber virus, tobacco mosaic watermelon strain, bottle gourd Indian mosaic virus
- Same Genus "Tobamovirus" = TMV, ToMV, PMMoV (solanum viruses First occurrence (official) in the US in 2013
- Long known in Europe, Asia, Middle East and Canada
- Very stable with long viability
- Damage can be extensive with significant loss

CGMMV Intro

- Several strains of exist.
- Distribution appears worldwide although thought to originate in Asia (i.e. India, Japan, Korea).
- Other Cucurbit Tobamoviruses: ZGMMV - Korea; KGMMV – Korea
Limited distribution
- Seed transmission has been reported more frequently in cucumber



CGMMV: Causes and Sources

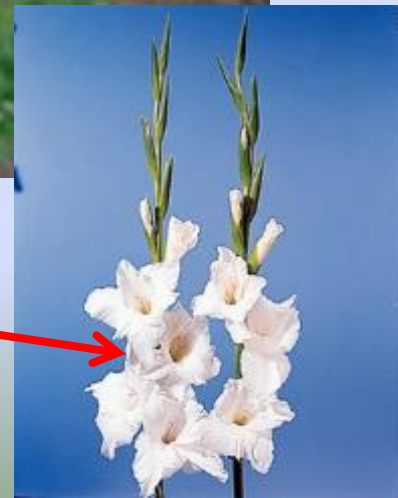
- Spreads in water
- Easily mechanically (handling, grafting, etc.) transmitted and by plant debris in soil
- Infection through roots or root to root contact
- Survives on surfaces for long periods
- Rootstocks or weeds can be hosts
- Pollen? Insects (chewing)?

CGMMV Host Range (Monsanto Vegetable Seeds)

- cucumber
- gherkin
- melon
- watermelon
- bottle gourd
- squash (zucchini)
- bitter gourd
- Non cucurbits- sword lilly, gladiolus

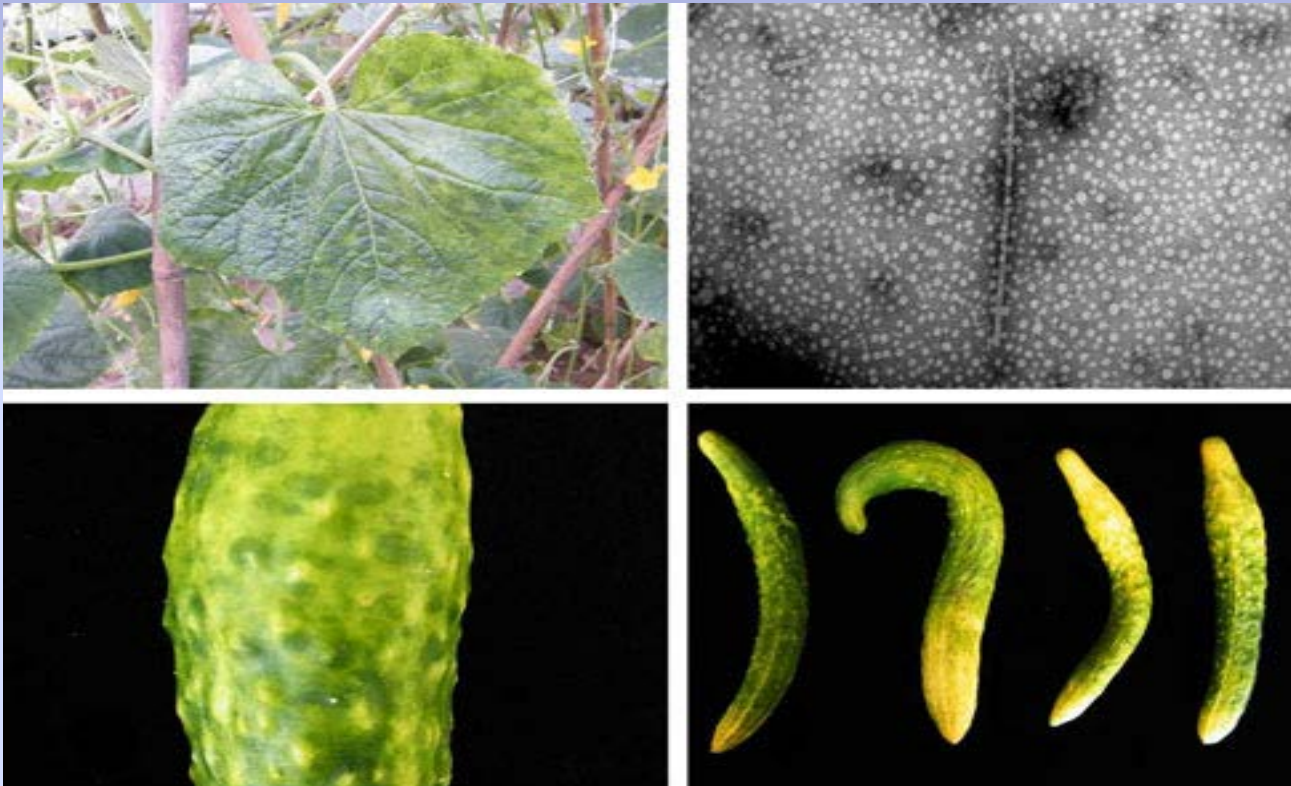


Bitter gourd



CGMMV on Cucumber (CDFA)

- Note rod-shaped virus



CGMMV on Seedlings (Monsanto Vegetable Seeds)



Foliar Symptoms Caused by CGMMV

Melon (Yolo Co. 2013, CDFA)



Cucumber (Yolo Co. 2013, CDFA)



Symptoms of CGMMV on Watermelon

Foliage (Monsanto Vegetable Seeds)



Fruit (Yolo Co. 2013, CDFA)



Symptoms of CGMMV on Cucumber and Melon

(K. S. Ling, CDFA)



How to Diagnose CGMMV (AgDia)

- Laboratory or Field Detection Tests
- Plant Symptoms
 1. Seedlings
 2. Leaf
 3. Fruit



CGMMV: Factors Influencing Symptom Expression

- Temperature and light
- Strain of the virus
- Host (species, variety, resistance)
- Crop stage of infection
- Tissue type
- Growth stage (seedling-adult)

CGMMV: Control

- Seed Health
- Transplant Production
- Commercial Production Growers: Open Field
- Commercial Production Growers: Protected Culture
- Seed Increase Growers

Tobamovirus Seed Assay (HM.CLAUSE)



Tobamovirus Seed Assay (HM.CLAUSE)



Thermotherapy for CGMMV

- Melon/cucumber: 72C – 73C for 72 hrs. No humidity control
- Seedless watermelon:
 - 1 day @ 35C
 - 1 day @ 50C
 - 3 days @ 72-73C No humidity control
- Need to have temperature and seed volume controlled
- Need bioassay after treatment to detect live virus

CGMMV: Questions

- What to do if CGMMV is suspected? Submit a sample to a diagnostic lab, Crop advisor or Extension Agent
- What makes CGMMV such a problematic disease for greenhouse cucurbit produce production?
- What is the most susceptible cucurbit to CGMMV?
- Is the incorporation of plant resistance a solution to control CGMMV? *C. ficifolia* rootstocks and some cucumber varieties have resistance. Reduces virus multiplication rate
- Does a seed sanitation method exist to control CGMMV?



Bacterial Fruit Blotch of Cucurbits

(melon, squash and watermelon)

Acidovorax citrulli (Ac)



Epidemiology Bacterial Fruit Blotch (Aac)

- **BFB favored by the following conditions:**
 - warm to hot temperatures (>F/30C)
 - humidity needs to be at least 55%
 - heavy dew formation or rainfall
- Dry cool weather is unfavorable for BFB development but infection can still occur producing no visible symptoms or atypical necrotic spots on fruits.
 - These necrotic spots are difficult to distinguish from other damage??.

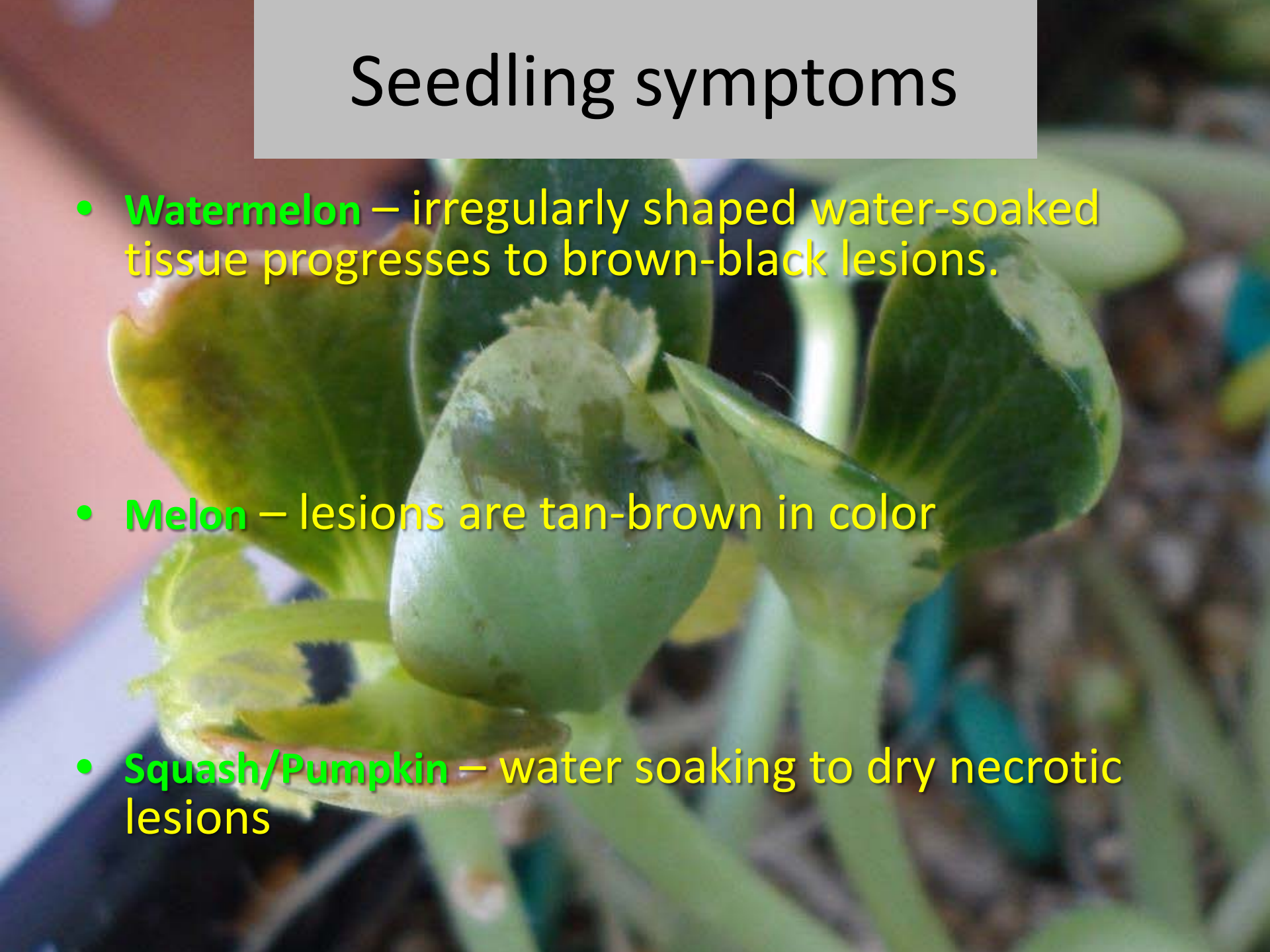
Fruit most susceptible when young--before development of waxy layer in watermelon or corky netting in melons.
- Aac has been found externally on seed surface, and internally on the papery layer (perisperm-endosperm layer PE)
- Aac is not thought to survive well in soil or on exposed surfaces for long periods of time especially in unfavorable harsh environments

Epidemiology Bacterial Fruit Blotch (Aac)

- Primary - **SEED-Borne inoculum**, volunteers, wild cucurbits can introduce disease and crop debris from previous crops.
- Secondary spread –
 - transplant house or field,
 - associated with humid conditions with free moisture (aerosols),
 - rain and irrigation splash can move bacteria around or
 - carried on machinery boots or animals which move through the crop.
 - Via manures

Seedling symptoms

- **Watermelon** – irregularly shaped water-soaked tissue progresses to brown-black lesions.
- **Melon** – lesions are tan-brown in color
- **Squash/Pumpkin** – water soaking to dry necrotic lesions



Foliage Symptoms

- **Watermelon** – discrete brown lesions may develop along veins. Additional symptoms include chlorosis pin-point lesions, veinal or interveinal necrosis and damping off.
In field lesions develop along leaf veins and eventually dry and may turn reddish brown-black.
- **Melon** – tan-brown necrosis along veins. Necrosis tends to form more readily in melon than watermelon.
- **Squash-Pumpkin** - similar to melon where one may observe extensive necrosis as well as elongated tan lesions along the leaf veins.

Symptoms on Mature Foliage

- Mature foliage – reddish brown lesions develop along leaf veins (often times confused with GSB, Anthracnose)
- V-shaped lesion from the margin to the base of the leaf





BFB in Yolo Co. Melon Field

(CDFA)



Note severity of symptoms

Fruit Symptoms

- **Watermelon-**
 - Dark, gray-green water-soaked lesions or blotches on rind surface.
 - fruit may also rupture or crack.
- **Melon** – varies with fruit type
 - Range from pinpoint spots to small raised sunken circular areas.
 - Net formation may be disrupted.
 - Water-soaking may occur around sunken lesions.
 - Fruit lesions rarely expand.
 - Internal lesions expand internally in a conical fashion.
- **Squash/Pumpkin** - Similar to symptoms on melon
 - water-soaked areas.
 - cracks in the rind.
 - internal rotting of fruit.

BFB Host Range



Watermelon
Melon
Pumpkin (*C. maxima*)
Squash
Cucumber
Honey dew
Wild bur Gherkin
Bitter and Bottle Gourd
Gramma
Weeds?
Rootstocks
Betel Vines (Taiwan)
Citron



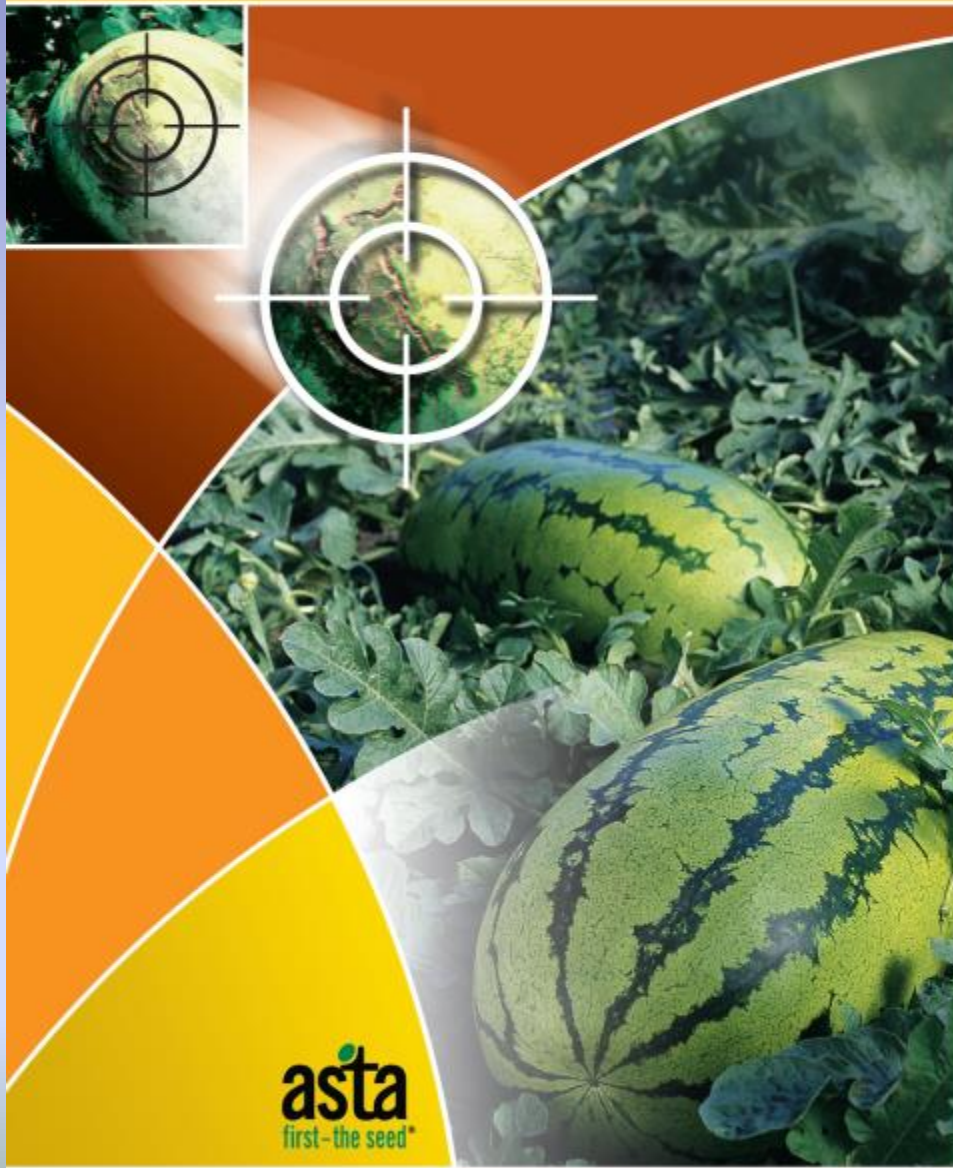
Diagnostics Scenario

- Sample submission (photos are extremely beneficial)
- Field test kits available
- Traditional media isolations
- PCR available (can type strains as needed)
- Pathogenicity (complete Koch's postulates)
- Results returned to Customer

Control / Management

- Clean Seed – growers should request a certificate that seed has been tested.
- Produce seeds in cool, dry climates.
- Incorporate crop residue to promote breakdown.
- Use a regular field (greenhouse) inspection program
- Rotation – 3-5 years for cucurbit rotation; 5-7 yrs if field was infected previously.
- Application of copper based products as a preventative.
- Rogue volunteers and monitor fields surrounding fields.
- Carry out disease risk assessments on new production areas.

Bacterial Fruit Blotch



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A COMMERCIAL GROWERS GUIDE

Concerns Regarding BFB in CA

- Symptoms express differently in different environments. In dry growing conditions it may cause only minimal leaf or fruit symptoms
- Equipment is moved from cucurbit field to field, possibly with minimal cleaning in between
- Easily spreads especially within a field and possibly to adjacent fields if overhead irrigation is used
- Moves via contaminated pollen, possibly resulting in internal fruit infection
- Very low levels of BFB can be hard to detect in a standard seed assay

Concerns Regarding BFB in CA

- Survives in intact debris from infested fields, and remains viable until the debris decomposes
- A 3-5 year rotation is recommended
- Survives and propagates via volunteer plants from a previous infected field, or on related cucurbit weeds such as gourds
- Can survive as an epiphyte on other species, possibly including tomato or other solanaceous and cucurbit hosts
- Effective seed treatments that eradicate the pathogen while not affecting seed germination are not currently known

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