Chapter 1

Introduction

1.1 Background

Coccinia grandis (L.) Voigt, also known as ivy or scarlet gourd, is a perennial climbing vine native to Southeast Asia, India, and Africa, although it also extends to other tropical and subtropical regions of the world (Hossain et al., 2024). In Indonesia, *C. grandis* is commonly known as “Timun Tikus” or “Papasan”, with its roots, fruits, and leaves utilized as ingredients in traditional cuisines and medicines for their analgesic and healing potential (Afriani et al., 2022; Daud & Manu, 2021). This is due to the rich metabolites within the plant, attributing it as a source of antioxidant, antidiabetic, anti-inflammatory, anti-aging, and antimicrobial properties (Kondhare & Lade, 2017; Lee & Joo, 2022).

Despite the advantages of the plant, the rapid growth of *C. grandis* has led to the species being classified as invasive in certain regions, such as Indonesia and the Pacific Islands, including Hawaii and Guam (Setyawati et al., 2015). The underexploitation and mismanagement of *C. grandis* resulted in a growth rate misaligned with their potential, thus posing a potential threat to the local ecosystems and agricultural productivity (Day & Callander, 2024; Steve, 2016). One of the contributing factors to this situation is the lack of awareness regarding its benefits due to its common traditional utilization, leading to its neglect (Yadav et al., 2024). Conversely, this shows an advantage for plant studies following the abundance of *C. grandis* in nature, which presents a promising biomass source for various applications, such as bioherbicide development.

C. grandis’ rich phytochemical profile is composed of secondary metabolites, such as flavonoids, terpenoids, phenolic compounds, and saponins. These metabolites support the utilization of the plant in the medical field and promote its rapid growth while inhibiting other plants *via* various pathways, also known as allelochemicals (Kato-Noguchi, 2024; Peduruhewa et al., 2022). Notably,

flavonoids, for example, are one type of phenolic compound that exhibits antioxidant activities, responsible for plant stress tolerance by regulating reactive oxygen species (ROS), and possess significant anti-inflammatory, anti-aging, and antimicrobial properties beneficial to human health (Dias et al., 2021). The release of the compound into the environment is also recognized for inhibiting plant germination and seedling growth, which is desirable for weed control (Patil et al., 2024).

The extraction of phytoherbicidal and allelochemical compounds from *C. grandis* presents a promising approach to control both the growth rate of the invasive plant and weed proliferation, particularly in tropical countries like Indonesia, where agricultural yield, such as palm oil plantations, is significantly impacted by excessive weed growth (Hakim et al., 2020; Kumalasari et al., 2021). Furthermore, the prolonged application of chemical herbicides not only promotes the evolution of herbicide-resistant weeds but also causes environmental damage, affecting crop yield despite their low cost (Ahmad et al., 2024). *C. grandis,* as a sustainable bioherbicide, offers an alternative to synthetic options, mitigating further environmental harm caused by synthetic herbicides (Duke et al., 2024). While the bioherbicides market faces challenges due to a scarcity of experimental studies that result in concerns about their stability and efficacy in field conditions, the increased demand for a safer weed control method followed by the development of *C. grandis* as a bioherbicide candidate could open new avenues for research, provided its field stability is validated (Islam et al., 2024). This path of research also utilizes the plant further, allowing for a more managed growth which counters the invasiveness of the species.

This study focuses on the development of *C. grandis* leaf extract as a bioherbicide candidate against *Nicotiana tabacum* and *Brachiaria humidicola*, representing two main groups of weeds which are dicot-broadleaf and monocot-grass types, respectively, aside from being able to be conveniently found on Indonesian ground (Santoso & Purnomo; 2021; Susilawati et al., 2023). *Nicotiana tabacum* is one of the plant species that has made a significant contribution to Indonesia's agricultural

economy, primarily due to its use in cigarette production (Suprihanti, 2022). In contrast, *Brachiaria humidicola* is a grass species commonly planted on pasture plots for organic fertilizer production and cattle feed (Prihantoro et al., 2023). The utilization of both *N. tabacum* and *B. humidicola* as model plants suggests the potential allelochemical effects of *C. grandis* leaf extract on other plants or weed species, similar in character or genetics to the respective model plants, as observed in this study (Cesarino et al., 2020).

1.2 Objectives

The primary objectives of this research were to extract the phytoherbicidal compounds present in *C. grandis* leaves. Subsequently, the leaf extract's phytoherbicidal activity was assessed on *N. tabacum* and *B. humidicola* as the model plants. The appropriate dosage of the *C. grandis* leaf extract herbicide was determined further based on the monitored growth of model plants when subjected to varying concentrations of the leaf extract.

1.3 Hypothesis

Null hypothesis (H0) : *Coccinia grandis* leaf extract does not detrimentally affect the growth of *Nicotiana tabacum* and *Brachiaria humidicola*, thus unfit as a bioherbicide alternative.

Alternative hypothesis (H1) : *Coccinia grandis* leaf extract detrimentally affects the growth of *Nicotiana tabacum* and *Brachiaria humidicola*, thus fitting as a bioherbicide alternative.