Geographic distribution, population dynamics and management of the Mediterranean fruit fly in northern Mediterranean countries

Nikos Papadopoulos
Laboratory of Entomology and Agricultural Zoology
University of Thessaly, Greece
Synopsis

• Geographical distribution and origin
• Distribution in Europe and Mediterranean
• Life history, overwintering, and population dynamics across a gradient of latitudes
  – Crete, south Greece
  – Chios, central Greece
  – Volos, central Greece
  – Thessaloniki, north Greece
  – Podgorica, Montenegro
  – Dubrovnik, Croatia,
  – Split, Croatia
• Summary of medfly phenology in different Mediterranean countries
• Modeling phenology and management decisions
• Conclusions
Mediterranean fruit fly, *Ceratitis capitata*, (Diptera: Tephritidae)

**Biological characteristics**
- Extremely polyphagous
  - Hosts: > 300 fruit species
- Multivoltine
  - 3 – more than 10 generation per year
- Plastic adjustments in life history traits
  - Thermal plasticity
- Geographic Distribution
  - Cosmopolitan
- One of the most important pest for the word fruit production
  - Stone, Pome, Citrus, other
- Control extremely difficult
  - Area wide control
Global Geographic Distribution

Malacrida et al 2007
Life cycle

1. Winter resting stage
2. Spring emergence
3. Adult female
4. Adult male
5. Egg laying
6. Larva
7. Graph showing seasonal activity
8. Overwintering site
Seasonal development
Distribution in Mediterranean and Europe

- Frequent detection in northern Mediterranean coasts
- Routes of dispersion
  - coastal areas
  - valleys

Medfly detection
Aim of the current paper

• Review the phenology of medfly
  – emphasis on cooler more temperate areas

• Define key life history traits of such a successful invader

• Understand phenology in extreme environments

• Understand patterns of dispersion in northern-temperate areas

• Develop simple model to base management strategies.
Methods

• Case studies along a gradient of latitudes
  – Crete, Greece
  – Chios, Greece
  – Volos, Greece
  – Thessaloniki, Greece
  – Montenegro
  – Dubrovnik, Croatia
  – Split, Croatia

• Summarize the phenology in different Mediterranean areas

• Life history data
  – Field and laboratory studies
Study areas
Life history, overwintering, and population dynamics in temperate areas
Crete, Greece

- Both adults and immature stages survive during winter
- Long developmental duration of immatures

Chios, Greece

Larvae within citrus fruits overwinter

Volos, Greece

- Mainly larvae within fruits overwinter, and pupae

Papadopoulos et al. 2010
Northern Greece

Adult phenology
Montenegro, Croatia

Split Croatia
Dubrovnik Croatia
Montenegro

Bjelics et al. 2007
Radovic 2010. (unpublished data)
How populations persist in cooler temperate areas?

Life history adjustments?

What makes medfly such a successful invader?
Survival of larvae in field conditions

Only larvae survived from autumn to spring

Survival of larvae in field conditions results.

Low temperatures + appropriate host

y = -6.9 + 18.3x - 11.1x^2 + 2.1x^3

r^2 = 0.93

Immature stages up to 6 months

Time that larvae left fruits to pupate

Plasticity in immatures developments

Papadopoulos and Katsoyannos 2002, unpublished data
Adult emergence, survival, and oviposition in field conditions

- Adult emergence
- Survival
- Egg laying

- April May June July Aug.
- Blossom
- Fruits ripening

Plasticity + adaptation

Adults longevity > 4 months
Variability in adult demographic traits

Variability in female traits among different biotypes

Model on medfly phenology in northern Greece

Adults occurrence (generations)

Overwintering larvae
Overwintering pupae

Overwintering generation >10 months

- Apricots
- Cherries
- Loquats
- Figs
- Peaches
- Pome fruits (apples, etc.)
- Oriental persimmons
Modeling medfly phenology at different latitudes
Management strategies

Invading – or feral population

Established

Non Established

Determine status

Detailed studies – regional, local
Ecology, genetics
Collaboration among counties
Regional Projects

Management Decisions

Eradication

Do nothing

Management if needed

Zero tolerance

Area-wide management
Acknowledgement

- James Carey, UCDavis
- Byron Katsoyannos, Aristotle University Thessaloniki, Greece
- Nikos Kouloussis, Aristotle University of Thessaloniki, Greece
- Mario Bjelics, Plant Protection Institute, Croatia
- Sanja Randovic, University of Montenegro
- Alex Diamantidis, University of Thessaly
- Dimitrios Papachristos, Benaki Phytopathological Institute

- International Atomic Energy Agency, IAEA
- Funding agents
  - OECD (Organization for Economic Co-operation and Development)
  - University of Thessaly Greece