INTRODUCTION

Rice (Oryza sativa L.) is probably the most adaptive cultivated crop grown under varying soil, water and climatic conditions. The crop may be cultivated under upland condition (unflooded) or under partial or continuous submergence. Rice plant is considered to be water loving and it has been reported that the growth and yield are favoured by submergence of soil during the crop growth (Matsushima, 1962). In tropics, better growth of plants under submergence is attributed mainly to the control of weed growth, increase in the availability of some of the essential nutrient elements and favourable conditions for the normal physiological processes of the plant. However, the yields have been reported to be higher under flooded condition than under unflooded condition where weed growth has been checked (Choudhry and McLean, 1963). There is not much information available on the effects of moisture regimes on physiological processes of the rice plant and the critical moisture limits for these processes.

It is understandable that rice may need moist condition of soil to meet its relatively higher water requirement than other crops of similar duration, but the above condition does not substantiate the reasons for the effect of submergence resulting in higher yields. Water control in rice cultivation has been accepted as one of the important ways to achieve the

objective of raising rice yield but there are different views regarding the suitable moisture regime for the optimum growth of rice. While Ghildyal and Jana (1967) found soil saturation comparable to submergence for good growth and yield of rice, Chang et al. (1958-63) reported that soil moisture even at 80 per cent of field capacity was comparable to submergence under loamy soil. On the other hand, Choudhry and McLean (1963) and Matsushima (1962) have reported conclusively better growth of rice under flooded condition than under unflooded condition. However, even if it is accepted that rice yields better when grown under flooded condition, the question whether rice needs to be submerged throughout its growth period, and if so, how much should be the depth of submergence, deserves investigation.

The transpiration ratio of rice plant is reported higher than that of many other aerable plants (Briggs and Shantz, 1914) and, consequently, it is reasonable to expect that rice plants grown under unflooded conditions may suffer from moisture stress more readily than other upland crops. Only less than one per cent of the water absorbed by a plant is used in photosynthesis. Thus it would seem probable that indirect effects of the water factor on photosynthesis are more pronounced than its direct effects. In other words, deficiency of water as a raw material is rarely a limiting factor in photosynthesis.

Nevertheless, a reduction in water content of the leaves usually results in a decrease in the rate of photosynthesis and adversely affects other physiological processes of the plant. It has been reported by Wu (1966) that the efficiency in photosynthesis of the rice plant decreases when the leaf water falls below 65 per cent. The moisture content to this extent has to be maintained if the plant has to gain in dry matter. The moisture content of the leaves is influenced more by the evaporative demand of the environment rather than the moisture content of the soil and the evaporative demand is governed by the environmental condition which, in general, is related to the season.

To achieve increase in rice production, endeavour for augmenting yield potentiality of land and enthusiasm for cultivating more than one crop a year have been emphasised as a national policy. According to the rainfall distribution pattern in this country, the growth season for rice may be classified as dry and wet. During the dry season, the high evaporative demand along with the inadequate supply of irrigation water restricts the cultivation of rice to a considerable extent. Even with the existing irrigation facilities, development of a technique for efficient use of water by the rice plant may brighten the prospect of increasing area for summer cropping. This efficient use of water may lead to two crops a year - one in dry season and the other in wet season. Realization of

the above objective may be further facilitated by the existing short duration, non-photosensitive and high yielding rice varieties suitable for different soil and climatic conditions in this country.

Further, with the preponderence of highly leachable nitrate forms of nitrogen under upland and denitrification under lowland soil conditions there may be interactive effects of water regimes and soil nitrogen, which may play a part in the final analysis of the differential growth and yield of rice under unflooded and flooded treatments. The soil moisture and nitrogen interaction needs further study particularly under lateritic soils and climatic conditions of this region for which information is rather fragmentary in nature.

With the above points in view, the objective of the present investigation has been to evaluate the effects of soil moisture and nitrogen, their interactions on the mineral nutrition and related physiology of the rice plant. Further, the studies have been made to identify the nature of limiting factors for the growth of rice under limited moisture and nitrogen supplies.