Expert systems: potential to provide weed control advice

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Recent developments in computer and information technologies have improved the dissemination of research information within the Western Australian Department of Agriculture (1). However, having information per se is often not enough to enable advisers and farmers to make the right decisions at the right time. Weed control advice needs to be timely, reliable and cost-effective. Non-specialist advisers faced with a deluge of herbicide information often seek help from weed experts - resulting in costly delays. The problem is to ensure that Australian farmers have ready access to reliable weed control advice, particularly during the peak periods of crop establishment and early growth.

An expert system would help address this problem and free advisers and researchers for other duties. Expert systems are computer programs that attempt to solve problems and provide advice in a manner akin to a human expert (2). The knowledge of a weed expert can be embodied in the knowledge base of an expert system in the form of facts and rules. For example, the knowledge base usually incorporates rules of the form IF condition THEN action, such as:

IF weed = ryegrass and
crop = wheat and
strategy = post-emergent

THEN output 'Recommend chemical x for post-emergent control of ryegrass in wheat'

How and when such rules are used to 'reason about' the problem depends on the set of heuristics (informal or imprecise rules derived from human experience) contained in the inference engine. The inference engine manipulates the rules in an attempt to closely model the expert's line of reasoning. For example, before the above rule can 'fire' the following heuristic must be used to add the fact that the optimum time for applying herbicide is post-emergent:

IF previous crop = wheat
THEN strategy = post-emergent

Proposed expert system for weed control

Planning has commenced at the Western Australian Department of Agriculture on an expert system to aid non-specialist advisers in the selection of control strategies for weeds in field crops. The weed expert system will be developed in a series of steps. This incremental approach means that we can use feedback from the system to refine its rules to ensure that responses match those of the weed expert. To construct a knowledge base we need to extract and organise the knowledge of the weed expert. However much of the skill of the expert may be approximate, intuitive and/or unrecorded, so this task may prove to be a key bottle-neck during development of the system. During later stages of development the credibility and performance of the system would be verified using a number of test cases.

The technology of expert systems should have a major impact on agronomic decision making in the future. It is hoped that ideas of the type outlined in this paper may prompt others to consider this technology when faced with agronomic problems of a predictive, diagnostic or educational nature.

1. Pasqual, G. (1986). Program. 20(3), 323-331.

2. Hayes-Roth, F., Waterman, D.A. and Lenat, D. (eds), Building Expert Systems. Addison-Wesley, 1983.