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The Preliminary Exposition of Soil Biological Activity, Microbial Diversity and Morpho-Physiological Indexes of Cucumber under Interactive Effect of Allelopathic Garlic Stalk: A Short-Term Dynamic Response in Replanted Alkaline Soil

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Abstract : Background and Aims: In recent years, protected cultivation trend, especially in the northern parts of China, spread dynamically where production area, structure, and crops diversity have expanded gradually under plastic greenhouse vegetable cropping (PGVC) system. Under this growing system, continuous monoculture with excessive synthetic fertilizers inputs are common cultivation practices frequently adopted by commercial producers. Such long-term cumulative wild exercise year after year sponsor the continuous cropping obstacles in PGVC soil, which have greatly threatened the regional soil eco-sustainability and further impose the continuous assault on soil ecological diversity leading to the exhaustion of agriculture productivity. The aim of this study was to develop new allelopathic insights by exploiting available biological resources in the favor of sustainable PGVC to illuminate the continuous obstacle factors in plastic greenhouse. Method: A greenhouse study was executed under plastic tunnel located at the Horticulture Experimental Station of the College of Horticulture, Northwest A&F University, Yangling, Shaanxi Province, one of the prominent regions for intensive commercial PGVC in China. Post-harvest garlic residues (stalk, leaves) mechanically smashed, homogenized into powder size and incorporated at the ratio of 1:100; 3:100; 5:100 as a soil amendment in a replanted soil that have been used for continuous cucumber monoculture for 7 years (annually double cropping system in a greenhouse). Results: Incorporated C-rich garlic stalk significantly influenced the soil condition through various ways; organic matter decomposition and mineralization, moderately adjusted the soil pH, enhanced the soil nutrient availability, increased enzymatic activities, and promoted 20% more cucumber yield in short-time. Using Illumina MiSeq sequencing analysis of bacterial 16S rRNA and fungal 18S rDNA genes, the current study revealed that addition of garlic stalk/residue could also improve the microbial abundance and community composition in extensively exploited soil, and contributed in soil functionality, caused prosper changes in soil characteristics, reinforced to good crop yield. Conclusion: Our study provided evidence that addition of garlic stalk as soil fertility amendment is a feasible, cost-effective and efficient resource utilization way for renovation of degraded soil health, ameliorate soil quality components and improve ecological environment in short duration. Our study may provide a better scientific understanding for efficient crop residue management typically from allelopathic source.

Keywords : garlic stalk, microbial community dynamics, plant growth, soil amendment, soil-plant system
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