Chapter – V

SUMMARY AND CONCLUSIONS
In the last few decades neem tree (*Azadirachta Indica* A.Juss. Family : Meliaceae) has assumed great significance, after it was recognized by scientists all over the world that the phytochemical properties of neem could be a natural, harmless and biodegradable substitute for chemical pesticide. Although neem is recognised as a commercial tree crop with multifarious uses, most of the scientific research has dealt with isolation, identification, formulation and testing of compounds and propagation and agroforestry practices. The tree is very hardy and evergreen and is a native to Indian sub continent. The tree is now introduced to several countries all over the world. The widely distributed naturalised population in India is an untapped natural resource offering wide scope for selection of superior trees or traits for improving the characteristics of the tree for better production. Keeping in view of the importance of the assessment of variability between populations of neem trees growing at various agroecosystem conditions in Kerala and Tamil Nadu, representing the two major biogeographic systems – the wet tropical and semi arid, of the Peninsular India the present study was undertaken. The main objectives of the study were; 1) To explore and collect neem (*Azadirachta indica* A. Juss.) from varied agroclimatic and environmental conditions of Kerala and Tamil Nadu for understanding the population and selection of sampling trees. 2) To study and analyse the phenological behaviour of the trees and the morphological characters of flower, fruit, seed and seedlings of selected trees. 3) To estimate the nature and extent of variability and heritability of selected characters present in the population. 4) To study the genetic divergence available in the population of Neem in Kerala and Tamil Nadu. 5) To select suitable genotypes for further improvement programmes.
Information on the population of neem trees was collected from various agro-ecosystems in Kerala and Tamil Nadu. Based on the population – eleven locations – three in Kerala and eight in Tamil Nadu were selected for diversity study. The population of neem trees in each ecosystem was assessed for growth, habit and a few candidate trees were selected. Quantitative measurements pertaining to DBH, bole and crown were taken for each candidate tree and the one which was having highest score was selected as the superior/plus tree in that location for further analysis. Data on various phenophases of the superior tree was recorded for a period of two years 1998-99 and 1999-2000 to understand the flowering and fruiting behaviour. The flower and fruit bearing capacity of the selected trees were also assessed in the field. Samples of flower, fruit and seeds were collected from the selected trees of each location and were studied for their morphological characters both qualitatively and quantitatively. Data on viability and germination of seeds and the morphology of the seedlings were also recorded for the samples collected from each location. The effect of chemical stimulants like Thiourea and Gibberllic acid at various concentration on germination and seedling growth were also assessed for each location. The whole data generated were subjected to statistical analysis like analysis of variance, variability estimates like phenotypic and genotypic coefficient of variations and Heritability. The Mahalanobis $D^2$ analysis to estimate genetic divergence between the samples and groups were also carried out.

The exploration and population studies reveal that wild naturalised neem trees were found all over Tamil Nadu, but it is found only in Palakkad and Trivandrum region in Kerala. Neem trees both natural and planted was not found at higher elevation (>1500m). However, some trees were noticed in Sultan Battery (Wynad
Dt.), Marayoor and Kanthalloor (Idukki Dt.) and Thenmala (Quilon Dt.) along road sides and private gardens. It is presumed that neem trees might have been brought to Kerala from Tamil Nadu by the travellers or migrators or settlers in early and recent period, through various travel routes and mountain passages.

Regarding phenology, significant variations between locations were observed for various phenophases like foliage, flowering and fruiting. Leaf fall, new leaf emergence and initiation of flowering and fruiting were observed first in South (Trivandrum/ Nagercoil) during December – January, slowly advanced to the Northern parts of Kerala and Tamil Nadu. But the flowering spread only one to three months in most of the locations with intermittent flowering at few places.

Variations in flower and fruit bearing capacity of selected trees were noted between locations including the size and number of panicles and flowers. Variations in morphological characters of flower, fruits and seeds recorded between sampling locations. The number, shape, size and arrangement of calyx varied between locations. However, no such variation is found for the character of corolla except in size and arrangement. Regarding androecium variations were found between locations in number of stamens; anther lobes, shape, size and aperture of pollen grains and diversity of hairs in staminal tube. In the case of gynoecium not much variation is noticed except for the character of stigma, placentation and size of appendages. Regarding fruits and seeds differences were noticed for size and weight between locations.

The data on viability and germination of seeds revealed significant difference between samples from different locations. The germination is epigeal and
phanerocotylar for neem seeds of all locations. No noticeable variation is recorded for
the number, shape and colour of cotyledons, phyllotaxy and shape of eophylls. However, size of both cotyledons and eophylls showed considerable variation between samples of various locations. The study revealed that the application of chemical stimulants like Thiourea and Gibberllic acid had no significant effect either for germination or for the speed of germination in the seeds of neem. But considerable variation is noticed in the size and weight of seedlings raised from seeds collected from various locations.

The quantitative data on flower, fruit, seed, germination and seedling were subjected to analysis of variance, which revealed very high significant genetic variation at 1.0% level for most of the characters among the eleven locations showing the process of inherent genetic variability in the population showing good scope for their appropriate utilisation in genetic improvement.

Though phenotype coefficient of variation was found to be higher than genotypic coefficient of variation for most of the characters, the difference were narrow, which indicate the comparatively stable nature of their characters due to little influence of environment in these characters.

The floral characters except two had high estimate of broad sense of heritability which indicate that these characters are largely under the genetic influence rather than environment and has a high potential for inheritance.

The genetic divergence studies grouped the samples into six clusters revealing the very high amount of diversity existing between the group of samples. Maximum genetic divergence based on the magnitude of the genetic distance was noted between
samples in the cluster 4 & 5. The medium to high inter cluster distances indicated that the genotype (samples) in each location to be a suitable parent with genotypes in other clusters.

The present study reveals the broad spectrum of natural/genetic variations existing among the population of neem trees in Kerala and Tamil Nadu. It has provided information on genetically divergent population and characters that can be utilized for further selection and improvement.