Model answer

AS-2318

M.Sc IIIrd semester-Forestry(FGR)

Paper: (Tree seed orchard)

Question 1: Objective type

i) Advanced generation orchard

ii) Only one parent is common which is usually the female parent

iii) Clonal seed orchard

iv) 4m X 4m

v) Random mating: In random mating, each female gamete is equally likely to unite with any male gamete and the rate of reproduction of each genotype is equal i.e. there is no selection in such situation 1) gene frequencies remain constant 2) variation for characters remain constant 3) the correlation between relatives does not change

vi) Grafting Wax. It's a mixture of wax (paraffin) and rol, which protect the upper part of budded graft against water and fungal infection.

vii) Graft incompatibility: the failure of the scion and the root stock to form or maintain union on grafting.

viii) Elite tree: a term reserved for selected trees that have proven to be genetically superior by means of progeny testing an elite tree is the "winner" from a selection programme and is the kind of tree that is most desired for use in mass production of seeds of vegetative propagules.

ix) Progeny testing. The evaluation of the worth of the plant on the basis of the performance of their progenies is known as progeny testing it's the major component of variation study. Progenies of two types 1) half sib 2) Full sib.

x) Seedling seed orchard. It is a seed orchard which has been raised from the seedlings obtained from seeds of plus trees. Such orchards take longer time to produce seeds but have the advantages of having a broader genetic base combined with progeny testing.

Q.2. Discuss the history of seed orchards?

Ans.The standard method of producing genetically improved seeds in operational quantities is to use the seed orchard approach(Anderson,1960)

Seed collection is the one of mans oldest occupations, and probably begin when seeds were first harvested for food .The establishment of man made plantataion from specially collected or

harvested and processed seed was a silvicultural system seldom practiced before the start of the 18th century.

The idea of establishment of forest plantation for production of seed first appeared in the literature as early as (1787) where F.A.L. Von Burgsdorf in Germeny suggested the use of vegetatively propagated material for the purpose.

Nowadays establishment of seed orchard is being taken up as a regular forestry activity as it guarantees reliable production and steady supply of quality seeds. Seeds from seed orchard have produced substantial genetic gain in terms of growth, tree form, adaptability, disease and pest resistant and wood qualities whenever the activity was taken up seriously with detailed knowledge about the genetics and reproductive biology of the species and consequences of in-breeding and other genetic phenomenon.

Clonal seed orchard were formed in 1880 by the Dutch in Java in attempts to increase the Quinine contents of *Cinchona lederiana* (Schreiner, 1919, in Malaya, clonal seed orchard had been used for breeding rubber (*Heavea brasiliensis*) (Keilding 1972) From the beginning of this century the idea of producing genetically improved seeds through seed orchard had been discussed in European forestry. Gunar Anderson in Sweden suggested the use of vegetative propagation in forest tree breeding (Anderson, 1963, Johansen, 1909) advocated the idea of establishing "elite stand". In which progeny from selected individual trees was to be kept separately and these stand were to be rouged on the bases of progeny test and the seed from them was to be used for establishing much larger plantation from which much amount of seed could be obtained for forestry purposes Sylren (1918) proposed that seed could be produced in stands specially planted for the purpose with seedlings of known good origin and Febricius (1922) included seed orchard in this proposal for a breeding programe with forest trees.Obermann (1923) suggested seedling seed orchard for producing of seed of hybrid Larch (Larix eurolepis) and Bates(1928) in the USA published an article on the tree seed forms in which he discussed seedling seed orchards.

The first forest tree seed orchards established in Britian was planted in 1931 by Serym geonr Wedderburn on his work hill state in five, Scotland (Faulkner, 1965) this orchard was basede on selected European Larch and hybrid Larch vigor and the better wood qualities of the European larch parents. This orchard is still in seed production.

Brief historical details of seed-orchard programmes world wide

Country	Main species	Total Area(Ha)	Year of starting	Reference
Belgium	Pinus sylvestris	10	1960	Nanson,1974
UK	Pinus sylvestris	60	1931	Faulkner, 1974
Norway	Picea abies	150	1963	Dletrichon,1974
USA	Pinus tulda	200	1962	Schreiener,1970
Brazil	Pinus oocarpa	20	1970	Nikdes,1973
India	Tectona grandis	100	1971	Venktesh,1974

Q.3. Discuss the advantages and disadvantages of CSO and SSO?

Ans. Clonal seed orchard is characterized by growing orchards plants from vegetatively propagated material usually taken from relatively mature plants. Its an orchard which has been raised by grafting clones in the form of scion or bud of plus trees on the stock of two or three years old seedling raised at proper spacing.

Clonal seed orchards provides following advantages (Marters and Beinere,1973)

1. Good genotypes are preserved
2. Max. genetic gain are obtained
3. The genetic material and combining ability are known
4. Early flowering of the grafts take place
5. Its easier to manage for increased growth and flowering control
6. Pressure to vogue for early seed production are less
7. Problem with early mating are less
8. Full sib progeny trail will eventually be available to verify and early rouging.
9. Improve seed is available before progeny testing is complete.

Seedling seed orchard.

It is a seed orchard, which has been raised from the seedlings obtained from seeds of plus trees, such orchards take longer time to produce seeds but have the adventages of having a broader genetic base combined with progeny testing.

1. In seedling seed orchard, progenies from open pollinated or controlled pollination of selected phenotypes are planted at normal planting spacing.

2. In seedling seed orchard the spacing used 4 x 4m^2 for teak.This will help in keeping optimum spacing at a later date when inferior families and inferior individuals within family are removed on the basis of genetic test result.
3. A progeny test plantation may be converted into seedling seed orchard.
4. Clonal seed orchards flowers and fruit early than seedling seed orchard however in species which flower early seedling seed orchards are advantageous.
5. More number of families can be accommodated in seedling seed orchard as compared to clonal seed orchard.

Q.4. **Write notes on the following**

i. Orchard fertilization

ii. Irrigation

Ans.

i) Fertilizers containing nitrogen, phosphorus or potassium is commonly used its difficult to formulate rules and provide prescriptions for general guidance on there use. Effective fertilizers prescription depends upon the knowledge of nutrient requirements of the plants and the amount of available nutrient in the soil. Good responses of fertilizers on flowering and seed yield have been demonstrated by different workers on pine species, fertilizer application has shown an increase in seed weight and germination energy in *Pinus elliottii*.

- Apply fertilizer to the orchard for promoting growth and vigor of clones when young and to induce flowering at a later date.
- Apply fertilizer immediately after rains. Remove all weeds and grasses around the trees and apply fertilizers around the periphery after proper soil working
- Apply fertilizers around the periphery of the plants after proper soil working.
- Apply fertilizers every alternate year from sixth year onwards.
- Apply fertilizer doses as prescribed below;

  Ist year -200gm

  IInd year -250gm

  IIIrd year -300gm

  IVth year -350gm

  Vth year -400gm

*ii)*Irrigation.

Its essential to maintain the soil moisture at an optimum level throughout the growing season to get max. tree growth and seed yield. Irrigation can also reduce frost damage in seed orchard .the duration and frequencies of Irrigation may vary from species to species. It also depend upon the climate , soil and other factors. There are number of reports on the beneficial effects of irrigation on growth of clones irrigate orchard at young age to maintain good growth and vigor. Apply irrigation when soil is dry enough to warrant it. The time of irrigation is crutial when the tree comes to flowering, moisture stress during the period. Just prior to flowering induces flowering .It has been found from experience that the irrigation sometimes delays flower and fruit as well as cone maturity and increase pollen production. In droughty years, irrigation may mean the difference between a poor and a good seed crop(Long et al,1976).It has been noticed in the Douglus fir orchards to delay maximum strobilus formation.

Q.5.What is gene conservation? Explain the method of conservation.

Ans. It's difficult to discuss gene conservation in an orderly and rational way because the subject sometimes becomes very emotionally charged. many persons equate gene conservation with this. Conservation is the management of human use of genetic resources so that they may yield the greatest sustainable benefit to the present generation, while maintaining their potential to meet the needs and aspirations of future generations (FAO 1993). The objective of gene conservation is to maintain genetic diversity or variation sufficient to sustain a forest population in perpetuity (Helms 1998).

Successful gene conservation efforts should not be directed at maintaining a forest population in a given state forever, but rather at ensuring the long-term enhancement of the genetic diversity presently available to meet future human needs. Moreover, gene conservation efforts should not concentrate only on those tree species and populations that are commonly used today, but also to those that may contain variation that will be useful in the future.

The growing human population is continuously increasing the stress on forests for wood products, including fuel for cooking and heating. Land is being cleared for agriculture, fuelwood, and urbanization. These practices are endangering forest genetic resources around the world. Many of the planet's most diverse ecosystems are found in the tropics and subtropics, often in

developing countries where pressure on the land is great and financial resources to protect the environment are limiting.

Additional support and security are often needed for breeds threatened by genetic erosion or extinction of forest tree species. There are three principal ways to conserve genetic resources:

In situ : Conservation of a breed in regular use in its original environment.

Ex situ in vivo : Conservation by maintaining an active living population outside the original environment.

Ex situ/in vitro (cryo) : Conservation of semen, oocytes, embryos or somatic cells in liquid nitrogen.

Therefore, protecting these valuable resources *in situ* (on site) is an ongoing challenge for conservation organizations. Establishing a representative portion of the gene base at a new location where it can be protected *ex situ*(off site) has also proven to be very effective. Additionally, *ex situ* conservation allows for the possible reintroduction of the species or population into the original area once local environmental concerns have been addressed.

Q.6. What do you mean by advance generation seed orchard? Explain in detail.

Ans. Seed orchards are a common method of mass-multiplication for transferring genetically improved material from breeding populations to production populations (forests) and in this sense are often referred to as "multiplication" populations. A seed orchard is often composed of grafts (vegetative copies) of selected genetypes, but seedling seed orchards also occur mainly to combine orchard with progeny testing. Seed orchards are the strong link between breeding programs and plantation establishment. They are designed and managed to produce seeds of superior genetic quality compared to those obtained from seed production areas, seed stands, or unimproved stands.

A seed orchard is a key element in a successful tree improvement program.seed orchards are advanced generation plantations of genetically superior trees, intensively managed to produce frequent, abundant, and easily harvested seed crops. As forest tree breeding programmes advance, resulting into higher genetic gain, and the original first generation seed orchards age, seed orchard managers plan the establishment of advanced generation orchards to capture higher gains and to secure future seed need. Experiences gained from establishing and managing first generation seed orchards provide invaluable information for the effective management of advanced generation orchards, specifically those related to clonal reproductive behaviours, such

as time to sexual maturity and expected reproductive output potential of the species under domestication

Advanced generation seed orchards, originate from seed produced from controlled pollination. In spring, female flowers from a superior parent are enclosed in a waterproof bag. Pollen, collected from non-related superior parents is then applied to the flowers, either by using an artist's brush or a modified airbrush. Once pollination has taken place, the bags are removed and the flowers, or conelets, are protected from potential insect attack by surrounding them with screen bags. The seed will be sown, ensuring identity is maintained, and the resulting seedlings are established in the orchard. These improved seed orchards are expected to produce seed for commercial reforestation programs that will grow up to 25% faster than using seed collected from surrounding stands.

Objectives Advanced generation seed orchards

following are the main Objectives for advanced generation seed orchards;

- Continue genetic upgrading of existing orchards to produce seed with higher gain.
- Develop technology transfer and demonstrations for industry clients and regional users (both seed producers and users).
- Produce genetically improved and insect- and disease-resistant seed and propagules from the seed production sites.

Q.7.Why progeny testing is essential for seed orchards?

Ans. The evaluation of the worth of the plant on the basis of the performance of their progenies is known as progeny testing it's the major component of variation study. Progenies of two types 1) half sib 2) Full sib. Progeny Testing is a test of the value for selective breeding of an individual's genotype by looking at the progeny produced by different matings. In plant breeding, progeny tests play a very important part. The reason for this is the fact that a progeny from a given specimen generally provide far better information with respect to those hereditary properties of the specimen which are of economic value than does the specimen itself. Under cultivation many characteristics are important which cannot possibly be judged from one single specimen. In forestry, the yielding capacity per area unit is a very significant varietal quality. Therefore little is generally gained by selecting trees whose offspring are very good when planted solitarily, if the output per area unit is low.

The results of the progeny tests may give a good expression of the properties of the progeny tested. But in many cases we are especially interested to get information of the parents selected, because we wish to

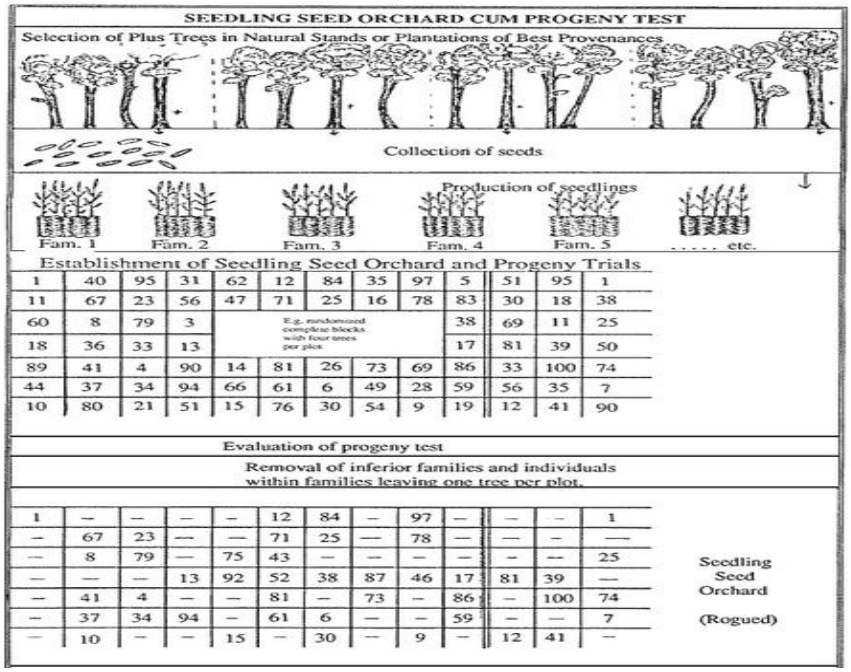
know if these parents are to be used in further breeding work or not. With this end in view, the experiments ought to be planned in such a manner that the greatest possible correlation is obtained between the characteristics of the progeny and the genotypes of the parents.

For the purpose of gaining some basis for such decisions, three different types of progeny tests are here presented, a discussion of which in greater detail seems justified.

(I) Definite seed trees are selected. The progeny of these trees are planted in experimental plots, each plot containing m ***progeny*** from ***each seed free,*** the experiment being carried out in *n* replications.

(11) In a number of stands, ***t seed trees are selected from each stand.*** The progeny of ***each seed free*** are planted out in experimental plots, with m progeny per plot, and in *n* replications.

(111) The progeny of a number of seed trees from different stands (provenances) are set out in experiments with ***rn progeny*** from ***each stand (provenance)*** in each plot, and in n replications.



Q.8. Write short notes on the following.

a) Seed production area

b) Plus tree selection

Ans. **) Seed Production Area**

A seed production area is defined as "a natural or planted stand or group of stands, set aside, periodically rouged, and treated to stimulate seed production. The genetic quality of the seed is not known ". The purpose of a seed production area is to provide, in quantity, seed of known origin from the best phenotypes available. The establishment of seed production areas is a stop-gap measure, designed to provide seed of the best possible quality until our seed orchards begin to bear.

Establishment of SPA:

The quickest way to make a seed production area is to convert existing mature stands of good quality trees for this purpose. A seed production area can also be developed from a progeny or provenance trial. There are no specific age limitations but the stand should be old enough to produce seed.

A planted stand suitable for conversion to a seed production area should have the following specifications.

(1) Details of the seed source used to establish the stand should be known.

Knowledge of the geographic origin and genetic base, which ideally will be broad, is important in determining the suitability of the stand for development into a seed production area.

(2) The trees should be mature for seed production, but not too old.

There are no age limitations, other than that the stand must be old enough for reliable selection and be sexually mature to produce seed. Individual trees must have sufficient crown density to potentially produce large seed crops.

Seeds from very young or very old trees often are of inferior quality compared to those from middle age trees. In addition, old trees tend not to respond to thinning by further crown development.

(3) The stand should be near full stocking and contain a large number of trees of good phenotype.

A suitable stand before conversion should be near full stocking to increase the selection intensity. The final stocking of a seed production is usually 150-200 stems per ha. An initial survey should reveal that the number of trees of good phenotypes is equivalent to that.

(4) Free from pests and diseases.

Evidence of pests or diseases may be an indication of inferior adaptability of the seed source. If the stand shows widespread symptoms of attack by insects or diseases it should not be used for conversion.

(5) The trees should have proven capacity to produce flowers and seeds in the area.

To avoid failure, a detailed survey of the candidate species' ability to flower and seed in a particular environment should be a prerequisite to establishing seed production area. This is especially important for exotic species where flowering may fail or seeds are not produced due to incompatibility with the site. Non-favorable environments, such as drought prone areas, may be unsuitable for seed production area. Availability of pollinators can also be important.

(6) The area should be easily accessible.

The conversion of a stand into a seed production area and subsequent management operations, such as harvest of seeds, requires that the area is accessible throughout the year. This implies that it should be relatively flat but well drained. Ideally it should not be in a very remote area or too far from available labor for ease of maintenance and management.

(7) The selected stand should not be subject to commercial harvesting.

Seed production areas will be maintained for many years. It is necessary, therefore, to ensure that the stand in question is safe from commercial harvesting operations. Good communication with the forest managers will help avoid the accidental loss of valuable seed production areas.

(8) Size of seed production areas.

In general a minimum of 4 ha is recommended for practical management of seed production areas for most tree species. Managing small stands is inefficient, and there is a great danger of contamination from outside pollen. However, for some species such as eucalypts an area as small as 0.5 ha may be sufficient, due to prolific seed production. The area should be as close to square as possible, rather than a long linear block to facilitate more cross pollination among the trees.

(9) Isolation.

Poor isolation will be a common disadvantage of seed production area developed from existing stands. Usually such stands are selected from mature plantations of the same species. It is

virtually impossible to eliminate completely contamination by stray pollen. However, an isolation zone or pollen dilution zone surrounding the seed production area can reduce it. The dilution zone may be an open area of some 200 m. If trees are to be grown in the dilution zone they must be of a species that does not hybridize with the species of interest for seed production. A seed production area must be managed properly and scientifically, as it serves as the source of future plantation. If we do not manage our seed production area properly, we may get inferior quality seed from the seed production areas. That will effect in our future plantations. So, management of seed production area plays a significant role.

b) Plus tree selection.

A tree that has been recommended for production or breeding orchards following grading. It has a superior phenotype for growth, form, wood quality, or other desired characteristics and appears to be adaptable. It has not yet been tested for its genetic worth.

SELECTION CRITERIA

Different species have by nature different architecture. Selection traits may vary between different species and improvement programmes. However, timber species to be cultivated in plantations share a number of desired features. The ideal plantation tree has following characteristics:

1) Straight, cylindrical, non-forking, non-twisting bole.
2) Fast growth
3) Narrow crown
4) Thin branches with wide branch angles
5) High wood density* and long fibres
6) Resistance to pest and diseases.

Where to select a plus tree.

Selection is carried out in natural stands or preferably in plantations. Certain considerations of importance in the choice of the site for selection are identified below:

1) Selection should be made from stands that are as pure in species composition as possible.

2) Selection should be concentrated on stands or plantations that are average or better in traits of interest.
3) Selection works better in an even aged stand, since the age difference can then be eliminated from the evaluation.
4) Selection is best carried out in a mature stand, i.e. near to maximum height.
5) Selection in natural forests where selective logging has taken place should be avoided since that may imply that the best trees have been logged, leaving the poorer (genetic material) behind. Logging may also have influenced crown competition.