ROLE OF ACTINOMYCETES IN DISEASE CONTROL IN AGRICULTURE AND HORTICULTURE CROPS

Abstract

Actinomycetes as a suitable biofertilizer and biocontrol agent in Agriculture and Horticulture crops compare to other microbes because laboratory to field transfer easily and good self-life under different biotic and abiotic factors. The prokaryotes with the highest commercial and biotechnological value are actinomycetes. *Streptomyces* spp., a genus of actinomycetes, are widely employed for the manufacturing of antibiotics and agrochemicals as well as biological control agents against fungal phytopathogens such *Pythium ultimum, Fusarium oxysporum, Sclerotinia homeocarpa, and Phytophthora fragariae* that cause soil-borne diseases. *Streptomyces coelicolor* HHFA2 strain is responsible for preventing bacterial rot in onions. *Streptomyces, Amycolatopsis, Micromonospora, Frankia, and Nocardia* actinobacterial strains have been shown to effectively reduce soil-borne diseases while assisting host plants in mobilizing and acquiring macro- and micronutrients. Testing was done on isolates of *Actinoplanes philippinensis, Actinoplanes missouriensis*, and *Streptomyces clavuligerus* against *Drosophila melanogaster*. Synthetic pesticides are widely used, which has resulted in the emergence of pathogens and insect pests that are resistant to them, environmental pollution, contamination of groundwater, and an overall ecological imbalance.

Keywords: Actinomycetes; Habitat; Biofertilizer; biopesticide, Agriculture; Pigments

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I. INTRODUCTION

The major problem of increasing agricultural crop production is the presence of diseases and insect pests. Due to their eco-friendliness, low production costs, and decreased use of non-renewable resources, the mode of application of potential bacteria with secondary metabolite and antimicrobial capabilities has emerged as one of the most alluring solutions for improving the sustainability of agricultural production. Actinomycetes are a good alternative among them for the control of illnesses and pest insects. Prokaryotic microorganisms called actinomycetes are used as biocontrol agents to treat plant diseases and insect pests. Their synthesis of primary and secondary metabolites with antibiotic properties against a variety of diseases is well documented (1, 2, 6, 7, 8). These prokaryotes are the most valuable in terms of technology and the economy. These make up a significant amount of the biomass of soil-dwelling microorganisms and are capable of producing a wide range of secondary metabolites. Actinomycetes have been found to create a variety of important bioactive metabolites, including those that are insecticides, herbicides, antibacterial, antifungals, and antibiotics. Streptomyces species, which are primarily used for the synthesis of antibiotics and agrochemicals, are responsible for the creation of more than 60% of all known antibiotics (4, 5). Therefore, actinomycetes are an effective alternative for the management of insect pests and diseases, and several well-documented publications have examined their potential (1, 2, 7, 8). Streptomyces has been used extensively in the manufacture of antibiotics, fungicides, bactericides, herbicides, insecticides, and acaricides. They are frequently used as a wettable powder, wettable granule suspension, wettable spore suspension, and wettable culture filtrate on target crops. The biocontrol of plant diseases is efficient and risk-free for all living creatures, even though it takes some time to take effect. The rhizosphere-colonizing bacteria are great candidates for use as biological control agents against soil-borne diseases, as demonstrated by Weller (1988). The lytic enzymes, antibiotics, and secondary metabolites that Streptomyces species produce have been extensively used as potential biological control agents against *Phytophthora fragariae, F. oxysporum* (11), *S. homeocarpa* (12), *P. ultimum* (10), and other fungal phytopathogens (13).

An isolated strain of *Streptomyces lavendulae* HHFA1 and *Streptomyces coelicolor* HHFA2 was used *in vivo* (pots and field) for controlling onion bacterial rot. *S. coelicolor* HHFA2 application resulted in enhancement in the photosynthetic pigments and some foliar growth parameters of onion plants confirming its growth-promoting effect. To control the biocontrol of soil-borne plant diseases, actinobacterial, bacterial, and fungal antagonists have been used. Actinobacterial strains of *Streptomyces, Amycolatopsis, Micromonospora, Frankia, and Nocardia* have been demonstrated to successfully lower soil-borne illnesses while supporting host plants in mobilizing and absorbing macro- and micronutrients. These distinct actinomycetes with their wide range of plant growth promotion and antagonistic-promoting parameters must be employed for safe agriculture practice. The present study deals with actinomycetes a comprehensive overview of the major soil pathogenic microbes that create the diseases that impact chickpea and pigeon pea, as well as prospective control techniques utilizing broad-spectrum actinomycetes, mainly *Streptomyces* spp (19).

The majority of actinomycetes strains were used in monkhood growth promotion and soil-borne root disease biocontrol after applying a mixed actinomycetes preparation to the soil, we also looked at the long-term effects on disease prevention and plant growth.

Sclerotium rolfsii a fungus that can cause southern blight, and *Fusarium oxysporum*, a fungus that can cause root rot, were both suppressed by the addition of cell-free culture filtrates from the strains Act12 and D74 in *A. Carmichaelii* (14). *Actinoplanes philippinensis*, *Actinoplanes missouriensis,* and *Streptomyces clavuligerus* isolates were tested against *Drosophila melanogaster*. The three actinomycetes were individually applied against *D. melanogaster*, and then in combinations of two and all three actinomycetes, isolates were used to study synergistic and antagonistic effects between them.

Scientific evidence for this claim is provided by (16) proven actinomycetes effectiveness against *Culexquinque fasciatus* and (15) very high mortality of larval and pupal stages of *Musca domestica* reaching up to 90% of mortality following actinomycetes treatments. The ability of actinomycetes to produce the enzyme chitinase, which breaks down the chitin surface of insects and enables the secondary compound to induce the kill of the organism into the insect body, is particularly responsible for the effective action of these organisms against insects (17).

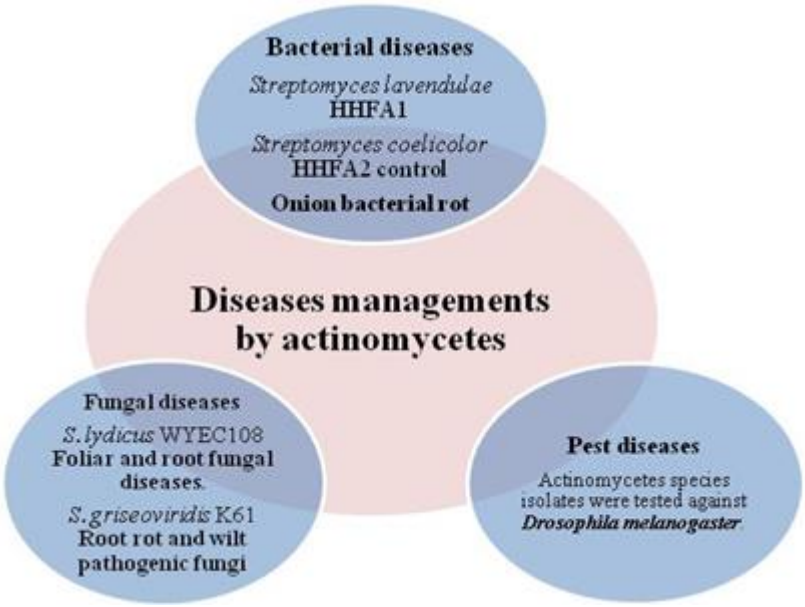

Figure 1: Actinomycetes as diseases and pest control

Continuing the use of chemical fertilizer application in the agriculture field, will support soil-born pathogens and create a huge loss of agriculture productivity, and create environment segment pollution and imbalance of ecosystem (3).

II. MARKET AVAILABLE PRODUCTS

Important producers of enzymes like cellulases, quininases, proteases, and peptidases are actinomycetes. The most crucial enzymes in the process of controlling phytopathogenic fungus are quitinases. Actinovate, a bio fungicide obtained from *Streptomycetes* sp, is used to combat soil- and seed-borne plant infections (*Fusarium, Alternaria, Phytophthora, and Pythium*) that cause damping-off and root diseases. This includes MYCOSTOP. For fresh market tomatoes, a strain of this species called *Streptomyces lydicus* WYEC108 has been

developed to effectively control fungal plant pathogens. PRE STOP is also used to effectively control the commercially available cucumber diseases Didymella (Mycosphaerella) gummy stem blight and Botrytis grey mold.

Figure 2: Markedly available products

III. APPLICATION METHOD OF ORGANIC BIOPESTICIDES AND BIO FUNGICIDES

Drone-based spraying: Actinomycetales are characterized by aerial mycelium development and substrates. They are the microorganisms in the soil that are most prevalent. They are crucial in the organic matter cycle and prevent the growth of several plant diseases in the rhizosphere. Actinomycetes have been investigated as natural pest management for insects and phytopathogenic fungi that cause significant losses in agriculture due to the presence of enzymes including proteases and chitinase. Actinomycetes are favored for the management of pests due to their diversity of generated metabolites and facilities for the industrial modification of cultures. Actinomycetes are also a "green" alternative to traditional pesticides because they are organic components of soil and do not harm the environment. Due to their capacity for degradation and capacity to produce stable humus, they also aid in the production and stabilization of compost piles, which contribute to the long-term sustainability of the soil.

Although the management of fungus-related plant diseases by streptomyces is well documented, there aren't many commercial products on the market that use particular strains of the microorganism or its metabolites. The use of perspective microorganisms in biocontrol programs like *S. plicatus* connecting their enzymatic characteristics seems practicable to create ways for manufacture by separation of an antimicrobial compound, or the direct use of separation of liquid culture, even though it is unmanageable for scale production (18).

For crop spraying on vast regions quickly, drones can transport appropriately sized reservoirs that can be filled with fertilizers, herbicides, or pesticides. Due to its

autonomous and pre-programmed operation on predetermined schedules and routes, crop spraying is significantly safer and more economical. Drones can also be set to automatically alter their speed and altitude.

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