Present practice, on-going research and future potential for non-chemical disease management in vegetable production in China

Yanbin Guo

Dr. Associate Professor

Department of Ecology and Ecological Engineering

China Agricultural University

E-mail: guoyb@cau.edu.cn;

yanbinguo@gmail.com

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Outline

- **Present Practice for non-chemical disease management in vegetable production in China**
- **On-going research for non-chemical disease management in vegetable production in China**
- **Future Potential work for non-chemical disease management in vegetable production in China**

Present Practice for Organic Vegetable production without fungicide

- 49.0% vegetable production in the world produced by China (FAO 2010)
- 36.8% vegetable produced in greenhouse at 2008 in China (Zhang 2008).
- 80% greenhouse in the world is in China which produce vegetable. (Yu 2011)
- A Chinese people consume more than 200 kg vegetable produced in greenhouse per year (Yu 2011).
- About 10-30% losses of vegetable caused by disease.

Present Practice for Organic Vegetable production without fungicide

❖ Rotation and intercrop

- ■ Kidney bean - celery - cucumber rotation
- ■ Tomato-celery- cucumber rotation, Cucumber-wheat rotation
- ◆ Pepper- cabbage intercrop, Chinese data - vegetable intercrop
- ◆ Green Chinese onion – tomato/cucumber intercrop

Rotation/intercrop significantly decrease powdery mildew, downy mildew and leaf blight of cucumber(Sun 2005, Yu 2008).

Present Practice for Organic Vegetable production without fungicide

❖ Graft

Cucumber was grafted onto figleaf gourd

Pepper, tomato and eggplant was grafted onto original species

Prevent root disease

Induce system resistance to pathogen

Present Practice for Organic Vegetable production without fungicide

❖ Change soil of greenhouse

Tillage layer soil was changed with soil without planting vegetable more than 5 years.

❖ Abiotic environmental factor

Temp: 40℃ for 2 hr or 45℃ for 1 hr;

Leaf pH: pH = 4.2-6.2 or pH = 7.5-10.4

Induce cucumber resistance to downy mildew and gray mildew and inhibit pathogen growth (Li 2005).

❖ Monitoring

Temperature, moisture, symptom of disease.

Remove the diseased leaves and plant from greenhouse

Present Practice for Organic Vegetable production without fungicide

- Resistant varieties
- Biocontrol
- Botanical fungicides
- Biological hedgerow

On-going research for Organic Vegetable production without fungicide

Intercrop

Intercrop system in Organic grape production in Xinjiang Province in past 5 years

Grape - Alfalfa

Grape - white clover

Grape - lavender

Grape-lavender system will be more efficient to control disease and insect of grape

On-going research for Organic Vegetable production without fungicide

Intercrop

Cucuber - perilla

Perilla:*Perilla frutescens,* a herb and spice in Asia

From Luo SM. 2011

On-going research for Organic Vegetable production without fungicide

Spice

Mint (*Mentha* spp.)

Basil (*Ocimum basilicum)*

Chinese Medicine

Aizoon Stonecrop
(*Sedum aizoon* L.)

Zibeitiankui
(*Begonia fimbristipulata* Hance)

On-going research for Organic Vegetable production without fungicide

Plant volatile oils

Plant volatile oils from Apiaceae, Lamiaceae, Lauraceae, Myrtaceae, and Poaceae showed efficient antimicrobial activity (Katherine and Christine, 2011).

Components: terpene, aldehydes, phenols, alcohols, ketones, esters, et al

Sichuan pepper

Sichuan pepper seeds

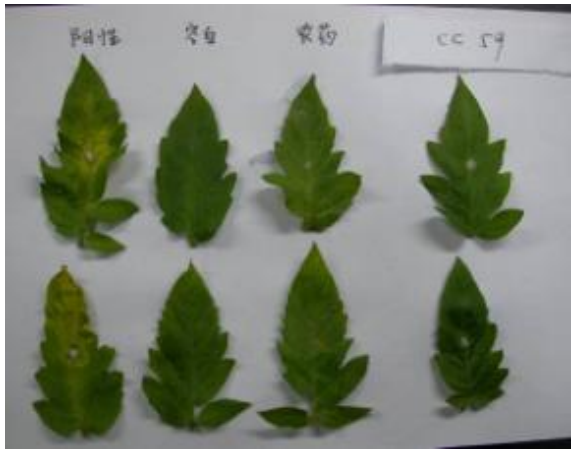
Applied Sichuan pepper seeds to control strawberry verticillium wilt in Boshan

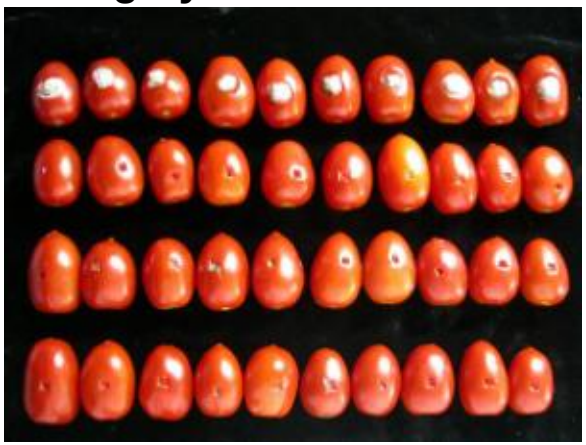
On-going research for Organic Vegetable production without fungicide

Biocontrol

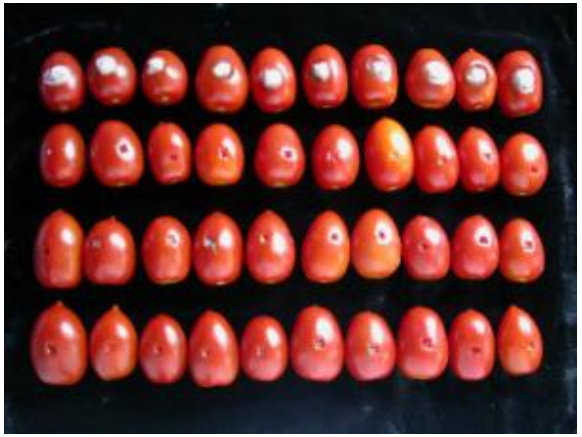
B. Cinerea **Inhibition to tomato grey mildew**

CC 59 ***Streptomyces* sp.**





MO28 ***Streptomyces erythrochromogenes***



Biocontrol effect of CC59 and MO28 were 78.3%- 96.6%

On-going research for Organic Vegetable production without fungicide

PGPR

PGPR agents: antimicrobials, and auxin phytohormone(IAA), phosphate solubilization

Greenhouse assays: Biocontrol to plant disease and the promoting to plant growth

Mechanisms: Role of antimicrobials and auxin in biocontrol and promoting to plant growth

CK **T**

CK **T**

***Rahnella aquqtilis* HX2:** antibacteria, IAA, MPS

***Arthrobacter globiformis* CK19:** IAA

***Pseudomonas* spp.:** Pa40, P94, antimicrobe, IAA

On-going research for Organic Vegetable production without fungicide

Botanical fungicide

Name	Come from	Target diseases/Function
Berberine	Coptis chinensis	Disease caused by bacteria
Osthol	Fructus cnidii	downy mildew，gray mold, powdery mildew, et al.
Vegard	Rheum	Powdery mildew, downy mildew，gray mold, et al.
Baicalin	Radix scutellariae	Powdery mildew, downy mildew，gray mold, et al.
Chitosan	Chitin	Induce plant resistance

Future Potential work for Organic Vegetable production without fungicide

Major disease of tomato in greenhouse

- **Leaves**

  Powdery mildew (*Podosphaera aphanis*)

  Gray mildew (*Botrytis cinerea***)**

  Downy Mildew (*Peronospora parasitica*)

  Anthracnose (*Colletotrichum acutatum***)**

  Viral Disease (TMV/CMV)

- **Root**

  Verticillium wilt (*Fusarium oxysporum*)

  Red stele (*Phytophthora fragariae*)

  Bacterial wilt (*Ralstonia solanacearum*)

Future Potential work for Organic Vegetable production without fungicide

❖ Object

Established a IPM protocol on organic vegetable production without fungicides.

❖ Experimental design

- **Intercrop**
- **Plant volatile oils**
- **Biocontrol**

Future Potential work for Organic Vegetable production without fungicide

❖ Intercrop

Treatments:

T1: Tomato - Perilla

T2: Tomato - Mint

T3: Tomato - Zibeitiankui

Ratio of tomato to spice plant: 3:1

Analysis:

Plant growth, production and economy

Disease index of viral disease, gray mildew, and et al.

Population density of insects including aphids, whitefly and et al.

Future Potential work for Organic Vegetable production without fungicide

❖ Plant volatile oils

Treatments:

T1: Sichuan pepper seeds 1.0 t/ha

T2: Sichuan pepper seeds 1.5 t/ha

T3: Rape seed 1.0 t/ha

T4: Rape seed 1.5 t/ha

Note: Seeds were killed by drying at 120 ℃ for 1.5 h

Analysis:

Plant growth and tomato production

Disease index of Verticillium wilt by *Fusarium*

Number of bacteria and fungi in soil (Reat-time PCR)

Community of bacteria and fungi in soil (DGGE)

Number and Community of *Fusarium* spp. In soil (Yergeau et al. 2010**)**

Future Potential work for Organic Vegetable production without fungicide

❖ Biocontrol

Treatments:

T1: *Streptomyces erythrochromogenes* MO28

T2: *Streptomyces* sp. CC59

T3: *Pseudomonas corrugata* P94

Analysis:

Inhibition activity of MO28, CC59 and P94 to powdery mildew and gray mildew of strawberry.

Future Potential work for Organic Vegetable production without fungicide

- Combined results of intercrop, plant volatile oils, and biocontrol with botanical pesticides, physical control to create a protocol applying to organic tomato production;
- Applied the protocol to other organic vegetable production

Thank you for your attention!