# Plant Pathology Seminar Series

## "Improving Cavendish Banana Resistance to *Fusarium* Wilt Tropical Race 4 (TR4) via Transgenics and an Integrated Agricultural Approach"

**Jonathan Eagle**

Banana production is threatened worldwide by the fungus *Fusarium oxysporum* f. sp. *Cubense*, which causes *Fusarium* wilt disease of banana (Dita et al. 2018). In the past, Race 1 of this disease took out the popular Gros Michel banana which was commercially replaced by the resistant cultivar Cavendish. Now a new race, Tropical Race 4 (TR4) threatens the Cavendish cultivar and has the capacity to kill more than 50% of the bananas grown today (Dale et al. 2017). Currently TR4 has spread to most banana growing regions with the exception of South America. Researchers are looking for a remedy, but since there are no Fungicide treatments available and the fact that the chlamydospores are viable for up to 40 years in the soil, few options are left. *Fusarium* is a soil borne disease and attacks the plant through the roots which eventually blocks xylem transport, thereby impeding water and nutrient flow (Ploetz, R. 2015). Recent research has shown that transgenic technology could be the best approach. Two genes have been successfully inserted into the Cavendish banana which confer resistance to *Fusarium* wilt disease TR4. One is the Ced9 anti-apoptosis gene derived from the nematode *C. elegans* and the other is RGA2, a putative nucleotide-binding and leucine-rich repeat (NLR)-type resistance (R) gene from wild banana (Dale et al. 2017). In a three-year field trial, these transgenic plants showed no signs of infection and tested negative at the end of the study. Edible bananas are ideal for genetic engineering since they are highly sterile which prevents transgene drift via pollen into the environment. (Remy et al. 2013). Another approach has been to look at soil amendments and microbiome structure in order to reduce the presence of *Fusarium oxysporum.* Quantitative PCR and high throughput sequencing were used to characterize soil microbial community structure and the results from both two-season studies showed that biofertilizer application after ammonia fumigation significantly reduced the incidence of banana Panama disease by approximately 55% and promoted plant biomass, compared to the control application of cow manure to non-fumigated soil (Shen et al. 2019). Ammonia fumigation significantly reduced total fungal and *F. oxysporum* abundances and bacterial and fungal diversities. Biofertilizer application after fumigation further depleted the abundance of the pathogen.

4:10 pm | Monday, April 15 | Johnson Hall 343

*Plant Pathology 515, Spring 2019*

College of
Agricultural, Human, & Natural Resource Sciences
Washington State University

References

Dale, James, et al. “Transgenic Cavendish Bananas with Resistance to Fusarium Wilt Tropical Race 4.” Nature Communications, vol. 8, no. 1, 2017, p. 1496.

Dale, James, et al. “Modifying Bananas: From Transgenics to Organics?” Sustainability, vol. 9, no. 3, 2017, pp. Sustainability, 2017 Mar, Vol.9(3).

Dita, Miguel, et al. “Fusarium Wilt of Banana: Current Knowledge on Epidemiology and Research Needs Toward Sustainable Disease Management.” Frontiers in Plant Science, vol. 9, 2018, p. 1468.

Ploetz, Randy C. “Fusarium Wilt of Banana.” Phytopathology, vol. 105, no. 12, 2015, pp. 1512–21.

Remy, S., et al. “Genetically Modified Bananas: Past, Present and Future.” Acta Horticulturae, no. 974, 2013, pp. 71–80.

Shen, Zongzhuan, et al. “Suppression of Banana Panama Disease Induced by Soil Microbiome Reconstruction through an Integrated Agricultural Strategy.” Soil Biology and Biochemistry, vol. 128, 2019, pp. 164–174.