CHAPTER I. INTRODUCTION

1.1. Background

Sweet corn (*Zea mays* L. *Saccharata* Sturt) is a type of vegetable characterized by its sweet taste, thin endosperm, and soft-textured pericarp, and it has high nutritional value (Kwiatkowski and Clemente, 2007). In Indonesia, sweet corn can be utilized as a source of food, animal feed, and industrial raw materials (Nelvia *et al*., 2010). Sweet corn as a food source can provide a significant amount of nutritional value compared to other grains. The nutritional content found in sweet corn includes glucose, carbohydrates, protein, and fat. Sweet corn can be processed into various dishes such as sour vegetable soup, corn fritters, corn syrup, corn ice cream, corn fritters, and various other food products (Syukur and Rifianto, 2013). Sweet corn can be utilized in its fresh form or processed as an addition to straw for livestock feed (Teixeira *et al*., 2001).

Sweet corn is a horticultural commodity with high economic and nutritional value, and its cultivation also offers opportunities to increase farmer income and support local agro-industries due to its relatively short growth cycle and consistent market demand. sweet corn typically produces fresh corn suitable for consumption within 75 to 90 days after sowing. Sweet corn contains 5-6% sugar, 10-11% starch, 3% water soluble polysaccharides and 70% water, besides moderate levels of protein and vitamin (yellow varieties) and potassium (Oktem and Oktem, 2005). Sweet corn plays an important role in the human diet because of its health-promoting nutritional characteristics.

The demand for sweet corn continues to increase in line with population growth and the rapid development of these sectors. National corn consumption has shown a significant upward trend, with an average annual growth rate of 17.23%, or approximately 900,000 tons per year (Saputra *et al.*, 2022). However, despite this growing demand, domestic production has faced several challenges. According to the Central Bureau of Statistics (2025), the harvest area for sweet corn increased from 2.4 million hectares in 2023 to 2.5 million hectares in 2024. Nevertheless, total production has declined, likely due to unfavorable weather conditions, pest infestations, and declining soil fertility. These constraints have led to reduced yields per hectare, highlighting the urgent need for improved cultivation practices and input strategies to sustain and increase sweet corn productivity.

The production of sweet corn in areas affected by climate change and soil conditions will yield fluctuating and unstable results. Additionally, the increasing demand for sweet corn has led to a greater need for its supply, even outside the season, which is considered a challenge because the quality of corn seeds deteriorates after the milk stage (Alan *et al*., 2014). Changing the planting date of sweet corn by planting earlier or later is a solution to the high demand for sweet corn, which results in an extended harvest period by planting corn earlier or later than the recommended planting date. In early sweet corn planting (spring), the plants face cold stress that results in low seed germination and reduces the number of plants per total area (Hassell *et al*., 2003; El-Hamed *et al*., 2012). Meanwhile, late planting of corn, corn plants face several insects and diseases (Williams, 2008) and the plants will also experience heat stress and drought due to high temperatures (Heshemi *et al*., 2017; Tabakovic *et al*., 2020).

Increasing crop production can be achieved through extensification, such as expanding cultivated land, or intensification, including improved fertilization practices (Zubachtirodin, 2011). Fertilizers, both organic and inorganic, are added to soil or plants to supply essential nutrients that support growth and yield (Soeryoko, 2011). In sweet corn production, using superior varieties and appropriate fertilization is important. However, continuous use of inorganic fertilizers over time can lead to reduced soil fertility and environmental damage, such as nutrient leaching and decreased microbial activity (Yafizham and Lukinawati, 2019). To overcome these problems, the use of organic fertilizers is recommended. Organic fertilizers help improve soil structure, increase nutrient availability, and enhance soil biological activity. They also reduce the negative residual effects of chemical fertilizers, contributing to sustainable agriculture and better crop productivity (Sinuraya and Melati, 2019).

Compost is a type of organic fertilizer that can be used to improve the chemical, physical and biological properties of soil, which ultimately can increase plant growth and yield (da Silva *et al*.,2014). Sources of organic fertilizer can come from plant remains or animal waste that have undergone a process of decomposition or weathering. One material that is often used as compost is cow dung (Mangardi *et al*., 2023).

NPK fertilizer is a balanced inorganic fertilizer containing nitrogen (N), phosphorus (P), and potassium (K), which are the three primary macronutrients essential for plant growth. Nitrogen promotes vegetative growth and chlorophyll formation, phosphorus supports root development and energy transfer, while potassium enhances stress resistance, enzyme activation, and overall plant vigor. The combined application of NPK helps optimize nutrient availability and improves yield, especially in soils with low fertility (Bindraban *et al*., 2020). but excessive and continuous application has negative impacts on soil conditions and contributes to the decline in soil fertility. Therefore, improving soil fertility requires a fertilization strategy that maintains a balance between inorganic and organic fertilizer inputs (Pandey *et al*., 2025).

Ultisols are typically acidic, highly weathered, and characterized by low nutrient availability and poor cation exchange capacity (Hardjowigeno, 2003). These conditions result in nutrient deficiencies especially of nitrogen (N), phosphorus (P), and potassium (K) and high aluminium (Al) saturation, which can inhibit root development and reduce crop yields (Pratamaningsih *et al*., 2023).

Biofertilizers play many roles to increasing plant production by stimulating growth (bio stimulants) through the synthesis and regulation of various plant growth regulators (phytohormones) such as IAA, gibberellins, and cytokinin. In addition, biofertilizers act as bioprotectants against soil-borne pathogens by producing anti-pathogen compounds or metabolites (McMillan, 2007). The application of biofertilizers can be done by watering with various concentrations. The application of this biofertilizer aims to ensure that the bacteria contained within it can colonize the seedlings as early as possible (Marom *et al*., 2017).

Plant Growth-Promoting Microorganisms (PGPM) are beneficial soil microorganisms that enhance plant growth and development through various mechanisms (Bhattacharyya and Jha, 2012). These microbes include bacteria and fungi such as *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, and *Rhizobium*, which live in association with plant roots and improve plant nutrient availability and health (Goswami *et al*., 2016). PGPM promote plant growth directly by fixing atmospheric nitrogen, solubilizing phosphorus, producing phytohormones such as indole-3-acetic acid (IAA), gibberellins, and cytokinin, and enhancing nutrient uptake efficiency (Calvo *et al*., 2014).

One of the commercial products that contains biofertilizer is FloraOne®. FloraOne® biofertilizer functions as a growth promoter for plants or as a biological control agent against diseases in plants, thereby increasing agricultural production (Nafiah *et al*., 2018). FloraOne® biofertilizer contains the bacteria *Azospirillum sp*, *Aspergillus niger*, and *Pseudomonas fluorescens*, as well as the fungus *Trichoderma harzianum*, which can affect the growth and yield of plants. The research results of Zhang *et al*. (2018) state that the inoculation of *Azospirillum brasilense* and *Pseudomonas fluorescens* in the rice rhizosphere can accelerate nitrogen transformation and increase rice plant biomass.

The results of Diky's (2021) found that the application of biofertilizer containing *Azospirillum* sp., *Rhizobium* sp., *Aspergillus Niger*, *Pseudomonas fluorescens*, and the fungus *Trichoderma harzianum* at a concentration of 5 ml/l in garlic cultivation can be beneficial in increasing plant height, number of leaves, pseudo stem diameter, bulb diameter, dry bulb weight per plant, dry bulb weight per plot and per hectare, number of cloves per bulb, and the diameter of the largest clove. Similarly, according to Hariyadi *et al*. (2019) found that applying 6 g of NPK per plant at intervals of day 0, 14, and 28 showed resulted in the highest plant height, number of leaves, total fruit number, and total fruit weight in tomato plants. According to Abdi *et al*. (2022), applying 300 kg/ha of NPK fertilizer significantly increased plant height at 60 days after planting and the weight of 1000 grains in the Rajasa 01 rice variety, outperforming lower doses of 200 and 250 kg/ha.

Based on these above issues, the research on "Effects of Plant Growth-Promoting Microorganisms, Organic, And Inorganic Fertilizer Applications and Their Combinations on The Growth and Yield of Sweet Corn (*Zea mays* L. *Saccharata* Sturt) in Ultisol ″ was conducted in Rumah Kawat in Padang, West Sumatra, Indonesia.

1.2. Problem formulation

1. Can the combination of PGPM, organic, and inorganic fertilizers synergistically improve the growth and yield of sweet corn compared to the use of each input alone in Ultisol?
2. Which of the three treatments PGPM, organic fertilizer, or inorganic fertilizer is the most effective in enhancing sweet corn productivity?

1.3. Research Objective

1. To evaluate the comparative effects of Plant Growth Promoting Microorganisms (PGPM), organic fertilizer, and inorganic fertilizer on the growth and yield of sweet corn (*Zea mays* L. *Saccharata* Sturt).
2. To identify the most effective treatment or combination of treatments for enhancing sweet corn productivity.

1.4. Benefit of the Research

This study explores the benefits of using biofertilizers and organic inputs compared to conventional fertilizers for farmers and agricultural practitioners. It aims to reduce production costs, increase crop productivity, and promote soil sustainability. The research will also contribute to knowledge on sustainable crop production techniques, particularly in sweet corn cultivation, and inspire future research on soil amendments' combined effects across different crops and agroecological conditions.