CHAPTER I

INTRODUCTION

“Rice is life” is the theme of United Nations for the “International year of Rice 2004 (IYR 2004)” for the second time (first in 1966) in the history of a single crop because it is the most predominant stable food crop of more than half of the world’s population. It provides about 27 per cent of the dietary energy and 20 per cent of dietary protein for the world population. Rice field covers about 11.2 per cent (160 m ha) of earth’s arable land, of which irrigated rice alone accounts for 55 per cent area and contributed around 75 per cent of global rice production (Anonymous, 2004). World demand for rice by the year 2025 is estimated to be about 765 million tonnes as against the present production of 556 million tonnes (Ravichandran and Singh, 2005). Therefore, the average rice yield must be raised from 6.1 (2010) to 6.7 t ha$^{-1}$ (2025). To achieve this targeted yield, about 30 per cent of farmers must accomplish yield of more than 8 t ha$^{-1}$ and 15 per cent to be more than 9 t ha$^{-1}$ in at least one crop in a year.

At global level, rice is grown in an area of 158.10 million hectares with a production of 447.42 million tonnes and having the productivity of 4.22 t ha$^{-1}$ (USDA, 2010). India has the largest acreage under rice of 44 million hectares with a production of about 141 million tonnes. However, the national productivity of rice is 3.21 t ha$^{-1}$. The burgeoning population of our country may stabilize around 1.4 and 1.6 billion by 2025 and 2050, requiring annually 380 and 450 million tonnes of food grains, respectively (Siddiq, 2000). To meet future food requirements, India has to increase its rice productivity by three per cent per annum (Gulab Singh Yadav et al., 2009). In Tamil Nadu, it is cultivated in an area of 21 lakh hectares with the production and productivity of 50.40 lakh tonnes and 2.82 t ha$^{-1}$, respectively (Anonymous, 2010).

The reasons for low rice yields are many and diverse in nature, inefficient utilization of applied nitrogen, ill effects of cloudy weather on photosynthetic activity of rice in monsoon season, heavy infestation of weeds (Subramanian, 2003). To meet the food demand of ever increasing human population, it is imperative to maximize
the productivity of rice, the staple food, as land and water are limited for extending the area under rice (Siddiq, 2000).

The green revolution had gradually turned into a “greedy revolution” (Swaminathan, 2002) as evident from the indiscriminate use of inorganic inputs to attain higher productivity. Excessive use of high analysis synthetic inputs, such as chemical fertilizers and pesticides in the intensive rice bowls, will likely be resulted in resource degradation and environmental pollution with adverse effects on human health, biotic and abiotic ecosystem (IRRI, 2003). As for as environmental capital stock concerned, the ecological aspects become relevant not only to environmentalists but also the agronomists.

Nitrogen is the kingpin for any fertilizer management programme in rice cultivation and is the universal key element for realizing the yield potential of high yielding rice varieties in Indian soils. Fertilizer N use efficiency varies from 18 to 40 per cent in different rice soils, because applied inorganic N hurriedly lost from soil by ammonia volatilization, denitrification, leaching and runoff (Natarajan and Pushpavalli, 1994). In recent years, soil health deterioration by the enormous application of chemical N fertilizer coupled with escalating price of N fertilizer has paved the way for an efficient N management strategy for lowland transplanted rice.

Therefore, there is a felt necessity to evaluate suitable agronomic strategies with emphasis on eco friendliness to accomplish the twin objectives of achieving the sustained production and maintaining the soil fertility over a longer period. One of the major practices to achieve sustainability is to partially substitute the chemical N fertilizers with suitable organic manures. They are considered as the promising renewable nutrient rich sources and can be served as substitute to cut down the cost of chemical fertilizer inputs and to increase the productivity of rice. The substitutes of cheaply available and renewable inputs such as FYM, vermicompost, pressmud and weed plant compost will encourage locally available resources in place of costly and high energy requiring industrial inputs thereby solacing waste management problems.

Farmyard manure (FYM) is the most commonly used organic manure. It supplies macro and micronutrients apart from improving physical conditions of the soil (Sengar et al., 2000). However, the availability of FYM in recent years is
declining due to reduced cattle population in India. Enriched farmyard manure (EFYM) has been recognized as an alternate viable and environmentally sound technology to supply nutrients without much loss to the crops. Incubation of chemical fertilizers with well decomposed farmyard manure has led to the sustained availability of applied nutrients to the crops.

Disposal of agro industrial wastes is a major problem and dumping it in the vicinity of industrial areas initiate environmental hazards. Recycling of industrial wastes is loom of disposal mechanism and resource management. One among the agro industrial wastes is pressmud from sugar industries. It has a greater potential in supplying higher quantity of nitrogen, phosphorus and potassium besides secondary and micronutrients (Ramesh and Vaiyapuri, 2008).

Conventional methods of composting resulted in losses of about 55 per cent of organic matter and 30-40 per cent of nitrogen (Ketkar, 1993). Hence, vermicompost has been identified as one of the major gears to convert the biodegradable organic materials into resourceful manure. It is rich in available nitrogen, phosphorus, potassium, calcium, vitamins, natural phytoregulators and micro flora in a balanced form that help in reestablishment of the natural fertility of soil (Banik and Ranjitha Bejbaruah, 2004).

Ipomoea and water hyacinth are the most problematic weeds, can be effectively composted and utilized as manure. The compost has an optimistic effect on the formation of the micro aggregates of the soil, augmented water holding capacity and cation exchange capacity which reflected on rice growth and yield (Shanjida Khan and Sarwar, 2002).

Weeds constitute a serious biotic stress in rice cultivation and they compete with rice for nutrients, water, light and space and inhibit crop growth, ultimately reduced grain yield. In India, the rice yield losses due to weeds have been put on a range of 10 per cent to as high as 90 per cent (Janardhan and Maniyappa, 1992) which amount to 15 million tonnes of rice. Weeds deplete nutrients of about 85 kg N, 15 kg P and 90 kg K ha\(^{-1}\) from rice field (Tandon, 1995). This is particularly unfortunate because weeds deprive not only the yield potential of crops but also 40 per cent of the
fertilizers, the costliest input for Indian farmers. Hence, weed management technology becomes necessary to increase the productivity of rice.

Although, hand weeding is widely practiced for effective weed control in rice, it is time consuming, expensive and laborious. Moreover, weeding during critical growth stages is not possible in several times due to scarcity of labour during the peak season. Therefore, controlling weeds by using herbicides is one of the best alternatives to hand weeding for increasing the rice yield.

The advent of herbicides has been considered as one of the major important advances in weed science. The continuous use of herbicides often affects the soil health and pollutes the environment (Singh et al., 2005). However, adoption of any single method of weed control is not satisfactory to control all type of weeds. Therefore, integrated approach involving chemical, cultural methods, etc. is vital to maximize the weed control efficiency. Integration of different methods of weed control may result in effective control of weeds and result in increasing the productivity of transplanted rice (Brar and Walia, 1995).

A number of herbicides are available in the market for effective and economical control of weeds. Further, a combination of pre-emergence herbicide plus a manual weeding at a later stage of crop is less costly and more effective in weed control than the conventional method of engaging labourers for manual weeding.

De Datta and Baltazar (1994) pointed out that even in integrated weed management systems, chemical weed control is often necessary at low rate of application. Promising new herbicides like pretilachlor and oxadiargyl are selective for rice and hence, it is essential to study their efficacy in controlling the weeds in transplanted rice.

Keeping in view the problems like heavy weed infestation and low nitrogen use efficiency encountered by the farmers in rice cultivation, the present study was mooted with the following objectives:

1. To optimize the dose of fertilizer N when applied with organic manure
2. To optimize the best weed management practices
3. To study the effect of integrated nutrient and weed management on growth and yield of transplanted rice

4. To study the effect of integrated nutrient weed management on nutrient uptake and soil fertility and

5. to work out the economics and identify the best sustainable integrated nitrogen and weed management practices in transplanted rice under lowland situation.