CHAPTER I
INTRODUCTION

1.1 Background

Cannabis sativa L., more commonly known as marijuana, belongs to the Cannabaceae family and is widely cultivated around the globe (Kanabus et al., 2021). Cannabis has served diverse purposes since ancient times; it has acted as a folk medicine, a psychoactive drug, and a material in the production of textiles and rope (Andre et al., 2016; Dariš et al., 2019; Rupasinghe et al., 2020). With the global interest in cannabis cultivation on the rise, optimizing plant health, productivity, and cultivation methods has become critically important. Among several options, organic cannabis farming has gained popularity due to concerns connected to the health, sustainability, and quality of the produce (Bruce et al., 2022). One promising approach for enhancing the growth and overall health of cannabis plants involves the use of plant-growth-promoting bacteria (PGPBs). In contemporary agriculture, addressing the dual challenges of increasing food demand and environmental sustainability has become imperative. PGPBs have emerged as sustainable bioresources capable of enhancing crop productivity and resilience in various agroecosystems. These bacteria not only improve nutrient availability and uptake efficiency but also enhance root development and stimulate systemic resistance in plants, thereby mitigating biotic and abiotic stresses (Bashan & De-Bashan, 2010; Hayat et al., 2010). Moreover, some PGPBs can produce enzymes like 1-aminocyclopropane-1-carboxylic acid (ACC) deaminase, which is able to alleviate plant stress by reducing ethylene stress levels (Glick, 2014). In the context of cannabis, the plant faces numerous challenges, such as nutrient depletion and susceptibility to pathogens. Incorporating PGPBs into cannabis farming has shown promise for enhancing plant growth, yield, and resilience. For instance, the supplementation of *Pseudomonas* and *Bacillus* during cannabis cultivation was found to improve plant health and productivity by suppressing soil borne pathogens and optimizing nutrient availability (Backer et al., 2018)

The efficacy of *Azospirillum brasilense* B. in enhancing root development and nutrient uptake in cannabis has been noted, while *Bacillus* species have demonstrated benefits through enhanced nitrogen availability and phytohormone production (Lyu et al., 2020). Hence, integrating PGPBs into cannabis cultivation could support sustainable agriculture and enhance the crop’s economic and environmental sustainability.

Among PGPBs, *Bacillus velezensis* (Ruiz-Garcia et al., 2005) has emerged as a key species with broad applications in agriculture. This bacterium is noted for its ability to produce bioactive metabolites such as indole-3-acetic acid (IAA), siderophores, and antimicrobial peptides, which collectively enhance plant growth, nutrient assimilation, and stress tolerance. Furthermore, its biocontrol properties effectively suppress phytopathogens, including fungi and bacteria, thereby reducing reliance on chemical pesticides and promoting eco-friendly practices (Cantoro et al., 2021; Chowdhury et al., 2015). The potential of *B. velezensis* in improving soil health, remediating contaminated soils, and increasing crop productivity makes it a cornerstone in sustainable agricultural initiatives (Fan et al., 2017; Wu et al., 2014).

One of the *B. velezensis* strains, specifically S141, has gained attention for its versatile applications in agriculture. It was isolated from the soybean (*Glycine max* (L.) Merr. (Fabaceae)) rhizosphere, which functions as a robust plant-growth-promoting rhizobacterium and a biocontrol agent against phytopathogens (Sibponkrung et al., 2020). Studies have reported its proficiency in enhancing crop yields and disease resistance in several crops, including rice, soybean, and maize (Kondo et al., 2023; Sibponkrung et al., 2020; Songwattana et al., 2023). However, research regarding the functional properties and utilization of *B. velezensis* S141 in cannabis, especially concerning growth-developing impacts, is scarce.

In this study, we investigated the use of S141 as a PGPB in cannabis cultivation and the potential mechanisms that activate the biological pathways in cannabis. This was achieved through a transcriptomic analysis of the bacterium’s influence.

1.2 Research objectives

1.2.1 To investigate the plant growth-promoting effect of *Bacillus velezensis* S141 in *Cannabis sativa*

1.2.2 To understand the molecular mechanism of *C. sativa* after inoculation with *B. velezensis* S141 using transcriptomic technology