HERMAPHRODITISM IN POPULUS

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The forest genetics research work of the Cabot Foundation has centered largely around investigations of the genus Populus. Populus species are normally dioecious, having staminate and pistillate flowers borne in aments or catkins on different trees. Such trees are designated respectively as male and female. Although some standard reference works simply refer to Populus species as dioecious, there are exceptions to this rule.

Since 1878, a number of references have appeared in the literature describing abnormal flowering habits in Populus, chiefly P. tremuloides. Individual trees having both staminate and pistillate catkins as well as trees with staminate and pistillate flowers mixed together on the same catkin were among the first reported. Occasionally, perfect flowers, having both .male and female flower parts, were found in combination with the other abnormalities. Terms such as monoecious, polygamo-monoecious, and polygamo-dioecious could be used to describe the aberrant individuals, but for the purposes of this paper all trees possessing both male and female flowers or

flower parts will be classified as hermaphroditic. In most cases these were predominantly female in character but some males were also found. When applying the terms male and female to hermaphroditic individuals, the predominant flower type is used. Hermaphrodites in Populus have usually been considered rarities, and the infrequent discovery of such individuals in the United States often has prompted the publication of notes or articles on the subject.

During the course of other investigations it was noted that, a considerable number of hermaphroditic individuals were present in the test plantations and a study was set up to determine the extent o1 this abnormal behavior. In the spring of 1954, about 10 catkins per tree were collected from all trees then flowering in the test areas and additional collections were made from wild trees growing in the vicinity of the Harvard Forest in Petersham, Massachusetts. The catkins were sealed in polyethylene bags, labeled, and placed in a deep freeze until examination. This investigation was performed by Mr. Claud L. Prawn and myself under the direction of Dr. Scott S. Pauley. The bulk of the material was F. tremuloides and P. grandidentata, as well as the progeny resulting from controlled intraspecific crosses of these two species. However, P. tremuloides was the only species that was examined in sufficient numbers to yield significant results.

P. tremuloides

Progeny	Female trees			Male trees		
	Observed	Hermaphroditic		Observed	Hermaphroditic	
	number	number	percent	number	number	percent
Wild	28	3	10.7	39	2	5.1
tremuloides x tremuloides	60	28	46.7	71	1	1.4
187 x tremuloides	212	115	54.7	244	7	2.9
Totals	300	146	48.7	354	10	2.8

Sixty-seven wild trees of P. tremuloides were examined. Three of the 28 females and 2 of the 39 males were found to be hermaphrodites. The corresponding percentages are 10.7 percent of the females and 5.1 percent of the males. Among the 131 trees from intraspecific crosses, 46.7 percent of the females and 1.4 percent of the males were hermaphroditic. The greatest number of trees of this species were the progeny resulting from intraspecific crosses utilizing a known hermaphrodite as the female parent. This tree, known as No. 187, is located in Weston, Massachusetts. Of the 212 female progeny examined, 115 or 54.7 percent showed evidence of hermaphroditism while only 7 or 2.9 percent of the 244 males had this property. It can be seen from

these figures that abnormalities in flowering behavior occur most, often in trees that appear to be basically female in character. Approximately percent of the females and 3 percent of the males of all classes were hermaphroditic.

No hermaphrodites were found among the small numbers of P. grandidenta, P. deltoides that were examined. This may have been due to the scarcity of females in these species or to some more basic factor. However, one of the two female hybrids of 187 X P. grandidentata was distinctly hermaphroditic. Other hermaphrodites were found in P. sieboldii from Japan and the hybrid P. tremuloides X P. adenopoda.

As high as these percentages are, they probably constitute a minimum. In explanation of this statement, perhaps more emphasis should be placed on a point which was not too well developed in the preceding discussion. It was stated that all trees producing both male and female flowers or flower parts were tailied as hermaphrodites. This does not imply that the bisexual characteristics were conspicuous upon casual observation or that they occurred in every catkin of a particular sample. In some cases the bisexual trait appeared on only one catkin, whereas in others it was noted on all catkins. On the female trees,, the anthers were usually inconspicuous and occurred in small numbers. In approximately 60 percent of the hermaphrodite females the male parts were hidden under the bud scales at the base of the catkin or in the tuft of bracts at the apex. With this criterion of hermaphroditism, it is not unreasonable to assume that a larger sample of catkins from each tree would have resulted in the discovery of more hermaphrodites.

It would appear from these figures that hermaphroditism in P. tremuloides is far from uncommon and furthermore that this trait is inherited. If the production of both sexual types on the same individual is controlled by genes, the Venetic situation is very complex and may involve something similar to the hypothesized sex chromosome mechanism. Certainly, the mode of inheritance of this trait is far too complex to be solved by this simple study.

It is often difficult to discover practical applications of the results of a purely descriptive study such as this and an investigator will often go to great lengths to justify his work, especially when presenting the results to a group of practical men. There are, however, certain points brought out here that may be of interest to the forest geneticist. If these hermaphrodites are self-fertile, and there is every reason to believe that they are, it may then be possible to build up inbred lines of various species. Inbreeding provides the best method for fixing genetic characteristics and for determining their mode of inheritance. There is also a warning to aspen breeders that they should check their mother trees carefully for any tendency to deviate, since some of the female flowers may be fertilized by the pollen from the inconspicuous anthers on the same catkin. The occurrence of hermaphrodites may well have phylogenetic importance also, in that this condition is considered to be more primitive than the normal dioecious habit in Populus.

Whether or not these considerations are valid, the fact remains that hermaphroditism occurs quite often in P. tremuloides and perhaps in other species as well. Hermaphrodites could provide a great deal of material for continued basic research and perhaps eventually a tool for forest tree improvement.