INTRODUCTION

In India rice is grown in about 40 million hectares of land, of which 16.5 million hectares are situated in low lying areas. These rainfed lowland rice areas prone to water logging are located in the states of West Bengal, Bihar, Orissa, Assam, eastern Uttar Pradesh, and the coastal districts of Andhra Pradesh, Tamilnadu, Kerala, Karnataka and Maharashtra, covering about eighty six rice growing districts of the country (Pande, 1986). The eastern region is characterised by high rainfall, where almost fifty per cent of the total rice area usually remains under chronic stress due to stagnant water with level as high as 50 cm (Biswas et al, 1986) during the major growth period of the crop .

Based on the degree of submergence, the rainfed lowlands have been classified (Swaminathan, 1979) into four major groups : shallow rainfed (5-15 cm), intermediate (15-50 cm), semi-deep (50-100cm) and deep water (more than 100 cm). Further, there are places where recurrence of flash flood is frequent due to heavy rains in the catchment areas. The crop under such situation remains under acute stress being partially or completely under water and the period of submergence stress extends from a few days to a fortnight.The time of flood occurence, the rise in water level, the maximum depth of water and the recession rate all vary with year and location.

In the rainfed lowland area, the practice followed for sowing is to drill rice directly in the dry soil before the onset of monsoon (June-Sept.). Sowing early in the season is essential in order for the plants to attain enough growth and vigour to withstand subsequent water stress due to water logging. However, in situations where lowlands get inundated earlier with the very first few monsoon showers, direct seeding is not possible and transplanting remains the common practice.

Excess water causing submergence affects the crop growth adversely and reduce the yield irrespective of the methods of sowing. The extent of yield reduction depends on the nature and time of flood occurence. In direct seeded crop, deficit water stress at early stage leads to poor seed germination, while excess water at a later stage causes low tillering, fewer panicles and finally low yield. This situation can possibly be partly mitigated by using higher seeding rate to initially provide more seedlings per unit area. Therefore, it is important to decide appropriate seeding density in case of direct sown rice in areas that suffer from submergence.

In waterlogged areas, transplanting which is the only practice, starts with the onset of active monsoon in the month of July and continues upto begining of September. In such areas, the height and age of seedlings are important consideration. Transplanting in about 30 cm stagnant water requires taller and older seedlings as they attain greater vigour and are ready to combat submergence (Jiang et al, 1981, Singh and Bhattacharjee, 1987).

The rice varieties grown in waterlogged and flood-prone areas are in general photosensitive, medium tall to tall in height, less responsive to fertilizer and are inclined to lodging. In order to improve productivity under such condition intensive breeding programme had been undertaken in the seventies and several improved varieties were evolved which could be suitable under lowland situation. The characters considered in such programmes were photosensitivity, fertilizer responsiveness, and tolerance to high level of submergence. The search is still continuing particularly for genotypes which could be non-lodging and would mature late after recession of the water from the field to facilitate harvesting. Any such genotypes developed need to be tested under varying situations of submergence to determine their relative yield. However, very little information is available on the appropriate management procedures for the tolerant varieties to realise the yield potential under varying environments of submergence. In this direction phytohormone may also provide an additional tool, since rapid elongation of treated plants can be a measure to escape the stress due to submergence (Singh, 1984).

Since lowlands in general are more fertile, traditional varieties grown in these areas exhibit good growth without much sign of nutrient deficiency, possibly because of their adaptability and low nutrient requirements, as well as due to better fertility status of the soil. However, it is evident that the recovery of nitrogen under submergence will be very low due to unavoidable losses particularly when applied as single basal dose at planting. Most of the Indian soils are abundant in potassium, moderately low in phosphorus and quite deficit in nitrogen. The effects of nitrogenous and phosphatic fertilizers on rice have been worked out in detail under controlled irrigated conditions. However, information in this direction is almost absent where rice is grown under waterlogged and flood prone conditions. Thus, there is a need to assess the performance of different genotypes with respect to the application of fertilizers, as well as on their ability and nature of uptake under varying submergence levels in the lowland areas.

The present investigation was undertaken to study the performance of tall and semi-dwarf varieties of rice under shallow (5-15 cm), intermediate (15-50 cm) and complete submergence and to determine the effects of different fertilizers under direct sowing and also in the nursery for transplanted rice . Another objective was to study the effects of phytohormones and to establish appropriate nursery management practices for transplanted rice to be grown under intermediate and completely submerged condition.