CHAPTER - I

INTRODUCTION

The Indo-Gangetic alluvial plains extend over a length of about 1600 km and a width of 320 km. In general, these soils are very fertile soils especially in the upper Gangetic plain and the Trans-Gangetic plain, largely falling in the state of U.P., Punjab, Haryana, and Rajasthan due to the availability of large scale irrigation facilities (Swarup, et al 1998). However, some of the soils of these alluvial plains are located in arid and semi arid regions, which face many constraints in satisfactory agricultural production. In the state of Haryana, many districts namely Jind, Hisar, Sirsa, Bhiwani, Mohindergarh, Rewari, Gurgaon, Jhajhar and Fatehabad are located in the arid and semi arid regions. The prominent problems for successful agriculture in these areas include scarcity of good quality irrigation water, low rainfall, saline ground waters, impeded Kankar layer in the root zone, high temperatures through out the year, low organic carbon content and poor fertility status of the soils.

In the semi arid areas of Jind district, the irrigation is mostly through tube wells and in some areas tube well irrigation is supported through canal system. Ground water is mostly saline and the depth of water table is more than 10 meter. Due to excessive withdrawal of ground waters, the depth of water table is increasing year after year. Generally, the water quality deteriorated with increasing depth. Many farmers who try to deepen their tube wells with the hope of getting better quality waters at deeper depths are disappointed when they find that waters are much more saline at deeper depths. In those areas where canal system has been introduced, the water supply is very less and erratic. The limited rainfall of about 55 cm. per annum in these areas has further aggravated the problems as it has caused the development of Kankar layer in the root zone (Singh, et al 1985), which is hindrance to the root development especially of trees. The main crop rotation in these areas is Cotton-Wheat. Although cotton
tolerates higher salinity waters but this crop is most uncertain as it is attacked by many pests and diseases. Many times the attack of pests is so much that whole crop is totally destroyed and the yields are very less to recover even the cost of cultivation and amount spent on pesticides etc. When the farmers incur heavy losses, they commit suicides. So, to reduce the heavy risk of total failure of cotton crop, there is need for diversification by introducing other crops preferably some useful fruit trees, which require less amount of water.

According to the recent trends available, there is decline in productivity of crops in the Indogangetic alluvial plains (Paroda, 1997) and the constraint analysis has identified declining organic matter content of soils as a probable reason for this (Swarup, 2004). The maintenance of soil organic carbon (SOC) in agricultural soils is primarily governed by climate, particularly annual precipitation, temperature and cropping system. Although the amount of SOC in soils of India is relatively low, ranging from 0.1 to 1% and typically less then 0.5%, its influence on soil fertility and physical condition is of great significance (Ali, et al 1966; Das, 1996; Jenny and Raychaudhuri, 1960; Mathan, et al 1978). Carbon losses by tillage are caused by greater oxidation of SOC and it ranges from 20 to 50% in soils dominating the semiarid region of India (Mann, 1986; Mutatkar and Raychaudhuri, 1959). In most of tropical cropping system, little or no agricultural crop residues are returned to the soil, which leads to a decline in soil organic carbon (Lal, 1986; Post and Mann, 1990). The increasing cost of fertilizers, the gradual removal of subsidies for fertilizers and the increasing concern of likely pollution of ground water by fertilizers through leaching from soil are discouraging the use of fertilizers (Kanwar, 1994). It has been stressed that along with balanced use of fertilizers, matching adoption of organic manures should be maintained for a sustainable agriculture (Goswami, 1997).

With the advent of mechanization in agriculture, tractors do most of the farm work and the number of drought animals has reduced to a great extent. This
There has been a reduction in the production of animal dung and thus production of farmyard manure has decreased. Thus in-cultivated soils, the organic carbon content continues to decrease. The presence of calcium carbonate further complicates the problem as it adversely affects the status of available nutrients. Thus there is need to apply organic manure from other sources. One of the other sources of organic manure can be green manure (Prasad and Goswami, 1992). However, it is expensive due to the unavailability of good quality irrigation water. Another source in the semi-arid areas could be crop residues in the form of cotton sticks. But these sticks are used as a source of fuel. Other potential sources of organic materials available locally to supplement plant nutrients include cereal crop residues, sugarcane trash, animal manures, compost, water hyacinth etc. (Sarkar, et al 1994). The other potential source is the Press Mud which is a by-product from Sugar mills in this area. These sugar mills use sulphur in the sulphitation process while preparing sugar from sugar cane juice. This press mud has been converted into useful amendment named as Acidified Press Mud (APM) by Dr.K.K.Mehta during 1995-96 and was used in 1996 in the field experiments on reclamation of alkali soils at CSSRI, research farm Shivery near Lucknow (Mehta, 1998). APM was prepared by treating Press mud with low cost sulphuric acid and adjusting the pH to 2.00. APM having pH of 4.00 was also prepared and used successfully for improving sodic waters from Karnal district of Haryana (Mehta, 2003). In our country, there are more than 579 sugar mills producing more than 5 million tonnes of press mud each year. A part of this huge quantity of press mud can be converted into APM which can be used for improving sodic soils and waters which can be a useful source for increasing soil organic carbon content. As APM is acidic in nature, it can also be used in calcareous soils which is likely to decrease soil pH, dissolve some of the calcium carbonate and thus improve the available nutrients in the soil. Thus, use of Acidified Press Mud for these calcareous soils deserve more attention.
application of APM to the soil will not only provide the essential nutrients but can also help in improving the availability of existing macro and micronutrients which otherwise are in the unavailable form due to poor organic carbon content and presence of calcium carbonate.

Growing of suitable fruit trees can be helpful to avoid the risk of total loss of economic returns if the main crop of cotton fails due to drought and/or attack of insects and pests. If fruit trees are planted in between the growing cotton-wheat crops, there will be additional income from fruit trees after a growth period of about four years. In addition to the expected increased economic returns, planting of fruit trees will increase the organic carbon content in the deeper soil layers also. Organic carbon content was about double in agro-horticultural and agro-forestry systems as compared to sole cropping (Das and Itmal, 1994). However, there is need to develop technologies for the establishment and care of fruit trees during the initial few years of growth. New techniques such as Auger hole method of planting fruit trees have been developed for different soils such as Alkali soils but no studies have been reported for such soils of Jind district where cotton-wheat crop rotation is followed and there is presence of impeded Kankar layer in the soil profile. There is increasing feeling that scientists should come forward to conduct research on farmers fields to solve some of the problems being faced by the farmers on such Calcic soils under irrigated conditions (Tyagi and Minhas, 1998).

In the arid areas of Bhiwani, the situation is grimmer where the rainfall is 35cm per annum only. The rainfall is mainly concentrated in the months of July to August and many times most of the rainfall occurs in one or two heavy rains. Most of the areas are rain fed having no source of irrigation. There is scarcity of good quality water for drinking also. The whole area has mainly two types of areas i.e. up lands, which are mainly sandy. The other types of soils are flat soils, which have varying problems of Kankar layer, salt accumulation in the
soil profile. Due to very high temperatures and poor cropping intensity both type of above soils have very low organic carbon content. The availability of Nitrogen, Phosphorus and other micronutrients is also very poor. Presence of calcium carbonate further reduces the availability of plant nutrients. The main crops during rainy season are Bajra and Guari, which fail very frequently due to the failure of rains. Irrigation through tube wells is restricted as the ground waters are highly saline. It has been reported that more than 60% of the ground water of arid areas of Bhiwani and Hisar regions had an EC higher than 8000 dSm\(^{-1}\) and these ground waters are mainly of sodium/ chloride type (Puri, 1989).

Due to all these problems, such soils produce very little crops. There is need for planting of useful trees like Khejri (*Prosopis cineraria*). The animal population is very low in these areas thus there is practically no source for addition of organic manures in these areas, there is need to use amendments like APM on the growth and uptake of nutrients by Khejri plants as APM is rich in organic carbon and is mainly a renewable source as it is prepared from press mud which is a by product during the manufacture of sugar from sugarcane.

So, keeping in view all the above-mentioned facts, the present studies were proposed so as to develop alternative and better agricultural production system for the irrigated and rainfed arid soils having Calcic layer in the soil profile. The present studies are being proposed with the following objectives.

1. To study the effect of APM (Acidified Press Mud) on soil properties of Impeded alluvial soils in irrigated and rain-fed conditions.
2. To understand the role of Calcic layer on the growth of fruit and forest plants and to study the changes in growth and nutrient uptake by different planting methods and application of APM.
3. To identify the problems of establishment of fruit and forest plants saplings and to suggest the necessary practices for successful establishment of these plants.