CHAPTER-V
DISCUSSION

A brief discussion of the results obtained from the present investigation entitled “Response of fenugreek (Trigonella foenum-graecum L.) to phosphorus and sulphur” has been presented in this chapter. It has been attempted to establish “Effect and cause relationship” in light of available evidences and literature. For the sake of convenience, the entire chapter has been divided in following heads.

5.1 Effect of weather on crop
5.2 Effect on plant population
5.3 Effect of levels of phosphorus
5.4 Effect of levels of sulphur
5.5 Interaction effect of levels of phosphorus and sulphur

5.1 EFFECT OF WEATHER ON CROP

In agriculture, the crop response is largely governed by soil, available soil moisture, nutrients and certain weather parameters during crop growth and development period. The meteorological data furnished in Table 3.1 and Fig. 3.1 revealed that all the meteorological parameters were quite congenial for the satisfactory growth and development of fenugreek during the rabi season of the year 2016-17. The crop was kept weed free by pre-emergence application of pendimethalin as well as by hand weeding. The crop stand was also normal and uniform. As the crop was normal during experimentation whatever variations observed can be attributed to the different treatments exercised in the experiment.

5.2 EFFECT ON PLANT POPULATION

From the data presented in Table 4.1 it can be revealed that initial and final plant population was not influences significantly due to application of the different levels of phosphorus and sulphur. This led to conclusion that levels of phosphorus and sulphur had no influence on germination and emergence, which tended to indicate that plant population was uniform in all the treatments and there was no any adverse effect on fenugreek crop.
5.3 EFFECT OF LEVELS OF PHOSPHORUS

5.3.1 Effect on growth parameters

Growth of plant can be measured vertically in terms of plant height and horizontally in terms of number of branches (primary and secondary). Growth characters viz., plant height, number of branches per plant increased with the advancement in the age of fenugreek crop irrespective of the treatments. The data pertaining to plant height as affected by different levels of phosphorus on different dates of observation are depicted in Table 4.2. In general the linear growth of plants increased progressively with advancement of the age. Application of 40 kg P₂O₅ ha⁻¹ recorded significant increase in plant height than 20 kg P₂O₅ ha⁻¹ and 0 kg P₂O₅ ha⁻¹ at all the growth stages. The application of 40 kg P₂O₅ ha⁻¹ recorded significantly maximum number of primary and secondary branches per plant at harvest.

Similar trend in results was also found by Meena et al. (2012) in fenugreek, Mehta et al. (2012) in fenugreek, Eetela et al. (2015) in ajwain, Kumar et al. (2015) in coriander, Ali et al. (2016) in fenugreek, Jat (2004) in fenugreek. Thus, increased endogenous level of P in plant by virtue of its increased availability in the soil medium and thereafter efficient absorption and translocation in various growth by way of active cell division and elongation resulting in greater plant height, number of primary and secondary branches. The improvement in morphological parameters under the influence of phosphorus application might have resulted in larger canopy development and presumably higher chlorophyll content of leaves as nutrient actively participate in its formation.

5.3.2 Effect on yield attributes and yield

Yield is the net result of various interactions viz., soil characters, weather parameters, leaf area and various metabolic and biochemical interactions taking place during crop growth. Effect of different levels of phosphorus on the yield attributes and yield is mentioned in the Table 4.5-4.8. Various yield attributing characters like as number of pods per plant, number of seeds per pod, length of pod (cm) and test weight (g) were influenced by the application of the different levels of phosphorus. Significantly higher number of pods per plant, number of seeds per pod, length of pods and test weight were recorded under application of 40 kg P₂O₅ ha⁻¹ and found statistically at par with application of 20 kg P₂O₅ ha⁻¹ (Table 4.5 and 4.6) in case of test weight. Seed and stover yield (kg ha⁻¹) were significantly influenced by different levels of phosphorus (Table 4.7). Application of 40 kg P₂O₅ ha⁻¹ recorded
significantly higher seed and stover yields. Similar result found by Bairagi (2014) in fenugreek, Koyani et al. (2014) in fennel, Sharma et al. (2014) in fenugreek, Srivastava et al. (2014) in fenugreek, Abha and Sharma (2016) in fennel and (Mishra et al. (2016) in coriander. Because the outside supply of phosphorus to the soil deficient in phosphorus might have accelerated various physiological processes in plants favoring increased seed and stover yields of crop. The increase in seed yield due to phosphorus application might be attributed to better source and sink relationship in terms of greater translocation of food material to yield attributing parts. It appears that greater translocation of photosynthates from source to sink (seed) might have increased the seed yield. So, ultimately increase the seed and stover yield of fenugreek.

5.3.3 Effect on quality parameter

The highest protein content of 23.72% and protein yield 378.51 kg ha\(^{-1}\) was noticed (Table 4.9) under application of 40 kg P\(_2\)O\(_5\) ha\(^{-1}\). Whereas, the lowest protein content (22.30%) and protein yield (232.48 kg ha\(^{-1}\)) were recorded under application of 0 kg P\(_2\)O\(_5\) ha\(^{-1}\) (Control). Similar results was found by Hans Raj and Thakral (2008) in fennel, Dar et al. (2015) in fenugreek, Muvel et al. (2015) in fennel and (Shiurkar et al., 2016) in fenugreek.

5.3.4 Effect on nutrient content and uptake

N, P, K and S content in seed and stover were presented in the Table 4.10-4.17. It can be seen from Table that there is no any significant effect of different levels of phosphorus on the N, K and S content in seed and stover. Phosphorus content in seed significantly influenced by application of 40 kg P\(_2\)O\(_5\) ha\(^{-1}\). Similar result was found by Kumar (2015) in fenugreek, Abha and Sharma (2016) in fennel and Patil et al. (2008) in fenugreek.

N, P, K and S uptake by seed and stover were presented in the Table 4.8. Significantly the higher P uptake by seed as well as stover was recorded under the application of 40 kg P\(_2\)O\(_5\) ha\(^{-1}\).

It may be due application of phosphors marked improvement in nitrogen and phosphorus content and their uptake. The release of nutrient in soil solution depends upon intensity and capacity of soil to supply these nutrients. Adequate supply of nutrient increased nitrogen and phosphorus content for their effective uptake. This result is similar with a finding of Bhunia et al. (2006) in fenugreek, Deora and Singh

5.3.5 Effect on post-harvest status of soil

The data presented in Table 4.18 revealed that the different levels of phosphorus did not showed any significant effect on available N, K and S status of soil after harvest of the crop. While P status of soil improved considerably as compared to initial status of soil.

5.3.6 Effect on economics

A perusal of the data presented in Table 4.19 and 4.20 revealed that the higher net realization of ₹ 46997 ha\(^{-1}\) was obtained under the treatment of 40 kg P\(_2\)O\(_5\) ha\(^{-1}\) with the B:C ratio of 2.06. Higher net returns met due to higher seed as well as stover yields under the treatment 40 kg P\(_2\)O\(_5\) ha\(^{-1}\) (P\(_2\)). Similar result was obtained by Kumar and Singh (2007) in fenugreek, Gour et al. (2009) in fenugreek, Singh (2015) in coriander.

5.4 EFFECT OF LEVELS OF SULPHUR

5.4.1 Effect on growth parameters

Sulphur levels proved significant in improving growth parameters. Sulphur application promoted chlorophyll synthesis which, in turn, increases dry matter production. Sulphur increased meristematic tissue activity resulting in taller plant at higher sulphur levels. Leaf formation depends on tissue differentiation and expansion. Sulphur is a constituent of three essential amino acids viz., cystine, cysteine and methionine. It resembles N in its capacity to enhance cell division, cell elongation and tissue differentiation. Thus, sulphur fertilization has improved all the growth parameters. The highest plant height was recorded with higher levels of sulphur 40 kg S ha\(^{-1}\) (S\(_2\)) which remained statistically at par with application of 20 kg S ha\(^{-1}\) (S\(_1\)). But both proved significantly superior over the control at all the dates of observation. Maximum number of primary and secondary branches per plant was recorded at 40 kg S ha\(^{-1}\) (S\(_2\)) which was significantly superior over the control. Similar results were also reported by Tuncturk et al. (2011), Lal et al. (2014), Verma et al. (2014), Meena et al. (2015), Boori et al. (2017) and Solanki et al. (2017).

5.4.2 Effect on yield attributes and yield

Number of pods per plant, number of seeds per pod, length of pod, seed yield, stover yield and test weight are showed in the Table 4.5-4.8. Most of the yield attributing characters found significant under application of 40 kg S ha\(^{-1}\) (S\(_2\)) and it is
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statistically at par with 20 kg S ha\(^{-1}\) (S\(_1\)). Because sulphur has increase the availability of the other nutrients like nitrogen, phosphorus etc. higher sulphur dose was responsible for increased leaf area and chlorophyll content of leaves causing higher photosynthesis and assimilation, metabolic activities which were responsible for overall improvement in yield attributes and finally seed yield of fenugreek. Meena \textit{et al.} (2017) also reported an increase in yield of fenugreek due to sulphur application. The increase in seed yield might be attributed to increased in number of pods per plant, number of seeds per pod, length of pod and test weight of seeds. Sulphur is mainly responsible for enhancing the reproductive growth and the proportion of the reproductive tissues. The total dry matter (seed + stover) yield followed the similar trends as in case of seed and stover yields. The increase in yield due to application of sulphur might be due to better metabolism and increased efficiency of the other nutrients. Beneficial effect of sulphur on yield attributes might be due to better availability of N, P and S and their translocation which reflects in terms of increased yield attributes of the crop. Manohar \textit{et al.} (2014) reported that significant response of 40 kg S ha\(^{-1}\) in seed and stover yields of fenugreek. This may be attributed to the increasing levels of S which resulted in greater accumulation of carbohydrates, protein and their translocation to the productive organs, which in turn improved all the growth and yield attributing characters resulted more seed yield. The results are in conformity with the finding of Bochalia \textit{et al.} (2011), Ruveyde and Murat (2011), Patel \textit{et al.} (2013) and Ramkishor \textit{et al.} (2015).

5.4.3 Effect on quality parameters

In present investigation increment in sulphur levels up to 40 kg S ha\(^{-1}\) produced the maximum protein content (22.68\%) and protein yield (342.31 kg ha\(^{-1}\)) but observed statistically at par with application of 20 kg S ha\(^{-1}\) (Table 4.9). Protein content in seed increased gradually with increasing sulphur levels up to 40 kg S ha\(^{-1}\). Non significant protein content in seed is mainly due to lower content of nitrogen found in seed. Because protein content is mainly depend upon the nitrogen content. The results are in close conformity with the findings of Patel (2005), Tuncturk \textit{et al.} (2011) and Patel \textit{et al.} (2013).

5.4.4 Effect on different nutrient content and uptake

N, P, K, S content in seed and stover were represented in the Table 4.10-4.17. Different levels of sulphur did not cause any significant effect on the N, P and K content in seed. While S content in seed and stover was found significant.
Different levels of sulphur produced the significant effect on the N, P, K and S uptake by seed and stover, except N and K uptake by stover. Application of 40 kg S ha\(^{-1}\) recorded significantly higher uptake of N, P, K and S by seed. Balanced nutrition had led to the higher seed and stover yield, so uptake of this nutrient is increased. This result is in conformity with the finding of Tripathi (2006), Bhoya (2008) and Vidyathi et al. (2011).

5.4.5 Effect on post-harvest fertility

Different levels of sulphur manifested their significant effect on the available sulphur status of soil after harvest of the fenugreek crop (Table 4.18). While N, P and K content was found non-significant. Skwierawska et al. (2008) reported that under field conditions, antagonistic effect of phosphorus and sulphur was noted only at their higher levels of combined application, whereas Chaudhary (2007) reported that higher levels of sulphur as sulphuric acid make the phosphorus available in calcareous soils.

Available sulphur content in soil after harvest of the crop increased due to addition of sulphur in the soil. Similar results were found by Vidyathi et al. (2011), Vaishali et al. (2013) and Verma et al. (2014).

5.4.6 Effect on economics

A data presented in Table 4.19 and 4.20 revealed that higher net realization of ₹ 37826 ha\(^{-1}\) was obtained under the treatment S\(_2\) (40 kg S ha\(^{-1}\)) with the B:C ratio of 1.94. Higher net returns was due to higher seed as well as stover yield recorded under the application of 40 kg S ha\(^{-1}\). Similar trend was observed by Manohar et al. (2014), Verma et al. (2014), Meena et al. (2017) and Solanki et al. (2017).

5.5 INTERACTION EFFECT OF SOURCES AND LEVELS OF SULPHUR

Data from present investigation as discussed in previous chapters revealed that the interaction effect of levels of phosphorus and sulphur was found non-significant with respect to all the parameters under the study.