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Linkages between soil micro-food webs and agroecosystem multifunctionality under organic and/or inorganic fertilization

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Reducing chemical fertilizers and agricultural residues substitution is a feasible practice to develop sustainable agriculture. However, there is a lack of evaluation on the ecosystem functioning and services of different reducing chemical fertilizers and agricultural residues substitution practices, as well as the roles of soil micro-food webs in sustainable agriculture. Here, we evaluated changes in crop yields, soil physico-chemical properties, soil micro-food web assembly, and ecosystem multifunctionality, and the contribution of soil micro-food web assembly to ecosystem multifunctionality under six long-term fertilization treatments: no fertilizer control, conventional chemical NPK fertilizers, and the reducing chemical NPK fertilizers and low- (30%) or high- (60%) levels of agricultural residues (i.e., straw or cattle manure) substitution. Our results showed that the reducing chemical fertilizers and agricultural residues substitution practices can maintain crop yields and improve soil fertility compared with chemical fertilizers application alone. The improvement of soil micro-food web was more obvious with the reducing chemical fertilizers and agricultural residues substitution practices, such as increased soil bacterial biomass, maintained soil biodiversity, and mitigated the negative effects of long-term chemical fertilizers application alone on soil micro-food web. More importantly, maintaining soil bacterial biomass, especiallly the beneficial microorganisms (e.g., *Proteobacteria* and *Firmicutes*), and bacterivorous nematode abundance is primarily important in maintaining ecosystem multifunctionality. Overall, the reducing chemical fertilizers and agricultural residues substitution practices improved agroecosystem functioning and services and contributed to sustainable agriculture.