SUMMARY AND CONCLUSIONS

Production of oilseed in recent years has fallen short of the requirement due to a number of reasons. One of the causes for low production is the inadequate attention given to the nutritional requirement of oilseed crops. In addition to nitrogen, another major nutrient, which has been attributed to have a multiple rôle in oilseed crop nutrition, is sulphur. Hence, sulphur deficiency in soils, where these crops are raised, is considered as a major factor responsible for low oilseed production in India. Further, low availability of S in soil limits N-use efficiency. The two nutrients are closely related, synergistic and of vital importance for plants, as they are the major constituent of amino acids that constitute the building blocks of protein. A strong interaction between nitrogen and sulphur for seed yield, oil yield and oil quality in oilseeds has been reported by various workers. It is, therefore, likely that the interaction between N and S metabolism is stronger in oilseed crops. Though several studies are able to demonstrate the essentiality of sulphur nutrition and interaction between N and S in optimizing seed and oil yield in oilseed crops, but are still insufficient to provide the biochemical basis of synergistic effect of S and N on oil biosynthesis. Hence, an attempt has been made in the present study to work out the interactive effect of S and N on various biochemical parameters related to growth, yield and quality attributes of *Arachis hypogaea* L. cv. Amber, *Arachis hypogaea* L. cv. Kaushal and *Glycine max* (L.) Merr. cv. PK-416, *Glycine max* (L.) Merr. cv. PK-1024.

The salient findings obtained in this study are as follows:

1. Biomass accumulation, leaf area index, leaf area duration and crop growth rate were maximum with the application of sulphur as single basal dose and nitrogen in two equal doses \((S_{20} \text{ N}_{20+20})\) in groundnut cultivars and, sulphur and nitrogen in two equal doses \((S_{20+20} \text{ N}_{20+20})\) in soybean cultivars.

2. Chlorophyll and soluble protein contents in the leaves were maximum with the application of sulphur as single basal dose and nitrogen in two equal doses \((S_{20} \text{ N}_{20+20})\) in groundnut cultivars and, sulphur and nitrogen in two equal doses \((S_{20+20} \text{ N}_{20+20})\) in soybean cultivars.

3. *In vivo* nitrate reductase activity and in vitro ATP-sulphurylase activity in the leaves were higher with the application of sulphur as single basal dose and nitrogen in two equal doses \((S_{20} \text{ N}_{20+20})\) in groundnut cultivars and, sulphur and nitrogen in two equal doses \((S_{20+20} \text{ N}_{20+20})\) in soybean cultivars.
4. Number of nodules, nodule weight and nitrogenase activity were maximum with
the application of sulphur as single basal dose and nitrogen in two equal doses
\((S_{20} N_{20+20})\) in groundnut cultivars

5. Nitrate content in the leaves was lower with the application of sulphur as single
basal dose and nitrogen in two equal doses \((S_{20} N_{20+20})\) in groundnut cultivars.

6. Sulphur and nitrogen concentrations in leaves, stem, pod and seeds were
maximum with the application of sulphur as single basal dose and nitrogen in two
equal doses \((S_{20} N_{20+20})\) in groundnut cultivars and, sulphur and nitrogen in two
equal doses \((S_{20+20} N_{20+20})\) in soybean cultivars.

7. Seed yield and oil yield were maximum with the application of sulphur as single
basal dose and nitrogen in two equal doses \((S_{20} N_{20+20})\) in groundnut cultivars
and, sulphur and nitrogen in two equal doses \((S_{20+20} N_{20+20})\) in soybean cultivars.

8. Protein concentration of the seed improved markedly with the application of
sulphur as single basal dose and nitrogen in two equal doses \((S_{20} N_{20+20})\) in
groundnut cultivars and, sulphur and nitrogen in two equal doses \((S_{20+20} N_{20+20})\)
in soybean cultivars.

9. Per cent oil content in seeds was maximum with the application of sulphur as
single basal dose and nitrogen in two equal doses \((S_{20} N_{20+20})\) in groundnut
cultivars and, sulphur and nitrogen in two equal doses \((S_{20+20} N_{20+20})\) in soybean
cultivars.

**FORMS AND TIMING OF APPLICATION OF SULPHUR**

1. The response of groundnut cultivars was highest to 20 kg S ha\(^{-1}\), when applied at
the time of sowing in the form of SGF and gypsum. The SGF, however, was
found to be a better source of sulphur.

2. In soybean cultivars, application of 40 kg S ha\(^{-1}\) in two splits in the form of
gypsum resulted into higher seed and oil yield; 20 kg S ha\(^{-1}\) was applied at the
time of sowing, while 20 kg S ha\(^{-1}\) at 35 days after sowing.

**CONCLUSIONS**

It can be concluded from the above findings that:

1. Sulphur must be included in the nutrient management package for optimum yield
and quality attributes of seed and oil of groundnut and soybean.

2. The S and N should be applied at the rates of 20 and 40 Kg ha\(^{-1}\) in groundnut and
40 and 40 kg ha\(^{-1}\) in soybean, respectively for optimum seed and oil yield.
3. In groundnut crop 20 kg S and 20 kg N ha\(^{-1}\) were applied at the time of sowing and 20 kg N ha\(^{-1}\) was applied at 35 days after sowing. In soybean crop 20 kg S and 20 kg N ha\(^{-1}\) were applied at the time of sowing and 20 kg S and 20 kg N ha\(^{-1}\) were applied at 35 days after sowing.

4. The application of sulphur at the rate of 20 kg ha\(^{-1}\) in the form of SGF (T\(_4\)) gave better results than 20 kg ha\(^{-1}\) in the form of gypsum (T\(_7\)). This is due to the fact that gypsum is first solubilized in the soil solution to release SO\(_4^{2-}\) ions, which are then taken up by the plant and subsequently assimilated into sulphur amino acids and protein. SO\(_4^{2-}\) ions being negatively charged are highly susceptible to leaching like NO\(_3^-\) ions. Moreover, SO\(_4^{2-}\) ions once escaped into the environment, are converted into the toxic sulfur compounds through microbial transformation. This causes environmental pollution. On the other hand; SGF has SO\(_4^{2-}\) along with PO\(_4^{3-}\) in glass network forming P-O-S BONDS. It slowly releases sulphur into the soil solution due to the low solubility in the presence of high CaO in glasses, which is explained on the basis of higher field strength of Ca\(^{2+}\) ions than K\(^+\) ions and reduction in number of nonbridging oxygen, effectively bridging the glass network. Consequently application of sulphur in the form of SGF maintains the availability of S during the various stages of crop growth and development with the least leaching losses. Thus, soluble glass frits (SGF) is the better source of sulphur than gypsum and can be used as S-fertilizer to optimize nitrogen accumulation and yield of groundnut and other oilseed crops also.