
Genetics in Silviculture

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IN the fields of agriculture and horticulture a great deal of useful work has been done in the production of improved strains of grasses, clovers, corn, vegetables, fruit and flowers. By comparison efforts to improve forest trees have been puny indeed.

There are, of course, some reasons for this backwardness in the silvicultural field. In agriculture and horticulture the number of plants suitable for the areas to be utilised are only planted out while in forestry we plant out at least ten times as many as we need for the final crop. This gives us a wide selection and, if thinning is skilfully done, the majority of the trees that will reach maturity should be those that have good inherent tendencies. In addition there is the point that the forester can "train" his trees.

It is well known that in plant improvement of any kind controlled pollination plays an important part. Here the tree improver runs into trouble right away. Trees often do not flower until late in life and then the female flowers are so inconveniently placed that controlled pollination is rendered extremely difficult. Even if carried out successfully a long period may have to elapse before the succeeding generation flowers and sets seeds.

Then there is the difficulty that trees selected for breeding are often widely scattered and, unlike agricultural plants cannot very well be uprooted and brought together in a breeding station. Also owing to the fact that trees take up so much room both above and below ground it is impossible to say that any two trees have grown under identical conditions. In selecting the best trees, therefore, it is difficult to

distinguish between genotype and phenotype—between the effects of heredity and environment.

In spite of the difficulties with which the tree improver has to contend, however, much useful work has been done in the last quarter of a century and there has been a decided quickening of interest in tree breeding particularly in the last decade.

The writer of this book Dr. C. Syrach Larsen of Copenhagen is one of the most outstanding workers in this field. He has a world-wide reputation as a pioneer in tree breeding and in this volume he gives an account of the results of his twenty-five years of work on the subject.

He scorns any attitude of despair regarding tree improvement. That the difficulties are great and almost insurmountable he readily admits, but only so long as we follow the same lines that have been used in agriculture and horticulture. If, instead, he says, we go our own way while, of course, establishing relationships with other branches of plant breeding and making use of already existing scientific results, the matter can be viewed in a very different light.

In this book Dr. Larsen charts a course along which the tree breeder may travel. In its twelve chapters he deals with every aspect of tree breeding and gives the fullest information on the procedures by which the goal of better trees can be achieved.

Historical.

Included is an historical sketch of the efforts at tree improvement in which he goes back through almost two centuries to the time when Duhamel du Monceau found that seed from a stunted tree produced ugly trees if it is stunted by nature but can produce fine trees when the difference in its form is due to injuries. In the past attention was concentrated mainly on provenance trials which did not go beyond selection on the basis of free uncontrolled pollination.

Provenance Trials.

In discussing provenance trials he shows that experiments prove beyond any shadow of doubt that several tree species display great differences when seed is used from a series of geographically distinct regions. He stresses that it is not enough to get seeds from regions with similar climate; importance should also be placed on the quality of the stand from which the seeds are collected and a sharp watch should be kept for variations in respect of attributes valuable in forestry.

Controlled Pollination.

From a chapter on controlled pollination it would seem that the genus *Populus* presents the least difficulty. As an example the commercial production in Denmark of the hybrid between *Populus tremula* and *P. tremuloides*—the European and American aspens—is described. The process, first employed by Wettstein of Austria, hinges on the

capacity of the poplars to flower and set viable seed on cut-off branches. The branches which are cut in February while still in the bud stage are handled like flowers in a vase. They are placed in water in a warm room and later in moist peat. The seeds are collected in early May.

The technique of controlled pollination of various genera is described in detail together with the aids such as transparent parchment bags, pollen blowers and all the impedimenta of the plant geneticist.

Vegetative Propagation.

The subject of vegetative propagation is dear to the heart of the author as he regards it as being of vital importance as a *technical aid*. By its means it is possible to produce seeds which will bring together and combine the valuable genes. Grafting, budding and propagation by cuttings are dealt with in such a way that even a tiro should be successful if he follows the instructions.

Seed Orchards.

On the subject of the seed orchard the author gives much information. This according to him is our "trump card." By its use we can produce any quantity of seed through controlled pollination. He brings up arguments in favour of seed gardens as a practical means of producing seeds. The system seems particularly suitable for conifers which are characterised by bearing many seeds on a single tree. They are also suitable he says for some leaf trees and mentions ash, alder and birch as examples in respect of which experience is available. He emphasises their special importance in regard to the production of hybrid seed. By means of seed orchards the aim of a more regular annual seed setting, instead of the production of large quantities of seeds in individual years, can be accomplished by the judicious applications of nutrients. The work should proceed hand in hand with controlled pollination which should show clearly whether or not the trees in question are good genotypes. It is pointed out however that we must not wait for the results of the pollination but get going right away on the selection of our finest and most luxuriant trees and give them a place in our orchards. When, later, controlled pollination and observation of their behaviour will reveal the inherent tendencies the poorest can be removed and the orchard in its final form will thus comprise only the most valuable trees.

Tree Shows.

As already mentioned the tree breeder is up against the difficulty of distinguishing between genotype and phenotype. Larsen, however, discusses a method which he claims helps considerably in appraising the genotype of trees; that is by the use of Tree Shows. Tree Shows "are groups of plants produced vegetatively, in which each group represents a single tree—a single clone—and they are laid out in such a manner that mutual comparisons can be carried out." Usually in order to know

sufficient about a tree there must be an opportunity of following the development of it from the seedling stage to maturity. If that were the only way it would be discouraging indeed. Tree Shows according to the author, however, can help us considerably to understand how the selected tree was capable of growing to be one of the finest in the forest. They can help us to judge the form of the tree, its growth, energy and resistance to disease. Judgment can be formed early—a close agreement has been found between the appraisal of the oldest tree show, now fifteen years of age and that which it was possible to make a few years after its establishment.

Genetics.

In a chapter on genetics all relevant aspects of the subject are discussed including the Mendelian segregation laws, cytology, mutation, apomixis, metandry, protandry, inbreeding and other fascinating aspects of the work. Here the author mentions an interesting case of apomixis (apomixis is the phenomenon that plants set viable seed without previous fertilization) in alder, which would seem to have practical value in forestry. The alder referred to is characterised by good growth in youth and heavy foliage which makes it a good nurse tree. It is peculiar, however, in that it is short-lived and dies at the time it should normally be removed thus saving the cost of cutting it out. It is produced in large quantities in a Danish nursery.

Hybrids.

There is a chapter devoted to hybrids in which the use of heterosis (hybrid vigour) on the basis of crosses between two species "unrelated" to one another is discussed. The superior qualities of hybrid larch and hybrid aspen are dealt with at length. In regard to heterosis Larsen echoes the statement of another Danish geneticist, Mogens Westergaard, who said: "It can scarcely be doubted that the heterosis method is the answer to breeding difficulties due to cross fertilization. In fact it eliminates entirely two unsolved problems, determination and fixation of the good genotype."

Breeding of Larch.

The breeding of larch is given a chapter to itself as larch is a tree which has long been subject to experiment, it flowers at a relatively early age and lends itself well to the process of improvement. In one example of the breeding of larch the author attempts to bring together the various links in the breeding of forest trees.

Breeding and Mechanisation.

The final chapter is on Breeding and Mechanisation. In it the author advocates that the botanist and the forester should be given a jeep, extension ladder and assistance to study the flowering in the tall tree crowns. Motor and air transport must be used for the rapid dispatch

of vegetative material. He gives an example of douglas scions having been grafted in Denmark four days after their dispatch from California and of pollen travelling as quickly in the opposite direction.

On reading this book one feels infected with the enthusiasm of the author: the possibilities in the field of tree breeding are good.

In a country such as ours where the forests of the future will be almost entirely the result of planting out nursery stock the book has a special significance.

The volume is well illustrated with many good black and white photographs, line drawings and diagrams.

J.J.D.
