A Comprehensive Strategy for Controlling the Fusarium Wilt of Banana Combining with Resistant Cultivars

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Foc TR4 is the threat for banana industry

- Spreading speed
- More virulent than STR4
- Biodiversity and evolution speed: 01213, 01216 and 01213/16
- Strict and Effective Quarantine regulations?
- Interaction between TR4 and banana?
- Effective control measures? only very few resistant/tolerant varieties
Reasons for Fusarium wilt epidemics

1. Large scale monoculture of bananas
2. Small-scale farming by individual owners
3. Irregular production of tissue culture plantlets
4. River pollution and farming operations
5. Disregard of quarantine regulations
6. Movement of plants, people and equipment
Characteristics of Foc TR4

- Soil-born, endophytic, semi-necrotrophic fungal pathogen
- Biodiversity and evolving rapidly
- Virulence factors
Banana industry changes in China

Production Zones for Bananas in China

YunNan Province (26%)
9.33x10^5 hectares, 3.5x10^6 tons

Guangxi Province (30%)
1.067x10^5 hectares, 4x10^6 tons

HaiNan Province (6%)
2.0x10^4 hectares, 0.75x10^6 tons

Guangdong Province (20%)
7.33x10^4 hectares, 2.75x10^6 tons

Fujian (8%)
2.87x10^5 hectares, 1x10^6 tons

3.64x10^6 hectares
13,570,000 tons
(2014)
Present Control Measures for *Foc* TR4

- Chemical control—poor internal absorption
- Biological control—weak colonization in soil
- Soil disinfection—Non-environment friendly, poor efficiency
- Formula fertilization—poor efficiency
- Rotation and intercropping—inefficiency
- Resistant varieties—very few
Integrative Control Measure

1. Basing on resistant or tolerant varieties
   ◆ Reducing fungicide application
   ◆ Facing the threat from the pathogen's evolution

2. Designing a good banana plantation
   ◆ Restricting the movement of personnel
   ◆ Cutting off the transmission routes, such tools, shoes and etc

3. Preparing the Banana Plantlets free of Foc

4. Water treatments: chlorine dioxide, Lime nitrogen, *Bacillus subtilis*

5. Soil management.
   PH value, Microbes, organic matters and etc
Earlier Screening Method

![Susceptible cultivars](image1.png)

![Highly resistant cultivars](image2.png)

The effect of root exudates on spore germination

1. Musa ABB cv `Dongguan Dajiao`; 2. Musa ABB cv `Zhongshan Dajiao`; 3. Musa AA cv `Haigong`; 4. Musa AAA Cavendish cv `Wilt-resistant #1`; 5. Musa AAA Cavendish cv `Brazilian`; 6. Musa AAA Cavendish cv `Wilt-resistant #5`; 7. Musa ABB Pisang awak cv `Guangfen #2`; 8. Musa AAA Cavendish cv `Dafeng #2`; 9. Musa ABB Pisang awak cv `Guangfen #1`. The germination of differed significantly among the cultivars (χ², df=8, p<0.0001).
The effect of root exudates on spore germination

Musa ABB cv `Dongguan Dajiao`
Musa AAA Cavendish cv `Wilt-resistant #5`
Musa AAA Cavendish cv `Brazilian`

Musa AAA Cavendish cv `Brazilian`
Musa ABB Pisang awak cv `Guangfen #1`
Musa AAA Cavendish cv `Dafeng #2`
The resistant varieties could decrease the *Foc TR4* population size

Harvesting the samples

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<th>depth</th>
<th>Zhongjiao No4</th>
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PCR amplification product from *Foc TR4*
Standardizing banana plantation

An undrained banana plantation
Preparing the Banana Plantlets free of *Foc*
Water treatments

chlorine dioxide

lime nitrogen
Chinese Leek control Fusarium Wilt of Banana

Chinese leek field

Sugarcane field

Rice field

Vegetable field
The extract affects *Foc* TR4 mycelial growth
The extract deformed *Foc TR4 Mycelium*
The extract killed *Foc* TR4 spores
Biology control
Fermentation the banana Pesoudostem with biological strains
Bioassay in Greenhouse
Biological Fertilizer
Field tests

Outbreak of Fusarium wilt in the field was delayed

Treatments

Control
Comprehensive prevention idea

- Source control: Tissue culture
- Cut off the transmission route
  - Irrigation water
  - Tools
  - Diseased soil
- Disease field management
- Increasing the immunity of banana
- Delaying the evolution
Thank you!