

CROP PROTECTION PROGRAMME

Fruit and Vegetable Fly Management in Pakistan

R 7447 (ZA 0318)

FINAL TECHNICAL REPORT

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Executive Summary

This project built on the success of an earlier one (R6924, ZA0195) which assessed the performance in farm fields of technologies to control fruit flies with reduced insecticide use, cost and labour than cover sprays, producing firm identification of improved technologies. This project presented the findings, together with evaluation of the implications of fruit fly management, at a workshop for policy makers and others in Pakistan, where uptake pathways were assessed for the promulgation of sustainable and economic fly control, together with other issues of fruit fly management such as quarantine. The projects have generated considerable enthusiasm for the adoption of improvements among key sections of the Pakistan agricultural establishment.

Background

Fruit flies are a major constraint to the production of fruit and vegetables in Pakistan. An earlier DfID Renewable Natural Resources Knowledge Strategy project demonstrated losses of approximately \$150 million/year (at current exchange rates) from a complex of fruit flies (Stonehouse, Mumford and Mustafa, 1997). Fruit flies of the genus *Bactrocera* are the primary cause of loss. Pakistan also faces a significant quarantine threat due to the presence of *Ceratitis* spp (which are more serious pests of citrus than *Bactrocera* spp) in the Mediterranean and Middle East.

The response to fruit flies in Pakistan has taken three forms. For the large number of small fruit and vegetable growers with limited resources no control is undertaken, fruit is often picked while green, avoiding loss but reducing value, or if left to mature damaged fruit is simply culled. Over the past three decades various schemes have been initiated to distribute fly traps in an effort to control fruit flies, both in commercial and non-commercial sectors. More recently larger commercial growers have resorted to intensive insecticide cover sprays. None of these methods has proved acceptable or fully effective, and cover sprays have resulted in rejection of produce exported to SE Asia and Dubai, while the continued presence of fruit flies has resulted in a refusal to import Pakistani produce in Japan (*The News*, Islamabad, August 1998).

Horticultural production is a significant agricultural sector (6.2 million tonnes of production) with over \$50 million in fruit exports in 1998 (Pakistan Ministry of Food, Agriculture and Livestock statistics). Only 3% of production is exported, mainly to SE Asia and the Gulf. Exports are expected to increase substantially in future years, assuming reliable quality is achieved, and the value of fruit and vegetable production may exceed cotton within a few years, especially if an export horticultural market develops as it has in a number of other Asian and African countries.

While fruit production provides an average of 39kg/person/year there is considerable variability in consumption by different social groups. Access to fruit by the poor in rural areas is limited, both in quality and quantity. Observation of fruits in this project showed 17% lost to theft, almost all in the early season when they are unguarded. These fruit are unripe and less nutritious. Pre-harvest losses, mainly from fruit fly vary by type and season of fruit for main/late season fruits they range from

20-80%. Post-harvest losses are reported to be 20-40%, some of which is exacerbated by pre-harvest fruit fly attack.

Project Purpose

The research project was established to develop and demonstrate improved fruit fly management. The follow-on project aimed to extend awareness of fruit fly problems and management options, and to agree future directions for extension, further research and the improvement of fruit fly quarantine.

Research Activities

A research project comprising two major components was undertaken over two years in the laboratory and the field, with staff from CABI Bioscience and local universities, with supervision in field management, research design and statistical interpretation from John Stonehouse, John Mumford and David Huggett from Imperial College, London. Further collaboration has involved participation by local fruit growers in the Punjab and NWFP, the University of Arid Agriculture, Rawalpindi, Punjab, the Peshawar Agricultural University, Peshawar, NWFP, the Agricultural Extension services at RY Khan and DI Khan, Punjab, the Arid Zone Research Institute at DI Khan, Punjab and the Ayub Agricultural Research Institute at Faisalabad, Punjab.

The field programme of on-farm trials of innovative technologies in four locations:

- Faisalabad, Punjab
- RY Khan, Punjab
- DI Khan, Punjab
- Mardan, NWFP

Three studies focussed on the damage and control of fruit flies, investigating:

- Relationship between fly infestation and damage (field study near Mardan, NWFP)
- Development of low cost protein baits (laboratory and field, Rawalpindi, Punjab)
- Optimisation of wood blocks for male annihilation (field study, Bhakkar, Punjab)

A one-day research methods training workshop in March 1999 for 15 attendees for research students and field supervisors involved in the research project and local university staff at CABI Bioscience, Rawalpindi to train participants in fruit fly identification, preservation, laboratory rearing and handling, and field loss assessment.

Milestone

A one day workshop was held on 24 February 2000 at Islamabad to present an analysis of the fruit fly problem and results from the field and laboratory studies on fruit fly control, and to develop a consensus for a future approach to fruit fly management covering both non-commercial and commercial horticultural sectors. This was attended by 32 participants from large and small-scale fruit producers,

government research, extension and quarantine services, NGOs, international donor agencies and universities. The workshop was covered by the local press, with a reporter observing and interviewing participants.

Outputs

Field research demonstrated yield and quality improvements following BAT application on guava, melon and jujube, and MAT on mango. Untreated fruit fly losses were up to 80% for guava, 40% for jujube, and 30% for melon; with BAT protection losses were reduced to 17% (guava), 3% (jujube) and 3% (melon). Untreated losses in late season mango were 20%, while MAT protection gave 0% loss. Insecticide cover sprays were approximately half as effective as BAT.

An alternative protein bait mixture using meat broth was demonstrated to be about 70% as effective as commercial protein hydrolysate. Brush application was as effective as spraying, and Malathion gave faster kill than Dipterex.

Studies on the seasonal progression of damage showed that attacked fruits remain on the trees, that fallen fruits do not attract oviposition, BAT reduced oviposition.

Square plywood blocks were shown to be the best shape and material for MAT application. A mixture of 6:4:1 was the optimal ratio of solvent (ethanol):lure (methyl eugenol):insecticide. Drying blocks did not reduce performance, but makes them much easier to handle. The effectiveness of blocks reduces by half after one month, and blocks should be replaced in field control programmes after 3-4 weeks.

MAT is well suited to large areas of fruits with lower levels of attack (for example mango plantings over several hectares) in which the blocks can be applied and replaced from the beginning of the fruiting season. BAT is more suited to smaller or scattered areas in which spot treatments can be applied, and are essential in fruits with high levels of attack (such as guava) since BAT gives control of both males and females. BAT must also be applied regularly from the beginning of the fruiting season. Both BAT and MAT offer substantial improvements in cost effectiveness, with much reduced operator exposure and no pesticide residue compared to cover spraying. Beneficial insects are not attracted in either case, so both BAT and MAT are appropriate as components in integrated crop management programmes in which other fruit pests are controlled by parasites and predators. Crop hygiene is an important companion component for effective crop protection using BAT or MAT.

Fruit fly management is an important component of any effort to increase the quality and quantity of fruit production. There are two ways in which fruit fly management is likely to be taken up: individual application of BAT/MAT (as appropriate) by commercial fruit growers as a replacement for insecticide cover sprays; local area-wide management programmes organised at a village level by government or NGOs as part of projects to uplift fruit and vegetable production in resource poor areas so that producers can move from home consumption and local trading into the formal market sector.

Contribution of Outputs

Following the 24 February 2000 Workshop it was agreed that the following would occur:

- Adoption of the BAT and MAT techniques by the Swiss Development Co-operation Project of Horticultural Promotion in the NWFP, in which crop protection will be managed by staff of the fruit fly project
- Form 17 approval (full commercial sale based on registration in an OECD country) for importation of protein hydrolysate bait (BAT) and methyl eugenol lure (MAT) will be supported by members of the pesticide registration board
- Pesticide importers will begin internal discussions on market development for BAT and MAT materials
- Adoption of BAT and MAT techniques to replace cover sprays on approximately 1000 ha of export fruit on Ali Khan Tareen Farms, Lodharn and other sites, Punjab through direct import of materials
- Completion during 2000 of three MSc degrees based on participation in project research (Peshawar Agricultural University, University of Arid Agriculture); one of the students has been taken onto full-time employment by CABI Bioscience
- Support was expressed by the Chairman of PARC for increased extension and quarantine activity to protect the growing horticultural sector
- Proposal for a village level fruit production survey as a starting point for a fruit management training and implementation programme (CABI Bioscience Pakistan)
- Proposal for fruit fly management extension support programme under the Government of Pakistan agricultural Productivity Enhancement Programme (PARC) and Agricultural Sector Investment Programme (PARC)
- Proposal for quarantine [risk assessment; training; legislation/institutions; surveillance implementation] (PARC)
- International publication is planned on seasonal progress of loss; development of low cost BAT and MAT application; on-farm trials of fruit fly management
- NGOs and donors involved in the horticultural sector in Pakistan have been exposed to the menace of fruit flies and the potential for effective, low cost and environmentally acceptable management with low technology demands

Abbreviations in text and presentations:

BAT	Bait application technique
CI	Confidence interval
DfID	United Kingdom Department for International Development
FAO	Food and Agriculture Organisation of the United Nations
Ha	Hectare
Kg	Kilogram
L	Litre
MAT	Male annihilation technique
MFAL	Pakistan Ministry of Food, Agriculture and Livestock
ml	Millilitre
NGO	Nongovernment organisation
NWFP	Northwest Frontier Province of Pakistan
OECD	Organisation of Economic Co-operation and Development

PARC	Pakistan Agricultural Research Council
SIT	Sterile insect technique
SPS	Sanitary and Phytosanitary [agreements under WTO]
UK	United Kingdom
USA	United States of America
WTO	World Trade Organization

Reference:

Stonehouse, J.M., Mumford, J.D., Mustafa, G. (1997) Economic losses to Tephritid fruit flies (Diptera: Tephritidae) in Pakistan. *Crop Protection* **17**:159-164.

Inventory Control Form

NRIL Contract Number: ZA0318

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No equipment over £500 or suitable for inclusion was obtained.