CHAPTER I

INTRODUCTION
The short fall in supply of pulses and oilseeds in the country compelled to import the pulses and edible oils to meet the demand which further restricted the growth of production of these crops in this country. Groundnut is the premier oil crop of the country. The kernels contain 45-50 per cent oil. The crop accounts for 56.4 percent of the total oilseeds produced in the country. The area and production of groundnut are 7.6 million ha and 7.8 million tones pods in India which is the largest producing country of the world. Uttar Pradesh stands ninth in both area and production of groundnut in the country. This crop was planted on 1.00 lakh hectare with production of 0.73 lakhs tones in 2006-07. The area production and productivity of groundnut in this State have indicated declining trend in comparison to 1974-75 position. The causes are the vagaries of monsoon, lack of proper early maturing varieties, non-availability of quality seed, vulnerability to pests and diseases and fungus ignorance about improved production technology. Presently, the availability of short duration (80-90 days maturity) high yielding, non-dormant variety has encouraged for its cultivation during summer season also which has almost a double yield to rainy season crop. For this crop, the sowing has to be done in last week of February to first week of March and raised under adequate facility of irrigation. The crop has to be harvested before onset of monsoon. With the facility for summer crop the farmer can take two groundnut crops in rainy season as well as in summer season on the same field with a catch crop like pea.
During winter season. Although pea accounts for 3.81 percent area and 5.36 percent production of the total pulses in the country but out of total Rabi pulses (10.62 m/ha and 8.24 m.t.) peas account for 8.19 and 8.5 percent area and production, respectively. During 2006-07 the estimated area and production of pea have been 6.75 lakh ha and 6.60 lakh tones, respectively, with productivity of 8.93 q/ha in Uttar Pradesh. The groundnut-field pea-groundnut cropping sequence may ensure high production provided their proper manurial schedule is worked out for different soil types in different environmental conditions.

Cropping systems of present day are heavy feeder and bound to extract heavily the nutrients from the soil. Deficiency of essential elements in Indian soils in crops started emerging from 1950’s. As food production increased with time, the number of elements becoming deficient in soils and crops also increased. Many pulse and oil seeds growing soils are now found deficient in nitrogen. Deficiency of N and P is now common across the entire country irrespective of soils and regions. However N and P dose recommendation is not one. Further it is thought that Indian soils are adequate in K supply but the optimum level of supply was not seriously considered. Deficiency of S has cropped up as a serious obstacle to the sustainability of yield in the oil seeds and pulses as S requirement of these crops is relatively high. Hence under intensive cropping system involving S responsive crops like oil-seeds and pulses, S fertilization should (form) a part of the package. Besides above, deficiency of micronutrients like as Zn, Fe and B is also seen in some pockets and cropping sequences. In order to release the full
fertilization which includes the aforesaid soil nutrient elements depending upon the deficiency of single or multi-nutrients in different soil conditions, cropping intensities and management practices.

Indian soils are universally deficient in available nitrogen. The general recommendation of N to legume crops is based on providing a starter dose of N to crops for their establishment. Accordingly 20 kg N/ha is recommended for field pea and 15 kg/ha for groundnut. This assumption is not mostly true as large gap exists between N addition and N removal by leguminous crops. Nitrogen fixation is often affected adversely by variable organic matter content, soil moisture and soil pH. Variation in N fixation is more in kharif and summer pulses. N fixation is also very wide in the winter pulses. Addition of organic manure like FYM enhances N fixation to a great extent in light textured alluvial soil belt of Indo-gangetic plains.

Phosphorus is involved in a wide range of plant processes from permitting cell division to the development of deep and proriferous roots which enable it to feed on a larger soil volume for water and nutrients. Phosphorus is a constituent of ADP and ATP, two of the important substances in life processes. In general plants having less than 0.1 percent P are designated as deficient. Under P stress condition, genotypes which can mobilize insoluble P from soil can do better whereas some genotypes. Most may utilize readily soluble applied fertilizer P, and perform better. Most of the oil-seeds and pulses growing soils are deficient in available P. Phosphorus fertility map by
Motsara (2002) indicated that 71 percent soil samples analysed indicated P deficiency in D.P. Large number of field experiments demonstrated response to P application. It has also been observed in other residues of P applied to a preceding groundnut or maize crop (Reddy et al. 1991).

Inoculation with Phosphate Solubilizing Bacteria (PSB) in multi-locational trials conducted with many crops viz., wheat, paddy, maize, chickpea, soybean, lentil and potato have shown increased crop yields. Use of these cultures increased the efficiency of rock phosphate and super-phosphate applied in neutral to alkaline soils. Beneficial role of Vesicular Arbuscular Mycorrhiza in mobilizing phosphors in high P fixing vertisols in field trials has also been demonstrated.

Potassium activates a number of enzymes involved in photosynthesis, metabolism of carbohydrates and proteins. It helps in the synthesis and translocation of carbohydrates, membrane permeability, stomatal regulation and water utilization as well as utilization of nitrogen. Potassium increases resistance of plants to drought, frost, salinity, sodicity and pest and disease resistance. In analysis largest number of soil samples indicating low potassium category was in Orissa (33 %) followed by D.P. (12 %). Medium range of K fertility of soil samples ranged from 18 % in Maharashtra to 55 % in D.P. The alluvial-inceptisols of Kanpur, Faizabad and Varanasi are deficient in available K status. If K concentration enters in sub-optimal levels, crop plants express K deficiencies. It has been observed that K application may not be required in groundnut unless there is less than 125 kg K/ha in soils.
Sulphur helps in biological oxidation and reduction processes and chlorophyll formation. In soils where available sulphur is less than 10 ppm, a sulphur application is necessary. However, additional sulphur to groundnut is not required when gypsum is applied because it contains 15 to 18% sulphur. Sulphur is required for the synthesis of sulphur containing amino-acids, cysteins and methionine which are essential components of protein. Sulphur is also involved in the formation of crops such as groundnut, soybean and rape-seeds and flax. Sulphur requirement of pulses is high and the response to sulphur on pulses has been observed in certain soils and cropping systems. Sulphur fertilization of pulses and oilseeds in intensive cropping should form a part of the package in sulphur responsive soils.

The use of FYM has a beneficial effect on soil physical properties, water holding capacities and chemical and biological properties of soil. FYM contains almost all plant food elements required by crops. Nath et al. (1972) observed that 57 days after addition of FYM there was improvement in soil properties like water stable aggregates, bulk density, saturation percentage and hydraulic conductivity. Lanza and Spallaci (1970) reported a greater increase in total nitrogen and available phosphorus, exchangeable potassium and organic matter content from addition of organic manures. Gaur (1984) reported that a few long term experiments have shown that the use of FYM/compost at 10-15 q/ha produced a moderate to high response and saved upto 40 kg N/ha and had a significant residual effect. Maskina and Meelu (1984) reported that the residual effect of FYM to the succeeding wheat crop was equivalent to that of 30 kg N and 13 kg P/ha. Singh and
Venkateshwar (1985) reported that with the use of NPK and FYM, the yield of crops can be further increased. Singh et al. (1985) reported that application of FYM gave 28.4 percent residual effect over control.

The most intensively researched interactions of phosphorus with other nutrients include N x P, P x Sand P x Zn. Nitrogen and phosphorus interact synergistically in augmenting yield of crops. Sometime legumes indicate additive performance. Phosphorus and sulphur interaction is synergistic at low to medium level of P and S. Interaction of P x K is also synergistic.

The decreasing trend in crop productivity even with recommended fertilizers doses in the recent past has enforced to combine them with organic manures and bio-fertilizers to achieve the benefits of the integration of balanced fertilizers and organic manure. In this context some important research work was conducted at Zonal Agricultural Research Station, Mainpuri, C.S.A. University of agriculture & Technology, Kanpur where Singh (1999 b) reported that the integrated use of recommended dose of N_{20}, P_{30} and K_{15} + FYM @ 100 q + gypsum @ 300 kg/ha resulted in significantly higher pod yield of groundnut (9.38 q/ha) followed by N_{20} + P_{30} and K_{45} + FYM @ 100 q + gypsum @ 300 kg + neem leaf powder @ 100 kg/ha (9.28 q/ha). The growth and yield contributing traits of groundnut were consistent to pods yield. The residue of N_{20}, P_{30} and K_{45} + FYM @ 100 q + gypsum @ 300 kg–neem leaf powder @ 100 kg/ha and application of N_{20} + P_{40} to wheat gave higher grain yield of wheat by 46.24 q/ha than other treatment under late sown conditions. The growth and yield contributing characters noted in wheat were concordant to the grain yield. Earlier to it, another experiment was conducted during winter season of 1993-94
and 1994-95 at Regional Station, Mainpuri by Singh (1999 a) to judge the efficiency of four levels of N + P₂O₅ + S + Ca on dwarf field pea after groundnut. Field pea responded upto 25 kg N + 50 kg P₂O₅ + 15 kg S + 30 kg Ca/ha significantly. The additional grain of field pea was reaped 12.86 q/ha (60.40 %) over no nutrients used. This combination of nutrients proved most suitable for degraded sandy soils under groundnut -field pea-cropping system.

In the experiment of organic farming and cropping system of groundnut-wheat-summer groundnut, groundnut cultivars ICGV-93468 gave significantly high pod yield (22.49 q/ha). The average yield of wheat was recorded at 55.66 q/ha after groundnut. In summer groundnut cultivar D₄D₈-4 (DH-86) gave higher yield (Singh 2006).

Further in cropping system of groundnut-vegetable pea-summer groundnut, 33 summer groundnut cultivars were tested. Cultivars D₄D₈-10, D₄D₈-14, ICGV 93468, ICGV 96360, ICGV 95337 were found most suitable which yielded 17.54, 17.17, 16.31, 12.97 and 12.45 q/ha pods, respectively (Singh et al. 1998).

To improve the groundnut and field pea production in groundnut -field pea-groundnut (summer season) cropping system, the present experiment was conducted with the following objectives:

(i) To assess the nutrient requirements for maximization of yield of the individual crop in a given sequence.
(ii) To work out the yield in the given sequence.
(iii) To work out the economics of various treatments in the sequence.
(iv) Nutrient uptake by different crops in the sequence (N and S).