INTRODUCTION
INTRODUCTION

Since the Green Revolution, which saw a dramatic increase in the production of yields of rice and wheat in the late sixties, the country seems to have reached a threshold in terms of yield and production of these two major staple foods. While the food demands of the country are growing day by day, the total cultivable area is decreasing and an increase is not anticipated (Chadha, 1994). In the coming decades, third world will experience the most dramatic increase in demand for human food due to rapid population growth and the rising per capita income. A time has, therefore, come now to look into future food needs and plan for the same.

Amongst many root and tuber crops used as human food in many countries, potato enjoys a unique distinction. The history of potato in Europe is a testimony to the fact that whenever there has been a scarcity of food grains, potato has come to the rescue of the people. As a crop it can yield upto 40-50 t/ha, and is among the most promising food crops particularly in areas having the high human population density like in Asia (Chadha, 1990). Further, it is the only non-cereal crop to be considered as a major food crop in the world and offers a potential for increasing food production and feed the millions.

Potato as a world crop

The potato is one of the world's most important, and widely grown crops. It is cultivated in 129 countries between 50° latitude on both sides of the equator and from sea level to snow lines upto 4000 meters altitude (Sikka, 1996). It ranks fourth in
terms of its economic value after rice, wheat and corn (Swaminathan & Sawyer, 1983). As a cheap food source for the working class, the potato contributed substantially to Europe's industrial revolution. In many parts of the world, the potato has provided famine relief during periods of war and crop failure (Horton & Anderson, 1992). Developing countries produce about 25% of the world's potatoes, and their share in global production is increasing rapidly. As a crop in the developing world, potatoes rank fourth in dollar value (Anonymous, 1984).

**Origin and spread of potato crop**

The potato belongs to the highland tropics of Andean mountains of Bolivia and Peru in South America where it has been under cultivation for over 6000 years. The centre of origin of cultivated potato is believed to be near the lake Titicaca basin in Peru-Bolivian regions where the largest genetic diversity of potato exists (Simmonds, 1976; Glendinning, 1983; Ross, 1986; Hawkes, 1990). The plant was selected as an article of food by Mayas, Incas, and Red Indians in south and central America. Sailors returning from the Americas brought potatoes to Spain in the sixteenth century. From Spain, the potatoes spread throughout Europe and then to the other parts of the world (Salaman, 1949).

In India, the potato was introduced in early seventeenth century (Pushkarnath, 1969). It is not certain whether it was brought by Portuguese or by Britishers. In an account of the travel through India during 1615-1617, Edward Terry (1655), Chaplain to Sir Thomas Roe, Ambassador of the East India Company to the Mughal Court.
found potato being grown "every where....in the Northern most part of the Empire". Similarly, Frayer's travel records (1672-1681) potato as a well established garden crop in Surat and Kamataka in 1675 (Watt, 1908). Historical evidence, however, reveals the earliest stocks to resemble those then grown in Europe and not to those of the South America (Pal & Pushkarnath, 1951). By 1839, potato cultivation had become well established providing a profitable source of income to the people in North West Hills in India (Upadhya, 1974). Later, cultivation had spread to plains which finally was accepted as a major vegetable crop at the beginning of the 20th century. There exists 15 distinct desi varieties of potato in India (Pal & Pushkarnath, 1951) which resembled the Andigena potatoes (Swaminathan, 1958; Sinha & Pushkarnath, 1964).

**Biosystematics of the potato**

The Potato (*Solanum tuberosum* L.) belongs to the genus *Solanum* in the family *Solanaceae*. This genus contains about 2000 species of which about 235 are tuber bearing (Hawkes, 1944, 1992) and has been kept in sub-section *Hyperbasarthurum* (now called *Potatoe*) of section *Tuberarium* (now called *Petota*) of sub-genus *Potatoe* (Hawkes, 1990). There exists disagreement amongst taxonomists regarding the delimitation of species in the sub-section Potatoe. Correll (1962) divided the Potatoe into 26 series encompassing a total of 159 species whereas Hawkes (1990) recognized 19 series and 235 species. The delimitation of species in the Potatoe is not yet definite as new species continue to be discovered from unexplored areas.

While conducting surveys in Andes of South America, Russian workers found that potato has about 200 wild species representing a polyploid series from 2x to 6x. With
a basic chromosome number 12, the wild species occur as diploids (73%), triploids (4%), tetraploids (15%), pentaploids (2%) and hexaploids (6%). In addition to *S. tuberosum* (2n=4x=48), 8 other species viz., *S. stenotomum* (2n=2x=24), *S. goniocalyx* (2n=2x=24), *S. phureja* (2n=2x=24), *S. ajanhuiri* (2n=2x=24), *S. chaucha* (2n=3x=36), *S. andigenum* (2n=2x=48), *S. juzpczukii* (2n=5x=60) and *S. curtilobum* (2n=6x=72) are also being cultivated in South America (Bukasov, 1985). Of these, *Solanum tuberosum* is an autotetraploid (Swaminathan & Howard, 1953) and is represented by two major sub-species, *Solanum tuberosum* ssp. *andigena* and ssp. *tuberosum* which are well separated geographically in their native areas with ssp. *andigena* at high altitudes in northern and central Andes mountains and ssp. *tuberosum* at sea level in southern Chile (Grun, 1990). Also, both *andigena* and *tuberosum* are morphologically distinct and are adapted to short days and long days, respectively (Hawkes, 1978). *S. tuberosum* ssp. *tuberosum* is the only species cultivated outside South America.

**Chemical composition and uses**

Fresh potatoes contain 75-80% water and 20-25% solids of which 20% is starch, 2.5-3.1% protein, 0.1% fat and 1% minerals (Verma, 1985). Nutritionally potato is superior to all other crops in protein production and more calories of high quality protein per unit area and per unit time by providing all the essential aminoacids needed in requisite amounts (Ross, 1986; Woolfe, 1987). These make potato second only to eggs in nutritional value as a single food source (Gray & Hughes, 1978; Swaminathan & Sawyer, 1983; Ross, 1986). In India, potato is grown round the year
in one or the other part of the country and is gaining important place in human diet. Besides its use as food for men and livestock, potato also serves as the source of starch and is used as raw material for alcohol, dextrin and glucose.

Area, production & productivity

Potato ranks fifth in area amongst major food crops grown in the world after wheat, rice, maize and sorghum; the fourth in production following wheat, rice and maize (FAO, 1989, 1994). In recent years area under cultivation, production and productivity of potato has enhanced drastically all over the world especially in developing worlds (Horton & Fano, 1985). During 1994, total annual world hectarage under this crop was 181.9 million hectares, production was 265.4 million metric tonnes and the productivity was 14.6 metric tonnes per hectare (FAO, 1994; Bist & Sharma, 1997). The leading potato growing countries in the world are the erstwhile USSR, China, Poland, India and USA.

Though a temperate crop, potato can be grown under diverse agro-climatic conditions ranging from sea level to sub-alpine conditions (Rhoades, 1982). These are grown in India in almost all the States under diverse agro-climatic conditions. One can see a standing crop of potato in different parts of the country all the year round. Nearly 82% of the potatoes are grown in the plains under the short winter days from October to March: about 10 per cent of the crop is grown in the hills under long days of April to October and the remaining 8 per cent in the plateau regions of south-eastern, central peninsular India where potatoes are grown as a rainfed crop from July to
October, and as an irrigated crop from October to March. However, in Nilgiris and Palni hills of Tamil Nadu in south India the crop is grown round the year under equinox conditions.

India ranks fifth in area and as well in production of potatoes. During 1996-97, total production of potato has been estimated to be 28.68 million metric tonnes in an area of 1.49 million hectares with average productivity amounting to 19.24 tonnes/ha (Anonymous, 1997). The average productivity of potato in India is slightly higher than the world average (14.5 t/ha). This is, however, very low when compared with some of the western countries, the Netherlands (43.6 t/ha), United Kingdom (40.8 t/ha), USA (39.1 t/ha), Germany (37.3 t/ha) and France (36.3 t/ha). Thus, it is amply clear that there is yet a considerable scope for improvement in yield of potato in our country. In this regard, the National Commission on Agriculture (1976) has envisaged that by 2000 AD, the area under potato should be raised to 1.5 million ha. and the yield raised to 20 t/ha. If these goals are achieved then the total annual production would reach 30 million tonnes and the per capita availability would rise to about 30 kg/year (Nayar & Verma, 1992).

One of the main reasons for the low productivity in India is attributed to the low potential of available cultivars (Nayar, 1986) and also to various constraints prevailing under varied agroclimatic zones and susceptibility to pests and diseases associated with the crop. Although the average yield data of the past three decades indicate an increasing trend in productivity yet there remains a marked gap between the yields of different zones. This could be narrowed down by developing varieties suitable for specific conditions. Basically, the increase in yield of other food crops has been
effected by plant breeding and application of improved agronomic practices. Of these, plant breeding is the simplest and cheapest way to improve plants and add to nations wealth and prosperity. The success of a breeding programme rests upon judicious selection, exploitation and utilization of the available genetic variability. In potato, therefore, enhancement of tuber yield by improving the yield potential of new cultivars through breeding is vital for increasing its production in the country. The potato breeding programme depends mainly on selection of superior parental combinations for making crosses and selection of superior genotypes from the progeny. Identification of superior parental lines with good breeding value is necessary to isolate improved genotypes in the segregating progenies. In the past studies on identification of superior parental lines with old accessions of germplasm and parental lines were made under short days. In recent years a number of exotic parental lines have been added to the germplasm collection besides newly developed advanced breeding lines. No information on the newly acquired germplasm and parental lines are available either under the short day conditions in the plains or for hills under the long days. In view of the above, the present study has, therefore, been undertaken to study the following aspects:

1. Genetic divergence among parents
2. General combining ability of parents
3. Specific combining ability of crosses
4. The general and specific combining ability interactions over locations
5. Heterosis of progenies
6. Phenotypic and genotypic correlation coefficient between various characters
7. Genetic parameters for economic characters