SUMMARY AND CONCLUSIONS

Seasonal activity, structural changes, dimensional variations of cell types and histochemistry of cambium and its derivatives have been studied in two deciduous trees i.e., Dalbergia sissoo Roxb; Holoptelea integrifolia (Roxb.) Planch. and an evergreen tree i.e., Syzygium cumini Skeels. growing under the influence of mixed air pollutants (affected trees). Similar studies are carried out in trees growing in localities which are comparatively free from air pollutants (normal trees). The studies have been made for one year i.e., January to December, 1990. The cambium is storied in Dalbergia and Holoptelea and nonstoried in Syzygium. The cambial zone shows distinct periods of activity and dormancy in Dalbergia and Holoptelea, whereas, it remains active for major part of the year in Syzygium.

Cambial activity occurs in one growth flush in both the normal and affected trees of Dalbergia. The activity initiates in April and June in normal and affected trees respectively. The maximum cambial cell divisions and cessation of activity occurs simultaneously in August and November respectively in normal and affected trees. In Holoptelea, cambial cell division occurs twice in the year in normal and only once in affected trees. Cambium in affected trees remains dormant when the activity is highest in normal trees. In normal trees of Syzygium cambial growth takes place in four flushes with peak activity in August. In affected trees three growth flushes of cambium are recorded with maximum activity in August and December. The number of cambial layers in

the main stem is compared with that of young branch. The yearly average number of stem cambial layers in normal and affected trees of Dalbergia are 7 and 8, Holoptelea are 7 and 6 and Syzygium are 6 and 5 respectively.

Cambial activity initiates at the time of fruit setting in normal trees of Dalbergia. Defoliation is complete in normal trees but partial and occurs twice in affected trees of Dalbergia and Holoptelea. Cambial reactivation occurred when the affected trees of Holoptelea were with full foliage. In Syzygium, flowering coincides with the reactivation of cambium in normal trees. Being an evergreen tree, it remains with full foliage all through the year.

Temperature is one of the important climatic factor for the cambial reactivation in normal trees of Dalbergia and Holoptelea. However in Syzygium, climatic factors seem to have a little impact on the cambial reactivation. Except in the affected trees of Holoptelea, peak cambial activity occurred in August, when the seasons highest rainfall was recorded.

Fusiform cambial cell radial walls are thick with prominent beaded nature during dormant period and thin and less beaded during active period. Cambial cells undergo both the periclinal (additive) and anticlinal (multiplicative) divisions. Additive cell divisions are rapid during active period in Dalbergia and Holoptelea. While in Syzygium, the divisions are slow and continuous all through the year. During the formation of xylem and phloem derivatives, tangential wall develops along the length of

fusiform cambial cells. The length and width of fusiform cambial cells are measured and correlated with the cambial activity and dormancy. The yearly averages of the length of fusiform cambial cells are 162μm, 246μm and 815μm in normal trees and 160μm, 246μm and 805μm in affected trees of Dalbergia, Holoptelea and Syzygium. The variations in the length of fusiform cambial cells and xylem fibres are compared throughout the year.

Cambial rays are uni, bi or multiseriate in all the three species. They are storied in Dalbergia and Holoptelea and non-storied in Syzygium. Ray initials are filled with dark phenolic contents in Syzygium. Rays undergo tangential and vertical fusion. Ray initials develop from fusiform cambial cells by lateral anticlinal or by transverse divisions. Cambial ray height and width in normal and affected trees are 113μm, 119μm and 31μm, 36μm in Dalbergia, 161μm, 159μm and 29μm, 28μm in Holoptelea and 323μm, 342μm and 45μm, 42μm in Syzygium. Much variation is not found in dimensions of ray cell diameter. Ray population in one cm tangential width of cambium was studied seasonally and compared between normal and affected trees.

The differentiation of phloem and xylem elements is simultaneous in normal and affected trees of Dalbergia. In Holoptelea, xylem differentiation precedes that of phloem. Cambial cell divisions are more or less continuous throughout the year but differentiation of vascular elements occur in definite growth flushes in Syzygium.

Phloem derivatives develop into sieve elements, companion cells, axial parenchyma, ray parenchyma and fibres. Sieve tube members possess simple and transverse sieve plate in Dalbergia and Holoptelea but compound and oblique sieve plate in Syzygium. Sieve tube members are functional for one year in Syzygium and Holoptelea. In Dalbergia, they remain functional for more than a year. Phloem anastamoses are commonly found in Holoptelea.

Xylem is diffuse porous in all the three species. Vessel elements are mostly solitary in Dalbergia, solitary or radial multiples in Holoptelea and they are mostly in radial multiples in Syzygium. Vessel element length, width, lumen diameter, number of vessels and xylem growth ring width have been measured and distinguished between the normal and affected trees. Vessel lumen diameter is found to be less in affected trees than that of normal ones in all the three species studied. The average number of vessels per 0.5 mm^2 in normal and affected trees are 5 and 5 in Dalbergia, 8 and 13 in Holoptelea and 9 and 12 in Syzygium. Xylem ring width is relatively less in affected trees of Syzygium and Holoptelea.

Starch, lipids and proteins have been histochemically localized in the cambial cells and its derivatives. Seasonal variation in the reserve food material accumulation has been studied and correlated with the activity of cambium. Seasonal starch content in all the vascular tissues of main stem and young branch has been studied. Starch accumulation is found to be more in affected trees of Dalbergia and Holoptelea. The variations in seasonal accumulation of starch of normal and affected trees are less

pronounced in Syzygium.

The variations observed in the structure and dimensions of cambial cells and their derivatives of affected trees are compared with that of normal trees and discussed in the light of influence of air pollutants on plant growth.

CONCLUSIONS

The following conclusions are drawn from the study of affected trees with reference to the normal ones.

1. The organization and structure of cambium remain unaltered in all the trees.
2. The number of cell layers in the cambial zone of main stem and young branch is reduced in Holoptelea and Syzygium. But no variation is found in Dalbergia.
3. The reactivation of cambium is delayed by two months in Dalbergia, five months in Holoptelea and two months in Syzygium.
4. The duration of the cambial activity is reduced in all the three species under pollution stress.
5. Definite correlation is not found between cambial reactivation and phenology.
6. Defoliation is partial and occurs twice in Dalbergia and Holoptelea.
7. Peak cambial activity is coincided with the maximum rain fall in August in Dalbergia and Syzygium. The cambium in Holoptelea remains dormant even during monsoon period (June to August).
8. Much variation is not found in the dimensions of fusiform cambial cells.
9. In Holoptelea and Syzygium the cambial ray height and width is less but the ray population is more.
10. The number of differentiating phloem elements from the cambial zone is less in all the three species.

11. The number of differentiating xylem elements derived from cambial zone is much reduced in Holoptelea and Syzygium.
12. The length of vessel elements is decreases in Holoptelea and Syzygium.
13. Vessel lumen diameter is decreased in all the three species.
14. The average number of vessels per $0.5mm^2$ cross sectional area is more in Holoptelea and Syzygium.
15. Xylem growth ring width is reduced in Holoptelea and Syzygium.
16. Starch accumulation is more in cambial cells and its derivatives of all the three species.

From the above conclusions, it is found that Holoptelea is highly susceptible, Syzygium is moderately susceptible and Dalbergia is least succeptible to air pollution stress.