THE DISEASE PROBLEM IN RELATION TO TREE IMPROVEMENT1/

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If the work done on other crop plants is any indication, adequate resistance to disease will be one of the most important phases of a forest—tree improvement program. I don't think any of you need to be convinced of this, but if such history with other plants isn't enough, we have a tree case in our own territory which is one of the worlds most striking examples of the need for properly recognizing diseases. This example is the chestnut blight disease, which in about 40 years resulted in the practical extinction of an entire species. The blight alone already has resulted in a fairly large amount of work of the type that we are discussing. In fact, such work represents some of the earliest on forest—tree genetics in the United States.

Before considering the possibilities and difficulties in planned studies on increasing resistance, let's spend a few moments on the general disease situation in virgin stands and in stands of today. Theoretically, virgin or undisturbed stands were largely a case of the survival of the fittest so that natural selection for disease resistance probably was a continuing operation. Since the chances of introduced diseases were remote and since native diseases seldom cause widespread devastation in natural stands, epidemic conditions must have been rare. Furthermcre, stands undoubtedly were often dense so that many trees could be lost without serious effect on final stocking. Similar tree losses today would be much more damaging, particularly in plantations with a limited number of trees and from which intermediate as well as final products are expected.

The situation now on disease liability depends on the practices that have been followed in cutting and reproducing the stands. For instance, the widespread early practice of "high grading" has worked to decrease rather than build up the resistance of the new forest. This practice still continues to some extent, particularly in the harvesting of hardwood stands. Even under the best management practice today, however, it is difficult to judge whether the chances for disease escape are better or poorer than under undisturbed natural conditions. To the extent that diseased trees are being eliminated early, mixtures are encouraged where pure stands existed before, and the best sites are favored for species — we are tending to improve the disease picture. On the other hand, disease liability tends to be increases to the extent that mixed stands are replaced by pure ones, trees are grown outside of their natural range, and plantations are favored over natural regeneration, particularly if the seed source is from some distant place.

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It is very doubtful whether natural selection for disease resistance is now operating as effectively as under an undisturbed stand condition. One reason for this is that the use of direct methods of disease control often permits the survival of susceptible as well as resistant individuals. One case in point is longleaf in areas where brown spot is heavy. In the absence of prescribed burning or fungicidal sprays, the plants making earliest height growth are likely to be the most resistant ones. These tend to comprise a larger proportion of the final stand than when brown spot control measures are employed. Finally, one cannot overlook the present real threat of introducing new diseases from other countries, plus the fact that abused and depleted sites often confront the tree with a changed natural environment that often may increase the disease hazard.

In a tree improvement program, the disease more than any other phase could eventually find us guilty of having looked through rose-colored glasses. It may seem from the following that I am substituting opaque ones instead, which is not the case, but we must be realistic and recognize some of the possible obstacles in our path. Among the foremost is that diseases of trees are largely caused by fungi, although there is a good possibility that the little-known virus agents will become increasingly important. If so, the problem will only become more complicated. Anyway, fungi, being plants, hybridize as we now talk of changing trees; and furthermore, mutations are net uncommon for many of them. Generations in their case are a matter of hours and days, not years or decades. This means that new varieties or biologic forms might arise that would make last year's resistant tree a susceptible one today. Among annual plants, the stem rust of wheat is an outstanding example of a disease that continues to produce new forms that periodically relegate resistant Wheats into the susceptible class. Among trees, there is recent suspicion that the resistant Buisman elm may be susceptible to a new form of the Dutch elm disease fungus. Variability within species for a number of other fungi, including those causing heart rots and mimosa wilt, is known to occur. Fortunately, the present evidence is that such tree rusts as those causing white pine blister rust and fusifom. canker diseases have not given rise to new forms differing in parasitism. However, it would be foolish to ignore the threat, considering the short time diseases have been observed and the long time needed for rotations or the development of superior individuals.

Another possible difficulty is that stock bred for resistance against certain diseases may prove susceptible to diseases normally harmless to the tree being replaced. This has been the case with some of the fast-growing poplars, and Asiatic and hybrid chestnuts. It has been strikingly true of the hybrid London plane, which showed resistance against sycamore anthracnose but has succumbed in large numbers to the canker stain disease. With the hybrid poplars and London plane, susceptibility to disease and hybrid vigor were associated. One advantage that trees have had over annual crop plants is what they are much hoe heterozygous. The closer genetic uniformity is reached in large populations the greater is the risk of heavy losses from epidemic diseases. Hazards would be very high, for instance, in extensive Plantings of clonal propagated stock since this would be a great refinement of pure stands of species. Such clonal varieties as Lombardy poplar, Norway poplar, and London plane already have been seriously troubled by diseases that apparently caused minor damage on the closely related native trees. As Hartley and Boyce have warned, unless mixtures of superior clones are at least used, the disease status in planted forests could easily approach that already apparent in our present-day orchards.