1. INTRODUCTION

Lentil (Lens culinaris Medikus sub sp. culinaris), a diploid \((2n = 2x = 14)\) plant, is a short, slender, annual legume that was among the earliest of plants to be domesticated in the Fertile Crescent of the Near East. It plays an important role in human, animal and soil health improvement. Its seed is a rich source of protein, minerals (K, P, Fe, Zn) and vitamins essentially required for human nutrition (Bhatty, 1988; Savage, 1988), and the straw is a valued animal feed (Erskine et al., 1990a). Furthermore, because of its high lysine and tryptophan content, its consumption with wheat or rice provides a balance in essential amino acids for human nutrition. Its cultivation improves soil nitrogen, carbon and organic matter status, thus providing sustainable crop production systems. Lentil is one of the most important pulses for crop intensification in South Asia and diversification in West Asia (Sarker et al., 2004a&b). Lentil is an important dietary component in Afghanistan, Bangladesh, India, Nepal, Pakistan, Ethiopia, Morocco, Tunisia, Sudan, Iran, Syria, Turkey, Egypt and Iraq. Countries in Southern Europe, Central Asia and the Caucasus and in Latin America grow and consume lentil to a lesser extent.

During the last two decades, this crop has also been grown in developed countries like Australia, Canada and the USA and has become an important agricultural export commodity. Canada is now the second largest producer of lentil after India, with an area of about 7,00,000 ha (Tullu et al.,
World lentil production has tripled in the last three decades from 1.05 million MT in 1971 to 3.8 million MT in 2004, through a 124% increase in sown area and a 58% increase in average national yield from 611 to 966 kg/ha (FAO, 2004). In South Asia lentil producing area can be conveniently divided into four agro-climatic zones i.e. Northwestern Plains, Northeastern Plains, Central Plateau and Tarai Region.

In India significant gain in area and production has been witnessed since 1979-80. During 1979-80 the area was 0.85 m ha and production 0.32 m ton as compared to 1.51 m ha and 0.95 m ton, respectively during 2005-06 (Anonymous, 2007).

The major lentil growing states in India include Madhya Pradesh, Uttar Pradesh, Bihar and West Bengal, i.e. contributing about 80 per cent production in the country.

The agro-climatic regions differ in rainfall pattern, period of crop duration, spectrum of diseases and soil types. The predominant crop sequences in different zones are rice-lentil, fallow-lentil and millet/maize/cotton-lentil. To make yield and production advances in the region, appropriate varieties and technologies should be identified for different cropping patterns. To achieve stability and sustainability of yields, genetic diversity from the germplasm collections and from the related wild *Lens* species should be exploited to develop suitable varieties coupled with resistance against biotic and abiotic stresses.

Internationally, the trade in small seeded and red colyledon lentil is dominated by Australia, Canada and Turkey, whereas the market in the large seeded and green lentil is held by Canada and USA. Countries in the
subcontinent, West Asia and North Africa are the major importers of red lentil. Southern Europe and South America import large-seeded green lentils (Sarker and Erskine, 2002).

Within the cultivated lentils, there exist two genetic complexes, the small seeded (microsperma) and large seeded (macrosperma) (Cubero, 1981). Microsperma lentils are characterized by small and round seeds with 2-6 mm in diameter, 100-seed weight less than 3.00 g, with red, orange or yellow cotyledons and testa of various colours from pale yellow to black and are generally more pigmented and shorter in plant height. It is mostly cultivated in South Asia, Afghanistan, Ethiopia and Egypt. On the other hand, macrosperma types have more flattened seeds having about 9 mm diameter, 100-seed weight more than 4.0g have usually yellow colyledons and pale green testa. Vegetative structure is more robust than that in microsperma and these have large leaflets and bolder pods. Macrosperma lentils are mainly cultivated in the Mediterranean region and the New World. Though lentils cultivated in South Asia are exclusively small seeded belonging to microsperma types, the cultivation of bold seeded cultivars are getting popularized in major lentil growing areas in India.

High yield is the main objective in most crop improvement programmes. Yield as such is the most complex character and is contributed by several components, most of which are polygenically inherited. Hence, improvement in the grain yield on the basis of per se performance is rather difficult. Therefore, determination of association among important metric traits, would enable the breeders to design appropriate breeding strategies for effective selection programme in this crop.
The other important objectives in lentil breeding programme include high harvest index (economic yield per unit of biological yield), response to higher plant density, input use efficiency and early maturity in the improved cultivars. The last attribute is important as early varieties of lentil will find an important place inter and multiple cropping patterns in this country (Jain, 1975).

Success of any plant breeding programme largely depends on the choice of an appropriate breeding procedure. The progress of crop improvement also depends upon the nature and magnitude of genetic variations available in the crop. The utilization of genetically diverse stocks helps in identifying promising hybrid combinations. Diallel mating design provides basic information on combining ability, heterosis and nature of gene action. However, it is based on following assumptions (Grifing, 1956b):

i. Normal diploid segregation

ii. Absence of maternal effect (no reciprocal differences)

iii. Independent action of non-allelic genes

iv. No multiple alleles

v. Homozygous parents

vi. Independent distribution of genes between the parents

vii. Inbreeding co-efficient equals to one

The present investigations were undertaken using ten lentil parental lines (Precoz, L4076, L4603, L4149, L4614, Sehore74-3, P22211, PL406, E153 and PKVL-1). Diallel crosses (without reciprocals) were made to know the combining ability, heterosis and nature of gene action for different yield and yield components.
The major objectives of present investigations are:

1. To estimate the components of variance and gene effects for different characters.

2. To study the extent and nature of genetic variability.

3. To assess types and magnitude of heterosis for economic traits.

4. To estimate general and specific combining ability variances and the effects in order to identify good general combining parental lines and specific combinations for various economically important characters.

5. To determine the extent of heritability and expected genetic advance for different characters.

6. To estimate genotypic and phenotypic associations among the traits of economic value.

7. To study the genetics of traits of economic importance like disease resistance (rust, wilt and powdery mildew).