A MICROCOMPUTER BASED PEST MANAGEMENT GAME

P.G. FENEMORE and T.M. STEWART

Department of Horticulture and Plant Health, Massey University, Palmerston North

Most models for the simulation and/or management of crop pests depend on complex mathematical algorithms which simulate pest population dynamics, crop development and their interactions. The computer based programme SIRATAC for the management of foliar pests of cotton in Australia, is an example of such a model (Ives *et al* 1984). COTGAME, developed at Mississippi State University also has a similar basis (Pieters *et al* 1981). However, the detailed information necessary for the construction of these models is available for few crop/pest situations.

A simpler approach was therefore sought to provide students with a learning experience involving the sorts of decisions that are required in most practical pest control situations based on incomplete, and sometimes uncertain, information. The starting point was consideration of a simple pay-off matrix where financial gain may be estimated based on cost and effectiveness of control measures applied against different levels of pest attack. It was realised that if a series of such models were linked together in sequence according to the phenology of a crop and its associated pests a "game" of the type desired could be devised. The obvious way to do this was to utilise a microcomputer. Being computer-based, the tedium involved in numerous calculations is removed, thereby allowing students to concentrate on decision making and allowing numerous "runs" at one sitting. An added advantage is that, once a shell programme has been put together, other variables such as random seasonal weather, can be introduced as subroutines.

The crop chosen for this exercise was maize, for several reasons:

- (a) there is a sequence of pests from seedling through to crop maturity
- (b) there is a reasonable amount of information about conditions that influence pest incidence
- (c) effective chemical controls are available for most pests
- (d) diseases are of relatively minor importance and could be ignored for purposes of the exercise.

In constructing the programme as much firm factual information as possible was utilised such as costs of cultivation and sowing, costs of seeds, fertilizer and pesticides.

However, only "soft" information was available concerning the effect of field conditions on pest incidence. For example, information concerning the effects of previous cropping history on incidence of seedling pests was of a descriptive nature. To produce a definitive result such relationships had to be expressed in quantitative terms. This involved setting values which were to some extent arbitrary. In the case of stem weevil following pasture for example the probability of a low population (which does not affect stand establishment) developing in seedling maize is set at 20%, probability of a medium population (resulting in 30% reduction of stand) at 60% and probability of a high population (resulting in 60% reduction of stand) at 20%. Following maize as the previous crop, the probabilities are 60% for a low population, 30% for a medium and 10% for a high population. Such information is provided to players of the game in the background notes.

Even more uncertain, or lacking, were data on the relationships between pest incidence and yield. Again values were assigned based on best available information and judgement. All such relationships are specified in the explanatory notes.

The pests included in the programme, the stage of the crop attacked and their effects (in broad terms) are set out in Table 1.

Before commencing, the player is provided with comprehensive background notes which describe the basis of the game and the sequence of events and decisions that must

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TABLE 1: Pests included in the programme and the crop stage affected.

Crop Stage	Pests	Effects
seedling	black beetle (adults) Argentine stem weevil slugs	reduce plant establishment
young plant at 2-4 leaf stage	cutworm	reduces plant stand and hence potential yield
6 leaf stage to cob ripening	armyworm	reduces yield indirectly through loss of foliage
silking to early cob ripening	corn earworm	reduces yield directly by feeding on the cobs

be made as it proceeds. Decisions required by the player include selection of such factors as previous cropping history and method of crop establishment (direct drilling or conventional cultivation) as well as decisions concerning application and choice of pesticides. At intervals throughout the programme the player is informed of the costs and consequences of each decision. At the same time players are requested to record all decisions made (in sequence on a form provided) as an aid to improving their performance in repeat runs of the programme.

Factors in the programme influencing pest incidence or directly affecting yield (which require decisions by the player other than seasonal weather) are as follows:

On completion, a summary table is presented on the display screen giving final yield and income derived, plus a breakdown of all costs and hence profit or loss for the current growing season. The player can then immediately re-run the programme as many times as desired.

CONCLUSIONS

The programme has now been used for two years by students taking an undergraduate course in pest management. Comments from students have generally been favourable and the programme is considered to have value in several ways.

1. It provides a useful learning experience in decision making under conditions of incomplete and uncertain information.
2. It has highlighted the need for much better quantitative information on the relationships between pest incidence and yield even for a relatively well researched

crop such as maize.

3. It has indicated that for maize seasonal weather may well be an overriding factor influencing yield compared with the effects of pests.
4. Refinement of such programmes to a reliable quantitative basis could provide a valuable practical management tool.

REFERENCES

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