Baits and lures get the upper hand on fruit flies

RIU

Validated RNRRS Output.

Simple, practical and economic fruit fly controls are helping poor farmers in India and Pakistan to cut their losses with tree fruit and cucurbit vegetables. Previously, because these farmers lacked the resources to buy insecticide sprays, they lost as much as 21% of their fruit and 24% of cucurbits to these pests. Home-made baits of banana or raw sugar (bait application technique, or BAT) and wood blocks soaked in insecticide (male annihilation technique, or MAT) are two very effective components of the control package. In cucurbits BAT reduced losses by 50% and MAT by 43%, while together they cut losses by 59%. In orchard fruit, MAT reduced losses by 39%, BAT by 36% and the two together by 69%.

Project Ref: **CPP19:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **Imperial College London, UK**
Source: **Crop Protection Programme**

Document Contents:

Description

CPP19

Research into Use
NR International
Park House
Bradbourne Lane
Aylesford
Kent
ME20 6SN
UK

Geographical regions included:

Bangladesh, India,

Target Audiences for this content:

Crop farmers,

A. Description of the research output(s)

1. Working title of output or cluster of outputs.
In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

IPM of Fruit Flies in Asia and Africa

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

Crop Protection

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

R8089, R8440 Fruit Flies in India
- Indian Council of Agricultural Research
- Indian Institute of Horticultural Research
- Indian Institute of Vegetable Research
- Kerala Agricultural University
- Anand Agricultural University
- Navsari Agricultural University
- Sardarkrushinagar Agricultural University

R6924, R7447 Fruit Flies in Pakistan
- CABI Bioscience
- Pakistan Agricultural Research Council
- Pakistan Agricultural Extension Service

4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? ***(max. 400 words)****. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

The problem was losses caused by the highly destructive *Bactrocera* genus of fruit flies (Diptera: Tephritidae) to tree **fruit** and cucurbit **vegetables**, falling particularly heavily on poor farmers without recourse to cover sprays of **insecticides**. Losses without control have been estimated as 21% of fruit and 24% of cucurbits in Pakistan (Stonehouse *et al*., 1998) and 12% of fruit and 21% of cucurbits in India (Mumford *et al*., 2005).

Outputs were simple, practical and economic fruit fly controls for use by individual farmers and village-level groups, developed in **Pakistan** between 1995 and 1999 and in **India** between 2001 and 2005.

Farm-Level Management studies found that Bait Application Technique (BAT) using home-made baits of banana or raw sugar, and Male Annihilation Technique (MAT) using wood blocks soaked in insecticide and lure, in isolation or in combination as **Integrated Pest Management** (**IPM**) packages, reduced losses to low levels. In cucurbits, BAT reduced losses by 50%, MAT by 43% and both together by 59%. In orchard fruit, MAT reduced losses by 39%, BAT by 36% and both together by 69%. Cultural controls, of fruit collection and soil disturbance, were a useful additional component.

Because of fly mobility and the nature of the IPM technologies, the coordination of control across areas larger than individual farms improves its effectiveness and efficiency. **Village-Level Management** was studied to the differential effectiveness of the same controls when used at the levels of a single farm and a whole village. With BAT in cucurbits, scaling up from farm to village level increased control by 71%. With MAT in orchard fruit, scaling up to village level increased control by 35%. If the returns to IPM are extrapolated by the additional returns to the expansion of scale, the reduction in losses by a village-level IPM package would be 100% in cucurbits, and 93% in orchard fruit.

Controls were optimised by the development of simple research **methodologies** allowing candidate controls to be assessed in the field to identify rapidly the most cost-effective and appropriate to the resources immediately and cheaply available. This will allow the refinement of fruit fly IPM in additional areas, either where research and validation have not yet been conducted or the fly species are recent invaders.

Mumford, J.D. and others. 2005. *Integrated Management of Fruit Flies in India*. Final Technical Report. RNRRS Crop Protection Project R8089. 183pp.
Stonehouse, J.M., Mumford, J.D., Mustafa, G. 1998. Economic losses to tephritid fruit flies (Diptera: Tephritidae) in Pakistan. *Crop Protection* **17**:159-64.

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	*Technology*	*Service*	*Process or Methodology*	*Policy*	*Other Please specify*
	X		X		

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

Horticultural fruits. These include a very wide range in two broad classes –"orchard" tree fruit such as mango, guava and citrus, and all cucurbit vegetables such as melon, cucumber and pumpkin. While fruit flies may attack a wide range of horticultural fruit, we know of no incidence in other commodities.

7. What production system(s) does/could the output(s) focus upon?
Please tick one or more of the following options. Leave blank if not applicable

Semi-Arid	*High potential*	*Hillsides*	*Forest-Agriculture*	*Peri-urban*	*Land water*	*Tropical moist forest*	*Cross-cutting*

	X			X			X

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions).
Leave blank if not applicable

Smallholder rainfed humid	***Irrigated***	***Wetland rice based***	***Smallholder rainfed highland***	***Smallholder rainfed dry/cold***	***Dualistic***	***Coastal artisanal fishing***
X	X					

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).*

Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

Fruit fly IPM is a necessary component of the development of tropical and subtropical horticulture. To maximise its effects in poverty reduction it therefore benefits from integration with the other requisites for horticultural development, and in particular access to markets for horticultural produce (R8274 and R8275 Farmer Access to Markets; R7151 Market Information Tools).

A major role to be played by these outputs in the reduction of poverty will be in Africa, where the *Bactrocera* species, native to Asia where their management was developed, have recently established and are spreading as invasive pests. In Africa, cucurbit vegetables offer considerable resources for future crops, including varieties with drought-tolerance and medicinal properties (Ng, 1993), and are under active promotion (IPGRI, 2004a,b). The development of cucurbit and other indigenous vegetables may enhance resilience as well as diversity (R6964 Indigenous Vegetables).

Work on fruit flies in Africa has been driven by the African Fruit Fly Initiative and a network of individuals and institutions. These have mostly studied the native African pest species, largely in the genus Ceratitis. These may be controlled in similar ways to Bactrocera, but the lures and baits are different, and the African species have not been amenable to control by Male Annihilation, so the Indian/Pakistani experience will be novel in Africa, and form a natural and important complement to work already going on. This also provides an excellent opportunity to develop “South-South” cooperation from Indian and Pakistani RNRRS fruit fly collaborators to work with new partners in all three PSA regions (E, W, S) of Africa, where Bactrocera is currently causing losses.

IPGRI (2004a). Plant Genetic Resources in Sub-Saharan Africa: Cucurbitaceae. www.ipgri.cgiar.org/regions/ssa/SpecificCrops/cucurbitaceae
IPGRI (2004b): Human Aspects: Socioeconomics and Ethnobotany. www.ipgri.cgiar.org/themes/human/ethnobotany.htm#gourds
Ng, TJ (1993). New opportunities in the Cucurbitaceae. pp.538-546. In: J. Janick and J.E. Simon (eds.), New Crops. Wiley, New York. http://www.hort.purdue.edu/newcrop/proceedings1993

Validation

B. Validation of the research output(s)

*10. **How** were the output(s) validated and **who** validated them?*

*Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation **(max. 500 words)**.*

Scientific Validation The findings of the farm-level research activities were gathered together into a single issue of the journal *Pest Management in Horticultural Ecosystems* (Verghese *et al*., 2005), produced as a CD-ROM as well as paper volume, and to promote *Bactrocera* management technologies these were distributed to the 350 participants at the *Seventh International Symposium on Fruit Flies of Economic Importance* in Brazil in September 2006. The findings of the village-level study are appearing in a peer-reviewed international journal (Stonehouse *et al*., in press). Other elements of the work, including that in Pakistan, have been published in peer-reviewed international journals with collaborating authors.

Farm Field Validation With small cucurbit farmers, Government researchers in Kerala and Goa (both members of the original research team) found enthusiastic support from local small farmers. With small and large orchard fruit farmers, cooperatives in Gujarat are finding widespread support for the introduction of controls at cooperative level. In the final year of the Indian project 1,000ha of fruit was under trial management, with saleable yield twice that in comparable unmanaged orchards; 7,000ha were planned for treatment by the Gujarat cooperatives in 2006.

Uptake Validation In parts of India, cooperatives and commercial companies have started to make routine use of fruit fly IPM in services and products (see below).

Stonehouse, J.M., Mumford, J.D., Verghese, A., Shukla, R.P., Satpathy, S., Singh, H.S., Jiji, T., Thomas, J., Patel, Z.P., Jhala, R.C., Patel, R.K., Manzar, A., Shivalingaswamy, T.M., Mohantha, A.K., Nair, B., Vidya, C.V., Jagadale, V.S., Sisodiya, D.B., Joshi, B.K.. In press. Village-level area-wide fruit fly suppression in India: Bait application and male annihilation at village level and farm level. *Crop Protection*.
Verghese, A., Mumford, J.D., Stonehouse, J.M., Sreedevi, K. (Eds). 2005. *Pest Management in Horticultural Ecosystems* **11**(**2**) - *Special Issue on "Integrated Management of Fruit Flies in India"*:

*11. **Where and when** have the output(s) been validated?*

*Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above **(max 300 words)**.*

In cucurbits, fruit fly IPM has been validated with groups of farmers in central Kerala (Thrissur) and Goa (Panaji) by farmer demonstration trials with researchers. As smallholder vegetable growers these are typically in *Irrigated* farming systems. In orchard fruit, wide-area IPM is being extended by cooperatives in southern Gujarat (Navsari) and pre-soaked blocks are being produced and marketed by local companies in central Gujarat (Ahmedabad), following initial demonstrations within the RNRRS research projects. These fruit growing areas are a mixture of *Smallholder Rainfed* and *Irrigated* farming systems. As suppliers of fresh horticultural produce to largely urban markets, these production systems may be categorised as both *Peri-Urban* and *High-Potential*.

Current Situation

C. Current situation

12. ***How and by whom*** *are the outputs currently being used? Please give a brief description* ***(max. 250 words****).*

The status of farmer adoption of fruit fly IPM in India beyond the immediate uptake during the project is currently unclear. Initial reports at the close of R8089/R8440 indicated good farmer responses to wide-scale demonstration/ validation trials, but the state of use in 2006 is not yet known. Adoption of soaked-block MAT by cooperatives and manufacturers continues, with active encouragement from local agricultural suppliers and cooperative managers.

13. ***Where*** *are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used* ***(max. 250 words).***

Cooperatives are promoting MAT in southern Gujarat, India. Small scale local agricultural supply manufacturers are producing MAT blocks in central Gujarat.

14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading ***(max 250 words).***

Among cooperatives, use was established within one year of the participatory validation trials. Use spread in the first year of use by cooperatives, to approximately 1,000ha, with plans for 7,000ha by the same cooperatives in 2006 (after termination of the project). The extent to which it continues to spread is not yet known.

15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? ***(max 350 words).***

Where fruit-growing cooperatives exist, these have been critically important. Cooperatives have the means to distribute low-cost tools such as lure blocks, and the technological information to use them. As importantly, as consumers and sellers of produce, they are seen by farmers as having interest in the profitability of production, whereas chemical salesmen are suspected of interest in selling their own products rather than optimising farmers' own returns. These advantages are also properties of NGOs, which may be able to promote technologies in

similar ways. Wholesale buyers have also played a part in spreading area-wide fruit fly control technology, through provision of technical advice and immediate financial responses to improved quality and quantity of production.

Fruit fly IPM is counterintuitive when first explained, and farmers are reluctant to try it without some demonstration, so a process of demonstration/validation trials on a scale sufficiently small for all farmers to witness them at first hand is very important.

Current Promotion

D. Current promotion/uptake pathways

*16. **Where** is promotion currently taking place? Please indicate for each country specified detail what promotion is taking place, by whom and indicate the scale of current promotion **(max 200 words).***

Current active promotion is being carried out by two large cooperatives in Navsari, southern Gujarat, India. These two cooperatives have approximately 4,000 members.

*17. What are the current barriers preventing or slowing the adoption of the output(s)? Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. **(max 200 words)**.*

A major barrier to adoption is the lack of impetus provided at official level, mainly because the large-scale promotion of technologies is the task of institutions, both official and NGOs, which are largely generalists, whereas IPM requires the input of specialists. Fruit fly IPM has yet to “cross the barrier” from specialist to generalist institutional attention.

Because fly lure is used and therefore bought in tiny quantities, it is not usually currently sold in sealed containers such as small ampoules, but the retailer dispenses it with a pipette into a bottle; as a result, farmers have no guarantee the product is not adulterated and this must be addressed by either (a) provision by trusted sources such as cooperatives or (b) provision of factory-sealed smaller packages (such as pre-soaked blocks, as is done by some Indian suppliers in response to R8089).

Most countries’ pesticide legislation requires that the admixture of a pesticide with any other component comprises a “new formulation” and therefore must complete the whole registration process in its own right. This gives the provision of MAT blocks by the private sector a prohibitively high entry cost.

*18. What changes are needed to remove/reduce these barriers to adoption? This section could be used to identify perceived capacity related issues **(max 200 words).***

Promotion of fruit fly IPM needs its incorporation into the generalist promotion activities of NGOs and Government agencies, A holistic “package” of horticultural development needs a fruit fly IPM component, and *vice versa*.

Regulations and advice need to be developed to allow the commercial production of MAT inputs in a form which farmers will trust. MAT blocks need to be legally sellable as pre-prepared blocks whose packaging specifies their contents, without the costly process of re-registration of each block type as a "novel pesticide formulation". Discussions have revealed that regulators understand this problem, but there is no obvious and clear "form of words" to allow MAT blocks to be exempt from requirements, and developing this would be a major contributor to success.

19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor people? ***(max 300 words).***

1. Fruit fly IPM benefits from integration into horticultural development packages to provide incentives to use.
2. Inputs which need to be purchased (lure blocks) must be made legally and cheaply available by local suppliers.
3. Locally-specific adaptive research is needed to ensure suitability for local people.
4. Demonstration trials which farmers can witness firsthand provide important reassurance. These may be combined with (3).

Impacts On Poverty

E. Impacts on poverty to date

20. Where have impact studies on poverty in relation to this output or cluster of outputs taken place? This should include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.

No studies specific to poverty levels have been carried out. However, quality and quantity of sales have been monitored in individual and village level trials. These show that, at village level, participating farmers can double their sales with minimal inputs of cash or labour. For most of these farmers fruit or vegetable sales are their main form of income, often from seasonally rented land in the case of vegetable growers.

21. Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) ***(max. 500 words):***

- *What positive impacts on livelihoods have been recorded and over what time period have these impacts been observed? These impacts should be recorded against the capital assets (human, social, natural, physical and, financial) of the livelihoods framework;*
- *For whom i.e. which type of person (gender, poverty group (see glossary for definitions)) has there been a positive impact;*

- *Indicate the number of people who have realised a positive impact on their livelihood;*
- *Using whatever appropriate indicator was used detail what was the average percentage increase recorded*

The information in Section 20 relates to male horticultural farmers in the *Moderate Poor* category in India. While costs and returns were recorded, the impact on actual livelihoods was not.

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

Direct environmental benefits are from the reduction in levels of pesticide use. Fruit fly IPM dramatically reduces the doses and costs of pesticide needed for fruit fly control and avoids direct contact of insecticides with produce. Bait and male annihilation methods have no drift and very little run-off, so their reduced impacts go beyond that caused by simply reducing the volumes of insecticides.

Indirect environmental benefits are two-fold. First, the promotion of horticultural tree crops may protect soil where the cultivation of arable crops creates erosion risk with repeated ploughings. Second, bait and lure controls, as they work individually as well as part of a package, are a good introduction to the whole concept of IPM and ecologically informed pest control, and so a good “trail blazer” for any general policy of the promotion of IPM.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

Bait and lure fruit fly controls do contain insecticides and so, while doses and costs entailed are much less than for cover sprays, to benefit the poorest they will require use and handling of pesticides by people who currently, or without IPM promotion, may not use them at all. Promoting the understanding of pesticide risks and precautions is another reason why IPM promotion needs to be holistic.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

Not really. Horticultural IPM is to a great extent part of a process of moving from subsistence to market agriculture, which arguably increases mutual dependence and lowers resilience. It does, however, improve livelihoods and provide a better financial base to withstand changes that may arise (including stresses on production induced by climate change).