PERI-URBAN INTERFACE PURPOSE 1

Benefits for poor people generated by application of new knowledge on crop protection to Peri-Urban production systems

Annual Report format unless otherwise stated

R8089 **Management of fruit flies (*Diptera: Tephritidae)* in India. *PCSS***
(Imperial College of Science, Technology and Medicine, UK)

R8104 **Promoting potato seed-tuber management for increased ware yields in Kapchorwa District, eastern Uganda. *PCSS***
(AT Uganda)

R8217 **Production of baculovirus to control lepidopteran pests in vegetable crops in peri-urban and rural areas.**
(Dudutech, Kenya)

R8247 **Promotion and impact assessment of tomato leaf curl virus disease resistant tomatoes: phase III of sustainable management and molecular characterisation of *Bemisia tabaci* and tomato leaf curl virus (ToLCV) on tomato in India. *PCSS***
(Natural Resources Institute, University of Greenwich, UK)

R8296 **Promotion of sustainable approaches for the management of root-knot nematodes on vegetables in Kenya. *PCSS***
(University of Reading)

R8297 **Development of private sector service providers for the horticultural industry in Kenya. *PCSS***
(International Centre of Insect Physiology and Ecology, Kenya)

R8299 **Accelerated uptake and impact of CPP research outputs in Kenya. *PCSS***
(CABI Africa Regional Centre, Kenya)

R8312 **Promotion of quality vegetable seed in Kenya. *PCSS***
(Horticultural Research International, UK and Central Science Laboratory, UK)

R8339 **Evaluation of the effects of plant diseases on the yield and nutritive value of crop residues used for Peri-Urban dairy production on the Deccan Plateau in India. *PCSS***
(International Crops Research Institute for the Semi-Arid Tropics, India)

R8341 **Promoting adoption of integrated pest management in vegetable production. *PCSS***
(Natural Resources Institute, University of Greenwich)

R8440 **Implementation of IPM of fruit flies in India.**
(Imperial College, London)

R8444 **Identifying options to reduce poverty and enhance the livelihoods of small-scale crop-livestock producers in sub-Saharan Africa.**
(Professor Lenné, indep.)

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Management of fruit flies in India	
DFID Project Reference No:	R8089	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Imperial College London	
Production System:	Peri-Urban	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to Peri-Urban production systems	
Commodity Base:	Fruit tree and vegetable crops	
Beneficiaries:	Smallholder fruit and vegetable growers	
Target Institutions:	Indian Institute for Horticultural Research Bangalore (ICAR), various state Agricultural Universities, Mother Dairy Ltd.	
Geographic Focus:	India	
Total Cost:	£192,980	
	Planned	**Actual**
Start Date:	01 December 2001	01 December 2001
Finish Date:	31 March 2005	31 March 2005

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1. Project Purpose:

There is a need for more effective on-farm and village-level controls for Tephritid fruit fly pests on fruit and cucurbits in India.

Through a multi-disciplinary survey, this project has established the economic, social and environmental costs of fruit flies, and constraints to their improved management. Food bait and sexual parapheromone lure controls have been tested, along with social studies of the resources, priorities and perceptions of farmers and village institutions. Practical management strategies that are effective and sustainable at farm and village level have been determined with collaborating Indian research, extension and fruit marketing agencies.

Scientific objectives:

- understanding constraints to improved farm-level fruit fly controls
- optimisation of fruit fly management at farm and village level
- mechanism for exchange of information and continued research progression

Development objectives:

- farm- and village-level suppression technologies for effective, low-cost, profitable and sustainable control, with minimal insecticide use, health and environmental risk
- uptake pathways for these technologies.

2. Outputs:

1 Problem analysis
Quantification of fly damage, by which species and where
Social consequences, and constraints to improved management

2 Improvement of farm-level management
Effectiveness and profitability of current and area-wide control assessed
Appropriateness, practicality and sustainability of controls demonstrated

3 Improvement of village-level management
Effectiveness and profitability of locally managed control programmes assessed

Appropriateness, practicality and sustainability demonstrated

4 Management plans demonstrated on larger areas
1–10 km^2 area-wide management with male annihilation to set limits on economies/ecology of scale

5 Scientific and management network for fruit fly researchers
Web based system for S Asia (SAFFN)

3. Contribution of Outputs to Project Goal:

Output 1. Problem analysis
The project has demonstrated the extent of damage caused by fruit flies to fruits and vegetables in India and difficulties for smallholder growers in particular to control these successfully on individual plots. Effective and feasible community action programmes using male annihilation, based on methyl eugenol and cue-lure baited traps (depending on the species of flies) have been demonstrated. Surveys of growers and local organisations have established constraints and opportunities for village-level cooperative control efforts to be organised. Collaboration with a fresh fruit and vegetable retailer has established quality and availability issues that must be addressed within the food supply chain to effectively generate additional income for smallholder fruit and vegetable growers if they apply improved fruit fly management on a village-level scale.

Output 2. Improvement of farm-level management
Bait plus insecticide application on individual trees provides partial control of fruit flies attacking fruit, but is of less benefit for vegetable fruit flies. It is unlikely that individual tree or small plot control using cover sprays or bait applications would provide reliable quantities of market quality fruit for smallholders, especially for highly susceptible fruits like guava, or for cucurbits. Male annihilation was shown to provide significant, but not complete, control on plots as small as 0.2 ha. Locally produced baits had different effects in different parts of the country, probably reflecting the great diversity of fruit fly complexes within India.

Output 3. Improvement of village-level management
Trials in 2003 and 2004 have demonstrated that market quality fruit can be produced from area-wide male annihilation control. Further experiments in 2005 are testing this for vegetable fruit flies. Trials in 2004 demonstrated that larger scale treatment, at 1 km square, gave double the effectiveness of male annihilation compared to farm-level treatment. Work with Mother Dairy has been examining how cooperative fruit fly control at village-level can be connected with other quality and value adding processes (such as grading and packing of produce locally) to increase small farm incomes and improve their position in the food supply chain.

Output 4. Management plans demonstrated on larger areas
During 2004 and 2005 several large area male annihilation control trials were done ranging from 1–10 km^2 set establish the limits on economies/ecology of scale. The 1 km trial done in 2004 showed incursions into the controlled grid of approximately 100–150 m. However, 'fingers' of incursions spread into the control area on occasions for 300–400 m. This suggests that village-level control using this technique (which is insecticide free) must be economically viable including at least a 100 m buffer zone outside the area that needs control, and that the risk level would be decreased further by extending the buffer to 300 m. Trials on a larger scale in 2005 will help to determine the ecological features of incursions so that this advice can be more accurately defined. The benefit to be gained within a control zone will be determined by the number and type of fruit trees and a simple calculator to show whether a particular zone would benefit from cooperative area-wide treatment will be developed with the 2005 season data.

Output 5. Scientific and management network for fruit fly researchers
The web-based S Asia fruit fly network (SAFFN) is hosted at Gujarat Agricultural University. It provides an accessible source of abstracted material from the project literature review, an on-line publication opportunity for fruit fly researchers and managers in the region, and a bulletin board for other information. This and the series of project workshops has generated

a spirit of cooperation and cohesion within the fruit fly research community in India and should help to provide a base of research on which to build further locally funded projects.

The project has established fruit fly research centres with principal investigators and junior researchers at the following institutions:

- Gujarat Agricultural University (GAU). Three campuses at Anand, Ghandevi and Palanpur.
- Kerala Agricultural University (KAU). Two campuses at Thrissur and Thrivananthapuram.
- Indian Institute of Vegetable Research (IIVR), Varanasi, Uttar Pradesh.
- Central Institute for Subtropical Horticulture (CISH), Lucknow, Uttar Pradesh.
- Indian Institute of Horticultural Research (IIHR), Bhubaneshwar, Orissa.
- with overall coordination from the Indian Agricultural Research Institute (IARI), New Delhi.

4. Publications:

STONEHOUSE, J.M., MUMFORD, J.D. and VERGHESE, A. (2005) Returns to Scale in Pest Suppression and Eradication: Issues for the Wide-Area Management of Fruit Flies in India. Proceedings of Indian Entomological Society Symposium, November, 2003 (in press).

STONEHOUSE, J.M., MUMFORD, J.D. and VERGHESE, A. (2005) Village-level suppressive fruit fly management in India: Issues determining the optimum scale and cooperative control. Proceedings FAO/IAEA International Conference on Area-wide Control of Insect Pests, IAEA, Vienna, Austria, 9–13 May 2005. (in press)

Stonehouse and Verghese paper in preparation on monitoring for invasive fruit flies in India. Insect Environment.

Various other publications are in preparation for international journals on statistical implications of Bactrocera distributions on sampling methods for damage assessment and control evaluation, on quantification of returns to village-level management of fruit flies under different production densities, and mapping of penetration of incursions into large area treatment blocks.

5. Internal Reports:

Proceedings of workshops in Delhi, 2003; Trivandrum 2004; Project Annual and Quarterly reports. A final workshop proceedings from Goa 2005 will also be distributed on CD-ROM.

6. Other Dissemination of Results:

Various TV and Radio and farm media articles and interviews. Mother Dairy technical staff have taken up ideas on control and provide dissemination to farmers selling to them.

7. Listing and reference to key datasets generated:

Access to a collection of literature (including electronic versions of abstracts) relevant to Indian fruit fly management is being made available on the SAFFN. Summaries of data from experiments done during the project have been collected and distributed to participating collaborators on CD-ROMs at the planning and review workshops held each year.

8. Follow-up indicated/planned:

The extension project through the end of the 2005 growing season will allow further field work on larger scale area-wide male annihilation programmes. This will determine the maximum

advantages likely to be derived by increasing the scale of control. The S Asia Fruit Fly Network is now running and during the extension period further assistance will be given to help this become an active focus for research and management exchanges. A final workshop will be held in Goa in October 2005 to summarise results of the project and to help plan for the future of fruit fly control in India.

9. Name of author of this report:

John D Mumford

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Promoting Potato Seed Tuber Management for increased ware yields in Kapchorwa, eastern Uganda	
DFID Project Reference No:	R8104	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Dr Rita Laker-Ojok, AT Uganda Ltd.	
Production System:	Peri-Urban	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to Peri-Urban production systems	
Commodity Base:	Potatoes	
Beneficiaries:	Small, resource poor farmers	
Target Institutions:	AT Uganda Ltd. CABI Biosciende UK Centre lengyere Agricultural Research Institute, NARO Makerere University, PRAPACE	
Geographic Focus:	Kapchorwa District Eastern Uganda	
Total Cost:	£102,310	
	Planned	**Actual**
Start Date:	01 February 2002	01 February 2002
Finish Date:	31 March 2005	31 March 2005

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1. Project Purpose:

Potato is becoming an important crop in Uganda due to the growing markets for chips and crisps. In Uganda, potato production is centered in the highlands close to the Kenyan and Rwandan boarders and is dominated by smallholder farms. Their major constraint is low yields attributed to high incidence of bacterial wilt and a shortage of disease-free seed. For this reason AT Uganda Ltd is establishing a sustainable system of farmer-led potato production that is suitable for planting improved seed in four subcounties of Kapchorwa District. Production is focused on the implementation of locally driven and monitored system of quality seed production and marketing, as they move through cycles of multiplication until delivery to the small-scale farmers.

The project outputs are:

- Training of Primary Seed Multipliers, extension staff/field assistant and small-scale farmers (beneficiaries) on seed potato production, disease management, and storage.
- Basic seed for new variety obtained and multiplied by Primary Seed Multipliers.
- Multipliers return three times the amount of seed received for redistribution and further multiplication by small-scale farmers.

2. Outputs:

- 20 Primary Seed Multipliers were identified and established. The project purchased seed- Victoria variety, from Kalengyere Research Station and loaned it to the Primary Seed Multipliers. These seed multipliers formed themselves into the Kapchorwa Seed Potato Producers' Association (KASPPA), which was registered as a local NGO in 2003.

- 20 Primary Seed Multipliers, 4 extension staff, 4 field assistants, 40 Production Committees, members of 8 Parish Development Committees and more than 1,400 farmers were trained in Best Practices i.e. potato production/multiplication, disease identification/management, and storage. 3,000 copies of the Farmers' Guide on Potato Production were produced and distributed to farmers.
- Crop Best Practices were developed for KASPPA, basically on crop production, disease monitoring/management, storage.
- The seed plot techniques were developed and introduced to farmers using small tubers less than 30mm in diameter. This method is suitable for farmers with limited land.
- 1,200 group members received seed for further multiplication using seed plot techniques. In 2004 an additional 210 partner group members also received seed for seed plot production.
- Two artisans were trained to construct diffused light stores (DLS) and thereafter constructed 20 DLS in collaboration with the seed multipliers. The project contributed 50% of the cost and the multipliers contributed the balance.
- A repayment rate of 98% was realised from the seed multipliers. The 2% default arose when some of the tubers were rejected for seed due to bacterial wilt infection.
- Kapchorwa Seed Potato Producers Association (KASPPA) was formed and empowered to handle their own Seed health monitoring procedures including Crop History Sheets, Labelling, and On-farm incubation testing for bacteria wilt.
- Disease threshold standards are being established. Early warning mechanisms have been identified that allow farmers to decide at the mid - season whether a given crop is likely to pass seed health standards or should be diverted for ware consumption. This reduces the loss risk to the multipliers of waiting for the final Elisa and on-farm incubation test results.
- Attempts have been made to monitor bacterial wilt disease among the seed lots using both ELIZA testing and on-farm incubation methods. The data based on the three seasons have shown a high correlation between the two methods.
- Two exchange visits to Kabale and one to Buginyanya research station were organised for the primary multipliers and extension staff/ field assistants.
- 4 internal exchange visits were organised for the members from 80 groups.
- 4 demonstration sites were established – one per sub-county. These were the field day sites for farmers to learn from.
- An impact survey was carried out in September 2004 .The survey results indicate that the project has made an impact among the multipliers and direct beneficiaries in terms of changing production practices, eating patterns, and income sources. As expected, impact has diffused to the neighbouring non-beneficiaries to a greater extent than to non-beneficiaries who are more distant from the project.

3. Contribution of Output to Project Goal:

Training: Through workshops, end of seasonal evaluations, field days, and exchange visits, production of high quality seed and increased level of proficiency in potato multiplication has been achieved. It proved critical to understand the difference between producing potato for seed and for table. Particularly the need to manage bacterial wilt and also optimise the choice of tuber size for seed as compared to what is best for food. The use of suitable stores (Diffused Light Stores) for seed encourages strong healthy sprouts and resulting plant vigour.

Multiplication: Through a multiplication system which involves basic seed obtained from Kalengyere NARO that is multiplied by the primary seed multipliers using ridge/furrow system under strict monitoring, seed quality has been assured. From the harvested seed, primary multipliers pay back three times the quantity of seed they received. This seed is distributed to numerous small-scale farmers (beneficiaries) who further multiply it for their own use employing small plot techniques. The poor farmers, who had previously failed to access healthy seed potato, now have access to clean seed as a result of this multiplication system. All of the target number of farmers and other partner group members have received

the improved seed, Victoria, and they further multiply for one generation, and then produce table potato. Some of this table potato is sold and the money used to purchase clean seed from the primary multipliers. An agreement on disease threshold levels has not yet been finalised with NARO. Best Crop Management Practices have been developed, and are being implemented by the Primary Seed Multipliers.

Distribution: The seed potato distribution has been successfully tracked by the local leaders i.e. Production Committees (PCs), at the group level, and Parish Development Committees (PDCs) at parish level. The local leaders have been involved in planning, implementing and monitoring the seed distribution. As a result, a total of 1,200 target farmers received the seed. Additional seed was even distributed to 210 members of the partner groups. A total of 330 bags of seed were distributed to small seed plot multipliers. As a result of the further multiplication, we estimate that 460 acres of potatoes were planted with the seed multiplied under the small plot system - more than the overall project target of 400 acres. The production estimates for season B, 2004 indicate that the seed tubers harvested by small seed plot multipliers can plant 860 acres if all the harvest will be committed to seed. This is much more than the end of project target of 300 acres.

Commercial Sustainability: The seed multipliers formed an association KASPPA , which manages the Crop Best Practices thus carrying out seed health monitoring to ensure production of high quality seed.

4. Publications:

NAMISI, S. and SMITH, J. (2004) Promoting Potato Seed Tuber Management for increased Ware yields in Kapchorwa, Eastern Uganda. A Paper presented on Theme 4: Technological Options that respond to demand. NARO Conference, 1–4 September 2004, Kampala.

5. Internal Reports:

- Annual Report 2002
- Annual Report 2002/03
- Annual Report 2003/04
- Annual Report 2004/05
- PPR1 April to September 2002
- PPR 2 October to December 2002
- PPR1 April to September 2003
- PPR2 October to December, 2003
- PPR1 April to September, 2004
- PPR 2 October to December 2004

6. Other Dissemination of results:

- Farmers' Guide on Potato Production, 3000 copies were distributed to farmers, district authorities, and extension staff.
- Copy of the summary of the final project report to be submitted to the District and four sub-counties.
- Impact Survey Report on Promoting Potato Seed Tuber Management for increased Ware Yields in Kapchorwa, Eastern Uganda. SARAH NAMISI, RITA LAKER-OJOK, and JULIAN SMITH December *2004. Draft Report not published.*

7. Listing and reference to key datasets generated:

- Potato impact survey data. (Survey data from a total of 116 beneficiaries and 240 non-beneficiaries captured using Access and analyzed in Excel.)

- Results from ELIZA and on-farm incubation tests for bacterial wilt from 6 seasons of testing.

8. Follow-up indicated/planned:

As a result of the strong foundation that has been laid in this project, AT Uganda is now well placed to expand project impact to new communities, strengthen KASPPA, and facilitate market linkages especially for ware potatoes. The planned activities include the following: KASPPA Strategic Planning, selection of new sub-counties, parishes and groups, training of new groups/sub-county marketing associations, establishing demonstration sites, organising field days, establishing PDCs and PCs in the new sub-counties, setting marketing committees, market promotion, establishing simple potato stores, holding end of season evaluation and conducting final external impact assessment. These activities are being funded by CPP under a 9-month extension.

9. Name of author of this report:
Namisi Sarah

Project Number:	R8217
Project Title:	Production of baculovirus to control *Plutella xylostella* in vegetable crops in peri-urban and rural areas in Kenya
Production System & Purpose:	Peri-Urban Purpose 1
Project Leader & Organisation:	Luciano Rovesti, Duduteck (K) Limited
Location:	Kenya
Start and End date:	01 April 2002 – 31 March 2005

Objectives
To develop knowledge and expertise for production of a Kenyan baculovirus for the control of diamond back moth (DBM) (*Plutella xylostella*), a major pest of vegetable crops. This will contribute to the improvement of livelihoods of poor people by improving crop productivity and quality, and reduce the need for agrochemicals.

Project Summary
DBM represents the main constraint to the production of brassica crops. Current control measures still rely heavily on the use of chemical insecticides, which poses risks to the final consumer. Besides, their use may be restricted on export crops and the level of resistance developed by DBM is alarming. The potential for use of naturally occurring baculoviruses to control DBM is well documented. The focus of this project is on implementation of the research so that a method for the production of a Granulosis Virus (GV) is developed, which is appropriate for Kenyan conditions. For this purpose a mass rearing of DBM has been established and streamlining of an economic mass production system for the virus is on-going. Trials to test the efficacy of the virus, both in the laboratory and in the field, have also been carried out.

Previous achievements
Despite the several difficulties which from the beginning hindered the development of the activities planned, it was still possible to establish a stable culture of DBM. Various methods of culturing were tested, both using plant material and artificial diet. For the latter, a comparison of two different diets was made. Results confirmed that the best production method was using one of the artificial diets and a stable production of approximately 50,000 eggs/day is presently ongoing. Small scale production of the virus was also initiated, to build up enough material to carry out the experimental work in the field. A few new strains of the GV were also obtained from different areas in Kenya. Finally, the legal requirements for the development of a viral biopesticide were discussed with the relevant official authorities.

Achievements in current year
Production of the original GV strain (NYA 01) continued, and enough virus to treat approximately 100 hectares is now available in stock. At the same time, 6 small-plot field trials were set up and 3 of them completed successfully. Overall, results indicate that the application of the virus caused a significant reduction in the number of DBM larvae, and its efficacy was almost comparable to that of Bt. At the same time, work was carried out in the laboratory to characterise the biological activity of the new GV strains, and also to evaluate the performance of some UV protectants to be used for field applications. From the bioassays carried out, it appears that one of the new strains isolated by Dudutech is more effective (i.e. lower LD_{50}) than the standard NYA01, while two out of the 9 potential coformulants tested showed some level of protection when the virus was exposed to UV light

Activities for next year
A three-month extension was recently obtained from CPP in order to complete some of the work undertaken. This includes some additional trials in the field and also the attempt to make the rearing system for DBM more amenable to the mass production of the virus.

Disseminations
See Disseminations Annex

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Promotion and impact assessment of tomato leaf curl virus disease resistant tomatoes: phase III of sustainable management and molecular characterisation of *Bemisia tabaci* and tomato leaf curl virus (ToLCV) on tomato in India	
DFID Project Reference No:	R8247	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Natural Resources Institute, University of Greenwich	
Production System:	Peri-Urban	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to Peri-Urban production systems	
Commodity Base:	Vegetables (tomato)	
Beneficiaries:	The main and direct beneficiaries will be the poorest tomato growers in South India. However, the project's outputs have worldwide relevance, as the situation in India is representative of many other areas where *B. tabaci* and ToLCV or similar plant-virus diseases cause serious losses. The organisations that will benefit through having a successful project are: the UASB, NRI, NRInternational, the KVKs and NGOs and DFID. The wider groups that will benefit are the private seed companies and breeders that request seed from AVRDC, distributors and consumers. The project is at a stage where we are able to produce a significant number of peer-reviewed scientific publications. Interest generated in the scientific and donor communities by research publications of this type should stimulate further research in this area, which will ultimately benefit the growers.	
Target Institutions:	University of Agricultural Sciences Bangalore (UASB), as well as the 25 other State Agricultural Universities in India. The Karnataka State Seed Agency, NGOs, the South Asian Vegetable Research Network managed by AVRDC and the CGIAR Tropical Whitefly IPM Project managed by CIAT	
Geographic Focus:	India	
Total Cost:	£224,416	
	Planned	**Actual**
Start Date:	1 January 2003	1 January 2003
Finish Date:	31 March 2005	31 March 2005

1. Project Purpose:

This project's purpose was to facilitate improvement in the quantity and quality of Indian tomato production through the sustainable and cost-effective management of two principal researchable constraints, the whitefly, *Bemisia tabaci* and tomato leaf curl virus disease.

2. Outputs:

Output 1. *Official release of ToLCV-resistant tomato varieties and non-exclusive agreements with NGOs and/or private seed companies to multiply and distribute, and/or market at least one variety*.
The three varieties, *Sankranthi*, *Nandi* and *Vybhav*, have been released and assigned, respectively, the following National Identity Numbers, IC 296388, IC 296389, IC 296390. Following consultation with the Central Seed Committee, official notification took place when the variety names were published in *The Gazette of India,* signifying that they can be used all over India. Negotiations by the UASB Technology Transfer Committee were carried out with 10 vegetable seed companies, which all purchased breeder quality seed from the UASB.

Output 2. *Data on the performance of at least one of the TLB varieties in at least one new location within India, with respect to the ToLCV strains and B. tabaci biotypes present in those locations.*
The varieties were grown in several new states, including northern India (Himachal Pradesh) and Nagpur (central India). Nine of the companies returned information on crop performance and stated that the tomatoes did not show any ToLCVD symptoms. Samples of ToLCV-infected tomato plants, weeds and *B. tabaci* populations were collected and analysed molecularly. The non-indigenous B biotype of *Bemisia tabaci* was identified in three regions (Kolar and Nagamangala in Karnataka and from several locations in Gujarat State), which supports previous predictions that its distribution within India would expand. Project staff provided information on best cultivation practices and prepared a single sheet pamphlet, written in the local language of Karnataka. This described the resistant tomato varieties' characteristics, their high yield potential, low production costs and the significant advantage that they can be grown without insecticides, which are normally sprayed intensively on susceptible tomato varieties to protect them against *B. tabaci* and ToLCVD.

Output 3. *Molecular and biological data on the B. tabaci biotypes and viruses associated with ToLCVD epidemics published in a scientific journal and web publication.*
Analysis of the Coat Protein DNA sequence data for the viruses found in leaf curl symptomatic plants showed that there were five different ToLCV groups in India. ToLCVs were detected in alternative hosts including chilli, cowpea, okra and tobacco, as well as the weeds *Croton* sp., *Parthenium* sp. and *Malvastrum* sp. *Papaya leaf curl virus* and *Pepper leaf curl Bangladesh virus* were also detected in tomato for the first time. At least two completely new ToLCV species were identified. These data appear in Chowda Reddy (2004) and Chowda Reddy *et al*. (2005), listed below.

Colonies of three *B. tabaci* populations from eggplant, collected from Rannibenur, Coimbatore and Belgaum, and a population from *E. geniculata*, collected from Bangalore, were established in the NRI insectary. The CO1 gene sequences of the Rannibenur, Coimbatore and Bangalore populations were obtained and they fitted into the previously identified population clusters. The reciprocal crosses were carried out and the data were published in Maruthi *et al*. (2004) and in Rekha A.R. Swamy (2004a) (see below). These data were also presented at the 2nd European Whitefly Symposium (see below) and there are sufficient whitefly data remaining to write an additional paper.

Output 4. *Impact assessment and benefit:cost data available for at least one TLB variety.*
A survey form was prepared and approved by the NRI statistician. Regions were identified in Karnataka and Andhra Pradesh where open pollinated (OP) tomato varieties are widely grown. More than 90 farmers were then visited and socio-economic data collected from them. As an additional activity, a small group of 20 farmers were given the ToLCV-resistant tomato seed. These were monitored closely and compared with another group of farmers in the same area who are growing the traditional ToLCV-susceptible varieties. A comparison of the benefit:cost obtained from the two farmer categories showed that those growing the project's tomatoes made up to 10 time more profit than those growing ToLCV-susceptible OPs.

The data from the survey carried out in the first year have been analysed and written up into a report, 'Socio-economic baseline survey of farmers growing open-pollinated and hybrid

tomatoes in Karnataka'. Additional survey data were also collected from farmers in Kaggere and Chittur districts. Sufficient data are now available for a journal publication and this has been proposed as one of the activities for the nine month extension period.

Links were also maintained with the private seed companies that purchased the projects ToLCV-resistant lines, in order to collect impact data. Companies such as Namdhari, Cee Kay and Ankur Seeds have been very co-operative and responded positively to our impact assessment questionnaire. They are making rapid progress towards producing ToLCV-resistant hybrid varieties that have our lines as one of the parents.

Output 5. *A policy briefing paper on the impact of ToLCVD,* B. tabaci *and, in particular, the B biotype and release of further press articles in the media.*
A policy briefing paper, 'Countering the whitefly and plant-virus disease threat to sustainable livelihoods in India', has been written and will be handed out to the appropriate participants at the project workshop, which is to be held during the extension period.

Press articles, radio and TV programmes have been released on the project's outputs.

Additional outputs: (Add-on) Setting up of a project web site
As part of the impact generation process, the project has developed a web site to provide a mechanism to disseminate electronically, the results, achievements, lessons learnt from the project. The website has not yet been handed over to the UASB, due mainly to this activity becoming more ambitious over time. Some outstanding alterations and text for the section on Impact Monitoring will be added before the end of March. The web site will then be handed over to the UASB and will be maintained within the UASB's web site under 'Breakthrough Research'. The project's web site can be viewed at: http://www.mensacomp.com//tomato/

(Add-on) Impact generation & promotion activities for the UAS National Seed Project, GKVK, and Extension Education Unit, Nagenahalli
By September 2004, it had become clear that the private sector, which is focussing on breeding ToLCV-resistant hybrids, would create enormous impact amongst 'better-off' tomato growers. The poorest growers, however, risked missing out on getting access to the project's OP varieties, because of a lack of effort at promoting them by the private sector. In order to address this potential problem, a 'revolving fund' has been set up by the National Seed Project.

Fifty thousand seed pouches have been produced for the sale of the ToLCV-resistant tomato varieties and the UASB conducted two field days and two training programmes at Mandya and Nagamangala taluks. Due to these promotional efforts, total quantities of seeds sold so far is *c*. 6 kg and demand is increasing.

3. Contribution of Outputs to Project Goal:

All of the outputs were achieved and in several cases exceeded. The only activity remaining to be completed is the updating and handing over to the UASB of the project web site. The outputs have contributed to the project goal by developing, promoting and disseminating ToLCV-resistant tomato varieties and pest management recommendations that, if followed, produce higher tomato yields and reduce insecticide use. They also provide the poorest farmers with up to 10 times the profit, which is spent on improved diet, children's education and health. The project has, therefore, begun to generate significant impact and, at the same time, has improved our understanding of the factors driving whitefly transmitted plant-virus disease epidemics in India.

4. Publications:

Journal papers

CHOWDY REDDY, R.V., COLVIN, J., MUNIYAPPA, V. and SEAL, S.E. (2005) Diversity and distribution of begomoviruses infecting tomato in India. *Archives of Virology,* in press. DOI 10.1007/s00705-004-0486-5.

MARUTHI, M.N., COLVIN, J., THWAITES, R.M., BANKS, G.K., GIBSON, G. and SEAL, S.E. (2004) Reproductive incompatibility and cytochrome oxidase I gene sequence variability amongst host-adapted and geographically separate *Bemisia tabaci* populations (Hemiptera: Aleyrodidae). *Systematic Entomology*, **29**, 560–568.

JEGER, M.J., HOLT, J., VAN DEN BOSCH, F., MADDEN, L.V. (2004) Epidemiology of insect-transmitted plant viruses: modelling disease dynamics and control interventions. *Physiological Entomology*, **29**, 291–304.

CHOWDY REDDY, R.V., MUNIYAPPA, V., COLVIN, J. and SEAL, S.E. (2005) A new begomovirus isolated from *Gossypium barbadense* in Southern India. *Plant Disease*, in press.

Abstracts

COLVIN, J., CHOWDA REDDY, R.V., REKHA, A.R., MUNIYAPPA, V., SEAL, S.E., MARUTHI, M.N. (2004) Ecological and reproductive isolation amongst African and Asian *Bemisia tabaci* populations. p. 12. In: *Proceedings of the 2nd European Whitefly Symposium*. 5–9 October. 2004. [abstract] English

GOVINDAPPA, M.R., COLVIN, J., KESHAVAMURTHY, K.V., CHOWDA REDDY, R.V., and MUNIYAPPA, V. (2004) Factors driving tomato leaf curl geminivirus disease epidemics in South India and management implications. p. 58. In: *Proceedings of the 2nd European Whitefly Symposium*. 5–9 October. 2004. [abstract] English

MARUTHI, M.N., REKHA, A.R., KIRAN KUMAR, M., CHOWDA REDDY, R.V., MUNIYAPPA, V. and COLVIN, J. (2004) Diversity of *Bemisia tabaci* populations in Karnataka, South India, and emerging problems associated with the spread of the B-biotype. pp. 15–16. In: *Proceedings of the 2nd European Whitefly Symposium*. 5–9 October. 2004. [abstract] English

RANGASWAMY, K.T., RAGHAVENDRA, N., SHANKARAPPA, K.S., GOVINDAPPA, M.R., ASWATHA NARAYANA, D.S. and PRAMEELA, H.A. (2004) Analysis of indigenous and B biotype *Bemisia tabaci* whitefly for esterase profiles and activity. Abstract In National symposium on Molecular Diagnostics for the management of Viral Diseases, held at IARI, New Delhi, 14–16 October. p. 78. [abstract] English

SHANKARAPPA, K.S., MANJUNATHA REDDY T.B., RAGHAVENDRA, N., RANGASWAMY, K.T. and PRAMEELA, H.A. 2004. Biotype determination of Karnataka populations of *Bemisia tabaci* whiteflies. Abstract In: Symposium on Biology, Biotechnology, Epidemiology and Management of Plant Diseases, held at Gulbarga 9–10 December, p. 40. [abstract] English

SHANKARAPPA, K.S., RANGASWAMY, K.T., RAGHAVENDRA, N., GOVINDAPPA, M.R., GIRISHA REDDY,M.C., MANJUNATH,B. and PRAMEELA, H.A. (2004) RAPD analysis of *Bemisia tabaci* whitefly populations of southern Karnataka. Abstract In: National symposium on Molecular Diagnostics for the Management of Viral Diseases, held at IARI, New Delhi, 14–16 October. p. 85. [abstract] English

MSc and PhD Theses

CHOWDA REDDY, R.V. (2004) Molecular characterisation of tomato leaf curls viruses and their vector, *Bemisia tabaci*. PhD Thesis, Natural Resources Institute, University of Greenwich. 269 pp.

REKHA A.R. SWAMY (2004a) Evidence of cryptic sibling species amongst the *Bemisia tabaci* populations of the Indian sub-continent and diversity of associated begomoviruses. MSc Thesis. Natural Resources Institute, University of Greenwich. 125 pp. (F).

REKHA A.R. SWAMY (2004b) Molecular characterisation of pumpkin yellow vein mosaic virus and *Bemisia tabaci* on vegetables and weeds. PhD thesis. University of Agricultural Sciences, Bangalore. 157 pp

5. Internal Reports:

- Quarterly reports submitted to NR International each quarter
- Annual reports submitted to NR International at the end of each financial year
- Field visit reports
- Varietal approval and notification meeting reports.
  - State Seed Sub-committee (03 December 2002).
  - Minutes of the 9th meeting of the Central Seed Committee on Crop Standards, Notification and Release of Varieties for Horticultural Crops. 27 December 2002, Coimbatore.

6. Other Dissemination of Results:

Extension information
Tomato leaf curl virus resistant varieties and their cultivation practices. Factsheet. Kannada. 1p. University of Agricultural Sciences, Bangalore, India. (Factsheet).

Dharwad Agricultral University have included photographs and descriptions of our ToLCV-resistant varieties in their book on Package of Practices for Horticultural Crops, pp. 172–173.

Radio, TV programmes & newspaper articles
All India Radio has been contacted and TV coverage has already taken place filmed at KVK, Gulbarga (Dharwad Agricultural University), 13th Feb 2005. An additional full TV programme has been prepared and will be put out on air shortly. Due to these promotional efforts, demand for seeds is increasing.

Wren Media also conducted interviews with project staff (October 2004, track 5) and produced a programme called, 'Sustainable solution to tomato virus'.

Deccan Herald (8 November 2003). The success of the ToLCV-resistant tomato genotypes was recognised at the valedictory function of the Krishi Mela-2003.

Varietal notification for use throughout India
The Gazette of India. The notified tomato variety seeds of *Sankranthi*, *Nandi* and *Vybhav* can be sold for the purposes of agriculture. 31 May 2004.

7. Listing and reference to key datasets generated:

MORENO, C. (2005) Dataset: Socio-economic baseline survey of farmers growing open-pollinated and hybrid tomatoes in Karnataka. Report and Excel data sheets. Natural Resources Institute, University of Greenwich, UK.

8. Follow-up indicated/planned:

The project has the potential to generate enormous impact throughout India, as well as in Africa, the Caribbean and Asia. The involvement of commercial seed companies developing resistant hybrids will also result in increased impact.

Sixty percent of the area under tomato production in India involves OP varieties grown by the poorest farmers. In order to maximise impact, a nine month extension has been applied for and approved with activities aimed at promoting the uptake and sustainable adoption of our technologies and ToLCV-management practices, with these poorer growers. If successful, this will ensure that tomatoes can be grown successfully, even in the peak of the ToLCV-epidemic season, with greatly reduced insecticide use and associated benefits to the poorest farmers, consumers and the environment. The extension proposal aims to provide added, sustainable value that builds directly on previous research, promotional achievements and dissemination.

9. Name of author of this report:
John Colvin

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Promotion of sustainable approaches for the management of root-knot nematodes on vegetables in Kenya	
DFID Project Reference No:	R8296	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	The University of Reading	
Production System:	Peri-Urban	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to Peri-Urban production systems	
Commodity Base:	Vegetables	
Beneficiaries:	Smallholders and commercial producers of vegetables for urban markets and export	
Target Institutions:	KARI, KIOF, CABI ARC, Dudutech (K) Ltd, FPEAK	
Geographic Focus:	East Africa	
Total Cost:	£154,683	
	Planned	**Actual**
Start Date:	01 April 2003	01 April 2003
Finish Date:	31 March 2005	31 March 2005

1. Project Purpose:

The project aimed to verify and promote sustainable approaches to the management of root-knot nematodes through the use of micro-organisms, cultural techniques and plant resistance. Through research participation smallholders have been acquainted with the production constraint and of potential ways of its alleviation. The novelty has been the inclusion of the naturally occurring biological control organisms within the cropping system preferred by (or acceptable to) the farmers. This will become an accepted practice when the national regulatory authority approves the use of 'biopesticides', when organisations have the capability to mass produce these products at an acceptable price and when there are appropriate channels to deliver them to the smallholder grower community. Progress has been achieved with each of these stages which will ensuring the long term benefit to all sectors of the Kenyan vegetable-producing community.

2. Outputs:

The amendments to the pesticide legislation to include those defined as 'biopesticides' such as *Pochonia chlamydosporia* and *Pasteuria penetrans* have been drafted and await final legislative ratification. This will then enable companies to produce and market these products. Dudutech have refined the production of *P. chlamydosporia* and are producing 40 kg of formulated product per week; this can be scaled up to 100 kg/week when required. There is no loss of pathogenicity in sequential batches of fungus.

Methods of scaling-up the *in vivo* system of mass-producing *P. penetrans* are being investigated but as yet no consistent process has yet been developed because of the dependence on uniformly warm temperatures and large supplies of nematode hosts on which to produce the parasite. Spore yields of 3.26–5.6 x 10^6 per g of dried tomato root have been achieved.

P. chlamydosporia was applied through a drip system spores were not evenly delivered along the line of the drippers. This could be a technical problem relating to formulation because of the size of chlamydospores. Distribution of spores of another biocontrol fungus, *Paecilomyces lilacinus,* through such a system is better, probably because spores of this fungus are smaller and consistent in size.

Farmers' perceptions and preferences of some different tomato varieties shows that a 'new' variety with root-knot nematode resistance was ranked best (of four) including the standard cultivar Cal J which is nematode susceptible.

Thirty five farmers from Kibirigwi (rainfed), 26 Kibirigwi (irrigated) and 36 at Mwea participated in evaluations on field days.

3. Contribution of Outputs to Project Goal:

An environmentally safe strategy for managing root-knot nematodes is now closer which need not include a hazardous chemical such as carbofuran (a product used by some of the commercial producers supplying tomatoes to the Nairobi market).

Dudutech have demonstrated their capacity to mass-produce both the biological control agents; the formulation of the fungus *Pochonia chlamydosporia* is of a consistent quality. Dudutech will still need to refine the methodology for mass-producing *Pasteuria penetrans.*

These 'products' are now available for wider use and will be of benefit to the poorer farmers growing nematode susceptible crops and indirectly to the wider community who buy these crops. In addition to improving the technology for the commercial export producers (a requirement of the European Union rules for harmonisation of use of pesticides [COLEACP]) commercial growers who grow crops on contract to the exporting companies will also benefit.

Farmers have participated in the evaluation of the nematode management strategy that has included biological control agents, nematode resistant varieties and crop rotations.

One scientist (D. Karanja) obtained his PhD (2004) from work done on this project (and the preceding project R7482)

4. Publications:

ATKINS, S.D., CLARK, I.M., MORTON, C.O. and KERRY, B.R. (2004) Fungal molecular diagnostics of nematophagous fungi. *IOBC Bulletin*, **27**(1) 9–15.

BOURNE, J.M., KARANJA, P.K., KALISZ, H., KARANJA, D.K., MAUCHLINE, T.M. and KERRY, B.R. (2004) Incidence and severity of root-knot nematodes (Meloidogyne spp.) and the isolation and screening of the nematophagous fungus, Pochonia chlamydosporia, from some of the main vegetable growing areas in the Eastern, Rift Valley and Central provinces of Kenya. *International Journal of Nematology* **14,** 111–122.

DARBAN, D.A., PEMBROKE, B. and GOWEN, S.R. (2004) The relationship of time and temperature to body weight and numbers of endospores in *Pasteuria penetrans*-infected Meloidogyne javanica females. Nematology, **6**: 33–36.

GOWEN, S.R. and PEMBROKE, B. (2004) *Pasteuria penetrans* and the integrated control of root-knot nematodes. *IOBC Bulletin*, **27**(1) 75–77.

KARANJA, D.K. (2004) Studies on integrated management of root-knot nematodes (*Meloidogyne* spp.) on tomato in Kenya. PhD Thesis, University of Reading. 200 pp.

KARANJA, D.K., KARANJA, P.K., KARIUKI, G., GOWEN, S.R., SIMONS, S., PEMBROKE, B., KERRY, B.R. and KIBATA, G. (2004). Effect of crop rotation and combined application of P*ochonia chlamydosporia* and *Pasteuria penetrans* for the management of root-knot

nematodes on tomatoes. Kenya Agricultural Research Institute, 9th Biennial KARI Scientific Conference and First Kenya Agricultural Research Forum, 8–12 November 2004, KARI Headquarters Complex, Nairobi, Kenya. (In press).

KERRY, B.R. and HIDALGO, L. (2004) Application of *Pochonia chlamydosporia* in the integrated control of root-knot nematodes on organically grown vegetable crops in Cuba. *IOBC Bulletin*, **27**(1) 123–126.

KERRY, B.R., ATKINS, S.D., MAUCHLINE, T., MORTON, C.O. and HIRSCH, P. (2004) Variation in *Pochonia chlamydosporia* and its potential as a biological control agent for root-knot nematodes. *IOBC Bulletin*, **27**(1) 127–132.

KERRY, B. (2004) Interactions in the rhizosphere and the biological control of root-knot nematodes using *Pochonia chlamydosporia. Advances in applied biology; providing new opportunities for consumers and producers in the 21st century. Centenary meeting of the Association of Applied Biologists, 15–17 December, 2004, Oxford, UK. (Abstract)*

PEMBROKE, B. and GOWEN, S.R. (2004) *Pasteuria penetrans* – friend tease or distraction? *IOBC Bulletin*, **27**(1): 225–228.

PEMBROKE, B., DARBAN, D.A. and GOWEN, S.R. (2004) *Pasteuria penetrans* a tritrophic intereaction? *IOBC Bulletin*, **27**(1) 229–234.

TROTTER, J.R., DARBAN, D.A., GOWEN, S.R., BISHOP, A.H. and PEMBROKE, B. (2004) The isolation of a single spore isolate of *Pasteuria penetrans* and its pathogenicity on *Meloidogyne javanica. Nematology,* **6**: 463–472.

THE UNIVERSITY OF READING; ANNUAL REVIEW 2003–2004
Using bacteria to halt spread of crop-destroying pest (page 9)
Article on *Pasteuria penetrans* The University of Reading Bulletin No 414 24 February 2004.

5. Internal Reports:

6. Other Dissemination of Results:

GOWEN, S. and PEMBROKE, B. (2004) Course on plant parasitic nematodes (and biological control) given to managers and technical staff of Homegrown and Dudutech, Naivasha and Muguga: 17–19 August 2004 (

7. Listing and reference to key datasets generated:

8. Follow-up indicated/planned:

Biological control agents for root-knot nematodes are now available in Kenya; until the pesticide legislation is ratified by Parliament these 'products' can be used only on farms owned by Homegrown the parent company of Dudutech. However, Dudutech are now in a position to produce sufficient product for sale to other commercial concerns and to the smallholder 'outgrowers' who supply vegetables to the commercial markets within and outside Kenya. This wider distribution of these products and the knowledge will be made available through organisations representing the export sector such as FPEAK and the organic growers such as KIOF.
The results of the research will be made available to the participants of the Gatsby Nematology Capacity Building Project for East Africa which begins 1 April 2005 and continues for 5 years and research projects associated with this will include further studies on the deployment of biological control agents for root-knot nematodes.

9. Name of author of this report:
S R Gowen

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Development of private service providers for the horticultural industry in Kenya	
DFID Project Reference No:	R8297	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	International Centre of Insect Physiology and Ecology (ICIPE)	
Production System:	Peri-Urban	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to Peri-Urban production systems	
Commodity Base:	Vegetable cluster	
Beneficiaries:	Smallholder outgrowers groups and farmers of horticultural crops, private service providers and Kenya fresh produce export companies	
Target Institutions:	Not Applicable	
Geographic Focus:	Kenya/East Africa	
Total Cost:	£141,938	
	Planned	**Actual**
Start Date:	1 April 2003	1 April 2003
Finish Date:	31 March 2005	31 March 2005

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1. Project Purpose:

Private service provision for advice, input supply and plant protection services in horticultural crops developed and promoted

2. Outputs:

- Business models for private service providers for horticultural producers were developed
- Appropriate training modules and curriculum were developed
- 15 private service providers graduated from the training. These are either self employed or working with fresh produce export companies to prepare small scale producers for EUREPGAP certification
- Awareness about the effects of the supply chain requirements e.g. EUREPGAP, and access to the export markets by small scale producers, for a wide range of stakeholders at national and international policy level was created. Some standard setters and donor agencies have recognised the fact that small-scale producers are at risk of being excluded from the export markets due to stringent food standard requirements. As a result some policy changes have already taken place:
  - A visit of Mr Nigel Garbutt, the chairman of EUREPGAP to Kenya from 19–25 February 2005 which led to the following changes:
    - EUREPGAP is committed to assist Kenya develop 'Kenya-GAP' benchmarked on the EUREPGAP standard, this will bring the services closer to the end users
    - Kenya will have a representative at the EUREPGAP committee
  - DFID is committed to co-finance the field-testing of the 'EUREPGAP Smallholder Quality Manual' in collaboration with GTZ. This will be a starting point for Kenya to create its own quality manual by adopting contents according to local production situation in a view to prepare farmers for EUREPGAP certification.
  - Some fresh produce export companies are working with outgrowers groups to meet the EUREPGAP standard

- The Ministry of Agriculture, Horticulture Department, has commissioned a review of the EUREPGAP Kenya training programme
- One outgrowers group in Kerugoya district was certified EUREPGAP compliant on 17 December 2004 by Africert Ltd, a local certification body accredited to EUREPGAP. Three other groups are due for full EUREPGAP certification (the groups have minor corrections to implement) soon.

3. Contribution of Outputs to Project Goal:

Yes. The project outputs have been achieved as indicated in the progress reports. The private service providers and farmers were trained in integrated pest management, which is a strategy to reduce pesticide usage and improve produce quality, food safety, human and environmental health. The training created awareness and facilitated some outgrowers groups to comply with market requirements. At policy level, awareness of the plight of the small scale farmers in respect to new food standards has prompted some of the standard setters to review the requirements, making them more end-user friendly.

4. Publications:

Not yet done

5. Internal Reports:

1. PPR1 (1 April to 30 September 2003) submitted 18 September 2003
2. PPR2 (1 September to 31 December 2003) submitted 24 January 2004
3. Annual report 2003–04
4. Project monitoring report 1 (1 April to 30 September 2004) submitted 19 October 2004
5. PPR3 (1 October to 31 December 2004) submitted 20 January 2005
6. NYAMBO, B., KINOTI, R., KIRIGA, J. and MAUNDU, J. (2004). Awareness campaign for export horticulture producers and outgrower groups to comply with EUREPGAP protocol: knowledge and attitude baseline study 12–17 July 2004. BSMDP contract Number H-SP-03
7. MACHARIA, IBRAHIM, AKIVAGA, F. and NDENGA, E. (2004). Awareness campaign for export horticulture producers and outgrower groups to comply with EUREPGAP protocol: Mid- term evaluation of the Radio awareness programme, 20–26 September 2004. BSMDP contract Number H-SP-03
8. ANON (2005) Awareness campaign for export horticulture producers and outgrower groups to comply with EUREPGAP standard [July-November 2004]: Final report submitted to BSMDP, February 2005. BSMDP contract Number H-SP-03
9. ANON (2004). Awareness campaign for export horticulture producers and outgrower groups to comply with EUREPGAP standard: radio magazine themes, December 2004. BSMDP contract Number H-SP-03

6. Other Dissemination of Results:

Conferences

- NYAMBO, B. (2004) Private service providers for the horticultural industry in Kenya: lessons in the use of mass media communication. Paper presented to the workshop on 'Effective communication between agricultural research, extension and farmer', Bolzano, Italy, 18–22 October 2004
- NYAMBO, B. (2004) Development of private sector extension services for the horticultural industry in Kenya. Presentation made to the UK Food Standards, 12th December 2004, London, UK
- NYAMBO, B. (2004) Development of private service providers for the horticultural industry in Kenya: a pilot study. Paper presented at the AAB Centennial conference 'Advances in applied biology: providing new opportunities for consumers and producers in the 21st century' 15–17 December 2004, St Catherine's College Oxford, UK.

Interviews (TV, radio and journals)

- Africa Farming Magazine, 12 December 2004

Posters, leaflets and comic booklets

- EUREPGAP – What smallholder producers of fruits and vegetables must do to access markets in European Union (poster)
- EUREPGAP STANDARD for small scale farmers of fresh fruits and vegetables to the European market (leaflet)
- Experience used by Pride Africa in the Drumnet programme to produce a locale specific (kikuyu language) comic booklet on the EUREPGAP requirements (comic booklet)

7. Listing and reference to key datasets generated:

NYAMBO, B., MAUNDU, J., GATAMA J. and MACHARIA, I. (2003) Development of private sector service providers for the horticultural industry in Kenya: Baseline data collection for outgrowers groups, October 2003.

8. Follow-up indicated/planned:

A one-year extension (April-December 2005) has been awarded by CPP. The lessons from the pilot and extension phases will be documented and form part of the final report for further use in East Africa

9. Name of author of this report:
Brigitte Nyambo

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Accelerated uptake and impact of CPP Research Outputs in Kenya	
DFID Project Reference No:	R8299	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	CAB International Africa Regional Centre	
Production System:	Peri-Urban	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to peri-urban production systems	
Commodity Base:	Food crops	
Beneficiaries:	Smallholder farmers	
Target Institutions:	Intermediary organisations	
Geographic Focus:	Kenya	
Total Cost:	£159,966	
	Planned	**Actual**
Start Date:	01 April 2003	01 July 2003
Finish Date:	31 March 2005	31 March 2005

1. Project Purpose:

The purpose of the project was to promote pro-poor strategies to reduce impact of key pests, improve yield and quality of crops, and reduce pesticide hazards in high potential systems in Kenya. New knowledge was being sought on how outputs from research funded by DFID and others could generate benefits for poor people by application of new technologies on crop protection to high potential/peri-urban production systems. The project addressed ways of producing and distributing demand driven dissemination materials to intermediary organisations and ways to document the impact on farmers' yields and livelihoods from adopting the new technologies.

2. Outputs:

The results from socio-economic work in Western Kenya revealed high demand for information on sweet potato, beans, maize, sorghum and kale production. Many farmers felt that they had limited access to new IPPM technologies as a result of weak research-extension-farmer linkages. They felt that the limited technologies accessible to them were not always relevant to their local conditions either because they were tested elsewhere or farmers were not consulted about their relevance. A wide range of IPPM research outputs was collated from different research institutes and validated by over 3500 farmers through their field schools, and results shared with about 2000 other farmers during field school open days. The farmers' participation in the validation of the technologies resulted in increased farmers' confidence to make informed decisions on which technologies to apply. The farmers have also adapted the technologies to suit their local production system. New knowledge has been acquired on uptake pathways for research outputs, and dissemination materials have been produced and distributed containing information on topics identified as of relevance by the farmers themselves. As a result of the project, 50 intermediary organisations working with farmers have access to a wide range of dissemination materials on five key crops for continued use in their work.

3. Contribution of Outputs to Project Goal:

Improved crop protection and production technologies and knowledge promoted by the project has achieved beneficial impact on poor farmers. As measured against baseline data the project has contributed to increased production, reduced use of toxic pesticides and enhanced income, all leading to end-user satisfaction with a number of the promoted technologies. The greatest improvements were seen in maize and kales. Farmers reported that incomes from maize production increased by 30%. There was also an increase in maize yield of up to 50%. Income from kale production increased by 20% and yields increased by 10%. Since maize is a staple food crop for the area, food self sufficiency and food security improved due to adoption of the technologies. Participatory extension and technology delivery has met field school members' demand for knowledge on their chosen crops produced for consumption and for the local market, while avoiding high investment in external inputs.

4. Publications:

There are no refereed publications from this project.

5. Internal Reports:

KIMANI, M, NJUKI J and ASABA, JFA (2003) Participatory identification of priority crops. Report of socio-economic activities. Prioritisation of constraints, baseline survey, and identification of dissemination materials. CAB International, Africa Regional Centre, Nairobi, Kenya.

KIMANI, M. and NJUKI, J. (2003) IPPM technologies for sweet potato and beans. Report on training workshop 25–29 August 2003. CAB International, Africa Regional Centre, Nairobi, Kenya.

KIMANI, M. and MUSEBE, R. (2004) IPPM technologies for maize and sorghum. Report on training workshop 9–13 February 2004. CAB International, Africa Regional Centre, Nairobi, Kenya.

KIMANI, M. and MUSEBE, R. (2004) IPPM technologies for groundnut and kale. Report on training workshop 16–20 August 2004. CAB International, Africa Regional Centre, Nairobi, Kenya.

MUSEBE, R., ODENDO, M., ASABA, J.F., KIMANI, M., KHISA, G. and AJANGA, S. (2004) Report of socio-economic activities. Prioritisation of constraints, baseline survey, and identification of dissemination materials.

SIMONS, S. (2003) Project Progress Report. Report on project progress from 3 July to 30 September 2003. CAB International, Africa Regional Centre, Nairobi, Kenya.

SIMONS, S. (2004) Project Progress Report. Report on project progress from 1 October to 31 December 2003. CAB International, Africa Regional Centre, Nairobi, Kenya.

SIMONS, S. (2004) Project Progress Report. Report on project progress from 1 April to 30 September 2004. CAB International, Africa Regional Centre, Nairobi, Kenya.

SIMONS, S. (2005) Project Progress Report. Report on project progress from 1 October to 31 December 2004. CAB International, Africa Regional Centre, Nairobi, Kenya.

6. Other Dissemination of Results:

CAB INTERNATIONAL (2003) Wadudu na magonjwa yanayoshambulia maharagwe. 200 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Leaflet] [Swahili]

CAB INTERNATIONAL (2003) Wadudu na magonjwa yanayoshambulia viazi vitamu. 200 copies. [Leaflet] [Swahili] CAB International, Africa Regional Centre, Nairobi, Kenya.

CAB INTERNATIONAL (2003) Options for managing Maize Grey leaf spot, 100 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Leaflet]

CAB INTERNATIONAL (2003) Umewahi kuuona huu ugonjwa? Huu ni Ugonjwa wa madoa ya kijivu kwenye majani ya mahindi, 200 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster] [Swahili]

CAB INTERNATIONAL (2005) IPPM information on sweet potato, beans, maize, sorghum, kale and groundnut, 100 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [CDROM]

CIAT (2003) (modified with permission) Bean Stem Maggot (bean fly) and its management, 250 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster]

CIAT (2003) (modified with permission) Funza wa maharage (inzi wa maharagwe) na namna ya kumdhibiti, 250 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster] [Swahili]

CIAT (2003) (modified with permission) Bruchids/ Bean Weevils, 250 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster]

CIAT (2003) (modified with permission) Vipekecha wa maharagwe, 250 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster] [Swahili]

CIAT (2003) (modified with permission) Wadudu na magonjwa yanayoshambulia viazi vitamu, 180 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster] [Swahili]

CIAT (2003) (modified with permission) Bean foliage beetles (Ootheca spp.) and their management, 250 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster]

CIAT (2003) (modified with permission) Virombosho (Ootheca spp.) na namna ya kuwadhibiti, 250 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster] [Swahili]

DFID (2001) Farmers' Friends; Recognition and conservation of natural enemies of vegetable pests in Zimbabwe, 100 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Manual]

DFID (2001) Farmers Friends, 180 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster]

INTERNATIONAL INSTITUTE OF BIOLOGICAL CONTROL (1994) Helpful Dudus in the shamba, 70 copies, CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster]

INTERNATIONAL INSTITUTE OF BIOLOGICAL CONTROL (1994) Wadudu Marafiki Mashambani, 70 copies, CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster] [Swahili]

KARI, CIMMYT, ICIPE (2002) Striga Biology and Participatory control approaches, 100 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Manual]

KARI (2201) Control of stalk borers in maize crops, 200 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Leaflet]

KARI (2004) Production of Kales (sukuma week) and onions Using Bucket Drip Irrigation, 180 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Leaflet]

NR INTERNATIONAL (2003) Trapping Rodents that Trash Crops, 180 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Leaflet]

NR INTERNATIONAl (2003) Avoiding Aflatoxin Groundnuts, 180 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Leaflet]

NR INTERNATIONAL (2002) Main Pests and Diseases of Brasicas and Tomatoes, 180 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster]

NR INTERNATIONAL (2003) Trapping Rodents that Trash Crops, 180 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Leaflet]

NR INTERNATIONAL (2002) Main Pests and Diseases of Brasicas and Tomatoes, 180 copies. CAB International, Africa Regional Centre, Nairobi, Kenya. [Poster]

7. Listing and reference to key datasets generated:

CAB INTERNATIONAL (2003) Participatory rural appraisals to identify priority crops and constraints. CAB International, Africa Regional Centre, Nairobi, Kenya. Excel spreadsheet [Unpublished data]

CAB INTERNATIONAL (2003) Baseline survey of socio-economic situation and production practices of participating farmers. CAB International, Africa Regional Centre, Nairobi, Kenya. Excel spreadsheet [Unpublished data]

CAB INTERNATIONAL (2004) Participatory rural appraisals to identify priority crops and constraints. CAB International, Africa Regional Centre, Nairobi, Kenya. Excel spread sheet [unpublished data]

CAB INTERNATIONAL (2004) Baseline survey of socio-economic situation and production practices of participating farmers. CAB International, Africa Regional Centre, Nairobi, Kenya. Excel spreadsheet [Unpublished data]

CAB INTERNATIONAL (2004) Farmer evaluation of IPPM. CAB International, Africa Regional Centre, Nairobi, Kenya. Excel spreadsheet [Unpublished data]

CAB INTERNATIONAL (2005) Impact assessment of IPPM technologies. CAB International, Africa Regional Centre, Nairobi, Kenya. Excel spreadsheet [Unpublished data]

8. Follow-up indicated/planned:

There is no adaptive research planned after this project. More copies of the CD ROM produced in this project will be disseminated to intermediary organisations in Kenya, Uganda, Tanzania and other countries with similar production systems. During this project demand was also expressed for tomato IPPM technologies, and this will be addressed in the extension to the project for which funding has been approved.

9. Name of author of this report:
Dr Sarah Simons

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Promotion of quality vegetable seed in Kenya	
DFID Project Reference No:	R8312	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Central Science Laboratory, Sand Hutton,York	
Production System:	Peri-Urban	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to Peri-Urban production systems	
Commodity Base:	Kale seed production	
Beneficiaries:	Low income category smallholder farmers, commercial smallholders who supply urban markets and those outgrowers contracted to the exporting companies, rural communities (through employment opportunities) micro-entrepreneurs or communities who can brand and market improved quality seed, thus benefiting from the economic returns.	
Target Institutions:	SACDEP, WINROCK, World Vision, Private sector seed company	
Geographic Focus:	Kenya	
Total Cost:	£158,654	
	Planned	**Actual**
Start Date:	1 April 2003	1 April 2003
Finish Date:	31 March 2005	31 March 2005

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1. Project Purpose:

Promotion of pro-poor strategies to reduce the impact of key pests and diseases, improve yield and reduce pesticide hazards in peri-urban systems. Specific objectives were to:

- Understand farmers' perceptions and market needs w.r.t. vegetable (kale) seed purchases;
- Evaluate potential models for sustainable kale seed production;
- Establish a sustainable kale seed multiplication system that will enable smallholders to produce healthy seed of good quality and that has an acceptable market value;
- Promote good seed multiplication practice for kale and improve seed certification using the preferred model;
- Develop a marketing strategy for the sale of improved quality seed and promote the value of producing/purchasing good quality seed;
- Distribute improved seed to 1,000 farmers.

2. Outputs:

- Baseline information on farmers' perceptions of seed and the existing constraints of PRA has been identified. A socio-economic survey identified potential opportunities for farmers to produce and market their own, improved quality seed
- Availability, distribution and supply of existing brassica seed in Kenya has been surveyed, and a seed inventory produced, providing baseline information re. entry into the commercial seed sector
- Baseline data relating to how far farmer produced seed in Kinale travels was collected using a questionnaire circulated by The Ministry of Agriculture and data collected by

KEPHIS; Several districts/divisions (e.g. Nyeri; Embu) were found to grow Kinale kale at the start of the project.

- A project development meeting held with agriculture staff and extension officers in Kinale allowed information to be gathered on how farmers who multiply kale seed are organized, and identified kale farmers and farmer groups to work with; as a result, Lari Division extension officers participated in the project thereafter, making many visits to farmer groups with the project team.
- The potential for establishing and registering a commercial seed business in Kinale was examined; information was gathered from farmers and seed companies eg. Lagrotech and constraints and opportunities identified. A recommended plan was drawn up to show the steps involved in progressing to a commercial seed business for consideration by farmers.
- The health of existing kale seed w.r.t. fungi, bacteria and viruses was determined; the bacterial black rot pathogen (*Xanthomonas campestris* pv. *campestris* (*Xcc*)) was present, and a range of fungi were also isolated; *Alternaria* was the most common. Most affected seeds are from farmers, demonstrating the importance of promoting seed health to these producers.
- A strategy for sustainable/viable production of improved quality kale seed was developed through participatory on-farm trials in Kinale with key farmers/farmer groups; this involved three on-farm trials with participatory farmer groups and one on-station trial at Njabini for demonstration purposes.
- A suitable model for a sustainable kale seed multiplication system that enables smallholders to produce healthy, good quality seed of an acceptable market value has been identified; in the preferred model, farmers to pick kale leaves up to flowering (half pick model) and then harvest seed. This was preferential to 'no-pick' and 'full pick' models, where seed harvests were lower. The model has been validated and established on land volunteered by 3 farmer groups directly represented by over 50 farming families in 3 key kale seed production areas in Kinale;
- Monthly participatory activities were established with farmer groups; these included sowing seed beds, transplanting seedlings, examining plants during the trial at regular intervals, participatory budgeting of inputs and harvesting of leaves and seed.
- Promotional materials encouraging good seed multiplication practice, and emphasising the value of producing/purchasing good quality vegetable seed, have been developed and disseminated to >1,000 potential smallholder farmers, NGOs and micro-entrepreneurs through KARI, extension services, NGO's and other CPP uptake pathways in Kenya.
- The incidence/prevalence *Xcc* in seed stocks currently used for production have been examined, to improve quality assurance; infection was found in several imported seed lots. The presence and survival of *Xcc* in brassica crop debris has been examined, to provide a direct indication of the importance of crop debris as a source of primary inoculum in seed production.
- Local seed-testing capability for *Xcc* has been improved; training for local personnel was provided by liaison between local collaborators and UK on requirements for black rot seed testing according to latest ISTA method. Key personnel from KEPHIS Plant Health Quarantine Station visited HRI for 3 weeks training in technical methodologies for seed testing/pathotyping of *Xcc*. A reciprocal visit was made to the laboratories at KEPHIS & KARI-NARL, providing practical training for appropriate staff.

3. Contribution of Outputs to Project Goal:

Anticipated outputs for this project have been achieved as expected. The socio-economic survey identified the types of kale that farmers use, their preferences, and the sources from which farmers obtain their seed. An inventory of brassica seed in Kenya has been drawn up from commercial seed companies/local markets. Farmers' views on current seed production and marketing systems that exist in Lari division, Kenya, have been documented and the feasibility of a community based seed production and seed marketing strategy explored. PRA activities have thus made significant contributions to our understanding of farmers' perceptions and needs with respect to seed purchases. Kinale farmers expressed a strong interest in multiplying/marketing seed with improved seed health and quality. In close

collaboration with KEPHIS inspectors, using international UPOV guidelines, significant progress has been made in analysis of Kinale kale as a variety. A crucial achievement by farmers and researchers has been the selection and evaluation of 7 lines from a trial of 24 Kinale kale lines, grown on the KARI research station (Njabini). These very impressive lines will be in demand from farmers in the future. In order to progress to these new varieties multilocational performance trials will be continued by the current research team in a follow-on project (see below). Multilocational trials yielded enormous quantities of seed, providing the opportunity to distribute excess seed to 1,000 farmers in most kale producing areas, and to invite further feed back re. kale performance. The feasibility of a community-based approach to seed multiplication in Kinale and potential for establishing and registering a commercial seed business in Kinale has been examined and indications are that farmers are keen to pursue this approach. Good seed multiplication practice for kale and seed certification using a preferred model has been promoted, and there is now demand to go beyond this and to register and release Kinale kale seed varieties. Practical strategies for sustainable management of black rot in brassica have also been developed, by examining the presence and survival of black rot in brassica crop debris in on-station trials at KARI-NARL. Good progress has also been made in improving seed testing capacity in Kenya with two KEPHIS staff having been trained in testing seed for black rot to ISTA standards, followed up by a KEPHIS/KARI training workshop in Kenya in November 2003 attended by about 10 staff. The project has contributed to sustainable rural livelihoods in that the outputs will help farmers to produce their vegetable crops (for consumption and sale) in a safe, more effective and economic way. Benefits will include improved nutrition for whole families, better cash returns from higher yields of better quality produce and an empowerment through agricultural knowledge which will help them to make informed choices on other cropping options.

4. Publications:

ANON (2003) Virus in the veggies – a short summary of results of the 'Vegetable Virus Project'. CABI in Africa issue 2003, p. 5.

ONIM, M. (2004) Seed market development for rural farmers. *Proceedings of the US-Africa Agribusiness Conference, 7–10 November 2004, Marriott Conference Center, Monterey, California, USA.*

PHIRI, N.A., SPENCE, N., HUGHES, S., MWANIKI, A., SIMONS, S., ODUOR, G., CHACHA, D., KURIA, A. and NDIRANGU, S. (2004) Identification of beet mosaic virus (BtMV), and its effect on the yield of Swiss chard in Kenya. *Proceedings of the 9th Biennial Scientific Conference and Agricultural Research Forum 9–12 November 2004, KARI Kenya.*

ANON (2004) Cleaning up the seedy business – a short summary of the current 'Promotion of Quality Vegetable Seed Project'. CABI in Africa issue 2004, p. 2.

PHIRI, N.A., HUGHES, S.L., NJUKI, J., MWANIKI, A., SIMONS, S., ODUOR, G., CHACHA, D., KURIA, A., NDIRANGU, S. and SPENCE, N.J. (2005) Identification of *Beet mosaic virus* (BtMV), and its effect on the yield of Swiss chard in Kenya. In preparation for submission to *Plant Pathology.*

PHIRI, N.A., HUGHES, S.L., NJUKI, J., MWANIKI, A., SIMONS, S., ODUOR, G., CHACHA, D., KURIA, A., NDIRANGU, S. and SPENCE, N.J. (2005) Characterisation of *Turnip mosaic virus* (TuMV) and *Cauliflower mosaic virus* (CaMV) isolates from Kenya and their economic impact on cabbage and kale production. In preparation for submission to *Plant Pathology*.

5. Internal Reports:

Back to Office Reports
ANON (2003) Kinale kale plants: description of plant characteristics.
ANON (2003) Map: Position of selected Kinale kale lines in relation to other lines at Njabini.

PHIRI, N., KOECH, S., KIMANI, M., MUSEBE, R., KALANGALA, F., CHACHA, D., SPENCE, N., ROBERTS, S., ONIM, M., KIBATA, G. and ODOUR, G. (KEPHIS, CSL, KARI, HRI, CABI) Report: Selection of 'Kinale kale' lines.

ANON (2003) Identification of a suitable model for kale seed multiplication.

ANON (2003) A report on meetings held with Ms G Maina and Mr J Mungai, 29 April 2003.

HOLDERNESS, M., DANIELSEN, S., MATHUR, S., MORTENSEN, C., NATHANIELS, FRIIS-HANSEN, E. (2003) Good Seed Initiative: Improving seed quality and health in staple crops for the resource-poor. Report on the East Africa Workshop on the Good Seed Initiative, Sokoine University of Agriculture, Morogoro, Tanzania 4–7 June 2003.

CHACHA, D. (CABI) Report of meeting to discuss execution of seed project activities, KARI NARL. 11 July 2003.

NJUKI, J. (CABI) Report of planning meeting of the quality vegetable seed project, KARI NARL, 18 August 2003.

ROBERTS, S. (HRI) Notes on design of field trials for leaf harvesting experiment 21 January 2004.

LANG'AT, E (KEPHIS) Report on the lay out of debris trial at NARL: January 2004.

ROBERTS, S.J. (HRI) Notes on design of field trials for leaf harvesting experiment (amended), 6 February 2004.

ANON (2004) Reported lists of attendees for farmers' meetings: Kinale, Githia Carbacid (Bathi), 17, 18 February 2004, and 26 March 2004.

ANON (2004) Report of planning meeting: Vegetable seed promotion in Kenya. 16 March 2004.

PHIRI, N., KOECH, S., CHACHA, D., KIMANI, M., MUSEBE, R. and MBEVI, B. (KEPHIS, CSL, KARI, HRI, CABI) Progress report on activities of the promotion of quality seed project in Kenya. 16 March 2004

ANON (2004) Lay out of the lines and plants in the Distinctiveness, Uniformity and Stability (DUS) experiment at Njabini KARI sub-station farm. 2 April 2004

LANG'AT, E. (2004) Update on the development of practical strategies for sustainable management of black rot. January – April 2004. KEPHIS.

MUSEBE, R. (2004) Report of planning meeting: Vegetable seed promotion in Kenya, 2 June 2004. CABI.

ONIM, M. (2004) A report on the characterisation of kale lines at Njabini KARI sub-station farm. 3 August 2004. Lagrotech Seed Company.

ONIM, M. (2004) A report of a visit to Njabini KARI sub-station farm to check on flowering and bees activities on kale. 27 August 2004. Lagrotech Seed Company.

LANG'AT, E. (KEPHIS) Update on the development of practical strategies for sustainable management of black rot: debris trials. June – September 2004

LANG'AT, E. (2004) A report on the brassica debris trial subjected into experimental plots at NARL-Kenya. January – October 2004. KEPHIS.

ONIM, M. (2004) A report on the development of Kale lines at Njabini KARI sub-station farm. 28 October 2004 Lagrotech Seed Company.

PHIRI, N, KOECH, S, CHACHA, D, MBEVI, B, MUSEBE, R (KEPHIS, CSL, KARI, HRI, CABI) Evaluation of the Kinale kale seed production models – Progress. November 2004

Project Progress Reports
Project Progress Report 1. April 2003 – September 2003
Project Progress Report 2. October 2003 – December 2003
Project Progress Report 1. April 2004 – September 2004
Project Progress Report 2. October 2004 – December 2004

Annual Reports
Annual Report 2003
SPENCE, N. (2005) CPP Highlight article for Annual Report: Sukuma Wikii Super Seed.

6. Other Dissemination of Results:

PRA Reports
NJUKI, J., KIMANI, M. and PHIRI, N. (2003) Farmer Perception of Kale Seed Production in Lari Division, Kenya: A Survey Report. CAB International-Africa Regional Centre. 19 pp.

Forms/questionnaires
NJUKI, J., KIMANI, M. and PHIRI, N. (2003) CAB International-Africa Regional Centre. Questionnaire: Farmer perceptions of seed production and marketing

PHIRI, N. (2004) Kinale kale characteristics: Form for data collection. CABI, Nairobi, Kenya.

CABI (2004) Form: Survey of Kinale kale 'variety'. CAB International-Africa Regional Centre.

Fact sheets
PHIRI, N., CHACHA, C., KURIA, A., MWANIKI, A., ACHIENG, B., NDIRANGU, S., SIMONS, S., KIBATA, G., NJUKI, J. and SPENCE, N. (2003) Potential of self selection of seed of tolerant/resistant components of land races of kale for disease management in Kinale.

PHIRI, N., CHACHA, C., KURIA, A., MWANIKI, A., ACHIENG, B., NDIRANGU, S., SIMONS, S., KIBATA, G., NJUKI, J. and SPENCE, N. (2003) Promotion of improved kale seed in Kinale.

Presentations
HOLDERNESS, M., DANIELSEN, S., MATHUR, S., MORTENSEN, C., NATHANIELS and FRIIS-HANSEN, E. (2003) Good Seed Initiative: Improving seed quality and health in staple crops for the resource-poor. East Africa Workshop on the Good Seed Initiative, Sokoine University of Agriculture, Morogoro, Tanzania 4–7 June 2003.

PHIRI, N., KOECH, S., KIMANI, M., CHACHA, D., MBEVI, B. and MUSEBE, R. (2004) Evaluation of the Kinale kale seed production models – Progress. Project Planning Meeting. KARI-NARL. 22 November 2004.

PHIRI, N., KOECH, S., KIMANI, M., MUSEBE, R., KALANGALA, F., CHACHA, D., SPENCE, N., ROBERTS, S., KIBATA, G. and ODUOR, G. (2004) Selection of 'Kinale kale' lines. KARI-NARL. 22 November 2004.

ONIM, M. (2004) (Lagrotech Seed Company) Seed market development for rural farmers. US-Africa Agribusiness Conference, 7–10 November 2004, Marriott Conference Center, Monterey, California, USA.

ONIM, M. (2004) (Lagrotech Seed Company) A report for the CABI Kinale Kale Seed Development Project: Promotion of quality seed project in Kenya by CABI.

7. Listing and reference to key datasets generated:

KARANJA, D. (2003) Dataset: Seed inventory (brassica seed and its suppliers). Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

MOORE, D. (2003) Dataset: Initial data collected from farmers re. criteria and factors affecting purchase/saving of kale seed. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

CABI (2004) Dataset: Njabini kale plant characterisation data. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

COWLEY, L. (2004) Dataset: Small pack seed pricelist 011003. Microsoft Excel Worksheet. Hygrotech Seeds (East Africa) Ltd., Nairobi, Kenya.

KAGECI (2004) Dataset: Kinale kale harvest data – October 2004: effect of kale leaf-harvesting on seed production (on-station and-on farm data). Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

KARANJA, D. (2004) Dataset: Threshed Kinale seed weights – 2003 F1. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

KARANJA, D. (2004) Dataset: Kinale kale characterisation data. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

KARANJA, D (2004) Figure: Kinale kale stem data. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

PHIRI, N. (2004) Dataset: Details of Kinale kale lines – 2004. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

PHIRI, N. (2004) Kinale kale characteristics: General Information sheet for data collection. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

PHIRI, N. (2004) Dataset: Kinale kales – characteristics – March 2004. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

PHIRI, N. (2004) Dataset: Kinale line evaluation. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

PHIRI, N. (2004) Dataset: Kinale seed-characteristics. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

PHIRI, N. (2004) Dataset: Seed stock (Kinale kale) v.210 (SJR)-2. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

CSL (2005) Folder of JPEG files: Library of over 140 images collected for the purposes of project: promotion of quality vegetable seed in Kenya, primarily supplied by CABI, Nairobi, Kenya. CSL, Sand Hutton, Yorks. UK.

KARANJA, P. (2005) Dataset: Kinale kale stem data. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

KARANJA, P. (2005) Dataset: Socio-economic data price range 2-2 December 2004. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

KARANJA, P. (2005) Dataset: Seed harvest data, characterisation and husbandry (on-farm and on-staion) on Kinale kale lines. Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

PHIRI, N. (2005) Table: Seeds infected by fungi (including listings of seed Company/Merchant, kale seed variety, seed lot no.s and place of purchase). Microsoft Excel Worksheet. CABI, Nairobi, Kenya.

8. Follow-up indicated/planned:

Follow-up project confirmed for 2005–2006. The chief objective will be to facilitate the registration and release process of new varieties of Kinale kale whilst also supporting existing informal farmer-to-farmer distribution under the regulation of KEPHIS and in collaboration with KARI and NGOs. Specific outputs will be the continued evaluation of new kale seed lines in trials for distinctiveness, uniformity and stability (DUS) using selfed seeds of each of four kale lines selected by farmers in R8312. In addition, a portion of these seeds will be submitted to KEPHIS National Variety Release Committee, which is made up of all seed companies and organisations who intend to enter their various crop varieties to be tested in the National Performance Trial (NPT). These trials will be conducted at several locations across the country, where the varieties are tested against many other similar varieties entered for NPT by other seed companies and organisations. Participatory multiplication trials of the new kale lines will be conducted at Njabini, KARI-NARL, Thika, Kisumu and Kakamega to obtain performance data on these lines, which may be used while defending the lines during the KEPHIS National Variety Release Committee meeting (March, 2006). Preparatory multiplications of seeds will also be carried out to ensure that sufficiently large amounts will be available when a variety is ready for official release. Genetic stability of kale populations will be assessed, and opportunities for *in situ* and *ex situ* conservation of kale diversity in Kinale will be considered, in consultation with IPGRI in Nairobi. Incidence of seed-borne pathogens of kale in seed production systems will be monitored. (This follows on from work by KEPHIS and KARI in current project R8312 on black rot of brassica (*Xanthomonas campestris* pv. *campestris*) and will form the basis for an MSc thesis by a member of staff at KEPHIS). The release process for new kale seed lines will be initiated through registration with a registered seed business, including consultation over legal matters. After seed growers have produced kale seed that meets all the field KEPHIS certification standards, seed will be bought by the Seed Company, have all post harvest KEPHIS viability and other quality tests done. Seed will then be processed, dressed, packaged as required by seed laws, and marketed within Kenya and beyond. Marketing the Kinale Kale seed to make it well known to farmers will be achieved through several forms of advertising (e.g. posters, brochures, radio, on-farm demonstrations, and agricultural shows). Lagrotech Seed Company already works with over 400 seed stockists all over the country, including marketing through the Kenya Farmers' Association (KFA) that has branches all over the country. Kinale Kale seed will be marketed through these outlets. Sustainable seed production technologies (i.e. management of a seed crop, seed multiplication methods, harvesting, germination, seed processing) will continue to be promoted through on-farm participatory demonstration plots, and via production and dissemination of publicity materials such as leaflets and posters.

9. Name of author of this report:
Dr Nicola Spence

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Evaluation of the effects of plant diseases on the yield and nutritive value of crop residues used for peri-urban dairy production on the Deccan Plateau in India	
DFID Project Reference No:	R8339	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	ICRISAT	
Production System:	Peri-Urban	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to Peri-Urban production systems	
Commodity Base:	Livestock (dairy production)	
Beneficiaries:	Small rural milk and fodder producers on mixed crop-livestock farms and landless peri-urban/urban milk producers	
Target Institutions:	Farmer Self-help Groups, the Rural Development Trust (NGO) and the National Dairy Development Board (NDDB)	
Geographic Focus:	India, but results applicable to South Asia region and sub-Saharan Africa	
Total Cost:	£100,000	
	Planned	**Actual**
Start Date:	01 April 2003	01 April 2003
Finish Date:	31 March 2005	31 March 2005

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1. Project Purpose:

The primary purpose of this extended phase of Project R7346 was to develop a pro-poor integrated disease management strategy to reduce the impact of foliar diseases, improve yield and quality of dual-purpose groundnuts, and reduce (in collaboration with Project R8298) mycotoxin contamination of the crop and milk supplies. The use of new disease-resistant, dual-purpose groundnut and sorghum cultivars, as part of the integrated disease management strategy, will lead to improved food security and increased incomes from the sale of crop residues and livestock products. To achieve this purpose, farmers must have assured access to good quality seed of the improved cultivars. For sorghum, the private seed industry can serve as a multiplier of improved cultivars. For groundnut, to achieve widespread seed dissemination, community-based seed production systems will need to be established through farmer self-help groups and non-government organisations.

2. Outputs:

Output 1. Some 214 farmers from 12 villages have participated in wet season and post-wet season multiplication/distribution of seed of disease-resistant, dual-purpose groundnut cultivars in the traditional groundnut growing district of Anantapur, following integrated management of foliar diseases. Farmer participatory seed multiplication/distribution has been undertaken based on self-help groups, including those of women. Farmers have contributed to village seed banks by returning twice the quantity given to them for planting. Farmers identified the new disease-resistant, dual-purpose ICGV-91114 as the outstanding cultivar for both grain and haulm production and quality. The area under new cultivars is now some 3,000 hectares.

In June 2004, 150 farmers from five villages attended an orientation programme in the local language (Telugu) on the importance of farmer participatory disease management of dual-purpose groundnuts. Discussions took place on foliar diseases, soil-borne diseases, mycotoxin contamination and their management. In January 2005, 140 farmers and staff from NARS, NGOs and the ICRISAT-ILRI attended a stakeholder workshop on integrated crop/disease management in groundnut for more pods, nutritious haulms and mycotoxin-free milk. Discussions were also held on project activities, future opportunities for collaboration and village-based seed multiplication and distribution. The two meetings attracted considerable interest from the local media, and a number of newspaper reports were published in the local language (Telugu).

Output 2. Surveys of sample farmers in the project villages indicate that groundnut accounts for 61–77% of the cropped area. Groundnut haulms provide >50% of dry fodder, and >25% of haulm fed to animals is traded within the village. Also, the farmers are purchasing substantial amounts of paddy rice straw from 100–150 km away, and sorghum straw from nearby villages. Compared to traditional varieties, ICGV-91114 is more resistant to diseases and drought. Mean pod yields for ICGV-91114 are 15% higher than those of local varieties, and mean haulm yields 17% higher. The farmers rated the palatability of the haulm of ICGV-91114, when fed to animals, as superior to that of the local varieties. Laboratory analyses of on-farm groundnut haulms confirm that nutritive value of improved cultivars is high. The ranges for crude protein content, *in vitro* digestibility and metabolisable energy level are 13.9–15.8%, 63.2–65.3% and 8.8–9.2 MJ/kg, respectively.

Output 3. Farmers perceive that foliar diseases reduce pod yields of traditional varieties by 10–20% and haulm production by 20–30%. Farmers observed disease incidence annually, but pest incidence was observed once in two years. Some 72 groundnut haulm samples from six cultivars (ICGS-44, ICGS-11, DRG-12, ICGV-86325, ICGV-92020, ICGV-92093) were collected from farms to study the effects of plant diseases on yield and nutritive value in relation to animal health. Samples were analysed for aflatoxin contamination by the ELISA technique. The aflatoxin contamination in these samples ranged from 0–33 µg/kg, and about 25% of the samples had more than the permissible level. Among the six cultivars, all the 15 haulm samples from ICGV-86325 were contaminated in the range of 12–33 µg/kg. In the other cultivars, the level of aflatoxin contamination was very low.

Output 4. Laboratory measurements of nutritive value were related to animal performance data using simple and multiple regression analyses. Laboratory measurements that predict animal performance accurately were used for the development of near infra-red spectroscopy equations to provide a rapid and non-destructive analytical tool for estimating crop residue feeding value.

Output 5. The groundnut crop on farms in 2003 was badly affected by drought. In 2004 rainfall was good, and data were available from the crops of farmers for economic analysis. Seed is the most expensive input accounting for 36–42% of total costs. Currently, farmers are receiving about Rs 24–28/kg for seed of ICGV-91114 compared to Rs 18–22/kg for seed of traditional varieties. Per unit production costs were lower for ICGV–91114 under both irrigated and rain-fed conditions. The net returns of farmers were 25–29% higher under irrigated and rain-fed conditions, as a result of growing the improved cultivar. Milk yields per animal on farm are 4.36 kg/day with improved cultivars and 3.92 kg/day with local varieties; an advantage of 0.44 kg/animal/day. Some 70–80% of milk is sold through both formal and informal channels, and income from sales ranges from 15–25% at the household level.

3. Contribution of Outputs to Project Goal:

Increased milk production and, therefore, enhanced farm incomes will require more crop residues of higher nutritive value for livestock feed in the future. However, on the Deccan Plateau, where sorghum and groundnut are the main sources of crop residues, plant diseases reduce production. Additionally, the development of mycotoxins by fungi present on the residues is a serious threat to animal health, and through milk, to human health. Breeding efforts have been directed towards meeting the demands of farmers for disease-resistant, dual-purpose cultivars that give high yields of both pods/grain and stover/haulm of

high nutritive value for livestock. In groundnut, resistance to foliar diseases is positively correlated with mycotoxin resistance. Dissemination of genotypes resistant to foliar diseases could, therefore, contribute to reduced mycotoxin contamination.

Outputs stated in the project memorandum form have been met. Disease-resistant, dual-purpose cultivars have been distributed to farmers, and the development of village-level seed multiplication/distribution systems, following integrated management of foliar diseases, has been successful. Farmers are being provided with access to good quality seed of improved cultivars, and have identified ICGV-91114 as outstanding for both grain and haulm production and quality. Farm surveys have confirmed the higher yields of the new cultivar, and laboratory analyses and on-farm feeding trials have confirmed the improved nutritive value and milk production. Thus, more crop residues are available for sale or feeding to livestock, whilst more milk is available for home consumption and sale. On average, farmers sell 70–80% of the milk produced through formal and informal channels. Demand for seed of this cultivar has exceeded supply. To meet requirements, several farmers with irrigation facilities have begun seed multiplication under guidance from NGOs and project scientists. Concurrently, seed traders have begun multiplying seed of the new cultivar on the fields of farmers on a buy-back basis, in anticipation of high demand. The area under improved cultivars is now about 3,000 hectares. As a result of a further extension to the project, it is anticipated that some 18,570 hectares will be under new cultivars by 2006. At current rates of adoption, some 400,000 hectares of groundnut (47% of the total area) will be under improved cultivars in Andhra Pradesh by 2010–11, with further extension of the growing area into the neighbouring states of Karnataka and Tamil Nadu.

4. Publications:

None.

5. Internal Reports:

None.

6. Other Dissemination of Results:

Newspaper and Magazine Articles (in Telugu)

AGRICULTURAL CORRESPONDENT (2004). ICRISAT targets for aflatoxin management and attempts for seed improvement. *Vartha*, 29 June (two articles).

AGRICULTURAL CORRESPONDENT (2004) Experimental validation of a new groundnut cultivar and research attempts to minimize aflatoxin risks. *Andhra Jyothi*, 29 June (two articles).

AGRICULTURAL CORRESPONDENT (2005) High yields with improved varieties. *Eenadu*, 4 January.

AGRICULTURAL CORRESPONDENT (2005) Agriculture development with fodder management. *Vartha*, 4 January.

AGRICULTURAL CORRESPONDENT (2005) Cultivate improved groundnut varieties. *Andhra Jyothi*, 5 June (two articles).

AGRICULTURAL CORRESPONDENT (2005) Farmers are interested to cultivate improved groundnut varieties. *Vartha*, 5th January.

AGRICULTURAL CORRESPONDENT (2005) High yields with ICIRISAT varieties. *Andhra Bhoomi*, 5 January.

Fact sheets, booklets, and information leaflets
PANDE, S., NARAYANA RAO, J. and LAKSHMI REDDY, P. (2004) Groundnut diseases and their management in Andhra Pradesh, India. ICRISAT, Patancheru, Andhra Pradesh, India. 4pp. (20 copies in English and 600 copies in Telugu).

8. Follow-up indicated/planned:

DFID-CPP has agreed to fund a short extension from 1 April 2005 to 31 March 2006. A project memorandum form entitled 'Promotion of farmers participatory management of groundnut diseases for higher yield and nutritive value of crop residues (haulm) used for peri-urban dairy production on the Deccan Plateau in India' was submitted.

9. Name of author of this report:
P. Parthasarathy Rao and Suresh Pande

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Promoting adoption of integrated pest management in vegetable production	
DFID Project Reference No:	R8341	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor	Natural Resources Institute	
Production System:	Peri Urban	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to Peri-Urban production systems	
Commodity Base:	Vegetables	
Beneficiaries:	Smallholder horticultural farmers	
Target Institutions:	HCDA, NGOs, export companies	
Geographic Focus:	Eastern Africa	
Total Cost:	£98,004	
	Planned	Actual
Start Date:	July 2003	1 Sept 2003
Finish Date:	31 March 2005	31 March 2005

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1. Project Purpose:

The project purpose was to promote improved methods for the control of pests and diseases affecting the quality and production levels of vegetables in Kenya, under the wider heading of 'Promotion of pro-poor strategies to reduce impact of key pests and diseases, improve yield and reduce pesticide hazards in peri-urban systems'.

Horticulture provides employment for around 2 million people in Kenya but many horticultural crops are susceptible to pests and diseases. Farmers often rely on chemical sprays to maintain and increase supply to an increasing urban population. They want easy, rapid and reliable crop protection but a common perception is that pesticides are the modern (and hence desirable) solution for successful farming. This training and dissemination-based project aimed to wean growers away from existing practices that include overuse of pesticides and overdosing, wrong choices of product leading to poor efficacy.

The Crop Protection Programme philosophy is that the mix of traditional and newer control techniques, important in integrated pest management (IPM), can reduce reliance on pesticides and improve sustainability. However, it was recognised that there was little objective and scientifically sound information, advice and training material on how to minimise their use or how to use them sustainably. The project supported this need by developing training capacity and piloting an effective system to disseminate information to trainers and farmers to enable them to use IPM to grow safe and healthy crops in a profitable and sustainable way

2. Outputs:

New vegetable IPM Instructor's Resource Kits were developed and used to train sixteen trainee IPM instructors. The kit was based on a training manual covering curriculums at two levels; a training of trainers course and farmer training materials for use by IPM Instructors in conjunction with existing dissemination resources such as handbooks and posters. The training manual contains guidance on course planning and delivery of sessions, practical training exercises, interactive games and materials that can be used in courses or issued as handouts. The manual concentrates on pest management in tomato, brassicas and green beans. The materials, all housed in a strong pilot case, are a tool to help plan and execute

training. Kits included posters, books, calendars, calculators, spray equipment and a hand lens in addition to the manual. Usefulness of the individual components was rated very highly at the workshop that took place after the Instructor's farmer training. Several supplementary dissemination resource materials were produced, including a calendar of IPM and two posters that were translated into Kiswahili. The images for the calendar were based on pest management themes created by the project team. This and the posters were printed in Nairobi. The planned print run of 1000 was doubled following negotiations with the printer. Having 2000 of each resource enabled them to be widely distributed to stakeholders who included the two other CPP dissemination projects on IPM promotion (through CABI and ICIPE) and many horticultural and export companies, outgrowers and organisations with a training mandate in the horticultural industry. All of the farmers (>500) trained by the project received a calendar of IPM and at least two posters. Feedback on the materials was positive and is summarised in the Final Technical Report.

The project timetable was that after the manual had been drafted, a team of would-be vegetable IPM instructors were given a detailed six day intensive course in integrated pest management, then this team carried out individual farmer courses. These instructors, numbering sixteen, and selected from the private, government and NGO sectors had the opportunity on the ToT course to do mock farmer training lessons before doing the real thing when they gave their own courses within six weeks of the end of the primary course. The training curriculum covered; What is IPM, Hygiene and healthy soil, Choosing varieties, Recognition and control of brassica pests and diseases, Recognition and control of tomato pests and diseases, Control of weeds, Recognition and control of bean pests and diseases, Recognition of natural enemies, Encouragement of natural enemies, Scouting, Putting recognition and scouting into practice, Toxicity, safety and first aid, Selective pesticide application, Calibration and residue implications, Spraying techniques, Putting pesticide use into practice, Planning and targeting training, Training techniques, Visual aids, Evaluation of training and Putting training into practice.

When the team of instructors trained farmers (over 500 in number) in how to adopt vegetable IPM techniques their secondary courses were funded by the project. Their trainees consisted of outgrower farmers and some small scale domestic vegetable growers. One third of the trainers' courses were observed by the project team while they taught farmers. Getting farmers to 'do' rather than merely 'listen' had been stressed on the primary ToT course and their own farmer courses were clearly being carried out in a far more participatory way than the traditional lecturing style commonly used with farmers.

Throughout the project, feedback and comments were captured. Information was gathered anonymously from participants after the ToT course and farmer courses. Usefulness of training kit components was also rated, and feedback comments were compiled from trainers and farmers, including how the courses could be improved and what additional resources would have helped. This information helped to formulate the objectives of the one-year project extension which will start in April.

Several impact assessment visits were made in March 2005 to farmers who had attended IPM courses run by project-trained instructors. The aim was not a systematic survey, more an informal appraisal of the success of the training programme so far and an opportunity to gather information that would inform the design and approach of the follow-on phase of the project to 2006. Responses were very positive with farmers stating that the training and materials provided were very useful. An indicator of impact and retention was that farmers could describe several of the calendar cartoons and explain the serious message without a copy in front of them. A direct indicator of adoption was that many farmers said that, since receiving the training, they now scouted rather than calendar sprayed their crops, and now realise how much money they had been wasting.

An assessment was made of the different sectors, in terms of how likely there was to be continuing beneficial impact from the training. For example, while the access, geographical reach and sustainability of agrochemical input agents are high, the integrity of the information may be compromised by the sales motives of the individual. In contrast, access and geographical reach of NGOs may be lower, but the 'fit' with their mission is better and

the long term beneficial impact is likely to be higher. One Instructor working with SACDEP had already delivered two additional farmer courses and was planning another.

3. Contribution of Outputs to Project Goal:

The project goal 'to promote improved methods for the control of pests and diseases affecting the quality and production levels of vegetables in Kenya' was achieved.

The planned outputs were all achieved, and in some cased exceeded. For example the number of printed materials produced and disseminated was greater than those planned.

In terms of numbers trained, the 500 or so farmers whom the project reached are only a small proportion of the production base that consists of many thousands. However the training manual and other resources produced by the team will be a major resource in the longer term. Used to carry out courses at several levels we expect the numbers trained to eventually far exceed the sixteen trainers and many hundreds of farmers who have already been reached by the project.

The project has contributed to the capacity to respond to the national and international groundswell of food safety, human safety and environmental protection, measures that are increasingly affecting the horticultural industry. It has done this by helping growers to overcome the important limiting factor - ability to control pests safely and sustainably. In this way it has made a useful contribution to the wider goal - Promotion of pro-poor strategies to reduce impact of key pests and diseases, improve yield and reduce pesticide hazards in peri-urban systems'.

4. Publications:

DOBSON, H.M., COOPER, J.F. AGUDAH, R. and WAINWRIGHT, H.A (2005) Manual for Trainers – Promoting Integrated Pest Management. Natural Resources Institute, Chatham, UK.

DOBSON, H.M., COOPER, J.F. AGUDAH, R., WAINWRIGHT, H. and MWAMPEMBWA, G.A (2005) Calendar of Integrated Pest Management – Pest Management for Smallholder Farmers. 2000 copies, Natural Resources Institute, Chatham, UK.

DOBSON, H.M., COOPER, J.F., MANYANGARIRWA, W., KARUMA, J. and CHIIMBA, W. The winding Road of Pest Management. Poster. (Swahili translation of poster produced previously) 2000 copies. Natural Resources Institute, Chatham, UK.

DOBSON, H.M., COOPER, J.F., MANYANGARIRWA, W., KARUMA, J. and CHIIMBA, W. (2005) Pests and Diseases of Tomato and Brassica Crops. Poster (Swahili translation of poster produced previously) 2000 copies. Natural Resources Institute, Chatham, UK.

DOBSON, H.M., COOPER, J.F. AGUDAH, R. and WAINWRIGHT, H. (2005) Pests, Diseases and Natural enemies in vegetables. Flash cards Natural Resources Institute, Chatham, UK.

DOBSON, H.M., MATTHEWS, G.A., OLEMBO, S., BALEGUEL, P. and WILES, T.L. (2004) Application challenges for small-scale African farmers: a training initiative in Cameroon. pp. 385–392. In: International Advances in Pesticide Application. *Aspects of Applied Biology*, vol. 71. Bateman, R.P., Cooper, S.E., Cross, J.V., Glass, C.R., Robinson, T.H., Stock, D., Taylor, W.A. Thornhill, E.W. and Walklate, P.J. (Eds). Association of Applied Biologists, c/o Horticulture Research International, Wellesborne, Warwick, UK. ISSN: 0265-1491.

5. Internal Reports:
In addition to quarterly and annual reports:

Visit to Kenya by J Cooper and H Dobson to
- carry out training of horticultural service providers (ICIPE-led project No. B0125)
- to start and set up the NRI-led project to promote IPM (project number A1123).

4–14 November 2003

Promoting adoption of integrated pest management in vegetable production – Report on the training course held in Juja, Thika, Kenya, at AICAD training facility in JKUAT, from 4–9 October 2004

Report on visit to Kenya to observe secondary training and hold a Post-training Workshop, 9–17 November 2004

Report on a visit to Kenya to carry out training impact assessment at farm level, 27 February – 6 March 2005.

Other Dissemination materials:
N/A

6. Other Dissemination of Results:

Course participants were selected to comprise people with a training role in their sectors. This will have an automatic multiplier effect within the companies, NGOs and parastatal organisations in which they work.

The additional copies of the printed posters and calendars allowed them to be distributed much more widely than originally planned. Details of recipients are given in the FTR. They included exporters and NGO groups as well as the two sister CPP dissemination projects led by CABI-ARC and ICIPE. This will strengthen their capacity to disseminate CPP-generated technologies and messages, and will broaden the reach of this project

7. Listing and reference to key datasets generated:

DOBSON, H. and COOPER, J. (2004) in Report on visit to Kenya to observe secondary training and hold a Post-training Workshop, 9–17 November 2004

I. Ranked usefulness of training kit components by trainers
II. Farmer feedback comments
III. Feedback information from trainers following their farmer courses
IV. Distribution list for project training resources (calendars of IPM and posters)

DOBSON, H. and COOPER, J. (2004) List of contact details for participants and trainers in Report on the training course held in Juja, Thika, Kenya, at AICAD training facility in JKUAT, from 4–9 October 2004

DOBSON, H. and COOPER, J. and WAINWRIGHT, H. (2005). Evidence of beneficial impact in Report on impact assessment visits to farmers who had been trained by project Instructors.

8. Follow-up indicated/planned:

Utilisation of the outputs of previous CPP-funded vegetable IPM work has been integrated with existing knowledge and practices within the IPM Instructors' course and other outputs from the project. Now that the Crop Protection Programme is extended to 2006, there is an opportunity to deepen the reach of this dissemination by supporting and developing materials to help the information that can be used by farmers. One concept to reach very large numbers of farmers uses Farmer Trainers, that is trained farmers who go on to deliver peer-to-peer training and awareness-raising in the community. The single year follow up project aims to resource this group so that they can multiply the impact of the parent project more effectively.

9. Name of author of this report:
Hans Dobson

Project Number:	R8440
Project Title:	Implementation of IPM of Fruit Flies in India
Production System & Purpose:	Peri Urban Purpose 1
Project Leader & Organisation:	J. Mumford, Imperial College, London
Location:	India
Start and End Date:	01 February 2005 – 31 January 2006

Project profile
Cost effective IPM technologies have been developed for some of the most damaging fruit pests in Asia. For example the relatively low cost of the parapheromone lure methyl eugenol, attractive to many species of orchard fruit flies in the genus *Bactrocera*, the most common group in India, suggests that the male annihilation technique may be the basic IPM method most suitable for these pests in India, depending on scale and reinvasion rate. However the relatively high cost of the parapheromone Cue-lure, the lure for Melon fly, the key pest of cucurbit vegetables in India, suggests that the bait application technique is the method most suitable for the control of cucurbit flies. The economic returns are much more favourable for village-level control instead of farm-level management – these returns are greater for male annihilation than for bait application technique.In addition a collection of all available published material on fruit flies in India, almost 400 papers and reports, much of it unavailable generally even within India, has been compiled and abstracted for inclusion in the web-based part of the South Asia Fruit Fly Network.

Previous achievements
Not applicable given the project's start date.

Achievements in current year
Not applicable given the project's start date.

Activities for next year
Small amounts of additional field research will permit (a) the closing of the few remaining 'knowledge gaps', particularly the extension of community-based wide-area control from one to ten square kilometres, and (b) the compatibility of controls assessed by the Project (largely bait and lure controls) with other IPM recommendations (particularly cultural controls). Specific activities will finalise research results into a form suitable for community-based extension, and the launch of extension to farming communities and organisations. Additionally a cost-benefit model will be developed to isolate the advantages of each case and to present general rules that can be followed by extension and community organisations.

Dissemination
See *Dissemination Annex*.

Project Number:	R8444
Project Title:	Identifying options to reduce poverty and enhance the livelihoods of small-scale crop-livestock producers in sub-Saharan Africa
Production System & Purpose:	Peri-Urban Purpose 1
Project Leader & Organisation:	J. Lenné, Independent
Location:	Africa
Start and End Date:	01 February 2005 – 31 July 2005

Project profile
Crop-livestock systems produce 92% of the world milk supply, all of the buffalo meat and 70% of small ruminant meat. Small-scale, mixed crop–livestock systems in rainfed sub-Saharan Africa are widespread and more important than any other system in terms of their contribution to the total output of animal products and involve 140 million people. During the past ten years, DFID research programme projects and other DFID projects have made major investments in increasing crop productivity through management of pests, diseases and weeds, genetic improvement and post-harvest management; improving fodder production; and increasing livestock productivity in priority production systems in sub-Saharan Africa to the benefit of the poor. However full realisation of the benefits from this substantial research effort has been hampered by the historical lack of cross-disciplinary and cross-sectoral approaches: research on crops and livestock has been removed from its integrated systems context.

Previous achievements
Not applicable given the project's start date.

Achievements in current year
Not applicable given the project's start date.

Activities for next year
A base of consolidated and synthesised knowledge and lesson-learning - both technical and institutional - from this substantial research investment by DFID and other donors will be an important step to enable improved targeting of the best opportunities for more efficient and effective use of crop-based feed resources, contributing to improved livelihoods, reduced malnutrition and overall poverty alleviation to the benefit of millions of poor in sub-Saharan Africa. This consolidation and synthesis of knowledge and lesson-learning will add considerable value as well as a cross-disciplinary and cross-sectoral framework to the contribution of DFID's past investment in crops and livestock research. A comprehensive database of integrated knowledge and lesson learning from research on two principal production components – crops and livestock will be developed and critical gaps identified as future priority research areas.

Dissemination

See *Dissemination Annex*.