CHAPTER I

1. INTRODUCTION

Rice has a remarkable capacity of wide adaptability to soil water conditions. Therefore, broadly there are two, 'dry' and 'wet', systems of rice cultivation. Although rice is not an aquatic plant, it grows best under submerged soil conditions. To achieve that objective soil puddling is followed by the farmers in major rice growing countries. Puddling of soil for rice crop basically means destruction of macro-structure and reduction of macropores and specific volume of soil (Bodman and Rabin, 1948) through repeated working (churning) of soil in presence of excess water.

Soil puddling, a widely practiced tillage operation, is believed to be 'wet-land' cultivation of rice. Although the exact mechanism and mode by which it helps rice growth is not very well understood, there is a general agreement among most of the specialists that puddling is beneficial because of the chemical, physical and physico-chemical changes emerging out of soil manipulation and submergence. How so ever desireable the practice of soil puddling may be, some difficult problems are also associated with it. Puddling is a tedious, time consuming and probably one of the most expensive tillage operations. Fast or heavy machinary can not be employed for planting and post planting operations on soft puddled fields. Thus it also imposes a limitation on large scale mechanization of rice farming. Scientists and technologists have always felt concerned about this problem and they have been thinking for some alternative operation to replace puddling without sacrificing yield.

A close examination of low-land paddy soils reveal that most of the benefits are actually a result of prolonged submergence leading to reduced soil conditions. Puddling only helps in achieving these conditions through considerably reduction in permeability of soil. If it is true, compaction of soil should also serve the purpose. This has prompted some scientists to a belief that soil compaction can replace puddling in rice fields. Compaction is a cheaper and easier operation than puddling from tillage engineering point of view because the former needs relatively dry fields (Proctor moisture) wherein fast and heavy machines can be used successfully. Besides this, compaction provides firm anchorage to plants, helps plants absorb more nutrients as greater soil mass is condensed in lesser volume (root zone) and increases flux of ions and water into plant because of larger and intimate contact between soil solids and root surface (Passioura and Leeper, 1963).

Numerous studies with grain, root and fiber crops hav revealed that compaction of soil beyond certain limits has an adverse effect on seedling emergence, root and shoot growth and yield. Thus a parabolic relation between soil compaction and cro growth is mostly reported (Hubbell and Staten, 1951; Vomocil, 195 Phillips and Kirkham, 1962; Taylor and Burnett, 1964; Drew <u>et al</u>. 1965 and Parker and Taylor, 1965). Critical densities vary from crop to crop and for a particular crop they are function of plant growth stages, moisture content and texture of soil (Rosenberg, 1964). Although a good deal of experiments are reported on other crops, very little information about critical density and soil strength is available for rice. With this consideration in view present investigation was under taken to study the effect of soil strength and seed placement on germination, emergence and growth of paddy seedlings. Further, it was also endevoured to find the influence of soil strength, water regime and aeration on uptake of nutrients and growth and yield of rice.

A linear correlation between soil bulk density or soil strength and shearing strength or resistance to penetration of certain needles has been reported (Taylor et al., 1966 and Lindner, 1967). These soil properties are generally measured with shear test apparatus or spring loaded proctor, pocket and cone penetrometers. Though very good tools in principle, they are mainly designed for foundation engineering wherein the magnitude of soil strength involved is very large. In addition to this they are used for making strength measurements on specially prepared samples of disturbed soils in laboratory. Thus they do not work satisfactorily under field condition for in situ. measurements. Moreover these tests are suitable for very high soil strengths, a problem which may not occure in cropped fields and the strength of soils in paddy fields is still lesser. Thus considering that the penetration resistance of soil of agricultural fields in general and paddy fields in particular can not be measured with reasonable accuracy with commercially available tools, it was felt essential to develop a suitable device for determination of penetration resistance in low range of soil strength. As one of the measurements included soil strength determination, design and fabrication of a suitable penetrometer was also under taken.