SUMMARY AND CONCLUSION

Forests are one of the most important natural resources and deserve a prominent status in the National economy. It is well established that the existance and stability of forests are very much intimately related with environment. It is important for us to note that from many points of view, animal life is also completely dependent on the maintenance of the proper balance in inanimate life. The maintenance of climate with the current balance of gases, particularly the oxygen and carbondioxide cycles in the atmosphere, plus the nourishment of animals and human. The numerous measures taken recently in our country for convervation of forests, control of population and education of our masses of these subjects are well known.

The large variety of economic plants such as, medicinal and aromatic plants, fibre and pulp yielding plants and other minor forest products of the region can largely contribute to economic amelioration of the people living in or near the forests.

Forests are plant communities which have closed canopy of trees beneath which may be other smaller trees, shrubs and a ground layer of herbs. Forests are the climax vegetation over

about 40% of the world's land surface, although man has substantially altered them or entirely removed them from vast areas. Different types of forests are found in different climates and there are striking convergences in forest structure and general appearance between different continents, where the same type of forests occur, although composed of different species. Physiological causes such as response to water stress or mineral deficiency are also involved. Tropical rain forest, dry (seasonal) tropical forest, sclorophyllous forest, warm temperate evergreen forest, summer deciduous forest and boreal forest are the major forest types of the world.

Champion and Seth (1963) have differentiated sixteen climatic forest types in India. The tropical wet evergreen forests, tropical semievergreen forests, tropical moist deciduous forests, littoral and swamp forests, tropical dry deciduous forests, tropical thorn forests, tropical dry evergreen forests, sub-tropical broad leaved hill forests, sub-tropical pine forests, sub-tropical dry evergreen forests, montane wet temperate forests, Himalayan moist temperate forests, Himalayan dry temperate forests, sub-alpine forests, moist alpine scrub and dry alpine scrubs are the types of forests found in our country.

Out of a total of 326,809 thousand hectares of geographical area in India, forests cover 75,351 thousand hectares,

just a 23% of the total. However, 33% is the norm for forests recommended by 1951 Forest Policy Resolution for the country as a whole. In the country, coniferous species cover 3,765 thousand hectares and the remaining area is stocked with broad leaved species.

The income from India's forests when contrasted with that in some other countries of the world is dismally low. Manmade forests comprise just about 2 percent of the total forest area in the country. Interestingly, India, which has one of the best forest Research Institutes in the tropical countries, has not given adequate attention to the economic aspects of the forestry. Independent India announced its forest policy statement in 1952, but even afterwards (upto seventh five year plan) there has not been proper socio-economic perspectives for forest development. The National Remote Sensing Agency (NRSA) did mapping of forest cover of India through visual interpretation of Satellite imagery (Land, Sat, NSS) for the period 1972-75 and 1980-82, all 1:1 million scale. The study lead to the conclusion that the forest cover in the country has gone down, from 16.89 percent (of the total geographical area) during 1972-75 to 14.10 percent during 1980-82. The Forest Survey of India (FSI) has also concluded that it has gone down. From these recent data it is quite certain that the area under forests is diminishing day by day inspite of the advancement in the number of five year plants. This certainly

is a serious matter as far as welfare of human is considered. Now, time has come to think over the problem quite seriously. It is, therefore, necessary to put all our efforts in Indian forestry. Various studies in forestry should be undertaken to understand the problems and difficulties and to overcome these in successful development of forests.

To study the behaviour of various forest trees it is highly essential to understand the natural pattern of their growth and development. In this direction there are several attempts by number of European and other scientist. However, the studies in physiology of trees in Indian forests are rare.

In the present study, therefore, an attempt has been made to carry out some preliminary investigation in a few selected, very common and popular trees grown in our side with respect to their organic constituents.

Sesbania grandiflora, Pers.; Moringa pterygosperma, Gaertn.Fruct.; Emblica officinalis, Gaertn Fruct.; Tamarindus indica, Linn.; Azadirachta indica, A.Juss.; Acacia arabica, Willd.; Lucaena leucocephala, Linn.; Polyalthia longifolia Benth. and Hook. growing in the University campus conditions have been used for the present studies. Organic constituents such as moisture, chlorophylls, carotenoids, carbohydrates, polyphenols, soluble proteins and proline, in the developing leaves (young, fully mature, and senescent), stem, bark, fruits

and seeds of the above tree species have been determined. The polyphenol composition of various parts of E.officinalis, A.arabica, P.longifolia and L.leucocephala has also been revealed both at quantitative as well as qualitative levels. Activities of nitrate reductase and nitrite reductase in the leaves at different developmental stages in all the tree species have also been determined.

For analytical work most recent and advanced methods and techniques were followed.

The significant findings of the investigation can be listed as follows :

1. The compound leaves of S.grandiflora and A.indica have recorded the maximum leaf area. The photosynthetic area per leaf has been found to be the lowest in A.arabica. The simple leaf of P.longifolia and the compound leaves of L.leucocephala and T.indica have an average photosynthetic area. High photosynthetic area per leaf in S.grandiflora may be an addative factor for it's very rapid growth and development. Highly reduced leaf area in A.arabica may be due to it's growth habitat of extreme conditions.

2. It is found that the moisture level in the leaves of almost all tree species studied, is reduced remarkably during senescence. However, it is slightly decreased in case of S.grandiflora, E.officinalis and A. indica. The leaves of

T.indica however, have shown an exceptional trend in which there is marked increase in the moisture level during senescence. It appears that due to the presence of more water in the tissue of aeging leaves they may remain on the plant for a considerable time. On the other hand, a rapid loss of water from the leaves of L.leucocephala, A.arabica and to some extent from those of P.longifolia may be the reason for high rate of leaf fall in those species. The values obtained for moisture content in the stem and bark or in the wood of above eight tree species are well comparable to those in case of various gymnosperm and angiosperm species.

3. It is observed that in all the specied studies the chlorophyll content in the leaves markedly increases with the age till the maturity and there is a rapid decline in it during senescence. Among the young leaves of tree species, the highest chlorophyll content has been observed in case of A.arabica, E.officinalis and T.indica. The mature leaves of P.longifolia and L.leucocephala have shown the highest amount of chlorophylls. It is also found that A.arabica and E.officinalis are able to retain sufficient amount of chlorophylls in the leaves during senescence. This can be taken as an adaptive feature of these tree species.

In most of the tree species studied chlorophyll a:b ratio is considerably increased with the age of the leaf increase till maturity whereas during the later stages of

development, it is drastically decreased. These observations indicated that the synthesis and breakdown of chlorophylls 'a' and 'b' are influenced differentially during leaf development. It appears that the synthesis of chlorophyll 'a' dominated that of 'b' upto leaf maturity. However, the rate of degradation of chlorophyll 'a' seems to be higher than that of chlorophyll 'b' during leaf senescence. From the chlorophyll a:b ratio of these tree species it is concluded that all the tree species studied most probably belong to C_3 type of plants.

4. Stem and bark of the tree species contain very little amount of carotenoids. Among the leaves, the mature leaves seem to be the major source of carotenoids. It is also observed that the mature leaves of P.longifolia and L.leucocephala are very rich in carotenoids. The level of carotenoids, similar to that of chlorophylls falls down very rapidly during senescence of the leaf. However, the chlorophylls are degraded relatively more than the carotenoids. As the leaves of A.arabica and L.leucocephala as well as those of T.indica contain higher amount of carotenoids, they may serve as a good source of β-carotene and hence vitamin A.

5. Among the tree species, the leaves of A.arabica, E.officinalis and A.indica seem to be highly rich in carbohydrates. On the other hand the leaves of S.grandiflora contain very low amount of carbohydrates. It is also observed that there is no definite pattern of accumulation of carbohy-

drates in the developing leaves of the tree species. However, in most cases the level of total carbohydrates in the leaves falls down during senescence.

The starch content of a leaf of all the tree species (except that of M.pterygosperma) is higher than that of soluble sugars. The leaves of E.officinalis and A.indica are found to be rich in soluble sugars as compared to those of remaining species. Interestingly it is found that the soluble sugar content of a leaf in M.pterygosperma is always higher than that of starch. It is quite surprising to observe that the soluble sugar content of the mature leaves of this tree species is almost three times or more than that of starch. High level of soluble sugars may be involved in the taste and palatable nature of the foliage of moringa. The level of soluble sugars in the leaves of moringa, avala, nim, babul and soo-babul delcines during senescence. On the other hand there is accumulation of those in the senescent leaves in case of S.grandiflora, T.indica and P.longifolia.

It is observed that the reproductive parts, namely fruits and seeds, are highly rich in carbohydrates. The fruit pulp of T.indica is very rich in soluble sugars. High level of soluble sugars adds probably to sweet taste of ripe fruit. In all other cases starch is the dominant carbohydrate in the

fruit. It is observed that the seed of T.indica contains the highest amount of carbohydrates among those of all the species studied. A seed of E.officinalis also contains high level of carbohydrates but little less than that of T.indica. The lowest amount of carbohydrates has been found to be present in the seeds of A.arabica. In the seeds of all the tree species starch is the only major component of the carbohydrates.

6. It is observed that almost each and every plant part of the tree species investigated contains measurable amount of soluble proteins. Among the young leaves, which are usually rich in soluble proteins, those of A.arabica, E.officinalis and L.leucocephala have shown high amount of soluble proteins. Also the mature leaves of A.arabica and E.officinalis are very rich in soluble proteins. The lowest amount of proteins are found in the leaves of S.grandiflora. The soluble protein values of the senescent leaves indicated that there is slight increase in the protein content as compared to that in the mature leaves of S.grandiflora, A.indica, A.arabica and a considerable increase in that of M.pterygosperma and P.longifolia. In the remaining species the level of soluble proteins is declined during senescence. It is suggested that the leaves of A.arabica and E.officinalis at any developmental stage can be used as a good source of protein. The young leaves of L.leucocephala may also serve the same purpose.

The bark of A.arabica seems to be very rich in soluble proteins while that of M.pterygosperma, however, is very poor in soluble protein contain. The fruit pulp of A.arabica and E.officinalis is highly rich in soluble proteins and therefore, the fruits of these tree species can be considered as proteinacious fruits. The fruit pulp of S.grandiflora, however, seems to be very low in protein content.

The seeds of almost all the tree species contain moderate amount of soluble proteins. The seeds of T.indica can be used as a balanced food with respect to carbohydrates and proteins. Same thing is true for M.pterygosperma and L.leucocephala and also to some extent for S.grandiflora. The seeds of A.indica, however, seem to be very poor in soluble proteins.

7. The leaves of A.indica, A.arabica and L.leucocephala upto the maturity are very rich in proline. The proline content (dry wt basis) is the highest in the leaves of A.arabica followed by those of S.grandiflora. It is observed that in most of the tree species investigated, proline accumulates in the leaves during senescence. However, the proline content when calculated on dry wt basis declines sharply during senescence in most of the tree species except in E.officinalis where proline is accumulated in the senescent leaves.

The reproductive parts, fruit and seed, also have considerable amount of free proline in their tissue. The fruit of

A.arabica is exceptionally highly rich in free proline. Seeds of the tree species seem to be relatively poor in proline.

8. Nitrate reductase activity in the leaves increases with the age, till maturity. This is quite evident in case of M.pterygosperma, A.arabica and L.leucocephala. It is observed that the enzyme is highly sensitive to phenolics in the leaves. The activity of nitrite reductase is found to be higher than that of nitrate reductase in the leaf tissue of all the tree species. The level of this enzyme is found to be increased during senescence of the leaves of almost all the tree species.

9. In most of the tree species leaf is the main plant part showing high level of phenolics. However, bark and seed of T. indica seem to be rich in these compounds as compared to the other parts. Fruit pulp in A.indica shows the highest amount of polyphenols of all the plant parts. It was clear that almost each and every part of A.arabica has shown the higher amount of polyphenols. The phenolic composition of the leaves in the tree species indicated no uniform pattern as far as the synthesis and/or break down of polyphenols with aeging is considered. It is suggested that almost all parts of A.arabica can be used as a good source of tannins. Similarly the leaves and fruits of E.officinalis and the seeds of T.indica may also provide sufficient amount of tannins.

The polyphenol composition and concentration varies from species to species and even from organ to organ in a single species. Not only this, but also the qualitative and quantitative composition of phenolics remarkably changes during leaf ontogeny.