TREE IMPROVEMENT STUDIES OF THE MARIA MOORS CABOT FOUNDATION FOR BOTANICAL RESEARCH

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The Maria Moors Cabot Foundation for Botanical Research was established at Harvard University in 1937 by Dr. Godfrey Lowell Cabot of Boston. The principal objective of the Foundation is to conduct research activities which will contribute to "increasing the capacity of the earth to produce fuel by the growth of trees and other plants." To this end the Foundation has devoted its research efforts to problems in tree biology, with particular emphasis on tree genetics and physiology.

I should like to emphasize that we do not, as yet, feel that we have reached the point where we can classify very much of our work as "tree breeding," in the sense, at least, that this term is used by wheat or corn breeders. We are of the opinion that our information on the mode of inheritance and the reaction range of most tree characteristics is still too meager to permit the undertaking of a "breeding" program having a specific direction and objective. For this reason most of our studies are still of a fundamental nature, with emphasis placed on the investigation of natural variation within several tree species.

Genetic studies of coniferous species, particularly species of Pinus, are carried on by Mr. A. G. Johnson at the Arnold Arboretum. Variation in red maple and red oak is being investigated, respectively, by Mr. W. J. Gabriel and Mr. Helge Irgens-Moller, both of whom are graduate students majoring in forest genetics at Cambridge. My own work is concerned chiefly with a study of variation patterns in our native Populus species.

Rather than attempt to give you a detailed report of the various tree genetic studies being carried on by the Cabot Foundation, I have decided to

restrict my remarks to our studies of the photoperiodic response in Populus

(A discussion, illustrated by lantern slides, concernedwith theecotypic variation of the photoperiodic response in was presented. A summary of these remarks follows.)

For the purpose of studying ecotypic variation. in Populus, a living collection representative of the ranges of various species in the genus was undertaken by the Maria Moors Cabot Foundationfor Botanical Research in 1947. The studies reported are Concerned primarily with the influence of the photoperiod on time of height growth cessation as observed in the various test areas located in the vicinity of Boston, Massachusetts.

Marked variation in the time that height growth sopped was observed between colonal lines of single species when grown in the same day-length regime and otherwise uniform environment. Analysis of these datea revealed that the time of height growth cessation was inversely Correlated with the latitude of origin of each clone. Among clones native of uniform day-length zones, the time at which height growth ceased was directly correlated with the length of the frost-free season prevailing in the native habitat of each clone. On the basis of these observations, the conclusion is made that adatpation of Populus species to various habitats differing in length of frost-free season is effected by genetic mechanism which controls the duration of their seasonal period of growth. The photoperiod, which is the only factor of the environment with a uniform seasonal variation that is constant from year to year, functions as the timing deice for the mechanism.

Modifications in time of height growth cessation were effected by exposing ramets of various clones to artificially lengthened or shortened photoperiods in otherwise uniform environments. The time of height growth cessation was thus deomonstrated to be the result of an interaction between the individual's genotype and the photperiod. Also observed were other interclonal modifications in time of height growth cessation that could not be attributed to photoperiodic response. Differences in temperature, available, nitrogen, intensity of cultivation, and various other factors are believed to exert a modifying influence on the time that height growth ceases.

Hybrids between clones of northern and southern origin gave a photoperiodic response intermediate to the responses of the parents. These results, and the widely varying photoperiodic response shown by the various ecotypes used in these studies, indicate that the number of genes involved in the photoperiodic resation is large.

Experiments on the break of dormancy in the spring indicated that, temperature rather than photoperiod is the major factor controlling the initiation *of* new growth after the period of winter dormancy.

Several practical generalizations concerning the photoperiodic response in trees and its importance in seed source problems and in breading were noted.

Although it would be unwise on tge basis of our present limited knowledge to extend the results of these studies to all ligneous species, several prac tical generalizations concerning tge photoperiodic response in trees and its importance in seed source problems may be noted.

(1) The utilization of seed from northern long-day races for planting in southern latitudes of long growing season will result in. early seasonal growth cessation and consequent dwarfing. Such seed sources should obviously be avoided for the establishment of forest plantations from which maximum produc-

tion of wood or fiber is desired. On the other hand, such seed sources might prove suitable for the establishment of protection forests in short growing season habitats at high elevations in southern latitudes. The typically small annual increment, of northern races when grown in a short-day environment might even make them suitable for special horticultural uses.

(2) Seed derived from ecotypes native of the short growing season, high-altitude habitats of mountainous areas in the low latitudes may be expected to react in a manner similar to northern long-day types and should therefore be avoided as seed sources for forest plantations at the same or more southern latitudes. Such sources of seed may, however, prove highly desirable for introduction into certain long-day environments in northern latitudes having suitably long growing seasons. Support for this generalization is attested by the long history of successful North American tree introductions into the maritime countries of Europe. Conversely, movement of long-day races of native European species into the United States has not met with notable success.

(3) Ecotypes native of long growing season habitats in any particular latitude should be avoided as seed sources for short season habitats at the same latitude because of their susceptibility to early autumn frost damage. For the same reason, such seed sources cannot be successfully moved northward into a long-day environment.

The problem of selecting suitable seed sources of any species for introduction into another environment must obviously take into consideration numerous other environmental factors and genetic characteristics. The above recommendations may be found useful, therefore, only to the extent that they may contribute to limiting the field of search for desirable genotypes. Final decisions on adaptability of the proposed introduction to the new habitat must be based on the observed interaction that results between the introduced genotype and all the factors of its new environment.