

Entomology and the Evolution of Generic Doses

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“Opportunities in Phytosanitary Irradiation”

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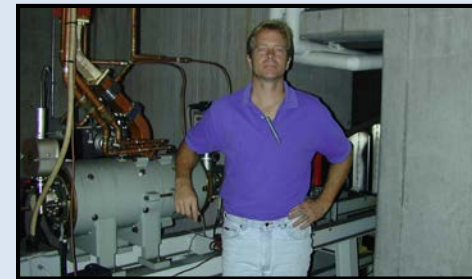
Phytosanitary irradiation

Advantages



- Broadly effective
- Good product tolerance
- Extend shelf-life
- Competitive cost
- Treatment is fast
- Treat in final packaging

- Treat at any temperature
- No resistance
- “Live” pests
- Generic treatments



Phytosanitary insect pests

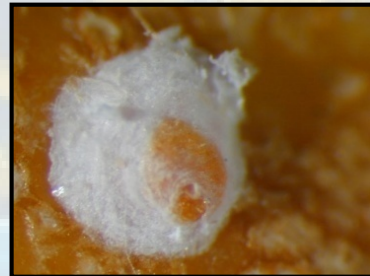
- **Internal pests**



- **Hitchhikers**



- **Surface pests**



- **Irradiation may be required, or used as “insurance”**

Regulations and generic treatments

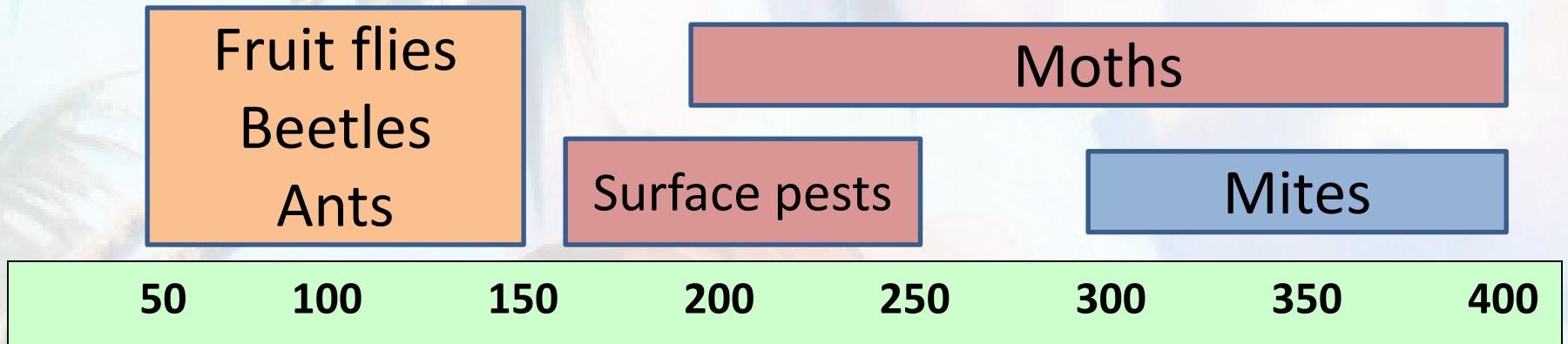
USDA and FSANZ

- US FDA approved irradiation doses up to 1000 Gy for preservation and disinfestation of fresh fruits and vegetables (1986)
- USDA APHIS approved generic irradiation doses for quarantine disinfestation of fresh commodities (2006).
 - *150 Gy tephritid fruit flies (IPPC-approved)*
 - *400 Gy all insects except Lepidoptera pupae*
 - *And 23 specific pests (USA)*

Brief history of generic doses...

- **ICGFI** – 150 Gy fruit flies, 300 Gy all insects proposed in 1986
- **Hawaii** – 250 Gy, 400 Gy used in 2000
- **Australia/NZ** – 150 Gy, 250 Gy, 300 Gy adopted in 2004 for tropical fruit
- **United States** – 150 Gy, 400 Gy adopted 2006 for all horticultural commodities
- **New Zealand** – broad list of generic doses in 2017

Insect Radiation Tolerance



Generic dose:

A single dose for a taxonomically defined group of phytosanitary pests

Why do we need more generic treatments?

- US FDA approved irradiation doses up to 1000 Gy (1 kGy) for preservation and disinfestation
- DUR = Maximum / minimum dose typically 1.5-2.0
- 400 Gy (generic dose) x 2 = 800 Gy
- Advantageous to lower the dose:
 - Avoid problem of 1 kGy limit
 - Lower cost, increase capacity
 - Minimize any quality problems

Rough sweetpotato weevil

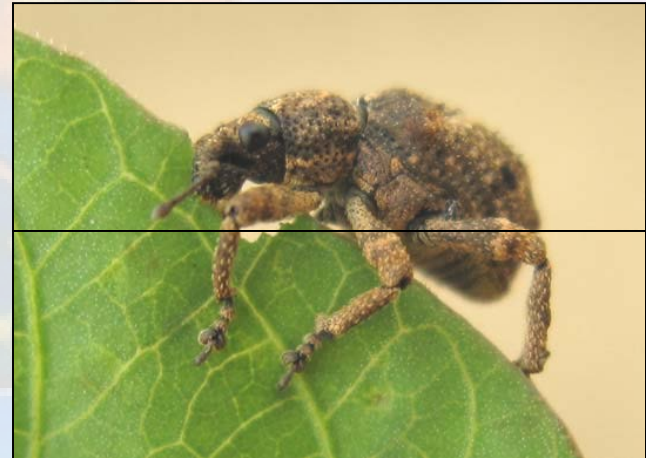
New quarantine pest



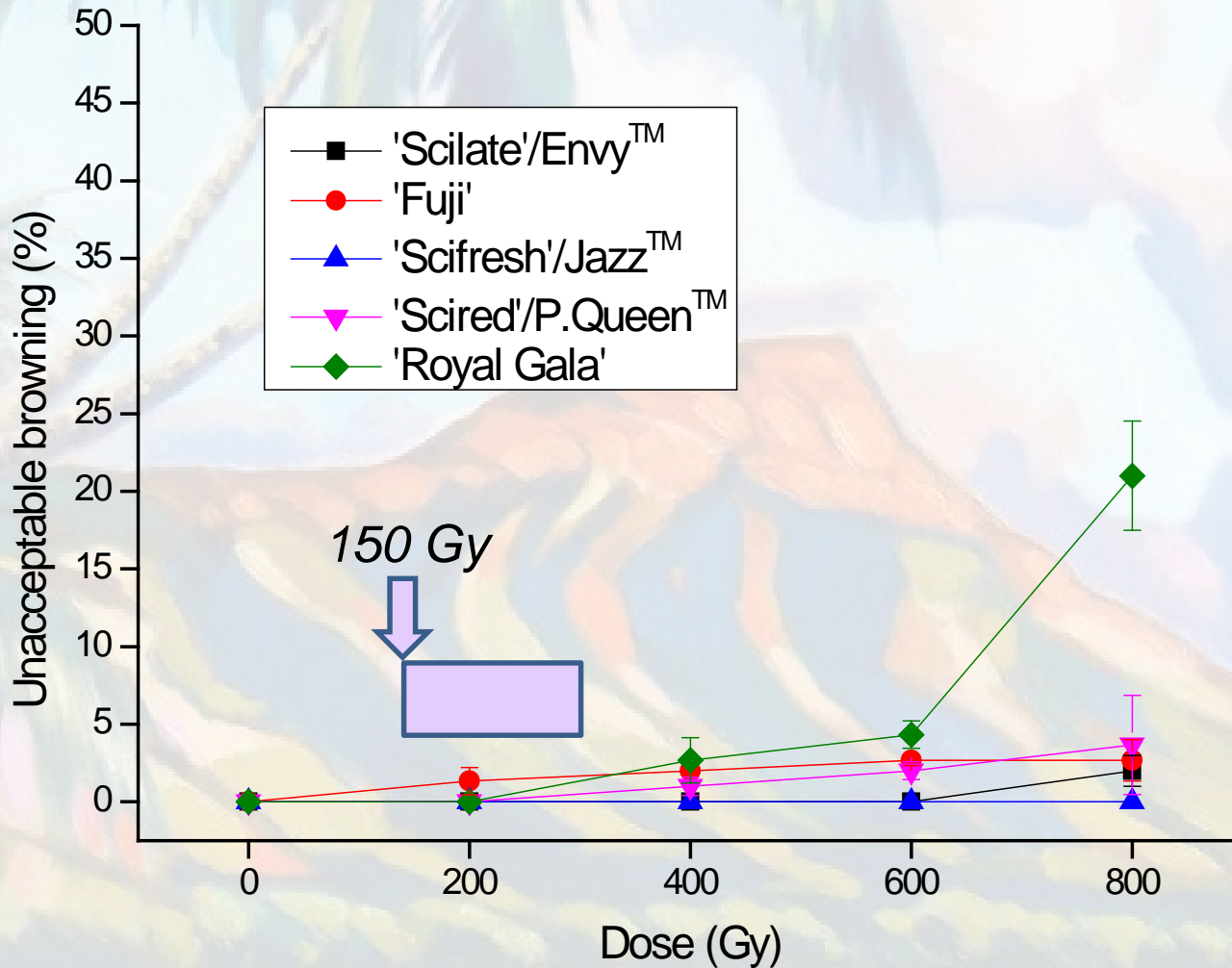
- Discovered on Hawaii island in 2014
- From SE Asia
- Sweetpotato exported with 150 Gy but now 400 Gy
- External feeder
- Difficult to raise in the lab

Irradiation

- Adult most tolerant stage
- Sterilized at <50 Gy

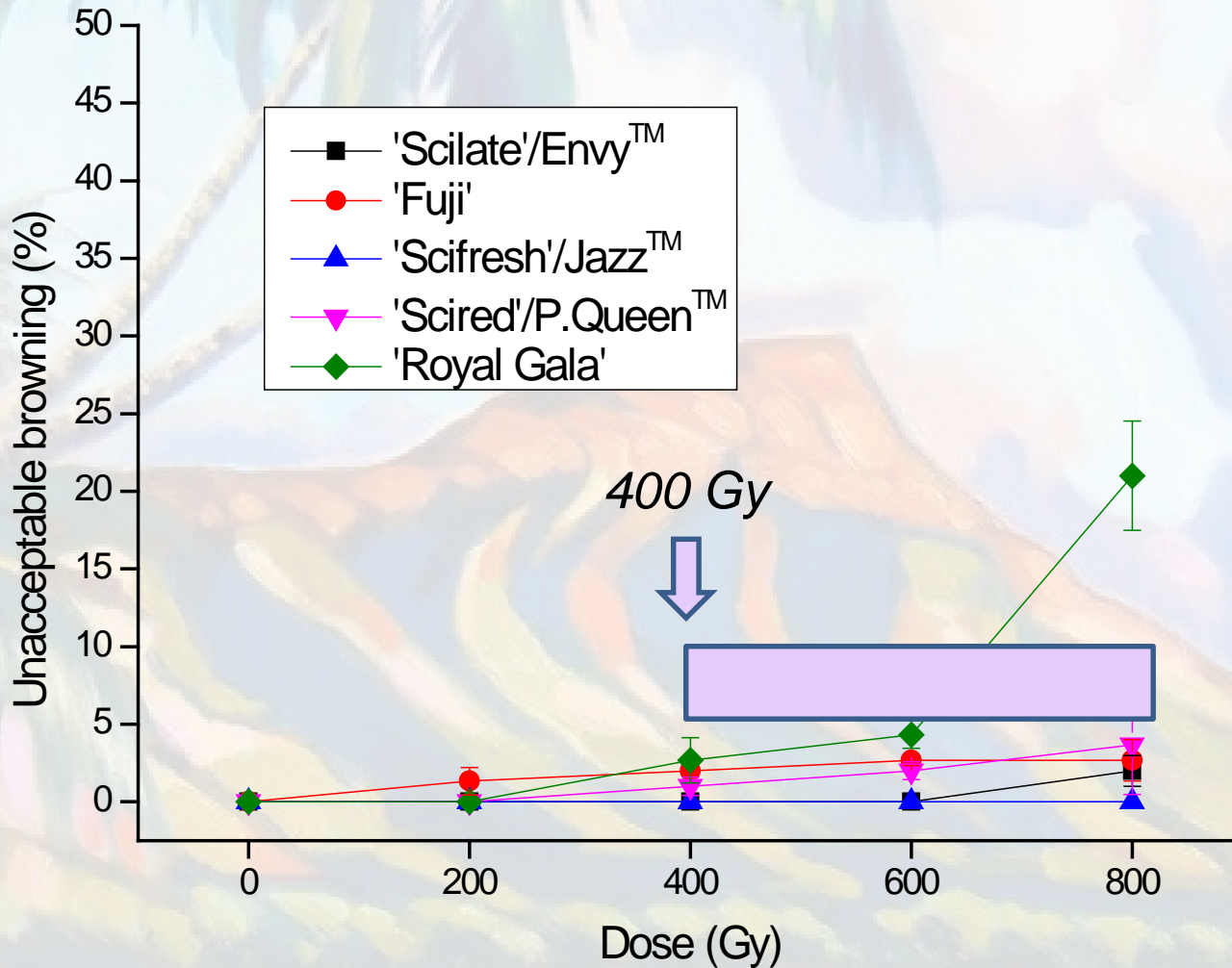


Fruit Quality



Irradiated 5 New Zealand apple cultivars

Fruit Quality



Irradiated 5 New Zealand apple cultivars

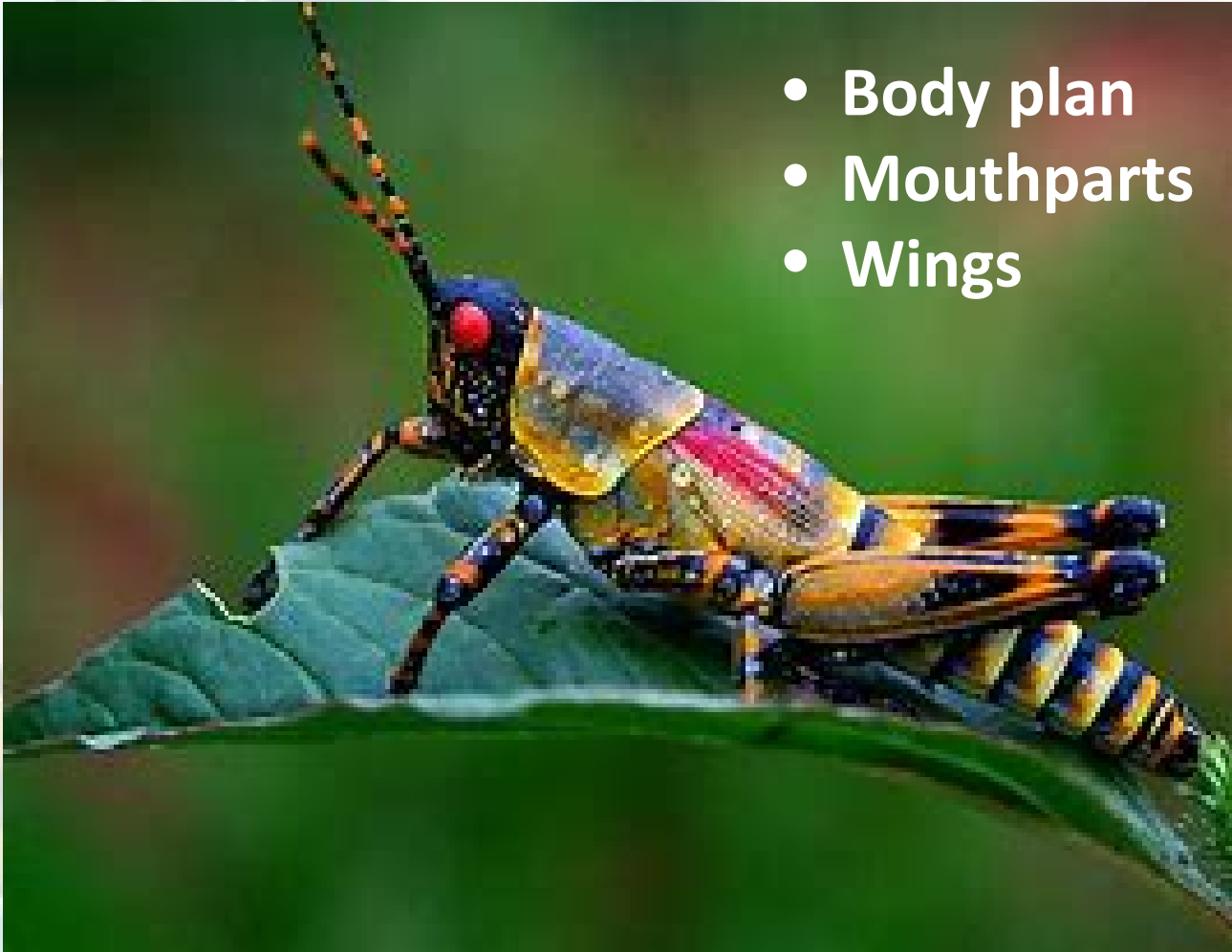
New generic doses

What data are sufficient?

- Major pests of economic importance
- Large scale confirmatory tests
- Supporting information from other species
- No glaring outliers
- May have different endpoints



Insect classification



- Body plan
- Mouthparts
- Wings

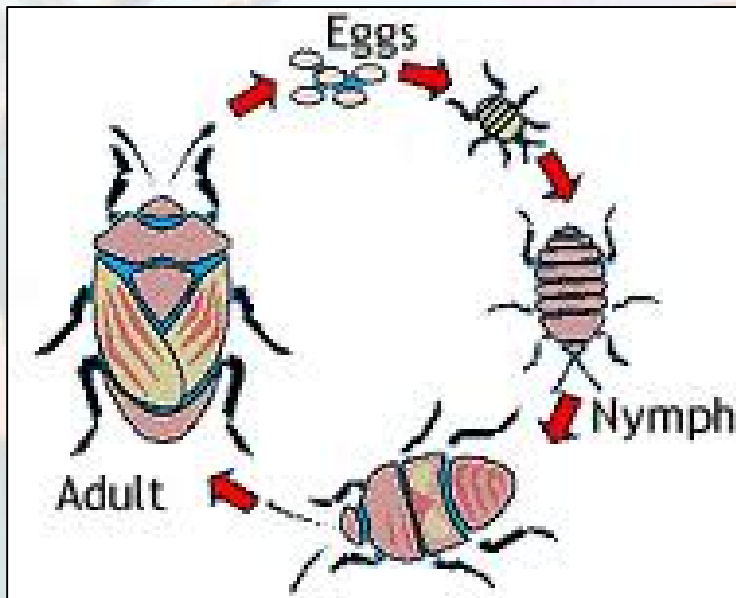
Metamorphosis

Incomplete

- Gradual changes

Complete

- Egg, larva, pupa, adult



Nomenclature



- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species
- Animalia
- Arthropoda
- Hexapoda
- **Diptera**
- **Tephritidae**
- *Ceratitis*
- *capitata*



- Animalia
- Arthropoda
- Hexapoda
- **Coleoptera**
- **Curculionidae**
- *Sternochetus*
- *mangiferae*

Developing new generic doses

What taxonomic level...?

- Arthropoda
 - Hexapoda
 - Diptera
 - **Tephritidae**
 - *Ceratitis, Rhagoletis, Bactrocera, Anastrepha*
(17 species)



Fruit flies set
the trend for
family level
doses

150 Gy

Developing new generic doses

Recently approved by USDA

- Arthropoda
 - Hexapoda
 - Lepidoptera
 - **Tortricidae**
 - *Cydia, Grapholita, Lobesia, Epiphyas...*
(12 species)



Leafroller moths
(eggs and larvae)

290 Gy

Developing new generic doses

New proposal to IPPC

- Arthropoda
 - Hexapoda
 - Coleoptera
 - **Curculionidae**
 - *Sternochetus, Cylas, Sitophilus, Conotrachelus...*
(15 species)



Weevils
150 Gy

Developing new generic doses

New proposal to IPPC

- Arthropoda
 - Hexapoda
 - Hemiptera
 - Pseudococcidae



Mealybugs

250 Gy

Developing new generic doses

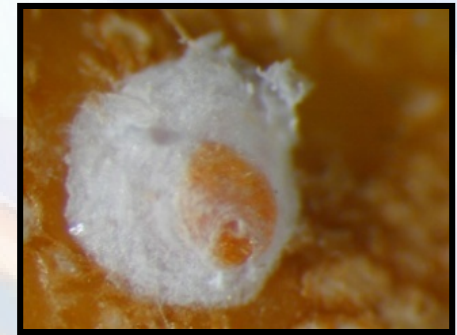
Should aim for the highest possible taxonomic level!

- Arthropoda

- Hexapoda

- Hemiptera

250 Gy



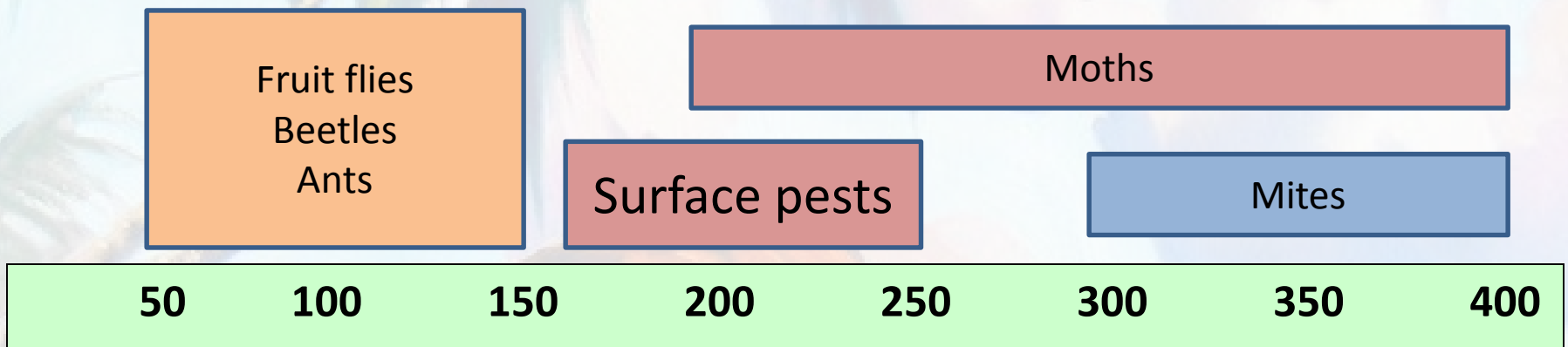
- Mealybugs

- But also important are scales, psyllids, whiteflies

Generic doses for new groups

- Major pests of economic importance
 - Large scale testing for many species in group
 - Low replication data for other species is supportive
- Choose highest taxonomic level possible
 - More inclusive
 - Avoids drops in coverage due to changing taxonomy

Comprehensive Generic Doses



150

Fruit flies
Weevils
Ants
Snails

250

Mealybugs
Scales
Psyllids
Thrips
Spiders

400

Moths
Mites

Finally...

Other pest groups

Parmarion sp.

