CHAPTER-VIII

GENERAL DISCUSSION
The heavy destruction of forest by man has appreciably disturbed the ecological balance in different parts of the globe and resulted in eroding soil cover that can neither hold water nor mineral nutrients. Poverty increases with the increase in environmental deterioration. Therefore, it is imperative to adopt afforestation and reforestation programmes in barren wastelands. This requires thorough study of superior quality of seeds, their germination potential and further survival of seedlings in the natural environs. Plantation of suitable and economically important species should be done in different regions, keeping in view all the factors like climatic conditions, topography, edaphic conditions, seed biology and laboratory techniques. Laboratory and Nursery raised seedlings have significantly revolutionized the plantation of forest tree species in past few years.

In the present investigation, four important leguminous species viz. *A. precatorius*, *B. monosperma*, *D. paniculata* and *P. marsupium* of the tropical dry deciduous forests of Sagar, Madhya Pradesh, were selected to study various aspects related to seed biology like seed production, collection, handling, processing, storage, germination and seedling establishment in laboratory. Phenological studies of the four species were done by visiting four different adjoining forests around Sagar for one complete year to record Leaffall, Leafing, flowering, fruit development and seed dispersal.
In *A. precatorius* the leaffall was observed in winter season from January to February and leafing has been observed from March to May. The flowering was observed from August to September. In *B. monosperma* the leaf fall was observed in December to February and leaf has been observed in April to June. All the four species were observed to bear new foliage in summer season.

Test of seed viability as compared to viability determined in the form of germination were found variable from species to species. These variations are obvious as the composition of seed, presence of active enzyme and other essential structure are influenced by the age of seed, habitat of seed source and the accumulation of food reserve. In the present study different morphological and other quantitative characters are not at all comparable because of variations in seed source, time of maturity and other inherent properties of individual species. However, datas are of importance for utilization of the comparisons to be made by others for the similar seed sources and species.

In continuation of germination studies determination of germination velocity index were calculated for all the four species. Seed vigour classified into 6 vigour classes of the seedlings was determined and observation recorded. These two studies indicate amply the seed quality. The GVI and the seed vigour are closely related, greater the GVI value higher is the seed vigour and viability. It is also
found that the seeds which were full and heavy accounted for greater vibility and germinability.

Determination of germination velocity index and excised embryo test can be safely recommended for seed testing.

Testing of viability should be repeated at the end of the storage period if more than a few months, and in the case of long-term storage. For conservation of genetic resources testing should be done at intervals throughout the storage period (Ellis et al., 1980).

Two vital staining procedures of tetrazolium salt (TZ) and indigo carmine (IC) were applied to determine viability of the seeds. TZ and IC test values gave highly significant but negative correlation one with vigour classes for *A. precatorius*, *B. monosperma*, *D. paniculata* and *P. marsupium* seed lots had equality in TZ and IC values of topographical pattern. The tests can no longer be useful, if the seed is having toxic load of fungicides, which interfere (Sharma et al., 1988) in the vital staining so as to give pseudopatterns enough for planting misinformation regarding the vitality.

The observations on catalase activity test of seeds stored for, fresh seeds, six month and twelve month old seeds has been presented in table 16 to 19. Average value of catalase quotient of *A. precatorius* seeds (Table-15) indicating the quality of the seedlot contained in different types of conditions exhibited higher value of CQ then unity.
In *B. monosperma* (Table-16) CQ value indicated better quality of seeds, after 6 months storage in all conditions. But in twelve months old seeds was indicated to be low because after fresh and six months storage, the value of CQ was lesser than unity.

Next suitable storage conditions, all the storage conditions were favourable for retaining the vitality of seeds upto different levels (CQ was more than unity in all cases).

Seeds of *P. marsupium* through exhibited opposite kind of relationship. The speed of germination was found to increase from fresh to six months storage period, but declined after that.

A large number of workers have also shown good relationship between seed viability determined by TZ staining test and germination capacity of a seed lot, specially in forest tree species. (Gopal and Thapaliyal, 1968; 69; Enescu, 1977; 81; Kumar and Sharma, 1982; Nautiyal and Purahit, 1985; Singh, 1986; Kandya and Babei, 1984; 86; 89; 90 & 91; Yadav et al., 1986; 88; 89; Knierim and Leist, 1988; Mishra and Singh, 1986 and Ramamorthi et al., 1990).

Electrolyte leakage showed a negative relationship with seed germination in seeds of *B. monosperma* and *D. paniculata*. It is evident from the results that seeds with high viability showed minimum electrical conductivity in leachates as compared to the seeds with low viability.
Electrical conductivity test showed viability near the germination in seeds of *B. monosperma* and *D. paniculata* and therefore, can be utilized on large scale testing for prediction of seed viability.

For any seed to germinate, water uptake and subsequently the imbibition of seeds are the two primary processes with which germination begins. Through each species considered in the study, yet seed soaking for more than this period results in a decline in seed germination. This may be due to the soaking injury, membrane damage due to excess of water uptake and prevention of oxygen diffusing into the cells (Orphanos and Heydecker, 1968; Sherwill and Simon, 1969 and Roos and Pollock, 1971).

In the present study, effect of different temperatures on seed germination indicates that the maximum germination was observed in *D. paniculata* and *P. marsupium*. Seed moisture content is important factor for stimulation of mitochondrial activity.

If the seeds are not to be used immediately they can be stored for long duration, provided suitable conditions of moisture, temperature, aeration, light etc. are give. Besides the atmospheric humidity, moisture of seeds is also a very important factor as seeds are normally hygroscopic and lose or gain moisture content depending upon the equilibrium between the moisture status of both the atmosphere and the seeds (which differs from species to species). The results indicates that the best condition found for the storage of *B. monosperma* and *D. paniculata* was Room temperature.
The seed viability of *A. precatorius* and *P. marsupium* showed that the deterioration in seeds became faster with the increase of temperature. The loss of seed viability at higher temperature can be attributed to the higher respiratory rates and other metabolic activities as a result of this, the reserve food material was used up within a short period. A higher decline in germination at room temperature and open conditions might be due to the fluctuation of moisture content of seeds, without control of humidity or to frequent opening or sealing of the containers. This resulted in deterioration in seeds (Wang, 1974; Stein et al., 1974).

Kandya (1990) has studied these constituents in dormant and non-dormant seeds of *Acacia auriculiformis*, *Albizia procera*, *Cassia glauca*, *Cassia signea* and *Peltophorus ferrugineum*. She had worked out the amino acid profile through TLC and reported their status in two kinds of seeds, characterising their physiological dormancy as nil, shallow and deep. There is reference of changed biochemical parameters due to the seed-coat structure.

Different biochemical components present in, variously aged seeds, collected from trees of four selected species, carbohydrates content bore a decreasing trend, viz. *P. marsupium* (5.40%) > *A. precatorius* (2.84%) > *D. paniculata* (2.58%) > *B. monosperma* (1.57%).

Protein constituted second major component after carbohydrates in variously aged seeds. The higher values
recorded from *A. precatorius* (12.01%) and lowest percentage in *D. paniculata* (8.97%).

Amino acids play an important role in seed viability and longevity. There appears to be a dynamism in quality and quantity of amino acids during the storage of seeds. In *B. monosperma* seeds showed presence of more amino acids (8) as compared to other 3 forest tree species. In case of *D. paniculata* concentration of cystine is increased because some of the amino acids might have degenerated during seed storage.

In the present investigation the amino acid profile (quantitative) presents a decreasing tendency with increasing age of the seeds. All amino acids, except cystine, in *D. paniculata* of all the species decrease with prolonged storage. Cystine in *D. paniculata* showed a tendency to increase with increasing age of the seeds. Quantitative analysis of the amino acids in seeds stored for an unknown period should be helpful in determining the seed quality. Quantity of specific amino acids like cystine is known to increase as a result of fungal infection in stored seeds of the species of cotton, gram and cucurbits (Vir satya and Grewal, 1974).
SUMMARY AND CONCLUSIONS
Modern life style and increasing consumerism has resulted in encroachment of the environment by man. Large scale deforestation during the period of industrial revolution has damage the natural environment. This has created vast waste lands which are fast losing their regenerative potential. Therefore, before ecological changes become irreversible it is the almost duty of every citizen of our country to check further deterioration of our environment. Programmes like conservation of the existing forests, aorestation, social forestry etc. Will go a long way in putting a check on further deterioration and save the land from becoming arid and unproductive. These objectives can be achieved only by selection of species in developing multispecies vegetation thereby saving the biodiversity of the earth.

In the present study an attempt has been made to critically examine the various aspects of seed biology and seedling technology of some selected native leguminous species of dry deciduous forests of central India namely A. precatorius, B. monosperma, D. paniculata and P. marsupium. The selected tree species under various laboratory and field conditions were studied for the following aspects:

(1) Phenology.
(2) Seed collection and seed characteristics.
(3) Seed germination, viability, vigour and better storability.
(4) Higher certainly in plant production.
(5) Biochemical studies.
Phenological studies of all the four species were done by visiting four different adjoining forests around Sagar for one complete year to record, leaf fall, leafing, flowering, fruit development, fruit ripening and fruit dispersal. Various phenological events were critically analyzed to understand the seedling behaviour and proper periods for collection of seeds of better quality.

Seeds of the four selected species were collected from the tree showing good and heavy seeding during later period of maturation.

Seed extraction from fruits was done. Fruits of all the four species were dried under shade before extraction of seeds. All the extracted seeds stored in scaled polythene bags, paper packet and glass bottles filled as nearly full as possible to displace the maximum air and were kept in laboratory at various storage conditions.

The observations on effect of seed dimensions showed that heavier seed possess more germination capacity as compared to light weight seeds in all the four individual species similarly. Seed length, width and thickness also indicated a positive relation with germination capacity and plant percent. In general, bigger seed size and higher weight of seed result in large amount of reserve food available to the embryo and hence the higher germination capacity.
Seed viability:

Estimating the germination potential of a seed lot by actually germinating a sample of it is often the method most adapted in practical forestry. But the tests take several weeks to complete and, for some species pretreatment may take some additional weeks on months. For this reason much research has been conducted to find other methods by which seed viability can be estimated accurately but much more rapidly than by germination testing. The quick viability test are follows:

(i) Catalase activity test:

Hydrogen peroxide ($\text{H}_2\text{O}_2$) has a stimulating effect on seed germination and has been used in a rapid test for germination of four forest tree species. Catalase is an enzyme which is present in nearly all living tissues. Catalase quotient was determined by following formula:

$$CQ = \frac{\text{Average oxygen liberated by stimulated seeds}}{\text{Average oxygen liberated by same quantity of dry seeds}}$$

(ii) Excised embryo test:

By this method, the seeds are soaked for some time and the embryos are then excised from the seeds and placed on moist filter paper or blotter disc in Petri dishes. The tests are conducted under normal light at a constant temperature of $25^\circ\text{C}$. The condition of the embryos is examined daily. Depending upon the species and lot
differences, the tests can be terminated after only a few
days, up to a maximum of 14 days, or as soon as distinct
differentiation into viable and non-viable embryos can be
made.

(iii) **Topographical tetrazolium test:**

In this method living cells are stained red by the
reduction of a colourless tetrazolium salt to form a red
formazan. The method emphasizes the need for a knowledge of
the soundness of individual embryo parts for predicting the
development of embryos into countable seedlings.

In a comprehensive study, compared the excised embryo
method with the tetrazolium method for determining the
viability of dormant tree seeds. The tetrazolium method
should receive preference over the embryo excision method.
Improvements in the tetrazolium test should be made by
providing for the use of bactericides and stronger reducing
solutions to resolve doubts in weakly stained tissues.

**Seed vigour:**

"Seed vigour is the sum total of those properties of
the seed which determine the level of activity and
performance of the seed or seed lot during germination and
seedling emergence. Seeds which perform well are termed high
vigour seeds and those which perform poorly are called low
vigour seeds". Differences in vigour is manifested as:

1. Biochemical process and reactions during germination
   such as enzymatic reactions and respiratory activity.
(2) Rate and uniformity of seed germination and seedling growth.

(3) Rate and uniformity of seedling emergence and growth in the field.

(4) Emergence ability of seeds under unfavourable environmental conditions. The effects of vigour level may persist to influence mature plant growth, crop uniformity and yield.

Seed storage:

In common with all other living things, seeds are subject to ageing and eventually, to death. In the case of orthodox seeds, the process of ageing and deterioration is so greatly affected by the conditions of storage that the "age" of seeds, expressed solely in terms of the period elapsed since ripening and harvesting, is an inadequate measure of the degree to which they have "aged" in the sense of losing viability and progressing towards the irreversible deterioration or death.

A number of physiological changes in cell tissues may be associated with physiological ageing in seeds. They include (1) loss of food reserves caused by respiration decrease in proteins and non-reducing sugars, accompanied by increase in reducing sugar and free fatty acids (2) loss of activity of enzyme systems.

Seeds were stored immediately after the collection, at different constant temperature, at high relative humidity
and in sealed different containers. Seeds of *A. precatoria*us maintained their viability for a long period in partial viability percentage at (10±1°C) to (40±1°C). During seed germination wrinkled and damaged seeds should not be sown. Seed viability should be tested by electrical conductivity 48 hours soaking period was found most suitable for earliest seed germination.

**Biochemical studies**

A study of biochemical compounds present in variously aged seeds collected from trees of different girths. The provides a simple and efficient tool in seed testing. Chromatography would become even more valuable if the application of extracts. The results indicates that the amount of protein percentage was found to be slightly differnece in four selected plant species. It was found in large quantity.

The data also envisaged that there was no much effect of tree girth on biochemical components of seeds but storage period of the seeds affected them slightly. Maximum amount of protein was found in seeds of *A. precatoria*us (12.01%) and minimum in seeds of *D. paniculata* (8.97%), carbohydrate content was found maximum (5.40%) in seeds of *P. marsupium* crude fat content was recorded highest in *P. marsupium* (2.90%) and least in *A. precatoria*us (0.69%).

A study of amino acids present in variously aged seeds (fresh, one year, two years and three years old) of four selected species revealed that the number of amino acids
was 5 in *A. precatorius* seeds. Though in *B. monosperma*, the number of amino acids was 8. In case of *D. paniculata*, the number of amino acids was 6 and in case of *P. marsupium*, the number of amino acids was 4. Different storage conditions were also found to affect the qualitative and quantitative changes of amino acids in relation to storage duration. However, no significant pattern could be observed. Some of the amino acids remained unidentified because of their Rf value and/or colour could not be matched with the standards.
<table>
<thead>
<tr>
<th>S. NO.</th>
<th>Subject</th>
<th>A. precatorius</th>
<th>B. monosperma</th>
<th>D. paniculata</th>
<th>P. marsupium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Time of seed collection</td>
<td>Ferbruary-March</td>
<td>May-June</td>
<td>June-July</td>
<td>May-July</td>
</tr>
<tr>
<td>2.</td>
<td>Number of seeds per kilogram</td>
<td>14,128</td>
<td>12,994</td>
<td>13,967</td>
<td>14,748</td>
</tr>
<tr>
<td>3.</td>
<td>Most suitable imbibition period</td>
<td>24 hours</td>
<td>24 hours</td>
<td>24 hours</td>
<td>24 hours</td>
</tr>
<tr>
<td>4.</td>
<td>Most suitable germination temperature</td>
<td>30°C</td>
<td>30°C</td>
<td>30°C</td>
<td>30°C</td>
</tr>
<tr>
<td>5.</td>
<td>Most suitable storage condition</td>
<td>(30±1°C)</td>
<td>(30±1°C)</td>
<td>(30±1°C)</td>
<td>Room temperature</td>
</tr>
<tr>
<td>7.</td>
<td>Most suitable sowing season</td>
<td>Winter</td>
<td>Winter</td>
<td>Winter</td>
<td>Winter</td>
</tr>
<tr>
<td>8.</td>
<td>Number of amino acids in qualitative analysis</td>
<td>Five</td>
<td>Eight</td>
<td>Six</td>
<td>Four</td>
</tr>
<tr>
<td>9.</td>
<td>Maximum &amp; minimum crude fat in Dormant seeds</td>
<td>120 mg/g</td>
<td>95 mg/g (mini.)</td>
<td>145 mg/g (ma.)</td>
<td>96 mg/g</td>
</tr>
<tr>
<td>10.</td>
<td>Maximum &amp; minimum protein content in Dormant seeds</td>
<td>230 mg/g (mini)</td>
<td>290 mg/g (ma.)</td>
<td>225 mg/g</td>
<td>235 mg/g</td>
</tr>
</tbody>
</table>

The important findings as concluded in the present study for the three selected tree species are shown in the table given above.