Bio. Res. Today 2026, 8(5):00-00

Biotica Research Today

e-ISSN: 2582-6654

May, 2026

Article ID: RT1889

Popular Article

Streptomyces: Nature's Antibiotic Factory

Pothiraj G.[1*], Gopalakrishnan R.[2], Elangovan A.[3] and Basavaraj Y.B.[1]

[1]*ICAR-Indian Agricultural Research Institute, Regional station, Pune, Maharashtra (410 067), India*

[2]*Division of Agricultural Entomology, ICAR-Indian Agricultural Research Institute, New Delhi (110 012), India*

[3]*Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi (110 012), India*

Open Access

Corresponding Author

Pothiraj G.

: pothiraj431@gmail.com

Conflict of interests: The authors have declared that no conflict of interest exists.

How to cite this article?

Pothiraj, G., Gopalakrishnan, R., Elangovan, A., *et al*., 2026. Streptomyces: Nature's Antibiotic Factory. *Biotica Research Today* 8(5), 00-00.

Abstract

As beneficial soil microorganism, Streptomyces species are widely recognized for their ability to biosynthesize a wide variety of antibiotics and bioactive compounds. These naturally occurring substances suppress detrimental bacterial and fungal pathogens through the impairment of essential physiological processes and also utilized in entomological research primarily to manipulate, study and eliminate insect gut microbiomes. Streptomyces derived antibiotics contain very potent and diverse kinds of antimicrobial activities and thus are very useful for agricultural applications. In addition to their antimicrobial functions, these microbes contribute to plant vigor and improved health. Streptomyces therefore are a rich source of environment friendly plant protection products that can be utilized for enhancing agricultural sustainability in the long run.

Keywords: Antibiotics, Classification, Streptomyces, Sustainable plant disease control

Introduction

The discovery of antibiotics is a milestone in the control of plant diseases. Antibiotics are defined as chemical substances produced by one microorganism that can inhibit the growth of or kill other microorganisms at very low concentrations (Ghosh and Mondal, 2024). These secondary metabolites are great values as therapeutic agents, plant growth promoters, feed additives and also antifungal or antibacterial agents to control plant pathogens. Since, then antibiotics have attracted considerable attention from plant pathologist and agricultural researcher because of their important role in controlling plant pathogens.

Streptomyces

Streptomyces is a soil-inhabiting, Gram-positive, non-motile actinobacterium characterized by the absence of flagella. It is an aerobic that forms white-colored or grey aerial mycelium when grown on culture media. Morphologically, Streptomyces forms a thread-like network called a mycelium, which bears chains of spores at maturity. Their branching filaments are typically 0.5-1.0 µm in diameter. The genus Streptomyces represents the largest group of antibiotic-producing microorganism, capable of synthesizing a wide array of antibacterial, antifungal other bioactive secondary metabolites. In 1944, Selman A. Waksman at Rutgers University discovered the antibiotic streptomycin, from a Streptomyces species making a breakthrough in antimicrobial therapy (Waksman *et al.*, 2010). Streptomyces are responsible for producing more than half of the world known antibiotics, making them indispensable in both medical and agricultural applications.

Classification of Antibiotics

In general, the antibiotics are classified into two group's *viz*., antibacterial antibiotics (effective against bacteria) and antifungal antibiotics (effective against fungi), as detailed in table 1. It is an important chemotherapeutic agent active against gram-positive and gram-negative including mycobacteria and fugal plant pathogens (Saikia and Chetia, 2024).

Mode of Action of Antibiotics

A number of antibiotics produced by Streptomyces species have important roles as inhibitors of crucial microbiological process. Streptomycin for example, acts as an uncoupling

Article History

RECEIVED on RECEIVED in revised form ACCEPTED in final form

agent and inhibits both electron transport and protein synthesis by binding to the 30S ribosomal subunit, causing misreading of mRNA during translation. Tetracycline prevents the attachment of the aminoacyl t-RNA to the acceptor site of the ribosome's thereby blocking the addition of amino acids to the growing peptide chain; it also affects the synthesis of certain amino acids and ribosomal proteins. Cycloheximde is an inhibitor of protein and nucleic acid synthesis that acts by binding to the translocation site on eukaryotic ribosome. Blasticidin inhibits protein synthesis by interfering with the formation and termination of peptide bonds during translation. All these antibiotics show diverse biochemical actions of microbial metabolites that either inhibit or kill the target pathogens.

Table 1: List of antibiotics used in plant disease management

Antibiotic	Source	Trade name/ Commercial name	Effective against
Antibacterial antibiotics			
Streptomycin sulphate	*Streptomyces griseus*	Agrimycin,-100, Plantomycin, Streptocycline, Paushamycin, Phytostrip, Agristrep, Embamycin	Fire blight of apple and pear, Citrus canker, Cotton black arm, Bacterial leaf spot of tomato, Wild fire of tobacco, soft rot of vegetables.
Tetracycline	*S. rimosus*	Terramycin, Oxymycin, Oxytetracyclin	Seed borne bacteria, Candidatus phytoplasma, Crown gall
Antifungal antibiotics			
Cycloheximide	*S. griseus, S. nouresi*	Actidione, Actispray	Powdery mildew of beans, Bunt of wheat, Brown rot of peach, Post-harvest rots of fruits
Blasticidin	*S. griseochromogenes*	Bla-s	Rice blast
Antimycin	*S. kaviengensis, S. lusitanus*	Antimycin	Early blight of tomato, Rice blast, Seedling blight of oats
Kasugamycin	*S. kasugaensis*	Kasumin	Rice blast
Thiolution	*S. albus*	Thiolution	Late blight of potato, Downy mildew of crucifers
Endomycin	*S. endus*	Endomycin	Leaf rust of wheat, Fruit rot of strawberry
Nystatin	*S. noursei*	Mycostain, Fungicidin	Anthracnose of banana, Downy mildew of cucumber
Validamycin	*S. hygroscopicus*	Validamycin	Sheath blight of rice

Role of Streptomycin in Entomological Studies

Semisynthetic Diet

Streptomycin plays a vital role in insect semi-synthetic diet preparation and maintaining the hygienic condition of the diet devoid of microbial contamination. Being aminoglycoside antibiotic, it suppresses the growth of other bacterial contamination and the major bacterial contaminant in laboratory condition is *Aspergillus* sp. The artificial diet devoid of streptomycin affects the shelf life and nutritional quality of the diet. It plays a valuable role in studies involving gut microbiota, in vivo assay, or bioassays where aseptic conditions are critical for reliable results. The concentration of streptomycin added to the diet is very crucial as higher concentration inhibit the bacterial endosymbionts in insect gut and results in incorrect report of results.

In vivo Studies

Streptomycin is commonly used in insect in vivo studies to suppress microbial contamination and stabilize artificial diets. It plays a key role in modulating gut microbiota and re –establishment of desirable microbiota for investigations of insect–microbe interactions. However, studies have demonstrated that excessive streptomycin exposure can reduce microbial diversity, impaired developmental and altered physiological and behavioral responses in insects such as *Spodoptera frugiperda, Drosophila melanogaster* and *Bombus impatiens* (Keles *et al.,* 2021).

Conclusion

A great number of antibiotics which have been used to control plant pathogens and to protect plants against plant pathogens are derived from soil microorganisms, particularly soil microorganism particularly from Streptomyces species. Many naturally occurring compounds that have been found in soil by exploring the soil microorganism have been revolutionizing medical science. These naturally occurring compounds have also made great contributions to sustainable plant disease management. Streptomyces species continue to be the most productive group of organism to yield bioactive secondary metabolites with broad spectrum activity against bacteria and fungi. Future research is needed to search for new antibiotic producing microorganism and their metabolites, in order to find new bioactive compounds, which are environmentally friendly and will reduce our dependence on synthetic chemical compounds.

References

Ghosh, S., Mondal, A., 2024. Role of antibiotics in plant disease control. *Agri Journal World* 4(9), 23-28.

Keles, V., Buyukguzel, K., Buyukguzel, E., 2021. The effect of streptomycin on survival, development and some biochemical aspects of *Drosophila melanogaster*. *Turkish Journal of Zoology* 45(6), 432-441. DOI: https://doi.org/10.3906/zoo-2101-14.

Saikia, S., Chetia, P., 2024. Antibiotics: From mechanism of action to resistance and beyond. *Indian Journal of Microbiology* 64(3), 821-845. DOI: https://doi.org/10.1007/s12088-024-01285-8.

Waksman, S.A., Schatz, A., Reynolds, D.M., 2010. Production of antibiotic substances by actinomycetes. *Annals of the New York Academy of Sciences* 1213(1), 112-124. DOI: https://doi.org/10.1111/j.1749-6632.2010.05861.x.