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LINKING WEED COMPOSITION WITH SOIL PHYSICO-CHEMICAL PROPERTIES FOR SITE SPECIFIC WEED MANAGEMENT IN HARUMANIS MANGO

NURUL AIZA BINTI MOHD FAUZI

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ABSTRACT

Chemical weed management, along with mechanical methods, is widely practiced in mango crops. However, the lack of information on weed composition, distribution, and soil physico-chemical properties can limit the effectiveness of these methods. Understanding the spatial variation in soil properties and weed distribution is essential for implementing site-specific weed management practices in mango cultivation. This research aimed to: 1) establish data collection for dominant and multiple weed species; 2) identify and quantify the effects of soil physicochemical properties on weed species composition, spatial distribution, and density; and 3) produce distribution maps of dominant and multiple weed species, as well as soil physicochemical maps for Harumanis mango. The field survey was conducted on a 14-year-old mature mango plot covering 2.49 hectares over two consecutive years. Weed counts were performed on a regular 20 × 20 m grid, comprising 60 observation points using a systematic sampling technique. Soil physico-chemical properties such as pH, temperature, moisture, total organic carbon, electrical conductivity, total nitrogen, available phosphorus, exchangeable potassium (Ex-K), exchangeable magnesium, exchangeable calcium, and exchangeable sodium were measured. Weeds were identified at each point, and the data were used to compute frequency, density, relative density, relative frequency, and importance value for each species. In total, 14 weed species in 2022 and 13 in 2023, from the Rubiaceae, Fabaceae, Cyperaceae, Asteraceae, Euphorbiaceae, and Poaceae families, were found in the mature mango farms. The four dominant weed species were *Imperata cylindrica*, *Mimosa pudica*, *Fimbristylis miliacea*, and *Ageratum houstonianum*. Redundancy analysis revealed no correlation between the spatial distribution of weeds and soil physico-chemical properties in 2022. However, in 2023, the spatial distribution of *M. pudica* exhibited a strong positive correlation with soil moisture and Ex-K, while the spatial variability of *A. houstonianum* was negatively correlated with these soil properties. The density of *I. cylindrica* was negatively correlated with soil moisture but strongly positively correlated with Ex-K. 17% of weed distribution in Harumanis mango farms was influenced by soil properties, while the remaining 83% of the variation could not be identified. Geostatistical analysis showed that spatial distribution of weed and soil variability could be modelled using semivariograms to construct soil and weed distribution maps. These maps could serve as valuable tools for implementing localized mechanical and chemical control methods, as well as nutrient management, thereby enhancing the cost-effectiveness of management for dominant and multiple weed species. This knowledge is crucial for making well-informed decisions regarding site-specific weed management in Harumanis mango cultivation.

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TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

1.1 Research Background

Harumanis mango is believed to have originated from Indonesia and has been domesticated in Malaysia since its official registration by the Department of Agriculture, Malaysia on May 28, 1971. Widely accepted by Malaysians, it is cultivated by both small-scale growers and commercial planters (Nor et al., 2024). In 2024, Perlis recorded a total Harumanis production of 2,022 metric tons, generating a value of RM46,512,782.00, with 2,693 farmers actively involved in its cultivation (Malaysia Aktif, 2024).

To sustain and improve both the quality and quantity of mango production, modern agricultural industries increasingly rely on technological advancements. Weed management is a crucial aspect of harumanis mango cultivation, with slashing, mulching, and herbicide application being the primary control strategies. Although slashing provides short-term benefits, it can lead to an increase in weed populations over time (Warnock et al., 2012). Effective weed suppression through slashing requires frequent and repeated applications, making it labor-intensive and less sustainable (Kerkhoven, 2009). On the other hand, herbicide application is widely adopted as it is one of the most cost-effective methods for weed control in mango orchards (Lorenzi, 2000)

Weed is one of the biotic concerns that can result in significant production losses around the world. Weed can be an issue for agricultural productivity since weed and crop compete for light, nutrients, water, and space. Weeds have more physiological, morphological, and anatomical plasticity than crop species, allowing them to be more tolerant of environmental stressors (Kaur et al., 2019). Weed will serve as a safe site for plant pests such as insects, fungi, and bacteria that harm crops close by (Smith et al., 2019). According to Olorunmaiye et al. (2013) mango crop production recorded high weed diversity of 33 species. On the other hand, Rahim (2020) reported that weed species diversity was quite similar among mature mango canopy (25 species), inter-rows of both mature (22 species) and immature (24 species) mango identified in Harumanis mango. Based on the highest relative abundance value, broadleaf weeds