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Agriculture occupies an important position in contributing the gross national production of many countries of the world. Like other nations, oilseeds (being a valuable commodity for industries producing edible and non-edible oils) hold a high rank in the agricultural economy of India. The important oilseed crops grown in India include castor, groundnut, linseed, mustard, nigerseed, rapeseed, safflower, sesame, soybean and sunflower (Samba Murty and Subrahmanyam, 1989).

Weight for weight, edible oils provide 2.5 times more calories than the carbohydrates. They also provide a medium for transport of fat soluble vitamins (A, D, E and K) in the human body. Besides, non-edible oils play a vital role in everyday life due to their substitute value in industries, like fuel, grease, hair oil, lubricants, paint, soap and varnish. The by-product left after extraction of oil is valuable feed for livestock and poultry. Other uses are as manure and nematicide (Hill, 1952; Anonymous, 1980; Samba Murty and Subrahmanyam, 1989).

Although its oil is seldom used for edible purposes (Hill, 1952), the importance of linseed (*Linum usitatissimum* L.) in industry is well recognised as its seeds have a high content of oil (35-44%) and it also furnishes good quality fibre. More recently, however, a low linolenic acid containing cultivar of linseed has been developed for edible purposes (Green, 1986). Linseed oil is mainly used in the linoleum, paint, printer's ink, soft soap and varnish industry.
(Hill, 1952). The fibre is used in the manufacture of canvas, coating, durries, shirting and strong twines. The woody matter left after extraction is converted into pulp for manufacture of paper (Samba Murty and Subrahmanyam, 1989). Linseed is also used for medicinal purposes. For example, the bark and leaves are given in gonorrhoea while the ash of the bark is styptic and vulnerary. The seeds are slightly diuretic and emollient and are administered in gonorrhoea, inflammatory gastro-intestinal disorder, irritation of the genito-urinary organs, nephritis, cystitis, colds, cough, sore chest and throat and pulmonary complaints (Dastur, 1962: Chevallier, 1996).

India has the dubious distinction of having a very large area (2 million ha) under linseed cultivation. This is about 40% of the total linseed crop area (5 million ha) world-wide. None the less, it accounts for only 22% (0.5 million mt) of the total (2.3 million mt) world production. The average yield of linseed in India (349 kg/ha) is far behind the averages of the other countries, like Iran - 1,000 kg/ha. The Netherlands - 1,111 kg/ha. Egypt - 1,225 kg/ha. Mexico - 1,364 kg/ha and New Zealand - 1,622 kg/ha (Samba Murty and Subrahmanyam, 1989: FAO, 1998).

Our low productivity of oilseeds in general and linseed in particular is due to several factors. Some of these are listed here (i) More than 75% of the Indian farmers own small or marginal holdings of less than two hectares. (ii) Only 15% of the area under oilseeds is under irrigation compared to 72% under wheat and 44% under rice. (iii) Most farmers are ignorant of the techniques of cultivation of high yielding varieties, post harvest technology and proper
processing facilities, (iv) Pests and diseases reduce the yields further as oilseeds are more prone to these, (v) Out of 100 flowers produced only 68 develop into pods. (vi) Prevalent low temperature adversely affects flower bud development and thereby lowers seed yield and (vii) Lack of knowledge of the precise dose of fertilisers recommended by the Agriculture Department for a particular cultivar and region. Further, it has been well established that species of a genus (and even varieties of a species) differ, in their ability to fully utilise inputs, including nutrients, under the same environmental conditions (Millikan, 1961; Evans and Sorger, 1966).

Therefore, in view of their low productivity coupled with increasing domestic and industrial demand, drastic increase in oilseed production is one of our national priorities. To achieve this goal, more than sixty research centres have been established by the Indian Council of Agricultural Research in different regions of the country to deal with various oilseed crops, including one for linseed improvement at Kanpur. Also, many research projects have been launched by non-government organisations to boost the production of oilseeds. However, it must be admitted that these efforts howsoever laudable have not yet succeeded in offsetting the undesired shortfall in the indigenous oil market. To meet the situation, the country has been importing huge quantity of edible oils every year. For example, the amount imported during 1997-98 was 89,000 tonnes (Anonymous, 1999).

One of the major achievements of our oilseed researchers is the development and introduction of improved varieties for various agro-climatic
regions. However, it may be emphasised that these high yielding varieties (HYV) require large quantity of fertilisers for their optimum performance. The majority of Indian farmers are, however, either ignorant of the fact or so poor (or both) that they do not apply the required quantity of fertiliser and other inputs. On the other hand, even when the full dose of fertilisers is applied basally as a single application much of it is rendered unavailable to plants due to many factors. For example, upto 50% of the applied nitrogen may be lost through leaching, decomposition, volatilisation, etc. (Anonymous, 1971) and upto 70% of the phosphorus, by fixation (Russell, 1950). Under such conditions, supplemental application of the nutrients as split doses (top-dressing or foliar spray) may be helpful (Wittwer and Teubner, 1959; De, 1971; Afridi and Wasiuddin, 1979; Kannan, 1986; Mohammed, 1989, 1994; Patnaik, 1997).

At Aligarh, although Afridi, Samiullah and their associates have done considerable work on the mineral nutritional requirement of some crops, including cereals, medicinal and aromatic plants, pulses and oilseeds, an in-depth study has not been done on linseed.

It was therefore, decided by the present author to undertake five field experiments on this important oilseed crop, keeping nutrient use efficiency in enhancing its productivity and quality.

The first field experiment was conducted to determine the basal dose of nitrogen suited best to each of four newly released high yielding cultivars of linseed under local conditions.
The second experiment was performed in the second season to determine the optimum requirement of phosphorus in the presence of the best dose of nitrogen determined in Experiment 1 for each of the same four cultivars of linseed.

The third experiment was based on the results of Experiment 1 and was undertaken concurrently with Experiment 2. The aim was to determine the possibility of nitrogen economy through supplemental foliar fertilisation of the four cultivars grown with sub-optimal doses of nitrogen.

The fourth experiment was based on the findings of Experiment 2 and was carried out in the third season. The object was to study the efficacy of leaf-applied supplemental phosphorus on the four cultivars of linseed grown with sub-optimal basal levels of phosphorus so as to determine whether phosphorus economy could be achieved without loss of productivity.

The fifth experiment was based on the data of Experiments 2 and 3 and was undertaken simultaneously with Experiment 4. The aim of this last field trial was to explore the possibility of maximisation of yield together with fertiliser economy by growing the four cultivars with sub-optimal basal doses of nitrogen and phosphorus supplemented with foliar application of these two nutrients. Further, the efficacy of two sources of leaf-applied phosphorus, including a commercial grade one, was also tested in this concluding experiment so as to make the technique more cost-effective, if possible.

The results of these experiments are given in detail in the following chapters and discussed in the light of the findings of other research workers in the field.