DISEASE RESISTANCE

By Dr. Albert H. Ellingboe

Diseases of plants are controlled by a combination of host plant resistance, use of pesticides, and cultural and other management practices. For some diseases there is an adequate level of host plant resistance so that the use of pesticides is unnecessary and, even if the cultural practices favor the pathogen, adequate control is still achieved. An example is the high level of resistance to rust in some cultivars of bluegrass. Other cultivars have an intermediate level of resistance that is adequate for control of rust in most, but not necessarily all, crop management schemes. Other cultivars may have such a low level of resistance that adequate disease control is achieved only under specific management practices or the use of pesticides.

The ability to breed for resistance to diseases is dependent on finding a source of resistance. That usually involves screening a large collection of individuals of that species for resistance, either by creating epidemics through inoculations or by planting in an area where the disease is known to be severe. Individuals that are classified as resistant, or having some potentially useful level of resistance are then crossed to the commercially acceptable cultivars, and selection in subsequent generations are for resistance and the other desirable agronomic traits.

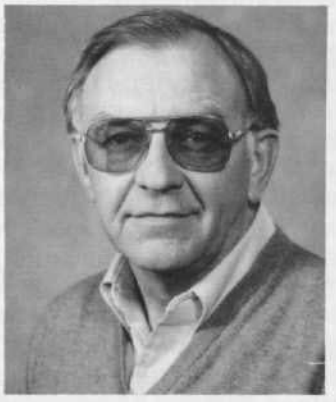
The availability of resistance in a plant species is dependent on the particular disease. For some diseases it is possible that 25 percent or more of the members of a worldwide collection of a species may be resistant to the pathogen. If such is the case, breeding for resistance is relatively easy. If, on the other hand, only a few members of the germplasm collection are resistant, then the development of agronomically acceptable and disease resistant cultivars may be more difficult.

The level of resistance available may also differ. For example, it is relatively common to find a high level of resistance to leaf pathogens but only low levels of resistance to root pathogens. The systems to screen for resistance to leaf pathogens are usually quite easy. The systems to screen for resistance to root pathogens are usually quite difficult, and less reliable. These differences help to explain why there has been extensive breeding for resistance to leaf pathogens and relatively little effort to breed for resistance to root pathogens. The difference also helps to explain why most basic research on the mechanisms of resistance have been with leaf pathogens. When there are high levels of resistance to a pathogen and it is easy to distinguish between resistant and susceptible plants, it is relatively easy to study the patterns of inheritance of resistance. Hence, most basic studies on the genetics of interactions between plants and pathogens have been done with leaf pathogens.

The development of disease resistant cultivars does not necessarily give long term disease control. That is because the pathogen may change from being avirulent to virulent on that cultivar. The frequency of the genetic changes in pathogens is dependent on the pathogens and the host genes that originally gave the plant its resistance. Therefore, breeders must continue to develop new cultivars that are resistant to a pathogen based on different genes. When one cultivar becomes susceptible, it can be replaced by cultivars that are essentially identical except for the genes that give it disease resistance.

Any one plant species, such as bluegrass, is affected by many different diseases. An objective for breeding is to develop cultivars with resistance to as many pathogens as possible and still retain the desirable agronomic traits. That means that techniques must be developed to screen for resistance to each of the important pathogens, and then the genes that give resistance to each pathogen must be combined into a single cultivar. Because of the difficulties of combining all the genes for disease resistance as well as the genes that affect growth habit, drought tolerance, etc., and the fact that the pathogens are constantly changing, new cultivars are released for usage that may have resistance to some but not all diseases. Some diseases are controlled by host resistance, some by the use of pesticides, and some by management strategies.

Breeding for disease resistance is considered a safe, effective means to control diseases. The availability of resistance in the plant species, the level of resistance, the ease with which that resistance can be transferred, and the stability of that resistance all affect the success of a program to breed disease resistant cultivars.



Editor's Note: Professor Al Ellingboe is a relatively new member of the Department of Plant Pathology at the University of Wisconsin — Madison, joining the staff in 1983. His previous experience includes twenty years as a plant pathologist on the faculty at Michigan State University (1960 — 1980) and three years of work with the International Plant Research Institute (1980 — 1983).

Born and raised on a Minnesota dairy farm, Dr. Ellingboe received all of his formal plant pathology education at the University of Minnesota — B.S., 1953; M.S., 1955; and Ph.D., 1957. His specialty in the Department is the study of diseases of field crops with emphasis on the genetics of host-parasite interactions and the cloning of genes controlling disease resistance.