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Preliminary Research on Soil Conditioner Mediated Citrus Huanglongbing Mitigation in the Field

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Huanglongbing (HLB, yellow shoot disease) is devastating citrus production worldwide. No effective control measure is currently available. In China, management of HLB through nutrient applications was raised in the past and the interest is renewed recently. In this study, the efficacy of a soil conditioner on different ages of huanglongbing (HLB)-affected citrus trees was evaluated at 3 orchards in Sihui and at different months post treatment in Longmen, Guangdong province. Two species, Shatangju (*Citrus reticulata* Blanco cv. Shatang ju) and Chuntianju (*C. reticulata* cv. Chuntian Ju) were evaluated in a completely random design. Symptomatology observation indicated that the treated plants, especially young tree, had more new shoots and young leaves than the untreated plants. In addition, the young leaves on treated plants looked healthy, with few HLB symptoms, compared to the untreated plants. Real-time PCR results indicated a significant “*Candidatus Liberibacter asiaticus*” (“Las”) reduction in the treated 2-year old citrus plants ($p=0.005$). “Las” titers were reduced by 2.19 and 2.45 times in the leaves of treated plants, compared to those of untreated 3 and 8-year-old affected Shatangju trees. Statistical data from different aged Shatangju trees showed “Las” titers were significantly positively related with treatment ($P=0.004$) and age of trees ($P=0.022$), but not with old and young leaves ($P>0.05$). Comparative analysis of the efficacy of soil conditioner treatment in 4-year-old Chuntianju at 2, 4, and 7 month-post treatment (mpt) showed that the quantities of “Las” were significantly lower in newly growing leaves at 7 mpt (94.51% decrease or 2.59 times lower than those at 4 or 2 mpt, $p=0.002$). Bacterial titers in treated plants were significantly lower (34.12% decrease) than control plants, and 82.72% lower in young leaves than in mature leaves. The P values of treatment (treated and untreated), leaf part (old leaf and new leaf), and sampling time (at different months after treatment) were $P=0.014$, $P<0.001$, and $P<0.001$, respectively. The Soil conditioner test revealed that the P, N, K, organic matter, and Mn contents in the soil conditioner-treated orchard soil were all significantly higher than in the non-treated soil at 2 mpt ($p<0.05$). Unexpectedly, microflora at the treated and nontreated sites in the orchards seemed to have no apparent difference in total viable colony numbers and microorganism types. Semi-quantitative RT-PCR found most defense response genes increased in the treated plants. On the other hand, most starch synthesis related genes, including genes coding for a phloem-specific lectin PP2-like protein, were more strongly expressed in the untreated plants. This study suggests that the soil conditioner not only works as a fertilizer, but also can play a role in “Las” titer management.

Key words Huanglongbing; Soil conditioner; “*Candidatus Liberibacter asiaticus*”