Editorial

Expert Systems: A New Tool for Plant Pathologists

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Plant pathologists are beginning to use expert systems. A symposium on expert systems at the 1987 annual APS meeting was very well attended and generated considerable discussion. The feature article by R. X. Latin et al in the October 1987 issue of PLANT DISEASE (p. 866) outlined what expert systems are and how they may be used in plant pathology. And in a new journal, *AI Applications in Natural Resource Management*, crop management systems, including plant pathology components, have been prominent.

I think that expert systems in plant pathology are developing rapidly—and will continue to do so—because they are well suited to solving problems in applied plant pathology. Successful applications of expert systems have usually been in the area of diagnostics, from identifying a bacterial infection in a human to troubleshooting a factory production line. After diagnosing a problem, such systems recommend a treatment. Some good examples of such applications were presented at the APS symposium last summer. The systems performed well in specific areas. In muskmelons and soybeans, for example, diagnostic systems have performed as well as or better than field personnel. Given a very well-defined and narrow field, evaluations indicate that expert systems do well determining the cause of a disease and prescribing a treatment.

In spite of such successes, potential problems may await those who are considering developing expert systems. For instance, some pathologists believe that expert systems are only a high-tech version of a dichotomous key or pest management guide and, as such, are not particularly innovative even in extension activities. Like a manual, an expert system is a means to transfer knowledge. But unlike the written word, which the user must interpret, the expert system does much of the interpretation. This is the power of an expert system. An expert system contains all the information a manual has plus some type of expert knowledge that instantly selects the relevant points and interprets these points in the context of a given problem. The expert system then gives an answer to the problem, e.g., "Apply 2 lb. per 100 gal. of captan 50WP on Thursday."

Yet it may not be easy to determine how good this answer is. Unless a problem is very simple, there may be a variety of ways to solve it and disagreement among experts as to the correct heuristics and conclusion. In a sense, an expert system is not so much like an electronic manual as it is like a new technique. Rather than simply reiterating well-known information, expert systems may significantly reformulate that information into a unique product. Knowledge from different experts can be combined. For example, expert systems offer a way to build a comprehensive crop management advisor and to truly integrate pest management. The only way to judge the value of a unique and innovative expert system may be to evaluate its performance, just as we evaluate a new fungicide.

Another potential stumbling block to expert system development is evaluation for purposes of professional credit. Getting a system from the conceptual stage to the point where a group of users gets consistent results with it is not a trivial task. Typically, hundreds of hours go into developing and testing a system. Expert systems may ultimately save thousands of hours of work and greatly improve plant disease management, but without professional acknowledgment, no one except a few zealots will do the work to develop them. If an expert system is presented for publication, we, as reviewers, have to judge whether it is scientifically sound and performs adequately and, if so, whether it is also a significant contribution to plant pathology.

Responsibility for expert system advice is another question. Even with thorough evaluation and peer review, it is not hard to imagine an expert system making a mistake. Even experts make mistakes. The question then becomes: Who is responsible for such mistakes? So far, the consensus seems to be that the expert system developer is no more or no less responsible than the author of written recommendations. The analogy may not be quite so accurate, however, when one considers that an expert may write and edit the recommendations, directly controlling their content, but may entrust development of the system to knowledge engineers or programmers who have little background in plant pathology.

This brings up another question: Should plant pathologists build their own systems with little or no help from programmers? One pat answer (from the programmers, usually) is "No," because the process of extracting expert knowledge is not simple and because heuristics behind expert knowledge are not always apparent, even to the expert. On the other hand, one who can learn to access one's own problem-solving processes and enter them into an expert system is in the best position to codify that process. Programming a system is not terribly difficult and will doubtless become simpler as software improves.

Finally, I hope that as the technology becomes more common, the term "expert system" will be dropped in favor of a less loaded term, such as "decision support system." The implication that the system is delivering the expert answer, rather than assisting in the decision process, makes me uncomfortable. It seems to me when we tout anything as a panacea, we ignore potential pitfalls. I think that if we develop these systems as tools to help make decisions, rather than as experts on a microchip, the results will be less fallible and more palatable to the user.