PAPER 3:
A COMPREHENSIVE STRATEGY FOR PREVENTION AND CONTROL OF FUSARIUM WILT OF BANANA BASED ON RESISTANT OR TOLERANT VARIETIES

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ABSTRACT

Fusarium wilt of banana is a devastating disease caused by *Fusarium oxysporum* f. sp. *cubense* (*Foc*). Based on virulence to specific banana cultivars, the pathogen can be classified into three races (i.e., races 1, 2, and 4). In 1950s, the export of Gros Michel banana from the Central America to America and Europe dramatically reduced due to *Foc* Race 1. *Foc* subtropical Race 4 reduced the production area in Taiwan from 50,000 ha to 5,000 ha in last 10 years, and nowadays *Foc* tropical Race 4 (*Foc* TR4), the most virulent strain of *Foc*, has been sweeping through banana plantations in Asia and become the major threat to banana industry. The reasons for Fusarium wilt epidemics include six aspects, (1) Large scale growing monoculture of bananas, mostly the Cavendish banana, which decrease the selection pressure for the pathogen. (2) Small-scale farming by individual owners in China, which make it very hard for the goverment to carry out consistent measures to restrict the spreading of the pathogen. (3) Irregular production of tissue clture plantlets, and many factories can't make good seedlings. (4) Pollution of the river water accelerate the spreading of the pathogen. (5) No strict quarantine regulations for the pathogen had been developed. (6) Movement of the plants, labors and equipment also accelerate the spreading of the pathogen. The disease had dislocated the geographical distribution of banana growing districts in China mainland. Ten years ago, banana output from Guangdong province was more than 50% of China, and now is about 20%, and also the growing area decreased from 140,000 to 70, 000 hectares, and ranks third after Guangxi and Yunnan Provinces now. The disease incidence in Guangdong province ranges between 20 to 40%, with individual plantations reaching a rate of 90% (Huang *et. al.*, 2012). Without effective quarantine inspection measures, this disease spread rapidly in new growing areas.

In order to control the spread of *Foc* TR4, we performed comparative genomic analysis on *Foc* by resequencing 80 *Foc* isolates covering three races and 24 vegetative compatibility groups (VCGs). We found that *Foc* evolved very fast, and that exogenous genetic materials had been transferred into linage-specific genomic regions. An effective future disease prevention and control strategy should serve dual roles, both improving host resistance and reducing *Foc* population size. Our group have bred some resistant banana varieties such as Zhongjiao No 3, 4, 6 and 9 against *Foc* TR4, the most virulent race of *Foc*. Experiments in vitro showed that root exudates from these resistant lines inhibited TR4 spore germination and hyphal growth. In addition, field survey over 4 years showed that these resistant varieties limited *Foc* population size. Furthermore, we investigated additional ways to control *Foc* including crop rotation, soil disinfection and biocontrol. The crop rotation involving Chinese leek or rice shows that compared to rice, Chinese leek inhibited or even completely destroyed *Foc* in soils. Soil disinfection using ammonium bicarbonate/lime significantly decreased the *Foc* population in top but not deep soils. Biocontrol applying fermented banana pseudostems with endophytic and antagonistic Trichoderma spp with high cellulose activity in the field limited disease incidence and suppressed the pathogen. In conclusion, we evaluated the feasibility of implementing these control measures in Fusarium wilt of banana diseased regions in Guangdong province, and therefore proposed a comprehensive disease prevention and control strategy integrating multiple measures including planting tissue cultural plantlets, resistant/tolerant banana varieties, crop rotation, designing the banana plantation to prevent *Foc* transmission and reducing population in the soil by biocontrol or soil fumigation.

Keywords: Fusarium wilt of banana, *Fusarium oxysporum* f. sp. cubense, disease prevention and control strategies.

REFERENCES

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