SECTION IV

GENERAL DISCUSSION
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Continuously decreasing forest resources are resulting in many kinds of environmental degradation, increasing human population and their needs have a marked impact on forests of the world. This shrinkage in forests is significant in tropical countries as compared to temperate zones. Consequently, there has been a tremendous reduction in forest resources around Sagar which inhabit tropical dry deciduous type of forests.

The replenishment of forests is going on by raising new plantations. However, the lack of scientific knowledge for selection, establishment and survival of species posed a serious problem. Ecophysiological studies of forest tree species seem to be of prime importance particularly those dealing with seed selection and establishment phases of seedlings. Apart from this phenological behaviour of tree is an important aspect in relation to the time of seed production and leaf fall behaviour. Ecophysiological behaviour of plants which determine the existence of species has been evolved and adapted through the course of evolution. Such behaviour changes from place to place depending upon the availability of water and nature of soil present at the site.

In tropical dry deciduous forests of Sagar, two leafing periods viz., summer and rainy have been observed.
Most of the species bear new leaves during summer months. Similarly, most of the species shed their leaves during late winter or early summer. In the present study, out of eight species taken into consideration, six species viz., *A. catechu, A. pendula, C. fistula, D. melanoxylon, L. parviflora* and *O. dalbergioides* showed new leaves during summer season. On the other hand *T. grandis* and *T. tomentosa* showed new leaves during rainy season.

Studies carried out in other tropical countries showed variations in the tune of leafing short dry season in January and February was noted to increase leaf fall and thereby changes the time of leafing in Ghana (Nye, 1961). Two periods of leaf fall were observed i.e., winter and summer. During winter, the following species were found leafless: *A. catechu, A. pendula, C. fistula, L. parviflora, O. dalbergioides, T. tomentosa* and *T. grandis*. Only *D. melanoxylon* was found leafless during summer. It is evident from these observations that a majority of species are found leafless during winter irrespective of their leafing periods.

In warm temperate forests, leaf fall is a continuous phenomenon throughout the year. However, maximum leaf fall is reported from January to March (Hatch, 1955). In few cases heavy leaf fall has also been reported during warm winter (Miller and Hunst, 1957). In conifers, maximum leaf
fall occurs during summer (Will, 1959).

Flowering initiation has been observed during rainy season in T. tomentosa and T. grandis. Where as other species showed summer flowering. Kennedy (1936) and Njoku (1963) observed peak flowering during winter to spring in forest trees of Nigeria. Daubenmire (1972) has reported flowering in dry months in semideciduous forests of Costa-Rica. Fruit fall in the present study can be classified in to two periods i.e., winter and summer. In A. pendula and L. parviflora fruit fall was observed during winter while in A. catechu, C. fistula, D. melanoxylon, O. dalbergioides, T. grandis and T. tomentosa it occurred during summer. It is evident from the phenological events that where fruit fall is after leaf fall (A. pendula, L. parviflora) seeds lie over litter and for a successful establishment radicle has to pass through litter for absorption of nutrients. Therefore, in such cases germination is easy to take place than the establishment. Where fruit fall is followed by leaf fall germination is hindered and establishment is only possible when plumule comes out of litter surface.

Phenological events of plants are controlled by a network of many external and internal factors (Krishnaswamy and Mathuda, 1954). External factors responsible for variation in phenology are humidity (Holtum, 1931), precipitation (Champion, 1948), frost (Vanderveen, 1951), temperature
(Leven, 1951; Ahlgren, 1957), soil moisture and light intensity (Wareing, 1957; Njoku, 1963), weather (Lindsey and Newman, 1956) and microclimate (Jackson, 1966).

Seed morphology, weight and dimensions are the genetic characteristics and adapted during the course of evolution for dispersal and survival. However, seed morphology can be affected by the habitat characteristics. Seeds collected from the dry deciduous forests around Sagar showed variation in the dimensions. Minimum and maximum, average weight of single seed was found to range from .008 to .261 g in A. pendula and C. fistula respectively. These studies on seed morphology can be compared to others who have done studies in different climatic conditions and type of forests.

Seed viability in four forest tree species seeds viz., A. catechu, C. fistula, L. parviflora and T. grandis was assessed with tetrazolium and indigocarmine staining tests. Presoaked seeds were treated with 1% tetrazolium solution. Result indicate that tetrazolium staining gave good results when viability was compared with laboratory germination. The principle for assessing the viability of seeds by tetrazolium salt is to measure the stained and unstained areas of seeds. However, it is the intensity of staining in different part of seed (embryo + cotyledon) which actually determines the viability of seed. In the assessment staining of cotyledonary part is equally important as that of embryo proper. Therefore,
intensity of staining is a direct measure of active enzymes present in the seed.

Lakon (1942) used tetrazolium topography to evaluate the seed viability. After testing many other seeds including those of some forest trees, he suggested that pH of the solution should be between 6 and 7 for best results (Lakon, 1949, 1950, 1954). Hyde (1949) used this method successfully in Festuca rubra seeds and classified embryo according to stain distribution. He reported that a high percentage of stained seed was viable as also indicated by germination test. Similar results have been observed in the present study in seeds of all the four forest tree species.

Some other derivatives of tetrazolium salts have been used for determining the viability of seeds. Favilli (1980) used tetrazolium chloride and tetrazolium bromide and found 3% more viability than indicated by germination on corn, wheat, rye and lupine. Bass (1953, 55, 55a, 55b) has done an extensive work on assessing viability with tetrazolium chloride and found it fairly reliable. Tetrazolium test was included as a biochemical test for detecting seed viability in International Rules for Seed Testing (ISTA, 1976).

Indigo carmine staining test has not been used frequently in seeds. However, few workers did observed the staining behaviour of this in certain seeds (Hao, 1939;
Kressskieuris, 1939; Kamra, 1972). These workers have done the seed testing in temperate plants including some forest trees. Tropical forest tree species seeds have not been taken for evaluation of viability with indigocarmine. In the present study, results envisaged that indigocarmine staining is also reliable for assessing viability in seeds of tropical trees. Further, it has also been experienced that indigocarmine staining is quicker and economical than tetrazolium test. It is less expensive, easily soluble in water and takes less time to stain the dead tissue. Kamra (1972) also compared indigocarmine staining with X-ray contract method and reported that it is equally reliable.

An attempt has also been made to classify seed vigour on the basis of staining pattern by tetrazolium and indigo carmine. Five seed vigour classes were made viz., very fast, fast, slow, sluggish growth and no growth with tetrazolium staining. Vigour class first was the completely stained embryo and cotyledons whereas in case of indigo carmine completely unstained seeds were kept. On the other hand no growth vigour class contained seeds without staining in case of tetrazolium and completely stained seeds in case of indigo carmine test. Combination of different vigour classes was done to separate non viable and viable seeds.
Gadd (1953), Moore (1962), Mian and Coffey (1968) were also reported tetrazolium staining for classifying vigour. However, indigo carmine staining to classify seed vigour has not been attempted so far as evident from the literature.

Seedling is the most delicate phase in the life of a plant. Its growth, tolerance and establishment is largely governed by environmental factors in which it is developing. The survival of seedling depends upon its ability to endure the adverse conditions such as low soil moisture, grazing, trampling etc. Further, it is also important to conserve food material sufficiently in different plant parts to survive. Finally, it is the ecological establishment strategy of seedling which determines the survival of seedling under natural conditions.

Results of the present study on seedling growth and establishment indicate that seedlings can be classified on the basis of their habitats such as growing in density dependent and density independent conditions. All the species studied for their seedling growth and establishment exhibit greater contribution of biomass in roots except in case of O. dalbergioides where comparatively more dry matter was found allocated in shoot. However, the forests remain under stress of grazing, trampling and fire throughout the year, all the species have been found to develop survival
mechanisms like die back, low grazing, palatability, resistance to fire etc. It is clear from table 38 that establishment feature of all the species showed in seeds, phenological events, seeding and tree stages.

On the basis of results, it can be said that all the seven species were found to follow 'k' strategy of establishment by allocating and conserving biomass in roots.

Halle et al. (1978) reported that allocation of energy in terms of biomass varied in different phases of life cycle in plants. Harper and Ogden (1970) however, reported that species growing in disturbed areas opt 'r' strategy and thereby allocated more energy for reproduction. In the present study, it seems that establishment strategy varied according to habit of plants because all the seven species were trees and all showed higher allocation of biomass towards vegetative parts than the reproductive parts.