CHAPTER 8:
SOIL ANALYSIS: PHYSICOCHEMICAL PROPERTIES

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INTRODUCTION

Soils are essential non-renewable natural resources on the earth's surface due to their extremely slow physical, biological and chemical weathering processes [1]. Soils are different across the world based on five major soil formation factors, namely parent material (e.g. rocks, sediments in the surface waters, volcanic ash, glacial tills, and organic matter), climate (e.g. temperature and rainfall), organisms (e.g. animal inhabitants, vegetation, and humans), topography or landscape (e.g. slope configuration and elevation above mean sea level), and time (e.g. lost, add, and transformation of soil components) [2]. As such, soils are living and dynamic environments with an understanding of soil characteristics that are important for different land use activities ranging from optimal agricultural production to waste disposal and land reclamation [3].

Soil physicochemical properties are key determinants of soil quality, plant growth and productivity [4]. Soil physical properties include texture (the proportion of sand, silt, and clay), colour (an indicator of drainage characteristics), structure (arrangement of soil particles into aggregates), porosity (pores or spaces within and between aggregates), and bulk density (an indicator of soil compaction) are good indicators for the root penetration, oxygen availability, and water mobility in soils [5, 6, 7]. Soil chemical properties including soil reaction (pH), nutrient availability, mineral solubility, and cation exchange capacity are important in planning fertilisation and fertigation [8].

In this chapter, the basic guide on laboratory analysis for soil texture, bulk density, porosity, water-filled pore space (WFPS), gravimetric water content, organic matter content and pH determination will be covered.

MATERIALS AND METHODS

Soil Texture (Percentage of Silt, Clay, and Sand)

Soil texture is determined through the soil particle size analysis test using the hydrometer method by Bouyoucos in 1927 [9], followed by the textural triangle and United States Department of Agriculture (USDA) soil taxonomy classification. Firstly, dry soil weighing ~25 to 50 g is treated with 100 mL of 5% dispersing solution (sodium hexametaphosphate) and then diluted to 1 L with deionised water in a measuring cylinder. The hydrometer and temperature readings are recorded, indicating the percentages of silt and clay in the soil after 40 seconds, and that of the percentage of clay only after 6 hours 52 minutes (Figure 8.1). The difference between both readings will account for the percentage of silt in the soil. Lastly, the percentages of silt and clay are subtracted from 100% to provide the percentage of sand in the soil. The percentages of all three mineral fractions can then be referred to the United States Department of Agriculture (USDA) textural triangle for classification.