INTRODUCTION
1. INTRODUCTION

1.1 IMPORTANCE OF THE CROP

Nature has gifted several fabulous items to mankind and *Citrus* fruits are the most bounteous among them. They are among the most delectable fruits of mankind and no fruit is more popular and desired than the *Citrus* fruit. They have many unique qualities such as distinct pleasant aroma, piquant taste, and typical colours due to the presence of various carotenoids. Most of the fruits have a combination of sour and sweet, that delights the palate of people of all ages throughout the world. *Citrus* is the third most important fruit crop, with regard to area under cultivation and production, both at the national and global levels. At the global level the annual production of *Citrus* fruits is about 68.37 million metric tonnes which constitutes 20 percent of the total production of fruits. In India the annual production of *Citrus* fruits is about 2.8 million metric tonnes which forms about 9 percent of the total fruit production of the country (National Horticulture Board, 1993). Many *Citrus* fruits are primarily used for dessert, fresh juice, drinks, baked goods, confectionery, perfumes, cosmetics pharmaceuticals etc., Fruits, like oranges, mandarins, grape-fruits, pummeloes, etc. are consumed fresh. The principal byproducts obtained from *Citrus* fruits are citric acid from the fruit juice and pectin and lemon oil
from the fruit rind. Several secondary products like molasses, lactic acid, citronade, alcohol and the like are also produced from the Citrus crop. Fruits are also important sources of several vitamins, minerals and trace elements, apart from some essential oils which are extensively used in pharmaceutical industry and therapeutics in mammals. Vitamin C is an important constituent of Citrus fruits and vitamins A, B and E are also present. Minerals like potassium, sodium, calcium, magnesium, phosphorus are present in Citrus fruits in substantial amounts. Copper, zinc, iron and manganese are the important trace elements in Citrus fruits.

1.2 ORIGIN AND DISTRIBUTION OF THE CROP

The commonly grown Citrus fruits belong to three genera viz., Citrus, Fortunella and Poncirus. All these genera are grouped under the sub-tribe Citrinae, tribe Citrae, sub-family Aurantoideae and family Rutaceae.

The genus Citrus is believed to have originated even before Australia was cut off from Asia, about 20 million years ago, and evolved into several species.

The vast majority of Citrus fruits and their wild relatives are native to South-Eastern Asia, the East Indian Archipelago, New Guinea, New Caledonia, Australia and tropical Africa. The various species of the genus are believed to have spread to other areas of the world and being
cultivated from remote ages. Comparatively little change has been required to develop our best present day varieties from the fruits of the most primitive types. It is likely that the Citrus fruits which first attracted the attention of primitive peoples were already highly developed through the process of natural evolution, and were chosen as fruits worthy of cultivation.

The diverse geographical regions characterized by varying temperature and rainfall conditions in conjunction with spontaneous mutations and natural hybridization, have given rise to a wide range of variability in Citrus and related genera. Thus, these phenotypes, which are the totality of characteristics of the original individual, with their appearance as a result of the interaction between the earlier genotypes and the diverse environments, have stabilized into new genotypes, in the course of centuries of cultivation. A number of these genotypes are presently available either in wild form or under cultivation throughout the world.

1.3 SCOPE OF PRESENT RESEARCH

Several cultivars / genotypes have been reported within each Citrus species. Inspite of great deal of work in describing and classifying them, there still persists confusion in this field. Morphological descriptions, however exhaustive and comprehensive, have not solved the taxonomical
problems in the genus Citrus. There appears an endless array of complex hybrids, often combining two or more different species in varying proportions. This situation had led to much confusion in attempting to define species of Citrus. Hence, new techniques are desirable to study the numerous genotypes / cultivars of Citrus, to understand their relationship, based on which crop improvement programmes can be planned.

Several reports are available on the morphological, chemical, cytological, palynological and also biochemical differences among the Citrus genotypes. Attempts were made to classify them on their differences. Novel techniques like polygraph method, devised by Hutchinson, (1936) to discover the seemingly similar groups is promising. A comprehensive study on these lines would be very helpful in understanding the genotypic relationship.

It has been well established that the confusion in Citrus taxonomy is mainly due to their evolution as a result of natural hybridization and mutations over centuries. Under these circumstances, genetic studies are of paramount importance. Estimates of genotypic co-efficient of variability and phenotypic co-efficient of variability indicate the nature and magnitude of variability available among the genotypes for the characteristics studied (Allard, 1960). Heritability and genetic advance indicate the degree
of transmission of traits. Heritability indicates the heritable portion of a given characteristic while genetic advance indicates the potential for improvement of a given characteristic (Burton and De Vane, 1953). Studies on correlations indicate the inter-relationship of the characteristics. Knowledge of these inter-relationships can be used in the construction of selection indices and to detect some simple characteristics which may be useful as indicators of more complex ones (Johnson et al., 1955). Studies on these lines can throw knowledge on the quantitative variation among the genotypes, the reliability of the characters and their inter-relationship. These studies are of interest not only from a theoretical consideration of the quantitative inheritance of characteristics, but also from a practical standpoint, since selection is usually concerned with changing two or more characteristics simultaneously.

Mahalanobis $D^2$ statistic of multivariate analysis is a powerful tool for quantifying the degree of affinity and divergence between the biological populations. Knowledge on the nature and degree of genetic distance among the genotypes serves useful in identifying desirable parents for breeding programmes. Selection of parents or lines based on individual attributes may not be as advantageous as that based on a number of important components collectively, especially if the aim is to seek improvement in complex quantitative
traits. $D^2$ analysis is a step in this direction. Phylogenetic affinities have been worked out in several crops through $D^2$ analysis.

Studies on enzyme polymorphism by gel electrophoresis have proven very useful in measuring the genetic variation in a population. These studies effectively support / supplement the studies on morphological, chemical and other traits when affected by environmental factors. Isoenzymes offer the most reliable single gene markers which are often co-dominant in inheritance and mostly free of epistasis or environmental effects (Simpson and Withers, 1986).

The enzyme peroxidase and its multiple molecular forms occur throughout the plant kingdom. It has been found to be catalytic in the oxidation of indole acetic acid. High levels of peroxidase activity were found to be correlated with resistance to disease infection. Peroxidase polymorphism studies have been reported to be adequate and valuable in providing information with regard to phylogenetic affinities in several crops and also in Citrus.

Successful crop improvement programmes need access to a wide range of genetic resources. Detailed empirical information about the nature and magnitude of variability, diversity and affinities among the genetic resources is pre-requisite for exploiting their potential in crop improvement.
programmes. Information on the above lines in *Citrus* is scanty and has not been systematically studied. Hence, the present investigations were undertaken through the following studies:

1. Characterization of the genotypes through morphological descriptions.
2. Numerical characterization of the morphological data.
3. Polygraphic analysis of the genotypes for some important characters.
4. Genetic analysis of the variation among the genotypes.
5. Analysis of character association among some important characters.
6. Genetic diversity and genotypic affinities among the genetic resources.
7. Genetic variation through enzyme polymorphism.
REVIEW OF LITERATURE