The potential of fungal biofilms in desert soil rehabilitation

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Abstract: Xinjiang Province, located in the northwest of China, holds immense importance both geographically and strategically. It borders eight countries, making it a vital bridge for international trade, economic cooperation, and cultural exchanges. Th Rikke Meyer its harsh conditions, the desert is dotted with oases that support agriculture and sustain life. Furthermore, the northern part of Xinjiang is known for its fertile grasslands and forests, which are essential for the region's livestock and agricultural industries. The plains and deserts of Xinjiang are dominated by soil types such as brown calcareous soil, light brown calcareous soil, grey desert soil, and aeolian sandy soil. However, due to the arid climate, high evaporation rates, high groundwater levels, and inefficient irrigation practices, soil salinization and alkalization can be seen there. Some areas of Xinjiang suffer from soil fertility problems, particularly low organic matter content and deficiencies in nutrients like nitrogen and phosphorus. Therefore, it is necessary to develop the soil conditions to overcome these issues. Microbial biofilms play a crucial role in agriculture, in the challenge of harsh environments and climatic change. Especially, fungal-fungal biofilms and fungal-bacterial biofilms can improve the soil fertility and plant growth promotion, when used as Biofilm biofertilizers (BFBFs). In this study, we focus on understanding biofilm formation and utilization of fungal biofilms to improve soil fertility in desert environments. Macrofungi which are taxonomically known as basidiomycetes are associated with all living plants as Arbuscular Mycorrhizal (AM) symbionts. In recent years, AM fungi (AMF) have shown significant effects in improving saline-alkali soil environments and promoting grass growth. To date, from Xinjiang, over 1000 species of fungi have been reported. Among these *Russula* and *Lactarius* are common examples of AMF with the potential bioprotectants promoting plant growth. In addition to this, *Trichoderma* is a common soil fungus genus, which consists of over 100 species. These species have been utilized to develop crop yield in saline-alkali land. Studies have shown that *Azotobacter chroococcum* and *Trichoderma viride* can develop biofilm which can induce plant defense enzyme activities in cotton and wheat seedlings. Cotton wilt disease caused by *Fusarium* has led to a significant reduction in cotton production in Xinjiang. Therefore, further studies are required to develop BFBFs to enhance crop production in Xinjiang. Even though the environmental factors are harsh in Xinjiang region, bacteria, mosses, algae, lichens, and other microorganisms are abundant in this soil, as well as lower plants and their secreted substances interact with the soil to form a tightly layered shell on the surface. In the future, these microbial resources can be utilized to develop fungal biofilms to address these fertility issues.

Keywords: Fungal biofilms, Phosphorus deficiency, Saline alkali soil, Desert, *Trichoderma,* Xinjiang Province