CHAPTER I

INTRODUCTION

Rice and wheat are the important cereal crops in India, grown mostly during 'Kharif' (June to October) and 'Rabi' (November to April) seasons respectively. These together produce about 103 million tonnes of food grains annually which constitute about 70 per cent of the total food grain production in the country (FAI, 1986). The present yield breakthrough in agriculture is due to the introduction of high yielding varieties which, being high demanding, require proper management of essential inputs. This would not only ensure full realization of their potential but also a high and sustained productivity. The yield achieved in research stations indicate the existence of an exploitable gap, the bridging of which would mean an overall increase at the national level. This is essential to keep pace with the ever-increasing demand of food grains.

The eastern part of the country, where 75 per cent of the rice area is under rainfed condition, accounts for about 45 per cent of the total area and contributes about 43 per cent of the total rice production. Cultivation of rice in 'Kharif' is the only suitable option in low-lying areas because of high rainfall. Thereafter, the cropping pattern is determined by the amount and distribution of rainfall, availability of irrigation water, climate, hydrology and the land and soil environment. Cultivation of wheat which has low water requirement is becoming

popular during 'Rabi' season, which otherwise remains mostly cropless except in some irrigated areas where dry season rice is grown. Besides this, gram also seems to be a promising crop with the dual advantage of meeting increasing demand of pulses and restoring fertility status which becomes excessively exhausted under cereal dominating crop rotations.

Of several factors essential for increasing crop production, fertilizer is the major one for increasing productivity. Both rice and wheat are heavy feeders of nutrients and rob the soil of its inherent fertility unless the same is replenished. In intensive agricultural system, replenishment involves greater attention for optimum crop productivity and maintenance of soil fertility. The use of chemical fertilizers, apart from causing pollution hazards, is becoming a costly affair because of the increasing energy crisis. Increased productivity resulting from the use of chemical fertilizers coupled with increased cropping intensity has tended to deplete soil organic matter and eventually deterioration of soil fertility.

Insufficiency of mineral fertilizers and the fear of soil degradation have led to concomit_ant promotion of the use of organic fertilizers. These can facilitate mobilization of cheap resources for productive purposes. Soil organic matter is the major source of plant nutrients, especially N in rice

nutrition. It is responsible for overall improvement in physical, chemical and biological properties of soil that are closely related to the growth of crops. Thus, it plays a prominent role in sustained productivity of tropical soils particularly the acid laterites which are generally low in organic matter. In view of the above, it has become absolutely essential to reconsider the prospects of organic matter in rice production and to prepare a new strategy in this field.

The organic materials most commonly used to improve soil conditions and fertility include farm yard manure, composts, crop residues and green manures. Farm yard manure is the traditional organic manure consisting of livestock excreta and other waste materials used as bedding. Composting is a microbiological process for degradation of solids with high C:N ratio to produce humified products of narrow C:N ratio. Water hyacinth, a free-floating problem weed, growing luxuriantly in ponds, lakes and water reservoirs, can be composted into a useful manure for use in wetland rice fields. Moreover, in rice and wheat growing areas, the most abundant and easily available organic materials are their residues themselves. Green manuring of rice with sunnhemp and dhaincha has been found suitable for improving soil fertility and productivity. Azolla is another such plant found in shallow ponds, ditches and channels in association with a blue green alga and has lately been of some interest in rice

research in the country. The algae which fix atmospheric nitrogen and azolla fern which is subsequently ploughed under, makes it essentially a green manure crop.

Organic materials, in general,are very bulky, requring time-consuming and labour intensive collection, transport and application. These low analysis materials therefore, have to be applied in larger doses to meet crop requirement. Further, it is more realistic to adopt a management system that will ensure its effectiveness. Organic materials of different kinds should be ploughed into the soil prior to the sowing of a crop, because decomposition of the material is important to ensure benefits with no deleterious effects such as nitrogen immobilization and accumulation of toxic substances which are usually associated with materials of high C:N ratio. Addition of nitrogen in the form of mineral fertilizer also accelerates the pace of mineralization by reducing C:N ratio of cereal residues rich in carbon and poor in nitrogen. However, mineralization of humified manures and compost is slow which can be incorporated in the soil just before sowing a crop. But, in absence of adequate information on relative efficiency of these materials under lowland rice conditions, it is necessary to investigate and establish their usefulness either singly or in combination.

It is universally accepted that mineral fertilizers are not a substitute for organic materials and vice versa; rather their role is complementary. The underlying principle behind this concept is to use organic and mineral fertilizers in a most efficient manner because of their limited availability and high prices. Organic matter can be used to regulate the nitrogen supply to rice plant as a nitrogen repressor as well as generator in early and later growth stages respectively. The only difference between mineral fertilizers and organic materials is that the nutrients contained in mineral fertilizer are used rapidly but incompletely and the nutrients supplied with organic matter are used slowly and stored for a longer time in the soil. Therefore, to obtain high rice yields, proper use of mineral fertilizers is necessary in addition to organic manuring. However, for a desired and expected result under rice based cropping, it becomes imperative to integrate both organic and mineral fertilizers in proper proportion. This can be achieved most effectively if, along with sources, their rate and time of application are also taken into account.

In the recent past, research on fertilizer use in our country was mainly confined to the nutritional requirement of individual crops and recommendations were made on the basis of fertilizer response data of a single crop. Generally, a farmer

applies fertilizer to every crop in a cropping system without realizing that fertilizer applied to one crop may meet the requirement of the succeeding crop, to some extent. This, therefore, implies that in calculating fertilizer needs for any crop, discount should be made for manures and fertilizers applied to the previous crop. Moreover, soil inherent characteristics and crop requirement should also be taken into account.

Keeping the above in view, a series of experiments were planned and conducted with the following major objectives :

1. To evaluate the direct effect of different sources of organic, bio- and mineral fertilizers on 'Kharif' rice and their residual effect on winter or dry season crops,
2. To determine the relative efficiency of different organic sources in improving soil productivity, and
3. To develop an appropriate integrated management schedule of different organic materials and mineral fertilizers for rice based cropping.