The biocontrol mechanisms of bioorganic fertilizer to control tobacco bacterial wilt in soil microorganism perspective

Yanxia LIU

GUIZHOU ACADEMY OF TOBACCO SCIENCE

Catalogue

- The Damages Caused by Tobacco Bacterial Wilt in China
- The Achievement of Bioorganic Fertilizer
- The Efficacy on Biological Control of Tobacco Bacterial Wilt
- The Possible Mechanisms of Bio-control Tobacco Bacterial Wilt in Soil Microorganism Perspective

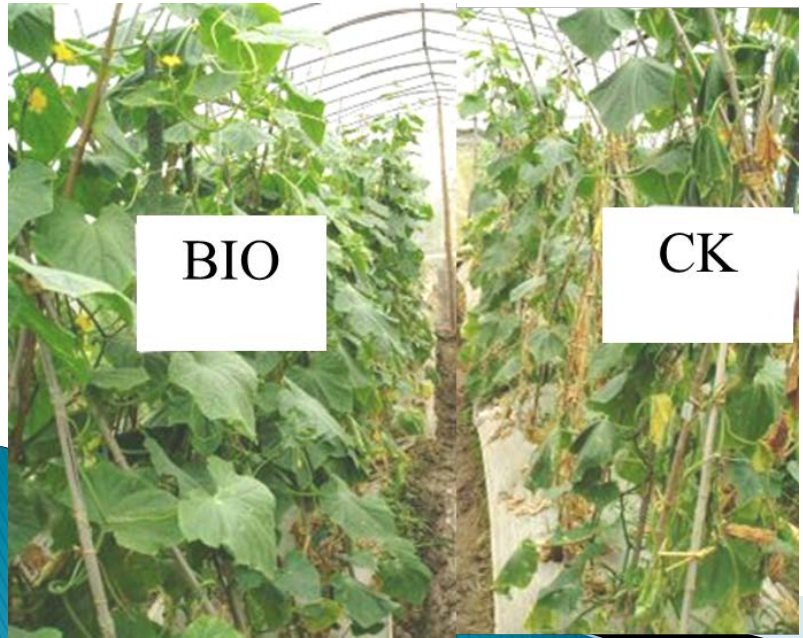
◆ The Background of Tobacco Bacterial Wilt in China

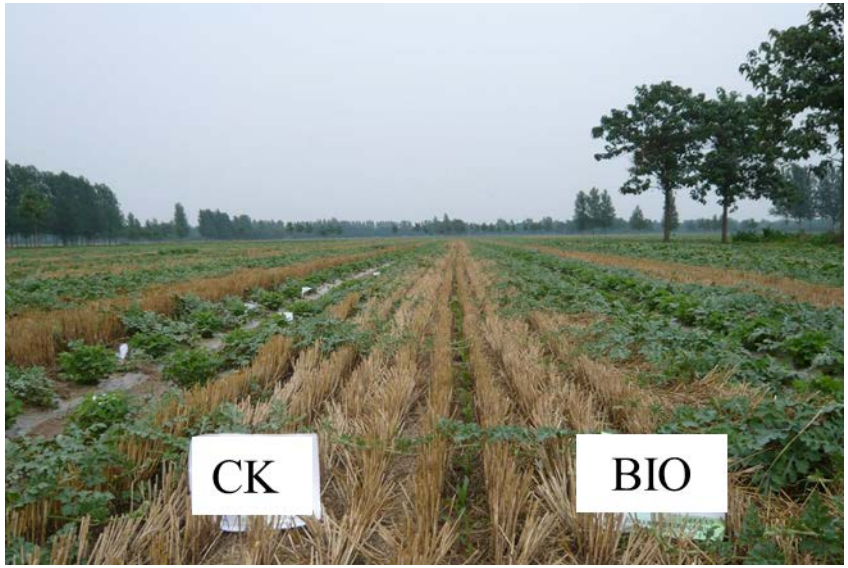
The most serious soilborne disease of tobacco in China is bacterial wilt which is caused by *Ralstonia solanacearum*. Monoculture on the same plots often causes the development of *R. solanacearum*, which can invade the vascular system of tobacco plants and prevent water transportation leading to death. So far, tobacco bacterial wilt has caused severe economic losses in China and no traditional control methods showed positive effects.

◆ The Achievement of Bioorganic Fertilizer in China

- The fact that there is no effective control method for tobacco bacterial wilt disease so far has stimulated the development of biological control of this soil-borne disease. More recently, the use of microbial antagonists has been considered a promising soil disease management strategy.

Different antagonists have been used to ferment organic fertilizers to produce bioorganic fertilizer, and these bioorganic fertilizers are showing a great potential to control different soil-borne diseases, such as banana Fusarium wilt (Zhang et al. 2011b), cucumber Fusarium wilt (Cao et al. 2011; Zhang et al. 2008b), Cucumis melo melon Fusarium wilt (Zhao et al. 2011a, b), watermelon Fusarium wilt (Ling et al. 2010), cotto Verticillium wilt (Lang et al. 2012; Luo et al. 2010), tomato bacterial wilt (Wei et al. 2011), and tobacco black shank (Ren et al. 2012).





◆ The Efficacy on Biological Control of Tobacco Bacterial Wilt

Field Experiment

Control Efficacy in Field Experiments

Treatments	50 d			105 d		
	Disease Incidence (%)	Disease Index	Control Efficacy (%)	Disease Incidence (%)	Disease Index	Control Efficacy (%)
1-A_{CK}	26.1±2.8a	17.4±0.8a	—	60.6±1.2a	54.9±6.0a	—
1-A_{BOF}	6.9±1.0b	3.1±0.3b	82.2	26.6±3.1c	13.6±0.6c	75.2
2-A_{CK}	23.9±0.6a	18.2±0.4a	—	52.7±2.0b	45.5±6.6b	—
2-A_{BOF}	1.0±0.9c	0.7±0.6c	96.2	3.1±1.0d	2.1±1.0d	95.4

Note: 1-A_{CK}, control treatment in the first year; 1-A_{BOF}, BOF applied treatment in the first year; 2-A_{CK}, control treatment in the second year; 1-A_{BOF}, BOF applied treatment in the second year

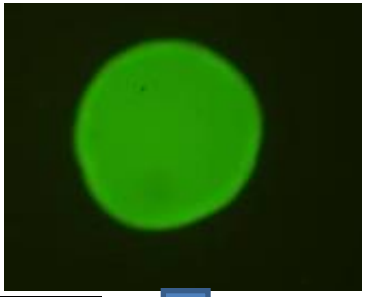
◆ The Possible Mechanisms of Bio-control Tobacco Bacterial Wilt in Soil Microorganism Perspective

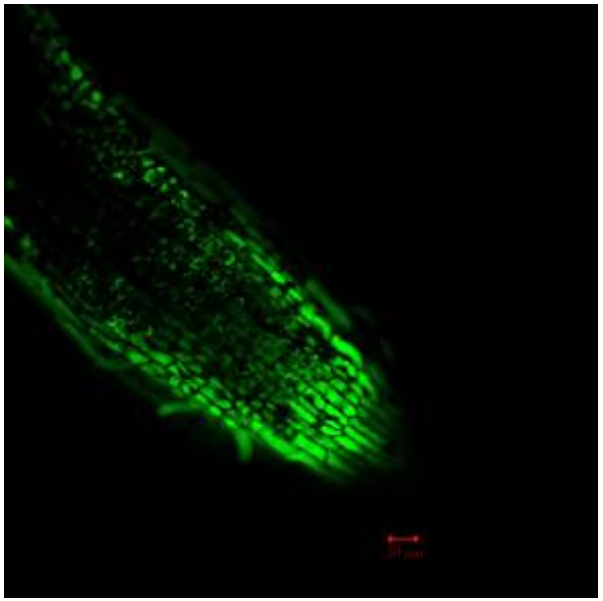
a. Microbial counts of rhizosphere soil in field experiment (cfu/g soil)

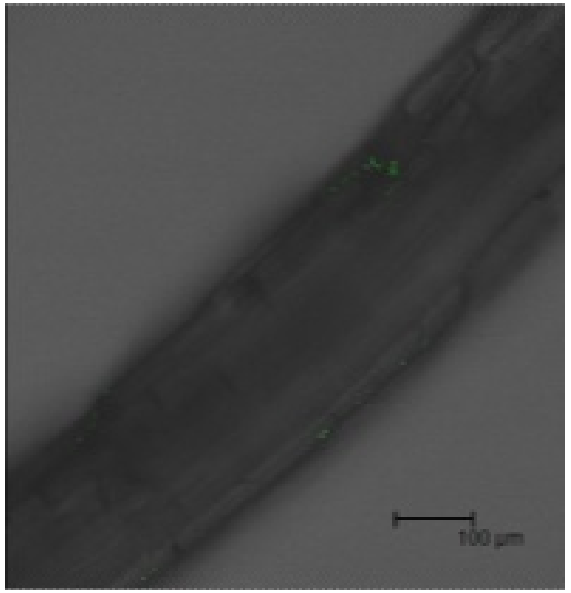
Treatments	Microbial counts of rhizosphere soil									
	50 d after transplanting					105 d after transplating				
	Bac ($\times 10^7$)	Act ($\times 10^5$)	Fun ($\times 10^4$)	Rs ($\times 10^6$)	Ant ($\times 10^3$)	Bac ($\times 10^7$)	Act ($\times 10^5$)	Fun ($\times 10^4$)	Rs ($\times 10^6$)	Ant ($\times 10^3$)
1-A_{CK}	1.4b	1.8b	67.4a	12.7a	4.7b	5.1b	1.7a	32.1a	7.6a	3.5b
1-A_{BOF}	33.1a	10.4a	8.4b	2.5b	1136.6a	14.3a	3.3a	2.8b	4.3a	46.9a
2-A_{CK}	2.0b	2.8b	23.3a	11.0a	9.5b	7.6b	1. 8a	31.5a	3.5a	2.5b
2-A_{BOF}	15.9a	20.9a	9.6b	1.0b	1054.9a	14.8a	5.0a	6.6b	1.1a	66.7a

Note: Bac, Bacteria; Act, Actinomycetes; Fun, Fungi; Rs, *R. solanacearum*; Ant: Antagonists

b. green fluorescent protein (*gfp*)-labeled *R. solanacearum*







CK: Tobacco roots was inoculated with *gfp*-Rs

Treated with Antagonists before inoculated with *gfp*-Rs

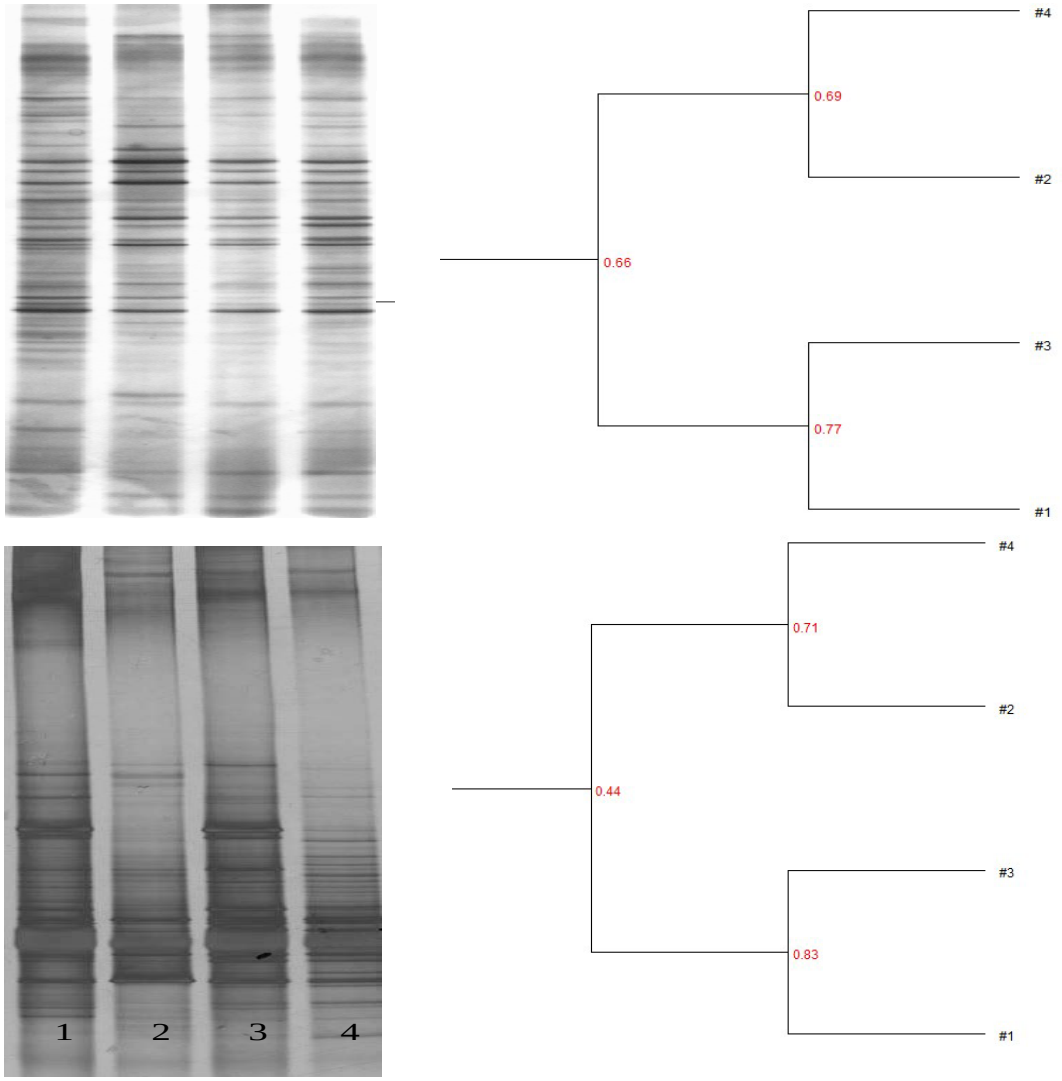
The colonization of *gfp*-Rs on root surface after 4 d inoculation

c. The diversity indics for rhizosphere microbial communities in field experiments

Treatments	50 d			105 d		
	Shannon Index	Simpson Index	McIntosh Index	Shannon Index	Simpson Index	McIntosh Index
1-A_{CK}	1.83c	27.7b	11.3c	1.79c	27.3c	11.0c
1-A_{BOF}	2.35b	48.5a	12.5b	2.30b	46.8b	12.3b
2-A_{CK}	1.77d	26.2c	11.0c	1.69d	25.2d	10.6d
2-A_{BOF}	2.41a	48.8a	13.1a	2.36a	48.1a	12.9a

Note: 1-A_{CK}, control treatment in the first year; 1-A_{BOF}, BOF applied treatment in the first year; 2-A_{CK}, control treatment in the second year; 1-A_{BOF}, BOF applied treatment in the second year

3. DGGE



Note: DGGE pattern and the phylogenetic tree of the bacterial community (upper) and fugal community (lower) of rhizosphere soil in different treatments in pot experiment #1, control treatment in the first year; #2, BOF applied treatment in the first year; #3, control treatment in the second year; #4, BOF applied treatment in the second year

Conclusion

This tobacco-specific BOF application can effectively improve the micro-ecology in the rhizosphere, and is thus a potentially promising treatment for the control of tobacco bacterial wilt disease.

Thank you for your attention!