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(REPORT)

TITLE:
DETERMINATION OF PLASTIC POLLUTION AND ITS DEGRADATION IN SOIL AT MANGOES CULTIVATION AREA

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ABSTRACT

Nowadays, plastic pollution has emerged a major environmental concern. The presence of plastic and microplastic in the soil can bring several harmful effects to the environment including disrupting the soil ecosystem and reducing soil fertility. Furthermore, it can easily be absorbed by soil creatures, enter the food chain and may harm human health. Since the presence of plastic particles in soil can give the negative impact on soil health for plant growth and the environment, Thus, the determination of plastic pollution and its degradation in the soil of agricultural land is crucial. This study aims to identify the functional group of plastic pollution that is present using Attenuated total reflectance-Fourier transform infrared spectroscopy(ATR-FTIR). The properties of plastic degradation products with their effects on soil quality also was collated. A total of 12 soil samples from agriculture areas were collected and evaluated throughout this research. The areas chosen to be research areas are the mango cultivation area in Lanchang, Pahang**(3.497873, 102.191079)**. A few steps were carried out to determine the presence of plastic pollution and its degradation sorting of plastic size, sample drying, density separation where a solid solution of sodium chloride is used, alkaline digestion using sodium hydroxide and the cleaning process. Based on FTIR spectrum, there have broad absorption bands at 2914cm-1, 2847cm-1, 1470cm-1, and 718cm-1, which are used to identify and quantify the presence of polyethylene(PE). In summary, the soil in the research area is contaminated with plastic and its degradation. Effective strategies for managing and mitigating plastic pollution in the environment need to be carried out in the future to have good soil quality.

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CHAPTER ONE

BACKGROUND

1.1. INTRODUCTION

Soil is a biologically rich, porous material found in the upper layer of the Earth's crust. It plays a crucial role in sustaining life on Earth as a provider of water and nutrients, a filter for harmful substances, a location for their decomposition, and a participant in the cycling of carbon and other elements throughout the planet's ecosystem. The characteristics and composition of soil can vary due to a variety of factors such as geographical, geological, biological, and climatic influences (Garrison, 2022). Minerals, soil organic matter, living organisms, gas, and water are the five components that make up soil. Clay, silt, and sand are the three size categories for soil minerals; the proportions of these particles that make up soil texture. Soils have a wide variety of mineralogies. Smectite, a type of clay mineral, may shrink and swell so much when wet and dry that it can topple structures. Quartz is the most prevalent mineral in soils; it forms lovely crystals but is not very reactive. The proportion of soil organic matter in a soil is one of the finest measures of agricultural soil quality since it represents plant, animal, and microbial remains in various stages of decomposition(Brian, 2013).

One of the greatest environmental issues of the modern era that affects ecosystems, including human beings, is the pollution of the environment with plastic debris (Koelmans et al., 2019). In order to improve certain qualities, plastics are typically polymeric hydrocarbons that have been supplemented with additives. Massive (bio)plastics manufacturing started in the 1940s and 1950s and is continuously growing now, reaching approximately 368 million tonnes globally in 2019. (PlasticsEurope, 2020).

In a nutshell plastic pollution can indirectly impact soil ecosystems and microbial communities by altering the microclimate and atmosphere of the soil. These plastic pollution act as a barrier on the surface of the soil, which can affect evaporation, gas exchange, temperature, and light penetration. The specific type of plastic used can also impact these changes, with certain types causing greater warming or less permeability than others(Kasirajan and Ngouajio, 2012). Additionally, plastic pollution can increase soil moisture levels, which can impact the physical structure of the soil and promote root growth. Increased root exudation may result from these modifications to the soil environment(Wang et al., 2016; Li et al., 2004b; Subrahmaniyan et al., 2006). In a nut shell, farmers must take into account these factors when choosing and applying materials (Goyal and Singh, 2018).

1.2 LITERATURE REVIEW

The pollution of the environment with plastic debris is a major global environmental concern that affects various ecosystems, including soil. The negative impacts of plastic pollution on soil health, plant growth, and biodiversity are well-documented. One of the main concerns associated with plastic contamination in soil is the presence of microplastics. These tiny particles, which are defined as being smaller than 5 mm, can be formed from the breakdown of larger plastic objects or from the intentional release of small plastic particles into the environment. Microplastics in soil can have a detrimental effect on soil health by disrupting microbial populations, reducing soil fertility, and hindering plant growth and biomass (De Souza Machado et al., 2018a). These microplastics can also linger in the ecosystem for hundreds of years.

Synthetic polymeric molecules, known as plastics, possess desirable properties such as softness, heat seal ability, and a strong weight-to-strength ratio, and transparency (Kumar et al., 2014). They have become an integral part of our daily lives and it is hard to imagine a world without them (Gibb, 2019). However, the extensive use of plastics has resulted in negative effects on soil fertility (Jalil et al., 2013) and has become a global problem that harms ecosystems and reduces biodiversity, ultimately impacting every person on the planet (Barnes, 2019). Most commonly used plastics are not biodegradable, causing harm as they break down into smaller particles in marine habitats and infiltrate food chains (Auta et al., 2017; Setälä et al., 2014).

The utilization of plastic materials, specifically plastic mulch films, in agriculture raises concerns about the plastic pollution in soil. Such films are commonly employed to maintain soil moisture and inhibit weed growth, but they can also lead to soil contamination from plastic waste. Plastic pollution have the potential to alter soil microbial communities, decrease soil fertility(Liu, He, and Yan, 2014), pollute water systems, and negatively impact aquatic habitats (Wang et al., 2015). The presence of plastic debris in the soil can have detrimental effects on the overall health of the soil and the plants grown in it. The presence of plastic can lead to changes in the soil's microbial population, resulting in poor soil structure and reduced plant growth(Koelmans et al., 2019). Additionally, plastic pollution can lead to the accumulation of harmful substances such as polychlorinated biphenyls (PCBs) and polyaromatic hydrocarbons (PAHs) which can be dangerous to both plants and animals. These contaminants can be adsorbed and concentrated by plastic fragments in the soil, further exacerbating the negative effects of plastic pollution on the soil ecosystem(Barnes et al., 2009).

In summary, microplastics, which are tiny particles of plastic that can persist in the environment for hundreds of years, can accumulate in soil over time as a result of plastic in soil breaking down.