CONTROL OF BANANA FUSARIUM WILT DISEASE BY REDUCTIVE SOIL DISINFESTATION

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Abstract: Banana Fusarium wilt caused by *Fusarium oxysporum* f. sp. *cubense* (FOC) is a worldwide soil-borne disease that causes serious economic losses every year. Traditionally, farmers use chemical pesticides and disease-resistance cultivars as relatively dependable methods of protecting banana from FOC. However, increased use of chemical pesticides have several negative effects on the environment and human health and restrictions have increased on use of a variety of chemical pesticides. The disease-resistance cultivar usually leads to an increase in fertilizer input and a reduction in banana quality. Therefore, there is an urgent need for effective ways to eliminate FOC from soil and then control banana Fusarium wilt diseases. Recently, reductive soil disinfestation (RSD) increasingly used in USA, Netherlands and Japan is considered as an effective and environmentally friendly way to suppress soil-borne pathogens. In this study, RSD with incorporation of various organic matters under flooding conditions combined with plastic mulching were applied to suppress FOC and prevent banana Fusarium wilt disease. The biological properties of the soil during the RSD process were investigated using quantitative real-time PCR and denaturing gradient gel electrophoresis. Besides, high performance liquid chromatography was used for investigating the role of organic acids in the mechanisms of RSD. The results showed that the values of soil redox potential significantly decreased by >800 mV in the RSD treatments incorporated with rice straw and bagasse under flooding conditions compared with untreated soil. The lowest soil pH (5.36) and a significant decline in the *F. oxysporum* population to 2.79% of untreated soil were obtained in flooded soil with the highest amount (1.2%, w/w) of rice straw (C/N, 46.0). Incorporation of bagasse (C/N, 129.6), pig manure (C/N, 12.8), and lime also significantly decreased the populations of *F. oxysporum*, but were less effective than rice straw. Application of rice straw under flooding conditions significantly decreased fungal diversity and increased soil bacterial diversity, and the increased bacteria, such as *Clostridium* spp. regarded as organic acids producers, were considered to have an antagonistic effect on *F. oxysporum*. In a field experiment, a wilt disease control efficiency of 82.3% was obtained in flooded soil incorporated with 0.5% (w/w) rice straw compared with untreated soil. Besides, four kinds of toxic organic acids to *F. oxysporum* were detected

in soil solutions of RSD treatments. Acetic acid and butyric acid were the primary organic acids, followed by small amounts of isovaleric acid and propionic acid. Furthermore, there was a significant negative correlation between the population of *F. oxysporum* and the total amount of toxic organic acids in RSD. These results indicated that RSD could reduce FOC populations in soil, ameliorate soil microbial communities, and prevent the occurrence of banana Fusarium wilt disease. Organic acids produced in RSD process contributed to the disinfestation effect of RSD.