Managing Bacterial Spot of Tomato by Application of Novel Compounds

Shouan Zhang, **Qingchun Liu**, and **Jeff B. Jones**

University of Florida
Tropical Research and Education Center
Plant Pathology
Homestead, Florida

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Bacterial Spot of Tomato

- Pathogens: *X. vesicatoria, X. euvesicatoria, X. Perforans,* and *X. gardneri*
- In USA, most important east of the Mississippi River
- Symptoms: Leaf/stem spots, defoliation, and fruit lesions
- In FL, *X. perforans* is the major species
- Conditions: warm (24-30°C), moist – common in Florida
- Loss can be significant if weather is favorable to disease (+ resistant strains)

Management

- Seed treatment – insufficient
- Field rotation
- Field sanitation
- Removing cull piles
- Resistant varieties

– unsuccessful in breeding for acceptable varieties:

a. frequent changes in pathogen

b. quantitative resistance in tomato plant

- Heavily relies on Cu-based bactericides

  Control is often marginal, unacceptable

  - warm, most weather in FL

  - development of Cu-resistant strains of pathogen

  Adding ethylene bis-dithiocarbamate (EBDC) can improve control by Cu bactericides

  - mancozeb: manganese/zinc-EBDC

  - more effective against resistant *Xanthomonas*

  - however, EBDC may be carcinogenic

  Affect the environment/plant health

  - accumulation of Cu in soil and ground water

- Antibiotics

  streptomycin – no longer recommended

  (due to resistance)

  kasugamycin (formulated as Kausin)

  - registered for control of bacterial diseases
  - but NOT available in US
  - likely develop resistance (similar modes of action)

- Bacteriophage

  - inconsistency

- Plant defense activator

  acibenzolar-S-methyl (ASM, Actigard®)

  – may adversely affect yield if not applied properly

CK

Agri-Mycin 17
(streptomycin sulfate)

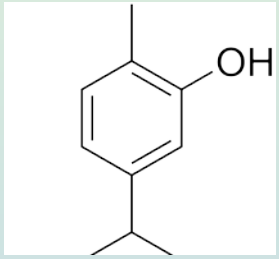
Further efforts are needed to provide more approaches to effectively managing bacterial spot for the tomato industry.

- One of the potential approaches is to develop management strategies for bacterial spot in tomato by exploring small molecule compounds that
  - enhance efficacy of copper-based bactericides
  - reduce bacterial resistance to copper bactericides
  - reduce copper application

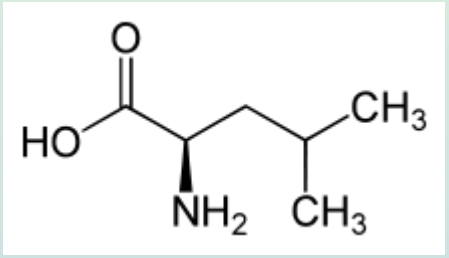
Compounds

– Most are small molecules

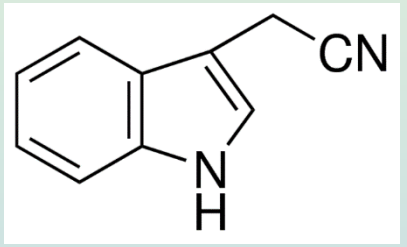
- carvacrol (150.22)
- D-Leucine (131.17)
- 3-Indoleacetonitrile (IAN) (156.18)
- N-acetyl-L-cysteine (NAC) (163.19)
- norspermidine (131.22)
- diphenyl disulfide (218.32)
- tannic acid (1701.21)



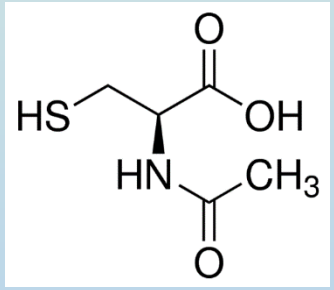
carvacrol



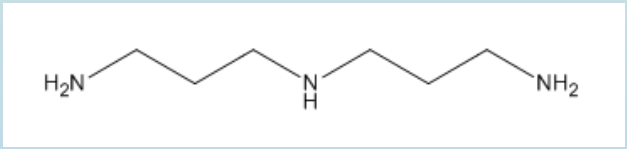
D-Leucine



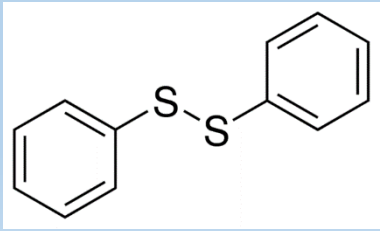
3-Indoleacetonitrile (IAN)



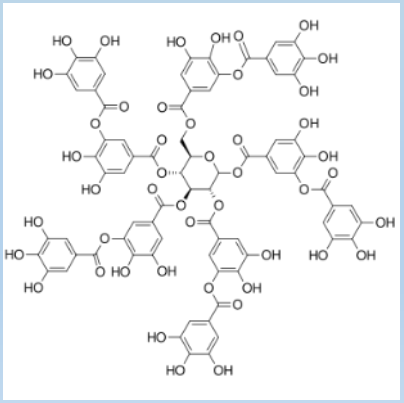
N-acetyl-L-cysteine (NAC)



norspermidine



diphenyl disulfide



tannic acid

In medical research:

- on clinically important pathogens
- antibacterial activity by breaking down bacterial biofilms
- safe and effective for treatment of many diseases

In plants:

- IAN and D-Leucine enhanced control of citrus canker caused by *X. citri* subsp. *citri*
- others incl. carvacrol, NAC and tannic acid have never been tested on any plants against bacterial diseases

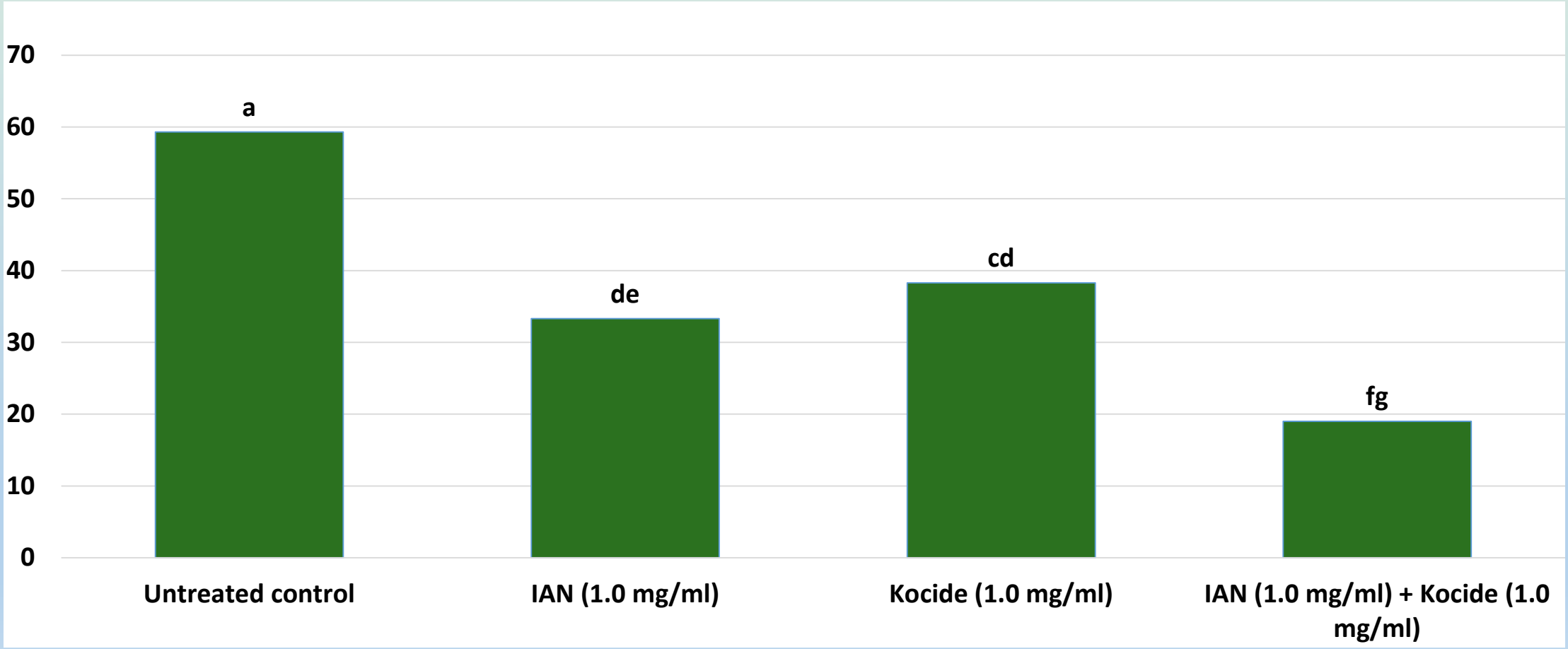
Summary - Evaluating select compounds for disease severity (%) of bacterial leaf spot on tomato (in greenhouses)

Compounds	Test I		Test II	
	Treatment	Control	Treatment	Control
Carvacrol (1.0 mM)	0.6 b	37.9 a	2.6 b	44.7 a
Diphenyl disulfide (1.0 mM)	8.4 b	28.0 a	41.8 a	44.7 a
D-Leucine (10 mM)	42.5 b	60.8 a	35.0 b	55.3 a
IAN (1.0 mg/ml)	23.6 b	44.7 a	36.0 b	60.5 a
NAC (10 mg/ml)	16.2 b	37.9 a	20.5 b	44.7 a
Norspermidine (0.3 mM)	4.7 a	8.6 a	40.5 a	44.7 a
Tannic acid (1.0 mM)	34.6 b	60.5 a	42.0 b	78.0 a

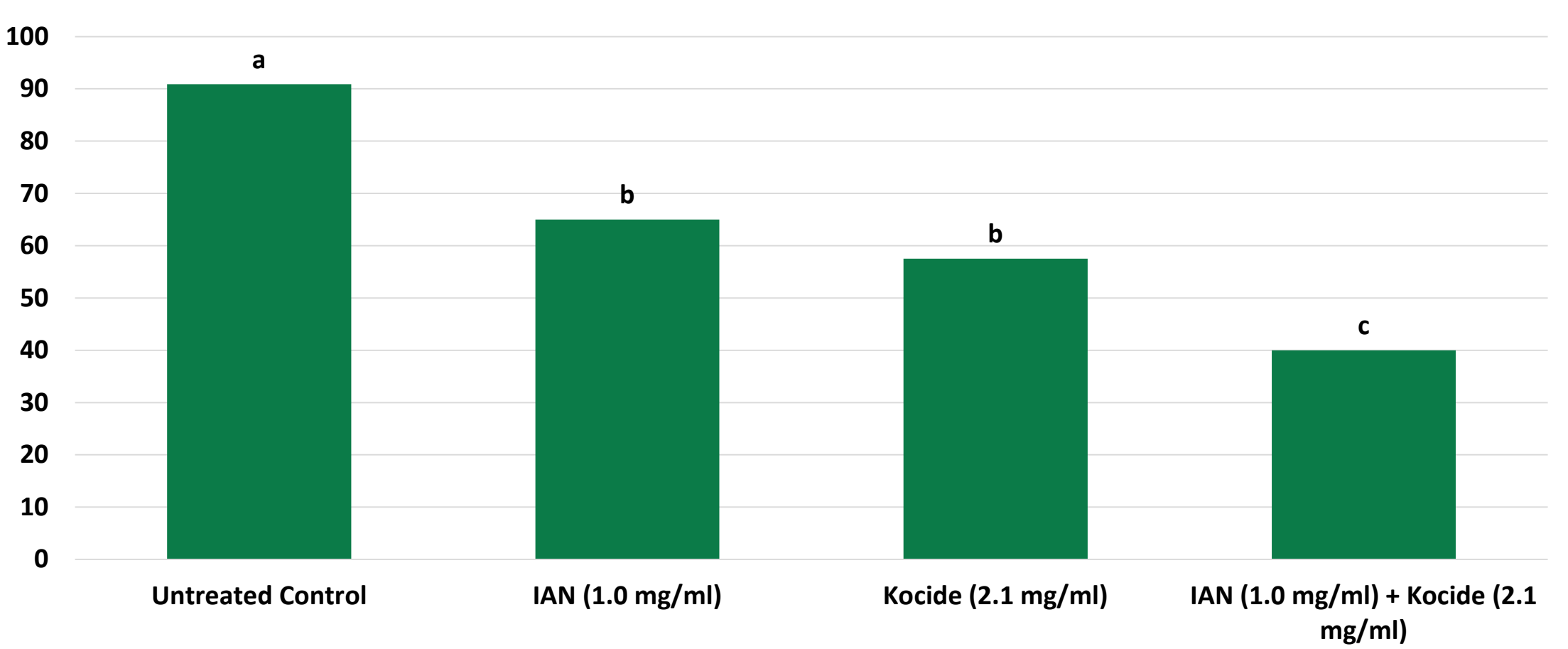
CK

IAN (1.0 mg/ml)

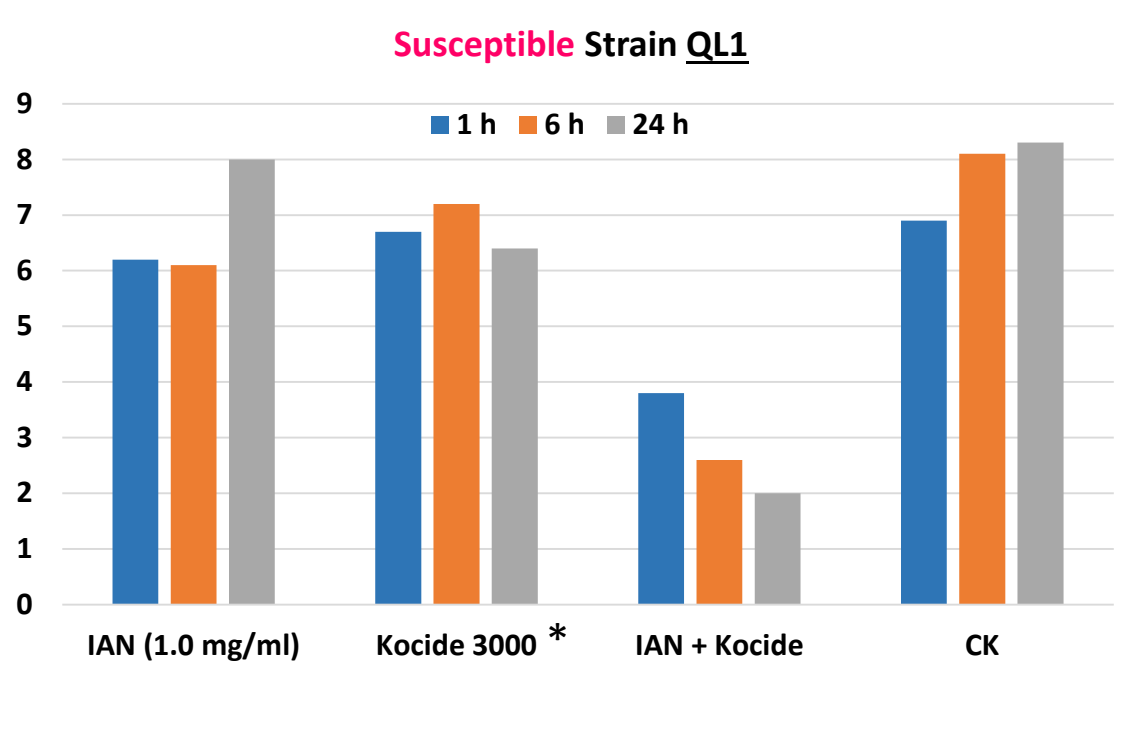
Disease severity (%) of bacterial leaf spot on tomato plants inoculated with a copper-sensitive strain QL1

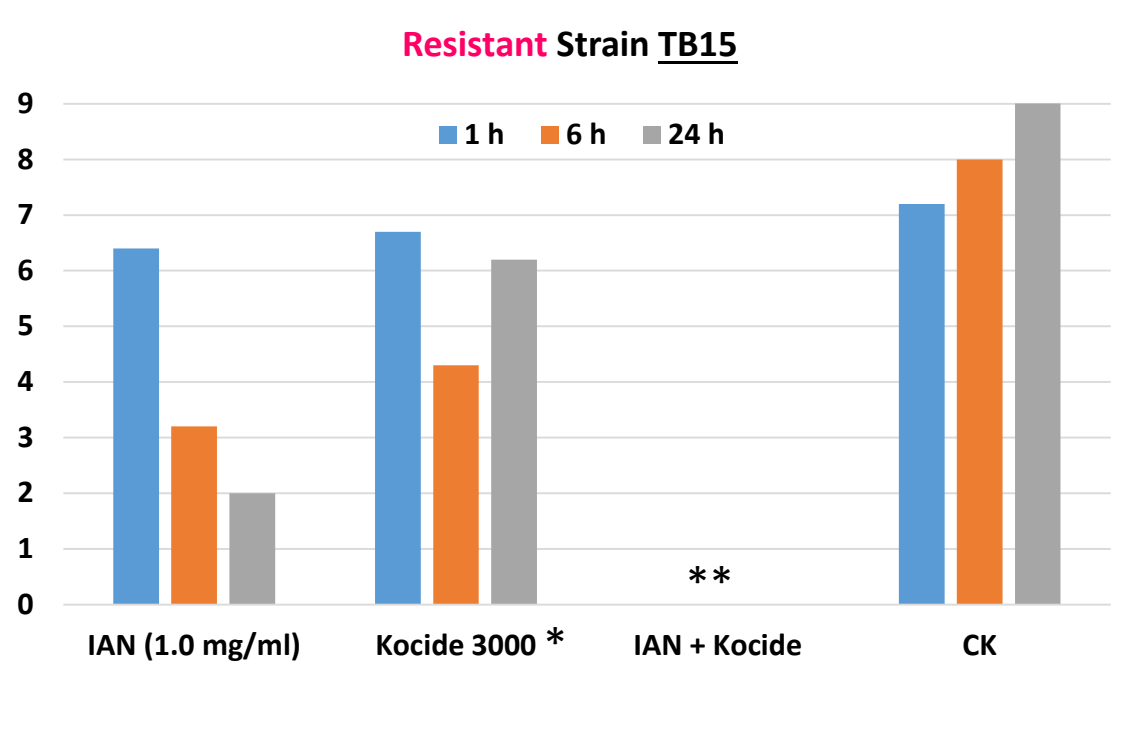


Disease severity (%) of bacterial leaf spot on tomato plants inoculated with a copper-resistant strain TB15



Population (Log CFU/ml) of *X. perforans* in liquid media





* Kocide 3000: 1.0 mg/ml (half label rate)

* Kocide 3000: 2.1 mg/ml (full label rate)

** Not detected by plating 20 µl of original solution (Limit =1.7, i.e. 50 CFU/ml)

Conclusions

- The compounds [carvacrol, D-Leucine, 3-Indoleacetonitrile (IAN), N-acetyl-L-cysteine (NAC), and tannic acid] tested in this preliminary study were effective to reduce bacterial leaf spot on tomato in greenhouse experiments.
- IAN inhibited population growth of *X. perforans* in liquid media.
- IAN significantly improved efficacy of copper-based bactericide (Kocide 3000) in control of bacterial leaf spot on tomato, esp. for disease caused by Cu-resistant strains of *X. perforans*.

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Shouan Zhang, Ph.D.

TREC, UF/IFAS

Homestead, FL

Phone: 786-301-9233

Email: szhang0007@ufl.edu