CHAPTER-I
INTRODUCTION

India is one of the leading oilseed producing countries in the world. Oilseeds form the second largest agricultural commodity after cereals. Indian mustard [Brassica juncea (L.) Czernj. & Cosson.] is the second important edible oilseed crop after groundnut, meeting the fat requirement of about 50 per cent population in all the northern states. It plays an important role in the oilseed economy of the country.

The growing of mustard was known from time immemorial in India. It was introduced in India from China. Its probable origin is Africa. It is extensively grown in Europe, Africa and Asia. Worldwide, India is the fourth largest mustard producer. European Union (EU) is the leading mustard seed producer in the world accounting for 34% of world production. It is followed by China (23%), Canada (19%), and India (14%). EU, China and Canada all together account for the 79% of the world mustard seed production. These oilseeds are rich source of energy and nutrition.

Mustard contributes worldwide 35.52 million hectares area with production of 71.45 million tonnes and productivity of 2010 kg/ha (Anon., 2017). India has 5.76 million hectares area under mustard with production of 6.82 million tonnes and productivity of 1184 kg/ha (Anon., 2017). More than 85% production of Rapeseed-mustard comes from 5 States namely Rajasthan (48%), Haryana (12%), MP (10%), UP (9%) and West Bengal (7%). Gujarat is on the fifth rank in the production of mustard after Rajasthan, Uttar Pradesh, Haryana and Madhya Pradesh. In India, Rajasthan ranks first both in area and production and Gujarat state has the highest productivity of mustard.

In Gujarat, it is mostly cultivated under irrigated condition in different types of soils in Northern parts and Saurashtra region. Its area is about 0.19 million hectares with 0.31 million tonnes of total production with productivity of 1611 kg/ha (Anon., 2017).

Indian mustard is a fairly high remunerative crop with a major source of high quality edible oil which meets the fat requirement. It is used as condiment and for medicinal use. Edible oils are next to food grains in Indian diet. The young plants are
used as vegetable as they supply enough sulphur and minerals in the diet. It is also the most common medium of lickling the food preserving. In the tanning industry, mustard oil is used for softening leather. It is used in the preparation of hair oils, medicines, soaps, greases etc. Edible oil and oil meals have an important role to play in relieving malnutrition and caloric nutrition of human being and animals. The oil cake is used as a cattle feed and manure. The mustard oil cake contains 5.1 per cent N, 1.8 per cent P$_2$O$_5$ and 1.2 per cent K$_2$O. It is a rich source of protein (40%). But its use is limited due to the anti-nutritional factor glucosinolate. Refined oil, called as colza, is used in Europe. The seeds are highly nutritive containing 38-57% erucic acid, 5-13% linolic acid and 27% oleic acid.

Indian Mustard (*Brassica juncea*) owing to its hardy nature and capacity to thrive well under poor conditions of moisture and fertility is generally raised as rainfed, without fertilizer resulting in low average yield. It has however been established that nutritional requirements of the crop are considered to be the most important factor. The nutrient requirement of oilseed crops, in general, is very high for almost all the essential mineral nutrients which are to be supplied in adequate quantities. It has been estimated that less than 15 per cent of nutrients absorbed by the oilseeds are contributed by fertilizers while the remaining are obtained from soil resources, organic manures, biological sources and residues as well as wastes (Davari and Mirzakhani, 2009).

Potassium is one of the three major essential nutrient elements required by plants. It is involved in nearly all processes needed to sustain the plant life. Potassium is known to help crop to perform better under water stress through the regulation of the rate at which plant stomata open and close. It is also known for its role to provide lodging resistance and insect/disease resistance to plants. Since, potassium is involved in many metabolic pathways that affect crop quality, it is often called as “the quality element” (Rao and Srinivasarao, 1996). Potassium is one of the major nutrients in soil, amongst the mineral cations required by plant. The earth crust contains 2.4% potassium. It is largely present in complex silicate components; some potassium is associated with organic matter and clay fraction of soil. The potassium content in the soil varies from 0.1 to 3.0% or even more.

Sulphur is a secondary plant nutrient but now considered as the fourth major plant nutrient after nitrogen, phosphorus and potash. Besides the major nutrient,
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sulphur plays important role in Indian mustard. Sulphur is needed for development of cell and increases cold resistance and drought hardness of plant. Sulphur is also known for enhancing nitrogen fixation in some oilseed like groundnut and soybean, since it is an active constituent of nitrogenous enzyme, which is vital for N\textsubscript{2} fixation. On an average, crops absorb as much S as they absorb phosphorus and field scale deficiencies of sulphur in soil and plants are becoming increasingly important. It is essential for synthesis of several vitamins, amino acids and proteins i.e., cystine, cysteine and methionine and it helps in photosynthesis and nitrogen fixation. Sulphur is found in mustard oil glycosides, which impart characteristic odours and flavours to mustard. In general, the amount of S taken up to produce one ton of economic yield (main produce) is considered to be 12 kg for oilseeds. Sulphur fertilization significantly improves various quality parameters within plant system. The N/S ratio and the content of nitrate and non-protein N were reduced, and protein content was increased with the application of S. Sulphur plays an important role in the formation of chlorophyll and improves the activity of ATP–sulphurylase enzyme. It is associated in the formation of biologically important compounds like thiourea, plant regulators, thiamin, biotin and glutathione. Sulphur is involved in the sulphyhydryl linkages which provide the source of pungency in oil. The interactions of sulphur with other nutrients improve the quality of crops.

For oilseeds, potassium and sulphur are most vital nutrients for the growth and development of mustard crop. Besides N and P, the use of K has been reported to influence the productivity of seed yield and seed oil contents (Ghosh et al., 1995). Application of K and S is also important in increasing the efficiency of other nutrients. Application of S in combination with balanced amounts of other nutrients significantly increased the oil content of Brassica spp. (5-6%) and also the protein content. To correct S deficiency in rapeseed- mustard in different soils, 40 kg S/ha was optimal under most field conditions. The recommendation of potassium in different states varies from 20 to 40 kg K\textsubscript{2}O/ha. The yield increase with the application of S varied from 12 to 48 per cent under irrigated conditions depending upon crop species, S carrier and extent of S deficiency.

In recent years, potassium and sulphur deficiency has been aggravated in the soils due to continuous crop removal and use of potassium and sulphur analysis NPK fertilizers. Leaching and erosion losses also contribute to sulphur deficiencies.
Sulphur deficiencies are widespread and have been reported from over 70 countries, including India. In India sulphur deficiency occurs in a scattered manner in about 180 districts and yield response of about 40 crops were observed to sulphur application (Tandon, 1991). Deficiency of sulphur in North and Middle Gujarat are more as compared to South Gujarat as well as Saurashtra and Kachchh regions. In Gujarat 17% of soils are deficient in available sulphur (Golakiya and Shobhana, 2000). The importance of S in balanced plant nutrition is realized with increasing S deficiency in several areas due to intensive cropping, focus on high yielding varieties. The medium black calcareous soils of Saurashtra region in Gujarat are tend to decline in available potassium due to intensive cropping and gradually shifted towards negative K balance.

Very little work has been done on the effect of potassium and sulphur in mustard in Saurashtra region. Hence, taking note of the facts highlighted above, a field experiment entitled “Effect of potassium and sulphur on growth, yield and quality of Indian mustard (Brassica juncea L.)” was undertaken at Instructional Farm, Junagadh Agricultural University, Junagadh during rabi season of 2016-17 with following objectives:

1. To study the effect of varying levels of potassium on growth, yield and nutrient uptake by mustard.
2. To study the effect of varying levels of sulphur on growth, yield and nutrient uptake by mustard.
3. To study the effect of potassium and sulphur on quality of mustard.
4. To ascertain the interaction effect of varying levels of potassium and sulphur on growth, yield and nutrient uptake by mustard.
5. To work out economics of different treatments.