CAPRA: the EPPO Computer Assisted PRA scheme*

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The EPPO Secretariat has developed computer software for Pest Risk Analysis (PRA) within the EC 7th Framework Programme PRATIQUE (Enhancements of Pest Risk Analysis Techniques) and with the support of the EPPO Panels. The software, Computer Assisted PRA (CAPRA), aims to assist pest risk analysts to run the EPPO Decision-support scheme for pest risk analysis [EPPO Standard PM 5/3(5) *Decision-support scheme for quarantine pests*], and other decision-support schemes. It is freely avaliable on the EPPO website or on http://capra.eppo.org/.

Introduction

The first EPPO Standards on pest risk analysis were adopted in 1997 [PM 5/3(1) *Pest risk assessment scheme*] and 2001 [PM 5/4(1) *Pest risk management scheme*]. These two standards were then merged into a single Standard renamed *Guidelines on Pest Risk Analysis: decision-support scheme for quarantine pests* in 2006 (slightly revised in 2007 and 2009). The latest revision, adopted in 2011 (EPPO, 2011), includes the outputs of the EU FP7 project PRATIQUE (for a general description of the project see Baker, 2012, pages 1–2 in this issue).

In 2005, experts using the EPPO standards on PRA recommended that a computer version should be prepared to provide a user-friendly interface for these standards. The PRA scheme is indeed fairly complex and comprehensive as it includes six different sections and more than 100 questions. Experts considered that the computer system would be particularly useful in showing only the questions that need to be answered. It was also considered that links to sources of information and references for performing PRAs should be provided (e.g. databases providing information on the taxonomy, distribution or impacts of pests). A first prototype was developed and presented to the EPPO experts in 2006, but was considered too rigid. In particular, the program could be performed only in a fixed sequence from the first section to the last, and all questions needed to be answered in order to proceed to the next section. It was, for instance, not possible to work on different parts of the scheme independently (e.g. to begin with the section on economic impact when this is the most critical factor of uncertainty for the pest risk). Following experts' advice, the first author developed a more flexible program. The principles of the project and a preliminary version were presented in 2007 to the EPPO Panel on PRA Development and were very well received. The EC Programme PRATIQUE (Enhancements of Pest Risk Analysis Techniques) then provided an opportunity and a framework to effectively develop this program from 2008 to 2010, which was then named Computer Assisted PRA (CAPRA).

The first beta version of the program was available in August 2008 and initially included only the categorization and the PRA part of the EPPO Decision-support scheme. This version was tested during an Expert Working Group for performing PRA, the EPPO Panel on PRA development, and two EPPO training workshops on PRA which were organized in Limassol, Cyprus (2008–11) and in Hammamet, Tunisia (2010–12). The workshops were crucial for the development of the computer program as it was tested by many experts and on different pests. After each meeting, the experts' comments were considered and integrated in a revised version of CAPRA. During the entire period of the PRATIQUE project, CAPRA was used to prepare PRA reports both before and during the meetings. This enabled several improvements to be made to the computer program, and facilitated testing of the generation of reports (as reports of PRAs have to be generated for risk managers).

Improvements made to the scheme

Some of the improvements made to the computer program during the testing with expert working groups are listed below:

- links to international definitions of phytosanitary terms;
- formatting functions (italicization, bold, underlining);
- text editor;
- automatic saving of justifications;
- adding images (e.g. maps) in the justifications made possible;
- link to dataset management explorer (direct access from the program to useful datasets);
- in case of a software bug, report automatically generated and sent to EPPO;
- visual alert on questions not answered;
- possibility to recall the answer to a previous question, and for some questions the answer given to a previous question automatically appears;
- several modifications to the interface of the program.

Nevertheless, CAPRA was dependent on mdb files and consequently on Microsoft. It did not support large files, and it was

difficult to make modifications to its structure. The final stage of preparation of the program was consequently the migration from 'CAPRA' to a more flexible version, 'CAPRA Evolution'. This change was made during summer 2010, and CAPRA Evolution was tested internally in the EPPO Secretariat and during the EPPO-PRATIQUE Workshop for PRA in November 2010.

In addition to the possibility of performing PRA according to the EPPO Decision-support scheme, the possibility to perform the Decision-support scheme for generating contingency plans and prioritizing action during outbreaks, developed during the EU FP7 PRATIQUE project, was added into the program. A scheme presenting the history of the different versions is presented in Fig. 1.

Technical elements

CAPRA is composed of client software and a web environment called CAPRA Network (internet/webservice site). CAPRA needs to be a simple but powerful tool. This is the reason why it was developed mainly in Delphi (Pascal objet). The file system is based on new standards such as OpenXML and OpenDocument; the work files are XML encapsulated in a ZIP file.

The questionnaire and the answers of the assessors are included in the same work file (.capra), which increases data continuity. The internet website is developed in php and uses PostgreSQL as databases.

The webservices will allow several assessors to work on the same PRA (see Conclusions and perspectives). Within the questionnaire, scripts specific to the tools have been prepared (written in Pascal and located in an XML file). For more information on the computing elements of CAPRA, please consult http://capra.eppo.org/download.php.
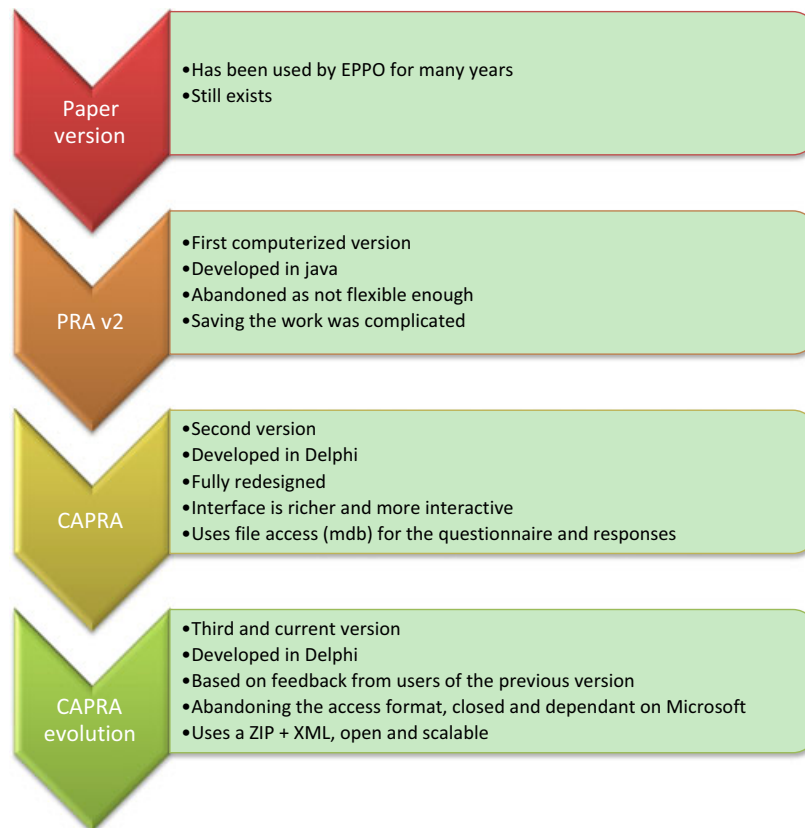
Functionalities of CAPRA Evolution

The computer program is a web-downloadable stand-alone version that has to be installed on individual computers. It can be downloaded freely at http://capra.eppo.org/download.php. This allows the user to work on a PRA even when he/she has no internet connection. When an internet connection is available, the program will automatically search for an updated version and, if available, will propose to update the current version.

What does the program do?
A user manual was drafted by the EPPO Secretariat in July 2011 and explains in detail how to run the program. It is freely available on the same webpage as the software (http://capra.eppo.org/download.php). It will be updated in due course when feedback from users is received or when new features are included within CAPRA. The main characteristics are described below.

The program asks all the questions of EPPO Standard PM 5/3(5). As in this Standard, for each question, a score should be

Fig. 1 The history of the versions leading to CAPRA's evolution.

- Paper version
  - •Has been used by EPPO for many years
  - •Still exists

- PRA v2
  - •First computerized version
  - •Developed in java
  - •Abandoned as not flexible enough
  - •Saving the work was complicated

- CAPRA
  - •Second version
  - •Developed in Delphi
  - •Fully redesigned
  - •Interface is richer and more interactive
  - •Uses file access (mdb) for the questionnaire and responses

- CAPRA evolution
  - •Third and current version
  - •Developed in Delphi
  - •Based on feedback from users of the previous version
  - •Abandoning the access format, closed and dependant on Microsoft
  - •Uses a ZIP + XML, open and scalable

given (usually on a five-level scale), as well as a level of uncertainty and a justification for choosing both the score and the level of uncertainty. Notes are included with questions. They do not appear automatically on the screen, to save space, but can be displayed by simply clicking on a button next to the question. Such text may be useful for assessors with limited experience of PRA.

The program shows only the questions that should be answered and will automatically skip questions that are not relevant (e.g. if the impact is clearly agricultural or environmental, then the assessor answers only the relevant questions). This helps save time when running the PRA and avoids misunderstanding of questions. Relationships between questions within one section may be visualized by clicking on a specific button: 'Gen Graph' ('generating graph'). CAPRA also warns the assessor when a question has not been answered (e.g. in the management parts, the assessor should justify if any of the pathways considered during the entry section are not considered for the management section).

All sections of the EPPO Decision-support scheme for quarantine pests are included, and the different sections of the EPPO scheme can be performed independently. This may be beneficial if the assessor wants first to study in more detail a section that is considered crucial before running the full PRA (e.g. establishment or economic impact). For a specific PRA, the home page lists the different sections of the PRA with their title and the number of questions. A horizontal bar colours in green as the work progress. The program indicates the date of the last modification made to each section.

Added value of the program

Better visualization of the questions for increased consistency

Some questions in different sections of the scheme are interrelated in the PRA. For example, the possibility of maintaining pest-free areas or pest-free crops is related to the spread capacity of the pest. In CAPRA, in question 7.20, the answer given to question 4.01 is shown.

EPPO Standard PM 5/3(5) now includes conclusions for each section. CAPRA allows the answers given in the previous conclusions to be visualized so that it is easier to be consistent. At the end of the management section, a table summarizing all the options selected as stand-alone measures or as part of a systems approach are presented. This is generated automatically: it provides a overview of the measures selected. This is very helpful during discussion in expert working groups. At any point while running the scheme, it is possible to visualize the answer to a previous question by clicking the button 'Search answer'.

Guidance

The main difficulty when performing PRAs is to ensure that different assessors will provide comparable answers for the same (or a similar) pest, given the same information, and will be consistent when evaluating different kind of pests (see Schrader

et al., 2012, pages 3–12 in this issue). All this guidance is included within CAPRA and can be accessed by clicking on the button 'Guidance' for all questions where this is available. It is often presented as a set of sub-questions that are easier to answer than the global question. The combination of sub-answers provides a final score for the question. New guidance may be developed in the future and included in new versions of CAPRA.

Examples

Examples of pests illustrating different cases for each score are included in CAPRA for some questions (e.g. in the establishment, spread and economic impact sections). They can be visualized by clicking on a ladybird icon. Only examples of the same taxonomic category as the pest under study are shown (e.g. only insects if the pest under study is an insect). Examples were taken from known pests or pests previously evaluated by PRA within the EPPO framework. The scale for the 'distance of natural spread' or the 'reproduction rate' will differ greatly between entomology and nematology, for example. Guidance has therefore been developed within PRATIQUE for different types of organisms. New examples will be included in new versions of CAPRA.

Links to relevant datasets

The lack of data is a major challenge in PRA worldwide. In order to identify appropriate sources of information, several projects have been launched to assemble datasets that contain useful information for pest risk analysts. Within CAPRA, a link is provided to a dataset explorer (the computer needs to be connected to the internet for this feature). The datasets presented in the dataset explorer result mainly from two projects: PRATIQUE and Pest Risk Assessment in the European Community: Inventory of Data Sources (Prassis), a project launched by the European and Food Safety Authority.

The datasets included in the dataset explorer contain information on the following:
- the pest in its current area of distribution;
- pathways, including trade, production and economic datasets;
- the area under consideration for the PRA;
- pest management.

Descriptors were identified for each dataset. The descriptors were chosen to reflect the categories of information needed when performing a PRA according to the EPPO Decision-support scheme for PRA, and thus allow the datasets to be linked to specific sections (or questions, when relevant) of the scheme. The datasets may be filtered by descriptors and quality, and remarks are provided to describe some datasets).

Risk matrices

The Rule-based matrix models mimic the evaluation processes used by experts and provide a mechanistic explanation of their

decision-making processes. Risk matrices are familiar tools in a number of PRA schemes (USDA, 2000; Biosecurity Australia, 2001). These models have been developed within PRATIQUE and are described in detail by Holt *et al.*, 2012, pages 35–41 in this issue. The level of agreement between the results of the models and expert judgement has generally been good for the set of cases considered so far, but it is intended that comparison of the two will improve consistency by prompting consideration of the reasons for any deviation in specific cases (see Schrader *et al.*, 2012).

Rule-based matrix models have been developed in GeNie software. This software needs to be installed on the computer in addition to CAPRA. Matrix models are easily accessible within CAPRA by clicking on the 'Genie entry' button. This is available at the end of the entry, establishment, spread and impacts sections.

Visualizer

To help assessors obtain a global view of their answers throughout the PRA, a visualization tool was developed and integrated into CAPRA. It is described in detail by Holt *et al.*, 2012 (pages 35–41 in this issue).

The Visualizer does not process the data, but uses bubble graphs to show question ratings on a numerical five-point scale on the *y*-axis, while the size of the bubble shows the uncertainty of the experts associated with that rating: the greater the uncertainty, the larger the bubble. Colour coding of the bubbles shows the thematic cluster for each question.

Overall summary ratings (and uncertainty scores), as provided by the assessor for each category, are displayed as grey bars in the background of the bubble chart. A very dark grey bar shows low uncertainty in the chosen score, but this becomes lighter and the surrounding grey area more diffuse when uncertainty in the summary score is greater (see Holt *et al.*, 2012 for examples).

The Visualizer is available at the end of the entry, establishment, spread and impacts sections. CAPRA makes it easy for the user to view the question associated with each score: the question is viewed by floating the mouse cursor over each bubble. The picture can be copied to the clipboard and then added to the justification of the conclusion of the PRA record.

PRA record

The user can choose to generate a record of the PRA in various formats (Word, XLS or XML). When consulting users, it was noted that different users have different preferences in presenting PRAs (e.g. tabular format or text). Considering that PRAs are

Fig. 2 Screenshot of the questionnaire editor: access to different sections.

Fig. 3 Screenshot of the questionnaire editor: example of individual questions.

usually quite long documents (frequently over 100 pages), the EPPO Secretariat has enabled each user to generate a format that they find clear and easy to read. CAPRA allows users to define and record their preferences for generating reports. A dedicated interface is in development to allow the PRA report to be personalized further.

In order to optimize maintenance of the questionnaire, an online tool will be accessible for administrators (those responsible for the Decision-support scheme supported in CAPRA). This tool will automatically generate XML files of the questionnaire (see Figs 2 & 3).

Conclusion and perspectives

CAPRA has proved useful when performing PRAs during expert working groups within EPPO. It is more user-friendly and easier to browse than a Word or Excel file.

In the future, new features will be developed, such as the possibility to work in team mode. Several assessors would then be able to work on different parts of the PRA, as well as to comment on the work done by others. An administrator would have the rights to compile all the comments. This would help save time in the drafting and review processes of PRA.

The CAPRA software was built so that it can be used in different languages. When the latest version of the EPPO Decision-support scheme for PRA becomes available in other languages (e.g. French, Russian), it will be incorporated within CAPRA and assessors will be able to run it in the language they select at the start.

CAPRA was also designed to be used for other schemes related to PRA: currently it has been adapted to be able to run the scheme developed by the Great Britain Non-native Risk Analysis Panel, as well as the decision-support scheme for generating contingency plans and prioritizing action during outbreaks. It may also be adapted to run the EPPO Express PRA scheme, which is currently under development.

Finally, other modules have been developed within PRA-TIQUE and will be considered for inclusion within CAPRA. This includes a decision-support scheme on climatic mapping (Eyre *et al.*, 2012, pages 48–55 in this issue); a decision-support scheme for mapping endangered areas (Baker *et al.*, 2012, pages 65–73 in this issue); and a protocol for the cost–benefit analysis of eradication and containment measures during outbreaks.

The EPPO Secretariat considers that the CAPRA software will help pest risk assessors in their daily work, and will help assure consistency in PRA. Feedback from users is welcomed so that CAPRA can evolve to best meet its users' needs.

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CAPRA, le Schéma d'ARP informatisé de l'OEPP

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CAPRA: компьютеризированная схема АФР ЕОКЗР

Секретариат ЕОКЗР в рамках проекта «PRATIQUE» 7-ой рамочной программы Европейского Союза и при поддержке групп экспертов ЕОКЗР разработал программное обеспечение для анализа фитосанитарного риска (АФР). Разработанное программное обеспечение, названное CAPRA (компьютеризированный АФР), призвано помочь аналитикам риска задействовать схему поддержки принятия решений ЕОКЗР при анализе фитосанитарного риска (Стандарт ЕОКЗР РМ 5/3 (5) «Схема поддержки принятия решений в отношении карантинных вредных организмов»), а также другие схемы поддержки принятия решений. Данная программа доступна для свободного скачивания на официальном сайте ЕОКЗР или по адресу http://capra.eppo.org/.

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