Among the 34 species of *Gossypium* reported so far, only four are commercially important as lint bearing species. India is unique as the country where all the four species of *Gossypium* namely, *G. herbaceum* and *G. arboreum* (diploids) and *G. hirsutum* and *G. barbadense* (tetraploids) are cultivated. Whereas, the old world diploids as a group are more adapted to a primitive agricultural system, the high quality New World tetraploids are amenable to modern scientific agriculture. Thus, the pattern of distribution of these four species depend on the ecological, as well as different levels of agronomic management existing in the country.

*G. hirsutum*, which was introduced into India gained prominence after the Second World War with the development of pesticides like D.D.T., and B.H.C. which helped farmers to realise economic yields from this species. From then onwards diploids were gradually replaced by tetraploid species in large areas and now *G. hirsutum* is the predominant species under cultivation. *G. hirsutum* in India was introduced from more than one source with the result, that the present day cultivars belonging to this species have wide divergence in their origin and genetic make-up. Since cotton cultivation in India extends from 31°N latitude to 9°N latitude covering both tropical and sub-tropical belt, both photosensitive and insensitive varieties of *hirsutum* have fitted well in the cropping pattern. Unlike the U.S.A., U.S.S.R., and other cotton growing countries
located in the northern latitudes where the varieties have to be necessarily photoinsensitive to escape severe winter temperature, the Indian cotton belt is more flexible to allow late maturing varieties to produce economic yields even in the winter season. In South India where photosensitivity is not a major obstacle, same varieties are grown in winter (August to February) and in summer (March to July).

The earliest *hirsutum* genotypes introduced into India were from U.S. cotton belt which reached the northern part of the country and the photosensitive South American types which came to South India and got established as commercial crop. Subsequently the breeding work was aimed at developing *G. hirsutum* genotypes combining high yield potential with better adaptability to local conditions. Hybridization of upland types and Cambodia types (introduced in 1904-1905) with the local arboreums and herbaceums led to the development of new genotypes, which were called Indo-American types and these were more adaptable even though late maturing. Thus, it is obvious that the Indian cotton crop is very diverse in its species composition and also within the species *G. hirsutum* shows wide diversity.

Another major role played by *G. hirsutum* is in the development of commercial hybrid cotton. India is the only country in the world where extensive area (9,55,000 hectares) is planted with hybrid cotton whose seeds are produced without the help of male-sterile lines or chemical gametocides. Here also the *hirsutum*
varieties of diverse origin have helped in developing hybrids suited for different areas. The highly heterotic commercial Hybrid-4 (H.4) is rather unique among intra-hirsutum hybrids. The magnitude of heterosis is not very appreciable (Marani, 1963; Miller and Marani, 1963) in intra-hirsutum hybrids but Hybrid-4 exhibits a high degree of heterosis and many farmers had achieved yields of 6,000 kg of seed cotton per hectare. However, this hybrid has got a limited adaptation and has not spread to the South. Its long duration (240 days) may be attributed to its female parent which is a derivative of interspecies hybrid involving G. hirsutum and G. arboreum.

Another new source of variability is the availability of the primitive races of G. hirsutum, namely, punctatum, palmeri, morrilli, richmondii and mariegalante.

Punctatums have been extensively used in breeding programmes in Africa where resistance to bacterial blight has been incorporated into latifolium by transferring resistant genes (Knight, 1944). In recent years considerable work has been initiated on the other races like palmeri, morrilli and richmondii (Haley and Stephen, 1975; Schuster, 1976; Wilson and Wilson, 1978; Kappleman et al., 1979; Wilson and George, 1979, 1980).

The objective of the present study was to evaluate the diverse groups of cultivars available in India, viz., varieties originating from U.S.S.R., U.S.A., Africa and different Indian
varieties. The methods chosen for the genetic analysis were confined to the non-segregating \( (F_1) \) generation.

A complete diallel analysis has been extensively employed to understand the genetic architecture of varieties which has helped the geneticists and breeders in understanding (a) the proportion of dominant and recessive genes in the parent materials from the distribution of their respective array points and their genetic diversity through graphic analysis, (b) mean degree of dominance, the proportion of genes with positive and negative effects in the parents, additive effects, the proportion of dominant and recessive genes in the parents through genetic analysis, (c) heritability estimates in a narrow sense, (d) heterosis, (e) general and specific combining ability of the parents and hybrids through combining ability studies.

This approach has already given valuable information, Turner (1953), Muramato (1958), Miller and Marani (1963), Miller and Lee (1964), White and Richmond (1963), White (1966), Lee et al. (1967), Verhalen and Murray (1967, 1969), Al-rawi and Kohel (1969, 1970), Meredith and Bridge (1972), Baker and Verhalen (1973, 1975), Quisenberry (1975) and Quisenberry and Kohel (1979) through diallel and top-cross studies. The detailed study of this nature will be helpful in understanding not only the genetic make-up of the diverse material but also provide useful informations on breeding potential of selected genotypes.
Another objective of the present study was to get an insight into the genetic make-up of the primitive non-cultivated races and explore the possibilities of using them as a source of breeding material. Another attractive proposition is to evaluate these races as parents for heterosis breeding.

With these objectives a line x tester analysis (Kempthorne, 1957) was made using cultivated varieties as lines and employing the races as testers. Wilson and Wilson (1978) and Kappleman et al. (1979) have already identified the breeding potential of non-cultivated races. The major objectives of this study was to get information on heterosis, general and specific combining ability of parents and in estimating various types of gene effects.

Major findings in this study are discussed in the following chapters.