INTRODUCTION

Phosphorus and sulphur are essential elements, which all plants must have for normal growth and development. Plants deficient in an essential nutrient have poor growth, give low yield and the produce is also inferior quality. Since soil is the chief source of their supply, it is, therefore, thought of considerable importance of study the phosphorus and sulphur in the soils. These nutrients receive priority attention because their deficiencies are widespread and crop removals are high. Increasing reports on phosphorus and sulphur deficiencies, crop responses and the fact that crops in general require P and S in equal amount suggest that both phosphorus and sulphur deserve for greater attention than what they have received so far.

The compilation made by Ghosh and Hasan (1979) on 8.2 million tests made by about 250 soil testing laboratories of 363 districts during the preceding seven years revealed that 46.3 per cent of samples were low, 51.5 per cent medium and 2.2 per cent high with respect to available P status. Out of 226 districts of the country, 106 were found to have low, 110 medium and only 10 high content of available phosphorus.
(Ramamoorthy and Bajaj, 1969). Formation of various chemical forms of phosphorus has been found to be related to pH, solubility of various phosphates, activities of various cations, degree and intensity of chemical weathering, age of soil, climate, topography, drainage, parent material, texture, depth of the soil, mineralogical composition of soil, organic matter and fertilizer practices.

Phosphorus as a nutrient is absorbed by plants largely in the form of primary and secondary orthophosphate ions ($\text{H}_2\text{PO}_4^-$ and $\text{HPO}_4^{2-}$) present in soil solution. Organic form of phosphorus made available to plants only after its mineralisation to soluble inorganic phosphates. Therefore, a thorough knowledge of various forms of phosphorus in soils and their availability to crop plants would be very useful in evaluating fertility and genesis of soil. Thus, considering the vital role of phosphorus in plant nutrition, it has become important to assess the status of this nutrient in the soil.

In India sulphur deficiencies found in 175 million hectares of gross cropped area. According to a study carried out by Naik and Das (1964), a large number of laterite, red and alluvial soils contained less than 10 ppm available S; black and coastal alluvial soils were richer and saline-alkali soils had very high amount of available S. Tandon (1986) has listed several districts which were potentially sulphur deficient. According to him, S deficiencies occur across Indo-Gangetic alluviums, tea growing soils of
Himachal Pradesh, red-yellow soils of Bundelkhand region of Uttar Pradesh, red and lateritic soils of Karnataka, Kerala and West Bengal, alluvial and black soils of Madhya Pradesh and several black soil area of Maharashtra, Gujarat and the southern parts of Rajasthan. Total sulphur content in Indian soils ranged between 19 and 3836 ppm. Wide variation have been recorded within Gujarat state (42-3836 ppm) by Reddy and Mehta (1970) and even within a district (213-482 ppm) by Tiwari and Pathak (1984).

Survey of literature indicates that normally light textured soils have poorer reserves of total sulphur and the acidic soils contain higher amount of total S in comparison to alkaline soils. Organic form of sulphur in soil generally predominates over the inorganic fractions, yet the reverse could also not be ruled out where, possibilities exist for rapid oxidation of organic matter resulting in mineralization of sulphur. Several workers have studied the forms of phosphorus and sulphur in Indian soils, but studies are still lacking a systematic and complete information on this aspect in soils of Ghaziabad district. Despite of great agricultural importance of the soils of this district, very little attention has been paid to study their phosphorus and sulphur status with relation to certain attributes. It was, therefore, essential to make a systematic study of the various forms of phosphorus and sulphur fractions including some soil characteristics of different zones of Ghaziabad district of Uttar Pradesh.
During the last few years, a number of methods for the determination of available P and S in the soils were suggested and soil test calibrations were also carried out in some cases with variable degree of success. The selection of more appropriate soil test method and their proper calibration in relation to crop response behaviour must be critically studied under a given set of conditions for a rational understanding of phosphorus and sulphur situations, and formulating suitable recommendations for ensuring nutritional demand of the crops. The critical level of any nutrient depends on soil properties, method of extraction and the crop grown. It is, therefore, necessary to know the available P and S status of soil before planning fertilizer schedule of the crops. However, the study for evaluation of suitable methods become necessary in view of diversity of soil and climatic conditions under which crops are grown. The information on a suitable test method for phosphorus and sulphur is not available in respect of soils of Ghaziabad. Hence, this investigation was initiated to compare the suitability of a number of soils tests for available phosphorus and sulphur.

Both phosphorus and sulphur are metabolically active plant nutrients. Phosphorus is the major plant nutrient next to nitrogen. It has been called the "key to life" because of its directly or indirectly involvement in most of the life processes occur at any stage of growth and development of the plant. It is the structural component of biological components such as phytin, nucleic acids, inositol, sugar phosphate.
phospholipids, ADP, ATP, etc., present in cell wall of plants as well as nitrogen fixing bacteria. Similarly, sulphur is the secondary plant nutrient indispensable for the synthesis of amino acids, oils and proteins. It is also involved in various metabolic and enzymatic processes of plant and also plays a vital role in respiration, chlorophyll and nitrogen fixation.

Inadequate supply of phosphorus and/or sulphur may affect the growth of plant exhibiting specific deficiency for each nutrient. Phosphorus deficiency often results in increased uptake of nitrogen leading to an increase in total and soluble nitrogen as plant fails to synthesize proteins (Rajan et al., 1962). This heavy accumulation of soluble N is presumable at the expense of amino acids. Several evidences have also shown that phosphorus and sulphur do not only interact on protein content but also influence the yield and nutrient uptake by the plants. Sulphur deficiency results in profound changes in nitrogen and carbohydrates metabolism. Protein synthesis is checked and accumulates the non-protein nitrogen (NPN).

In India one-fourth population is calories deficient and undernourished and malnutrition recognised as the single major maledy threatening factor for the health of our nation. FAO estimates that by the 2000, we must triple over present food production and also increase the level of protein production by a factor 40 to feed the growing population (Colvin, 1968). This challenge can be met by increasing production of protein rich food of animal and plant origin.
Although animal protein are rich in amino acids and have higher biological value than plant protein, yet due to high prices and disliking the animal protein are restricted in Indian diet. Thus, we have to depend on vegetable protein of cereals and pulses for our protein requirements. With the rapid increase in the population and only marginal increase in the production of pulses, their availability has gone down from 75 g/capita/day during 1959 to around 40g/capita/day at present.

Among the various pulses grown in the country, black gram stand third after Bengal gram and arhar contributing 7.7 lakh tonnes over an area of 24 lakh hectares. Uttar Pradesh contributes about 12.7 per cent of the country's produce over an area of about 1.88 lakh hectares. Black gram is one of the most important kharif pulse grown in the northern India. It has 24 per cent protein content in seed. It also enriches the soils in nitrogen through symbiotic activities of Rhizobium bacteria. Concerted efforts are being made to improve the yields of pulse crops worldwide. Pulses, edible legumes or food legumes occupy a very significant place in farming as well as in a predominantly vegetarian diet of our people. Since they are major food ingredients and soil enriching green fodder. The importance of this group of crops has further increased due to global shortage of chemical fertilizers and energy crises. Phosphorus and sulphur deficiencies are the most important factor responsible for poor yield of pulses.
Very limited information are available in the form of literature as far as the optimum dose of phosphorus and sulphur for black gram grown in Ghaziabad district of Uttar Pradesh is concerned.

Keeping in view of the facts stated above the present investigation was undertaken with the following objectives:

1. To assess the phosphorus and sulphur status in soils of district Ghaziabad.

2. To evolve suitable soil test methods for estimation of available phosphorus and sulphur for these soils.

3. To study the response of black gram (*Vigna mungo* L.) to phosphorus and sulphur application.