The impact of alternate-furrow irrigation with livestock wastewater on antibiotic resistance gene abundance in soil

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One effective approach to treating large amounts of wastewater produced during livestock production is to use it to irrigate crops. However, antibiotics and antibiotic resistance genes (ARGs) associated with wastewater may enter the soil and plants. ARGs are spread readily among microbial populations by mobile genetic elements, and may pose threats to human health. Compared with conventional furrow irrigation (CFI), alternate-furrow irrigation (AFI) can reduce water use and still achieve high yields. These different irrigation methods may influence the fate of ARGs in soil, but few reports have studied the combined effects of AFI and livestock wastewater upon the distribution of ARGs in soil. Here, swine wastewater was used to irrigate cultivated peppers, and compared to relatively ARG-free groundwater. AFI was compared to CFI (100%) at three AFI irrigation rates (80%, 65% and 50% of CFI). The results showed that wastewater irrigation resulted in greater accumulation of antibiotics and ARGs in soil than groundwater irrigation. The effect of wastewater was much more pronounced in rhizosphere than in the bulk soils. Compared with CFI, AFI using wastewater reduced the relative abundance of ARGs in rhizosphere, but the concentration of antibiotics was largely unaffected; though antibiotic concentrations in roots were significantly lower, the abundance of ARGs in roots at 50% and 65% rates and in fruits at 50% rate were significantly increased when using wastewater. The soil bacterial communities did not change significantly between the different irrigation rates, but different behaviours were observed between ARGs and antibiotics at different irrigation rates. Antibiotic availability plays an important role in the diffusion of ARGs. In conclusion, AFI with livestock wastewater can reduce the relative abundance of ARGs in rhizosphere, but reducing irrigation amount should be employed carefully for the safe agricultural production.

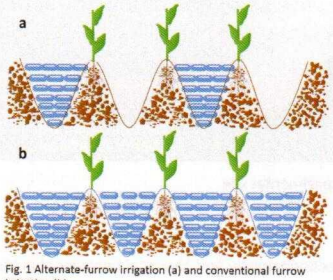

Fig. 1 Alternate-furrow irrigation (a) and conventional furrow irrigation (b)

Biography

Professor Zhongyang Li is mainly engaged in the research on agricultural safety utilization of livestock wastewater and reclaimed water and the amelioration technology of soil polluted with heavy metals, antibiotics in farmland.

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