Chapter 1

Introduction
Chapter 1

INTRODUCTION

Four macronutrients, carbohydrates, fats, proteins and water, are essential in our diet. Of these, fat is obtained in two forms - visible and non-visible. Those that are used as such at the table or for cooking are termed as visible fats. Invisible or hidden forms fats are those that form an integral part of various foods and are present in cells, cell walls and membranes of both plant and animal tissues (Singh, 2000). Edible vegetable oils and fats are major source of visible fats. They provide not only comparatively more calories (9 kcal/g in comparison with 4 kcal/g obtained from proteins or carbohydrates) but also a vehicle for the transport of the fat-soluble vitamins, viz. A, D, E and K (Singh and Yadav, 2003). Vegetable oils supply essential fatty acids which are precursors of important hormones, i.e. prostaglandins (Prakash et al., 2003). The vegetable oils have greater proportion of polyunsaturated fatty acids and are more fluid than those composed of saturated fatty acids.

The phospholipids of the vegetable oils are important for stability of cell membranes and their deficiency may affect satisfactory psychomotor development. The vegetable oils are also a good source of required ratio of omega-6 and omega-3 fatty acids and natural antioxidants and are known to reduce the risk of cardiac diseases and to enhance the quality of life (Prakash et al., 2001). In addition, non-edible visible oils also play an important role in every day life due to their value as substitutes in industries engaged in producing fuel, grease, hair oil, soap, lubricant, paint, varnish, etc. The seed meal remaining after extraction of oil is a valuable animal feed high in protein and may also be used as manure and as nematicide (Bharti et al., 2003).

India is a paradise of oilseed crops. They play a key role in Indian agriculture. In fact, they are next to food crops in importance and occupy a sizable share (13%) of the country’s gross crop production. Their net value
(10%) of all agricultural products is also substantial. As far as their contribution to the gross national production is concerned, oilseeds have a 5% share, and an annual turnover of Rs 60,000 crores (Hegde, 2002). India has the largest number of commercial varieties of oilseeds as she has vast tracts of arable land and diverse agro-climatic conditions. The major oilseeds include castor, coconut, groundnut, linseed, niger, rapeseed-mustard, safflower, sesame, soybean and sunflower (Samba Murty and Subrahmanyam, 1989; Shukla et al., 2000; Hedge, 2002).

Rapeseed-mustard, or the brassicas, is the third most important, among oilseed crops of the world, after soybean and palm (Batra, 2000). The crop is cultivated in 53 countries spreading overall the 5 continents across the globe, covering an area of 24.2 million hectares with an average yield of 1451 kg/ha and net a total production of 13.1 million tonnes. Asia alone accounts for 59.1% of the hectarage under this crop but contributes only 58.6% of the world average production. Of this, India has the largest area under this crop and is the second important producer in the world. In India, rapeseed-mustard ranks second after groundnut in area and production. The crop occupies an area of approximately 6.81 million hectares with a production of about 6.96 million tonnes of seeds, mainly in northern plains, contributing 40.7% and 47.9% to the Asian hectarage and production and 28.3% and 19.8%, to the world hectarage and production, respectively. Of the total oilseed production in India, rapeseed-mustard accounts for 27.8% from a hectarage of 25.6% (Kumar, 1999; Yadava and Singh, 1999; Batra, 2000). In India, seven rapeseed-mustard types, belonging to the family Brassicaceae, are grown and account for 65% of the total rabi oilseed crops. These rapeseed-mustard forms include Indian mustard, commonly called rai or raya or laha (Brassica juncea L. Czern. & Coss), the three ecotypes of Indian rape Brassica rapa L. syn. Brassica campestris L. spp. oleifera, viz. toria, brown sarson and yellow sarson, Swede rape or gobhi sarson (Brassica napus L.), Ethiopian mustard or karan rai (Brassica carinata Braun) and taramira or tara (Eruca sativa Mill.). Of these, Brassica juncea (the
dominant species) along with *Brassica campestris* L. and *Brassica napus* L. are the important sources of edible oil in India (Yadava and Singh, 1999). According to Yadava and Singh (1999) and Bajoria (2000), rapeseed-mustard is produced in the states of Assam (2.1%), Bihar (1.2%), Gujarat (7.1%), Haryana (13.4%), Madhya Pradesh (10.1%), Punjab (1.7%), Rajasthan (39.9%), Uttar Pradesh (18.8%) and West Bengal (4.2%).

The average yield of rapeseed-mustard in India (1022 kg/ha) is far behind the averages of other countries, like Canada—1288 kg/ha, China—1405 kg/ha, Germany—3096 kg/ha, UK—3231 kg/ha and France—3528 kg/ha (Kumar, 1999).

The history of oilseed production and consumption in India is a story of paradoxes. We were supposedly self-sufficient until the Second World War. This was due to comparatively low population count compounded by very low per capita consumption as the purchasing power of the masses was inadequate even to buy their minimal nutritional requirement of 12 kg/capita/year of oils and fats. The availability of these commodities did increase considerably as a result of enhanced productivity of the new HYV’s leading to the so-called “Yellow Revolution” (on the pattern of the earlier attained “Green Revolution” concerning cereal productivity) as a result of the concerted efforts of farm scientists and the liberal grant of subsidies to farmers for purchase of inputs, including fertilizers. None-the-less, the continuous exponential growth of population offset the situation so much towards the close of the 20th century that, despite of the reasonably enhanced purchasing power of the consumer the average consumption of oils and fats (a meager 8.2 kg/capita/year) was still much short of the minimal requirement (12 kg/capita/year).

The requirement of fats and oils will increase further in view of the still increasing population coupled with improved standard of living of our people in the 21st century. Even today, the Government of India is compelled to import huge quantities of edible oils (more than one million tonnes every year) to fill up the gap between production and consumption (Batra, 2000). Moreover,
Indian rapeseed-mustard oil and cake are inferior to those of many other countries mainly for two reasons. First, rapeseed-mustard varieties commonly grown in India contain 40-50% erucic acid in the seed, far in excess of the desired upper limit of less than 2%. It is believed that consumption of high erucic acid containing oil may lead to cardiac malfunctioning. Secondly, the presence of high amount of sulphur compounds (glucosinolates) to the extent of 80-160 micro molecules/g against the desired level of less than 30 micro molecules/g in the oil-free meal or oil cake as they are considered the precursors of goitrogenic chemicals (Pachauri, 2001).

The problem of low production of rapeseed-mustard in India may be traced to several factors. These include (i) more than 75% of the Indian farmers own small or marginal holdings of less than two hectares, (ii) the oilseeds are grown, generally, on rainfed and poor quality land, whereas farmers grow cereals such as wheat and rice on irrigated and good quality land, (iii) only 15% of the area under oilseeds is under irrigation compared with 72% under wheat and 44% under rice, (iv) most farmers are ignorant of the techniques of cultivation of high yielding varieties, post harvest technology and proper processing facilities, (v) pests and diseases reduce the yields further as oilseeds are more prone to these, (vi) prevalent low temperature adversely affects flower bud development and thereby lowers seed yield and (vii) lack of knowledge of the precise dose of fertilizers recommended by the Agriculture Department for a particular cultivar and region (Siddiqui, 1999; Batra, 2000; Khan, 2000).

In view of the low productivity, coupled with increasing domestic and industrial demand, it is necessary to bring about vertical growth essentially as also horizontal growth where possible. Further, the wide gap in yields between improved techniques, and farmers' practices needs to be narrowed to get enhanced productivity and production (Kumar, 1999).

Keeping this in view, the Central Government has been launching various programmes. For example, a Technology Mission on Oilseeds was set up in May 1986 to harness the potential of oilseed production, integrated with
better processing and management technologies so as to achieve self-sufficiency in meeting oilseeds demand. Recently a scheme ‘Oilseeds Production Programme (OPP)’ has been sanctioned by the government up to the IX five year plan and is likely to continue during the X five year plan with the objective to increase the production of oilseeds in the country to achieve self sufficiency. Efforts are being made at various Indian Council of Agricultural Research (ICAR) laboratories and State Agriculture Universities to radically improve the quality of rapeseed-mustard cultivars. The Tata Energy Research Institute also initiated efforts in this direction and developed several improved quality strains of rapeseed-mustard, which have low erucic acid content. Also, the Advanta India Ltd. (a Holland based multinational company) has developed a strain (Hyola PAC-401 which is a “00” type rape) and introduced it for cultivation for India (Batra, 2000; Pachauri, 2001).

Thus, by the extensive work in the field of oilseeds, oilseeds researchers have been able to develop and introduce several improved quality cultivars for various agro-climatic regions of the country. However, it may be emphasized that these improved cultivars require large quality of fertilizers for their optimum performance. The majority of the Indian farmers is, however, either ignorant of the fact or so poor (or both) that they do not apply the required quantity of fertilizer and other inputs. On the other hand, even when the full dose of fertilizers is applied basally as single application, much of it is rendered unavailable to plants due to many factors. For example, up to 50% of the applied nitrogen may be lost through leaching, decomposition, volatilization, etc. (Anonymous, 1971; Dejoux, 2003) and up to 70% of the phosphorus, by fixation (Russell, 1950; Gikaara et al., 2004). Under such conditions, supplemental application of the nutrients as split doses (top-dressing or foliar spray) may be helpful. Moreover, use of inexpensive source of nutrients may help in their economic cultivation (Wittwer and Teubner, 1959; De, 1971; Afridi and Wasiuddin, 1979; Kannan, 1986; Mohammad, 1989; 1994; Patnaik, 2003).
It was, therefore, decided by the present author to undertake four field experiments on newly released high yielding cultivars of rapeseed-mustard, including erucic acid free ones.

The first experiment was of an exploratory nature and was planned to analyze and compare the performance of seven cultivars (including erucic acid free) of rapeseed-mustard grown with a uniform recommend dose of nutrients under local agro-climatic conditions.

The second experiment was planned on the three best performing cultivars of rapeseed-mustard of Experiment 1 selected on the basis of the data for seed and oil yield and fatty acid composition of oil to determine the best combination of basal nitrogen and phosphorus for each of the three selected cultivars of rapeseed-mustard under local conditions.

Keeping their sulphur-rich nature in view, the third experiment was aimed whether the productivity of the selected rapeseed-mustard cultivars could be maximized by inclusion of sulphur in the basal treatment containing nitrogen and phosphorus determined in Experiment 2.

The fourth experiment was planned (i) to test whether or not the productivity of the selected three cultivars (Experiment 2) could be improved by exploiting the technique of foliar application and (ii) to examine if addition of a small quantity of sulphur in the spray containing nitrogen and phosphorus could enhance the yield further.

The present chapter is followed by a brief review of relevant available literature on recently released high yielding rapeseed-mustard cultivars (Chapter 2). It is followed by the details of the description of the agro-climatic conditions of Aligarh where the study was undertaken and the methodology adopted (Chapter 3). The details of the data, analyzed statistically according to the design of each experiment, are presented in Chapter 4 and discussed in Chapter 5 in the light of the results of other workers. Chapter 6 consisted of the summary of the thesis and is followed by Bibliography containing an up-to-date list of references.