| | |
|---|---|
| Project title: | Upgrade of EMA software package to include fruit |
| Project number: | TF 124 [Previously APRC SP 124] |
| Report: | Final report 2001 |
| Project leader: | Dr K Lewis, University of Hertfordshire |
| Key words: | EMA, apple, pear, fruit |

**This project report was originally issued by the Apple & Pear Research Council, under project number SP 124.**

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

**CSG 15**

Research and Development

# Final Project Report

(Not to be used for LINK projects)

Two hard copies of this form should be returned to:
Research Policy and International Division, Final Reports Unit
MAFF, Area 6/01
1A Page Street, London SW1P 4PQ
An electronic version should be e-mailed to c.csgfinrep@csg.maff.gsi.gov.uk

| | |
|---|---|
| Project title | Upgrade of EMA Software Package to Include Fruit |
| MAFF project code | **HH1943SSF** |
| Contractor organisation and location | AERU, University of Hertfordshire<br>College Lane, Hatfield<br>Herts, AL10 9AB |
| Total MAFF project costs | £ 63,032 |
| Project start date | 01/08/00 |
| Project end date | 31/07/01 |

## Executive summary (maximum 2 sides A4)

### Introduction

The Agriculture and Environment Research Unit (AERU) in collaboration with a number of collaborating organisations (ADAS, IACR-Rothamsted, WIRS, CSL, SSLRC) have developed a computer-based tool, known as EMA (Environmental Management for Agriculture), to promote and enhance sound environmental practices in agriculture. The original project was funded by DEFRA (NT 1908, CSA 2628) and the Milk Development Council. Additional work to extend and upgrade the software has also been funded by DEFRA with further support coming from a range of other organisations including BAA, Waitrose and Levington Agriculture.

Despite its unparalleled success regarding the use of software in agriculture one of EMA major limitations was its non-applicability to fruit growing enterprises. This project has fully addressed this problem.

### The EMA Advisory System

A major extension to the EMA advisory system has been made to cover all aspects of growing fruit crops and the potential for environmental impact. The fruit crops covered include topfruit, currants, berries and various hybrids, Information provided includes:

- Good practice notes (field and orchards)
- IPM and ICM guidance
- Health and safety
- Special techniques e.g. soil sterilisation
- Pest and disease information including a photo gallery

This text is hyperlinked (electronic cross-referencing) and includes links to the internet to further expand the available information. This part of the system has been publically released.

## The EMA Technical System

The following amendments and extensions have been made:

- Extension of the RB209 'Fertiliser Recommendations' to include fruit crops
- Extension of the pesticide database to include products and active ingredients applied to fruit crops
- Extension of the pesticide database to include SOLA's and biopesticides applicable to fruit crops
- Extension of the LERAPS module to make it applicable to orchard pesticide sprayers

## The EMA Evaluation System

The following amendments and extensions have been made to the main EMA shell:

- Modification of the pesticide risk module for orchards and airblast sprayers
- Modification of the nitrate and phosphate environmental loss audits for fertiliser applications to fruit
- Modification of the lime audit - inclusion of target pH for fruit crops
- Extension of the conservation module to include the orchard environment
- Development of an audit for 'best fruit management'
- Multiple minor amendments to many of the other EMA audits
- Amendments of the EMA shell utilities to allow the new data to be stored, retrieved and modified.
- Links to HRI's information software - MORPH and HORTIS.

## Piloting, Validation and Dissemination

The modified system has been tested in-house and with various potential users. Modifications have been made as necessary. No serious problems were identified. The main issue was related to the large volume of information now held by EMA. In order to help overcome difficulties some users experienced in finding information 'specialised information centres' have been developed which draw together information within EMA on a speciifc subject area into a central hub. The 'Fruit Information Centre' has a distinct contents and index allowing information on fruit growing to be identified quickly and efficiently. However, all information within the hub can also be accessed from any where else in the Advisory System.

This is the first release. It is anticipated that further additions and amendments will occur in furture EMA releases as a greater level of feed-back occurs. Further field testing will be undertaken before final release of the full system early in 2002.

The system was demonstrated at the 'Fruit Focus' show in July 2001 and will also be demonstrated at the National Fruit Show in October 2001. Workshops with fruit growers are now being requested by that sector of the industry.
This adaptation of EMA has recently won the Environmental Award from the Worshipful Company of Fruiterers sponsored by Marks and Spencer plc.

# Scientific report (maximum 20 sides A4)

## Introduction

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EMA sold over 1200 copies during 2000 following its now established trend of increasing sales approximately 20% annually. Extension of the system is now being undertaken for Scotland and interest is being shown from Northern Ireland. Despite its unparalleled success regarding the use of software in agriculture one of EMA's major limitations was its non-applicability to fruit growing enterprises. This project has fully addressed this problem; in collaboration with Horticulture Research International (HRI) fruit growing enterprises have now been fully incorporated into the EMA shell.

The Table below shows the fruit which have been included.

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| Desert, culinary and cider apples | Whitecurrants |
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| Plums & damsons | Vines |
| Strawberries | Hops |
| Blackberries | Gooseberries |
| Tayberries | Cranberries |
| Loganberries | Hybrid-berries |
| Raspberries | |

The EMA shell sub-divides the environmental management process into three stages or modes of action.

The first stage is to identify process strengths and weaknesses. This is achieved via an auditing process which uses various techniques (including formal risk assessment, scoring and ranking and budgeting) to derive performance related activity indices across the whole farm. Indices lie on a fixed scale allowing comparisions across different farming activities in order to identify areas most in need of attention. For example, the audit on pesticide risk uses formal risk assessment techiques to determine environmental concentrations and to assess ecotoxicity to a range of fauna and flora which may be present in the local environment. A single farm value for pesticide environmental performance is derived (as are individual values for farm, application and active substance). Similarly, performance values can be determined for the use of nutrients, organic manures, water and energy, conservation etc. By comparing these values farm performance highs and lows can be identified. This process uses the EMA *Evaluation System.*

Once the farm performance profile has been developed then the second stage is to identify solutions to any problems identified. This process uses the EMA *Technical System* which is a collection of interactive decision support tools which allow 'what-if' scenarios to be explored. Consequently, farm environmental improvement programmes can be developed.

The third stage is to use the EMA *Advisory System* for background support. This part of EMA includes a comprehensive database on regulation, a large collection of UK based Codes of Practice developed by regulators and the wider industry. It also includes a library of additional information, definitions, glossaries, contact databases and graphics.

This project expanded and amended all parts of the EMA system. Various modifications to the shell and operational utilities were also carried out.

## The EMA Advisory System

A major extension to the EMA advisory system has been made to cover all aspects of growing fruit crops and the potential for environmental impact from commonly carried out practices. Information has been sourced from the key organisation including HRI, ADAS and others and from extensive literature reviews. The information provided in the extended EMA Advisory system has been fully integrated into the existing EMA Advisory System and includes:

- Detailed good practice notes (field and orchard situations plus fruit specific information). This includes information on organic fruit production and IFS production as well as conventional.
- Integrated Pest and Crop Management guidance. This includes information for increasing biodiversity, crop protection (including biological controls), crop nutrition, post-harvest and storage practices and general husbandry.
- Health and safety issues. This includes general information and an introduction to the basic legislation plus relevant codes of practice and information appropriate to the food assurance schemes.
- Special techniques e.g. soil sterilisation
- Pest and disease information including a photo gallery. Pictures and other graphics are include to help identify pests and diseases.

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## The EMA Technical System

The following amendments and extensions have been made:

- *Extension of the RB209 'Fertiliser Recommendations' to include fruit crops.* Work on this module was carried out in part for this specific project and in part as general EMA updating. DEFRA released a new version of this guidance booklet early in 2001 which presented new data and a new approach to determining fertiliser recommendations. Consequently, the old EMA module, which originally applied only to arable, vegetable and grass crops, needed to be replaced. The new module includes fruit crops.
- *Extension of the pesticide database to include products and active ingredients applied to fruit crops.* The old Pesticide database within EMA originally included only products and active substances that were applied to arable crops, vegetables and grassland. This has now been extended to include products and active substances applied to all fruit crops.
- *Extension of the pesticide database to include SOLA's and biopesticides applicable to fruit crops.* As part of the previous exercise the database has been further expanded to include biopesticides and SOLA's.
- *Extension of the LERAPS module to make it applicable to orchard sprayers.* There was originally in EMA a module desigend to support the LERAP (Local Environmental Risk Assessment for Pesticides) regulations but it only applied to boom and hand held sprayers. This has now been extended to include airblast sprayers which are commonly used in orchard situations.

Some parts of this system have been publically released.

## The EMA Evaluation System

The following amendments and extensions have been made to the main EMA shell:

- *Modification of the pesticide risk module for orchards and airblast sprayers.* Recently a DEFRA funded project (CSA4719) has been completed to develop a field based risk assessment module closely allied to the UK regulatory system, the main differences being that the environmental fate models and the ecotoxicological routines have been modified such that they are responsive to variations in the local site and farming practices. The original project was developed specifically for field crops. It has now been extended to include the orchard environment and airbast sprayers. This work was carried out in collaboration with Central Science Laboratory and Cranfield University.
- *Modification of the nitrate and phosphate environmental loss audit for fertiliser applications to fruit.* As discussed earlier a new version of the DEFRA guidance booklet RB209 was released early in 2001. The old version of this booklet was the basis for the nutrient performance indices within EMA. Recommendations were determine from user inputs and these values compared with site applications of N, P and K. A set of expert system type rules and simple meta-models are then implemented to determine the risk of nitrate leaching and phosphate runoff. The old module has now been modified to use the recommendations and calculation methods provided by the new RB209 and has been extened to include fruit crops.
- *Modification of the lime audit - inclusion of target pH for fruit crops.* This audit uses expert system type rules to compare liming practices and applications with best practice rules and target soil pH values for crops. The rule base has been extended to include fruit crops and the orchard situation.
- *Extension of the conservation module to include the orchard environment.* The orchard environment can be unique on the farm as habitat for birds, insects and small mammals. The amendments to this audit include asessment of practices to protect and develop semi-natural areas close to the fruit trees and use of buffer zones to protect waterbodies.

- *Development of audit for 'best fruit management'.* This new audit has been based on the information sourced during the literature review which formed the fundamental part of the EMA Advisory System extension. It uses a broadly qualitative 'checklist' type aproach with scoring and ranking procedures to determine best practice performance indices which consider:
  - *Choice of site for orchards and fruit fields*
  - *Use of scion and rootstock varieties specifically with respect to their resistance to site specific and local pest and disease threats*
  - *Use of techniques to avoid pesticide drift and protect waterbodies and habitats*
  - *Management of orchard ground cover - weed free strips etc. including impacts on biodiversity and pollution potentials*
  - *General nutrient management*
  - *Use of growth regulators for vigour control and reduction of fertiliser inputs*
- *Multiple minor amendments to many of the other EMA audits.* These include modifications to the:
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  - General Pesticides Audit - calibration of orchard sprayers, monitoring of orchard pests and diseases, use of threshold limits, forcasting systems, biological control etc.
  - General Soils Audit - use of pre-planting cultivations, orchard alleys
- *Amendments of the shell utilities to allow the new data to be stored, retrieved and modified.*
- Links to HRI's information software have been added to allow direct links to MORPH and HORTIS, if present from the EMA shell.

## Piloting, Validation and Dissemination

The modified system has been tested in-house and with various potential users. This process identified a few teething problems. No serious problems were identified. The main issue was associated with for the large volume of information now held by EMA. In order to help overcome difficulties some users experienced in finding information 'specialised information centres' have been developed which draw together information within EMA on a specific subject area into a central hub. The 'Fruit Information Centre' has its own distinct contents and index allowing information on fruit growing to be identified quickly and efficiently. However, all the information in the new hub is also accessible from any where else in the Advisory System. A few other modifications were carried out.

This is the first version of the package and it is anticipated that further additions and amendments will occur in future EMA releases as a greater level of feed-back occurs and further information is identified. Additional field testing will be undertaken before final release of the full system which is planned for early in 2002 (EMA-2002).

The system was demonstrated at the 'Fruit Focus' show in July 2001 and will also be demonstrated at the National Fruit Show in October 2001. Workshops with fruit growers are now being requested by that sector of the industry and individual arrangements are being made. Information on the extended system is now on the EMA website.

This adaptation of EMA has recently won the Environmental Award from the Worshipful Company of Fruiterers sponsored by Marks and Spencer plc.

As is the practice with the Milk Development Council, as the Horticulture Development Council and the Apples and Pears Development Council part funded this project it has been agreed that a £10 discount per CD copy will be passed on to levy payers if they purchase the EMA CD via these organisations.

Please press enter

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

# CSG 15A

Research and Development

# Supplementary Information to Final Project Report

(Not to be used for LINK projects)

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Research Policy and International Division, Final Reports Unit
MAFF, Area 6/01
1A Page Street, London SW1P 4PQ
An electronic version should be e-mailed to c.csgfinrep@csg.maff.gsi.gov.uk

## Section I : Project identification

1. (a) Is the completed CSG 15 attached? Enter YES or NO — YES

***IMPORTANT: No Final Report will be accepted unless both parts (the CSG 15 and 15A) are received. Please do not submit these forms separately.***

(b) Project title: Upgrade of EMA Software Package to Include Fruit

(c) MAFF project code: **HH1943SSF**

(d) MAFF Project Officer: Dr Clive Wall

(e) Name and address of contractor:
University of Hertfordshire
College Lane
Hatfield
Herts
Postcode AL10 9AB

(f) Contractor's Project Officer: Dr Kathy Lewis

(g) Project start date: 01/08/00 — Project end date: 31/07/01

(h) Final year costs:
**approved** expenditure: £ 63,032
**actual** expenditure: £ 63,032

(i) Total project costs / total staff input:
**approved** project expenditure: £ 63,032
**actual** project expenditure: £ 63,032
***approved** staff input: 1.1
***actual** staff input: 1.1

**Staff years of direct science effort*

(j) Is there any Intellectual Property arising from this project which is suitable for commercial exploitation? NO

(k) It is MAFF's intention to publish the attached CSG 15. Do you agree to such publication? YES
If NO, please explain why the Final Report should not be released into the public domain.

## Section II : Scientific objectives / Milestones

2. Please list the scientific objectives as set out in the CSG 7 (original project application form). If necessary these can be expressed in an abbreviated form. Indicate where amendments have been agreed with the MAFF Project Officer, giving the date of amendment.

1. To extend and adapt the EMA package to enable its application to fruit growing enterprises;
2. To provide a tool to assist growers to minimise and optimise chemical inputs to fruit enterprises;
3. To provide a tool to assist growers to minimise and optimise other inputs to fruit enterprises;
4. To help growers ensure regulatory compliance
5. To enable data sharing and integral links with other relevant decision support systems.

3. List the primary milestones for the final year.

**It is the responsibility of the contractor to check fully that ALL primary milestones have been met and to provide a detailed explanation if this has not proved possible**

| Milestones | | Target date | Milestones met? | |
|---|---|---|---|---|
| Number | Title | | in full | on time |

| | | | | |
|---|---|---|---|---|
| 01/01 | Fully applicable to fruit growing enterprises - see note 1 | 31/07/01 | YES | YES |
| 01/02 | Upgrade of Advisory System | 30/11/00 | YES | YES |
| 01/03 | Technical system upgrade | 31/01/01 | YES | YES |
| 01/04 | Auditing system upgrade | 31/03/01 | YES | YES |

4. If any milestones have not been met in the final year, please give an explanation below.

Work has been completed to schedule but full public release of software will not be possible until Spring 2002. The main reasons for this are:

1 The changes to the system are significant - greater than originally anticiapted and this would require a complete new pressing of the EMA CD. Costs rule this out. Internet release is also not fully possible due to the file size.

2 Partial release has been achieved. The Advisory and Technical systems upgrades were released via the internet on 1st August 2001.

3 There are advantages of holding back the full system upgrade. The partial release to date will act as an introduction to the full system encouraging users to re-purchase next year.

4 This short delay will enable us to carry out additional field testing for robustness.

## Section III : Declaration

5. I declare that the information I have given in forms CSG 15 and 15A is correct to the best of my knowledge and belief. I understand that the information contained in both forms may be held on a computer system and may be made public.

| | | | |
|---|---|---|---|
| Signature | K A Lewis | Date | 01/08/01 |
| Name | Kathleen Anne Lewis | | |
| Position in Organisation | Reader in Agri-Environmental Science, Head of AERU | | |

# Sp124 Upgrade of EMA Software Package to Include Fruit

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The modified system has been tested in-house and with various potential users. This process identified a few teething problems. No serious problems were identified. The main issue was associated with for the large volume of information now held by EMA. In order to help overcome difficulties some users experienced in finding information 'specialised information centres' have been developed which draw together information within EMA on a specific subject area into a central hub. The 'Fruit Information Centre' has its own distinct contents and index allowing information on fruit growing to be identified quickly and efficiently. However, all the information in the new hub is also accessible from any where else in the Advisory System. A few other modifications were carried out.

This is the first version of the package and it is anticipated that further additions and amendments will occur in future EMA releases as a greater level of feed-back occurs and further information is identified. Additional field testing will be undertaken before final release of the full system which is planned for early in 2002 (EMA-2002).

The system was demonstrated at the 'Fruit Focus' show in July 2001 and will also be demonstrated at the National Fruit Show in October 2001. Workshops with fruit growers are now being requested by that sector of the industry and individual arrangements are being made. Information on the extended system is now on the EMA website.

This adaptation of EMA has recently won the Environmental Award from the Worshipful Company of Fruiterers sponsored by Marks and Spencer plc.

As is the practice with the Milk Development Council, as the Horticulture Development Council and the Apples and Pears Development Council part funded this project it has been agreed that a £10 discount per CD copy will be passed on to levy payers if they purchase the EMA CD via these organisations.