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Soil Actinomycetes as Promising Alternative to Synthetic Herbicides

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Abstract

Weed management is a key agronomic practice in agriculture. Since decades, synthetic herbicides played an indispensable role in weed control due to high effectiveness. However, recently there has been growing interest on exploring alternative weed control methods due to negative impacts of synthetic herbicides on the environment. Besides, there is an increasing demand for organic farm products. Actinomycetes, a group of filamentous, Gram-positive bacteria known for their bioactive secondary metabolites, have emerged as potential candidates for bioherbicides. In this study, we investigated herbicidal potential of twenty-three morphologically distinct actinomycetes strains isolated from soil using lettuce (*Lactuca sativa*) as a model plant. Eight weeks-old cell-free culture fermentation broth of actinomycetes strains were used for screening the effect on seed germination and seedling growth. Lettuce seeds were exposed to fermentation broth for two weeks while for control, sterilized distilled water was used. Ten seeds per treatment in three replicates were used. The results showed that sixteen actinomycetes strains, *ACM*25, 26, 29, 33, 34, 35, 36, 38, 41, 42, 43, 47, 48, 49.1 and 49.2 and *ACM*50 were able to completely inhibit seed germination while seeds treated with *ACM*32 did not produce roots although seed germination had initiated. It appears that these seventeen strains would be effective at pre-emergence weed control. Seeds that treated with the rest of the six strains had no effect on the seed germination. However, seedlings of *ACM*24, 45 and *ACM*46-treated seeds showed deaths by two weeks. Their gradual death started with discoloration of leaves followed by watery rotting of the entire plant. Seedlings of *ACM*30, 31, 37-treated seeds survived, and their growth performance were observed for two weeks compared to the control. Seedlings were dwarf and exhibited growth deformations such as reduced leaf size, chlorosis, leaf curling and stunted roots. Further, number of leaves, shoot length and root length were significantly different (p<0.05) from that of the control. These observations suggest that the effect of *ACM*24, 30, 31, 37, 45 and *ACM*46 would be systemic. In conclusion, our results clearly showed strong herbicidal effects of all tested twenty-three strains of actinomycetes at pre- and post-emergence stages of seed germination. Thus, they can be promising candidates for bioherbicide formulations.

***Keywords**:* Actinomycetes, Bioherbicides, Weed management, Sustainable agriculture