Ministry for Primary Industries
Manatū Ahu Matua

International Developments in Determining Levels of Intervention on Risk Pathways

NAPPO International Symposium for Risk-Based Sampling

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www.mpi.govt.nz

Talk Outline

- Background to Statistical Sampling in New Zealand
- Recent International Developments in Systems Management
- Improving the Versatility of Interventions
- Conclusions.

Background

- Late 1980's – move interventions up the supply chain
- 1990's - Develop model to determine level of per-treatment sampling

(Baker *et al*. (1990) and Cowley *et al.* (1993)

Background continued

$$DS = \frac{MPL}{\mu \times V \times TE}$$

- ***DS*** **=** sample detection sensitivity (pre-treatment)
- ***MPL*** **=** maximum pest limit
- ***μ*** **=** mean number of pests per infested fruit
- ***V*** **=** maximum assembled lot size
- ***TE*** **=** efficacy of the phytosanitary measure

(Baker *et al*. 1990)

Background continued

- Model was applied to establish the statistical sampling rate for pre-treatment inspection
- If a pest was detected, the lot was rejected for export to New Zealand

$$\mathbf{0.5\% = \frac{5}{15 \times 1,000,000 \times \frac{1}{15,000}}}$$

- 600 sample required to provide 95% confidence that infestation rate not exceeding 0.5%

Background continued

- Assumptions behind model:

1. The mean number of fruit flies within an infested fruit is known;
2. The inspected lot is (near) homogeneous;
3. The detection rate per inspection is 100%;
4. The efficacy of the phytosanitary measure is known;
5. The phytosanitary measure acts independently on different fruit fly individuals;
6. Pest infestation rates are only reduced by the phytosanitary measure;
7. The maximum lot size assembled per day at one location (in the country of destination) is known.

Recent International Developments

- Considerable research and analysis has been undertaken to develop methods to more accurately determine levels of risk mitigation on risk pathways

- Further emphasis arisen since the adoption of ISPM 31.

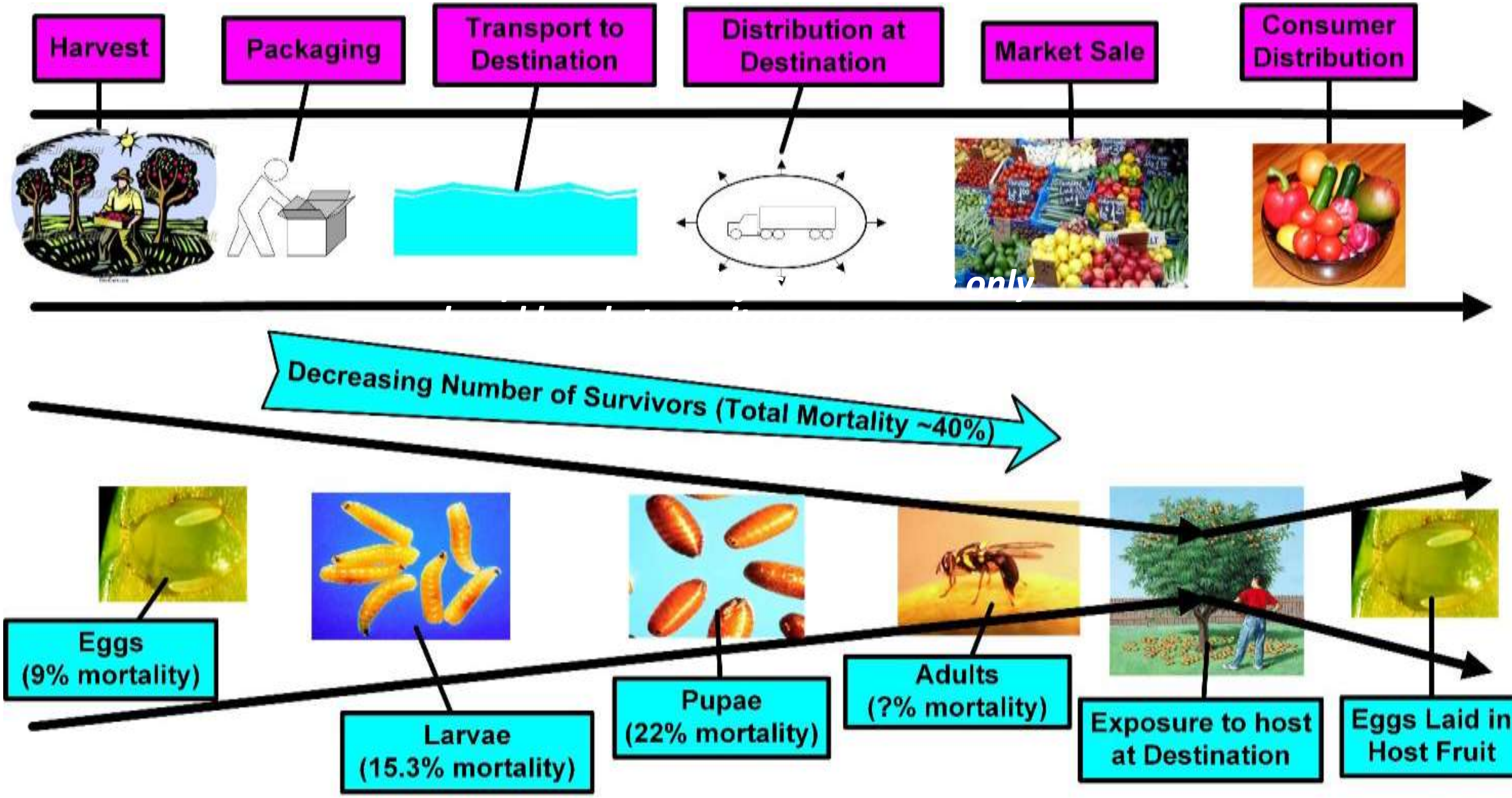
Recent International Developments

Two model assumptions have undergone further analysis:

- Assumption 1: The detection rate per inspection is 100%

- Assumption 2: Pest infestations are only reduced by phytosanitary measure

Recent International Developments

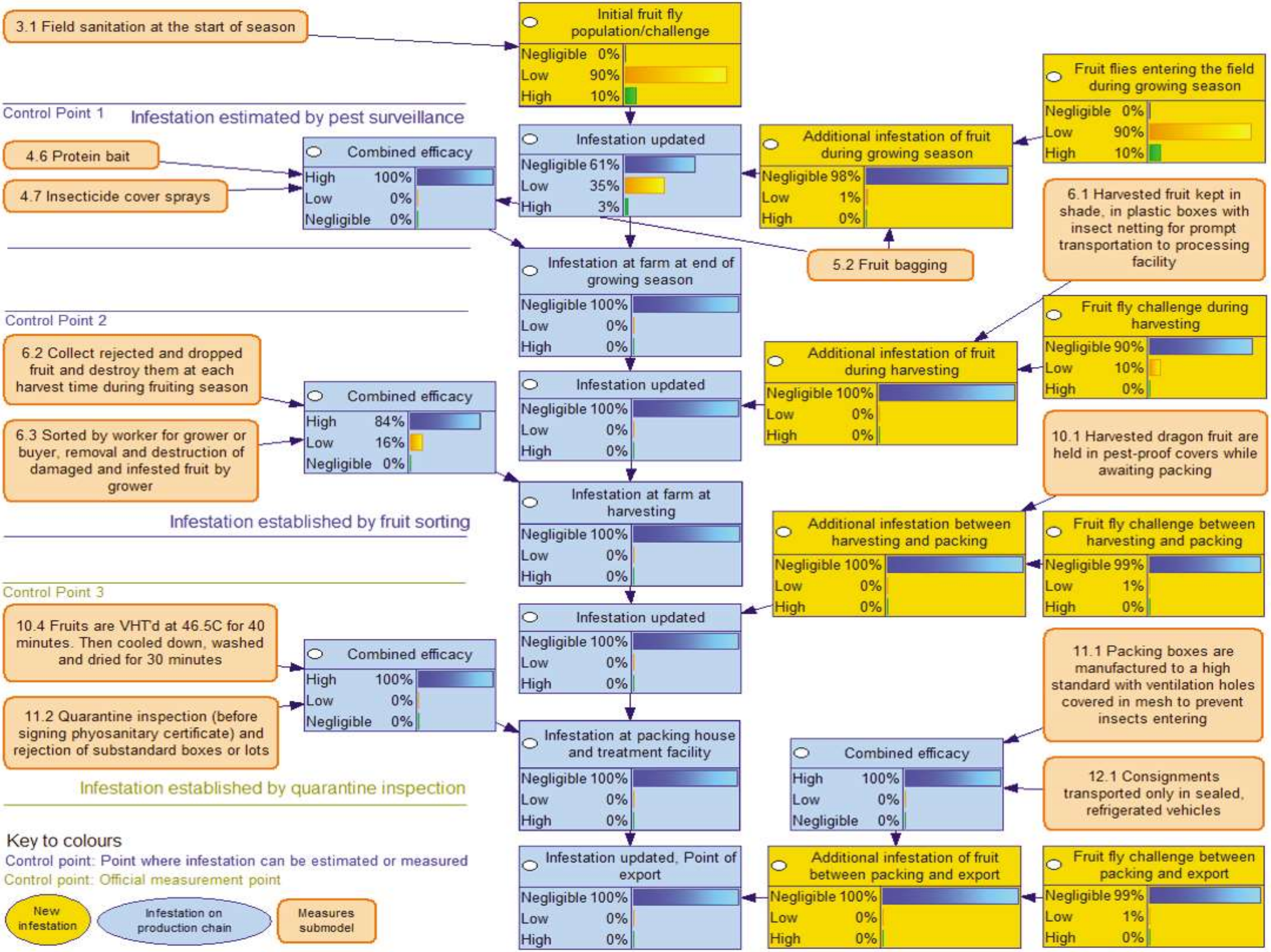


Pictures of Queensland fruit fly provided by NSW Department of Primary Industries

Improving the Versatility of Interventions

- Beyond Compliance research programme, demonstrated the use of a Control Point–Bayesian Network (CP-BN) to present the collated phytosanitary risk-based knowledge about a system.

(Quinlan et al. 2016)



3.1 Field sanitation at the start of season
Initial fruit fly population/challenge
Negligible 0%
Low 90%
High 10%
Fruit flies entering the field during growing season
Negligible 0%
Low 90%
High 10%
Control Point 1
Infestation estimated by pest surveillance
4.6 Protein bait
4.7 Insecticide cover sprays
Combined efficacy
High 100%
Low 0%
Negligible 0%
Infestation updated
Negligible 61%
Low 35%
High 3%
Additional infestation of fruit during growing season
Negligible 98%
Low 1%
High 0%
6.1 Harvested fruit kept in shade, in plastic boxes with insect netting for prompt transportation to processing facility
5.2 Fruit bagging
Infestation at farm at end of growing season
Negligible 100%
Low 0%
High 0%
Control Point 2
Fruit fly challenge during harvesting
Negligible 90%
Low 10%
High 0%
Additional infestation of fruit during harvesting
Negligible 100%
Low 0%
High 0%
6.2 Collect rejected and dropped fruit and destroy them at each harvest time during fruiting season
Combined efficacy
High 84%
Low 16%
Negligible 0%
Infestation updated
Negligible 100%
Low 0%
High 0%
6.3 Sorted by worker for grower or buyer, removal and destruction of damaged and infested fruit by grower
10.1 Harvested dragon fruit are held in pest-proof covers while awaiting packing
Infestation at farm at harvesting
Negligible 100%
Low 0%
High 0%
Infestation established by fruit sorting
Additional infestation between harvesting and packing
Negligible 100%
Low 0%
High 0%
Fruit fly challenge between harvesting and packing
Negligible 99%
Low 1%
High 0%
Control Point 3
10.4 Fruits are VHT'd at 46.5C for 40 minutes. Then cooled down, washed and dried for 30 minutes
Infestation updated
Negligible 100%
Low 0%
High 0%
Combined efficacy
High 100%
Low 0%
Negligible 0%
11.1 Packing boxes are manufactured to a high standard with ventilation holes covered in mesh to prevent insects entering
11.2 Quarantine inspection (before signing phyosanitary certificate) and rejection of substandard boxes or lots
Infestation at packing house and treatment facility
Negligible 100%
Low 0%
High 0%
Combined efficacy
High 100%
Low 0%
Negligible 0%
Infestation established by quarantine inspection
12.1 Consignments transported only in sealed, refrigerated vehicles
Key to colours
Control point: Point where infestation can be estimated or measured
Control point: Official measurement point
New infestation
Infestation on production chain
Measures submodel
Infestation updated, Point of export
Negligible 100%
Low 0%
High 0%
Additional infestation of fruit between packing and export
Negligible 100%
Low 0%
High 0%
Fruit fly challenge between packing and export
Negligible 99%
Low 1%
High 0%

Improving the Versatility of Interventions

- Research in New Zealand on the use of Bayesian Networks to develop decision support models to evaluate biosecurity risks

(Jamieson et al. 2016)

- European Food Safety Authority Plant Health Panel developing a method for pest risk assessment and the identification and evaluation of risk-reducing options that focuses on changes in pest abundance during the invasion process.

(Gilioli et al. 2017)

Improving the Versatility of Interventions

- Statistical sampling can be applied at various points in the supply chain.

- When used to ensure pest infestation levels do not exceed pre-measure thresholds, relatively small sample sizes can be used to support relatively simple decision criteria

- Sampling to detect a pest infestation level after measures, when a failure in the measure may still result in infestation levels close to the MPL, will create relatively complicated decision criteria.

Conclusions

- Statistical sampling allows for relatively straight forward compliance requirements
- Where detection thresholds are far below the sensitivity of the sample, decision criteria become more complicated
- Production and supply chain analysis allows for the use of statistical sampling at numerous points of intervention, both to provide simple decision criteria, and to measure overall system performance over extended production periods.