CHAPTER - VII

India started efforts in increasing agricultural production since 1966, when the new agricultural strategy was launched (Bhatia, 1980). It has been now realized that Indian agriculture offers immense potential for increasing agricultural production using improved farm technology and various inputs to go with it viz., new varieties of crop plants, fertilizers, manures, insecticides, pesticides, herbicides, etc. As a result of this, under the banner of ‘Green revolution’ the country has now became self sufficient in food grain production. However, the higher production potential seems to be illusory as 36% of the population live below poverty line, meaning they do not get sufficient food to eat daily.

One of the reason for this situation is that in spite of having huge livestock population, very little attention has been paid towards animal nutrition. Undernutrition and malnutrition among the livestock leads to low productivity of food of animal origin. There is a huge gap between demand and supply of all kinds of feeds and fodders. Therefore, in order to meet the requirement of growing human population, the production of milk, meat and other animal products has to be increased by increasing production of nutritious fodder for feeding animals.
Cattle feeding plays significant role in animal husbandry in the form of increasing growth rate, attaining early maturity, promoting high level of milk production and utilizing food resources properly (Arora, 1978). Supply of optimum nutrients, in quantity as well as quality, is essential to nourish animals. The livestock derive feed from grasslands, cultivated fodder crops, crop residues, fodder trees and concentrates. Cultivation of suitable fodder crops using appropriate agronomic practices assumes special importance in this context. While cultivating fodder crops the use of fertilizer nitrogen (N) plays an important role to increase productivity of green produce per unit area of land per unit time. However, investigations in this laboratory and at other places indicated ill effects of excess use of nitrogen fertilizers to both soil as well as plants. Heavy doses of fertilizer nitrogen make the soil saline and modify its structure making them less productive and unfit for cultivation. Furthermore, application of nitrogen on large scale may increase toxic constituents in plant foliage in the form of nitrates and oxalates. This makes fodder unfit for animal nutrition.

In view of above facts, it was thought worthwhile to evaluate the possibility of reducing the use of chemical fertilizers by introducing organic fertilizers, manures or bio-fertilizers, either alone or in combination with chemical fertilizers. Thus attempts were undertaken under integrated fertilizer management (IFM) to use chemical fertilizers in moderate amount along with organic manures and bio-fertilizers. The main objective was to make minimum use of fertilizers in the form of chemicals by substituting
them with organic or bio-fertilizers. It was assumed that by doing so, apart from increasing productivity of fodder crops, sustainable yield would be obtained and soil texture / structure will remain intact. The experiments for this purpose were undertaken either in the field or pots, and the results obtained are presented in four main chapters.

A brief introduction to the topic, review of literature, topography of the region, and information about plants and on meteorological data of the region have been summarized initially in two chapters.

The effect of nitrogen (N) and phosphorus (P) fertilizers on the growth and fodders productivity has been summarized in chapter III. For this purpose maize, *Sorghum, Dolichos, Phaseolus* and wheat were cultivated. Maize responded well to the application of fertilizer nitrogen, particularly when it was amended along with farm yard manure (FYM). It was evident from the observations in the form of increase in height of maize plant from 31 to 95 cm, number of leaves from 5.2 to 6.8, dry weight of the plant from 3.8 to 16.2 gm and N content in dry matter (DM) from 1.25 to 1.66 %. Furthermore use of FYM along with nitrogen (N) led to accumulation of 270 mg N/plant against 48 mg N/plant on control or untreated pots. The yield of green food on field experiment significantly increased from 14705 to 31204 kg/ha due to the application of 60 kg N/ha. The optimum economic dose calculated for maize was 120 kg/ha. The crop used fertilizer nitrogen efficiently. Almost similar results were observed with *Sorghum* showing more efficient use of fertilizer nitrogen in presence
of FYM. The yield of green fodder from *Sorghum* significantly increased from 7890 to 12304 kg/ha with an improvement in N % of DM from 1.38 to 1.74 %. *Sorghum* also used nitrogen fertilizer efficiently; the efficiency of fertilizer N use decreased with increasing dose of nitrogen. The optimum economic dose for *Sorghum* was calculated as 35.5 kg/ha.

As with nitrogen, application of phosphorus (P) also responded well, when applied to either *Phaseolus* or *Dolichos* along with FYM. However, application of phosphorus failed to increase the yield of green fodder in both of the crops. Thus P$_2$O$_5$ responded well along with FYM rather than its application alone.

When the effect of N, P and K on wheat was studied, it was observed that application of N along with P and K was more beneficial. The yield of green fodder significantly increased due to the application of N, either alone or with either P or P + K with an improvement in N % of DM in foliage. The results thus indicated that fertilizer nitrogen largely governs yield and protein content in green foliage, particularly in the presence of farm yard manure (FYM).

Effect of vermicompost and biofertilizers in the form of *Azotobacter* and *Rhizobium* were studied on growth and productivity of maize, cowpea and *Dolichos*. Application of vermicompost to the soil along with fertilizer nitrogen showed improvement in the growth of cowpea as well as maize. However nodulation in case of cowpea was not influenced by vermicompost as well as nitrogen. The N % of DM in maize increased due
to the application of vermicompost and nitrogen from 1.08 to 2.15 % with increased accumulation of nitrogen in plant. Similarly the two biofertilizers i.e. *Azotobacter* and *Rhizobium* improved the growth of maize and *Dolichos* respectively. When the experiments were undertaken in field, application of vermicompost along with nitrogen failed to increase green fodder yield from cowpea, however, maize responded favourably to the application of vermicompost along with nitrogen and phosphorus. The green fodder yield increased from 3084 to 19511 kg/ha from maize due to integrated use of vermicompost along with fertilizer nitrogen and phosphorus. Though *Azotobacter* was beneficial in increasing the yield of maize, *Rhizobium* was not much influential in improving the performance of *Dolichos*. The results thus suggested that use of vermicompost and biofertilizers is beneficial in fodder production, particularly, when applied along with nitrogen.

Cultivation of two or more crops simultaneously on the same piece of land with definite geometric proportion in rows is called intercropping. When one of the component crop is a leguminous species, then the nitrogen (N) fixed by it is used by another, resulting in increased productivity with minimum use of chemical fertilizers. Attempts were made during present investigation to cultivate maize with *Dolichos* and *Sorghum* with either *Dolichos* or Gram in various proportions. The advantage of their simultaneous cultivation was evaluated using the concept of land equivalent ratio (LER) as well as by studying competitive relationship between them. Maize + *Dolichos* and *Sorghum + Dolichos* showed yield advantage with
the value of total LER exceeding unity. *Sorghum* + Gram however was not found suitable for increased productivity, though there was no yield disadvantage except in 1 : 1 proportion of sowing. The results obtained with intercropping indicated that cultivation of a leguminous fodder with non-legume in proper proportion results in higher fodder productivity providing nutritious foliage.

Attempts made to prepare hay from green fodder from maize, *Sorghum*, bajra and *Dolichos* gave encouraging results. All these crops resulted in good quality of hay when they were either dried in sun covered with black cloth or initially dried in sun followed by that in dark. The drying rates were determined using the concept of relative water content (RWC). The chemical composition of hay or silages prepared from various crops is also given, which indicated that good and nutritious feed can be made available either as hay or silage particularly during scarcity due to drought conditions in summer.

The overall results obtained during present research programme can be summarized in the form of following conclusions:

1) Application of either nitrogen (N) fertilizer to non-leguminous fodder crop, or phosphorus (P) in case of leguminous fodder species, increase fodder productivity, particularly in the presence of farm yard manure (FYM).

2) Vermicompost is most suitable manure which can increase fodder productivity in association with fertilizer nitrogen (N).
3) Bio-fertilizers, in the form of either *Azotobacter* or *Rhizobium* can be employed to achieve higher crop productivity which can reduce the use of fertilizer nitrogen (N) to some extent.

4) Legume + non-legume intercropping leads to higher biomass productivity in the form of green foliage with minimum use of chemical fertilizers.

5) Intercropping, apart from providing green fodders in large proportions per unit land area, offers nutritious feed to the cattle.

6) The surplus green fodder obtained during favourable season can be conserved either as hay or silage of high nutritive value.

7) Hay making is most simple and cheap method of conservation of green foliages.

8) Use of chemical fertilizers along with organic or biofertilizers coupled with intercropping and proper conservation practice can offer ample feed to the cattle round the year.

It is felt that the conclusions derived during present investigation will be useful in raising cattle in a more proper way to obtain maximum benefit for human welfare.