SUMMARY AND CONCLUSION

Seasonal activity, structural changes, dimensional variations of cell types and histochemistry of cambium and its derivatives have been studied in Tectona grandis L., Acacia nilotica (L) Del, Azadirachta indica A. Juss. and Tamarindus indica L. growing in three different forest types viz. moist deciduous forest (MDF, at Waghai-Dangs forest), dry deciduous forest (DDF, at Pavagadh) and scrub land forest (SF, at Bhuj and Nakhatrana-Kutch). The studies have been made from monthly collected samples for one year i.e from January to December 1994. Cambium is nonstoried in Tectona, Acacia and Azadirachta, while storied in Tamarindus. Cambial zone shows distinct periods of activity and dormancy in Tectona whereas depending on locality it remains active either throughout the year or for major part of the year in Acacia, Azadirachta and Tamarindus.

In Tectona, cambial growth occurs for six months in both the, MDF, DDF In Acacia growing in MDF cambial cell division and differentiation continue for major part of the year except in March and May. In trees of DDF, it occurs throughout the year. In SF, cambial cell division occurs in two distinct growth flushes lasting for seven months and then the cambium remains dormant for five months (May-September). Azadirachta growing in MDF shows cambial growth for major part of the year except in April. In DDF, cambial growth occurs in two flushes. lasting for ten months. Cell divisions are suspended in May and December. In SF cambium is found active throughout the year. Cambial activity in Tamarindus growing in MDF occurs for nine months and remain dormant from

March to May. In DDF, divisions in cambial zone cells occurs for eight months from June to January and found inactive from February to May. In SF, cambial cell division occurs from March to December and during January-February cambium remains dormant.

Being a tropical deciduous tree Tectona does not bear leaves throughout the year. The floral and foliar parts begin to dry in November and December respectively. The time of leaf shedding differs in trees of MDF and DDF However, by March, in both the forests trees shed their leaves and become leafless until June. Cambial cell division in MDF commences in March soon after complete shedding of leaves. In DDF initiation of cambial cell division coincides with the sprouting of young leaves from dormant shoot buds. However, in Acacia, Azadirachta and Tamarindus no distinct gap exists between cambial activity and phenological variations of trees.

Rainfall and air temperature are interdependant factors , the latter reaches peak in May when the number of daily sunshine hours are also at maximum. With the onset of rains air temperature begins to fall reaching minimum when the rains are heavy.

In Tectona growing in MDF, though cambial activity starts in March, rapid cell divisions occur only after the arrival of rains. In DDF, cambial cell division initiates in June though the maximum temperature is recorded in May In both the forests cambial growth reaches maximum when the rains are heavy (July-

September) and ceases at the end of monsoon (October-November) Acacia and Azadirachta growing in all the three forests exhibit active cambial divisions in December and January when the temperature recorded is minimum of the year. In Acacia, cell division remains suspended in March and May in MDF and May to September in SF. Cambial cell divisions in Azadirachta remain suspended in April in MDF and May in DDF. In Tamarindus growing in DDF, cell divisions are suspended in January when the temperature is lowest of the year. However, except in MDF, cambium is found active till February. Initiation of cambial growth in trees growing in MDF, in the month of May coincides with maximum temperature It starts in June in the trees of DDF, though the temperature is maximum in May In SF, cambial growth commences from March.

The length and width of fusiform cambial cells are measured and correlated with the cambial activity and dormancy The yearly average length of fusiform cambial cells of Tectona is 344 µm and 310 µm. The length measures 330 µm, 300 µm, 310 µm in Acacia 394 µm, 377 µm, 369 µm in Azadirachta and 354 µm, 338 µm and 334 µm in Tamarindus growing in MDF, DDF and SF respectively.

Cambial rays are nonstoried and predominantly multiseriate in Tectona, Acacia and Azadirachta while in Tamarindus they are storied and mostly uniseriate. Ray cambial cells are filled with dark phenolic content in Acacia. Ray cambial cells develop by lateral anticlinal or by transverse divisions of fusiform cambial cells

Maximal ray height and width is noticed in Tectona growing in MDF (443 µm) and DDF (67 µm), Acacia in SF (374 µm and 65 µm), Azadirachta in SF (298 µm and 69 µm) and Tamarindus in MDF (213 µm) and SF (29 µm) respectively. Ray population in one cm tangential width of cambium has been studied seasonally and compared in each species growing among the three forests.

In Tectona growing in DDF and Tamarindus trees growing in all the three forests xylem and phloem development starts simultaneously. In Tectona growing in MDF and Acacia and Azadirachta growing in all the three forests, xylem development preceds that of phloem in all the three forests and phloem development ceases first followed by xylem in the trees of all the forests. In MDF, a sudden burst of phloem differentiation results in production of more amount of phloem than xylem in early part of the growth season (June-July). Later in August, xylem development overtakes that of phloem. In both the forest xylem differentiation ceases in October and November but the maturation of elements continues. In Acacia, Azadirachta and Tamarindus development of xylem and phloem occurs almost for the major part of the year but culminates between July and September. In SF, cambial cell division and deveopment of xylem and phloem remain suspended in Acacia from May to September.

Phloem fibres form continuous tangential bands interrupted by phloem rays in Tectona, Acacia and Azadirachta In Tamarindus irregularly distributed groups of phloem fibres are encountered Secondary phloem in all the four species is typically composed of all the elements like other dicotyledons In nonfunctional phloem massive deposition of callose is observed in sieve plates in all the four tree species. Sieve tube members possess simple and transverse to slightly oblique sieve plate in Tectona and Tamarindus while oblique and compound sieve plate in Acacia and Azadirachta.

Xylem is ring porous in Tectona with distinct growth rings and diffuse porous in Acacia, Azadirachta and Tamarindus with indistinct growth rings However, the annual increment of xylem produced by cambium is discernible due to the occurrence of ray noding pattern, tangential bands of initial parenchyma, abruptly narrow vessel elements and thick walled parenchyma cells Vessels are mostly solitary but multiples of 2-3 vessels are also encountered. Compared to fusiform cambium cells, vessel element length decreases slightly but width increases in all the species studied. Perforation plates of vessel elements are simple on slightly oblique to transverse end walls. Axial parenchyma are vascicentric, aliform to confluent.

Vessel elements length, width, lumen diameter, number of vessels and xylem growth ring width have been measured and distinguished between all the three forest types. Yearly average of vessel lumen diameter is found to be maximal in Tectona growing in MDF (124 μm), Acacia in MDF (158 μm), Azadirachta in in DDF (150μm) and in Tamarındus in MDF and SF (85 μm) It ıs mınımal ın Tectona growing in DDF (113 μm), Acacia and Azadırachta ın SF (150 μm) (131 μm) and Tamarindus in DDF (85 μm).

Starch, lipid and protein have been histochemically localised in cambıal cells and their derivatives. The variations in the accumulation of these materials have been correlated with the seasonal activity of cambium. In all the specıes starch accumulation increases with decline of cambial cell division and abundant starch is observed when the cambium is dormant. Starch deposition decreases concommitantly with the rapid cell division and found either in traces or completely exhausted when the cambium reaches peak.

The variations observed in structure and dimensions of cambıal cells and their derivatives of each genera are compared among all the three forests and discussed in light of influence of environmental conditions on radial growth

After analyzing the foregoing observations on each species growing in differnt forest types the following conclusions are made :

1. The organization and structure of cambium remaın unaltered except ın Tectona which shows tendency towards storiedness in MDF Seasonal behaviour of vascular cambium varies among all the species depending on the forest types

2. Grand period of cambial growth in young branches and main stem doesnot coincide in the same species. However, initiation and cessation of cambial growth in young branches and main stem varies within the species growing in different forest types.

3. The phenological characters of each species varies depending upon the forest types. However, there is no definite correlation between cambial growth and phenological variations of the species except in Tectona.

4. Peak cambial growth coincide with maximal rainfall in July-September in all the species except Acacia growing in SF. No significant correlation is noticed with maximal and minimal temperatures

5. Initiation and cessation of cambial growth in all the species differ based on the forest types.

6. Periodicity of xylem production is more in Acacia growing in DDF, Azadirachta in SF and Tamarindus in MDF. However the rate of xylem differentiation is more in Tectona growing in MDF. Xylem growth ring is also relatively wider in Tectona growing in MDF, Acacia in DDF, Azadirachta in SF and Tamarindus in MDF.

7. Length of fusiform cambial cells and xylem fibres is maximal in the species growing in MDF except in Acacia. Cambial ray height is noticed maximal in Tectona and Tamarindus growing in MDF, and Acacia and Azadirachta

growing in SF Ray population is maximal in all the trees growing in DDF except in Tamarindus.

8. Vessel members are longer in Tectona and Acacia growing in MDF and in Azadirachta and Tamarindus growing in DDF. Xylem has more number of vessels in Acacia growing in SF and Azadirachta and Tamarindus in MDF

9 The variations in the deposition of reserve metabolities are correlated with the activity of the cambium but not with the forest types irrespective of the forest types

From the above observations it is concluded that the trees of Tectona, Acacia, Azadirachta and Tamarindus growing in MDF, DDF, SF and MDF respectively produce relatively more wood biomass. This may be due to the suitability of local climatic conditions for the fast radial growth of the species.