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Andisols Water Retention Under Peasant Oil Palm Plantation

Bujang Rusman[#], Agustian[#], Aprisal[#], Syafrimen Yasin[#]

[#] *Departement of Soil Science, Faculty of Agriculture, University Andalas, Padang, Indonesia*
E mail: bujang.rusman@yahoo.com

Abstract— **Available water soil is one of the critical factors that influence oil palm growth and production. This research used field survey method. Soil samples were taken in the field and then analyzed in the laboratory using the membrane plate apparatus for assessment of the filed capacity and the permanent wilting. This research aimed to obtain data about water retention variability of Andisols in oil palm plantation of peasants on various age levels of oil palm in Pasaman sub-district, West Sumatera. The advantage of this research was to find out the effect of different age levels of oil palm on soil water retention and other physical soil properties in Andisols. This research identified water retention of the soil was between 21.2-42.7% volume with the bulk density (BD) was between 0.31-0.83 g/cc. The results showed that there is no significant difference between the oil palm ages (5-10 years, 10-15 years, and above 15 years) on either the soil water retention or the soil bulk density for both the topsoil (0-20 cm) and the subsoil (20-40 cm). This research indicated that there is no effect of the oil palm age on the soil bulk density, field capacity, permanent wilting point, and plant available water. This research suggested that the soil should be saturated with high water content since West Sumatera has very high rainfall intensity so that the situation can be an advantage for oil palm growth over the years.**

Keywords— **Andisols; available water; oil palm; soil water retention.**

I. Introduction

The Indonesian archipelago encompasses one of the most active volcanic areas in the world, surrounded by 128 active volcanoes. On the island of Sumatera, there are 31 volcanoes, situated mostly along the Barisan Mountain Range [1].Most of the Indonesian Andisols are among the most productive soils. The soils are being cultivated with both annual and perennial of upland crops, such as tea, coffee, cacao with quite high productivity. The areas in the vicinity of volcanoes are also well known as the horticultural center and support more than 50% of the Indonesian people needs [2]. Various kinds of soils can be formed from volcanic ash based on the individual set of soil formation factors at different sites. Among these soils, Andisols show unique properties mostly due to abundant noncrystalline materials, such as allophane, imogolite, Al-humus complexes, and ferrihydrite. Highly porous structures made of aggregated no-crystalline Andisols material have a light and fluffy nature, accommodating large amounts of both plant-available and hygroscopic water [3]. These soils have unique and distinct properties with low bulk density, high water retention, high permeability, stable structure, high amount of current Al and Fe, variable charge, and high phosphate fixation [4].

The potential of natural resources in the region of North Sumatera is enormous with a vast plantation reaches 15.2% of Indonesia palm oil plantation. Crude Palm Oil (CPO) reach 7.9% of total Indonesia palm oil export [5]. Deforestation for oil palm plantation in West Sumatera conducted since last few decades [6]. Deforestation for tree cash crop plantation, such as oil palm, rubber, and cacao agro-forest in the tropics results in sharp decreases in soil organic carbon (SOC) stocks. Much of this carbon lost through carbon dioxide (CO2) emission and leaching [7]. The land use change from native forest to pasture exposed the soil to higher mechanical stresses leading to soil compaction. Since soil shrinkage during drying, the bimodal character of the water retention curve changed only the macropore range. Meanwhile, the textural range remained constant when native forest (NF) changed to P50 (permanent pasture for over 50 years). The land use change affected the saturated hydraulic conductivity of the soil [8].

Farming in sloping areas is not the only risk for the erosion, but also problematic to the fertility [9]. Soil characteristics influence essential soil functions, such as: (1) Moderating and partitioning water and solute movement and their redistribution and supply to plant, (2) Storing and cycling nutrients, (3) Filtering, buffering, immobilizing and detoxifying organic and inorganic materials, (4) Promoting root growth, and (5) Promoting resistance to erosion [10]. Bulk density (BD) of Andisols in Indonesia was highly varied that was 0.37-0.90 g/cm^3. This low BD of Andisols depend on amorphous mineral-dominated by this soil. Since Andisols dominated by amorphous mineral, the soil has