# Field performance of Nano Magnesium oxide, a new antibacterial compound against bacterial spot of tomato

**M. L. PARET** (1,2), Y. Y. Liao (1,2), A. L. Strayer (1,2), S. Wright (1), M. Young (3), G. E. Vallad (4)-" S. Santra (3), J. B. Jones (2), J. H. Freeman (1)

(1) North Florida Research and Education Center, University of Florida, Quincy, FL
(2) University of Florida, Department of Plant Pathology, Gainesville, FL
(3) NanoScience Technology Center, Department of Chemistry, University of Central Florida, Orlando, FL
(4) Gulf Coast Research and Education Center, University of Florida, Wimauma, FL

UF | IFAS Research
UNIVERSITY of FLORIDA

University of Florida Plant Pathology

UCF

# Severe leaf spots due to bacterial spot

# Bacterial Spot of Tomato

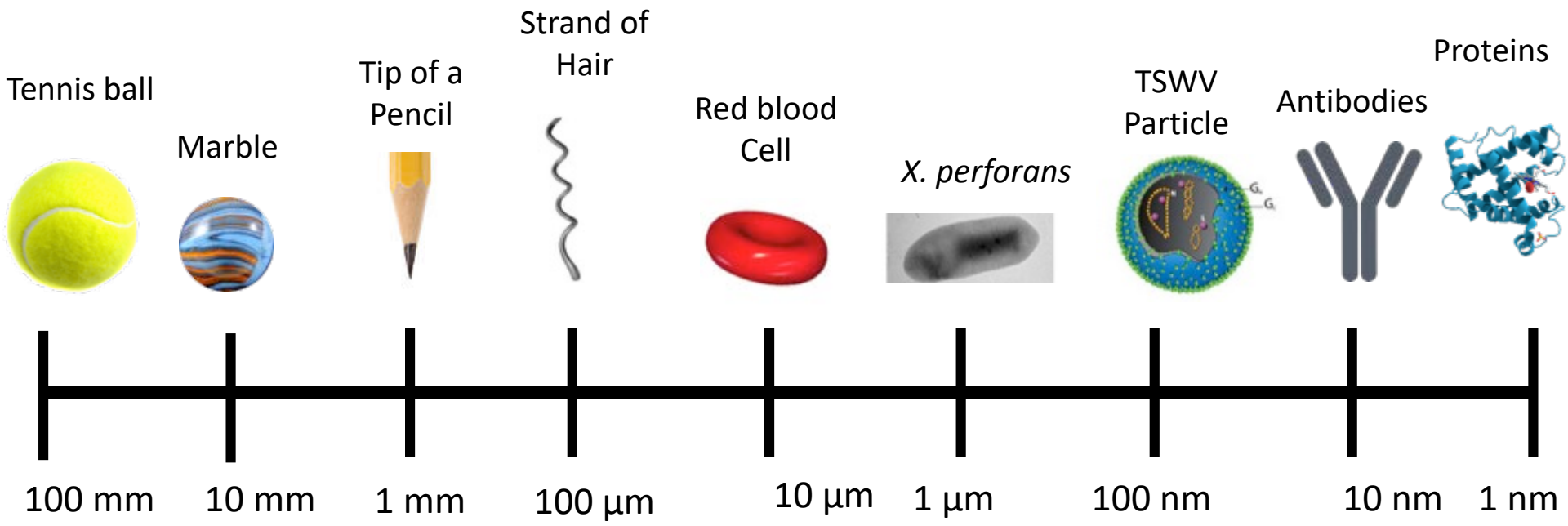
- First discovered in South Africa in 1914
- Caused by four distinct species of ***Xanthomonas*** (*X. euvesicatoria, X. gardneri, X. perforans,* and *X. vesicatoria*)
- As of 2006, *X. perforans* is the dominant species in Florida.
  - Antibiotics was in use 1950s; continuous field use led to bacterial resistance development. Currently only used in transplant production.
  - Current Practices: Pathogen free seed and clean transplants
  - **Use of Copper + EBDC (e.g. Mancozeb) (++)**
    - As of 2006, all *X. perforans* strains (375+) in Florida are copper-tolerant. **Copper (-)**.
  - Other materials: **SAR inducer (Actigard; ++)**, **bacteriophages (+/-)**, **biocontrol agents (+/-)**
  - Limited options necessitates development of new approaches

- Can you tackle copper-tolerance?
  - **Nanoparticles vs. micron counterparts**: antibacterial activity of metallic compounds is size dependent
    - Smaller particles with larger surface to volume ratios have more activity
    - Interact more closely with microbes
    - Releases more metal ions in solution

Credits: Ying-Yu Liao

**Hypothesis:** Reducing the size of some elements to nanosize form will improve antibacterial properties when compared to micron size particles

# What is a Nanometer?




**Photos courtesy of Ocsoy et al. 2013, Phillips et al. 1980, and Sherwood et al. 2003.**

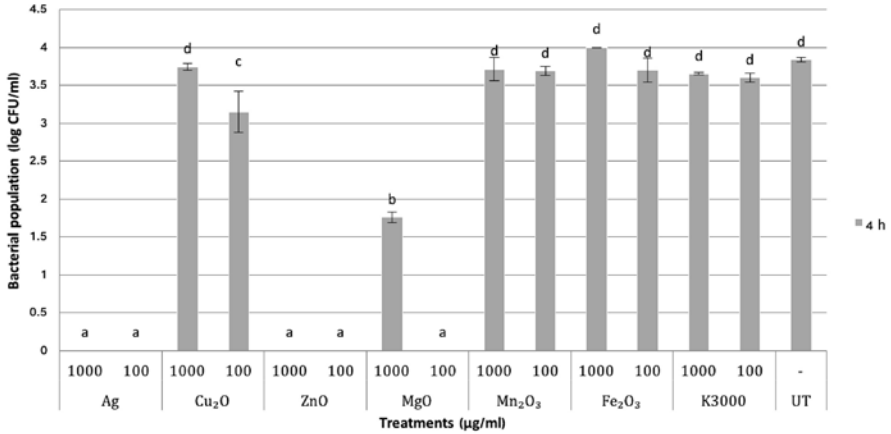
Credits: Amanda Strayer

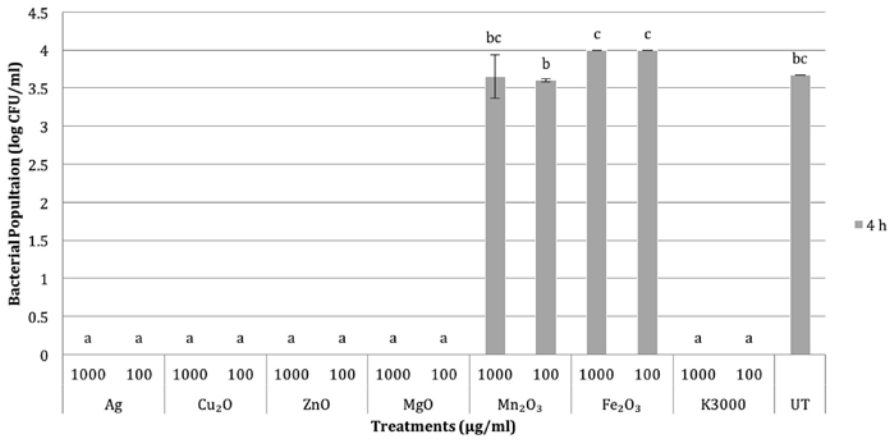
# 1. In vitro antibacterial activity of metal oxides and Ag

## Copper- tolerant strain GEV 485

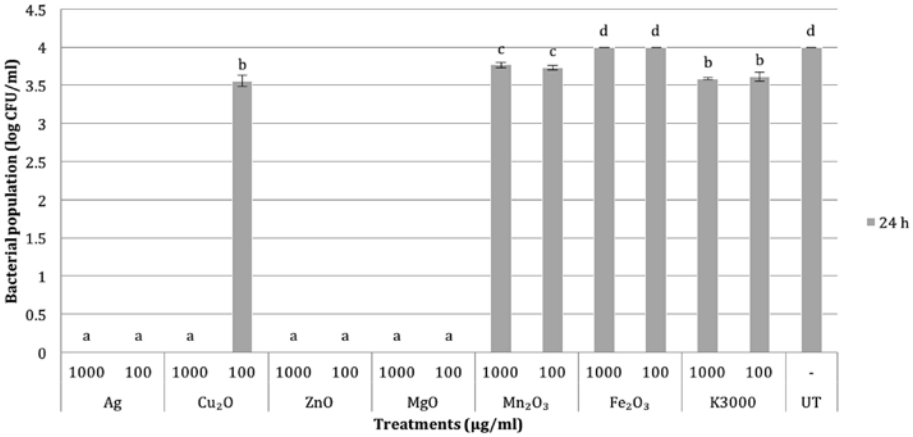
## Copper-sensitive strain 91-118

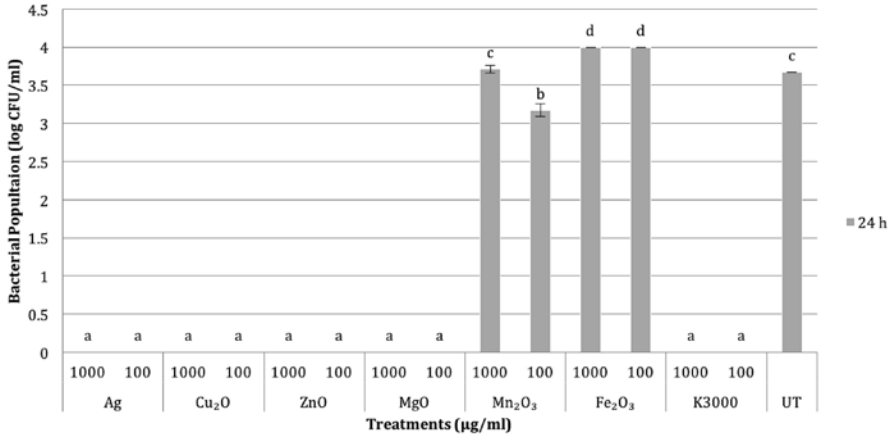
**4 h**



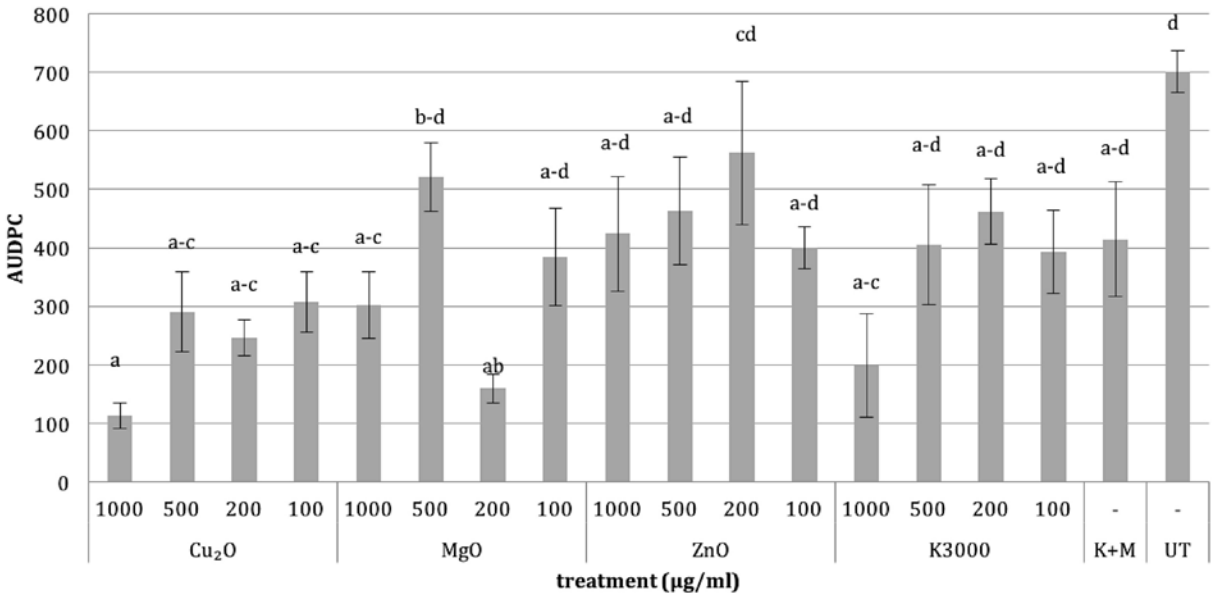

**24 h**

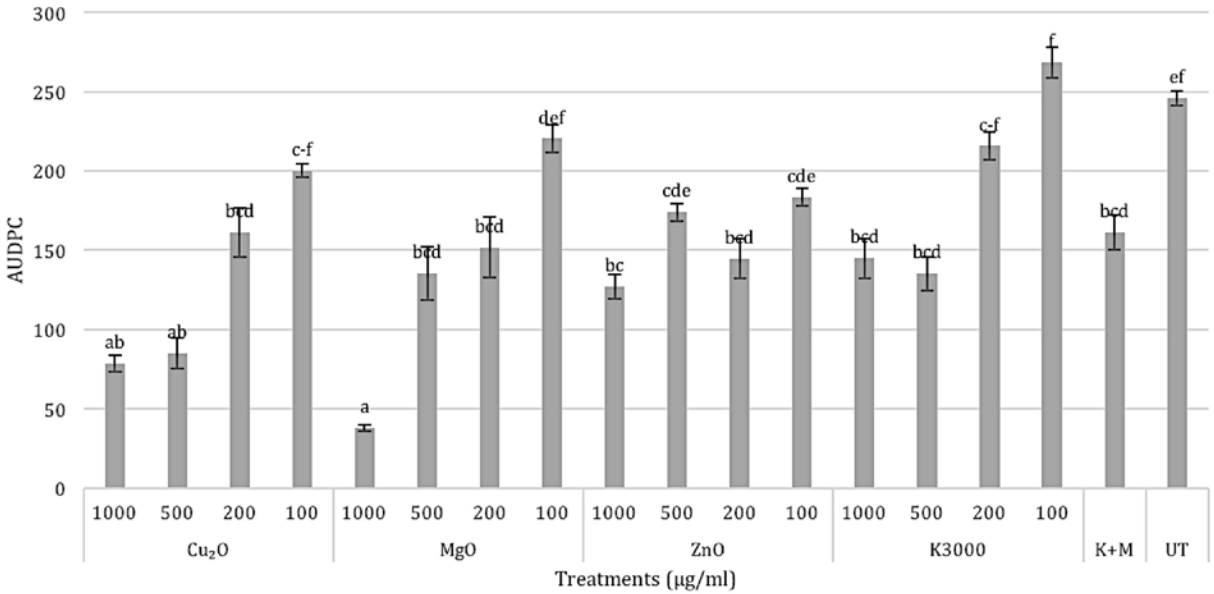



SNK analysis p=0.05

# 2. Activity of metal oxides against bacterial spot in Greenhouse




SNK analysis p=0.05

No Phyto-toxicity was noted

# 3. Activity of metal oxides against bacterial spot in field

| | | AUDPC in different location, season | | |
|---|---|---|---|---|
| Treatment | rate (µg/ml) | Quincy, FL 2015 Fall | Wimauma, FL 2016 Spring | Quincy, FL 2016 Spring |
| Nano-$Cu_2O$ | 1000 | 987.4 ab | 669.6 a | 1,063.8 a |
| Nano-$Cu_2O$ | 200 | 930.4 ab | 761.4 ab | 877.7 a |
| Nano-MgO | 1000 | 805.0 a | 866.4 ab | 913.5 a |
| Nano-MgO | 200 | 836.9 a | 580.1 a | 853.6 a |
| Kocide 3000 | 2100 | 1,196.4 ab | 972.1 ab | 1,135.4 ab |
| Copper-mancozeb | | 1,092.9 ab | 773.4 ab | 1,188.0 ab |
| water | | 1,330.9b | 1,136.8 b | 1402.1 b |

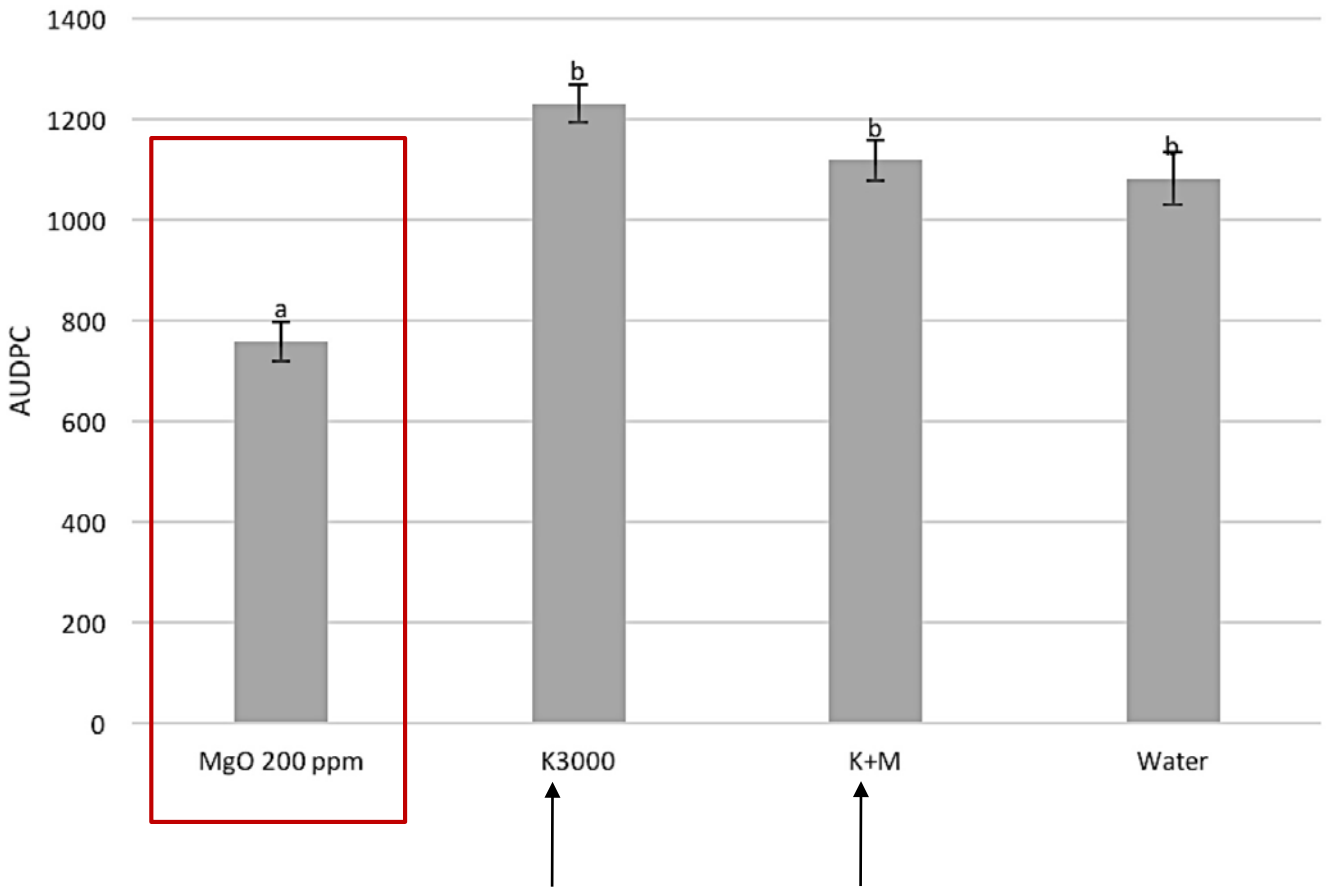
No Phyto-toxicity was noted

LSD analysis p=0.05

# Field, twice a week application

Quincy 2016 Fall

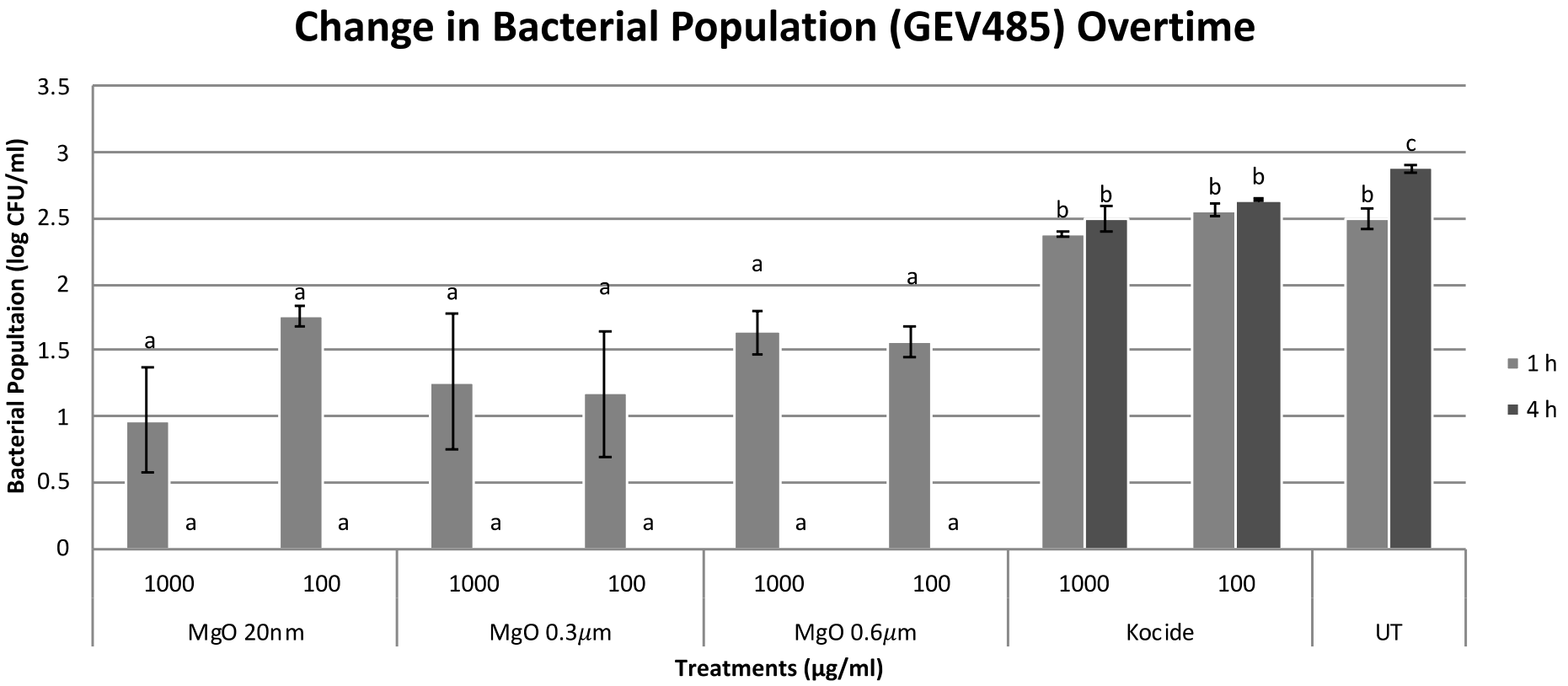
**To be more realistic.**




SNK analysis p=0.05

No Phyto-toxicity was noted

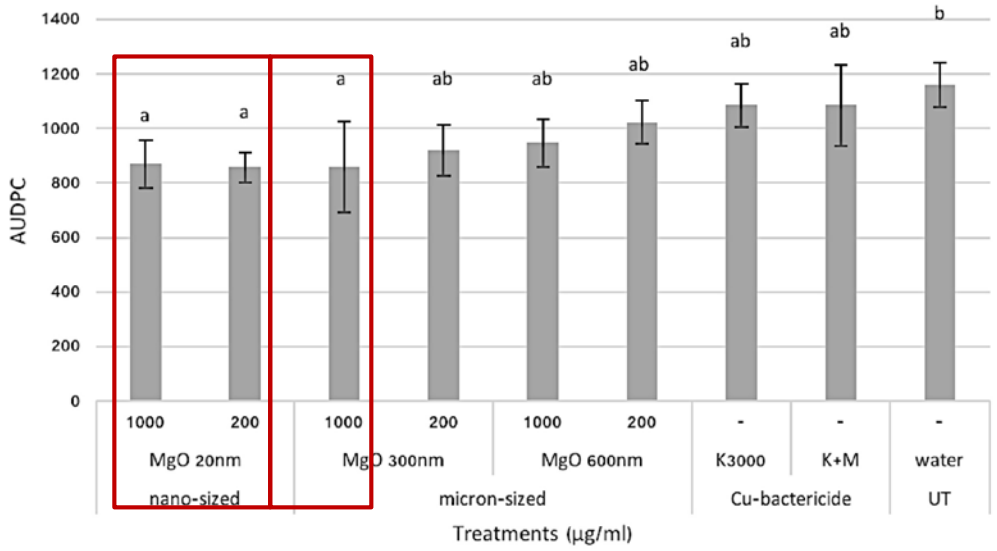
# 4. In vitro antibacterial activity of nano vs micron-size MgO



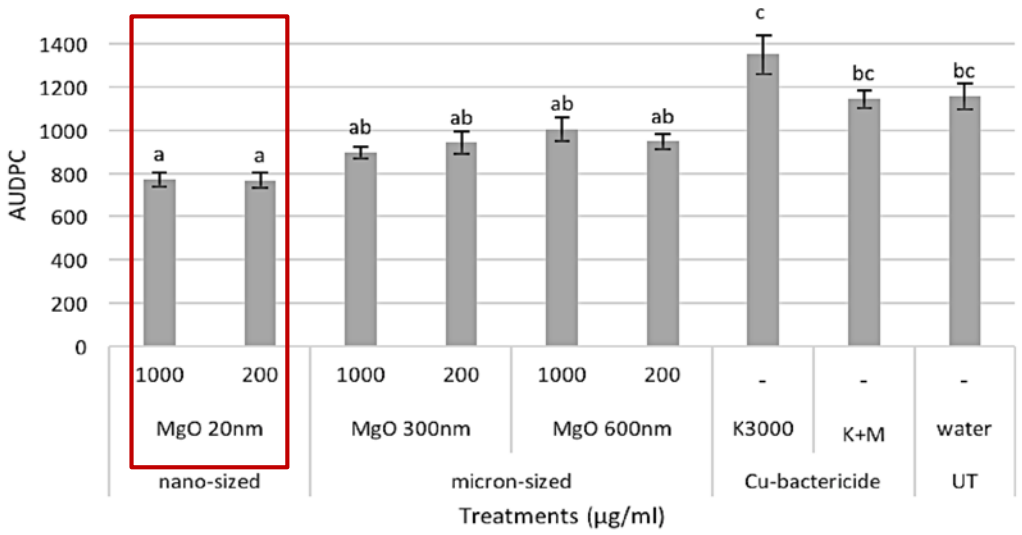

SNK analysis p=0.05

# 5. Nano-Micron MgO against bacterial spot in field

Spring, 2016, Quincy



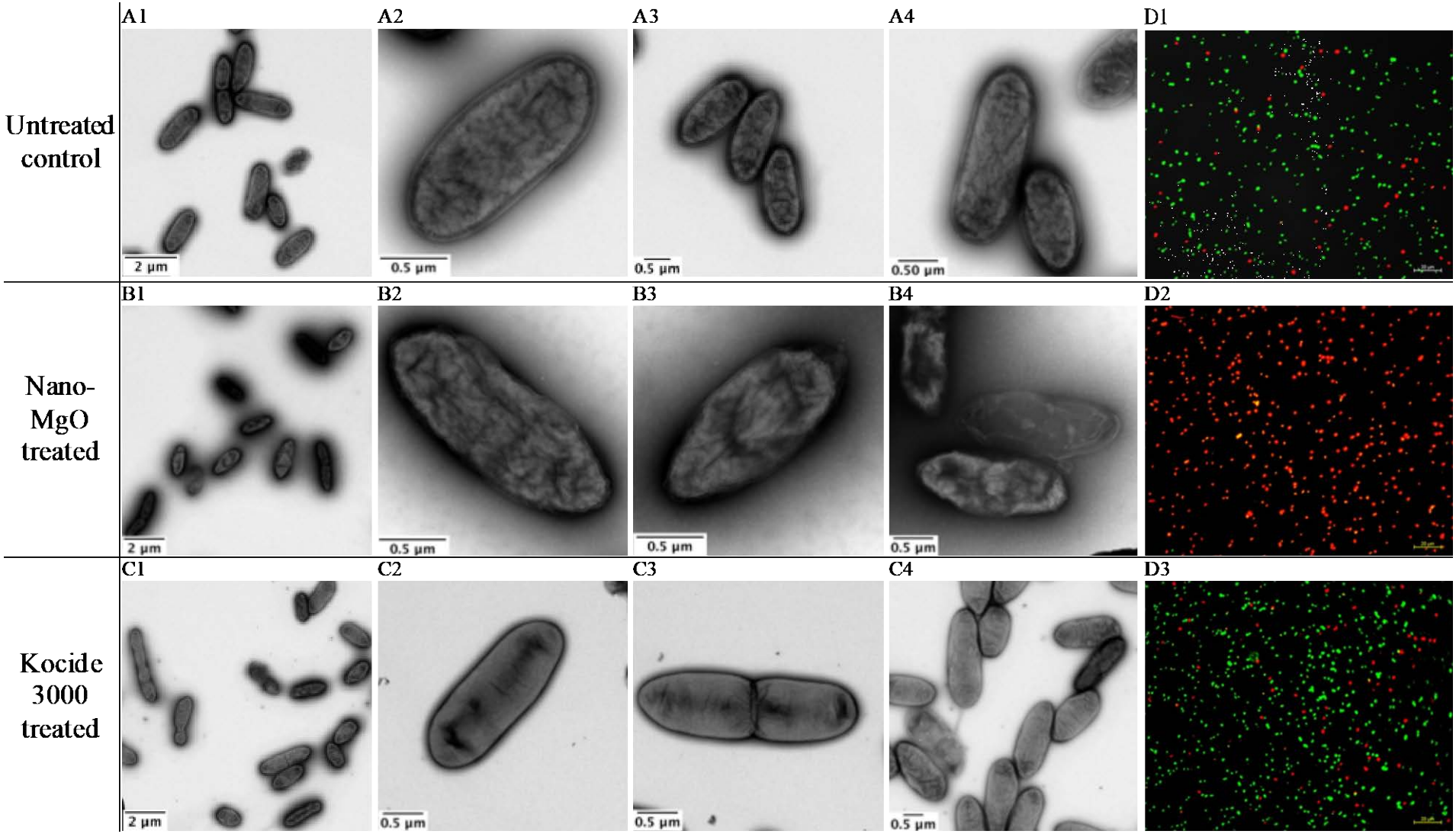

Fall, 2016, Quincy




SNK analysis p=0.05

No Phyto-toxicity was noted

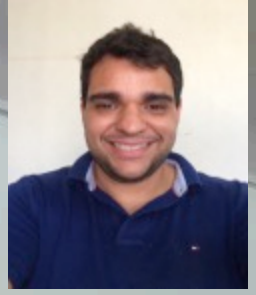
# 6. Mode of action indicated by TEM and Epifluorescence microscopy

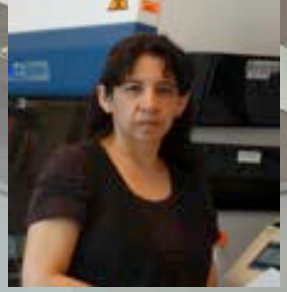


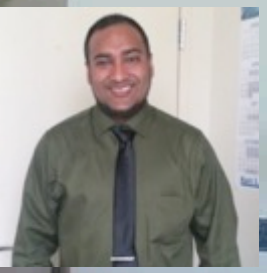
# Conclusion

- Non-formulated MgO is an **effective bactericide** against copper-tolerant *X. perforans* in vitro, and effective against bacterial spot in the greenhouse and in the field. MgO is a **GRAS** compound under EPA guidelines.
- **Size-dependent activity** of MgO in field trials
- **No negative yield impact** (data not shown)
- **No significant elemental accumulation in fruits** determined by ICP-MS (data not shown)

(Liao et al. Phytopathology. 2018), Liao et al. In Review







paret@ufl.edu

FLORIDA TOMATOES