4. DISCUSSION

The results of present investigation have already been presented in the preceding chapter in detail. In this chapter, an attempt has been made to explain the important results on the basis of scientific reasonings.

4.1 Green yield

The biological yield of a crop is the result of the interaction between genotype (variety) and environment (management). Thus the highest green fodder yield obtained with strain Vidisha 60-1 (404.19 q/ha) could be attributed to its high genetic potential. This variety also produced leaves with greater breadth providing larger leaf area for photosynthetic base resulting in increased fodder yield. The high fodder yield of Vidisha 60-1 has also been reported with multilocation trials under All India Coordinated Sorghum Improvement Project (Paroda, 1975). The forage yield attributing characters in favour of Ujjain 8, the second ranking germplasm (317.19 q/ha) were: taller plant height, number of total and functional leaves/plant and longest leaf length (Tables 1B, 11, 12 and 14). The lowest fodder production with JS 263 (260.36 q/ha) could, however, be attributed to its low yielding potential reflected by inadequate contribution of growth parameters.
Among the various nitrogen levels used under investigation, 90 kg N/ha produced significantly higher (P < 0.05) yield (338.44 q/ha) than 30 kg N/ha (315.78 q/ha) (Table 6). Increase in yield due to progressive increments of nitrogen doses could be examined in the light of the fact that nitrogen as a constituent of protoplasm increases the protoplasmic contents and thus faster cell division which ultimately reflects in increased growth of the crop (Ishizuka, 1965). The maximum fodder yield of 338.44 q/ha with 90 kg N/ha was definitely due to higher nitrogen uptake in the crop resulting in vigorous, succulent and palatable fodder, on one hand and slightly taller plants with longest leaves, on the other. Increasing trend in fodder yield with increasing nitrogen doses observed in the present investigation suggests, that much higher levels of nitrogen are needed for the fuller expression of the green fodder production potential of sorghum germplasm, of course it varies from variety to variety. The results reported by many workers (Verma, 1955; Burleson et al., 1956; Singh, 1957; Porter et al., 1960; Vijaya and Yawalkar, 1966; Shukla et al., 1967; Tomar and Singh, 1968; Srivastava, 1969; Aaron et al., 1970; Bagga, 1971 and Hegde and Kelwani, 1974) confirmed the present findings as they reported progressive increase in the fodder yield with increasing levels of nitrogen. The non significant differences between 30 and 60 and between 60 and 90 kg nitrogen might be due to medium available nitrogen content (400 and 350 kg/ha, respectively for 0 to 15 and 15 to 30 cm depth) of the experimental field.
The significant responses to applied nitrogen with high yielding forage crop varieties are realised either in nitrogen deficient soil or at high levels of its application.

The yield differences due to different methods of nitrogen application were within the normal range of variations. However, soil + foliar method proved slightly better over soil or foliar alone. This might be due to the reason that at initial stages of crop growth, the nitrogen need of the plant has to be met mainly from soil through roots. But in the latter stages when crop has developed full foliage for retention and rapid absorption of the applied nitrogen, the foliar application supplements to the remaining nutritional requirement of crop. It is well established fact that the foliar application is not a substitute for soil application; at best it may be considered as a supplement to soil application for increasing fertilizer use efficiency (De, 1971). The advantage, though not so much marked of soil + foliar application outlined above is in accordance with the advantages reported in different experiments by Seth and Prasad (1965), Mukherjee et al. (1966); Sharma et al. (1966), Mudhalkar and Sankaran (1968); Mahapatra et al. (1971) and Shekhawat et al. (1971).

4.2 Dry matter yield

Although the green weight of the fodder is important as the forage is mostly fed in this form but the ultimate value
of a crop variety is assessed in terms of its dry matter production as daily ration of an animal is computed on this basis. The dry matter production is indicated by the balance between the total photosynthesis and total respiration. From the net assimilation and yield point of view, the study on dry matter production as a result of development as influenced by varieties, nitrogen levels and its management is quite essential. Thus, the dry matter production is the best criterion for judging the production and nutritional value of a forage.

Dry matter production is a function of all the growth characteristics i.e. plant height, number and length and breadth of the leaves. Thus it is a single entity which defines plant growth as influenced by various treatments under investigation.

The dry matter production of Vidisha 60-1 and Ujjain 8 was almost the same but significantly superior (P < 0.01) to JS 263 (Table 8). The maximum dry matter accumulation in Vidisha 60-1 (111.25 q/ha) was mainly due to its high green yield. However, high fodder yield associated with greater DM content largely contributed to dry matter production (108.74 q/ha) of Ujjain 8. The lowest dry matter production of only 78.06 q/ha with JS 263 could be attributed to its low green fodder yield (260.36 q/ha) (Table 6).

Vidisha 60-1 and Ujjain 8 took more number of days (110 and 107 days, respectively) to reach in soft dough stage (harvest
stage) than the JS 263 (85 days), suggesting that dry matter accumulation was directly correlated with number of days a crop remains in the field. As already discussed in green yields, the varieties Vidisha 60-1 and Ujjain 8 with vigorous plant growth provided higher rate of dry matter accumulation with these varieties (Watson, 1952) as compared to JS 263. It follows that the dry matter production per hectare/day was of the same order in Vidisha 60-1 and Ujjain 8 because of similar level of dry matter production and number of days taken to reach harvest stage. Whereas, JS 263 took comparatively less number of days to reach harvest stage but it produced significantly ($P < 0.01$) lower dry matter per unit area in a unit time due to its lower dry matter production. The influence of nitrogen fertilization on dry matter production followed the pattern of green fodder yields as the dry matter accumulation went on increasing with successive increase in the nitrogen doses from 30 to 90 kg/ha. However, it could not reach the level of significance. Since the dry matter per cent in forage remained unaffected with increasing levels of nitrogen, the only explanation for slight variation in dry matter increase could be attributed to simultaneous increase in green fodder yields.

The dry matter accumulation was not significantly influenced by different methods of nitrogen application. However, a combination of soil + foliar came out to be slightly superior; compared to either full soil or full foliar application. It
indicates that the dry matter accumulation in relation to mode of nitrogen fertilization followed mainly the pattern of green forage yield and to some extent the dry matter content of forage. A slightly higher per cent of dry matter was also observed with this method of N application.

4.3 Yield attributes

The yield is a co-ordinated function of a combination of factors including the genetic make up of the variety, its yield attributing characters, soil and management factors operating in the entire period of crop growth. Therefore, the study on the growth and development behaviour of sorghum varieties in relation to levels and modes of nitrogen fertilization as measured by growth characters contributing to the forage yield constitutes the sound basis for selecting better plant type responsive to high level of management.

Plant height, number of functional, dry and total leaves and length of the longest leaf were slightly greater with Ujjain 8 but did not vary statistically from these parameters observed in the case of Vidisha 60-1. A leaf breadth of 6.12 cm with Vidisha 60-1 was an important growth character directly responsible for high forage yield and DM production as leaf area index is one of the components (the other being the efficiency of carbon fixation by crop) of crop growth rate (Bidowes, 1969). Moreover, the stem leaf ratio of Vidisha 60-1
was also narrower as compared to Ujjain 8 but slightly wider than JS 263; on the dry matter basis; suggesting the greater contribution of leaves towards increased dry matter production, palatability and digestibility of forages at harvest.

In so far as the doses of nitrogen application were concerned, the highest level of 90 kg N/ha took lead over 30 and 60 kg N levels; with respect to plant height, number of functional leaves, length and breadth of the longest leaf and stem thickness and finally the narrow stem : leaf ratio. This indicated that the higher level of nitrogen was needed for enhanced crop growth. Thus a well established fact that nitrogen sufficiency to fodder crop varieties results into vigorous and high vegetative growth has been proved under the present investigation as well.

Although the different methods of N application did not influence the growth characters to any appreciable extent, but in general the nitrogen applied half through soil and half through foliage was superior with respect to height, number of leaves and stem thickness. The foliar applied nitrogen, however, was able to produce longer leaves with more breadth. The proportion of leaf to stem was greater and hence close stem : leaf ratio when nitrogen was applied in combination. The overall picture suggests that nitrogen applied in the spray form was able to modify the leaf size more than other growth components of the crop.
4.4 Economics of nitrogen fertilization

The economic consideration of nitrogen fertilization described in the preceding chapter indicates that additional application of nitrogen beyond 30 kg N/ha was not profitable because of the law of diminishing return on productivity. Although the total forage yield increased with additional unit of nitrogen (11.4 q green fodder for every additional 30 kg of N) beyond 30 kg but the return in descending order. With the perusal of the equations it is apparent that the ratio \( \frac{q}{p} \) of cost of input \( q \) to the price of the forage \( p \) is greater than \( b \) (the slope of the cost line) which indicates that the nitrogen in excess of 30 kg/ha does not pay the additional profit because the additional gain with increasing unit of nitrogen will continue to decrease.