Fruit fly management in Pakistan

CABI Bioscience Pakistan
Imperial College, London

Funding from United Kingdom Department for International Development Renewable Natural Resources Knowledge Strategy Crop Protection Programme
Fruit fly management in Pakistan

John Mumford
Fruit fly management project

- The fruit fly problem
- Research programme for management
- Options for future management
- A fruit fly management plan for Pakistan
Fruit production in Pakistan
(FAO and Pakistan MFAL Databases)

• All fruit 6.2 million tonnes 1998
  • up from 3.9 million tonnes 1990
  • 39 kg/person/year

• Most fruits susceptible to some fruit flies
  • Citrus 2.1 million tonnes 1998
  • Mango .92 million tonnes 1998
  • Guava .45 million tonnes 1998
Fruit exports from Pakistan
(Pakistan MFAL Database)

- All fruit exports $55 million
  - fresh fruit is about 40%
- 202,000 tonnes (3%)
- Average value about $272/tonne
  - average for all fruit is $148/tonne
- Substantial opportunity for additional exports with good quality
Export and production problems

- Export
  - Quality demands in high value markets in the Gulf and SE Asia
  - Pesticide residue rejections in SE Asia

- Production
  - Small scattered farms
  - Poor access to inputs, information, markets
  - Post-harvest handling losses up to 40%
The fruit fly problem

- Poorly managed fruit fly control
  - lack of control on poorer farms
  - cover sprays are not ideal
- Income reduced
  - commercial producers
  - farm labour
- Health problems
- Quarantine risk
Income affected by fruit flies

- $150 million/year lost production
  - despite control efforts
- 50-90% of late season fruit affected, depending on variety
- Exports lost due to quarantine
  - added cost of post harvest treatment for export
Health is affected by fruit flies

- Children suffer from diarrhoea from eating infested fruit
- Pesticide residues and drift from cover sprays can cause illness
- Diet is poor with less fruit
**Quarantine risk from fruit flies**

- Fruit flies are the major quarantine pests
  - Europe, USA, Japan and Australasia
- Pakistan on the Mediterranean/Asian ecological border
- Egypt is a recent victim of an Indo-Pak fruit fly invasion ($100 million/year)
- Pakistan faces a risk both as an importer and an exporter
Bactrocera *fruit fly species*
Ceratitis *fruit fly species*

Present
Eradicated
Fruit fly risk to/from Pakistan

Ceratitis
Bactrocera
The quarantine “front lines”

Ceratitis
Bactrocera
Research project and results

- John Stonehouse
- Riaz Mahmood
- Qamar Zia
- Abdul Hai
- Muhammad Afzal
Plan for fruit fly management

- Objectives
  - commercial sector sales
  - village consumption

- Outputs
  - Bait and Male annihilation capacity
    - materials in the markets, use organised

- Activities
  - commercialisation, extension, NGO mobilisation, research, quarantine
A research project comprising two major components

- Programme of on-farm trials of innovative technologies in four locations
- Three focussed studies on the damage and control of fruit flies
  - Relationship between fly infestation and damage
  - Development of low cost protein baits
  - Optimisation of wood blocks for male annihilation
Farm-Level Assessment of Innovative Options for Fruit Fly Control in Pakistan

Riaz Mahmood
Opportunities for Fruit Fly Control

- Cover sprays
- Bait Application Technique (BAT)
- Male Annihilation Technique (MAT)
- Sterile Insect Technique (SIT)
- Biological Control
Fruit Flies of Major Economic Importance in Pakistan

- *Bactrocera zonata* (Saunders) - Peach Fruit Fly
- *Bactrocera dorsalis* (Hendel) - Oriental Fruit Fly
- *Bactrocera cucurbitae* (Coquillet) - Melon Fly
- *Dacus ciliatus* (Loew) - Cucurbit Fly, Lesser Pumpkin Fly
- *Carpomya vesuviana* (Costa) - Ber Fruit Fly
Programme of Field Research, 1998-1999

• BAT
  • Guava    DI Khan, Mardan
  • Jujube   DI Khan, Faisalabad
  • Melon    RY Khan, DI Khan, Faisalabad

• MAT
  • Mango    RY Khan
Guava infestation in BAT & check plots
Ripe fruit sampled before harvest

DIK A - Check
Uninfested (17.00%)
Infested (83.00%)

DIK A - BAT
Infested (7.00%)
Uninfested (93.00%)

DIK B - Check
Uninfested (23.00%)
Infested (77.00%)

DIK B - BAT
Infested (27.00%)
Uninfested (73.00%)

Mardan - Spray
Uninfested (60.00%)
Infested (40.00%)

Mardan - BAT
Infested (17.00%)
Uninfested (83.00%)
Jujube infestation in BAT/check plots
D.I. Khan - before and at harvest

Ripe fruit - Check
- Infested (43.33%)
- Uninfested (56.67%)

Ripe fruit - BAT
- Infested (3.33%)
- Uninfested (96.67%)

Harvest - Check
- Infested (64.98%)
- Uninfested (35.02%)

Harvest - BAT
- Infested (0.00%)
- Uninfested (100.00%)
Jujube infestation at harvest
Check, BAT & Cover sprays, Faisalabad

Check
Infested (2.13%)
Uninfested (97.87%)

BAT
Infested (0.66%)
Uninfested (99.34%)

Cover spray
Infested (1.07%)
Uninfested (98.93%)
Melon infestation in BAT & check plots

RY Khan - before and at harvest

Before harvest - Check
- Infested (23.33%)
- Uninfested (76.67%)

Before harvest - BAT
- Infested (1.67%)
- Uninfested (98.33%)

Harvest - Check
- Infested (5.62%)
- Uninfested (94.38%)

Harvest - BAT
- Infested (0.56%)
- Uninfested (99.44%)
Melon infestation in BAT & check plots
DI Khan - before and at harvest

Before harvest - Check
- Infested (20.00%)
- Uninfested (80.00%)

Before harvest - BAT
- Infested (5.00%)
- Uninfested (95.00%)

Harvest - Check
- Infested (6.13%)
- Uninfested (93.87%)

Harvest - BAT
- Infested (0.65%)
- Uninfested (99.35%)
Infestation in check/BAT/sprayed melon
Faisalabad - before and at harvest

Before harvest - Check
- Infested (10.00%)
- Uninfested (90.00%)

Harvest - Check
- Infested (2.87%)
- Uninfested (97.13%)

Before harvest - BAT
- Infested (0.00%)
- Uninfested (100.00%)

Harvest - BAT
- Infested (1.64%)
- Uninfested (98.36%)

Before harvest - Spray
- Infested (0.00%)
- Uninfested (100.00%)

Harvest - Spray
- Infested (1.65%)
- Uninfested (98.35%)
Pristine melon yield with/without BAT
Kg/hectare - five farms

- Faisalabad
- DI Khan B
- DI Khan A
- RY Khan B
- RY Khan A

BAT
Check
Melon yields with and without BAT
Kg/ha - 15 Kulachi melon farms
Mango infestation in check & MAT plots

Early-season varieties, before harvest

A - Check
- Infested (3.33%)
- Uninfested (96.67%)

B - Check
- Infested (6.67%)
- Uninfested (93.33%)

C - Check
- Infested (10.00%)
- Uninfested (90.00%)

A - MAT
- Infested (0.00%)
- Uninfested (100.00%)

B - MAT
- Infested (0.00%)
- Uninfested (100.00%)

C - MAT
- Infested (0.00%)
- Uninfested (100.00%)
Mango infestation in check & MAT plots
Late season varieties, ripe & harvest

Ripe fruit - Check
- Infested (20.00%)
- Uninfested (80.00%)

Ripe fruit - MAT
- Infested (0.00%)
- Uninfested (100.00%)

Harvest - Check
- Infested (13.51%)
- Uninfested (86.49%)

Harvest - MAT
- Infested (0.00%)
- Uninfested (100.00%)
Mango infestation in check & MAT plots
Early-season varieties, at harvest

A - Check
- Infested (4.38%)
- Uninfested (95.62%)

A - MAT
- Infested (0.41%)
- Uninfested (99.59%)

B - Check
- Infested (15.79%)
- Uninfested (84.21%)

B - MAT
- Infested (0.00%)
- Uninfested (100.00%)

C - Check
- Infested (5.26%)
- Uninfested (94.74%)

C - MAT
- Infested (0.00%)
- Uninfested (100.00%)
Summary

- **Guava, season end infestations**
  - BAT 17% Untreated 80%
  - Cover spray 40%

- **Jujube**
  - BAT 3% Untreated 43%

- **Melon**
  - BAT 3% Untreated 26%

- **Mango, late season**
  - MAT 0% Untreated 20%
The role of fruit flies in damage and loss of plums

Abdul Hai
Fruit fly losses may be from

- 1- infested fruit harvested but of no value
- 2- infested fruit which fall from the tree
- 1 is shown by data on percentage infestation of fruit on the tree and at harvest; but if 2 is prevalent then these data will underestimate true losses
Fruit fly losses

- Infestation is often higher in fruit on the ground than in fruit on the tree, because:
  - infested fruit are more likely to fall
  - fallen fruit are attacked on the ground
  - more developed, riper fruit are more likely to be infested and to fall
Observations from quantification of fruit progress

- Fruit fly larval survival was low, at 36%
- Fruit fly attacked 23% of fruit in unprotected orchards; 13% in protected orchards, larvae emerge in 6% of fruit in both
Observations from quantification of fruit progress

- Losses of fruit were 6% to fruit bats, 3% to birds, 17% to human theft
  - thefts were largely of green fruit early in the season, 14% of fruit fell from the tree and 60% survived until harvest
- Bat losses were greatest on the west side of trees
  - there were no significant differences in the compass orientations of losses to flies, birds or humans
Timing of fruit fates - BAT trees

Number of fruit suffering each fate

Days into the fruiting season

Fruit fly
Theft
Bird
Bat
Fell
Harvest

Pakistan-United Kingdom Fruit Fly Management Workshop 24 February 2000
Timing of fruit fates - Check trees

Number of fruit suffering each fate

Days into the fruiting season

Fruit Fly
Theft
Bulbul
Bat
Fell
Harvest
The relationship between attack, ripening and drop

- Fruit are rarely attacked after they fall to the ground (1 fruit in 1200)
- Attacked fruits do not fall before unattacked fruits
- Attacked fruits ripen at the same rate as unattacked fruits
The relationship between attack, ripening and drop

• Faster-ripening, more developed fruits were no more likely to be attacked or to fall prematurely
• Most loss comes from unsaleable but harvested fruit, not from fruit flies causing fruit fall before harvest
Assessment of low-cost bait control of fruit flies in Pakistan

Qamar Zia
Fly mortality comparison

Commercial mix: Water only

Water only (7.61%)

Commercial mix (92.39%)
Fly mortality comparison
Commercial mix:Commercial mix

Commercial mix (50.45%)
Commercial mix (49.55%)
Fly mortality comparison
Commercial mix: Insecticide only

Insecticide only (6.32%)
Commercial mix (93.68%)
Fly mortality comparison

Commercial mix: Home-made mix

Home-made mix (40.71%)

Commercial mix (59.29%)
Fly mortality comparison
Home-made mix with/without urea

- Home-made mix (50.00%)
- minus urea (50.00%)
Fly mortality comparison
Home-made mix with/without cucumber

Home-made mix (49.53%)
minus cucumber (50.47%)
Comparison of bait substrates
Fly catches per baitspot after 5 days

Plastic
Cloth
Wood
Leaves

Mean catches and 95% C.I.s

0  2  4  6  8  10  12
Comparison of bait strengths
Fly catches per baitspot after 10 days

Mean catches and 95% C.I.s

Bait strength (ml/l)

Mean catches and 95% C.I.s

Pakistan-United Kingdom Fruit Fly Management Workshop 24 February 2000
Comparison of baits and applicators
Fly catches per baitspot after 5 days

- Home-made, sprayer
- Commercial, sprayer
- Home-made, brush
- Commercial, brush

Mean catches and 95% C.I.s
Comparison of baits and insecticides
Catches per baitspot after 5 days

- Home-made, dipterex
- Home-made, malathion
- Commercial, dipterex
- Commercial, malathion

Mean catches and 95% C.I.s
Summary

- Beef broth 71% effect of commercial protein hydrolysate
- Brushes are as effective as spraying
- Dipterex is 62% as effective as Malathion
- Spray is most effective on foliage
- Urea and cucumber extract gave no benefit
- Possible health risks mixing insecticide and beef broth - care should be taken!
Optimisation of wood blocks for Male Annihilation Technique in Pakistan

Muhammad Afzal
Results

• A series of acetate overheads were displayed to show the results of MAT block experiments which are summarised in the next slide
Summary

- Blocks attract and kill flies in the field for about four weeks
- Plywood gave the best results
- Square and rectangular blocks were more effective than round or hexagonal blocks
- Lure:insecticide:alcohol ratio of 6:4:1 was most effective
Conclusions and implications of the Pakistan-UK Fruit Fly Project

John Stonehouse
What we have found so far

- Presence of flies
- Distribution, abundance and damage
- Control effectiveness
- Control cost-effectiveness
Questions remaining

• Scale effects
• Application
• Markets and flows of resources
• Extension and flows of information
Challenges remaining

- MAT-BAT as orphan technologies
- Safety and health risks
- Need for publicity and information provision to ensure that there is a successful launch of the technology
Objectives and options for fruit fly research and control

Workshop sessions
24 February 2000
Workshop planning session

- Objectives
  - commercial sector sales
  - village consumption

- Outputs
  - Bait and Male Annihilation capacity
    - materials in the markets, use organised

- Activities
  - commercialisation, extension, NGO mobilisation, research, quarantine
Workshop sessions

• Research needs for on-farm control
  • Riaz Mahmood
• Extension and technology transfer
  • Ashraf Poswal
• Commerce, markets and supplies
  • John Stonehouse
• Quarantine challenges
  • John Mumford
Workshop outputs

• Objectives
  • objectives relevant to commercial orchard sector and to village consumption

• Outputs
  • what will be achieved or delivered?
  • what timescale?

• Activities
  • what should be done? where? by whom?
  • likely costs and resources