QUALITY OF MODELLING IN FRUIT RESEARCH AND ORCHARD MANAGEMENT: AN INTRODUCTION TO THE WORKSHOP

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1. Background

Models are used in research and extension, to draw together information and to suggest actions. In combination with computers, models constitute frequently used means of information transfer within and among groups of people in agricultural knowledge systems: researchers, farmers, policy makers, and consultants. Assessment of the effectiveness of models as means of communication is topic of a Study Group of the International Organisation for Biological Control, West Palearctic Section. To date, the Study Group has organised workshops together with groups working on greenhouse commodities (van Lenteren, 1996) and orchard management (this volume).

Decision support systems (DSS) provide a framework to structure ecological and management information and enhance efficient use of financial and natural resources. Despite these promising traits, the contribution of DSS to practical Integrated Crop Management (ICM) in orchards has been limited. Most DSS have been developed solely based on expertise and empirical information. The drawback of such a purely empirical approach to designing and managing ICM systems is that systems in new commodity groups or new additions to existing systems need to be made by trial and error. The area of validity is limited, but the actual limits are often not clear. Among the causes of failure, lack of clarity on the role of DSS in learning and decision making, as well as organisational problems related to user support and updating the model seem to stand out. The currently prevailing mismatch between demand for and supply of quantitative information is a problem for (applied) research and practice.

Within the research community, the wide-spread adoption of systems analysis and process-based modelling as research tools has its problems, too.

(1) Process-based models are often presented as new, even if they use ecological concepts that have been used many times before. The application in a specific system may be new, but the concepts may be well known and often applied. The newness and importance of process-based models is hard to assess unless explicit statements are made regarding relationships to existing models: ecological concepts, underlying data, and implementation (programming language, hardware requirements, etc.).
(2) Models are developed for specific purposes and environmental conditions, and are tested accordingly. However, lack of specification of the domain of validity may lead to applications for which the model was not intended. Disappointing results and

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rejection of basically sound approaches may ensue. The illiterate use of models as black boxes poses a threat to the credibility of models.

(3) Data for model validation are scarce and the input requirements of process-based models usually are substantial and require major experimental resources. The shortness of validation data hampers thorough evaluation of model performance in relation to model purpose.

The three problems noted call for a structured qualitative and quantitative evaluation of modelling approaches in orchard management, in relation to the objectives for which they were developed.

2. Aims of the workshop

i) To investigate reasons for low and high adoption rates of DSS in grower's practice, starting at the 'demand' side (growers or intermediates between growers and research).

ii) To evaluate the scientific contents of eco-physiological models on pest dynamics, crop growth and management, and their potential usefulness for growers.

3. Approach

Written contributions were invited (Blaise *et al.*, Boshuizen and van der Maas; DeJong; Graf *et al.*; Groot; Hardman *et al.*; Mols and Boers; Szafran *et al.*; van der Werf *et al.*; this volume). These contributions describe either (i) decision-support technologies for (a component of) orchard management (empirical models, not necessarily based on eco-physiological processes but used by growers or intermediates), or (ii) an application-oriented model based on eco-physiological processes in pest and/or crop dynamics (not necessarily used by growers or intermediates). To enable comparison of approaches, authors were asked to address the questions in Chapter 4 (DSS) or 5 (process-based models).

During the workshop the papers were reviewed using recent insights in factors governing successes and failures of such information technologies (Leeuwis, 1996; Rossing, 1996). The major part of the session was devoted to discussions among participants.

4. Questionnaire for Decision Support Systems

Problem context

- From whom does the initial idea for this DSS originate (research, extension, policy, growers, etc.)?
- To which problem is the DSS expected to be an answer/solution?
- Who is the 'problem owner'? To what extent are growers aware of the problem?
- Is the problem 'permanent' or 'once only'?

Strategy

- What is the concept behind DSS? How is it expected to contribute to problem solving?
- Which stages of learning, decision making or problem solving should be supported?
- What is the input required and output furnished by DSS?

Means
- Why has a DSS been chosen as a tool to help solve the problem?
- What other and/or competing means are available to users; have they been considered?
- What is the added value of DSS vis-a-vis other means?
- How complex are the models on which the DSS is based? (Range from very simple, straightforward to very complex.) Approximately how many variables are considered?
- Are concept and operation of the model easy to understand for users?

Targeting
- Who are the prospective users of the DSS?
- Which sub-categories of users exist, and to which sub-categories is the DSS directed?

Organisation
- What training activities have been carried out to make users familiar with DSS?
- What other support services are available to users in working with DSS?
- How much money must users invest for gaining access to appropriate hardware and software?
- On whose co-operation does the success of the DSS crucially depend?
- What activities are carried out to assess whether or not the DSS must be updated?
- Who is responsible for updating the DSS?
- How often has the DSS been updated?
- Are there any bottlenecks in updating the technology?

Development process
- Who have been directly involved in the development of the DSS?
- What software development method was used? A formal method? Prototyping?
- Did development start from scratch, or were already existing models used?
- How long did the development process last?
- How were prospective end-users involved in the development process?
- What forms of user and/or market research have preceded the development process?

Experiences
- How widely has the DSS been adopted by the prospective users?
- How long do users use the DSS? Do they continue to use it, or do they discontinue their use after a while?
- What unexpected forms of use, or unexpected events have occurred since the introduction of the DSS?
- Has the DSS been formally or informally evaluated?
- Which main conclusions can be drawn on the basis of evaluations?

5. Questionnaire for process-based models

Purpose of the model
- initial purpose and later purposes
- description of the problem and of the problem-owners
- description of the system

Application domain of the model
- study of system behaviour
- to be used in decision support system?
- to be used for deriving decision rules?

Structure of the model
- limits of the system: spatial, temporal, physical and geographic
- which basic ecological concepts are used to model the problem?

History of the model code
- versions, programming languages, computer platforms

Programming aspects
- hard- and software aspects
- availability

Sensitivity and uncertainty analysis
- parameters chosen, analysis of result

Evaluation of the model
- range of evaluation conditions
- evaluation criteria
- nature of evaluation: subjective or objective (statistical); partial or exhaustive
- conclusions of the evaluation: validity range

Usefulness of the modelling exercise
- were objectives reached
- more appropriate approaches in retrospect

Future plans
Outlook
Key publications

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