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PLANT GROWTH PROMOTION BY ACTINOMYCETOTA OTHER THAN STREPTOMYCES

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ABSTRACT

Microorganisms play an important role in the plant system and have incredible metabolic capabilities. They assist the host in dealing with a wide range of biotic and abiotic stressors. *Actinomycetota* members are abundant in soil and have been shown to aid plant growth in a variety of ways, including increased nutrient availability, disease prevention, nitrogen fixation, and the production of hydrolytic enzymes and phytohormones. There is a wealth of literature focusing on *Streptomyces* members reporting plant growth promotion. The current review will focus on *Actinomycetota* other than *Streptomyces* that promote plant growth.

KEYWORDS: *Actinomycetota*; Plant growth promotion; Plant- microbes interaction.

INTRODUCTION

Plants coexist with a diverse array of microorganisms, including parasites, mutualists, and commensals found in the plant rhizosphere, inside plant tissues (as endophytes), and on the soil surface (phyllosphere).[1,2] Plants provide shelter and nourishment for resident microorganisms, and the microbes in turn secrete compounds that promote plant growth.[3] Microbes can help plants grow in a variety of ways, including increased nutrient availability, disease prevention, nitrogen fixation, and the production of hydrolytic enzymes and phytohormones.[4,5]

Actinomycetota members are Gram-positive bacteria that are common in soil, have many characteristics that are similar to fungi, and form one of the largest bacterial phylum.[6,7] The most recent classification divided the phylum into six classes, 46 orders, and 79 families, with 16 new orders and 10 new families.[8] The use of *Actinomycetota* for agricultural applications has increased in recent years, owing to their potential for plant growth promotion and their ubiquitous repartition in plants.[9,10]

Streptomyces is the most commonly described *Actinomycetota* genus, and it is also known as one of the most abundant sources of bioactive natural products.[11,12] Various *Streptomyces* members have been reported to enhance plant growth promotion[13,14] and in the past few years, various review articles on plant growth promotion by *Streptomyces* members have been covered. Various *Streptomyces* members have been reported to promote plant growth[13,14] and in recent years, several review articles on plant growth promotion by *Streptomyces* members have been published.[15,16] The present review will discuss the plant growth promotion by *Actinomycetota* other than *Streptomyces.*

Plant growth promotion by *actinomycetota* other than *streptomyces*

Plant growth-promoting bacteria enhance plant growth by a wide variety of mechanisms like biological nitrogen fixation, phosphate solubilization, exhibiting antimicrobial activity, and production of phytohormones, 1-Aminocyclopropane-1-carboxylate (ACC) deaminase, siderophore, and volatile organic compounds.[9,17]

Nitrogen is widely regarded as one of the most important limiting nutrients in plant growth.[18,19] It is well known that *Frankia* (the first *Actinomycetota* endophyte) fixes atmospheric nitrogen in symbiosis with plants via root nodule induction.[18,19] Apart from *Frankia*, various non-*Streptomyces* members have been reported for nitrogen fixation. *Intrasporangium* was reported to fix nitrogen in rice plants. The PCR analysis revealed the presence of *nif* gene.[20] A novel endophytic and halotolerant *Actinomycetota*, namely *Brachybacterium saurashtrense* (isolated from *Salicornia brachiate*) has been reported to fix nitrogen.[21] Similarly, a novel endophytic species *Micromonospora veneta* isolated from a surface-sterilized root sample of a native pine tree has been reported for nitrogen fixation.[22]

Microbes play a critical role in phosphorus availability to plants. They also produce phytohormones, which play an important role in plant growth.[23,24] *Nocardia alni* isolated from the root nodule of an *Alnus glutinosa* plant revealed the presence of genes associated with phosphate solubilization, phytohormone production, lytic enzyme, and siderophore production.[25] *Kutzneria* sp. strain TSII isolated from mangrove sediments was reported to produce IAA, protease, phosphatase, siderophores, lipase, cellulases, and amylase, indicating its ability to enhance the growth of plants.[26] Shrivastava et al., reported the production of IAA by *Kitasatospora* sp.[27]

Actinomycetota has also been reported to suppress plant disease and promote plant growth. *Micromonospora* sp. SF-1917 was reported to produce dapiramicin that helps to overcome rice root diseases.[28] *Actinoplanes* spp. was reported to control damping-off disease in Table beet caused by *Pythium ultimum.*[29] Similarly, *Micromonospora chalcea* was reported to control damping-off disease in cucumber caused by *Pythium aphanidermatum*.[30] *Nocardioides* sp. was reported to overcome root rot disease in raspberries caused by *Phytophthora fragariae* var. *rubi*.[31]

Abiotic stress refers to any environmental factor that prevents or restricts plant growth and productivity and is brought on by elements like water, salt, light, temperature, and nutrients.[6] Various *Actinomycetota* members have been reported to overcome plant abiotic stress. *Dermacoccus abyssi* MT1.1^{T} isolated from the deep sea has been reported to promote tomato growth under salt stress.[32] *Citricoccus zhacaiensis* B-4 (MTCC 12119), a novel osmotolerant plant growth-promoting actinobacterium, has been shown to improve onion seed germination under osmotic stress conditions.[33] Similarly, *Arthrobacter endophyticus* SYSU 333322 and *Nocardiopsis alba* SYSU 333140 were reported to overcome the salt stress of *Arabidopsis thaliana.*[34] *Arthrobacter arilaitensis* when used as bioinoculants increased growth and reduced the drought stress negative effects of maize plants.[35]

CONCLUSION

Actinomycetota members were abundant in soil and have been shown to aid plant growth in a variety of ways. Although there is a wealth of literature focusing on *Streptomyces* members reporting plant growth promotion but reports on plant growth promotion by non-*Streptomyces* members are scanty. The current review focused on plant growth promotion by non-*Streptomyces* members. Various non-*Streptomyces* members were reported for plant growth promotion through various ways such as nitrogen fixation, phosphate solubilization, exhibiting antimicrobial activity, and production of phytohormones, enzymes, and volatile organic compounds. Looking at the *Actinomycetota* genera, only the tip of the iceberg of non-*Streptomyces* members has been evaluated for plant growth promotion and hence further studies are needed.

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