# Chapter I

## 1. INTRODUCTION

Plant growth is intimately related to the growth and function of its root system. The development of the root system in spread, depth and density provides with the necessary anchorage and controls the possibilities of soil utilisation for water, nutrients and oxygen. In recent years, attempts have been made to increase crop productivity by either genetically developing a superior root system or by so changing the soil conditions that the root system will become more efficient. The latter line of approach offers greater possibilities.

In order to change or create soil conditions conducive to root growth, it is essential to understand soil and plant mechanics simultaneously. It has been established that plant growth is remarkably influenced by the physical edaphic factors such as soil moisture (Gingrich and Russell, 1956), soil air (Lemon, 1962; Letey and Stolzy, 1967), soil temperature (Chapman and Peterson, 1962) and mechanical impedance (Gill and Miller, 1956) through their effects on root elongation. Most of these soil physical characteristics are in turn governed by the particle and aggregate size distribution of soil. Particle size distribution and density of the soil have pronounced effects on root penetration and growth primarily through their influence on mechanical strength and capability of the geometry to permit adequate movement of roots, air and water through the soil. The intricate relationships between the solid, liquid and gaseous phases of the soil affect the uptake of water, oxygen and nutrients by the roots for optimum growth.

The physical parameters of the soil influencing the behaviour of plants are relatively few but their interactions are so complex as to

make it almost impossible to reach quantitative conclusions with respect to the significance of the individual factor . The situation becomes further complicated when the internal plant processes are considered in relation to soil physical conditions. For instance, it is well known that for rice roots in which plant aeration is the dominant path way, soil aeration may not be very helpful, whereas for most field crops it is generally assumed that soil aeration is the dominant process (Myers and Van Bavel, 1963). The optimal range of soil physical conditions greatly varies with the different species and varieties of plants. Depending on the nature and habitats of the plant root system, soil physical characteristics may have to be partially or completely modified.

Rice plant is highly adaptive in its physiological and morphological functions as is shown by its capacity to grow under varying physical and chemical conditions of the soil. Its root system consists of both primary and adventitious roots. Rice roots are highly complementary in their functions and the non-functioning older roots are replaced by the newly developed adventitious roots (Okajima, 1961 ). The soil physical conditions that cause the degeneration of primary and older adventitious roots are not clearly defined.

Rice is grown in various textural soil types under different soil water and temperature regimes as influenced by climatic variations and irrigation practices. The bulk density of rice soils also varies from place to place because of the differences in soil texture and management practices. A moderate range of bulk density, achieved through compaction of soil, favourably influences rice growth (Varade and Ghildyal, 1967 ).

Like other crop plants, the nature of rice roots and their functions with respect to water and nutrient uptake are also influenced by temperature, moisture stress and oxygen tension of soil.

Knowledge of the nature and extent of rice root growth under varying soil physical condition is very scanty. An assessment of the soil physical factors such as particle size distribution, mechanical impedance, moisture, aeration and temperature conducive to optimum rice root growth was made to meet the following objectives:

i) to understand the phasic nature and extent of rice root growth under flooding and unsaturation,

ii) to investigate rice root growth as influenced by the bulk density of different soils under varying soil moisture regime,

iii) to analyse the influence of soil temperature regime in relation to bulk density of different soils on rice root growth,

iv) to find out the response of rice root system to particle and pore size distribution of synthetic soils.