CHAPTER-I

INTRODUCTION

Oil and fat are essential components of human diet. India is among the largest vegetable oil economies in the world. Oilseeds ranks second only to food grains in Indian agricultural economy. Nine annual oilseed crops; soybean, groundnut, rapeseed-mustard, sunflower, sesame, safflower, linseed, castor and niger are grown in India. Oilseed sector in India has witnessed a sea change; from being an exporter till mid sixties it turned to be net importer of vegetable oil in early seventies. During the green revolution phase main emphasis was given to cereals like rice and wheat, while, oilseed and pulse crops got neglected, as a result oilseed production could not keep pace with ever increasing population. Technology Mission brought in 1986 though, succeeded in bringing back to self sufficiency upto 95 percent during 1993-94, however, the gains could not be sustained and gap between demand and availability from domestic sources rose enormously, turning India to a huge importer of vegetable oil amounting to 11.82 million tonnes (mt) during 2013-14. Rapeseed-mustard production trends have been inconsistent over the years, representing higher vulnerability of these crops to climate changes. Highest production (8.18 mt) was recorded during 2010-
11, from 6.9 mha area, while, highest yield (1262 kg/ha) was recorded during 2012-13. Rajasthan, Madhya Pradesh and Uttar Pradesh are the major rapeseed-mustard growing states with 46%, 12% and 10% contribution, respectively, to the national acreage during 2013-14. The corresponding contribution to production was 48%, 11% and 9%, respectively (Fig 1.1 & 1.2).

Fig 1.1. Contribution of major states in total rapeseed mustard production during 2013-14
Rapeseed (Brassica napus), also known as rape, oilseed rape, rapa, rippi, rapaseed (and, in the case of one particular group of cultivars, rapeseed-mustard), is a bright-yellow flowering member of the family Brassicaceae (mustard or cabbage family), consumed in China Mandarin Pinyin yóucài; Cantonese: yau choy) and Southern Africa as a vegetable. The name derives from the Latin for turnip, rāpa orrāpum, and is first recorded in English at the end of the 14th century. Older writers usually distinguished the turnip and rape by the adjectives 'round' and 'long'
(‘rooted’), respectively. Rutabagas, *Brassica napo brassica*, are sometimes considered a variety of *B. napus*. Some botanists also include the closely related *B. campestris* within *B. napus*. *B. napus* is cultivated mainly for its oil-rich seed, the third-largest source of vegetable oil in the world. Rapeseed is known by many common names in the English language. Some names have only been applied to certain subspecies (subsp.), forms (f.), or varieties (var.) of *B. napus*. *B. napus* = *B. napus* subsp. *napus* = *B. napus* subsp. *napus*.

Under the name rapeseed and mustard, seven important annual oilseeds belonging to the Brassicaceae (Cruciferae) are grown in India. They are Indian mustard (*Brassica juncea* [L.] Czern. & Coss.), commonly called rai (raya or laha), the three ecotypes of Indian rape, *B. campestris* L. ssp. oleifera viz., toria, brown sarson (lotni and tora types) and yellow sarson, Swede rape or gobhi sarson (*B. napus* L.), Ethiopian mustard or karan rai (*B. carinata* Braun.) and taramira or tara (*Eruca sativa* Mill.).

In the Indian subcontinent *B. juncea* is the dominant species grown and alongwith. *B. rapa* (syn. *B. campestris* L.) and *B. napus* L. are the important sources of edible oil in India. These species are regarded as of Asiatic origin. Besides, taramira, believed to be a native of southern Europe and North Africa is grown in the drier parts of northwest India. Of late, two
other exotics, namely gobhi sarson and karan rai are becoming popular with the farmers in the areas where winter spell is longer. The rapeseed mustard group of crops is largely grown under the hardy conditions of rainfed agriculture with low input management during rabi season, but have a good inherent potential to convert natural resources into usable biological energy.

Mustard (Brassica Juncea L.) is one of the most important oil seed crops of winter season contributing 28.4% of the total oil production in India. Sulphur deficiency in soils is on the increase with intensification of agriculture. The continuous use of major plant nutrients such as NPK through chemical fertilizers has resulted in the depletion of soils of their secondary and micronutrient reserves. There are instances where application of adequate amounts of N, P and K failed to give optimum yields until the deficiency of sulphur was corrected. The sulphur fertility status of soils in oilseed growing regions is poor and wide spread sulphur deficiency has been observed in crops and soils in 120 district of India irrespective of soil texture and cropping pattern.(Tandon1991). Wheat crops are the important Rabi crop grown in the Vindhya region MP. It has been reported that removal of sulphur per ton of grain is 3 kg in cereals against 12 kg in oil seeds (Tandon 1995)
Rapeseed was mainly produced as a source of lubricant for machinery due to its high levels of glucosinolate, a bittering agent which made the oil unpalatable, and erucic acid, a toxic substance associated with cardiac lesions. However, in 1973, Canadian agricultural scientists bred strains of rapeseed sufficiently low in these substances to make the crop palatable and safe for both human and livestock consumption. Today, rapeseed is grown for the production of animal feeds, edible vegetable oils, and biodiesel; leading producers include the European Union, Canada, China, India, and Australia. In India, 6.7 million tons are produced annually. According to the United States Department of Agriculture, rapeseed was the third-leading source of vegetable oil in the world in 2000, after soybean and palm oil; it was the world's second-leading source of protein meal; it forms one-fifth of the production of the leading soybean meal World production is growing rapidly. The FAO reports 36 million tons of rapeseed were produced in the 2003–2004 season, and estimated 58.4 million tons in the 2010–2011 seasons. In Europe, rapeseed is primarily cultivated for animal feed, owing to its very high lipid medium protein content Rapeseed-mustard seeds. Natural rapeseed oil contains 50% erucic acid. Wild seeds also contain high levels of glucosinolates (mustard oil glucosindes), chemical compounds that significantly lowered the nutritional value of rapeseed press cakes for animal
feed. In North America, the term "rapeseed-mustard" a contraction of Canada and ola, for "oil low acid" came into usage in the 1980s to avoid the linguistic resemblance between the term "rapeseed" and rape. It became widely used to refer to rapeseed, and is now a trade-name for "double low" (low erucic acid and low glucosinolate) rapeseed. The rapeseed is the harvested component of the crop. The crop is also grown as a winter cover crop. The plant is ploughed back in the soil or used as bedding. On some organic operations, livestock such as sheep or cattle are allowed to graze on the plants.

Rapeseed pollen contains known allergens. Whether rape pollen causes hay fever has not been well established, because rape is an insect-pollinated (entomophilous) crop, whereas hay fever is usually caused by wind-pollinated plants. The inhalation of oilseed rape dust may cause asthma in agricultural workers.

Physical characteristics of rapeseed-mustard oil Rapeseed-mustard oil is light yellow and has neutral taste of brassica plants. In general, rapeseed-mustard seeds pressed either employing traditional cold-pressing methods or in large scale, by hexane extraction method. Colour, taste, and odor of cold-pressed oil indeed more pronounced than that of refined oil.
Its specific gravity @ 25 °C is 0.916-0.921. Iodine value-110–120; and saponification values-188-198.

**Rapeseed oil: The nutrition facts :-**

- Being a fat, rapeseed-mustard oil is high in energy; 100 g of oil provides 884 calories. However, its high ratio of mono-unsaturated fatty acids to saturated fatty acids makes it one of the healthy oil for consumption.
- It is one of the cooking oils with a high smoke point; 450 °F. This property can be exploited in setting oil temperature high while deep-frying food items. Rapeseed-mustard oil has very good lipid profile. It has good distribution of saturated, monounsaturated and polyunsaturated (SFA: MUFA: PUFA= 8: 61: 31) fats in healthy proportions. Cold-pressed oil is one of the stable cooking oils possessing very long shelf life.

**Health benefits of rapeseed-mustard oil :-**

- Rapeseed-mustard oil possesses unique health benefits than many other vegetable-oils and fast emerging as one of the healthiest oils in tandem with olive oil.
- Like olive oil, rapeseed-mustard also has very low saturated fats. It contains linoleic (omega-6) and linolenic acid (omega-3) essential fatty acids at 2:1 ratio, marking it as one of the healthiest cooking oils.
• It has highest levels of plant sterols, especially β-sitosterol and campesterols. The US FDA has approved the following claim for phytosterols: "Foods containing at least 0.4 gram per serving of plant sterols, eaten twice a day with meals for a daily total intake of at least 0.8 gram, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease." Phyto-sterols competitively inhibit cholesterol absorption in the gut and thereby can reduce cholesterol levels by 10% to 15%.

• Rapeseed-mustard oil is high in calories. However, its high-calorie content comes from better fats. It is especially rich in mono-unsaturated fatty acids (MUFA) like oleic acid (18:1) which constitutes about 61% of total fats. MUFA helps in lowering LDL or "bad cholesterol" and increase HDL or "good cholesterol" in the blood. Research studies suggest that Mediterranean diet that is very rich in monounsaturated fatty acids help to prevent coronary artery disease and strokes by favoring healthy blood lipid profile.

• It contains valuable amounts of anti-oxidant vitamin E, particularly gamma-tocopherol. 100 g fresh oil has 27.34 µg of a-tocopherol and 17.46 µg of alpha-tocopherol. Vitamin E is a powerful lipid soluble antioxidant, required for maintaining the integrity of cell membrane of
mucus membranes and skin by protecting it from harmful oxygen-free radicals.

- Being a vegetable source, it has very high levels of plant sterols, especially ß-sitosterol. The FDA has observed the following claim for phytosterols: "Foods containing at least 0.4 gram per serving of plant sterols, eaten twice a day with meals for a daily total intake of at least 0.8 gram, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease." Phyto-sterols competitively inhibit cholesterol absorption in the gut and thereby can reduce cholesterol levels by 10% to 15%.

- Rapeseed-mustard oil has the highest smoke point oil is also an ideal choice for deep frying because it can be heated to a higher temperature (smoke point -450 °F). This results in lower oil retention in the fried foods.

The projected demand for oilseeds in India is around 34 million tonnes by 2020, of which about 14 million tonnes (41%) is to be met by rapeseed-mustard.

India is a major Rape/Mustard seed growing country of the world contributing the second position in terms of total production of
Rape/Mustard seed after China and first position in terms of area covered for production of Rape/Mustard seed.

The productivity of Rape/Mustard seed has been increased in India from 870 kg/hectare in 1998-99 to 935 kg/hectare in 2000-01. It is estimated that the productivity of Rape/mustard seed in India will reach to 1057 kg/hectare in 2006-07. Such a remarkable performance in production and yield of rapeseed-mustard leading what is commonly being called Yellow Revolution visible in all rapeseed-mustard growing states as well as in non-traditional areas of the country is reminding the production of wheat in the late sixties enabling the country to enter into the era of Green Revolution. This is to be attributed to the development of high yielding varieties coupled with improved production technologies, their widespread adoption and good support price.

Due to poor yield, oil seed production in the country does not meet the requirement of growing population. The productivity of mustard can be increased by proper fertilizer management and putting more area under irrigation. Sulphur is the fourth important nutrient after nitrogen, phosphorus and potassium for Indian agriculture. Sulphur deficiency has been found to occur in soils which are coarse textured and low in organic matter. Sulphur
requirements of crop plants are quite high and high yielding varieties require higher amounts of sulphur as compared to low yielding varieties of the crops. About 42.3%, Indian soils and 32.0% U.P. soils are deficient in sulphur. It is well accepted that sulphur deficiency in Indian soils is widely spread and major constraint in the way of increasing crop productivity, produce quality and farm incomes (Tandon 2010). With the introduction of high yielding varieties and increased cropping intensity, large amounts of nutrients are removed from the soil gradually. Oilseed crops have been reported to deplete the soil sulphur relatively to a greater extent. Knowledge of the concentration of plant nutrients in a crop and the amount of nutrients removed by a particular crop from the soil may be a helpful guide for the formulation of a sound fertilizer management programme. In light of these, the present investigation was therefore, undertaken to study the effect of sulphur levels on mustard genotypes. Sulphur plays direct and prominent role in fatty acid synthesis. In oleic ferrous brassicas, it is required in the formation of flavouring compounds known as glucosinolates. It is a constituent of amino acids viz., cysteine and methionine (Marschner, 1995). Zinc plays vital role in carbohydrate and protein metabolism as well as it controls the plant growth hormone IAA. It is essential component of
dehydrogenase, proteinase and promotes starch formation, seed maturation and production (Nuttal et al., 1987; Mandal et al., 2002).

It is a fact that all the biochemical compounds synthesized by plant whether as an end products or as secondary metabolites are constituted with the help of uptake of nutrients present in the medium or soils where they alive.

Thus the present research work is an attempt to cover the following objectives:

1. To assess the physico- chemical properties of soils of Allahabad
2. To study the effect of sulphur and zinc in relation to quality, yield and uptake of nutrients in mustard.
3. To study the relationship amongst yield, nutrient uptake and oil quality.

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