DEVELOPMENT AND USE OF EXPERT SYSTEMS IN PLANT PATHOLOGY

Expert systems are computer programs that try to equal and, better yet, surpass the logic and ability of an expert professional in solving problems, the solutions of which require experience, knowledge, judgment, and complex interactions. The dependability of an expert system is proportional to the knowledge of the expert(s) who produced it. Expert systems can use data in almost any format and can suggest a solution to the problem; they can even use incomplete or incorrect data, as long as the degree of certainty of data is quantified by the expert and is included in the knowledge base. Expert systems in plant pathology are used frequently for diagnostic purposes, i.e., identifying the cause of a disease by the symptoms and related observations. Several expert systems, however, incorporate the decision-making process of the expert and advise producers in making disease management decisions. By incorporating infection models of the important diseases of a crop into the knowledge base of the computer, the expert system can advise growers of disease potentials on the basis of the actual occurrence of infection periods and provide pesticide recommendations and suggestions for pesticide amounts and timing of application.

The development of even simple expert systems is quite complex, but advances in computers and increasing familiarity with their use are making the development and use of expert systems increasingly attractive. In their simplest form, expert systems utilize a bank of data pertinent to the problem stored in the computer and also a knowledge base inputed by the expert(s) and consisting of one or more “IF conditions” followed by a conclusion or action (THEN action) and, finally, a recommendation. In addition to the requirement of being familiar with computer programming, the most important part of creating an expert system is the quality (expertise) of the expert(s) providing the knowledge that is inputed in the system. This knowledge of the expert(s) is then represented in a form that can be converted into computer code. Once a prototype expert system is generated, it is first tested for logic and accuracy. Usually, the expert system is also reviewed and, if necessary, revised by other experts; subsequently, it is tested with the intended users, and additional revisions are made before the expert system is released for use. Even after an expert system is released to its final users, it must be revised and updated regularly.

BLITECAST (1975), which is a computerized forecasting system for potato late blight, and the computer based apple scab predictive system (1980) are considered to be the precursors to expert systems. The first expert system in plant pathology was developed in 1983 to diagnose nearly 20 soybean diseases in Illinois. Since then, expert systems have been developed for the diagnosis or management of diseases of tomato (TOM), grape (GrapES), wheat (CONSELLOR), peach and nectarine (CALEX), apple (POMME, the Penn State apple orchard consultant PSAOC), wheat (MoreCrop), and others.

An example of an “expert” advisory system is More- Crop, which stands for “Managerial Options for Reasonable Economical Control of Rusts and Other Pathogens.” MoreCrop is designed to provide disease management options in different geographic regions and agronomic zones of the Pacific Northwest using the vast information available on wheat diseases as well as advances in computers. The components of MoreCrop and their functional relationships are understood. Some of the frames (“windows”) of the program show the wheat diseases about which one should be concerned.

Brief information about each disease, suggestions for disease control through seed treatment and foliar spray, timing of sprays, spray label restrictions, and which diseases can or cannot be controlled through a particular treatment are shown in relevant frames. Expert systems are used primarily, but not exclusively, with high value horticultural crops that require frequent application of pesticides as part of their disease and pest management, usually in response to site specific weather conditions. Although expert systems are aimed for use by growers of such crops, they are also used by individuals, such as county agents and pesticide distributors, who influence grower decisions.