**Role of Actinomycetes in diseases control in agriculture and horticulture crops**

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**ABSTRACT**

The actimycets as a suitable biofertilizer and biocontrol agent in Agriculture and Horticulture crops compare to other microbes because lab 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 *P. ultimum, F. oxysporum, S. homeocarpa, and Phytophthorafragariae* that cause soilborne diseases. *Streptomyces coelicolor's* HHFA2 starin 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 *Actinoplanesphilippinensis, Actinoplanesmissouriensis*, 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.

**Keywards:** Actinomycets; Habitate; Biofertilizer; biopesticide, Agriculture; Pigments

**INTRODUCTION**

Diseases and insect pests are the major hurdle in enhancing the production of agricultural crops. The use of bacteria having antimicrobial properties has become one of the most attractive options for enhancing the sustainability of agricultural production due to their eco-friendliness, low production cost, and reduced use of non-renewable resources. Among them, actinomycetes are the good alternative for the management of insect pests and diseases. Actinomycetes are prokaryotic microbes being exploited as biocontrol agents for the management of insect pests and diseases of plants. They are well known for the production of primary and secondary metaboliteshaving antibiotic activities against a variety of pathogens (1, 2, 6, 7, 8).These are the most economically and biotechnologically valuable prokaryotes. These represent a high proportion of the soil microbial biomass and have the capacity to produce wide variety of secondary metabolites. Several strains of actinomycetes have been acknowledged as prolific producer of valuable bioactive metabolites as antibacterial, antifungal, antibiotic, antiparasitic, insecticide, and herbicide. Among the known antibiotics, more than 60 % are produced by *Streptomyces* spp. which are largely being exploited for production of antibiotics and agrochemicals (4, 5). Therefore, actinomycetes are the good alternative for the management of insect pest and diseases, and many reports are well documented to explore its potential (1, 2, 7, 8). It is observed that Streptomyces has been greatly exploited for the production of antibiotics, fungicides, bactericides, herbicides, insecticides, and acaricides. Generally, they are applied to target crops in the form of culture filtrate, spore suspension, wettable powder, emulsifiable concentrate, and wettable granules. Biocontrol of plant diseases is though slow in action, it can be long lasting and harmless toliving beings. Weller (1988)demonstrated that microorganisms that colonize the rhizosphere are ideal for the use of biological control agents against soilborne diseases. *Streptomyces* spp. produce secondary metabolites, antibiotics, and lytic enzymes, which have been used extensively as potential biological control agents against fungal phytopathogens such as *P. Ultimum* (10*), F. Oxysporum* (11)*, S. Homeocarpa* (12) *and Phytophthoora fragariae* (13).

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.Biocontrol of soil-borne plant pathogens has been managed using antagonistic actinobacteria, bacteria, and fungi. Actinobacterial strains of *Streptomyces, Amycolatopsis, Micromonospora, Frankia, and Nocardia* were reported to exert effective control on soil-borne pathogens and help the host plants to mobilize and acquire macro- and micronutrients. Such novel actinomycetes with wide range of plant growth-promoting (PGP) and antagonistic traits need to be exploited for sustainable agriculture. This chapter gives a comprehensive analysis of important soil-borne diseases of chickpea and pigeonpea and how broad-spectrum actinomycetes, particularly *Streptomyces* spp., could be exploited for managing them(19).

**Table 1: Causative organism and Diseases**

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| --- | --- | --- |
| **Actinomycetes** | **Name of isolate/strain** | **Target pathogen/disease** |
| *Streptomyces sp.* | CACIS-1.16CA | *Curvularia* sp., *Aspergillus niger, Helminthosporium* sp., *Fusarium* sp. *Alternaria* sp., *Phytophthora capsici, Colletotrichum* sp., and *Rhizoctonia* sp. |
| *Streptomyces rochei* | – | Pepper root rot (*P. capsici*) |
| *S. lydicus* | WYEC108 | Foliar and root fungal diseases |
| *Streptomyces griseoviridis* | K61 | Root rot and wilt pathogenic fungi |
| *Streptomyces violaceusniger* | g10 | Banana wilt (*F. oxysporum* f. sp. cubense) |
| *S. cacaoi* | 182-2 | Brown spot of tobacco  (*A. alternata*) |
| *Streptomyces lavendulae* | HHFA1 | Onion bacterial rot  (*Erwinia carotovora* subsp. *carotovora and Burkholderia cepacia*) |
| *Streptomyces coelicolor* | HHFA2 |
| *Streptomyces halstedii* | K122 | *Aspergillus fumigatus, Mucorhiemalis,*  *Penicillium roqueforti*, and *Paecilomyces variotii* |

Actinomycetes strains (*Streptomyces pactum* Act12 and *Streptomyces rochei* D74) in the biocontrol of soil-borne root diseases and growth promotion of monkhood (*Aconitum carmichaelii*). We also examined their long-term effects after soil application of a mixed Actinomycetes preparation significant effects of disease control and plant growth promotion. Adding cell-free culture filtrates of both strains Act12 and D74 inhibited the growth of fungal pathogens capable of causing southern blight (*Sclerotiumrolfsii*) and root rot (*Fusarium oxysporum*) 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*, andthen in combinations of two and all three actinomycetes isolates were used to study synergistic and antagonistic effectsbetween them.

Scientificall documented by (15) very high mortalityof larval and pupal stages of *Musca domestica* reachingup to 90% of mortality, after actinomycetes treatments and (16) verified actinomycetes effectiveness against *Culexquinque fasciatus*. The effective action of actinomycetes against insects is not only attributed to the production of bioactive compounds, but especially attributed to their capacity to produce chitinase enzyme, which degrades the insect chitin surface, allowing penetration of bioactive toxic lethal compound in the insect body (17).

**Figure 1: Actinomycetes as diseases and pest control**

The frequent use of synthetic pesticides has led to the development of pesticide-resistant pathogens and insect pests, environmental pollution, negative effects on natural enemies, human health hazards, and pollution of underground water, thereby causing ecological imbalance (3).

**MARKET AVAILABLE PRODUCTS**

Actinomycetes are important enzyme producers, such as quitinases, proteases, peptidases and cellulases. Quitinases are the most important in the process of phytopathogenic fungi control. biofungicides such as MYCOSTOP are produced using actinomycetes for the control of seed- and soil-borne plant pathogens (*Fusarium, Alternaria, Phytophthora* and *Pythium*) which cause damping-off and root diseases, Actinovate isolated from streptomycetes species. *Streptomyces lydicus WYEC108* is a strain of this species which has been formulated to control fungal plant pathogens effectively for fresh market tomatoes, PRESTOP is used for controlling damping-off and rootdiseases (*Pythium, Fusarium, Phytophthora and Rhizoctonia*) as well as for the control of *Botrytis greymould* and Didymella (*Mycosphaerella*) gummy stemblight in cucumber whichare all available commercially.

**Figure 2: Markedly available products**

**APPLICATION METHOD OF ORGANIC BIOPESTICIDES AND BIOFUNGICIDES**

**Drone based spraying**

Actinomycetales and are characterized by substrates and aerial mycelium growth. They are the most abundant microorganisms in soil. They play important roles in the cycling of organic matter and inhibit the growth of several plant pathogens in the rhizosphere. Due to the presence of enzymes such as proteases and chitinase, actinomycetes have been studied as a natural controller of insects and phytopathogenic fungi that cause considerable losses in agriculture. Additionally, the facilities for the industrial manipulation of cultures, and the diversity of metabolites produced make actinomycetes preferred for the control of pests. Furthermore, actinomycetes constitute a “green” alternative for controlling insects and fungi, since they do not contaminate the environment, and are natural members of the soil. They also contribute to the sustainability of soil by formation and stabilization of compost piles, due to their degrading capabilities, and ability to form stable humus.

Fungal plant diseases management by Streptomyces has been well documented, but few commercial products are in the market using specific strains of the microorganism or its metabolites. While it is unmanageable for massive production, the potential microorganisms like *S. plicatus* used in biocontrol programmes connecting their enzymatic properties seems to be practical to develop methods for production and extraction of secondary metabolites, or the use of extract of broth directly (18).

Drones can carry suitably sized reservoirs, which can be filled with fertilizers, herbicides, or pesticides for crop spraying on large areas in less time. Crop spraying is much safer and cost-effective by its autonomous and pre-programmed run on specific schedules and routes. Drones are also programmed to self-adjust its altitude and speed.

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