

**Cold treatment of Australian summerfruit
(plums, nectarines / peaches)
infested with eggs and larvae of the Queensland fruit fly
(*Bactrocera tryoni* (Froggatt)) Diptera : Tephritidae .**

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PART ONE - MAIN REPORT

OF THE MOST TOLERANT STAGE AND LARGE SCALE TRIAL
PROTOCOLS FOR COLD DISINFESTATION OF
QUEENSLAND FRUIT FLY

CONDUCTED AT

NEW SOUTH WALES DEPARTMENT OF PRIMARY INDUSTRIES,
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i. Format of this Report

This Report, on experiments carried out to prove the efficacy of storage at 1°C or 3°C against immature life-stages of Queensland fruit fly (*Bactrocera tryoni* (Froggatt)) in Australian summerfruit (plums, nectarines/peaches), is in four parts.

Part One: Main Report:	Description of experimental facilities, materials and methods, results and discussion.
Part Two: Photos and Diagrams:	Photos and diagrams of experimental facilities, procedures and equipment.
Part Three: Summary Tables:	Tables for each replicate experiment showing dates of activities, results of experiments, summaries of temperature records.
Part Four: Tables of Temperature Data:	Tables of raw temperature data for each replicate for the Large Scale Confirmatory trials.

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1. Abstract

Australian summerfruit (plums and nectarines/peaches*) were subjected to cold storage treatment at temperatures of $1.0\pm0.5^{\circ}\text{C}$ and $3.0\pm0.5^{\circ}\text{C}$ for disinfestation of Queensland fruit fly (*Bactrocera tryoni* (Froggatt)).

Larval development studies were conducted to determine the course of development of each immature life-stage and the dates when each stage (i.e. eggs, first instar, second instar and third instar) should be tested.

The most tolerant life-stage trials were conducted by exposing each stage to cold treatment for 3, 4, 5, 6, 7, 8, 9, 10, 12 and 14 days.

Data showed that when plums were stored at either 1°C or 3°C the third instar larvae were the most cold-tolerant. When nectarines were stored at 1°C the second instar larvae were the most tolerant, and at 3°C the first instar were the most tolerant. When large scale trials were carried out on the most cold-tolerant life-stages, there were no survivors following storage at either $1.0\pm0.5^{\circ}\text{C}$ for a period of 14 days or $3.0\pm0.5^{\circ}\text{C}$ for a period of 14 days.

Trials were replicated between two and five times.

In summary:

Nectarines / peaches

- 1°C for **14 days**: 0 survivors from a total of 57,847 insects treated
- 3°C for **14 days**: 0 survivors from a total of 62,675 insects treated

Plums

- 1°C for **14 days**: 0 survivors from a total of 38,382 insects treated
- 3°C for **14 days**: 0 survivors from a total of 79,598 insects treated

Results from the work described here have proven that:

Storage treatments at 1°C for 14 days or at 3°C for 14 days for Australian summerfruit are suitable as quarantine treatments against Queensland fruit fly.

***Peaches and nectarines are the same species (*Prunus persica*) and are considered as the same fruit for purposes of developing quarantine disinfestation treatments.**

2. Introduction

Australian producers are in a position to supply fresh high quality summerfruit to markets in the Northern Hemisphere when local supplies in those countries are not available because of the different growing seasons.

Cold treatments offer a commercially viable method for quarantine disinfestation of summerfruit, which maintain their quality during cold storage. Previous studies have demonstrated that cold disinfestation is an effective treatment against Queensland fruit fly in oranges, lemons, tangerines and tangelos for export to Japan.

BAPHIQ has requested a trial protocol that demonstrates treatment efficacy of cold disinfestations on the most treatment tolerant life-stage of *B. tryoni*. The most tolerant stage is determined by subjecting all life-stages of *B. tryoni* to different durations of cold storage, and determining mortality for each life-stage.

The life-stage that is found to be the most tolerant of the treatment is used in a series of large scale trials under simulated export conditions. These large scale trials comprise between two and five replicates of the treatment applied to the most tolerant stage. To be considered successful, the large scale trial must demonstrate that there are no survivors when at least 30,000 insects are exposed to the treatment.

Trials using *B. tryoni* were conducted in New South Wales, on the east coast of Australia, at New South Wales Department of Primary Industries' Gosford Horticultural Institute (GHI). All trial techniques are fully explained in this report.

3. General information

This section contains general background information required on test insects, test fruits, research laboratories, cold room facilities, temperature monitoring devices and methods used in the trials.

3.1. Test insect

Queensland fruit fly *Bactrocera tryoni* (Froggatt)

[For more information refer to Part 2, Figures 1 – 4, –Photos and diagrams]

3.2. Origin

Test insects were sourced from a laboratory colony of *B. tryoni* that is managed by scientists from New South Wales Department of Primary Industries' GHI. Scientists at the GHI laboratories have been managing different colonies of *B. tryoni* since 1956.

Wild characteristics of the *B. tryoni* colony are maintained through regular introductions of *B. tryoni* reared from field collected fruit from the Central and North Coasts of New South Wales. Four to six times a year, infested fruit is brought into the GHI laboratory from these areas and flies are reared out, sorted and checked to ensure 100 percent are *B. tryoni*. They are then reared under laboratory conditions, separate from the established laboratory colony, for six generations. At the sixth generation these flies are used to replace the old colony.

3.3. Rearing methods for *B. tryoni*

Eggs are collected from adult *B. tryoni* flies in plastic cups that have been pierced with more than 200 fine holes, through which the fly oviposits. The egg cups are removed after 24 hours and eggs are placed on artificial larval rearing medium using a pipette. The medium comprises diced dried carrot, yeast hydrolysate, water and preservatives.

Developing larvae are kept in the insectary at $26\pm 2^{\circ}\text{C}$ and $65\pm 5\%$ relative humidity (RH). Larvae pupate in trays of slightly dampened vermiculite. Mature pupae are separated from the vermiculite and placed into cages (1665 x 510 x 250 mm high) where they emerge as adults.

At any time there are 16 cages of adult flies aged between one and four weeks housed in the insectary. At the end of each week, the four cages of oldest flies are killed off and four new cages of flies are prepared to replace them. Eggs are collected from 2 to 3 week-old adults for subsequent laboratory generations.

Each cage is lit from above by a single 1200 mm long 40W fluorescent light tube which allows at least 2000 Lux of light into the cage. The lighting regime in the insectary is 12 hours full light, then 1 hour slowly dimming to full dark, then 10 hours full dark, then 1 hour slowly brightening to full light.

[For more information refer to Part 2, Figures 1 – 4 – Photos and diagrams]

3.4. Adults

The adult flies are fed on a diet of yeast hydrolysate, sugar and water. Each of the 16 cages houses about 15,000 to 20,000 flies. Fly populations in the laboratory have a sex ratio of approximately 1:1 (male:female).

Quantity of eggs collected: Approximately 10 mL per egg cup per day.

3.5. Larvae

Larval rearing is done on an artificial medium based on diced dried carrot. Special larval rearing cages are used to house the developing larvae. Mature larvae are channelled via a chute into a pupation tray (530 x 350 x 195 mm) containing damp vermiculite. Larvae are reared in the insectary. The following ingredients are mixed in the specified proportions into a homogenous mix which is then spread on plastic covered trays for egg deposition.

Medium:

2.7 L Dried carrot
20 g Sodium benzoate
480 g Yeast hydrolysate
72 g Citric acid
7 L Water

Quantity of medium: Approximately 16 trays of medium is made in each mix. It is distributed in the following way: 4 trays/chute (tray size: 295 x 195 x 30 mm).

Quantity of eggs inoculated: 0.4 mL/tray x 16 trays/cage. This gives approximately 15,000 to 20,000 adult flies per cage or a total of 60,000 to 80,000 flies per week.

Insectary conditions: 26±2°C: 65% ± 5%

Development duration of different life stages of *B. tryoni* in the insectary:

Eggs: between 0 and 2 days

Larvae: between 5 and 7 days.

Pupae: between 10 and 12 days.

Adults are culled 4 weeks after emergence.

Rate of egg hatch: approx. 70 - 90%

Rate of larval pupation (of eggs that hatch): 80 - 90%

Note: development times in artificial media differ from those in infested fruit.

3.6. Pupae

Maturation of pupae: The trays containing larvae in vermiculite (530 x 350 x 195 mm) remain underneath the chutes until all larvae have left the medium. The resulting trays of pupae are removed from underneath the chutes and are stacked and stored in the same insectary as the larvae. Thereafter, they are transferred to the adult colony cages for emergence as described above.

Number of pupae reared: Approx. 3750 – 5000 pupae/tray x 4 trays x 4 chutes
x 1 cage = approximately 60,000 – 80,000 pupae in total.

Rate of emergence: Approximately 90- 98%.

3.7. Test fruit

For the trials conducted in 2006, Class 1 Angeleno plums and Class 1 Arctic Snow white-fleshed nectarines were sourced from V.F Siciliano & Sons, Woorinen North, Victoria (35° 15' South, 143° 27' East). For the trials conducted in 2007, Class 1 Angeleno plums were sourced from Stone fruit packing Pty Ltd, Lake Boga Victoria (35° 29' South, 143° 38' East), and Class 1 Arctic Snow white-fleshed nectarines were sourced from S&F Ierace, Tresco Victoria (35° 30' South, 143° 40' East).

These regions fall within the fruit fly exclusion zone (FFEZ) and are classified as fruit fly free areas, so fruit are not sprayed with insecticides to control fruit fly. Fruit used in these experiments were sourced from orchards which had not been sprayed with insecticides during fruit growth and maturation. The fruit was therefore suitable for the survival of immature stages of *B. tryoni*.

Produce met specification as per FreshSpecs product specifications (Section 7).

For verification purposes, small scale studies were conducted upon receipt of fruit to confirm infestation was possible, prior to the large scale trials. The fruits were of excellent quality in terms of maturity and were suitable for the survival of immature stages of *B. tryoni* at the time of infestation.

3.8. Research laboratory

Organisation

New South Wales Department of Primary Industries

Location of trials

The *B. tryoni* trials were conducted at the disinfestation laboratory, Gosford, NSW. This laboratory is part of the Postharvest Section of the GHI. The Postharvest Section is responsible for the research and advisory work on disinfestation and other related *B. tryoni* work in NSW.

Facilities of the postharvest disinfestation laboratory

The postharvest disinfestation facilities include the following:

- *B. tryoni* insectary
- Cold room for fruit holding
- 3 cold rooms for cold disinfestation trials
- 3 hot storage rooms for insect development
- Fruit fly preparation room
- Disinfestation studies laboratory

3.9. Specifications of the cold treatment facilities.

[For more information refer to Part 2 – Photos and diagrams]

3.9.1. Description of cold treatment facilities

The cold treatment facilities are situated at GHI. The treatment facilities were constructed by Thermoline Australia in 2004.

3.9.2. Number of cold rooms

Three cold rooms were used for these trials. The rooms have the designated labels cold treatment room (CTR) 7, CTR 8 and CTR 9.

3.9.3. Room construction

The three temperature and humidity controlled rooms are located within a larger freestanding building. All rooms are manufactured from structural, polystyrene sandwich panels for high level thermal resistance. The rooms are formed from 75 mm panels with all internal and external seams sealed. Floors in the rooms are formed from 75 mm thick concrete finished with welded vinyl flooring.

3.9.4. Performance

Rooms CTR 7 and CTR 9 have been designed to provide temperature and humidity control (0.0 to 45.0°C and 30 - 95% RH). CTR 8 has been designed to provide temperature and humidity control (-10.0 to 45.0°C and 30 - 95% RH).

3.9.5. Air circulation

Five axial type fans attached to the refrigeration unit provide air circulation in each room.

3.9.6. Refrigeration

Air cooling is achieved by means of direct expansion refrigeration evaporators in the fan coil assembly attached to the roof of each room. An air cooled, hermetically sealed condensing unit, using R404a refrigerant, is located outside the rear of each room.

3.9.7. Cooling regulation

Time proportional signals from the temperature controllers switch liquid line solenoid valves. These regulate the flow of refrigerant into the evaporators; thereby controlling the cooling effect.

3.9.8. Humidification

Humidification is generated by a 'Defensor' atomiser type humidification system. This introduces water vapour without the addition of heat as is usually done via steam injection.

3.9.9. Dehumidification

Dehumidification is by water condensation on the surface of the direct injection refrigeration evaporator. The liquid line solenoid valves, also used to regulate cooling, are switched by time proportional pulsed signals from the humidity controllers.

3.9.10. Sensors

All rooms are fitted with Rototronic Hygroclip C temperature and humidity sensors, capable of monitoring temperature in the range of 0.0 to 85.0°C and humidity in the range of 0% RH to 100% RH. CTR 8 is fitted with a DIN standard, pt100 resistance sensor, which will measure temperature down to -10°C.

3.9.11. Size and capacity of each room

The three cold rooms measure 3750 x 2400 x 2800 mm with a total volume of 25.5 m³. Door openings are 1000 mm by 2005 mm. The door is fitted on all four sides with double neoprene labyrinth gaskets. The door overlaps the opening by 75 mm and is 120 mm thick.

3.9.12. Description of temperature recorders

Core temperatures of fruit were monitored with a Grant 2040 series Squirrel Data Logger with metal oxide 2 K Ohm thermistor probes. Probes have a temperature range between -50 and 150°C with an accuracy of $\pm 0.2^\circ\text{C}$. The thermistor probes are connected to the logger by a factory built and calibrated cable of 5 m length. The Grant 2040 series Squirrel data Logger has 32 channels available for temperature input. The summary details are as follows:

- Type: Grant 2040 series Squirrel Data Logger with 32 channels
- Temperature sensor: U 2 K Ohm thermistors
- Number of probes: 8
- Logger accuracy: $\pm 0.05\%$

Temperature sensors were calibrated before the trial to verify that they were functioning according to specification. Each probe was held in ice slurry (melting ice and distilled water). Recordings were taken on each probe each minute for 60 minutes. The readings were stored on disk via a USB interface.

[For more information refer to Part 3, Table 43 – Calibration for data loggers and Part 2, Figure 33 – Photos and diagrams]

3.9.13. Recording intervals for temperature and relative humidity

Fruit core temperatures were recorded every 30 minutes during the cool down and cold storage periods of the treatment.

[For more information refer to Part 2 – Photos and diagrams]

3.10. Description of hot storage room

3.10.1. Temperature and relative humidity of hot storage room.

The hot storage room was set at $26 \pm 0.5^\circ\text{C}$ and 50 - 60% relative humidity.

3.10.2. Duration of storage after cold treatment

After cold treatment, summerfruit were stored in the hot storage room for up to 18 days with periodic inspections.

3.10.3. Description of hot storage room

The hot storage room is constructed from panels of 125 mm expanded polystyrene with internal and external skins of polished 22 gauge, 0.75 hardness marine grade aluminium sheeting permanently bonded to the polystyrene. External joints are caulked with silicone rubber adhesive. The floor consists of an insulated layer (100 mm expanded polyurethane) covered with 75 mm concrete. All sheet aluminium is finished with white baked enamel.

The door openings are 1350 mm clear width by 2100 mm. The door is fitted on all four sides with a double neoprene labyrinth gasket. The door overlaps the opening by 75 mm, the door is 125 mm thick.

4. Materials and methods

4.1. Plan of the trials

The trials were conducted in the following manner in three stages:

STAGE 1 : Larval development studies were conducted first to determine the rate at which *B. tryoni* larvae develop at 26°C. This determined when treatment for each life-stage should commence in subsequent trials.

STAGE 2: The **most tolerant life-stage** trials were conducted by exposing more than 200 insects of each life-stage to a series of treatment periods (from 3 to 14 days) at 1°C and 3°C. From these studies it was determined which life-stage of *B. tryoni* was most tolerant to the specific cold treatment. The data obtained from the most tolerant life-stage trials were subjected to Probit analysis to calculate Probit 9 for each stage. The life-stage with the highest Probit 9 value was selected for the large scale trials.

STAGE 3: The **large scale trials** were conducted by exposing at least 30 000 larvae (at the life-stage demonstrated to be most tolerant to the treatment in stage 2) to cold storage at 1°C or 3°C for a period of 14 days. This was done across several replicates.

4.2. Method of fruit storage before infestation

After harvest, fruit were packed and stored under normal commercial conditions. Fruit was held in a cold storage room until required for the trials.

4.2.1. Storage temperature after harvest

Fruit were harvested into field bins which were placed into storage at 5°C to 7°C. They were sorted and packed into cartons on pallets within the next 5 days and returned to 5°C storage.

4.2.2. Duration of storage after harvest

Fruit in cartons, on pallets, were stored at 5°C for between 3 and 10 days before being transported to GHI for the commencement of the trials.

4.2.3. Storage temperature and duration prior to start of trials

Upon receipt, fruit was stored at 0°C, 95% relative humidity, in export fibreboard cartons, in 10 kg units for up to 3 days until ready to start the trials. Cartons had a low-density polyethylene (LDPE) liner. The cartons containing fruit were then allowed to warm up to the optimum fruit fly infestation temperature of 26±2°C in the insectary. The fruit in cartons was protected from contaminant insects by covering with a fine terylene cloth.

4.3. Method of infesting test fruits

After overnight equilibration to $26\pm 2^{\circ}\text{C}$ (the optimum temperature for *B. tryoni* egg-laying) the fruit were placed on top of cages of 2 to 4 week old *B. tryoni*. Fruit remained on the cages for 2 to 4 hours for studies to determine the most cold tolerant insect life-stage or overnight (16 hours) for large scale trials. A longer time period was required to infest fruit for the large scale trials due to the large number of fruit being infested. Flies infested the fruit by ovipositing eggs through the gauze roof of the cage into the fruit.

[For more information refer to Part 2, Figures 14 - 24 – Photos and diagrams]

4.4. Storage conditions of infested fruit prior to treatment

Infested fruit were placed in plastic racks measuring 350 x 430 x 60 mm, lined with 2 mm mesh, in the hot storage room. To prevent desiccation of *B. tryoni* eggs, infested fruit were covered with damp material, and kept damp until treatment commenced.

4.5. Fruit handling

4.5.1. During treatment

Once insects in the treated fruit had reached the target immature life-stage, fruit was labelled and repacked into labelled export summerfruit (plum or nectarine) cartons. Filler fruit (non-infested apple fruit) were used to fill the cold room to the specified loading factor ($>35\%$). Apples were chosen as filler fruit due to their low cost and excellent ability to store. Temperature probes were inserted into several non-infested summerfruit to monitor fruit core temperatures throughout the cool-down, the cold storage and the warm-up periods of the treatment. Temperature monitored fruit were placed throughout the load of fruit to provide data on temperature variations within the cold rooms.

4.5.2. After treatment

Treated fruit were removed from the cold room and placed in the hot storage room. Infested fruit were removed from their cartons and placed in 60 x 40 x 250 mm plastic boxes. Each box was fitted with a wood-framed plastic mesh insert which allowed treated fruit to be suspended above dampened vermiculite contained in the bottom of the box. Vermiculite was the pupation medium for surviving insects. The box containing the infested fruit was covered with terylene cloth to allow air exchange and prevent post-treatment infestation with *B. tryoni* and *Drosophila* spp. The fruit were held in the hot storage room to enable any potential survivors to emerge.

4.5.3. Sieving

Vermiculite beneath control fruit was sieved approximately 10 days after infestation, another sieve was conducted after approximately another 7 days. If there was fruit remaining after an additional 7 days, a third sieve was conducted at approximately this

time. Vermiculite beneath treated fruit was sieved at approximately 7 days after removal from cold storage and again approximately every week until no survivors were found. Surviving pupae and larvae in the vermiculite and fruit remains were collected and counted.

[For more information refer to Part 2, Figure 25 and Figure 36 – Photos and diagrams]

4.6. Storage conditions of infested test fruit

Test fruit infested with the most tolerant stage *B. tryoni* were labelled and placed in summerfruit export cartons amongst non-infested fruit. Nectarines were packed 30 to a carton whilst plums were packed at 50 to a carton.

The temperature of the cold rooms was set so that fruit temperature was maintained within the range of $1.0 \pm 0.5^{\circ}\text{C}$ for 14 days for the 1°C trials; and $3.0 \pm 0.5^{\circ}\text{C}$ for 14 days for the 3°C trials. Temperature data loggers monitored fruit core temperatures throughout the duration of the treatments. The relative humidity in each cold room was between 50% and 60%. Relative humidity was monitored but not logged.

4.7. Storage conditions of control (untreated) fruit

Control fruit were stored in the hot storage room and were covered with fine terylene cloth to prevent contamination by *Drosophila* spp.

4.8. Description of fruit cartons

Fruit were received at GHI in export fibreboard cartons on wooden pallets. Test fruit and filler fruit were placed in the cold storage treatment rooms in their export cartons.

Four pallets of filler fruit were placed in each of the cool rooms. Each pallet was comprised of 60 cartons.

Infested fruit were placed within each stack of filler fruit according to a system. Certain cartons of filler fruit were removed from certain rows of each pallet and replaced with a labelled carton of test fruit in which a temperature probe was inserted.

[For more information refer to Part 2, Figures 6-13 – Photos and diagrams]

4.9. Larval development study

To determine the course of development of the immature stages of *B. tryoni* in the plums and nectarines, test fruit was infested by placing them on top of a wire mesh cage housing 15,000 to 20,000 sexually-mature *B. tryoni*.

Approximately 20 fruit were selected and placed on cages of mature (2 to 3 weeks from adult eclosion) *B. tryoni* adults for about 2 to 4 hours for adequate infestation to occur. These fruit were then placed in containers and covered with fine mesh bags to prevent contamination with other fruit flies and placed in the hot storage room to allow eggs to hatch and larvae to develop. Every 2 to 3 days a sample of 3 or 4 fruit were

removed from storage. Eggs and larvae were removed from each fruit after dissection of the fruit by washing. Eggs and larvae were counted and larval instars (life-stages) were identified by examination of mouthparts under a dissecting microscope. Each larval stage has distinctive mouthparts, which enable identification of the different life-stages. [For more information refer to Part 2, Figures 37 – Photos and diagrams].

The proportion of insects at each life-stage was determined for each stage after infestation.

These data enabled treatment of infested fruit to commence at each target life-stage.

[For more information refer to Part 3, Table 1 and Table 2– Summary tables]

4.10. Determination of the most tolerant stage

Each insect life-stage must be tested with a range of doses (days of cold treatment). This will result in a dose-mortality response which can be evaluated by probit analysis to determine which life-stage is most tolerant. This most tolerant stage is then the subject in the large scale trials.

At each replicate treatment, fruit was sampled and divided into control (infested but untreated) fruit and treated (infested and cold-stored) fruit. Approximately 72 fruit were labelled as ‘controls’ and about 360 as ‘treated’.

Controls were infested and placed in trays on mesh sub-trays suspended over a pupation medium consisting of damp Grade 1 (fine particles) vermiculite. The hot storage room was maintained at a temperature of $26\pm0.5^{\circ}\text{C}$ and 50 – 60% RH. Each tray of control fruit was enclosed in a fine mesh bag to prevent contamination by other fruit flies and *Drosophila* spp.

Treated fruit were randomly divided into sub-groups representing the four insect life-stages (eggs, first instar, second instar or third instar). A sample of each sub-group was removed from cold treatment on days 3, 4, 5, 6, 7, 8, 9, 10, 12 and 14. Three replicates were conducted for each life-stage and each replicate was treated in a separate cold room.

At completion of the treatment, fruit was removed from the cold treatment room and stored as described in section 4.5. Fruit was then sieved as described in section 4.5. The criterion for survival was the formation of an apparently normal puparium.

The numbers of surviving insects per fruit from the controls were used to estimate the numbers of insects that would be in the treated fruit before treatment. Mortality at each dose was estimated by comparing the number of surviving insects in the treatments with the number of surviving insects in the controls. A dose-mortality curve was produced and analysed to predict Probit 9 (or 99.99683% mortality, the parameter for quarantine security). These data were used to determine the insect life-stage that was most tolerant of cold storage.

Most tolerant stage trials were conducted for plums and nectarines, at both 1°C and 3°C for each.

See Tables 1, 2, 3 and 4 for the experimental schedules and treatment dates for the most tolerant stage.

4.11. Large scale trials

These experiments were conducted over two growing seasons of Australian summerfruit from March 2006 to April 2007 at GHI. Plums and nectarines were infested with Queensland fruit fly (*B. tryoni*) reared at GHI. Replication occurred over time and across three different treatment rooms. Replicate experiments were performed at both 1°C and 3°C to achieve the required number of treated insects.

Between 60 and 300 fruit per replicate were used as controls and the rest were treated. All treated fruit were infested and placed in the hot storage room to allow development to the most tolerant stage. Prior to being placed in treatment, a sample of fruit was dissected and examined to confirm that the larvae were at the most tolerant life-stage at the time of treatment. If larvae had not yet developed to the most tolerant stage, fruit for treatment was returned to the hot storage room and sampled periodically until the most tolerant life-stage was reached. Treated fruit was then placed into the cold treatment room as described in section 4.5. At completion of the treatment, fruit was removed from the cold treatment room and stored as described in section 4.5. The control and treated fruit were sieved as described in section 4.5.

See Tables 5, 6 and 7 for the experimental schedules and treatment dates for the large scale trial.

4.12. Method of calibration of temperature probes before and after each trial

Temperature sensors were calibrated before each trial to verify that they were functioning according to specifications. Each probe was submerged in ice slurry. Recordings were taken at 10 minute intervals.

[For more information refer to Part 2, Figure 33 – Photos and diagrams]

4.13. Recording of temperature

Temperature data logger probes were placed so that the measurement surface of the probe was in the centre of test fruit. Data loggers measured fruit core temperature every 30 minutes for the duration of the experiments.

Probes were placed in non-infested filler fruit (plums or nectarines) placed near the infested fruit within a pallet of apples. For the most tolerant stage studies, infested fruit were removed from cold storage at intervals (i.e. 3, 4, 5, 6, 7, 8, 9, 10, 12 and 14 days) after more than 50% of probes reached the target temperature (i.e. 1.5°C or 3.5°C). If there were 6 probes used in one of the most tolerant stage studies at 1°C then treatment commenced from the time 4 probes read < 1.5°C.

Filler fruit with probes remained in the cold room after each removal of test fruit for the most tolerant stage trials.

Staff on site were able to read temperature records while the data logger was recording to determine when treatment commenced. Between 8 to 10 probes were used for each experiment.

4.14. Placement of temperature data loggers probes

Probes were placed in the centre (i.e. against the seed) of each fruit to be logged. Logged fruit were placed randomly within each carton of treated fruit. Cartons were marked and placed in various positions around the cold treatment room and within each pallet load of fruit.

[For more information refer to Part 2 – Photos and diagrams]

4.15. Experimental cool room loading factor

The loading factor was greater than 35 percent. The bulk of fruit required to make up that loading factor was pallets of cartons of second quality apples. Three cold treatment rooms were used.

4.16. Layout of pallets and test fruit in cool rooms

Pallets of filler fruit plus test fruit were placed so that there was a 10 cm gap between the cartons of fruit and the cool room walls and the next pallet. There was a gap of 40 cm down the middle of the room to allow access to each pallet of fruit. The gap between the top of the fruit and the cool room ceiling was about 100 cm. Each pallet of fruit sat on a wooden pallet 20 cm above the floor.

[For more information refer to Part 2, Figures 7, 12 and 13 – Photos and diagrams]

4.17. Trial schedule

Table 1. Experimental schedule of activities for most treatment tolerant life-stage trials at 1°C in plums (1STS: first instar larvae; 2NDS: second instar larvae; and 3RDS: third instar larvae).

Date	Temperature	Life-stage	Activity
18 Jul 06	1°C	EGGS	Infest approx. 432 fruit on cages at GHI
19 Jul 06	1°C	EGGS	Remove fruit from cages, randomly select sample of 72 fruit as controls (non-cold treated fruit). Controls into hot storage room.
19 Jul 06	1°C	EGGS	Treatment units into treatment at 1°C.
20 Jul 06	1°C	EGGS	Day 1 of treatment (no activity required)
21 Jul 06	1°C	EGGS	Day 2 of treatment (no activity required)
22 Jul 06	1°C	EGGS	Day 3 of treatment. Remove 3 samples of 12 fruit
23 Jul 06	1°C	EGGS	Day 4 of treatment. Remove 3 samples of 12 fruit
24 Jul 06	1°C	EGGS	Day 5 of treatment. Remove 3 samples of 12 fruit
25 Jul 06	1°C	EGGS	Day 6 of treatment. Remove 3 samples of 12 fruit
26 Jul 06	1°C	EGGS	Day 7 of treatment. Remove 3 samples of 12 fruit
27 Jul 06	1°C	EGGS	Day 8 of treatment. Remove 3 samples of 12 fruit
28 Jul 06	1°C	EGGS	Day 9 of treatment. Remove 3 samples of 12 fruit
29 Jul 06	1°C	EGGS	Day 10 of treatment. Remove 3 samples of 12 fruit 1st sieving of control fruits
30 Jul 06	1°C	EGGS	Day 11 of treatment. (no activity required)
31 Jul 06	1°C	EGGS	Day 12 of treatment. Remove 3 samples of 12 fruit
01 Aug 06	1°C	EGGS	Day 13 of treatment. (no activity required) 1st sieving of day 3 treatments
02 Aug 06	1°C	EGGS	Day 14 of treatment. Remove 3 samples of 12 fruit 1st sieving of day 4 treatments
03 Aug 06	1°C	EGGS	1st sieving of day 5 treatments
04 Aug 06	1°C	EGGS	1st sieving of day 6 treatments
05 Aug 06	1°C	EGGS	1st sieving of day 7 treatments 2nd sieving of control fruits
06 Aug 06	1°C	EGGS	1st sieving of day 8 treatments
07 Aug 06	1°C	EGGS	1st sieving of day 9 treatments
08 Aug 06	1°C	EGGS	1st sieving of day 10 treatments
09 Aug 06	1°C	EGGS	2nd sieving of day 3 treatments
10 Aug 06	1°C	EGGS	2nd sieving of day 4 treatments 1st sieving of day 12 treatments
11 Aug 06	1°C	EGGS	2nd sieving of day 5 treatments
12 Aug 06	1°C	EGGS	2nd sieving of day 6 treatments 1st sieving of day 14 treatments
13 Aug 06	1°C	EGGS	2nd sieving of day 7 treatments
14 Aug 06	1°C	EGGS	2nd sieving of day 8 treatments
15 Aug 06	1°C	EGGS	2nd sieving of day 9 treatments
16 Aug 06	1°C	EGGS	2nd sieving of day 10 treatments
17 Aug 06	1°C	EGGS	No activity required
18 Aug 06	1°C	EGGS	2nd sieving of day 12 treatments
19 Aug 06	1°C	EGGS	No activity required
20 Aug 06	1°C	EGGS	2nd sieving of day 14 treatments
<hr/>			
13 Jun 06	1°C	-	Infest approx. 432 fruit on cages at GHI
14 Jun 06	1°C	1STS	Remove fruit from cages, randomly select sample of 72

		1STS	fruit as controls (non-cold treated fruit). Controls into hot storage room.
15 Jun 06	1°C		Larvae developing (no activity required)
16 Jun 06	1°C	1STS	Larvae developing (no activity required)
17 Jun 06	1°C	1STS	Treatment units into treatment at 1°C.
18 Jun 06	1°C	1STS	Day 1 of treatment (no activity required)
19 Jun 06	1°C	1STS	Day 2 of treatment (no activity required)
20 Jun 06	1°C	1STS	Day 3 of treatment. Remove 3 samples of 12 fruit
21 Jun 06	1°C	1STS	Day 4 of treatment. Remove 3 samples of 12 fruit
22 Jun 06	1°C	1STS	Day 5 of treatment. Remove 3 samples of 12 fruit
23 Jun 06	1°C	1STS	Day 6 of treatment. Remove 3 samples of 12 fruit
24 Jun 06	1°C	1STS	Day 7 of treatment. Remove 3 samples of 12 fruit
		1STS	1st sieving of control fruits
25 Jun 06	1°C		Day 8 of treatment. Remove 3 samples of 12 fruit
26 Jun 06	1°C	1STS	Day 9 of treatment. Remove 3 samples of 12 fruit
27 Jun 06	1°C	1STS	Day 10 of treatment. Remove 3 samples of 12 fruit
28 Jun 06	1°C	1STS	Day 11 of treatment. (no activity required)
29 Jun 06	1°C	1STS	Day 12 of treatment. Remove 3 samples of 12 fruit
30 Jun 06	1°C	1STS	Day 13 of treatment.
		1STS	1st sieving of day 3 treatments
01 Jul 06	1°C		Day 14 of treatment. Remove 3 samples of 12 fruit
		1STS	1st sieving of day 4 treatments
02 Jul 06	1°C		1st sieving of day 5 treatments
03 Jul 06	1°C	1STS	1st sieving of day 6 treatments
		1STS	2nd sieving of control fruits
04 Jul 06	1°C		1st sieving of day 7 treatments
05 Jul 06	1°C	1STS	1st sieving of day 8 treatments
06 Jul 06	1°C	1STS	1st sieving of day 9 treatments
07 Jul 06	1°C	1STS	1st sieving of day 10 treatments
		1STS	2nd sieving of day 3 treatments
08 Jul 06	1°C		2nd sieving of day 4 treatments
09 Jul 06	1°C	1STS	2nd sieving of day 5 treatments
		1STS	1st sieving of day 12 treatments
10 Jul 06	1°C		2nd sieving of day 6 treatments
11 Jul 06	1°C	1STS	1st sieving of day 14 treatments
		1STS	2nd sieving of day 7 treatments
12 Jul 06	1°C		2nd sieving of day 8 treatments
13 Jul 06	1°C	1STS	2nd sieving of day 9 treatments
14 Jul 06	1°C	1STS	2nd sieving of day 10 treatments
15 Jul 06	1°C	1STS	No activity required
16 Jul 06	1°C	1STS	2nd sieving of day 12 treatments
17 Jul 06	1°C	1STS	No activity required
18 Jul 06	1°C	1STS	2nd sieving of day 14 treatments
-----	-----	1STS	-----
06 Jul 06	1°C	-	---
07 Jul 06	1°C		Infest approx. 432 fruit on cages at GHI
		2NDS	Remove fruit from cages, randomly select sample of 72
		2NDS	fruit as controls (non-cold treated fruit).
08 Jul 06	1°C		Controls into hot storage room.
09 Jul 06	1°C		Larvae developing (no activity required)
10 Jul 06	1°C	2NDS	Larvae developing (no activity required)
11 Jul 06	1°C	2NDS	Larvae developing (no activity required)
12 Jul 06	1°C	2NDS	Larvae developing (no activity required)
13 Jul 06	1°C	2NDS	Treatment units into treatment at 1°C.
14 Jul 06	1°C	2NDS	Day 1 of treatment (no activity required)
15 Jul 06	1°C	2NDS	Day 2 of treatment (no activity required)
16 Jul 06	1°C	2NDS	Day 3 of treatment. Remove 3 samples of 12 fruit

17 Jul 06	1°C	2NDS	Day 4 of treatment. Remove 3 samples of 12 fruit
		2NDS	Day 5 of treatment. Remove 3 samples of 12 fruit
18 Jul 06	1°C	2NDS	1st sieving of control fruits
19 Jul 06	1°C		Day 6 of treatment. Remove 3 samples of 12 fruit
20 Jul 06	1°C	2NDS	Day 7 of treatment. Remove 3 samples of 12 fruit
21 Jul 06	1°C	2NDS	Day 8 of treatment. Remove 3 samples of 12 fruit
22 Jul 06	1°C	2NDS	Day 9 of treatment. Remove 3 samples of 12 fruit
23 Jul 06	1°C	2NDS	Day 10 of treatment. Remove 3 samples of 12 fruit
24 Jul 06	1°C	2NDS	Day 11 of treatment. (no activity required)
		2NDS	Day 12 of treatment. Remove 3 samples of 12 fruit
25 Jul 06	1°C	2NDS	Day 13 of treatment.
			2nd sieving of control fruits
26 Jul 06	1°C	2NDS	1st sieving of day 3 treatments
			Day 14 of treatment. Remove 3 samples of 12 fruit
27 Jul 06	1°C	2NDS	1st sieving of day 4 treatments
28 Jul 06	1°C		1st sieving of day 5 treatments
29 Jul 06	1°C	2NDS	1st sieving of day 6 treatments
30 Jul 06	1°C	2NDS	1st sieving of day 7 treatments
31 Jul 06	1°C	2NDS	1st sieving of day 8 treatments
01 Aug 06	1°C	2NDS	1st sieving of day 9 treatments
		2NDS	1st sieving of day 10 treatments
02 Aug 06	1°C	2NDS	2nd sieving of day 3 treatments
03 Aug 06	1°C		2nd sieving of day 4 treatments
04 Aug 06	1°C	2NDS	2nd sieving of day 5 treatments
05 Aug 06	1°C	2NDS	1st sieving of day 12 treatments
06 Aug 06	1°C	2NDS	2nd sieving of day 6 treatments
		2NDS	1st sieving of day 14 treatments
07 Aug 06	1°C	2NDS	2nd sieving of day 7 treatments
08 Aug 06	1°C		2nd sieving of day 8 treatments
09 Aug 06	1°C	2NDS	2nd sieving of day 9 treatments
10 Aug 06	1°C	2NDS	2nd sieving of day 10 treatments
11 Aug 06	1°C	2NDS	No activity required
12 Aug 06	1°C	2NDS	2nd sieving of day 12 treatments
13 Aug 06	1°C	2NDS	No activity required
-----	-----	2NDS	2nd sieving of day 14 treatments
		2NDS	-----
23 May 06	1°C	-----	---
24 May 06	1°C	-	
			Infest approx. 432 fruit on cages at GHI
		3RDS	Remove fruit from cages, randomly select sample of 72
25 May 06	1°C	3RDS	fruit as controls (non-cold treated fruit).
26 May 06	1°C		Controls into hot storage room.
27 May 06	1°C		Larvae developing (no activity required)
28 May 06	1°C	3RDS	Larvae developing (no activity required)
29 May 06		3RDS	Larvae developing (no activity required)
30 May 06	1°C	3RDS	Larvae developing (no activity required)
31 May 06	1°C	3RDS	Larvae developing (no activity required)
01 Jun 06	1°C	3RDS	Larvae developing (no activity required)
01 Jun 06	1°C	3RDS	Treatment units into treatment at 1°C.
03 Jun 06	1°C	3RDS	Day 1 of treatment (no activity required)
		3RDS	Day 2 of treatment (no activity required)
04 Jun 06	1°C	3RDS	Day 3 of treatment. Remove 3 samples of 12 fruit
05 Jun 06	1°C	3RDS	1st sieving of control fruits
06 Jun 06	1°C		Day 4 of treatment. Remove 3 samples of 12 fruit
07 Jun 06	1°C	3RDS	Day 5 of treatment. Remove 3 samples of 12 fruit
08 Jun 06	1°C	3RDS	Day 6 of treatment. Remove 3 samples of 12 fruit
09 Jun 06	1°C	3RDS	Day 7 of treatment. Remove 3 samples of 12 fruit
10 Jun 06	1°C	3RDS	Day 8 of treatment. Remove 3 samples of 12 fruit

		3RDS	Day 9 of treatment. Remove 3 samples of 12 fruit
11 Jun 06	1°C	3RDS	Day 10 of treatment. Remove 3 samples of 12 fruit
12 Jun 06	1°C	3RDS	2nd sieving of control fruits
13 Jun 06	1°C		Day 11 of treatment. (no activity required)
		3RDS	Day 12 of treatment. Remove 3 samples of 12 fruit
14 Jun 06	1°C	3RDS	Day 13 of treatment.
15 Jun 06	1°C	3RDS	1st sieving of day 3 treatments
16 Jun 06	1°C		Day 14 of treatment. Remove 3 samples of 12 fruit
17 Jun 06	1°C	3RDS	1st sieving of day 4 treatments
18 Jun 06	1°C	3RDS	1st sieving of day 5 treatments
19 Jun 06	1°C	3RDS	1st sieving of day 6 treatments
20 Jun 06	1°C	3RDS	1st sieving of day 7 treatments
21 Jun 06	1°C	3RDS	1st sieving of day 8 treatments
		3RDS	1st sieving of day 9 treatments
22 Jun 06	1°C	3RDS	1st sieving of day 10 treatments
23 Jun 06	1°C	3RDS	2nd sieving of day 3 treatments
			2nd sieving of day 4 treatments
24 Jun 06	1°C	3RDS	2nd sieving of day 5 treatments
25 Jun 06	1°C	3RDS	1st sieving of day 12 treatments
		3RDS	2nd sieving of day 6 treatments
26 Jun 06	1°C	3RDS	1st sieving of day 14 treatments
27 Jun 06	1°C	3RDS	2nd sieving of day 7 treatments
28 Jun 06	1°C		2nd sieving of day 8 treatments
29 Jun 06	1°C	3RDS	2nd sieving of day 9 treatments
30 Jun 06	1°C	3RDS	2nd sieving of day 10 treatments
01 Jul 06	1°C	3RDS	No activity required
02 Jul 06	1°C	3RDS	2nd sieving of day 12 treatments
		3RDS	No activity required
		3RDS	2nd sieving of day 14 treatments
		3RDS	

Table 2. Experimental schedule of activities for most treatment tolerant life-stage trials at 1°C in nectarines.

Date	Temperature	Life-stage	Activity
13 Feb 2007	1°C	EGGS	Infest approx. 402 fruit on cages at GHI
14 Feb 2007	1°C	EGGS	Remove fruit from cages, randomly select sample of 72 fruit as controls (non-cold treated fruit). Controls into hot storage room.
15 Feb 2007	1°C	EGGS	Treatment units into treatment at 1°C.
16 Feb 2007	1°C	EGGS	Day 1 of treatment (no activity required)
17 Feb 2007	1°C	EGGS	Day 2 of treatment (no activity required)
18 Feb 2007	1°C	EGGS	Day 3 of treatment. Remove 3 samples of 11 fruit
19 Feb 2007	1°C	EGGS	Day 4 of treatment. Remove 3 samples of 11 fruit
20 Feb 2007	1°C	EGGS	Day 5 of treatment. Remove 3 samples of 11 fruit
21 Feb 2007	1°C	EGGS	Day 6 of treatment. Remove 3 samples of 11 fruit
22 Feb 2007	1°C	EGGS	Day 7 of treatment. Remove 3 samples of 11 fruit
23 Feb 2007	1°C	EGGS	Day 8 of treatment. Remove 3 samples of 11 fruit
24 Feb 2007	1°C	EGGS	Day 9 of treatment. Remove 3 samples of 11 fruit 1st sieving of control fruits
25 Feb 2007	1°C	EGGS	Day 10 of treatment. Remove 3 samples of 11 fruit
26 Feb 2007	1°C	EGGS	Day 11 of treatment. (no activity required)
27 Feb 2007	1°C	EGGS	Day 12 of treatment. Remove 3 samples of 11 fruit
28 Feb 2007	1°C	EGGS	Day 13 of treatment. (no activity required)
01 Mar 2007	1°C	EGGS	Day 14 of treatment. Remove 3 samples of 11 fruit 1st sieving of day 3 treatments
02 Mar 2007	1°C	EGGS	1st sieving of day 4 treatments
03 Mar 2007	1°C	EGGS	1st sieving of day 5 treatments 2nd sieving of control fruits
04 Mar 2007	1°C	EGGS	1st sieving of day 6 treatments
05 Mar 2007	1°C	EGGS	1st sieving of day 7 treatments
06 Mar 2007	1°C	EGGS	1st sieving of day 8 treatments
07 Mar 2007	1°C	EGGS	1st sieving of day 9 treatments
08 Mar 2007	1°C	EGGS	1st sieving of day 10 treatments 2nd sieving of day 3 treatments
09 Mar 2007	1°C	EGGS	2nd sieving of day 4 treatments
10 Mar 2007	1°C	EGGS	2nd sieving of control fruits 1st sieving of day 12 treatments
11 Mar 2007	1°C	EGGS	2nd sieving of day 5 treatments 2nd sieving of day 6 treatments 1st sieving of day 14 treatments
12 Mar 2007	1°C	EGGS	2nd sieving of day 7 treatments
13 Mar 2007	1°C	EGGS	2nd sieving of day 8 treatments
14 Mar 2007	1°C	EGGS	2nd sieving of day 9 treatments
15 Mar 2007	1°C	EGGS	2nd sieving of day 10 treatments
16 Mar 2007	1°C	EGGS	No activity required
17 Mar 2007	1°C	EGGS	2nd sieving of day 12 treatments
18 Mar 2007	1°C	EGGS	No activity required
19 Mar 2007	1°C	EGGS	2nd sieving of day 14 treatments
<hr/>			
13 Feb 2007	1°C	-	Infest approx. 402 fruit on cages at GHI
14 Feb 2007	1°C	1STS	Remove fruit from cages, randomly select sample of 72 fruit as controls (non-cold treated fruit). Controls into hot storage room.
15 Feb 2007	1°C	1STS	Larvae developing (no activity required)
16 Feb 2007	1°C	1STS	Larvae developing (no activity required)

17 Feb 2007	1°C	1STS	Treatment units into treatment at 1°C.
18 Feb 2007	1°C	1STS	Day 1 of treatment (no activity required)
19 Feb 2007	1°C	1STS	Day 2 of treatment (no activity required)
20 Feb 2007	1°C	1STS	Day 3 of treatment. Remove 3 samples of 11 fruit
21 Feb 2007	1°C	1STS	Day 4 of treatment. Remove 3 samples of 11 fruit
22 Feb 2007	1°C	1STS	Day 5 of treatment. Remove 3 samples of 11 fruit
23 Feb 2007	1°C	1STS	Day 6 of treatment. Remove 3 samples of 11 fruit
24 Feb 2007	1°C	1STS	Day 7 of treatment. Remove 3 samples of 11 fruit
		1STS	1st sieving of control fruits
25 Feb 2007	1°C		Day 8 of treatment. Remove 3 samples of 11 fruit
26 Feb 2007	1°C	1STS	Day 9 of treatment. Remove 3 samples of 11 fruit
27 Feb 2007	1°C	1STS	Day 10 of treatment. Remove 3 samples of 11 fruit
28 Feb 2007	1°C	1STS	Day 11 of treatment. (no activity required)
01 Mar 2007	1°C	1STS	Day 12 of treatment. Remove 3 samples of 11 fruit
02 Mar 2007	1°C	1STS	Day 13 of treatment. (no activity required)
03 Mar 2007	1°C	1STS	Day 14 of treatment. Remove 3 samples of 11 fruit
		1STS	1st sieving of day 3 treatments
			2nd sieving of control fruits
04 Mar 2007	1°C		1st sieving of day 4 treatments
05 Mar 2007	1°C	1STS	1st sieving of day 5 treatments
06 Mar 2007	1°C	1STS	1st sieving of day 6 treatments
07 Mar 2007	1°C	1STS	1st sieving of day 7 treatments
08 Mar 2007	1°C	1STS	1st sieving of day 8 treatments
09 Mar 2007	1°C	1STS	1st sieving of day 9 treatments
10 Mar 2007	1°C	1STS	1st sieving of day 10 treatments
		1STS	2nd sieving of day 3 treatments
11 Mar 2007	1°C		2nd sieving of day 4 treatments
12 Mar 2007	1°C	1STS	1st sieving of day 12 treatments
		1STS	2nd sieving of day 5 treatments
13 Mar 2007	1°C		2nd sieving of day 6 treatments
14 Mar 2007	1°C	1STS	2nd sieving of day 7 treatments
		1STS	1st sieving of day 14 treatments
15 Mar 2007	1°C		2nd sieving of day 8 treatments
16 Mar 2007	1°C	1STS	2nd sieving of day 9 treatments
17 Mar 2007	1°C	1STS	2nd sieving of day 10 treatments
18 Mar 2007	1°C	1STS	No activity required
19 Mar 2007	1°C	1STS	2nd sieving of day 12 treatments
20 Mar 2007	1°C	1STS	No activity required
21 Mar 2007	1°C	1STS	2nd sieving of day 14 treatments
-----	-----	1STS	-----
13 Feb 2007	1°C	-	---
14 Feb 2007	1°C		Infest approx. 402 fruit on cages at GHI
		2NDS	Remove fruit from cages, randomly select sample of 72
		2NDS	fruit as controls (non-cold treated fruit).
15 Feb 2007	1°C		Controls into hot storage room.
16 Feb 2007	1°C		Larvae developing (no activity required)
17 Feb 2007	1°C	2NDS	Larvae developing (no activity required)
18 Feb 2007	1°C	2NDS	Larvae developing (no activity required)
19 Feb 2007	1°C	2NDS	Larvae developing (no activity required)
20 Feb 2007	1°C	2NDS	Treatment units into treatment at 1°C.
21 Feb 2007	1°C	2NDS	Day 1 of treatment (no activity required)
22 Feb 2007	1°C	2NDS	Day 2 of treatment (no activity required)
23 Feb 2007	1°C	2NDS	Day 3 of treatment. Remove 3 samples of 11 fruit
24 Feb 2007	1°C	2NDS	Day 4 of treatment. Remove 3 samples of 11 fruit
		2NDS	Day 5 of treatment. Remove 3 samples of 11 fruit
25 Feb 2007	1°C	2NDS	1st sieving of control fruits
26 Feb 2007	1°C		Day 6 of treatment. Remove 3 samples of 11 fruit

27 Feb 2007	1°C	2NDS	Day 7 of treatment. Remove 3 samples of 11 fruit
28 Feb 2007	1°C	2NDS	Day 8 of treatment. Remove 3 samples of 11 fruit
01 Mar 2007	1°C	2NDS	Day 9 of treatment. Remove 3 samples of 11 fruit
02 Mar 2007	1°C	2NDS	Day 10 of treatment. Remove 3 samples of 11 fruit
03 Mar 2007	1°C	2NDS	Day 11 of treatment. (no activity required)
		2NDS	Day 12 of treatment. Remove 3 samples of 11 fruit
04 Mar 2007	1°C	2NDS	2nd sieving of control fruits
			Day 13 of treatment.
05 Mar 2007	1°C	2NDS	1st sieving of day 3 treatments
			Day 14 of treatment. Remove 3 samples of 11 fruit
06 Mar 2007	1°C	2NDS	1st sieving of day 4 treatments
07 Mar 2007	1°C		1st sieving of day 5 treatments
08 Mar 2007	1°C	2NDS	1st sieving of day 6 treatments
09 Mar 2007	1°C	2NDS	1st sieving of day 7 treatments
10 Mar 2007	1°C	2NDS	1st sieving of day 8 treatments
11 Mar 2007	1°C	2NDS	1st sieving of day 9 treatments
		2NDS	1st sieving of day 10 treatments
12 Mar 2007	1°C	2NDS	2nd sieving of day 3 treatments
13 Mar 2007	1°C		2nd sieving of day 4 treatments
14 Mar 2007	1°C	2NDS	1st sieving of day 12 treatments
15 Mar 2007	1°C	2NDS	2nd sieving of day 5 treatments
		2NDS	1st sieving of day 14 treatments
16 Mar 2007	1°C	2NDS	2nd sieving of day 6 treatments
17 Mar 2007	1°C		2nd sieving of day 7 treatments
18 Mar 2007	1°C	2NDS	2nd sieving of day 8 treatments
19 Mar 2007	1°C	2NDS	2nd sieving of day 9 treatments
20 Mar 2007	1°C	2NDS	2nd sieving of day 10 treatments
21 Mar 2007	1°C	2NDS	No activity required
22 Mar 2007	1°C	2NDS	2nd sieving of day 12 treatments
23 Mar 2007	1°C	2NDS	No activity required
-----	-----	2NDS	2nd sieving of day 14 treatments
		2NDS	-----
13 Mar 2007	1°C	-----	---
14 Mar 2007	1°C	-	
			Infest approx. 402 fruit on cages at GHI
		3RDS	Remove fruit from cages, randomly select sample of 72
15 Mar 2007	1°C	3RDS	fruit as controls (non-cold treated fruit).
16 Mar 2007	1°C		Controls into hot storage room.
17 Mar 2007	1°C		Larvae developing (no activity required)
18 Mar 2007	1°C	3RDS	Larvae developing (no activity required)
19 Mar 2007	1°C	3RDS	Larvae developing (no activity required)
20 Mar 2007	1°C	3RDS	Larvae developing (no activity required)
21 Mar 2007	1°C	3RDS	Larvae developing (no activity required)
22 Mar 2007	1°C	3RDS	Larvae developing (no activity required)
23 Mar 2007	1°C	3RDS	Treatment units into treatment at 1°C.
24 Mar 2007	1°C	3RDS	Day 1 of treatment (no activity required)
		3RDS	Day 2 of treatment (no activity required)
25 Mar 2007	1°C	3RDS	Day 3 of treatment. Remove 3 samples of 11 fruit
26 Mar 2007	1°C	3RDS	1st sieving of control fruits
27 Mar 2007	1°C		Day 4 of treatment. Remove 3 samples of 11 fruit
28 Mar 2007	1°C	3RDS	Day 5 of treatment. Remove 3 samples of 11 fruit
29 Mar 2007	1°C	3RDS	Day 6 of treatment. Remove 3 samples of 11 fruit
30 Mar 2007	1°C	3RDS	Day 7 of treatment. Remove 3 samples of 11 fruit
31 Mar 2007	1°C	3RDS	Day 8 of treatment. Remove 3 samples of 11 fruit
		3RDS	Day 9 of treatment. Remove 3 samples of 11 fruit
01 Apr 2007	1°C	3RDS	Day 10 of treatment. Remove 3 samples of 11 fruit
02 Apr 2007	1°C	3RDS	2nd sieving of control fruits
03 Apr 2007	1°C		Day 11 of treatment. (no activity required)

04 Apr 2007	1°C	3RDS	Day 12 of treatment. Remove 3 samples of 11 fruit
		3RDS	Day 13 of treatment.
		3RDS	1st sieving of day 3 treatments
05 Apr 2007	1°C		Day 14 of treatment. Remove 3 samples of 11 fruit
06 Apr 2007	1°C	3RDS	1st sieving of day 4 treatments
07 Apr 2007	1°C		1st sieving of day 5 treatments
08 Apr 2007	1°C	3RDS	1st sieving of day 6 treatments
09 Apr 2007	1°C	3RDS	1st sieving of day 7 treatments
10 Apr 2007	1°C	3RDS	1st sieving of day 8 treatments
		3RDS	1st sieving of day 9 treatments
11 Apr 2007	1°C	3RDS	1st sieving of day 10 treatments
12 Apr 2007	1°C	3RDS	2nd sieving of day 3 treatments
			2nd sieving of day 4 treatments
13 Apr 2007	1°C	3RDS	1st sieving of day 12 treatments
14 Apr 2007	1°C	3RDS	2nd sieving of day 5 treatments
			2nd sieving of day 6 treatments
15 Apr 2007	1°C	3RDS	1st sieving of day 14 treatments
16 Apr 2007	1°C	3RDS	2nd sieving of day 7 treatments
17 Apr 2007	1°C		2nd sieving of day 8 treatments
18 Apr 2007	1°C	3RDS	2nd sieving of day 9 treatments
19 Apr 2007	1°C	3RDS	2nd sieving of day 10 treatments
20 Apr 2007	1°C	3RDS	No activity required
21 Apr 2007	1°C	3RDS	2nd sieving of day 12 treatments
		3RDS	No activity required
		3RDS	2nd sieving of day 14 treatments
		3RDS	

Table 3. Experimental schedule of activities for most treatment tolerant life-stage trials at 3°C in plums.

Date	Temperature	Life-stage	Activity
17 Aug 06	3°C	EGGS	Infest approx. 432 fruit on cages at GHI
18 Aug 06	3°C	EGGS	Remove fruit from cages, randomly select sample of 72 fruit as controls (non-cold treated fruit). Controls into hot storage room.
19 Aug 06	3°C	EGGS	Treatment units into treatment at 3°C.
20 Aug 06	3°C	EGGS	Day 1 of treatment (no activity required)
21 Aug 06	3°C	EGGS	Day 2 of treatment (no activity required)
22 Aug 06	3°C	EGGS	Day 3 of treatment. Remove 3 samples of 12 fruit
23 Aug 06	3°C	EGGS	Day 4 of treatment. Remove 3 samples of 12 fruit
24 Aug 06	3°C	EGGS	Day 5 of treatment. Remove 3 samples of 12 fruit
25 Aug 06	3°C	EGGS	Day 6 of treatment. Remove 3 samples of 12 fruit
26 Aug 06	3°C	EGGS	Day 7 of treatment. Remove 3 samples of 12 fruit
27 Aug 06	3°C	EGGS	Day 8 of treatment. Remove 3 samples of 12 fruit
28 Aug 06	3°C	EGGS	Day 9 of treatment. Remove 3 samples of 12 fruit 1st sieving of control fruits
29 Aug 06	3°C	EGGS	Day 10 of treatment. Remove 3 samples of 12 fruit
30 Aug 06	3°C	EGGS	Day 11 of treatment. (no activity required)
31 Aug 06	3°C	EGGS	Day 12 of treatment. Remove 3 samples of 12 fruit
01 Sep 06	3°C	EGGS	Day 13 of treatment. 1st sieving of day 3 treatments
02 Sep 06	3°C	EGGS	Day 14 of treatment. Remove 3 samples of 12 fruit 1st sieving of day 4 treatments
03 Sep 06	3°C	EGGS	1st sieving of day 5 treatments
04 Sep 06	3°C	EGGS	1st sieving of day 6 treatments 2nd sieving of control fruits
05 Sep 06	3°C	EGGS	1st sieving of day 7 treatments
06 Sep 06	3°C	EGGS	1st sieving of day 8 treatments
07 Sep 06	3°C	EGGS	1st sieving of day 9 treatments
08 Sep 06	3°C	EGGS	1st sieving of day 10 treatments
09 Sep 06	3°C	EGGS	2nd sieving of day 3 treatments
10 Sep 06	3°C	EGGS	2nd sieving of day 4 treatments 1st sieving of day 12 treatments
11 Sep 06	3°C	EGGS	2nd sieving of day 5 treatments
12 Sep 06	3°C	EGGS	2nd sieving of day 6 treatments
13 Sep 06	3°C	EGGS	1st sieving of day 14 treatments 2nd sieving of day 7 treatments
14 Sep 06	3°C	EGGS	2nd sieving of day 8 treatments
15 Sep 06	3°C	EGGS	2nd sieving of day 9 treatments
16 Sep 06	3°C	EGGS	2nd sieving of day 10 treatments
17 Sep 06	3°C	EGGS	No activity required
18 Sep 06	3°C	EGGS	2nd sieving of day 12 treatments
19 Sep 06	3°C	EGGS	No activity required
20 Sep 06	3°C	EGGS	2nd sieving of day 14 treatments
<hr/>			
17 Aug 06	3°C	-	Infest approx. 432 fruit on cages at GHI
18 Aug 06	3°C	1STS	Remove fruit from cages, randomly select sample of 72 fruit as controls (non-cold treated fruit). Controls into hot storage room.
19 Aug 06	3°C	1STS	Larvae developing (no activity required)
20 Aug 06	3°C	1STS	Larvae developing (no activity required)
21 Aug 06	3°C	1STS	Treatment units into treatment at 3°C.

22 Aug 06	3°C	1STS	Day 1 of treatment (no activity required)
23 Aug 06	3°C	1STS	Day 2 of treatment (no activity required)
24 Aug 06	3°C	1STS	Day 3 of treatment. Remove 3 samples of 12 fruit
25 Aug 06	3°C	1STS	Day 4 of treatment. Remove 3 samples of 12 fruit
26 Aug 06	3°C	1STS	Day 5 of treatment. Remove 3 samples of 12 fruit
27 Aug 06	3°C	1STS	Day 6 of treatment. Remove 3 samples of 12 fruit
28 Aug 06	3°C	1STS	Day 7 of treatment. Remove 3 samples of 12 fruit
		1STS	1st sieving of control fruits
29 Aug 06	3°C		Day 8 of treatment. Remove 3 samples of 12 fruit
30 Aug 06	3°C	1STS	Day 9 of treatment. Remove 3 samples of 12 fruit
31 Aug 06	3°C	1STS	Day 10 of treatment. Remove 3 samples of 12 fruit
01 Sep 06	3°C	1STS	Day 11 of treatment. (no activity required)
02 Sep 06	3°C	1STS	Day 12 of treatment. Remove 3 samples of 12 fruit
03 Sep 06	3°C	1STS	Day 13 of treatment.
		1STS	1st sieving of day 3 treatments
04 Sep 06	3°C		Day 14 of treatment. Remove 3 samples of 12 fruit
		1STS	1st sieving of day 4 treatments
			2nd sieving of control fruits
05 Sep 06	3°C		1st sieving of day 5 treatments
06 Sep 06	3°C	1STS	1st sieving of day 6 treatments
07 Sep 06	3°C	1STS	1st sieving of day 7 treatments
08 Sep 06	3°C	1STS	1st sieving of day 8 treatments
09 Sep 06	3°C	1STS	1st sieving of day 9 treatments
10 Sep 06	3°C	1STS	1st sieving of day 10 treatments
		1STS	2nd sieving of day 3 treatments
11 Sep 06	3°C		2nd sieving of day 4 treatments
12 Sep 06	3°C	1STS	1st sieving of day 12 treatments
		1STS	2nd sieving of day 5 treatments
13 Sep 06	3°C		2nd sieving of day 6 treatments
14 Sep 06	3°C	1STS	1st sieving of day 14 treatments
		1STS	2nd sieving of day 7 treatments
15 Sep 06	3°C		2nd sieving of day 8 treatments
16 Sep 06	3°C	1STS	2nd sieving of day 9 treatments
17 Sep 06	3°C	1STS	2nd sieving of day 10 treatments
18 Sep 06	3°C	1STS	No activity required
19 Sep 06	3°C	1STS	2nd sieving of day 12 treatments
20 Sep 06	3°C	1STS	No activity required
21 Sep 06	3°C	1STS	2nd sieving of day 14 treatments
-----	-----	1STS	-----
17 Aug 06	3°C	-	Infest approx. 432 fruit on cages at GHI
18 Aug 06	3°C		Remove fruit from cages, randomly select sample of 72
		2NDS	fruit as controls (non-cold treated fruit).
		2NDS	Controls into hot storage room.
19 Aug 06	3°C		Larvae developing (no activity required)
20 Aug 06	3°C		Larvae developing (no activity required)
21 Aug 06	3°C	2NDS	Larvae developing (no activity required)
22 Aug 06	3°C	2NDS	Larvae developing (no activity required)
23 Aug 06	3°C	2NDS	Treatment units into treatment at 3°C.
24 Aug 06	3°C	2NDS	Day 1 of treatment (no activity required)
25 Aug 06	3°C	2NDS	Day 2 of treatment (no activity required)
26 Aug 06	3°C	2NDS	Day 3 of treatment. Remove 3 samples of 12 fruit
27 Aug 06	3°C	2NDS	Day 4 of treatment. Remove 3 samples of 12 fruit
28 Aug 06	3°C	2NDS	Day 5 of treatment. Remove 3 samples of 12 fruit
		2NDS	1st sieving of control fruits
29 Aug 06	3°C	2NDS	Day 6 of treatment. Remove 3 samples of 12 fruit
30 Aug 06	3°C		Day 7 of treatment. Remove 3 samples of 12 fruit
31 Aug 06	3°C	2NDS	Day 8 of treatment. Remove 3 samples of 12 fruit

01 Sep 06	3°C	2NDS	Day 9 of treatment. Remove 3 samples of 12 fruit
02 Sep 06	3°C	2NDS	Day 10 of treatment. Remove 3 samples of 12 fruit
03 Sep 06	3°C	2NDS	Day 11 of treatment. (no activity required)
04 Sep 06	3°C	2NDS	Day 12 of treatment. Remove 3 samples of 12 fruit
		2NDS	2nd sieving of control fruits
05 Sep 06	3°C	2NDS	Day 13 of treatment.
			1st sieving of day 3 treatments
06 Sep 06	3°C	2NDS	Day 14 of treatment. Remove 3 samples of 12 fruit
			1st sieving of day 4 treatments
07 Sep 06	3°C	2NDS	1st sieving of day 5 treatments
08 Sep 06	3°C		1st sieving of day 6 treatments
09 Sep 06	3°C	2NDS	1st sieving of day 7 treatments
10 Sep 06	3°C	2NDS	1st sieving of day 8 treatments
11 Sep 06	3°C	2NDS	1st sieving of day 9 treatments
12 Sep 06	3°C	2NDS	1st sieving of day 10 treatments
13 Sep 06	3°C	2NDS	2nd sieving of day 3 treatments
14 Sep 06	3°C	2NDS	2nd sieving of day 4 treatments
		2NDS	1st sieving of day 12 treatments
15 Sep 06	3°C	2NDS	2nd sieving of day 5 treatments
16 Sep 06	3°C		2nd sieving of day 6 treatments
		2NDS	1st sieving of day 14 treatments
17 Sep 06	3°C	2NDS	2nd sieving of day 7 treatments
18 Sep 06	3°C		2nd sieving of day 8 treatments
19 Sep 06	3°C	2NDS	2nd sieving of day 9 treatments
20 Sep 06	3°C	2NDS	2nd sieving of day 10 treatments
21 Sep 06	3°C	2NDS	No activity required
22 Sep 06	3°C	2NDS	2nd sieving of day 12 treatments
23 Sep 06	3°C	2NDS	No activity required
24 Sep 06	3°C	2NDS	2nd sieving of day 14 treatments
-----	-----	2NDS	-----
		2NDS	---
28 Aug 06	3°C	-----	
29 Aug 06	3°C	-	Infest approx. 432 fruit on cages at GHI
			Remove fruit from cages, randomly select sample of 72
		3RDS	fruit as controls (non-cold treated fruit).
30 Aug 06	3°C	3RDS	Controls into hot storage room.
31 Aug 06	3°C		Larvae developing (no activity required)
01 Sep 06	3°C		Larvae developing (no activity required)
02 Sep 06	3°C	3RDS	Larvae developing (no activity required)
03 Sep 06	3°C	3RDS	Larvae developing (no activity required)
04 Sep 06	3°C	3RDS	Larvae developing (no activity required)
05 Sep 06	3°C	3RDS	Larvae developing (no activity required)
06 Sep 06	3°C	3RDS	Treatment units into treatment at 3°C.
07 Sep 06	3°C	3RDS	Day 1 of treatment (no activity required)
08 Sep 06	3°C	3RDS	Day 2 of treatment (no activity required)
		3RDS	Day 3 of treatment. Remove 3 samples of 12 fruit
09 Sep 06	3°C	3RDS	1st sieving of control fruits
10 Sep 06	3°C	3RDS	Day 4 of treatment. Remove 3 samples of 12 fruit
11 Sep 06	3°C		Day 5 of treatment. Remove 3 samples of 12 fruit
12 Sep 06	3°C	3RDS	Day 6 of treatment. Remove 3 samples of 12 fruit
13 Sep 06	3°C	3RDS	Day 7 of treatment. Remove 3 samples of 12 fruit
14 Sep 06	3°C	3RDS	Day 8 of treatment. Remove 3 samples of 12 fruit
15 Sep 06	3°C	3RDS	Day 9 of treatment. Remove 3 samples of 12 fruit
		3RDS	Day 10 of treatment. Remove 3 samples of 12 fruit
16 Sep 06	3°C	3RDS	2nd sieving of control fruits
17 Sep 06	3°C	3RDS	Day 11 of treatment. (no activity required)
18 Sep 06	3°C		Day 12 of treatment. Remove 3 samples of 12 fruit
		3RDS	Day 13 of treatment.

19 Sep 06	3°C	3RDS	1st sieving of day 3 treatments
		3RDS	Day 14 of treatment. Remove 3 samples of 12 fruit
20 Sep 06	3°C		1st sieving of day 4 treatments
21 Sep 06	3°C	3RDS	1st sieving of day 5 treatments
22 Sep 06	3°C		1st sieving of day 6 treatments
23 Sep 06	3°C	3RDS	1st sieving of day 7 treatments
24 Sep 06	3°C	3RDS	1st sieving of day 8 treatments
25 Sep 06	3°C	3RDS	1st sieving of day 9 treatments
		3RDS	1st sieving of day 10 treatments
26 Sep 06	3°C	3RDS	2nd sieving of day 3 treatments
27 Sep 06	3°C	3RDS	2nd sieving of day 4 treatments
			1st sieving of day 12 treatments
28 Sep 06	3°C	3RDS	2nd sieving of day 5 treatments
29 Sep 06	3°C	3RDS	2nd sieving of day 6 treatments
			1st sieving of day 14 treatments
30 Sep 06	3°C	3RDS	2nd sieving of day 7 treatments
01 Oct 06	3°C	3RDS	2nd sieving of day 8 treatments
02 Oct 06	3°C		2nd sieving of day 9 treatments
03 Oct 06	3°C	3RDS	2nd sieving of day 10 treatments
04 Oct 06	3°C	3RDS	No activity required
05 Oct 06	3°C	3RDS	2nd sieving of day 12 treatments
06 Oct 06	3°C	3RDS	No activity required
		3RDS	2nd sieving of day 14 treatments
		3RDS	
		3RDS	

Table 4. Experimental schedule of activities for most treatment tolerant life-stage trials at 3°C in nectarines.

Date	Temperature	Life-stage	Activity
03 Jan 07	3°C	EGGS	Infest approx. 432 fruit on cages at GHI
04 Jan 07	3°C	EGGS	Remove fruit from cages, randomly select sample of 72 fruit as controls (non-cold treated fruit). Controls into hot storage room.
05 Jan 07	3°C	EGGS	Treatment units into treatment at 3°C.
06 Jan 07	3°C	EGGS	Day 1 of treatment (no activity required)
07 Jan 07	3°C	EGGS	Day 2 of treatment (no activity required)
08 Jan 07	3°C	EGGS	Day 3 of treatment. Remove 3 samples of 12 fruit
09 Jan 07	3°C	EGGS	Day 4 of treatment. Remove 3 samples of 12 fruit
10 Jan 07	3°C	EGGS	Day 5 of treatment. Remove 3 samples of 12 fruit
11 Jan 07	3°C	EGGS	Day 6 of treatment. Remove 3 samples of 12 fruit
12 Jan 07	3°C	EGGS	Day 7 of treatment. Remove 3 samples of 12 fruit
13 Jan 07	3°C	EGGS	Day 8 of treatment. Remove 3 samples of 12 fruit
14 Jan 07	3°C	EGGS	Day 9 of treatment. Remove 3 samples of 12 fruit 1st sieving of control fruits
15 Jan 07	3°C	EGGS	Day 10 of treatment. Remove 3 samples of 12 fruit
16 Jan 07	3°C	EGGS	Day 11 of treatment. (no activity required)
17 Jan 07	3°C	EGGS	Day 12 of treatment. Remove 3 samples of 12 fruit
18 Jan 07	3°C	EGGS	Day 13 of treatment. 1st sieving of day 3 treatments
19 Jan 07	3°C	EGGS	Day 14 of treatment. Remove 3 samples of 12 fruit 1st sieving of day 4 treatments
20 Jan 07	3°C	EGGS	1st sieving of day 5 treatments
21 Jan 07	3°C	EGGS	1st sieving of day 6 treatments 2nd sieving of control fruits
22 Jan 07	3°C	EGGS	1st sieving of day 7 treatments
23 Jan 07	3°C	EGGS	1st sieving of day 8 treatments
24 Jan 07	3°C	EGGS	1st sieving of day 9 treatments
25 Jan 07	3°C	EGGS	1st sieving of day 10 treatments 2nd sieving of day 3 treatments
26 Jan 07	3°C	EGGS	2nd sieving of day 4 treatments
27 Jan 07	3°C	EGGS	1st sieving of day 12 treatments 2nd sieving of day 5 treatments
28 Jan 07	3°C	EGGS	2nd sieving of day 6 treatments
29 Jan 07	3°C	EGGS	2nd sieving of day 7 treatments 1st sieving of day 14 treatments
30 Jan 07	3°C	EGGS	2nd sieving of day 8 treatments
31 Jan 07	3°C	EGGS	2nd sieving of day 9 treatments
01 Feb 07	3°C	EGGS	2nd sieving of day 10 treatments
02 Feb 07	3°C	EGGS	No activity required
03 Feb 07	3°C	EGGS	2nd sieving of day 12 treatments
04 Feb 07	3°C	EGGS	No activity required
05 Feb 07	3°C	EGGS	2nd sieving of day 14 treatments
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		-	
10 Jan 07	3°C		Infest approx. 432 fruit on cages at GHI
11 Jan 07	3°C	1STS	Remove fruit from cages, randomly select sample of 72 fruit as controls (non-cold treated fruit). Controls into hot storage room.
12 Jan 07	3°C		Larvae developing (no activity required)
13 Jan 07	3°C	1STS	Larvae developing (no activity required)

14 Jan 07	3°C	1STS	Treatment units into treatment at 3°C.
15 Jan 07	3°C	1STS	Day 1 of treatment (no activity required)
16 Jan 07	3°C	1STS	Day 2 of treatment (no activity required)
17 Jan 07	3°C	1STS	Day 3 of treatment. Remove 3 samples of 12 fruit
18 Jan 07	3°C	1STS	Day 4 of treatment. Remove 3 samples of 12 fruit
19 Jan 07	3°C	1STS	Day 5 of treatment. Remove 3 samples of 12 fruit
20 Jan 07	3°C	1STS	Day 6 of treatment. Remove 3 samples of 12 fruit
21 Jan 07	3°C	1STS	Day 7 of treatment. Remove 3 samples of 12 fruit
		1STS	1st sieving of control fruits
22 Jan 07	3°C		Day 8 of treatment. Remove 3 samples of 12 fruit
23 Jan 07	3°C	1STS	Day 9 of treatment. Remove 3 samples of 12 fruit
24 Jan 07	3°C	1STS	Day 10 of treatment. Remove 3 samples of 12 fruit
25 Jan 07	3°C	1STS	Day 11 of treatment. (no activity required)
26 Jan 07	3°C	1STS	Day 12 of treatment. Remove 3 samples of 12 fruit
27 Jan 07	3°C	1STS	Day 13 of treatment.
		1STS	1st sieving of day 3 treatments
28 Jan 07	3°C		Day 14 of treatment. Remove 3 samples of 12 fruit
		1STS	1st sieving of day 4 treatments
			2nd sieving of control fruits
29 Jan 07	3°C		1st sieving of day 5 treatments
30 Jan 07	3°C	1STS	1st sieving of day 6 treatments
31 Jan 07	3°C	1STS	1st sieving of day 7 treatments
01 Feb 07	3°C	1STS	1st sieving of day 8 treatments
02 Feb 07	3°C	1STS	1st sieving of day 9 treatments
03 Feb 07	3°C	1STS	1st sieving of day 10 treatments
		1STS	2nd sieving of day 3 treatments
04 Feb 07	3°C		2nd sieving of day 4 treatments
05 Feb 07	3°C	1STS	2nd sieving of day 5 treatments
		1STS	1st sieving of day 12 treatments
06 Feb 07	3°C		2nd sieving of day 6 treatments
07 Feb 07	3°C	1STS	2nd sieving of day 7 treatments
		1STS	1st sieving of day 14 treatments
08 Feb 07	3°C		2nd sieving of day 8 treatments
09 Feb 07	3°C	1STS	2nd sieving of day 9 treatments
10 Feb 07	3°C	1STS	2nd sieving of day 10 treatments
11 Feb 07	3°C	1STS	No activity required
12 Feb 07	3°C	1STS	2nd sieving of day 12 treatments
13 Feb 07	3°C	1STS	No activity required
14 Feb 07	3°C	1STS	2nd sieving of day 14 treatments
-----	-----	1STS	-----
		-----	---
16 Jan 07	3°C	-	
17 Jan 07	3°C		Infest approx. 432 fruit on cages at GHI
		2NDS	Remove fruit from cages, randomly select sample of 72
		2NDS	fruit as controls (non-cold treated fruit).
18 Jan 07	3°C		Controls into hot storage room.
19 Jan 07	3°C		Larvae developing (no activity required)
20 Jan 07	3°C	2NDS	Larvae developing (no activity required)
21 Jan 07	3°C	2NDS	Larvae developing (no activity required)
22 Jan 07	3°C	2NDS	Larvae developing (no activity required)
23 Jan 07	3°C	2NDS	Treatment units into treatment at 3°C.
24 Jan 07	3°C	2NDS	Day 1 of treatment (no activity required)
25 Jan 07	3°C	2NDS	Day 2 of treatment (no activity required)
26 Jan 07	3°C	2NDS	Day 3 of treatment. Remove 3 samples of 12 fruit
27 Jan 07	3°C	2NDS	Day 4 of treatment. Remove 3 samples of 12 fruit
		2NDS	Day 5 of treatment. Remove 3 samples of 12 fruit
28 Jan 07	3°C	2NDS	1st sieving of control fruits
29 Jan 07	3°C		Day 6 of treatment. Remove 3 samples of 12 fruit

30 Jan 07	3°C	2NDS	Day 7 of treatment. Remove 3 samples of 12 fruit
31 Jan 07	3°C	2NDS	Day 8 of treatment. Remove 3 samples of 12 fruit
01 Feb 07	3°C	2NDS	Day 9 of treatment. Remove 3 samples of 12 fruit
02 Feb 07	3°C	2NDS	Day 10 of treatment. Remove 3 samples of 12 fruit
03 Feb 07	3°C	2NDS	Day 11 of treatment. (no activity required)
		2NDS	Day 12 of treatment. Remove 3 samples of 12 fruit
04 Feb 07	3°C	2NDS	2nd sieving of control fruits
			Day 13 of treatment.
05 Feb 07	3°C	2NDS	1st sieving of day 3 treatments
			Day 14 of treatment. Remove 3 samples of 12 fruit
06 Feb 07	3°C	2NDS	1st sieving of day 4 treatments
07 Feb 07	3°C		1st sieving of day 5 treatments
08 Feb 07	3°C	2NDS	1st sieving of day 6 treatments
09 Feb 07	3°C	2NDS	1st sieving of day 7 treatments
10 Feb 07	3°C	2NDS	1st sieving of day 8 treatments
11 Feb 07	3°C	2NDS	1st sieving of day 9 treatments
		2NDS	1st sieving of day 10 treatments
12 Feb 07	3°C	2NDS	2nd sieving of day 3 treatments
13 Feb 07	3°C		2nd sieving of day 4 treatments
14 Feb 07	3°C	2NDS	2nd sieving of day 5 treatments
		2NDS	1st sieving of day 12 treatments
15 Feb 07	3°C	2NDS	2nd sieving of day 6 treatments
16 Feb 07	3°C		2nd sieving of day 7 treatments
		2NDS	1st sieving of day 14 treatments
17 Feb 07	3°C	2NDS	2nd sieving of day 8 treatments
18 Feb 07	3°C		2nd sieving of day 9 treatments
19 Feb 07	3°C	2NDS	2nd sieving of day 10 treatments
20 Feb 07	3°C	2NDS	No activity required
21 Feb 07	3°C	2NDS	2nd sieving of day 12 treatments
22 Feb 07	3°C	2NDS	No activity required
-----	-----	2NDS	2nd sieving of day 14 treatments
		2NDS	-----
16 Jan 07	3°C	-----	---
17 Jan 07	3°C	-	
			Infest approx. 432 fruit on cages at GHI
		3RDS	Remove fruit from cages, randomly select sample of 72
18 Jan 07	3°C	3RDS	fruit as controls (non-cold treated fruit).
19 Jan 07	3°C		Controls into hot storage room.
20 Jan 07	3°C		Larvae developing (no activity required)
21 Jan 07	3°C	3RDS	Larvae developing (no activity required)
22 Jan 07	3°C	3RDS	Larvae developing (no activity required)
23 Jan 07	3°C	3RDS	Larvae developing (no activity required)
24 Jan 07	3°C	3RDS	Larvae developing (no activity required)
25 Jan 07	3°C	3RDS	Larvae developing (no activity required)
26 Jan 07	3°C	3RDS	Treatment units into treatment at 3°C.
27 Jan 07	3°C	3RDS	Day 1 of treatment (no activity required)
		3RDS	Day 2 of treatment (no activity required)
28 Jan 07	3°C	3RDS	Day 3 of treatment. Remove 3 samples of 12 fruit
29 Jan 07	3°C	3RDS	1st sieving of control fruits
30 Jan 07	3°C		Day 4 of treatment. Remove 3 samples of 12 fruit
31 Jan 07	3°C	3RDS	Day 5 of treatment. Remove 3 samples of 12 fruit
01 Feb 07	3°C	3RDS	Day 6 of treatment. Remove 3 samples of 12 fruit
02 Feb 07	3°C	3RDS	Day 7 of treatment. Remove 3 samples of 12 fruit
03 Feb 07	3°C	3RDS	Day 8 of treatment. Remove 3 samples of 12 fruit
04 Feb 07	3°C	3RDS	Day 9 of treatment. Remove 3 samples of 12 fruit
05 Feb 07	3°C	3RDS	Day 10 of treatment. Remove 3 samples of 12 fruit
06 Feb 07	3°C	3RDS	Day 11 of treatment. (no activity required)
		3RDS	Day 12 of treatment. Remove 3 samples of 12 fruit

07 Feb 07	3°C	3RDS	Day 13 of treatment.
		3RDS	2nd sieving of control fruits
			1st sieving of day 3 treatments
08 Feb 07	3°C		Day 14 of treatment. Remove 3 samples of 12 fruit
09 Feb 07	3°C	3RDS	1st sieving of day 4 treatments
10 Feb 07	3°C		1st sieving of day 5 treatments
11 Feb 07	3°C	3RDS	1st sieving of day 6 treatments
12 Feb 07	3°C	3RDS	1st sieving of day 7 treatments
13 Feb 07	3°C	3RDS	1st sieving of day 8 treatments
		3RDS	1st sieving of day 9 treatments
14 Feb 07	3°C	3RDS	1st sieving of day 10 treatments
15 Feb 07	3°C	3RDS	2nd sieving of day 3 treatments
			2nd sieving of day 4 treatments
16 Feb 07	3°C	3RDS	2nd sieving of day 5 treatments
17 Feb 07	3°C	3RDS	1st sieving of day 12 treatments
			2nd sieving of day 6 treatments
18 Feb 07	3°C	3RDS	2nd sieving of day 7 treatments
19 Feb 07	3°C	3RDS	1st sieving of day 14 treatments
20 Feb 07	3°C		2nd sieving of day 8 treatments
21 Feb 07	3°C	3RDS	2nd sieving of day 9 treatments
22 Feb 07	3°C	3RDS	2nd sieving of day 10 treatments
23 Feb 07	3°C	3RDS	No activity required
24 Feb 07	3°C	3RDS	2nd sieving of day 12 treatments
		3RDS	No activity required
		3RDS	2nd sieving of day 14 treatments
		3RDS	

Table 5. Experimental schedule of activity for large scale trial at 1°C.

Date	Fruit	Replicate	Activity
12 Sep 2006	Plums	1, 2	Infest fruit on cages at GHI.
19 Sep 2006	Plums	1, 2	Remove fruit from cages. Place fruit in hot storage room.
21 Sep 2006	Plums	1, 2	Larval development test, test fruit into 1°C, controls into hot storage room.
22 Sep 2006	Plums	1, 2	Test fruit reaches target temperature.
25 Sep 2006	Plums	1, 2	1st sieving of controls
02 Oct 2006	Plums	1, 2	2nd sieving of controls.
06 Oct 2006	Plums	1, 2	14 day treatment ends. Into hot storage room.
09 Oct 2006	Plums	1, 2	Sieve 3 controls.
16 Oct 2006	Plums	1, 2	1st sieving of treated fruits.
23 Oct 2006	Plums	1, 2	2nd sieving of treated fruits.
30 Oct 2006	Plums	1, 2	Sieve 3 treated fruits, dissect fruits for survivors.
10 Oct 2007	Plums	3	Infest fruit on cages at GHI.
11 Oct 2007	Plums	3	Remove fruit from cages. Place fruit in hot storage room.
18 Oct 2007	Plums	3	Larval development test, test fruit into 1°C, controls into hot storage room.
19 Oct 2007	Plums	3	Test fruit reaches target temperature.
23 Oct 2007	Plums	3	1st sieving of controls.
30 Oct 2007	Plums	3	2nd sieving of controls.
02 Nov 2007	Plums	3	14 day treatment ends. Into hot storage room.
06 Nov 2007	Plums	3	Sieve 3 controls.
13 Nov 2007	Plums	3	1st sieving of treated fruits.
20 Nov 2007	Plums	3	2nd sieving of treated fruits.
27 Nov 2007	Plums	3	Sieve 3 treated fruits, dissect fruits for survivors.
27 Mar 2007	Nectarines	1	Infest fruit on cages at GHI.
28 Mar 2007	Nectarines	1	Remove fruit from cages. Place fruit in hot storage room.
31 Mar 2007	Nectarines	1	Larval development test, test fruit into 1°C, controls into hot storage room.
01 Apr 2007	Nectarines	1	Test fruit reaches target temperature.
09 Apr 2007	Nectarines	1	1st sieving of controls.
15 Apr 2007	Nectarines	1	14 day treatment ends. Into hot storage room.
16 Apr 2007	Nectarines	1	2nd sieving of controls.
23 Apr 2007	Nectarines	1	Sieve 3 controls.
25 Apr 2007	Nectarines	1	1st sieving of treated fruits.
02 May 2007	Nectarines	1	2nd sieving of treated fruits, dissect fruits for survivors.
11 Apr 2007	Nectarines	2	Infest fruit on cages at GHI.
12 Apr 2007	Nectarines	2	Remove fruit from cages. Place fruit in hot storage room.
15 Apr 2007	Nectarines	2	Larval development test, test fruit into 1°C, controls into hot storage room.
16 Apr 2007	Nectarines	2	Test fruit reaches target temperature
23 Apr 2007	Nectarines	2	1st sieving of controls
30 Apr 2007	Nectarines	2	14 day treatment ends. Into hot storage room.
10 May 2007	Nectarines	2	2nd sieving of controls.
17 May 2007	Nectarines	2	

			1st sieving of treated fruits. 2nd sieving of treated fruits, dissect fruits for survivors.
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Table 6. Experimental schedule of activities for large scale trials at 3°C.

Date	Fruit	Replicate	Activity
18 Oct 2006	Plums	1	Infest fruit on cages at GHI.
19 Oct 2006	Plums	1	Remove fruit from cages. Place fruit in hot storage room.
27 Oct 2006	Plums	1	Larval development test, test fruit into 3°C, Controls into hot storage room.
28 Oct 2006	Plums	1	Test fruit reaches target temperature.
30 Oct 2006	Plums	1	1st sieving of controls.
06 Nov 2006	Plums	1	2nd sieving of controls.
11 Nov 2006	Plums	1	14 day treatment ends. Into hot storage room.
13 Nov 2006	Plums	1	Sieve 3 controls.
22 Nov 2006	Plums	1	1st sieving of treated fruits.
29 Nov 2006	Plums	1	2nd sieving of treated fruits.
06 Dec 2006	Plums	1	Sieve 3 treated fruits, dissect fruits for survivors.
<hr/>			
20 Mar 2007	Plums	2	Infest fruit on cages at GHI.
21 Mar 2007	Plums	2	Remove fruit from cages. Place fruit in hot storage room.
26 Mar 2007	Plums	2	Larval development test, test fruit into 3°C, Controls into hot storage room.
27 Mar 2007	Plums	2	Test fruit reaches target temperature.
02 Apr 2007	Plums	2	1st sieving of controls.
09 Apr 2007	Plums	2	2nd sieving of controls.
10 Apr 2007	Plums	2	14 day treatment ends. Into hot storage room.
16 Apr 2007	Plums	2	Sieve 3 controls.
20 Apr 2007	Plums	2	1st sieving of treated fruits.
27 Apr 2007	Plums	2	2nd sieving of treated fruits.
04 May 2007	Plums	2	Sieve 3 treated fruits, dissect fruits for survivors.
<hr/>			
27 Mar 2007	Plums	3	Infest fruit on cages at GHI.
28 Mar 2007	Plums	3	Remove fruit from cages. Place fruit in hot storage room.
02 Apr 2007	Plums	3	Larval development test, test fruit into 3°C, Controls into hot storage room.
03 Apr 2007	Plums	3	Test fruit reaches target temperature.
09 Apr 2007	Plums	3	1st sieving of controls.
16 Apr 2007	Plums	3	2nd sieving of controls.
17 Apr 2007	Plums	3	14 day treatment ends. Into hot storage room.
23 Apr 2007	Plums	3	Sieve 3 controls.
27 Apr 2007	Plums	3	1st sieving of treated fruits.
04 May 2007	Plums	3	2nd sieving of treated fruits.
11 May 2007	Plums	3	Sieve 3 treated fruits, dissect fruits for survivors.
<hr/>			
03 Apr 2007	Plums	4	Infest fruit on cages at GHI.
04 Apr 2007	Plums	4	Remove fruit from cages. Place fruit in hot storage room.
09 Apr 2007	Plums	4	Larval development test, test fruit into 3°C, Controls into hot storage room.
10 Apr 2007	Plums	4	Test fruit reaches target temperature.
16 Apr 2007	Plums	4	1st sieving of controls.
23 Apr 2007	Plums	4	2nd sieving of controls.
24 Apr 2007	Plums	4	14 day treatment ends. Into hot storage room.
30 Apr 2007	Plums	4	Sieve 3 controls.
04 May 2007	Plums	4	1st sieving of treated fruits.
11 May 2007	Plums	4	2nd sieving of treated fruits.

18 May 2007	Plums	4	Sieve 3 treated fruits, dissect fruits for survivors.
11 Apr 2007	Plums	5	Infest fruit on cages at GHI.
12 Apr 2007	Plums	5	Remove fruit from cages. Place fruit in hot storage room.
17 Apr 2007	Plums	5	Larval development test, test fruit into 3°C, Controls into hot storage room.
18 Apr 2007	Plums	5	Test fruit reaches target temperature.
23 Apr 2007	Plums	5	1st sieving of controls.
30 Apr 2007	Plums	5	2nd sieving of controls.
02 May 2007	Plums	5	14 day treatment ends. Into hot storage room.
07 May 2007	Plums	5	Sieve 3 controls.
12 May 2007	Plums	5	1st sieving of treated fruits.
19 May 2007	Plums	5	2nd sieving of treated fruits.
26 May 2007	Plums	5	Sieve 3 treated fruits, dissect fruits for survivors.
<hr/>			
30 Jan 2007	Nectarines	1,2	Infest fruit on cages at GHI.
31 Jan 2007	Nectarines	1,2	Remove fruit from cages. Place fruit in hot storage room.
02 Feb 2007	Nectarines	1,2	Larval development test, test fruit into 3°C, Controls into hot storage room.
03 Feb 2007	Nectarines	1,2	Test fruit reaches target temperature.
12 Feb 2007	Nectarines	1,2	1st sieving of controls.
19 Feb 2007	Nectarines	1,2	2nd sieving of controls.
17 Feb 2007	Nectarines	1,2	14 day treatment ends. Into hot storage room.
27 Feb 2007	Nectarines	1,2	1st sieving of treated fruits.
06 Mar 2007	Nectarines	1,2	2nd sieving of treated fruits.
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07 Feb 2007	Nectarines	3	Infest fruit on cages at GHI.
08 Feb 2007	Nectarines	3	Remove fruit from cages. Place fruit in hot storage room.
10 Feb 2007	Nectarines	3	Larval development test, test fruit into 3°C, Controls into hot storage room.
11 Feb 2007	Nectarines	3	Test fruit reaches target temperature.
19 Feb 2007	Nectarines	3	1st sieving of controls.
25 Feb 2007	Nectarines	3	14 day treatment ends. Into hot storage room.
26 Feb 2007	Nectarines	3	2nd sieving of controls.
07 Mar 2007	Nectarines	3	1st sieving of treated fruits.
14 Mar 2007	Nectarines	3	2nd sieving of treated fruits.
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20 Feb 2007	Nectarines	4	Infest fruit on cages at GHI.
21 Feb 2007	Nectarines	4	Remove fruit from cages. Place fruit in hot storage room.
22 Feb 2007	Nectarines	4	Larval development test, test fruit into 3°C, Controls into hot storage room.
23 Feb 2007	Nectarines	4	Test fruit reaches target temperature.
04 Mar 2007	Nectarines	4	1st sieving of controls.
10 Mar 2007	Nectarines	4	14 day treatment ends. Into hot storage room.
11 Mar 2007	Nectarines	4	2nd sieving of controls.
20 Mar 2007	Nectarines	4	1st sieving of treated fruit.
27 Mar 2007	Nectarines	4	2nd sieving of treated fruit.

Table 7. Key dates and location of large scale trials for plums and nectarines at 1°C and 3°C.

<i>Fruit</i>	<i>Replicate</i>	<i>Treatment</i>	<i>Infestation date</i>	<i>Fruit into treatment</i>	<i>Fruit reaches target temperature</i>	<i>Treatment ends</i>	<i>Room number</i>
<i>Plums</i>	1	14 d at 1°C	12 Sep 2006	21 Sep 2006	22 Sep 2006	06 Oct 2006	CTR 7
<i>Plums</i>	2	14 d at 1°C	12 Sep 2006	21 Sep 2006	22 Sep 2006	06 Oct 2006	CTR 7
<i>Plums</i>	3	14 d at 1°C	10 Oct 2006	18 Oct 2006	19 Oct 2007	02 Nov 2006	CTR 7
<i>Nectarines</i>	1	14 d at 1°C	27 Mar 2007	31 Mar 2007	01 Apr 2007	15 Apr 2007	CTR 9
<i>Nectarines</i>	2	14 d at 1°C	11 Apr 2007	15 Apr 2007	16 Apr 2007	30 Apr 2007	CTR 9

Table 7 (continued). Key dates and location of large scale trials plums and nectarines at 1°C and 3°C.

<i>Fruit</i>	<i>Replicate</i>	<i>Treatment</i>	<i>Infestation date</i>	<i>Fruit into treatment</i>	<i>Fruit reaches target temperature</i>	<i>Treatment ends</i>	<i>Room number</i>
<i>Plums</i>	1	14 d at 3°C	18 Oct 2006	27 Oct 2006	28 Oct 2006	11 Nov 2006	CTR 8
<i>Plums</i>	2	14 d at 3°C	20 Mar 2007	26 Mar 2007	27 Mar 2007	10 Apr 2007	CTR 8
<i>Plums</i>	3	14 d at 3°C	27 Mar 2007	02 Apr 2007	03 Apr 2007	17 Apr 2007	CTR 8
<i>Plums</i>	4	14 d at 3°C	03 Apr 2007	09 Apr 2007	10 Apr 2007	24 Apr 2007	CTR 8
<i>Plums</i>	5	14 d at 3°C	11 Apr 2007	17 Apr 2007	18 Apr 2007	02 May 2007	CTR 8
<i>Nectarines</i>	1	14 d at 3°C	30 Jan 2007	02 Feb 2007	03 Feb 2007	17 Feb 2007	CTR 8
<i>Nectarines</i>	2	14 d at 3°C	30 Jan 2007	02 Feb 2007	03 Feb 2007	17 Feb 2007	CTR 7
<i>Nectarines</i>	3	14 d at 3°C	07 Feb 2007	10 Feb 2007	11 Feb 2007	25 Feb 2007	CTR 8
<i>Nectarines</i>	4	14 d at 3°C	20 Feb 2007	23 Feb 2007	24 Feb 2007	10 Mar 2007	CTR 8

4.18. Data analysis

Bioassay data were obtained from the most tolerant life-stage studies where summerfruit containing the four immature *B. tryoni* life-stages – eggs, first, second, and third instars – were subjected to sub-lethal and lethal periods of storage at $1.0\pm0.5^{\circ}\text{C}$ or at $3.0\pm0.5^{\circ}\text{C}$.

These data were analysed by probit regression analysis. Probit 9 mortality values were determined.

4.19. Quality of fruit after treatment

Fifty non-infested summerfruit were randomly chosen in each replicate and assessed for quality attributes prior to storage and then again after 14 and 21 days in cold storage. These fruit were stored with infested fruit in replicates 1, 2 and 3 of the large scale trial at both 1°C and 3°C .

Summerfruit were assessed for these quality attributes:

- a) **External damage:** i.e. pitting, browning or splitting scored from 1 to 5 (0% surface area damaged to 100% surface area damaged).
- b) **Fruit weight loss.**

Data were analysed by analysis of variance where differences between treatment means were significant if $P<0.05$. K-lsd values were calculated at $k=100$ using the Duncan-Waller Bayesian k-ratio test.

5. Results

5.1. Larval development

Larvae developed normally at 26°C (Part 1, Table 8). Eggs and first instar larvae were always the dominant life-stages within infested fruit at 1 to 2, and 4 days after infestation respectively. Second instar larvae and third instar larvae often occurred together in infested fruit, but on days 5 and 7 after infestation there were more than 50% at each stage respectively.

Table 8. Approximate days post-infestation at 26°C for insects to develop to target life-stage.

Fruit	Egg	1 st instar	2 nd instar	3 rd instar
Plum	0-2	2-4	4-6	6+
Nectarine	0-2	2-4	4-6	6+

[For more information refer to Part 3 – Summary tables – as below]

Table numbers for larval development studies for most tolerant stage and large scale trials in Part 3

Fruit	Larval development studies	
	1°C	3°C
Plums	Most tolerant stage: Part 3, Table 1 Large scale trials: : Part 3, Table 13	Most tolerant stage: Part 3, Table 1 Large scale trials: Part 3, Table 15
Nectarines	Most tolerant stage: Part 3, Table 2 Large scale trials: Part 3, Table 14	Most tolerant stage: Part 3, Table 2 Large scale trials: Part 3, Table 16

5.2 Most treatment tolerant stage

In plums, third instar larvae were identified as the most tolerant life-stage for both the 1°C and 3°C treatments. In nectarines, second instar larvae were identified as the most tolerant life-stage for the 1°C treatment and first instar larvae for the 3°C treatment (Part 1, Table 9 and Table 10).

Table 9. Most tolerant stages for nectarines and plums at 1°C and 3°C.

<i>Fruit</i>	<i>Treatment temperature</i>	<i>Most treatment tolerant life-stage</i>
<i>Plums</i>	1°C	3 rd instar
<i>Plums</i>	3°C	3 rd instar
<i>Nectarines</i>	1°C	2 nd instar
<i>Nectarines</i>	3°C	1 st instar

Table 10. Probit mortality (Probit 9) against days in cold storage (non-transformed) shows the most tolerant stage of the fruit fly.

1°C	REGRESSION FORMULA	REGRESSION CO-EFF (R ²)	SLOPE	Y-INTERCEPT	Est. Probit 9 ^a
PLUMS					
EGG	y=1.3920x+2.8400	0.8663	1.3920	2.8400	4.43
FIRST	y=0.6633x+3.8100	0.9793	0.6633	3.8100	7.82
SECOND	y=0.4554x+5.2971	0.7904	0.4554	5.2971	8.13
THIRD	y=0.3442x+5.1667	0.9638	0.3442	5.1667	11.14
NECTARINES					
EGG	y=1.0630x+4.8500	0.9939	1.063	4.8500	3.90
FIRST	y=0.9300x+4.1140	0.9756	0.9300	4.1140	5.25
SECOND	y=0.3147x+5.3289	0.8169	0.3147	5.3289	11.67
THIRD	y=1.6300x+3.9100	0.9568	1.6300	3.9100	3.12
3°C	REGRESSION FORMULA	REGRESSION CO-EFF (R ²)	SLOPE	Y-INTERCEPT	Est. Probit 9 ^a
PLUMS					
EGG	y=1.5820x+2.4650	0.9881	1.5820	2.4650	4.13
FIRST	y=0.6395x+3.8096	0.9455	0.6395	3.8096	8.12
SECOND	y=0.4743x+4.2194	0.9446	0.4743	4.2194	10.08
THIRD	y=0.4854x+3.5333	0.9552	0.4854	3.5333	11.26
NECTARINES					
EGG	y=0.7711x+3.9480	0.9202	0.7711	3.9480	6.55
FIRST	y=0.4361x+5.1364	0.9288	0.4361	5.1364	8.86
SECOND	y=0.4196x+5.4900	0.8120	0.4196	5.4900	8.37
THIRD	y=0.4330x+6.5810	0.8737	0.4330	6.5810	5.59

^a Est. Probit 9: Estimate of the number of days at the target temperature to reach Probit 9 (i.e. 99.99683% mortality)

[For more information refer to Part 3 — Summary tables — as below]

Table numbers referring to most treatment tolerant stage studies in Part 3

Fruit	Most tolerant stage trials	
	1°C	3°C
Plums	Part 3, Tables 3, 4, 5, 6, 7	Part 3, Tables 22, 23, 24, 25, 26
Nectarines	Part 3, Tables 8, 9, 10, 11, 12	Part 3, Tables 27, 28, 29, 30, 31

5.3. Large scale confirmation of treatment efficacy

Insect life-stage at time of treatment

These procedures were carried out on the first (3°C) and second (1°C) instar (nectarines) and third (1°C and 3°C) instar (plums) larvae of *B. tryoni*. These were shown to be the most treatment tolerant stages for their respective temperatures and fruit type. The life-stage/s present at time of treatment was confirmed by fruit dissection, larval recovery, and determination of larval instar by examination of mouth parts.

Table 11. Demonstration of treatment efficacy.

<i>Fruit (Replicate)</i>	<i>No. fruit treated at 1°C</i>	<i>Average no. of insects treated per fruit ± SD *</i>	<i>Estimated no. of insects treated at 1°C</i>	<i>No. insects surviving treatment at 1°C</i>
<i>Plums (1)</i>	500	27.10 ± 2.50	13551	0
<i>Plums (2)</i>	500	27.10 ± 2.50	13551	0
<i>Plums (3)</i>	500	22.56 ± 9.91	11280	0
Total Plums	1500		38382	0
<i>Nectarines (1)</i>	274	88.55 ± 35.02	24262	0
<i>Nectarines (2)</i>	300	111.95 ± 16.35	33585	0
Total Nectarines	574		57847	0
<i>Fruit (Replicate)</i>	<i>No. fruit treated at 3°C</i>	<i>Average no. of insects treated per fruit ± SD *</i>	<i>Estimated no. of insects treated at 3°C</i>	<i>No. insects surviving treatment at 3°C</i>
<i>Plums (1)</i>	500	6.69 ± 1.71	3346	0
<i>Plums (2)</i>	390	38.80 ± 7.98	15141	0
<i>Plums (3)</i>	566	47.36 ± 8.25	26805	0
<i>Plums (4)</i>	384	69.62 ± 10.71	26736	0
<i>Plums (5)</i>	400	18.93 ± 3.58	7570	0
Total Plums	2240		79598	0
<i>Nectarines (1)</i>	240	59.50 ± 20.32	14280	0
<i>Nectarines (2)</i>	240	59.50 ± 20.32	14280	0
<i>Nectarines (3)</i>	240	13.91 ± 8.74	3339	0
<i>Nectarines (4)</i>	240	128.23 ± 18.9	30776	0
Total Nectarines	960		62675	0

* The average number of insects per fruit in the controls has been rounded to 2 decimal places.

[For more information refer to Part 3 – Summary tables – as below]

Table numbers referring to large scale trials in Part 3

Fruit	Large scale trials	
	1°C	3°C
Plums	Part 3, Tables 17, 18, 21	Part 3, Tables 32, 33, 34, 35, 36, 40
Nectarines	Part 3, Tables , 19, 20, 21	Part 3, Tables 37, 38, 39, 40

5.4. Temperature records

Summaries of the temperature records are presented in Part 3 as referred to on the pages below. There was some temperature variation in the cold rooms, with some temperature probes recording above the target temperatures, even after calibration

correction. Data loggers recorded the vast bulk of the time within the target temperature $\pm 0.5^{\circ}\text{C}$. Temperatures very rarely went below 0.5°C .

Temperature variation within the room would be due mainly to the position of the test fruit in the room and the efficiency of air circulation around the room.

Because temperature data logger probes were placed at the centre of fruit, randomly within each carton of treated fruit, we have a close estimate of the temperature that the insects in the infested fruit were exposed to. The large scale trials showed nil (0) survival from all experiments. Temperature records show that some fruit did not experience 14 days at exactly 1°C or 3°C but at a slightly higher temperature, at least for part of that period. Treatment efficacy records show that there were no survivors from those fruit.

[For more information refer to Part 3 – Summary tables – as below]

Table numbers referring to temperature records in Part 3

Cultivar	Temperature records	
	1°C	3°C
Plums	Part 3, Tables 44, 45, 46	Part 3, Tables 49, 50, 51 52, 53
Nectarines	Part 3, Tables 47, 48	Part 3, Tables 54, 55, 56, 57

5.5. Fruit quality

Treating summerfruit for 14 days at 1°C or 14 days at 3°C had no significant effect on quality attributes when compared to fruit quality prior to storage. A very minimal loss in fruit quality was observed but fruit were still of a Class 1 marketable quality.

[For more information refer to Part 3, Tables 41, 42 – Summary tables]

6. Discussion

6.1. Larval development

There were differences in the rate of larval development in the fruits for the most tolerant stage and large scale trials. To verify that the correct life stage was being treated in the large scale trials, a sample of five fruit were dissected and evaluated for larval development just prior to infested fruit being placed into cold storage. This ensured that the target life stage was the dominant life-stage being treated.

6.2. Most treatment tolerant life-stage

When plums were stored at either 1°C or 3°C, the third instar larvae were the most cold-tolerant life-stage. When nectarines were stored at 1°C the second instar larvae were the most tolerant, and at 3°C the first instar larvae were the most tolerant. This was based on estimation of Probit 9 (LD_{99.99683}) dose / mortality response.

6.3. Large scale trials

Third instar larvae were treated with storage at 1°C and 3°C in plums. In nectarines, second instar larvae were treated at 1°C, and first instar larvae was treated at 3°C. No insects survived treatment at either temperature in either plums or nectarines when stored for 14 days. The number of insects treated exceeded the minimum requirements for each variety/temperature combination required by the Taiwanese trial protocol.

The results offer proof of efficacy for treatment at either 1°C for 14 days or 3°C for 14 as a quarantine treatment against *B. tryoni* eggs and larvae for Australian summerfruit.

6.4. Fruit quality

Standard fruit descriptions are available for plums and nectarines (Part1, Table 12). All fruit satisfied these quality parameters before and after the cold treatment and were classed as acceptable for export.

7. Product specifications

Table 12. Product specifications for plums

FreshSpecs

Produce Specifications

PRODUCE: PLUM

TYPE: Black

VARIETY: Angeleno

CLASS: One

GENERAL APPEARANCE CRITERIA	
Colour	Deep purple to very dark purple over a red ground colour. Flesh amber to yellow in colour.
Visual Appearance	Sound fruit with or without stalks. Intact skins. Semi - Clingstone. Free from juice and spray residues or foreign matter on the skin
Sensory	A firm and sweet plum. Free from foreign and 'off ' smells or tastes.
Shape	Round to flat round.
Size	In counts and/or diameters; Uniform per pack. Minimum 50mm diameter. Maximum variance 5mm.
Maturity	Firm but yield to gentle pressure. No hard fruit.
Major defects	
Insects	With evidence of live insects.
Diseases	With evidence of progressive fungal or bacterial rots on the skin, flesh or stone of the plum.
	With evidence of discolouration or disfigurement due to viruses.
Physical / pest Damage	With unhealed cuts, holes or splits in the skin on the cheeks of the fruit
Skin marks / Blemishes	With deep seated bruises.
Temperature Injury	With evidence of dark water-soaked areas (freeze damage).
Physiological Disorders	With open split stone
	With deformed or disfigured fruit.
Minor defects	
Physical / pest Damage	With superficial bruising >1sq cm.
	With > 10 bacterial spots >0.5mm diameter.
Temperature Injury	With evidence of sunburn >1.5 sq cm.
Skin marks / Blemishes	With healed scars, hail damage or slight skin rubs; 48 - 55 mm > 1.5 sq cm, >55 mm > 2 sq cm
	With healed stem end cracks > 0.5 cm in length.
	With brown indentations or healed scars at the stem end > 1 sq cm.
Consignment criteria	
Tolerance per Consignment	Total minor defects (within allowance limit) to be < 2 defects per item Total minor defects (outside allowance limit) must not exceed 10% of consignment. Total major defects must not exceed 2 % of consignment. Combined Total not to exceed 10%.
Packaging & Labelling	Packaging manufactured from new food grade materials or sanitised returnable crates. All labelling must meet the current legislative requirements. Labelling to identify grower's name/brand (plus growers name/code if via a packhouse), address, contents, class, size and/or minimum net weight. Produce to identify Country of Origin (eg. Produce of Australia) on outer container.
Shelf life	Produce must provide not less than 14 days clear shelf life from date of
Receival	Compliance with Quarantine Treatments (if required) for Interstate

Conditions	Consignment. Stacked onto a stabilised pallet. Refrigerated van with air bag suspension, unless otherwise approved. Pulp Temperature 6 - 15 °C for Receival.
Chemical & Contaminant Residues	All chemicals used pre/postharvest must be registered and approved for use in accordance with the requirements of the APVMA regulatory system. Residues, Contaminants and Heavy Metals to comply to the FSANZ Food Standards Code ML's and MRL's.
Food safety Requirements	Produce is to be grown and packed under a HACCP based food safety program that is subject to an annual third-party audit. A copy of current certification to be forwarded to receiver. Produce that meets the above specifications but is not grown under a HACCP based food safety program must not be labelled Class 1.
Specifications reviewable: e.g. to account for specific regional effects or adverse seasonal quality or early or late seasonal variances as agreed and communicated formally in writing.	

Product specifications for nectarines

PRODUCE: NECTARINE

TYPE: White Flesh

VARIETY: Various

CLASS: One

FreshSpecs

Produce Specifications

GENERAL APPEARANCE CRITERIA	
Colour	With red blush skin and white flesh; red blush > 40% of surface with red speckle on white / slightly green background.
Visual appearance	Full bodied, with clean (washed) smooth skin. No foreign matter. With or without a small amount of sugar speckle spotting. With need for stickers with PLU and produce / variety name or barcode when available, per requirements.
Sensory	Firm to touch. Sprung not soft: sweet juicy flavour, not dry and 'woolly' (internal breakdown); free from foreign smells or taste.
Shape	Round to slightly oval, according to variety.
Size	In counts and/or diameters; Uniform per pack. Minimum 50mm diameter. Maximum variance 5mm.
Maturity	Hand sprung at receipt, with sufficient maturity to achieve good development of sweet, juicy flavour and the required level of blush at receipt.
Major defects	
Insects	With evidence of live insects.
Diseases	With fungal or bacterial rots of the skin or flesh (eg. mouldy core, botrytis, scab).
Physical / pest Damage	With cuts, holes, punctures, cracks or wounds (that break the skin).
	With unhealed damaged stem ends due to stem pull that has removed skin
	With deep, soft water-soaked bruises or discolouration (browning).
Temperature Injury	With scalded, discoloured skin, which slips easily from the flesh (condensation injury)
	With dark discolouration of skin and flesh and skin shrivelling without the application of pressure (cool storage breakdown)
	With water-soaked, translucent areas (freezer damage).
	With tissue shrivelling, softening and browning of the stem cavity (heat damage).
Physiological Disorders	With suture or stem end splits; no 'splitstone' with open stem end
Minor defects	
Physical / pest Damage	With slight depression / flattening of skin > 2 sq cm.
	With bacterial spot > 3 dry spots (1 mm); not sunken & water-soaked
Skin marks / Blemishes	With light superficial marks / blemishes (not dark against background skin colour), eg russet, affecting in aggregate > 1.5 sq cm
	With dark superficial skin marks / blemish, eg. Limb rub, dipping injury (black lesions, mostly on red skin areas) affecting in aggregate > 1 sq cm of surface.
	With severe sugar spotting where spots have joined to form a solid patch affecting >30% of surface area of fruit.
Consignment criteria	
Tolerance per Consignment	Total minor defects (within allowance limit) to be < 2 defects per item Total minor defects (outside allowance limit) must not exceed 10% of consignment. Total major defects must not exceed 2 pieces per single layer tray or 2 % of the total consignment. Combined Total not to exceed 10%.
Packaging & Labelling	Packaging manufactured from new food grade materials or sanitised returnable crates. All labelling must meet the current legislative

	requirements. Labelling to identify grower's name/brand (plus growers name/code if via a packhouse), address, contents, class, size and/or minimum net weight. Produce to identify Country of Origin (eg. Produce of Australia) on outer container.
Shelf life	Produce must provide not less than 14 days clear shelf life from date of receipt.
Receival Conditions	Compliance with Quarantine Treatments (if required) for Interstate Consignment. Stacked onto a stabilised pallet. Refrigerated van with air bag suspension, unless otherwise approved. Pulp Temperature 6 - 13 °C for Receipt.
Chemical & Contaminant Residues	All chemicals used pre/postharvest must be registered and approved for use in accordance with the requirements of the APVMA regulatory system. Residues, Contaminants and Heavy Metals to comply to the FSANZ Food Standards Code ML's and MRL's.
Food safety Requirements	Produce is to be grown and packed under a HACCP based food safety program that is subject to an annual third-party audit. A copy of current certification to be forwarded to receiver.
Specifications reviewable: e.g. to account for specific regional effects or adverse seasonal impacts on quality or early or late seasonal variances as agreed and communicated formally in writing.	

Specifications released by the Australian Chamber of Fruit and Vegetable Industries (<http://www.freshmarkets.com.au/FreshSpec/freshspecs.html>)

Cold treatment of Australian summerfruit
(plums, nectarines / peaches)
infested with eggs and larvae of the Queensland fruit fly
(*Bactrocera tryoni* (Froggatt)) Diptera : Tephritidae .

* * * * *

PART TWO – PHOTOS and DIAGRAMS

OF THE MOST TOLERANT STAGE AND LARGE SCALE TRIAL
PROTOCOLS FOR COLD DISINFESTATION OF
QUEENSLAND FRUIT FLY

CONDUCTED AT

NEW SOUTH WALES DEPARTMENT OF PRIMARY INDUSTRIES,
GOSFORD, NSW. AUSTRALIA 2250

JULY 2008

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Figure 1
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Figure 2
By day 6 after egg laying, at 26°C, larvae have moulted through 1st and 2nd instars and have reached the mature 3rd instar.



Figure 3
Mature 3rd instar larvae pupate. They remain in the pupal state for 10 to 12 days at 26°C and then eclose as adult flies.



Figure 4
Adult flies must become sexually mature (takes about 5 to 7 days at 26°C) before they can lay eggs. The whole cycle from egg to egg takes approximately 22 to 29 days, at 26°C.



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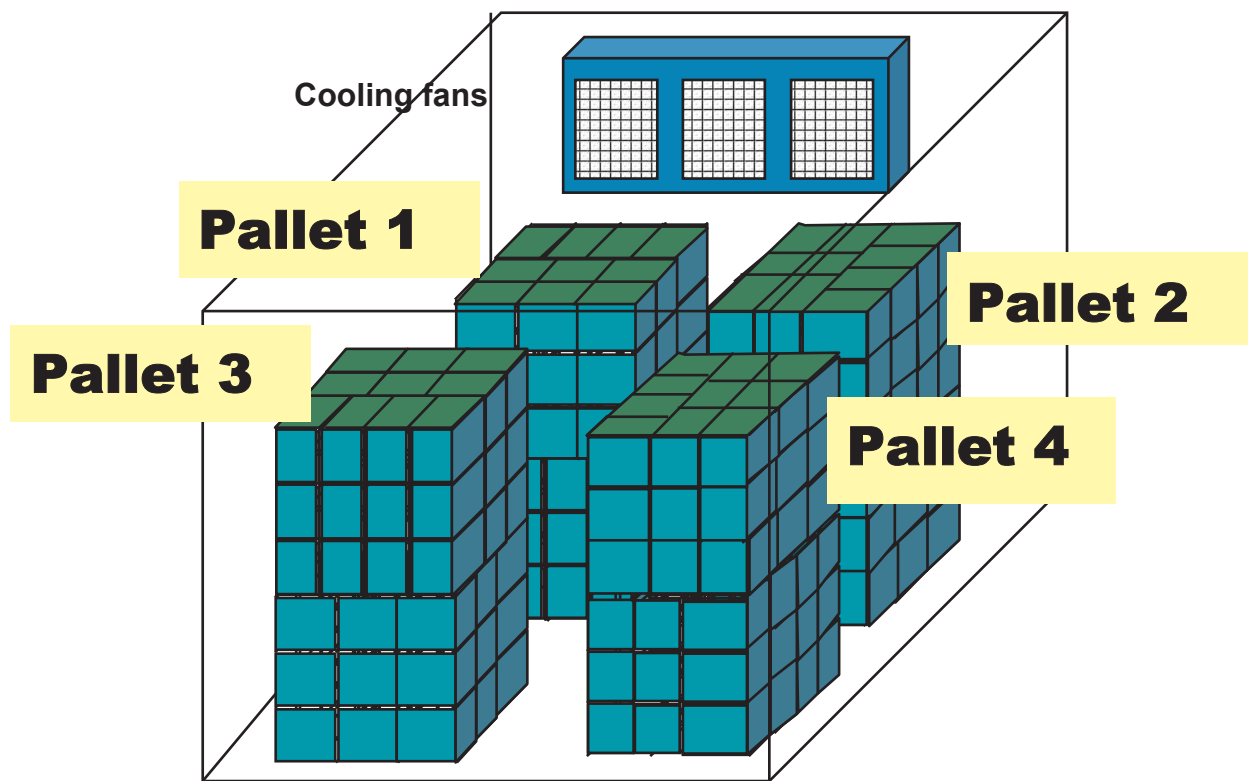
10kg Carton

**Weight with fruit
is about 10 kg**



Figure 6

The fruit cartons used in these trials. Two stacked cartons are shown here. Each carton measures 425mm X 125mm X 360mm and holds 10kg of fruit.



Layout of cold rooms 1, 2 and 3 showing placement of pallet loads of fruit in cartons. Pallets are numbered from 1 to 4. The layouts in rooms 1, 2 and 3 are identical.

Figure 7

The layout of pallets in the three cold rooms were identical. Equivalent cartons of filler fruit in each stack and each room were replaced with cartons of treated (test) fruit throughout the trials.

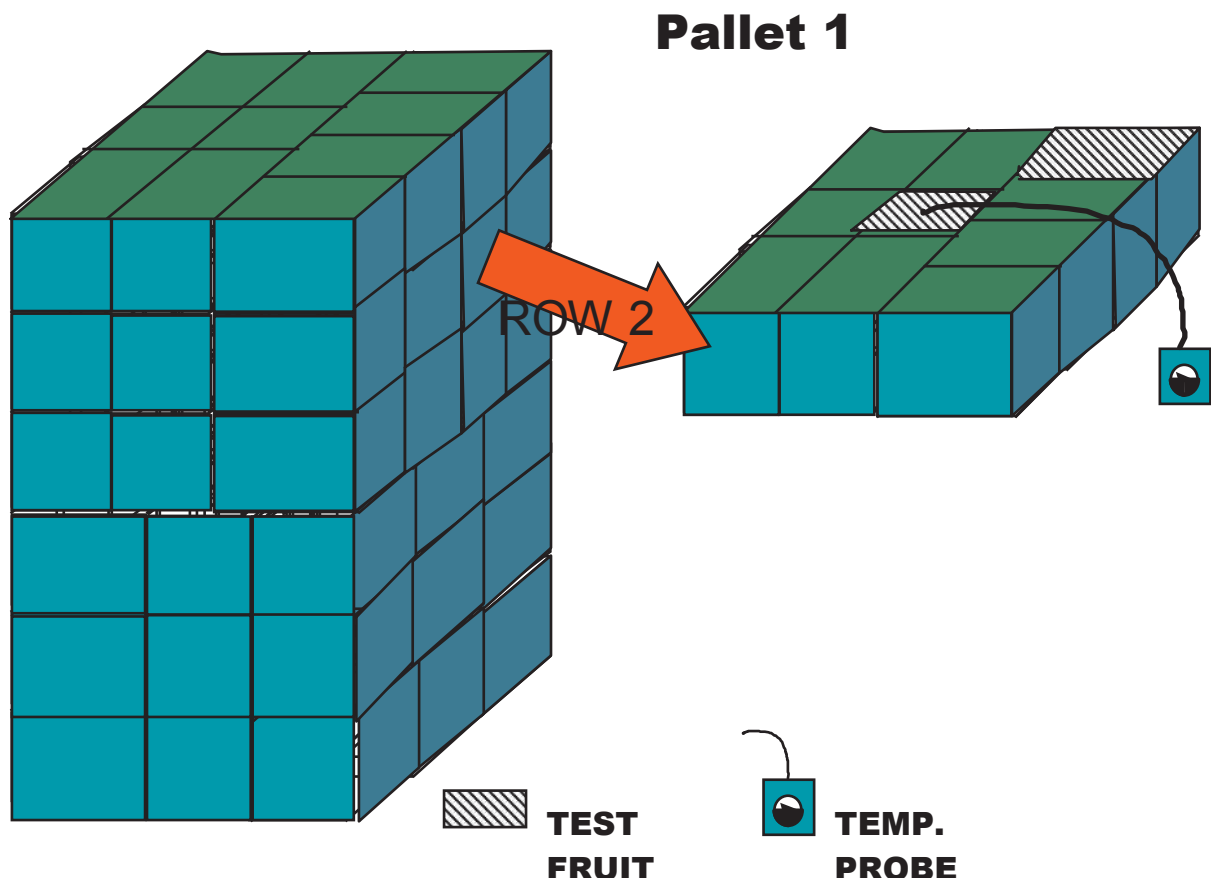


Figure 8
PALLET 1: Placement of infested (TEST) fruit and temperature data logger probes.
 Please refer to the room diagram for the pallet's location and alignment.

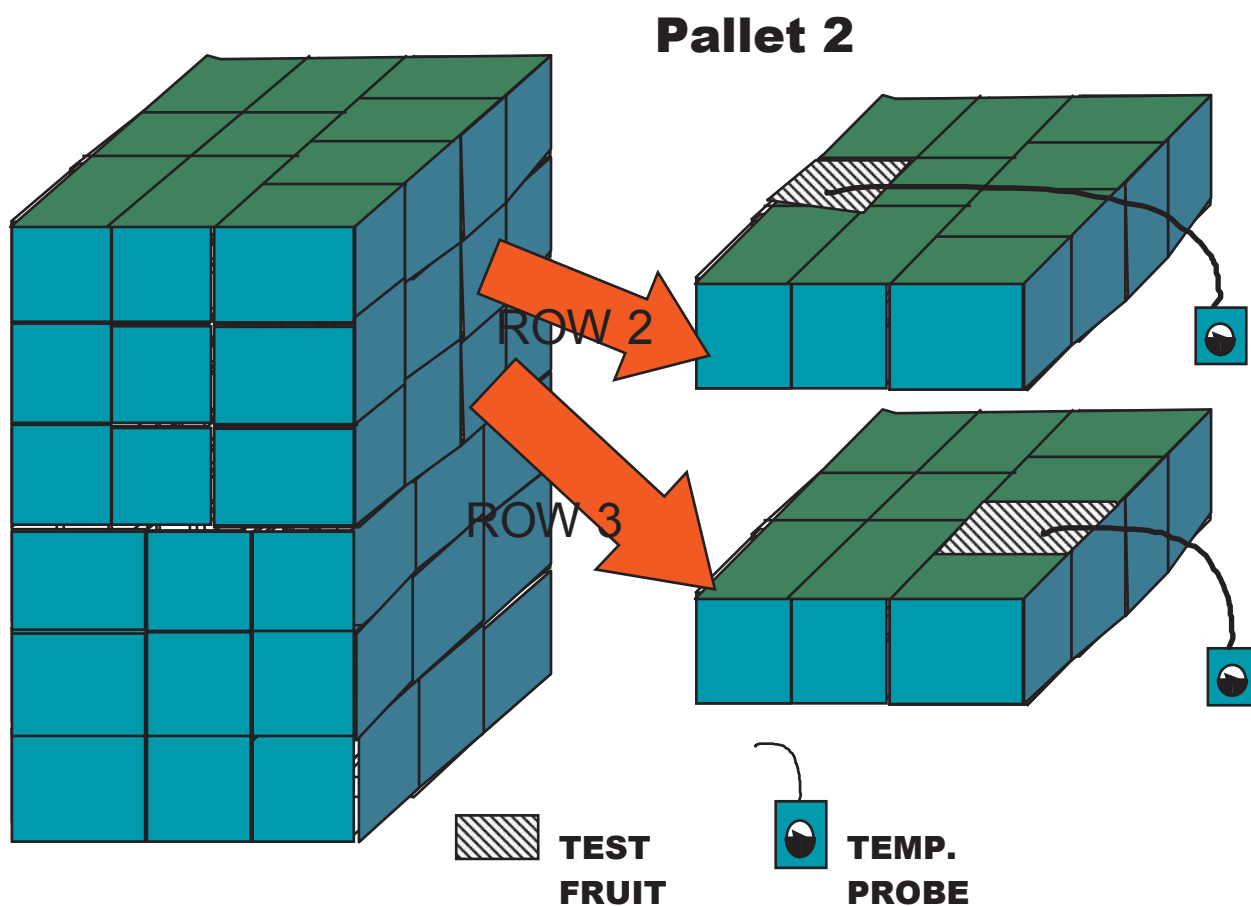


Figure 9
PALLET 2: Placement of infested (TEST) fruit and temperature data logger probes.
 Please refer to the room diagram for the pallet's location and alignment.

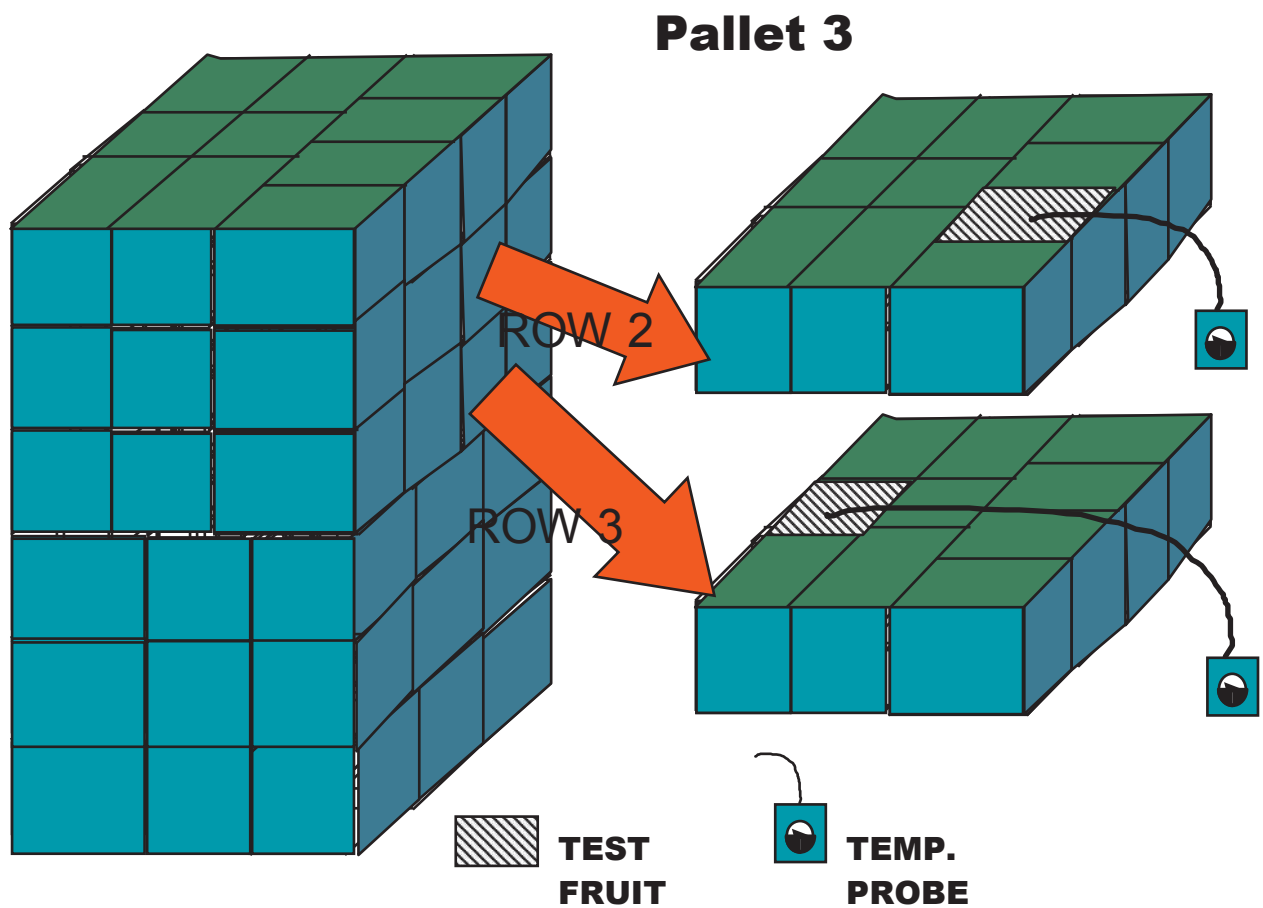


Figure 10
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 Please refer to the room diagram for the pallet's location and alignment.

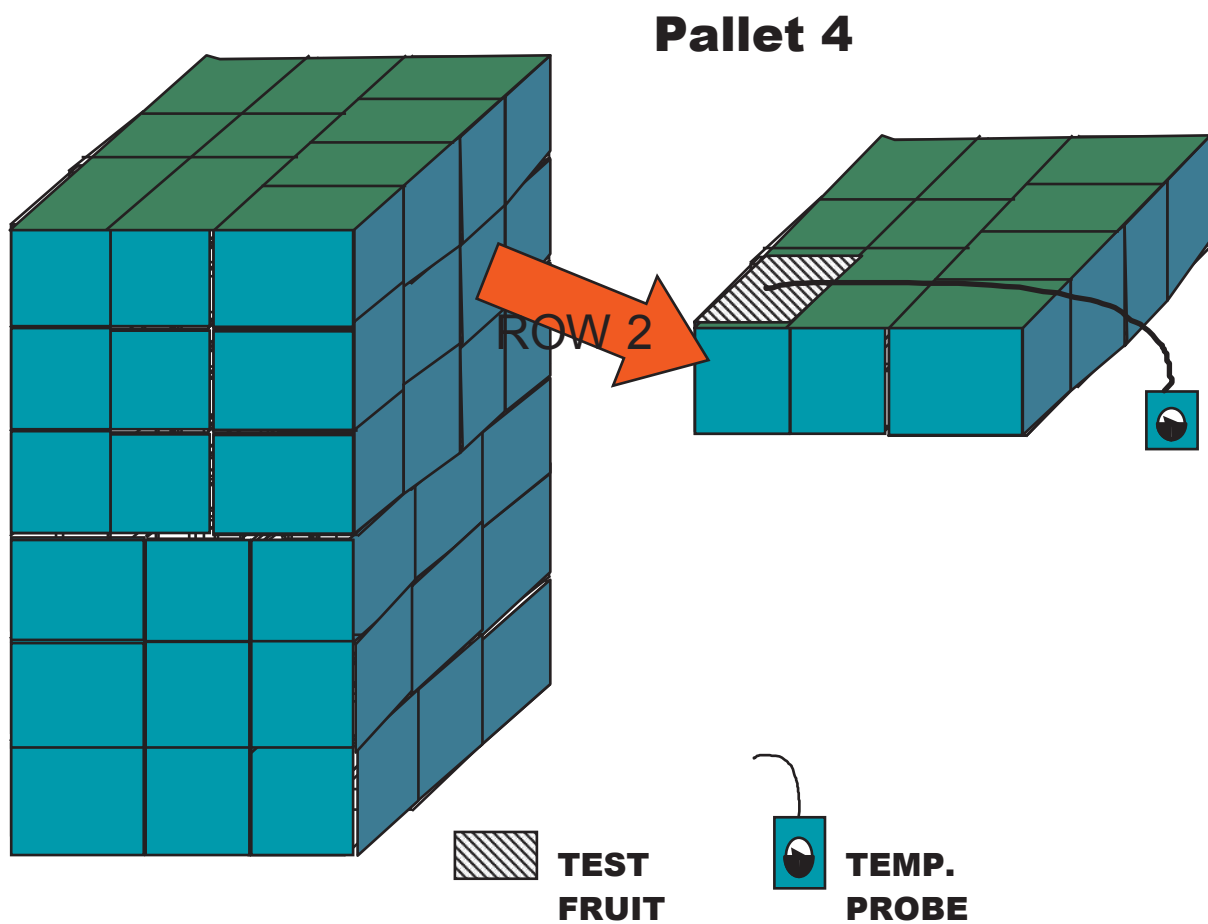


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PALLET 4: Placement of infested (TEST) fruit and temperature data logger probes.
Please refer to the room diagram for the pallet's location and alignment.



Figure 12
 Filler fruit, apples in citrus cartons surround summerfruit cartons with infested summerfruit and non-infested summerfruit that are monitored for temperature (the temperature probe cables connecting the summerfruit to the data logger can be seen suspended from the ceiling).



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 At the correct time (14 days at 1°C or 3°C) during the cold storage treatment in the large scale trials, fruit are removed from their position embedded in the pallet of apples (filler fruit).



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Female *Bactrocera tryoni* preparing to lay eggs into a plum in the laboratory.



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Infested fruit with typical “sting marks” made evident by fruit tissue necrosis caused by bacteria and fungi associated with fruit flies.



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Nectarines and other summerfruit are favourable hosts to fruit flies.



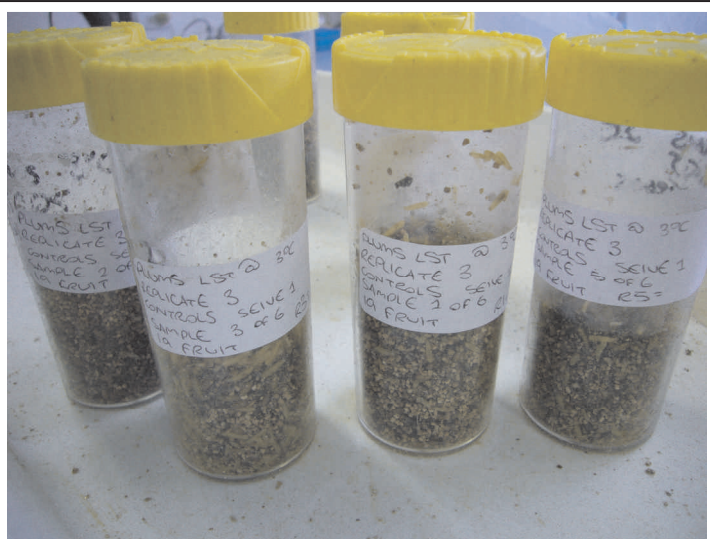
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Figure 17
A plum eaten out by fruit fly larvae.

Figure 19
Surviving larvae and pupae surviving in the control (untreated) fruit are collected and counted during the large scale trials.

Figure 20
The number of surviving insects in the controls is used to estimate the number of insects treated in the treated fruit



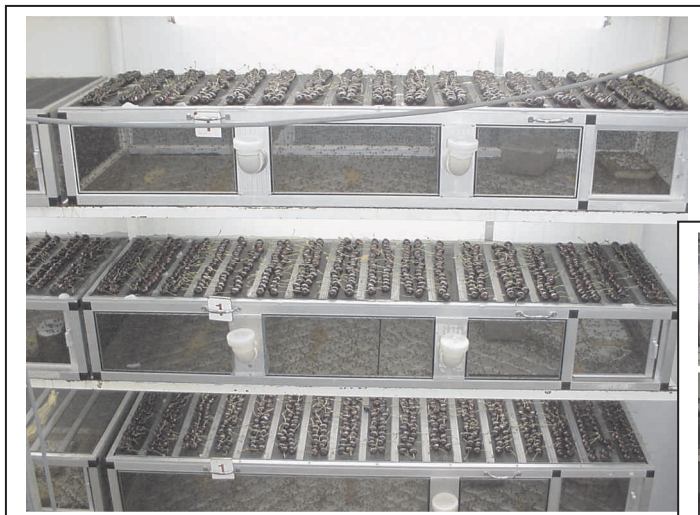


Figure 21
(Below) Fruit laid out on fruit fly cages for infestation prior to treatment.



Figure 22
(Above) Here are the fruit laid out on top of the fruit fly cages in the Gosford facility. The fruit remain there for up to 16 hours before being removed at random and allocated to life stage and treatment dose.

Figure 23
(Right) Fruit flies lay their eggs into test nectarines and plums through the cage mesh.



Figure 24
(Left) Nectarines laid out on fruit fly cages for infestation prior to treatment.



Figure 25
Treated infested test fruit are removed from the cartons they were cold treated in and then placed on a mesh tray suspended over damp vermiculite (as a pupation medium) and held at 26°C (for optimal larval survival). Surviving insects emerge from the infested fruit and drop down into the vermiculite to pupate.



Figure 26
The mesh trays with infested fruit on top are placed inside a large plastic tub which are stacked allowing adequate ventilation. The stack is then covered with a fine terylene netting to stop contamination by *Drosophila* spp. (vinegar flies).



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Each stack is labelled with fruit type, trial (here: large scale trial), replicate number and whether treated or control.



Figure 28
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The front, bottom air circulation fan.



Figure 31
The rear, top cooling fans.



Figure 32
The bank of three cool rooms CTR7, CTR8 and CTR9 used in these trials.



Figure 33
Squirrel data logger probes being calibrated in an ice/water slurry prior to treatment commencement.



Figure 34
The Squirrel data logger.

Figure 35
Destructive method of sampling for determination of the development times for each immature life stage (i.e. egg, first instar, second instar and third instar) in plums and nectarines.

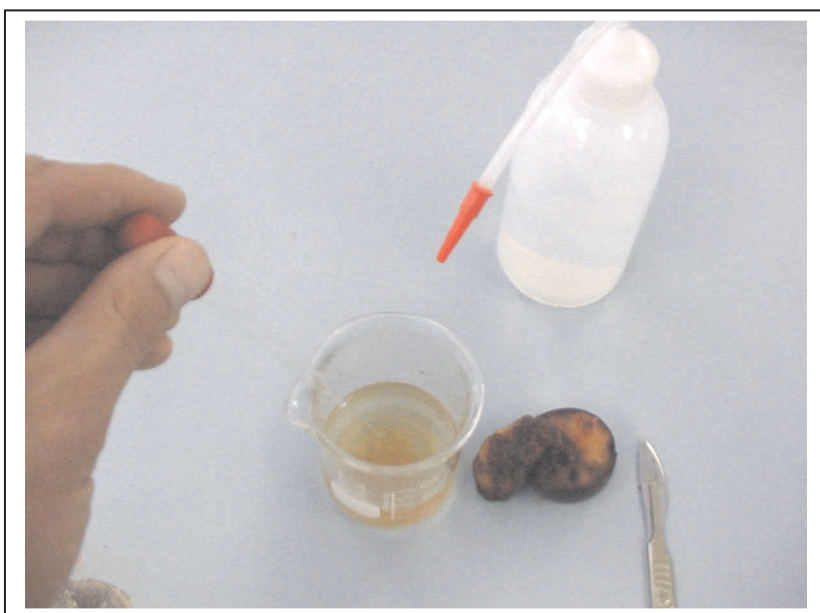


Figure 36

After sieving the vermiculite at least three times (once a week for three weeks) after the conclusion of the cold treatment any remaining fruit were dissected and checked for live larvae or pupae.

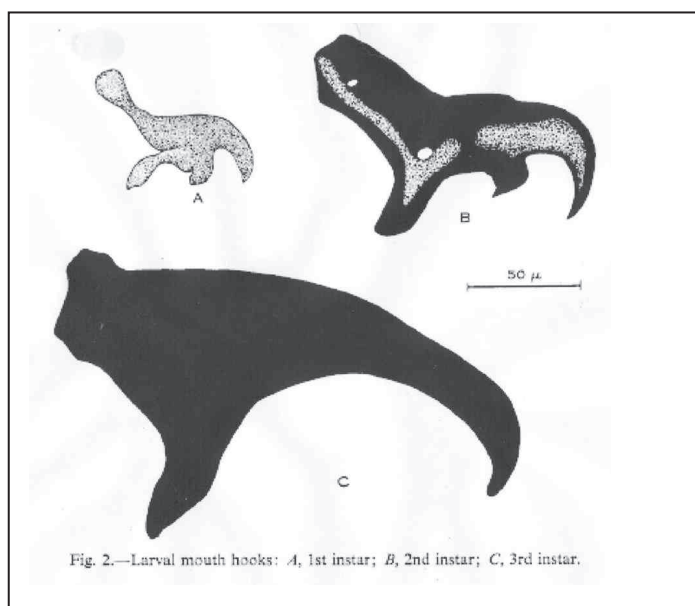


Figure 37

Diagram showing the mouthparts of each larval stage of *B. tryoni*. A – 1st instar, B – 2nd instar, C – 3rd instar.

**Cold treatment of Australian summerfruit
(plums, nectarines / peaches)
infested with eggs and larvae of the Queensland fruit fly
(*Bactrocera tryoni* Froggatt) Diptera : Tephritidae .**

* * * * *

PART THREE – SUMMARY TABLES

OF THE MOST TOLERANT STAGE AND LARGE SCALE TRIAL
PROTOCOLS FOR COLD DISINFESTATION OF
QUEENSLAND FRUIT FLY

CONDUCTED AT

NEW SOUTH WALES DEPARTMENT OF PRIMARY INDUSTRIES,
GOSFORD, NSW. AUSTRALIA 2250

JULY 2008

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Table 1: PLUMS: larval development studies conducted at 26°C (replicates 1, 2 and 3) eggs, first, second and third instars

Date of ovipositing	Date of larval dev.	Sample unit	NUMBERS OF EACH LIFESTAGE				TOTAL	PERCENT AT EACH LIFESTAGE			
			EGGS	1st instar	2nd instar	3rd instar		Eggs	1st instar	2nd instar	3rd instar
15 to 16 August 2006 (overnight)	18 August 2006	1	825	102	0	0	927	89	11	0	0
		2	419	52	0	0	471	89	11	0	0
		3	539	94	0	0	633	85	15	0	0
		4	667	65	0	0	732	91	9	0	0
		5	389	72	0	0	461	84	16	0	0
							AVERAGE	88	12	0	0
	19 August 2006	1	22	103	0	0	125	18	82	0	0
		2	29	125	2	0	156	19	80	1	0
		3	40	98	8	0	146	27	67	5	0
		4	35	128	1	0	164	21	78	1	0
		5	21	106	3	0	130	16	82	2	0
							AVERAGE	20	78	2	0
	21 August 2006	1	0	15	42	2	59	0	25	71	3
		2	0	12	45	1	58	0	21	78	2
		3	0	19	61	5	85	0	22	72	6
		4	0	20	55	1	76	0	26	72	1
		5	0	12	39	0	51	0	24	76	0
							AVERAGE	0	24	74	2
	23 August 2006	1	0	0	25	34	59	0	0	42	58
		2	0	0	10	28	38	0	0	26	74
		3	0	0	12	32	44	0	0	27	73
		4	0	0	9	29	38	0	0	24	76
		5	0	0	8	39	47	0	0	17	83
							AVERAGE	0	0	27	73

Table 2: NECTARINES: larval development studies conducted at 26°C (replicates 1, 2 and 3) eggs, first, second and third instars

Date of ovipositing	Date of larval dev.	Sample unit	NUMBERS OF EACH LIFESTAGE				TOTAL	PERCENT AT EACH LIFESTAGE			
			EGGS	1st instar	2nd instar	3rd instar		Eggs	1st instar	2nd instar	3rd instar
16 to 17 December 2007 (overnight)	18 December 2007	1	1125	221	0	0	1346	84	16	0	0
		2	1288	185	0	0	1473	87	13	0	0
		3	1562	294	0	0	1856	84	16	0	0
		4	1009	325	0	0	1334	76	24	0	0
		5	1533	275	0	0	1808	85	15	0	0
							AVERAGE	83	17	0	0
	20 December 2007	1		109	5	0	165	31	66	3	0
		2	51	98	4	0	130	22	75	3	0
		3	28	112	9	0	175	31	64	5	0
		4	54	59	0	0	137	57	43	0	0
		5	78	77	0	0	140	45	55	0	0
			63				AVERAGE	37	61	2	0
	22 December 2007	1		10	85	1	96	0	10	89	1
		2	0	15	58	5	78	0	19	74	6
		3	0	37	49	1	87	0	43	56	1
		4	0	38	62	0	100	0	38	62	0
		5	0	15	77	4	96	0	16	80	4
			0				AVERAGE	0	25	72	3
	24 December 2007	1		1	12	48	61	0	2	20	79
		2	0	0	11	33	44	0	0	25	75
		3	0	2	14	54	70	0	3	20	77
		4	0	0	8	38	46	0	0	17	83
		5	0	0	8	42	50	0	0	16	84
							AVERAGE	0	1	20	79

Table 3: PLUMS Most tolerant stage at 1°C Untreated (control)

LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
EGGS	1	0	96	96	12	8		
EGGS	2	0	194	194	12	16.17		
EGGS	3	0	144	144	12	12		
EGGS	4	0	368	368	12	30.67		
EGGS	5	1	287	288	12	24		
EGGS	6	0	366	366	12	30.5	20.22	9.62
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
1STS	1	88	341	429	12	35.75		
1STS	2	55	260	315	12	26.25		
1STS	3	136	324	460	12	38.33		
1STS	4	14	206	220	12	18.33		
1STS	5	122	312	434	12	36.17		
1STS	6	126	177	303	12	25.25	30.01	7.92
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
2NDS	1	3	168	171	12	14.25		
2NDS	2	0	66	66	12	5.5		
2NDS	3	5	79	84	12	7		
2NDS	4	3	104	107	12	8.92		
2NDS	5	17	93	110	12	9.17		
2NDS	6	6	102	108	12	9	8.97	2.96
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
3RDS	1	219	649	868	12	72.33		
3RDS	2	100	99	199	12	16.58		
3RDS	3	166	479	645	12	53.75		
3RDS	4	103	306	409	12	34.08		
3RDS	5	149	604	753	12	62.75		
3RDS	6	59	287	346	12	28.83	44.72	21.57

Table 4: PLUMS Most tolerant stage at 1°C Treated eggs

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
EGGS	3	1	6	70	76	12	6.3333			
EGGS	3	2	18	133	151	12	12.583			
EGGS	3	3	16	162	178	12	14.833	11.25 ± 4.40	20.22 ± 9.62	44.37
EGGS	4	1	17	130	147	12	12.25			
EGGS	4	2	14	94	108	12	9			
EGGS	4	3	21	100	121	12	10.083	10.44 ± 1.65	20.22 ± 9.62	48.35
EGGS	5	1	1	6	7	12	0.5833			
EGGS	5	2	0	3	3	12	0.25			
EGGS	5	3	3	39	42	12	3.5	1.44 ± 1.79	20.22 ± 9.62	92.86
EGGS	6	1	0	0	0	12	0			
EGGS	6	2	0	0	0	12	0			
EGGS	6	3	0	0	0	12	0	0	20.22 ± 9.62	100
EGGS	7	1	0	0	0	12	0			
EGGS	7	2	0	0	0	12	0			
EGGS	7	3	0	0	0	12	0	0	20.22 ± 9.62	100
EGGS	8	1	0	0	0	12	0			
EGGS	8	2	0	0	0	12	0			
EGGS	8	3	0	0	0	12	0	0	20.22 ± 9.62	100
EGGS	9	1	0	0	0	12	0			
EGGS	9	2	0	0	0	12	0			
EGGS	9	3	0	0	0	12	0	0	20.22 ± 9.62	100
EGGS	10	1	0	0	0	12	0			
EGGS	10	2	0	0	0	12	0			
EGGS	10	3	0	0	0	12	0	0	20.22 ± 9.62	100
EGGS	12	1	0	0	0	12	0			
EGGS	12	2	0	0	0	12	0			
EGGS	12	3	0	0	0	12	0	0	20.22 ± 9.62	100
EGGS	14	1	0	0	0	12	0			
EGGS	14	2	0	0	0	12	0			
EGGS	14	3	0	0	0	12	0	0	20.22 ± 9.62	100

Table 5: PLUMS Most tolerant stage at 1°C Treated first instar (1STS)

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
1STS	3	1	38	245	283	12	23.58			
1STS	3	2	57	145	202	12	16.83			
1STS	3	3	89	247	336	12	28	22.80 ± 5.62	30.01 ± 7.92	24.02
1STS	4	1	13	177	190	12	15.83			
1STS	4	2	2	160	162	12	13.5			
1STS	4	3	2	117	119	12	9.92	13.08 ± 2.98	30.01 ± 7.92	56.41
1STS	5	1	1	109	110	12	9.17			
1STS	5	2	2	37	39	12	3.25			
1STS	5	3	9	80	89	12	7.42	6.61 ± 3.04	30.01 ± 7.92	77.97
1STS	6	1	13	11	24	12	2			
1STS	6	2	14	25	39	12	3.25			
1STS	6	3	6	13	19	12	1.58	2.28 ± 0.87	30.01 ± 7.92	92.41
1STS	7	1	2	0	2	12	0.17			
1STS	7	2	1	2	3	12	0.25			
1STS	7	3	0	2	2	12	0.17	0.19 ± 0.05	30.01 ± 7.92	99.35
1STS	8	1	0	0	0	12	0			
1STS	8	2	1	0	1	12	0.08			
1STS	8	3	0	0	0	12	0	0.03 ± 0.05	30.01 ± 7.92	99.91
1STS	9	1	0	1	1	12	0.08			
1STS	9	2	0	0	0	12	0			
1STS	9	3	0	0	0	12	0	0.03 ± 0.05	30.01 ± 7.92	99.91
1STS	10	1	0	0	0	12	0			
1STS	10	2	0	0	0	12	0			
1STS	10	3	0	0	0	12	0	0	30.01 ± 7.92	100
1STS	12	1	0	0	0	12	0			
1STS	12	2	0	0	0	12	0			
1STS	12	3	0	0	0	12	0	0	30.01 ± 7.92	100
1STS	14	1	0	0	0	12	0			
1STS	14	2	0	0	0	12	0			
1STS	14	3	0	0	0	12	0	0	30.01 ± 7.92	100

Table 6: PLUMS Most tolerant stage at 1°C Treated second instar (2NDS)

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
2NDS	3	1	15	24	39	12	3.25			
2NDS	3	2	13	7	20	12	1.67			
2NDS	3	3	6	15	21	12	1.75	2.22 ± 0.89	8.97 ± 2.96	75.23
2NDS	4	1	1	1	2	12	0.17			
2NDS	4	2	5	4	9	12	0.75			
2NDS	4	3	2	15	17	12	1.42	0.78 ± 0.63	8.97 ± 2.96	91.33
2NDS	5	1	3	0	3	12	0.25			
2NDS	5	2	2	5	7	12	0.58			
2NDS	5	3	1	5	6	12	0.5	0.44 ± 0.17	8.97 ± 2.96	95.05
2NDS	6	1	0	0	0	12	0			
2NDS	6	2	1	0	1	12	0.08			
2NDS	6	3	0	0	0	12	0	0.03 ± 0.05	8.97 ± 2.96	99.69
2NDS	7	1	0	0	0	12	0			
2NDS	7	2	0	0	0	12	0			
2NDS	7	3	0	0	0	12	0	0	8.97 ± 2.96	100
2NDS	8	1	2	0	2	12	0.17			
2NDS	8	2	4	2	6	12	0.5			
2NDS	8	3	0	0	0	12	0	0.22 ± 0.25	8.97 ± 2.96	97.52
2NDS	9	1	0	0	0	12	0			
2NDS	9	2	1	0	1	12	0.08			
2NDS	9	3	0	0	0	12	0	0.03 ± 0.05	8.97 ± 2.96	99.69
2NDS	10	1	0	0	0	12	0			
2NDS	10	2	0	0	0	12	0			
2NDS	10	3	0	0	0	12	0	0	8.97 ± 2.96	100
2NDS	12	1	0	0	0	12	0			
2NDS	12	2	0	0	0	12	0			
2NDS	12	3	0	0	0	12	0	0	8.97 ± 2.96	100
2NDS	14	1	0		0	12	0			
2NDS	14	2	0		0	12	0			
2NDS	14	3	0		0	12	0	0	8.97 ± 2.96	100

Table 7: PLUMS Most tolerant stage at 1°C Treated third instar (3RDS)

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
3RDS	3	1	226	75	301	12	25.08			
3RDS	3	2	45	40	85	12	7.08			
3RDS	3	3	131	15	146	12	12.17	14.78 ± 9.28	44.72 ± 21.57	66.96
3RDS	4	1	60	25	85	12	7.08			
3RDS	4	2	49	16	65	12	5.42			
3RDS	4	3	78	57	135	12	11.25	7.92 ± 3.00	44.72 ± 21.57	82.30
3RDS	5	1	33	17	50	12	4.17			
3RDS	5	2	32	8	40	12	3.33			
3RDS	5	3	47	17	64	12	5.33	4.28 ± 1.00	44.72 ± 21.57	90.43
3RDS	6	1	20	16	36	12	3			
3RDS	6	2	20	6	26	12	2.17			
3RDS	6	3	10	4	14	12	1.17	2.11 ± 0.92	44.72 ± 21.57	95.28
3RDS	7	1	6	7	13	12	1.087			
3RDS	7	2	1	9	10	12	0.837			
3RDS	7	3	6	14	20	12	1.67	1.20 ± 0.43	44.72 ± 21.57	97.33
3RDS	8	1	0	2	2	12	0.167			
3RDS	8	2	7	6	13	12	1.08			
3RDS	8	3	6	2	8	12	0.67	0.64 ± 0.46	44.72 ± 21.57	98.57
3RDS	9	1	3	3	6	12	0.5			
3RDS	9	2	10	3	13	12	1.08			
3RDS	9	3	1	0	1	12	0.08	0.56 ± 0.50	44.72 ± 21.57	98.76
3RDS	10	1	1	0	1	12	0.08			
3RDS	10	2	0	0	0	12	0			
3RDS	10	3	2	0	2	12	0.17	0.08 ± 0.08	44.72 ± 21.57	99.81
3RDS	12	1	0	0	0	12	0			
3RDS	12	2	0	0	0	12	0			
3RDS	12	3	2	0	2	12	0.17	0.06 ± 0.10	44.72 ± 21.57	99.88
3RDS	14	1	0	0	0	12	0			
3RDS	14	2	0	0	0	12	0			
3RDS	14	3	0	0	0	12	0	0	44.72 ± 21.57	100

Table 8: NECTARINES Most tolerant stage at 1°C Untreated (control)

LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
EGGS	1	582	65	647	12	53.92		
EGGS	2	364	20	384	12	32		
EGGS	3	488	46	534	12	44.5		
EGGS	4	339	53	392	12	32.67		
EGGS	5	502	71	573	12	47.75		
EGGS	6	430	57	487	12	40.58	41.90	8.61
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
1STS	1	582	65	647	12	53.92		
1STS	2	364	20	384	12	32		
1STS	3	488	46	534	12	44.5		
1STS	4	339	53	392	12	32.67		
1STS	5	502	71	573	12	47.75		
1STS	6	430	57	487	12	40.58	41.90	8.61
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
2NDS	1	582	65	647	12	53.92		
2NDS	2	364	20	384	12	32		
2NDS	3	488	46	534	12	44.5		
2NDS	4	339	53	392	12	32.67		
2NDS	5	502	71	573	12	47.75		
2NDS	6	430	57	487	12	40.58	41.90	8.61
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
3RDS	1	66	1	67	12	5.58		
3RDS	2	565	5	570	12	47.5		
3RDS	3	197	17	214	12	17.83		
3RDS	4	234	68	302	12	25.17		
3RDS	5	25	46	71	12	5.92		
3RDS	6	152	3	155	12	12.92	19.15	15.75

Table 9: NECTARINES Most tolerant stage at 1°C Treated eggs

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
EGGS	3	1	36	5	41	11	3.73			
EGGS	3	2	68	23	91	11	8.27			
EGGS	3	3	124	17	141	11	12.82	8.27 ± 4.55	41.90 ± 8.61	80.26
EGGS	4	1	1	1	2	11	0.19			
EGGS	4	2	3	12	15	11	1.36			
EGGS	4	3	9	5	14	11	1.27	0.94 ± 0.66	41.90 ± 8.61	97.76
EGGS	5	1	0	0	0	11	0			
EGGS	5	2	1	0	1	11	0.09			
EGGS	5	3	0	0	0	11	0	0.03 ± 0.05	41.90 ± 8.61	99.93
EGGS	6	1	0	0	0	11	0			
EGGS	6	2	0	0	0	11	0			
EGGS	6	3	0	0	0	11	0	0	41.90 ± 8.61	100
EGGS	7	1	0	0	0	11	0			
EGGS	7	2	0	0	0	11	0			
EGGS	7	3	0	0	0	11	0	0	41.90 ± 8.61	100
EGGS	8	1	0	0	0	11	0			
EGGS	8	2	0	0	0	11	0			
EGGS	8	3	0	0	0	11	0	0	41.90 ± 8.61	100
EGGS	9	1	0	0	0	11	0			
EGGS	9	2	0	0	0	11	0			
EGGS	9	3	0	0	0	11	0	0	41.90 ± 8.61	100
EGGS	10	1	0	0	0	11	0			
EGGS	10	2	0	0	0	11	0			
EGGS	10	3	0	0	0	11	0	0	41.90 ± 8.61	100
EGGS	12	1	0	0	0	11	0			
EGGS	12	2	0	0	0	11	0			
EGGS	12	3	0	0	0	11	0	0	41.90 ± 8.61	100
EGGS	14	1	0	0	0	11	0			
EGGS	14	2	0	0	0	11	0			
EGGS	14	3	0	0	0	11	0	0	41.90 ± 8.61	100

Table 10: NECTARINES Most tolerant stage at 1°C Treated first instar

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
1STS	3	1	120	38	158	11	14.36			
1STS	3	2	177	118	295	11	26.8			
1STS	3	3	74	16	90	11	8.18	16.46 ± 9.49	41.90 ± 8.61	60.73
1STS	4	1	66	113	179	11	16.27			
1STS	4	2	23	39	62	11	5.64			
1STS	4	3	4	4	8	11	0.73	7.55 ± 7.95	41.90 ± 8.61	81.99
1STS	5	1	20	1	21	11	1.91			
1STS	5	2	43	1	44	11	4			
1STS	5	3	10	1	11	11	1	2.305 ± 1.54	41.90 ± 8.61	94.50
1STS	6	1	0	0	0	11	0			
1STS	6	2	3	0	3	11	0.27			
1STS	6	3	1	0	1	11	0.09	0.125 ± 0.14	41.90 ± 8.61	99.71
1STS	7	1	0	0	0	11	0			
1STS	7	2	0	0	0	11	0			
1STS	7	3	0	0	0	11	0	0	41.90 ± 8.61	100
1STS	8	1	0	0	0	11	0			
1STS	8	2	0	0	0	11	0			
1STS	8	3	0	0	0	11	0	0	41.90 ± 8.61	100
1STS	9	1	0	0	0	11	0			
1STS	9	2	0	0	0	11	0			
1STS	9	3	0	0	0	11	0	0	41.90 ± 8.61	100
1STS	10	1	0	0	0	11	0			
1STS	10	2	0	0	0	11	0			
1STS	10	3	0	0	0	11	0	0	41.90 ± 8.61	100
1STS	12	1	0	0	0	11	0			
1STS	12	2	0	0	0	11	0			
1STS	12	3	0	0	0	11	0	0	41.90 ± 8.61	100
1STS	14	1	0	0	0	11	0			
1STS	14	2	0	0	0	11	0			
1STS	14	3	0	0	0	11	0	0	41.90 ± 8.61	100

Table 11: NECTARINES Most tolerant stage at 1°C Treated second instar

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
2NDS	3	1	62	2	64	11	5.82			
2NDS	3	2	75	4	79	11	7.18			
2NDS	3	3	50	3	53	11	4.82	5.94 ± 2.03	41.90 ± 8.61	85.83
2NDS	4	1	36	0	36	11	3.27			
2NDS	4	2	33	3	36	11	3.27			
2NDS	4	3	74	1	75	11	6.82	4.454 ± 2.05	41.90 ± 8.61	89.37
2NDS	5	1	105	6	111	11	10.09			
2NDS	5	2	47	20	67	11	6.09			
2NDS	5	3	24	17	41	11	3.73	6.64 ± 3.22	41.90 ± 8.61	84.16
2NDS	6	1	66	1	67	11	6.09			
2NDS	6	2	14	0	14	11	1.27			
2NDS	6	3	22	0	22	11	2	3.124 ± 2.60	41.90 ± 8.61	92.55
2NDS	7	1	13	2	15	11	1.36			
2NDS	7	2	15	0	15	11	1.36			
2NDS	7	3	12	0	12	11	1.09	1.274 ± 0.47	41.90 ± 8.61	96.96
2NDS	8	1	2	0	2	11	0.18			
2NDS	8	2	18	0	18	11	1.64			
2NDS	8	3	9	0	9	11	0.82	0.88 ± 0.73	41.90 ± 8.61	97.90
2NDS	9	1	19	0	19	11	1.73			
2NDS	9	2	8	0	8	11	0.73			
2NDS	9	3	2	0	2	11	0.18	0.88 ± 0.78	41.90 ± 8.61	97.90
2NDS	10	1	4	0	4	11	0.36			
2NDS	10	2	0	0	0	11	0			
2NDS	10	3	3	0	3	11	0.27	0.21 ± 0.19	41.90 ± 8.61	99.49
2NDS	12	1	0	0	0	11	0			
2NDS	12	2	0	0	0	11	0			
2NDS	12	3	0	0	0	11	0	0	41.90 ± 8.61	100
2NDS	14	1	0	0	0	11	0			
2NDS	14	2	0	0	0	11	0			
2NDS	14	3	0	0	0	11	0	0	41.90 ± 8.61	100

Table 12: NECTARINES Most tolerant stage at 1°C Treated third instar

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
3RDS	3	1	51	0	51	11	4.64			
3RDS	3	2	76	0	76	11	6.91			
3RDS	3	3	18	0	18	11	1.64	4.39 ± 2.64	19.15 ± 15.75	77.06
3RDS	4	1	1	0	1	11	0.09			
3RDS	4	2	7	0	7	11	0.64			
3RDS	4	3	16	0	16	11	1.45	0.73 ± 0.69	19.15 ± 15.75	96.20
3RDS	5	1	0	0	0	11	0			
3RDS	5	2	0	0	0	11	0			
3RDS	5	3	0	0	0	11	0	0	19.15 ± 15.75	100
3RDS	6	1	0	0	0	11	0			
3RDS	6	2	0	0	0	11	0			
3RDS	6	3	0	0	0	11	0	0	19.15 ± 15.75	100
3RDS	7	1	0	0	0	11	0			
3RDS	7	2	0	0	0	11	0			
3RDS	7	3	0	0	0	11	0	0	19.15 ± 15.75	100
3RDS	8	1	0	0	0	11	0			
3RDS	8	2	0	0	0	11	0			
3RDS	8	3	0	0	0	11	0	0	19.15 ± 15.75	100
3RDS	9	1	0	0	0	11	0			
3RDS	9	2	0	0	0	11	0			
3RDS	9	3	0	0	0	11	0	0	19.15 ± 15.75	100
3RDS	10	1	0	0	0	11	0			
3RDS	10	2	0	0	0	11	0			
3RDS	10	3	0	0	0	11	0	0	19.15 ± 15.75	100
3RDS	12	1	0	0	0	11	0			
3RDS	12	2	0	0	0	11	0			
3RDS	12	3	0	0	0	11	0	0	19.15 ± 15.75	100
3RDS	14	1	0	0	0	11	0			
3RDS	14	2	0	0	0	11	0			
3RDS	14	3	0	0	0	11	0	0	19.15 ± 15.75	100

Table 13: PLUMS: Larval development studies at 1°C for large scale trials (replicates 1, 2 and 3)

Date of infestation	Sample unit	NUMBERS OF EACH LIFESTAGE				TOTAL	PERCENT AT EACH LIFESTAGE			
		EGGS	1st instar	2nd instar	3rd instar		Eggs	1st instar	2nd instar	3rd instar
12 September 2006	1	0	1	5	26	32	0	3	16	81
Date of larval assessment	2	2	0	12	32	46	4	0	26	70
	3	1	0	4	19	24	4	0	17	79
	4	1	1	8	25	35	3	3	23	71
21 September 2006	5	3	0	10	33	46	7	0	22	71
AVERAGE							4	1	21	74

Table 14: NECTARINES: Larval development studies at 1°C for large scale trials (replicates 1 and 2)

Date of infestation	Sample unit	NUMBERS OF EACH LIFESTAGE				TOTAL	PERCENT AT EACH LIFESTAGE			
		EGGS	1st instar	2nd instar	3rd instar		Eggs	1st instar	2nd instar	3rd instar
27 March 2007	1	15	32	75	1	123	12	26	61	<1
Date of larval assessment	2	10	45	82	2	139	7	32	59	2
	3	4	19	71	0	94	4	20	76	0
31 March 2007	4	8	20	69	5	102	8	20	67	5
	5	0	41	85	1	127	0	32	67	<1
AVERAGE							6	26	66	2

Table 15::PLUMS: Larval development studies at 3°C for large scale trials (replicates 1, 2, 3, 4 and 5)

Date of infestation	Sample unit	NUMBERS OF EACH LIFESTAGE				TOTAL	PERCENT AT EACH LIFESTAGE			
		EGGS	1st instar	2nd instar	3rd instar		Eggs	1st instar	2nd instar	3rd instar
20 March 2007	1	5	2	18	31	56	9	4	32	55
Date of larval assessment	2	1	6	12	20	39	3	15	31	51
	3	2	10	15	31	58	4	17	26	53
26 March 2007	4	0	5	24	38	67	0	7	36	57
	5	0	1	5	29	35	0	3	14	83
AVERAGE							3	9	28	60

Table 16: NECTARINES: Larval development studies at 3°C for large scale trials (replicates 1, 2, 3 and 4)

Date of infestation	Sample unit	NUMBERS OF EACH LIFESTAGE				TOTAL	PERCENT AT EACH LIFESTAGE			
		EGGS	1st instar	2nd instar	3rd instar		Eggs	1st instar	2nd instar	3rd instar
30 January 2007	1	29	85	5	0	119	25	71	4	0
Date of larval assessment	2	23	78	6	0	107	21	73	6	0
	3	15	85	8	0	108	14	79	7	0
2 February 2007	4	18	115	1	0	134	13	86	<1	0
	5	44	128	2	0	174	25	72	<1	0
AVERAGE							20	76	4	0

Table 17: PLUMS: Survival of insects in untreated (control) fruit – large scale trial at 1°C (replicates 1 and 2)

800 plums were infested by puncturing the fruit and placing on top of the fly cages at GHI. 300 fruit (CONTROL) were randomly chosen and placed in 6 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 500 fruit (TREATED) were packed into trays and allowed to develop to 3rd instar larval stage for the 1°C disinfestation treatment.								
LARGE SCALE TRIAL AT 1°C ANGELENO PLUMS REPLICATE 1 & 2 – Infested 12 Sep 2006								
Sample unit (50 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	25 September 2006	02 October 2006	09 October 2006					
1	418	608	176	1202	50	24.04		
2	483	732	266	1481	50	29.62		
3	398	691	236	1325	50	26.5		
4	643	650	216	1509	50	30.18		
5	484	673	219	1376	50	27.52		
6	196	885	157	1238	50	24.76	27.1	2.5

Table 18: PLUMS: Survival of insects in untreated (control) fruit – large scale trial at 1°C (replicate 3)

650 plums were infested by puncturing the fruit and placing on top of the fly cages at GHI. 150 fruit (CONTROL) were randomly chosen and placed in 3 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 500 fruit (TREATED) were packed into trays and allowed to develop to 3rd instar larval stage for the 1°C disinfestation treatment.								
LARGE SCALE TRIAL AT 1°C ANGELENO PLUMS REPLICATE 3 – Infested 10 October 2006								
Sample unit (50 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	23 October 2006	30 October 2006	06 November 2006					
1	271	881	314	1466	50	29.32		
2	128	775	456	1359	50	27.18		
3	46	355	158	559	50	11.18	22.56	9.91

Table 19: NECTARINES: Survival of insects in untreated (control) fruit – large scale trial at 1°C (replicate 1)

334 nectarines were infested by puncturing the fruit and placing on top of the fly cages at GHI. 60 fruit (CONTROL) were randomly chosen and placed in 4 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 274 fruit (TREATED) were packed into trays and allowed to develop to 2nd instar larval stage for the 1°C disinfestation treatment.								
LARGE SCALE TRIAL AT 1°C “ARCTIC SNOW” WHITE NECTARINES REPLICATE 1 – Infested 27 March 2007								
Sample unit (15 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	09 April 2007	16 April 2007	23 April 2007					
1	1279	5	0	1284	15	85.6		
2	570	41	0	611	15	40.73		
3	1519	86	0	1605	15	107		
4	1670	143	0	1813	15	120.9	88.55	35.02

Table 20: NECTARINES: Survival of insects in untreated (control) fruit – large scale trial at 1°C (replicate 2)

360 nectarines were infested by puncturing the fruit and placing on top of the fly cages at GHI. 60 fruit (CONTROL) were randomly chosen and placed in 6 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 300 fruit (TREATED) were packed into trays and allowed to develop to 2nd instar larval stage for the 1°C disinfestation treatment.								
LARGE SCALE TRIAL AT 1°C “ARCTIC SNOW” WHITE NECTARINES REPLICATE 3 – Infested 11 April 2007								
Sample unit (10 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	23 April 2007	30 April 2007	07 May 2007					
1	933	213	0	1146	10	114.6		
2	875	132	0	1007	10	100.7		
3	945	128	0	1073	10	107.3		
4	776	114	0	890	10	89		
5	954	346	0	1300	10	130		
6	1198	103	0	1301	10	130.1	111.95	16.35

Table 21: PLUMS & NECTARINES: Large scale trials at 1°C (replicates 1, 2, and 3) – Treated fruit

VARIETY	REPLICATE	TREATMENT	TREATMENT UNIT	No. FRUIT	No. PUPAE SIEVE 1	No. PUPAE SIEVE 3	No. PUPAE SIEVE 3
PLUMS	1	14 DAYS @ 1°C	1	50	0	0	0
PLUMS	1	14 DAYS @ 1°C	2	50	0	0	0
PLUMS	1	14 DAYS @ 1°C	3	50	0	0	0
PLUMS	1	14 DAYS @ 1°C	4	50	0	0	0
PLUMS	1	14 DAYS @ 1°C	5	50	0	0	0
PLUMS	1	14 DAYS @ 1°C	6	50	0	0	0
PLUMS	1	14 DAYS @ 1°C	7	50	0	0	0
PLUMS	1	14 DAYS @ 1°C	8	50	0	0	0
PLUMS	1	14 DAYS @ 1°C	9	50	0	0	0
PLUMS	1	14 DAYS @ 1°C	10	50	0	0	0
SUB TOTAL				500	0	0	0
PLUMS	2	14 DAYS @ 1°C	1	50	0	0	0
PLUMS	2	14 DAYS @ 1°C	2	50	0	0	0
PLUMS	2	14 DAYS @ 1°C	3	50	0	0	0
PLUMS	2	14 DAYS @ 1°C	4	50	0	0	0
PLUMS	2	14 DAYS @ 1°C	5	50	0	0	0
PLUMS	2	14 DAYS @ 1°C	6	50	0	0	0
PLUMS	2	14 DAYS @ 1°C	7	50	0	0	0
PLUMS	2	14 DAYS @ 1°C	8	50	0	0	0
PLUMS	2	14 DAYS @ 1°C	9	50	0	0	0
PLUMS	2	14 DAYS @ 1°C	10	50	0	0	0
SUB TOTAL				500	0	0	0
PLUMS	3	14 DAYS @ 1°C	1	50	0	0	0
PLUMS	3	14 DAYS @ 1°C	2	50	0	0	0
PLUMS	3	14 DAYS @ 1°C	3	50	0	0	0
PLUMS	3	14 DAYS @ 1°C	4	50	0	0	0
PLUMS	3	14 DAYS @ 1°C	5	50	0	0	0
PLUMS	3	14 DAYS @ 1°C	6	50	0	0	0
PLUMS	3	14 DAYS @ 1°C	7	50	0	0	0
PLUMS	3	14 DAYS @ 1°C	8	50	0	0	0

PLUMS	3	14 DAYS @ 1°C	9	50	0	0	0
PLUMS	3	14 DAYS @ 1°C	10	50	0	0	0
SUB TOTAL				500	0	0	0
NECTARINES	1	14 DAYS @ 1°C	1	30	0	0	*
NECTARINES	1	14 DAYS @ 1°C	2	30	0	0	*
NECTARINES	1	14 DAYS @ 1°C	3	30	0	0	*
NECTARINES	1	14 DAYS @ 1°C	4	30	0	0	*
NECTARINES	1	14 DAYS @ 1°C	5	30	0	0	*
NECTARINES	1	14 DAYS @ 1°C	6	30	0	0	*
NECTARINES	1	14 DAYS @ 1°C	7	30	0	0	*
NECTARINES	1	14 DAYS @ 1°C	8	30	0	0	*
NECTARINES	1	14 DAYS @ 1°C	9	34	0	0	*
SUB TOTAL				274	0	0	
NECTARINES	2	14 DAYS @ 1°C	1	33	0	0	*
NECTARINES	2	14 DAYS @ 1°C	2	33	0	0	*
NECTARINES	2	14 DAYS @ 1°C	3	33	0	0	*
NECTARINES	2	14 DAYS @ 1°C	4	33	0	0	*
NECTARINES	2	14 DAYS @ 1°C	5	33	0	0	*
NECTARINES	2	14 DAYS @ 1°C	6	33	0	0	*
NECTARINES	2	14 DAYS @ 1°C	7	33	0	0	*
NECTARINES	2	14 DAYS @ 1°C	8	33	0	0	*
SUB TOTAL				264	0	0	
NECTARINES	3	14 DAYS @ 1°C	1	33	0	0	*
NECTARINES	3	14 DAYS @ 1°C	2	33	0	0	*
NECTARINES	3	14 DAYS @ 1°C	3	33	0	0	*
NECTARINES	3	14 DAYS @ 1°C	4	33	0	0	*
NECTARINES	3	14 DAYS @ 1°C	5	33	0	0	*
NECTARINES	3	14 DAYS @ 1°C	6	33	0	0	*
NECTARINES	3	14 DAYS @ 1°C	7	33	0	0	*
NECTARINES	3	14 DAYS @ 1°C	8	33	0	0	*
SUB TOTAL				264	0	0	

Table 22: PLUMS: Most tolerant stage at 3°C Untreated (control) fruit

LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
EGGS	1	6	252	258	12	21.5		
EGGS	2	27	294	321	12	26.75		
EGGS	3	13	144	157	12	13.08		
EGGS	4	28	182	210	12	17.5		
EGGS	5	23	122	145	12	12.08		
EGGS	6	5	167	172	12	14.33	17.54	5.66
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
1STS	1	6	252	258	12	21.5		
1STS	2	27	294	321	12	26.75		
1STS	3	13	144	157	12	13.08		
1STS	4	28	182	210	12	17.5		
1STS	5	23	122	145	12	12.08		
1STS	6	5	167	172	12	14.33	17.54	5.66
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
2NDS	1	6	252	258	12	21.5		
2NDS	2	27	294	321	12	26.75		
2NDS	3	13	144	157	12	13.08		
2NDS	4	28	182	210	12	17.5		
2NDS	5	23	122	145	12	12.08		
2NDS	6	5	167	172	12	14.33	17.54	5.66
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
3RDS	1	191	241	432	12	36		
3RDS	2	470	323	793	12	66.08		
3RDS	3	228	278	506	12	42.17		
3RDS	4	243	348	591	12	49.25		
3RDS	5	336	391	727	12	60.58		
3RDS	6	180	419	599	12	49.92	50.67	11.19

Table 23: PLUMS Most tolerant stage at 3°C Treated eggs

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
EGGS	3	1	14	302	316	12	26.33			
EGGS	3	2	9	181	190	12	15.83			
EGGS	3	3	20	174	194	12	16.17	19.44 ± 5.97	17.54 ± 5.66	-10.85
EGGS	4	1	27	93	120	12	10			
EGGS	4	2	85	132	217	12	18.08			
EGGS	4	3	81	90	171	12	14.25	14.11 ± 4.04	17.54 ± 5.66	19.56
EGGS	5	1	34	79	113	12	9.42			
EGGS	5	2	2	24	26	12	2.17			
EGGS	5	3	4	22	26	12	2.17	4.58 ± 4.19	17.54 ± 5.66	73.87
EGGS	6	1	6	6	12	12	1			
EGGS	6	2	3	2	5	12	0.42			
EGGS	6	3	1	0	1	12	0.08	0.5 ± 0.46	17.54 ± 5.66	97.15
EGGS	7	1	0	0	0	12	0			
EGGS	7	2	0	0	0	12	0			
EGGS	7	3	0	0	0	12	0	0	17.54 ± 5.66	100
EGGS	8	1	0	0	0	12	0			
EGGS	8	2	0	0	0	12	0			
EGGS	8	3	0	0	0	12	0	0	17.54 ± 5.66	100
EGGS	9	1	0	0	0	12	0			
EGGS	9	2	0	0	0	12	0			
EGGS	9	3	0	0	0	12	0	0	17.54 ± 5.66	100
EGGS	10	1	0	0	0	12	0			
EGGS	10	2	0	0	0	12	0			
EGGS	10	3	0	0	0	12	0	0	17.54 ± 5.66	100
EGGS	12	1	0	0	0	12	0			
EGGS	12	2	0	0	0	12	0			
EGGS	12	3	0	0	0	12	0	0	17.54 ± 5.66	100
EGGS	14	1	0	0	0	12	0			
EGGS	14	2	0	0	0	12	0			
EGGS	14	3	0	0	0	12	0	0	17.54 ± 5.66	100

Table 24: PLUMS Most tolerant stage at 3°C Treated first instar

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
1STS	3	1	90	53	143	12	11.92			
1STS	3	2	98	112	210	12	17.5			
1STS	3	3	103	81	184	12	15.33	14.92 ± 2.81	17.54 ± 5.66	14.96
1STS	4	1	79	101	180	12	15			
1STS	4	2	20	8	28	12	2.33			
1STS	4	3	59	31	90	12	7.5	8.28 ± 6.37	17.54 ± 5.66	52.81
1STS	5	1	2	8	10	12	0.83			
1STS	5	2	5	10	15	12	1.25			
1STS	5	3	11	5	16	12	1.33	1.14 ± 0.27	17.54 ± 5.66	93.51
1STS	6	1	17	11	28	12	2.33			
1STS	6	2	15	3	18	12	1.5			
1STS	6	3	12	6	18	12	1.5	1.78 ± 0.48	17.54 ± 5.66	89.87
1STS	7	1	0	1	1	12	0.08			
1STS	7	2	3	2	5	12	0.42			
1STS	7	3	4	0	4	12	0.33	0.28 ± 0.17	17.54 ± 5.66	98.42
1STS	8	1	1	0	1	12	0.08			
1STS	8	2	0	0	0	12	0			
1STS	8	3	1	1	2	12	0.17	0.08 ± 0.08	17.54 ± 5.66	99.52
1STS	9	1	0	1	1	12	0.08			
1STS	9	2	0	0	0	12	0			
1STS	9	3	0	0	0	12	0	0.03 ± 0.05	17.54 ± 5.66	99.84
1STS	10	1	0	0	0	12	0			
1STS	10	2	0	0	0	12	0			
1STS	10	3	0	0	0	12	0	0	17.54 ± 5.66	100
1STS	12	1	0	0	0	12	0			
1STS	12	2	0	0	0	12	0			
1STS	12	3	0	0	0	12	0	0	17.54 ± 5.66	100
1STS	14	1	0	0	0	12	0			
1STS	14	2	0	0	0	12	0			
1STS	14	3	0	0	0	12	0	0	17.54 ± 5.66	100

Table 25: PLUMS Most tolerant stage at 3°C Treated second instar

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
2NDS	3	1	91	41	132	12	11			
2NDS	3	2	63	49	112	12	9.33			
2NDS	3	3	108	33	141	12	11.75	10.69 ± 1.23	17.54 ± 5.66	39.03
2NDS	4	1	44	17	61	12	5.08			
2NDS	4	2	86	3	89	12	7.42			
2NDS	4	3	44	7	51	12	4.25	5.58 ± 1.64	17.54 ± 5.66	68.17
2NDS	5	1	66	12	78	12	6.5			
2NDS	5	2	68	11	79	12	6.58			
2NDS	5	3	39	2	41	12	3.42	5.5 ± 1.80	17.54 ± 5.66	68.65
2NDS	6	1	13	6	19	12	1.58			
2NDS	6	2	24	4	28	12	2.33			
2NDS	6	3	65	15	80	12	6.67	3.53 ± 2.74	17.54 ± 5.66	79.89
2NDS	7	1	10	1	11	12	0.92			
2NDS	7	2	2	0	2	12	0.17			
2NDS	7	3	10	0	10	12	0.83	0.64 ± 0.41	17.54 ± 5.66	96.36
2NDS	8	1	5	0	5	12	0.42			
2NDS	8	2	2	0	2	12	0.17			
2NDS	8	3	2	0	2	12	0.17	0.25 ± 0.14	17.54 ± 5.66	98.57
2NDS	9	1	8	0	8	12	0.67			
2NDS	9	2	0	0	0	12	0			
2NDS	9	3	3	0	3	12	0.25	0.31 ± 0.34	17.54 ± 5.66	98.26
2NDS	10	1	2	0	2	12	0.17			
2NDS	10	2	0	0	0	12	0			
2NDS	10	3	0	0	0	12	0	0.06 ± 0.10	17.54 ± 5.66	99.68
2NDS	12	1	0	0	0	12	0			
2NDS	12	2	0	0	0	12	0			
2NDS	12	3	0	0	0	12	0	0	17.54 ± 5.66	100
2NDS	14	1	0	0	0	12	0			
2NDS	14	2	0	0	0	12	0			
2NDS	14	3	0	0	0	12	0	0	17.54 ± 5.66	100

Table 26: PLUMS Most tolerant stage at 3°C Treated third instar

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
3RDS	3	1	180	380	560	12	46.67			
3RDS	3	2	210	222	432	12	36			
3RDS	3	3	220	220	440	12	36.67	39.78 ± 5.98	50.67 ± 11.19	21.49
3RDS	4	1	194	186	380	12	31.67			
3RDS	4	2	182	240	422	12	35.17			
3RDS	4	3	187	147	334	12	27.83	31.56 ± 3.67	50.67 ± 11.19	37.72
3RDS	5	1	117	147	264	12	22			
3RDS	5	2	134	106	240	12	20			
3RDS	5	3	221	130	351	12	29.25	23.75 ± 4.87	50.67 ± 11.19	53.13
3RDS	6	1	95	71	166	12	13.83			
3RDS	6	2	68	88	156	12	13			
3RDS	6	3	91	160	251	12	20.92	15.92 ± 4.35	50.67 ± 11.19	68.59
3RDS	7	1	75	45	120	12	10			
3RDS	7	2	67	56	123	12	10.25			
3RDS	7	3	74	110	184	12	15.33	11.87 ± 3.01	50.67 ± 11.19	76.59
3RDS	8	1	9	7	16	12	1.33			
3RDS	8	2	21	14	35	12	2.92			
3RDS	8	3	13	14	27	12	2.25	2.17 ± 0.79	50.67 ± 11.19	95.72
3RDS	9	1	13	9	22	12	1.83			
3RDS	9	2	20	10	30	12	2.5			
3RDS	9	3	14	6	20	12	1.67	2 ± 0.44	50.67 ± 11.19	96.05
3RDS	10	1	9	2	11	12	0.92			
3RDS	10	2	3	1	4	12	0.33			
3RDS	10	3	3	6	9	12	0.75	0.67 ± 0.30	50.67 ± 11.19	98.68
3RDS	12	1	4	3	7	12	0.58			
3RDS	12	2	1	0	1	12	0.08			
3RDS	12	3	1	0	1	12	0.08	0.25 ± 0.29	50.67 ± 11.19	99.51
3RDS	14	1	0	0	0	12	0			
3RDS	14	2	0	0	0	12	0			
3RDS	14	3	0	0	0	12	0	0	50.67 ± 11.19	100

Table 27: NECTARINES

Most tolerant stage at 3°C Untreated (control) fruit

LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
EGGS	1	1401	61	1462	12	121.83		
EGGS	2	1385	99	1484	12	123.67		
EGGS	3	1113	53	1166	12	97.17		
EGGS	4	1301	68	1369	12	114.08		
EGGS	5	1024	90	1114	12	92.83		
EGGS	6	1125	198	1323	12	110.25	109.97	12.67
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
1STS	1	379	70	449	12	37.42		
1STS	2	335	115	450	12	37.5		
1STS	3	289	89	378	12	31.5		
1STS	4	234	6	240	12	20		
1STS	5	426	123	549	12	45.75		
1STS	6	755	161	916	12	76.33	41.42	19.11
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
2NDS	1	450	0	450	12	37.5		
2NDS	2	155	20	175	12	14.58		
2NDS	3	442	32	474	12	39.5		
2NDS	4	410	4	414	12	34.5		
2NDS	5	196	7	203	12	16.92		
2NDS	6	338	14	352	12	29.33	28.72	10.64
LIFESTAGE	Sample	Sieve 1	Sieve 2	Total insects	No. fruit	Insects per fruit	Average Insects per fruit	STDEV
3RDS	1	196	1	197	12	16.42		
3RDS	2	645	1	646	12	53.83		
3RDS	3	620	14	634	12	52.83		
3RDS	4	435	7	442	12	36.83		
3RDS	5	402	0	402	12	33.5		
3RDS	6	530	0	530	12	44.17	39.60	14.01

Table 28: NECTARINES Most tolerant stage at 3°C Treated eggs

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS)	% MORTALITY
EGGS	3	1	405	72	477	12	39.75			
EGGS	3	2	404	134	538	12	44.83			
EGGS	3	3	369	87	456	12	38	40.86 ± 3.55	109.97 ± 12.67	62.84
EGGS	4	1	403	108	511	12	42.58			
EGGS	4	2	382	154	536	12	44.67			
EGGS	4	3	446	164	610	12	50.83	46.03 ± 4.29	109.97 ± 12.67	58.15
EGGS	5	1	230	29	259	12	21.58			
EGGS	5	2	140	54	194	12	16.17			
EGGS	5	3	266	28	294	12	24.5	20.75 ± 4.23	109.97 ± 12.67	81.13
EGGS	6	1	29	12	41	12	3.42			
EGGS	6	2	39	3	42	12	3.5			
EGGS	6	3	54	17	71	12	5.92	4.28 ± 1.42	109.97 ± 12.67	96.11
EGGS	7	1	0	1	1	12	0.08			
EGGS	7	2	2	2	4	12	0.33			
EGGS	7	3	4	1	5	12	0.42	0.28 ± 0.17	109.97 ± 12.67	99.75
EGGS	8	1	0	0	0	12	0			
EGGS	8	2	0	0	0	12	0			
EGGS	8	3	0	0	0	12	0	0	109.97 ± 12.67	100
EGGS	9	1	0	0	0	12	0			
EGGS	9	2	0	0	0	12	0			
EGGS	9	3	0	0	0	12	0	0	109.97 ± 12.67	100
EGGS	10	1	0	0	0	12	0			
EGGS	10	2	0	0	0	12	0			
EGGS	10	3	0	0	0	12	0	0	109.97 ± 12.67	100
EGGS	12	1	0	0	0	12	0			
EGGS	12	2	0	0	0	12	0			
EGGS	12	3	0	0	0	12	0	0	109.97 ± 12.67	100
EGGS	14	1	0	0	0	12	0			
EGGS	14	2	0	0	0	12	0			
EGGS	14	3	0	0	0	12	0	0	109.97 ± 12.67	100

Table 29: NECTARINES Most tolerant stage at 3°C Treated first instar

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
1STS	3	1	201	13	214	12	17.83			
1STS	3	2	146	16	162	12	13.5			
1STS	3	3	89	12	101	12	8.42	13.25 ± 4.71	41.42 ± 19.11	68.01
1STS	4	1	93	2	95	12	7.92			
1STS	4	2	25	0	25	12	2.08			
1STS	4	3	23	0	23	12	1.92	3.97 ± 3.42	41.42 ± 19.11	90.41
1STS	5	1	29	6	35	12	2.92			
1STS	5	2	21	1	22	12	1.83			
1STS	5	3	39	3	42	12	3.5	2.75 ± 0.85	41.42 ± 19.11	93.36
1STS	6	1	32	7	39	12	3.25			
1STS	6	2	14	1	15	12	1.25			
1STS	6	3	3	1	4	12	0.33	1.61 ± 1.49	41.42 ± 19.11	96.11
1STS	7	1	0	0	0	12	0			
1STS	7	2	23	6	29	12	2.42			
1STS	7	3	0	0	0	12	0	0.81 ± 1.40	41.42 ± 19.11	98.06
1STS	8	1	2	0	2	12	0.17			
1STS	8	2	0	0	0	12	0			
1STS	8	3	0	0	0	12	0	0.06 ± 0.10	41.42 ± 19.11	99.87
1STS	9	1	2	0	2	12	0.17			
1STS	9	2	2	0	2	12	0.17			
1STS	9	3	1	0	1	12	0.08	0.14 ± 0.05	41.42 ± 19.11	99.66
1STS	10	1	0	0	0	12	0			
1STS	10	2	0	0	0	12	0			
1STS	10	3	0	0	0	12	0	0	41.42 ± 19.11	100
1STS	12	1	0	0	0	12	0			
1STS	12	2	0	0	0	12	0			
1STS	12	3	0	0	0	12	0	0	41.42 ± 19.11	100
1STS	14	1	0	0	0	12	0			
1STS	14	2	0	0	0	12	0			
1STS	14	3	0	0	0	12	0	0	41.42 ± 19.11	100

Table 30: NECTARINES Most tolerant stage at 3°C Treated second instar

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
2NDS	3	1	99	0	99	12	8.25			
2NDS	3	2	47	0	47	12	3.92			
2NDS	3	3	22	0	22	12	1.83	4.67 ± 3.27	28.72 ± 10.64	83.75
2NDS	4	1	7	0	7	12	0.58			
2NDS	4	2	16	0	16	12	1.33			
2NDS	4	3	31	0	31	12	2.58	1.5 ± 1.01	28.72 ± 10.64	94.78
2NDS	5	1	19	0	19	12	1.58			
2NDS	5	2	4	0	4	12	0.33			
2NDS	5	3	7	0	7	12	0.58	0.83 ± 0.66	28.72 ± 10.64	97.10
2NDS	6	1	49	6	55	12	4.58			
2NDS	6	2	3	1	4	12	0.33			
2NDS	6	3	16	0	16	12	1.33	2.08 ± 2.2	28.72 ± 10.64	92.75
2NDS	7	1	0	0	0	12	0			
2NDS	7	2	4	0	4	12	0.33			
2NDS	7	3	0	0	0	12	0	0.11 ± 0.19	28.72 ± 10.64	99.61
2NDS	8	1	1	0	1	12	0.08			
2NDS	8	2	2	0	2	12	0.17			
2NDS	8	3	2	0	2	12	0.17	0.14 ± 0.20	28.72 ± 10.64	99.52
2NDS	9	1	0	0	0	12	0			
2NDS	9	2	0	0	0	12	0			
2NDS	9	3	0	0	0	12	0	0	28.72 ± 10.64	100
2NDS	10	1	0	0	0	12	0			
2NDS	10	2	0	0	0	12	0			
2NDS	10	3	0	0	0	12	0	0	28.72 ± 10.64	100
2NDS	12	1	0	0	0	12	0			
2NDS	12	2	0	0	0	12	0			
2NDS	12	3	0	0	0	12	0	0	28.72 ± 10.64	100
2NDS	14	1	0	0	0	12	0			
2NDS	14	2	0	0	0	12	0			
2NDS	14	3	0	0	0	12	0	0	28.72 ± 10.64	100

Table 31: NECTARINES Most tolerant stage at 3°C Treated third instar

LIFESTAGE	TREATMENT DAYS	REPLICATE	SIEVE 1	SIEVE 2	TOTAL PUPAE	NO. FRUIT	INSECTS PER FRUIT	AVERAGE INSECTS PER FRUIT ± STDEV	INSECTS PER FRUIT (CONTROLS) ± STDEV	% MORTALITY
3RDS	3	1	7	0	7	12	0.58			
3RDS	3	2	7	0	7	12	0.58			
3RDS	3	3	5	0	5	12	0.42	0.53 ± 0.10	39.60 ± 14.01	98.67
3RDS	4	1	6	0	6	12	0.5			
3RDS	4	2	8	0	8	12	0.67			
3RDS	4	3	4	0	4	12	0.33	0.5 ± 0.17	39.60 ± 14.01	98.74
3RDS	5	1	0	0	0	12	0			
3RDS	5	2	0	0	0	12	0			
3RDS	5	3	2	0	2	12	0.17	0.06 ± 0.10	39.60 ± 14.01	99.86
3RDS	6	1	0	0	0	12	0			
3RDS	6	2	0	0	0	12	0			
3RDS	6	3	0	0	0	12	0	0	39.60 ± 14.01	100
3RDS	7	1	0	0	0	12	0			
3RDS	7	2	0	0	0	12	0			
3RDS	7	3	0	0	0	12	0	0	39.60 ± 14.01	100
3RDS	8	1	1	0	1	12	0.08			
3RDS	8	2	0	0	0	12	0			
3RDS	8	3	1	0	1	12	0.08	0.06 ± 0.05	39.60 ± 14.01	99.86
3RDS	9	1	0	0	0	12	0			
3RDS	9	2	0	0	0	12	0			
3RDS	9	3	0	0	0	12	0	0	39.60 ± 14.01	100
3RDS	10	1	0	0	0	12	0			
3RDS	10	2	0	0	0	12	0			
3RDS	10	3	0	0	0	12	0	0	39.60 ± 14.01	100
3RDS	12	1	0	0	0	12	0			
3RDS	12	2	0	0	0	12	0			
3RDS	12	3	0	0	0	12	0	0	39.60 ± 14.01	100
3RDS	14	1	0	0	0	12	0			
3RDS	14	2	0	0	0	12	0			
3RDS	14	3	0	0	0	12	0	0	39.60 ± 14.01	100

Table 32: PLUMS: Survival of insects in untreated (control) fruit – large scale trial at 3°C (replicate 1)

650 plums were infested by puncturing the fruit and placing on top of the fly cages at GHI. 150 fruit (CONTROL) were randomly chosen and placed in 3 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 500 fruit (TREATED) were packed into trays and allowed to develop to 3rd instar larval stage for the 3°C disinfestation treatment.								
LARGE SCALE TRIAL AT 3°C ANGELENO PLUMS REPLICATE 1 – Infested 18 October 2006								
Sample unit (50 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	30 Oct 2006	06 November 2006	13 November 2006					
1	14	217	5	236	50	4.72	6.69	1.71
2	56	311	20	387	50	7.74		
3	71	285	25	381	50	7.62		

Table 33: PLUMS: Survival of insects in untreated (control) fruit – large scale trial at 3°C (replicate 2)

470 plums were infested by puncturing the fruit and placing on top of the fly cages at GHI. 80 fruit (CONTROL) were randomly chosen and placed in 5 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 390 fruit (TREATED) were packed into trays and allowed to develop to 3rd instar larval stage for the 3°C disinfestation treatment.								
LARGE SCALE TRIAL AT 3°C ANGELENO PLUMS REPLICATE 2 – Infested 20 March 2007								
Sample unit (16 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	02 April 2007	09 April 2007	16 April 2007					
1	115	560	22	697	16	43.56		
2	101	350	23	474	16	29.63		
3	115	586	37	738	16	46.13		
4	98	370	23	491	16	30.69		
5	111	547	48	706	16	44.13	38.83	7.98

Table 34: PLUMS: Survival of insects in untreated (control) fruit – large scale trial at 3°C (replicate 3)

680 plums were infested by puncturing the fruit and placing on top of the fly cages at GHI. 114 fruit (CONTROL) were randomly chosen and placed in 6 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 566 fruit (TREATED) were packed into trays and allowed to develop to 3rd instar larval stage for the 3°C disinfestation treatment.								
LARGE SCALE TRIAL AT 3°C ANGELENO PLUMS REPLICATE 3 – Infested 27 March 2007								
Sample unit (19 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	09 April 2007	16 April 2007	23 April 2007					
1	659	162	55	876	19	46.11		
2	1000	136	35	1171	19	61.63		
3	776	148	484	972	19	51.16		
4	561	105	48	714	19	37.58		
5	655	117	53	825	19	43.42		
6	623	168	50	841	19	44.26	47.36	8.25

Table 35: PLUMS: Survival of insects in untreated (control) fruit – large scale trial at 3°C (replicate 4)

464 plums were infested by puncturing the fruit and placing on top of the fly cages at GHI. 80 fruit (CONTROL) were randomly chosen and placed in 4 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 384 fruit (TREATED) were packed into trays and allowed to develop to 3rd instar larval stage for the 3°C disinfestation treatment.								
LARGE SCALE TRIAL AT 3°C ANGELENO PLUMS REPLICATE 4 – Infested 03 April 2007								
Sample unit (20 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	16 April 2007	23 April 2007	30 April 2007					
1	746	737	0	1483	20	74.15		
2	844	553	0	1397	20	69.85		
3	861	734	0	1595	20	79.75		
4	325	770	0	1095	20	54.75	69.63	10.71

Table 36: PLUMS: Survival of insects in untreated (control) fruit – large scale trial at 3°C (replicate 50

480 plums were infested by puncturing the fruit and placing on top of the fly cages at GHI. 80 fruit (CONTROL) were randomly chosen and placed in 5 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 400 fruit (TREATED) were packed into trays and allowed to develop to 3rd instar larval stage for the 3°C disinfestation treatment.								
LARGE SCALE TRIAL AT 3°C ANGELENO PLUMS REPLICATE 5 – Infested 11 April 2007								
Sample unit (16 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	23 April 2007	30 April 2007	07 May 2007					
1	92	224	0	316	16	19.75		
2	32	186	0	218	16	13.63		
3	66	217	29	312	16	19.5		
4	52	308	6	366	16	22.88		
5	15	322	12	349	16	21.81	19.51	3.58

Table 37: NECTARINES: Survival of insects in untreated (control) fruit – large scale trial at 3°C (replicates 1 & 2)

300 nectarines were infested by puncturing the fruit and placing on top of the fly cages at GHI. 60 fruit (CONTROL) were randomly chosen and placed in 6 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 240 fruit (TREATED) were packed into trays and allowed to develop to 1st instar larval stage for the 3°C disinfestation treatment.								
LARGE SCALE TRIAL AT 3°C “ARCTIC SNOW” NECTARINES REPLICATE 1 & 2 – INFESTED 30 January 2007								
Sample unit (10 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	12 February 2007	19 February 2007	26 February 2007					
1	330	92	0	422	10	42.2		
2	553	37	0	590	10	59		
3	758	60	0	818	10	81.8		
4	486	73	0	559	10	55.9		
5	291	49	0	340	10	34.0		
6	756	85	0	841	10	84.1	59.5	20.32

Table 38: NECTARINES: Survival of insects in untreated (control) fruit – large scale trial at 3°C (replicate 3)

310 nectarines were infested by puncturing the fruit and placing on top of the fly cages at GHI. 70 fruit (CONTROL) were randomly chosen and placed in 7 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 240 fruit (TREATED) were packed into trays and allowed to develop to 1st instar larval stage for the 3°C disinfestation treatment.								
LARGE SCALE TRIAL AT 3°C “ARCTIC SNOW” NECTARINES REPLICATE 3 – INFESTED 07 February 2007								
Sample unit (10 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	19 February 2007	26 February 2007	05 March 2007					
1	53	8	0	61	10	6.1		
2	53	55	0	108	10	10.8		
3	176	50	0	226	10	22.6		
4	175	121	0	296	10	29.6		
5	76	5	0	81	10	8.1		
6	103	11	0	114	10	11.4		
7	78	10	0	88	10	8.8	13.91	8.74

Table 39: NECTARINES: Survival of insects in untreated (control) fruit – large scale trial at 3°C (replicate 4)

300 nectarines were infested by puncturing the fruit and placing on top of the fly cages at GHI. 60 fruit (CONTROL) were randomly chosen and placed in 6 pupation trays and held at 26°C until larvae had “hopped” from the fruit. These were counted to obtain an average number of survivors per fruit. The remaining 240 fruit (TREATED) were packed into trays and allowed to develop to 1st instar larval stage for the 3°C disinfestation treatment.								
LARGE SCALE TRIAL AT 3°C “ARCTIC SNOW” NECTARINES REPLICATE 3 – INFESTED 20 February 2007								
Sample unit (10 fruit/tray)	No. pupae (sieve 1)	No. pupae (sieve 2)	No. pupae (sieve 3)	Total pupae	No. fruit	Pupae per fruit	Average	Stdev
Sieve date	04 March 2007	11 March 2007	18 March 2007					
1	760	247	0	1007	10	100.7		
2	935	327	0	1262	10	1126.2		
3	1415	170	0	1585	10	158.5		
4	965	350	0	1315	10	131.5		
5	1135	194	0	1329	10	132.9		
6	860	336	0	1196	10	119.6	128.2	18.9

Table 40: PLUMS & NECTARINES: Large scale trials at 3°C (replicates 1, 2, 3, 4 and 5 (plums)) – Treated fruit

VARIETY	REPLICATE	TREATMENT	TREATMENT UNIT	No. FRUIT	No. PUPAE SIEVE 1	No. PUPAE SIEVE 2	No. PUPAE SIEVE 3
PLUMS	1	14 DAYS @ 3°C	1	50	0	0	0
PLUMS	1	14 DAYS @ 3°C	2	50	0	0	0
PLUMS	1	14 DAYS @ 3°C	3	50	0	0	0
PLUMS	1	14 DAYS @ 3°C	4	50	0	0	0
PLUMS	1	14 DAYS @ 3°C	5	50	0	0	0
PLUMS	1	14 DAYS @ 3°C	6	50	0	0	0
PLUMS	1	14 DAYS @ 3°C	7	50	0	0	0
PLUMS	1	14 DAYS @ 3°C	8	50	0	0	0
PLUMS	1	14 DAYS @ 3°C	9	50	0	0	0
PLUMS	1	14 DAYS @ 3°C	10	50	0	0	0
SUB TOTAL				500	0		0
PLUMS	2	14 DAYS @ 3°C	1	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	2	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	3	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	4	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	5	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	6	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	7	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	8	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	9	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	10	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	11	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	12	30	0	0	0
PLUMS	2	14 DAYS @ 3°C	13	30	0	0	0
SUB TOTAL				390	0	0	0
PLUMS	3	14 DAYS @ 3°C	1	50	0	0	0
PLUMS	3	14 DAYS @ 3°C	2	50	0	0	0
PLUMS	3	14 DAYS @ 3°C	3	50	0	0	0
PLUMS	3	14 DAYS @ 3°C	4	50	0	0	0
PLUMS	3	14 DAYS @ 3°C	5	50	0	0	0
PLUMS	3	14 DAYS @ 3°C	6	50	0	0	0
PLUMS	3	14 DAYS @ 3°C	7	50	0	0	0
PLUMS	3	14 DAYS @ 3°C	8	50	0	0	0

PLUMS	3	14 DAYS @ 3°C	9	50	0	0	0
PLUMS	3	14 DAYS @ 3°C	10	50	0	0	0
PLUMS	3	14 DAYS @ 3°C	11	66	0	0	0
SUB TOTAL				566	0	0	0
PLUMS	4	14 DAYS @ 3°C	1	50	0	0	0
PLUMS	4	14 DAYS @ 3°C	2	50	0	0	0
PLUMS	4	14 DAYS @ 3°C	3	50	0	0	0
PLUMS	4	14 DAYS @ 3°C	4	50	0	0	0
PLUMS	4	14 DAYS @ 3°C	5	50	0	0	0
PLUMS	4	14 DAYS @ 3°C	6	50	0	0	0
PLUMS	4	14 DAYS @ 3°C	7	50	0	0	0
PLUMS	4	14 DAYS @ 3°C	8	34	0	0	0
SUB TOTAL				384	0	0	0
PLUMS	5	14 DAYS @ 3°C	1	50	0	0	0
PLUMS	5	14 DAYS @ 3°C	2	50	0	0	0
PLUMS	5	14 DAYS @ 3°C	3	50	0	0	0
PLUMS	5	14 DAYS @ 3°C	4	50	0	0	0
PLUMS	5	14 DAYS @ 3°C	5	50	0	0	0
PLUMS	5	14 DAYS @ 3°C	6	50	0	0	0
PLUMS	5	14 DAYS @ 3°C	7	50	0	0	0
PLUMS	5	14 DAYS @ 3°C	8	50	0	0	0
SUB TOTAL				400	0	0	0
NECTARINES	1	14 DAYS @ 3°C	1	30	0	0	0
NECTARINES	1	14 DAYS @ 3°C	2	30	0	0	0
NECTARINES	1	14 DAYS @ 3°C	3	30	0	0	0
NECTARINES	1	14 DAYS @ 3°C	4	30	0	0	0
NECTARINES	1	14 DAYS @ 3°C	5	30	0	0	0
NECTARINES	1	14 DAYS @ 3°C	6	30	0	0	0
NECTARINES	1	14 DAYS @ 3°C	7	30	0	0	0
NECTARINES	1	14 DAYS @ 3°C	8	30	0	0	0
SUB TOTAL				240	0	0	0
NECTARINES	2	14 DAYS @ 3°C	1	30	0	0	0
NECTARINES	2	14 DAYS @ 3°C	2	30	0	0	0
NECTARINES	2	14 DAYS @ 3°C	3	30	0	0	0
NECTARINES	2	14 DAYS @ 3°C	4	30	0	0	0
NECTARINES	2	14 DAYS @ 3°C	5	30	0	0	0
NECTARINES	2	14 DAYS @ 3°C	6	30	0	0	0
NECTARINES	2	14 DAYS @ 3°C	7	30	0	0	0
NECTARINES	2	14 DAYS @ 3°C	8	30	0	0	0
SUB TOTAL				240	0	0	0
NECTARINES	3	14 DAYS @ 3°C	1	30	0	0	0

NECTARINES	3	14 DAYS @ 3°C	2	30	0	0	0
NECTARINES	3	14 DAYS @ 3°C	3	30	0	0	0
NECTARINES	3	14 DAYS @ 3°C	4	30	0	0	0
NECTARINES	3	14 DAYS @ 3°C	5	30	0	0	0
NECTARINES	3	14 DAYS @ 3°C	6	30	0	0	0
NECTARINES	3	14 DAYS @ 3°C	7	30	0	0	0
NECTARINES	3	14 DAYS @ 3°C	8	30	0	0	0
SUB TOTAL				240	0	0	0
NECTARINES	4	14 DAYS @ 3°C	1	30	0	0	0
NECTARINES	4	14 DAYS @ 3°C	2	30	0	0	0
NECTARINES	4	14 DAYS @ 3°C	3	30	0	0	0
NECTARINES	4	14 DAYS @ 3°C	4	30	0	0	0
NECTARINES	4	14 DAYS @ 3°C	5	30	0	0	0
NECTARINES	4	14 DAYS @ 3°C	6	30	0	0	0
NECTARINES	4	14 DAYS @ 3°C	7	30	0	0	0
NECTARINES	4	14 DAYS @ 3°C	8	30	0	0	0
SUB TOTAL				240	0	0	0

Table 41: PLUMS: Quality

Effects^A of cold storage at 1°C and 3°C on quality of Angeleno plums.

Attribute	On receipt from grower	After 14 days at 1°C	After 21 days at 1°C
External damage^z	1.00 <i>a</i>	1.10 <i>a</i>	1.15 <i>a</i>
Fruit weight (g)	117.8 <i>a</i>	115.9 <i>a</i>	116.0 <i>a</i>

Attribute	On receipt from grower	After 14 days at 3°C	After 21 days at 3°C
External damage	1.00 <i>a</i>	1.13 <i>a</i>	1.22 <i>a</i>
Fruit weight (g)	117.8 <i>a</i>	115.6 <i>a</i>	114.9 <i>a</i>

A Mean separation in each row by Duncan-Waller Bayesian k- ratio test (k=100) (4). Each figure represents the mean of five replicates of 50 fruit each.

z Scored from 1: 0% surface area damaged to 5: 100% surface area damaged.

Table 42: NECTARINES: Quality

Effects^A of cold storage at 1°C and 3°C on quality of Arctic Snow nectarines.

Attribute	On receipt from grower	After 14 days at 1°C	After 21 days at 1°C
External damage^z	1.00 <i>a</i>	1.21 <i>a</i>	1.29 <i>a</i>
Fruit weight (g)	172.5 <i>a</i>	168.9 <i>a</i>	166.5 <i>a</i>

Attribute	On receipt from grower	After 14 days at 3°C	After 21 days at 3°C
External damage	1.00 <i>a</i>	1.32 <i>a</i>	1.35 <i>a</i>
Fruit weight (g)	172.5 <i>a</i>	162.0 <i>b</i>	162.1 <i>b</i>

A Mean separation in each row by Duncan-Waller Bayesian k- ratio test (k=100) (4). Each figure represents the mean of five replicates of 50 fruit each.

z Scored from 1: 0% surface area damaged to 5: 100% surface area damaged.

Table 43: Temperature data logger calibration, statistics and graphs

Four Grant 2040 series Squirrel Data Loggers with metal oxide 2 K Ohm thermistor probes were used with serial numbers KV0529008, KV0624006, KV0624007, KV0445002. Probes have a temperature range between -50 and 150 °C with an accuracy of $\pm 0.2^{\circ}\text{C}$. The thermistor probes are connected to the logger by a factory built and calibrated cable of 5m. The Grant 2040 series Squirrel Data Logger has 32 channels available for temperature input. Loggers were calibrated by placing probes in ice slurry in an insulated vessel for 1 hour and logging the temperature at 10 minute intervals. The calibration details are as follows:

Calibration for data loggers for large scale cold disinfestation trial

LOGGER KV0529008								
DATE / TIME	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
26/03/2007 10:41:31.090	-0.01	0.03	-0.01	-0.01	0	0.05	0.11	-0.09
26/03/2007 10:51:31.090	-0.01	0.03	-0.01	-0.01	0	0.04	0.11	-0.08
26/03/2007 11:01:31.090	-0.01	0.03	-0.01	-0.01	0	0.04	0.1	-0.08
26/03/2007 11:11:31.090	-0.02	0.03	-0.01	-0.01	-0.01	0.04	0.1	-0.08
26/03/2007 11:21:31.090	-0.02	0.03	-0.01	-0.01	-0.01	0.04	0.1	-0.08
26/03/2007 11:31:31.090	-0.02	0.03	-0.01	-0.01	-0.01	0.04	0.09	-0.08
26/03/2007 11:41:31.090	-0.02	0.02	-0.01	-0.01	-0.01	0.03	0.09	-0.08
Calibration (°C)	-0.02	0.03	-0.01	-0.01	-0.01	0.04	0.1	-0.08

Calibration for data loggers for large scale cold disinfestation trial

LOGGER KV0624006								
DATE / TIME	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
21/03/2007 13:17:51.090	0.13	0.2	-0.09	0.09	0.09	0.1	0.13	0.14
21/03/2007 13:27:51.090	0.15	0.1	-0.11	0.08	0.07	0.07	0.12	0.11
21/03/2007 13:37:51.090	0.14	0.1	-0.1	0.08	0.07	0.07	0.11	0.11
21/03/2007 13:47:51.090	0.14	0.1	-0.1	0.09	0.07	0.07	0.11	0.09
21/03/2007 13:57:51.090	0.14	0.11	-0.1	0.1	0.07	0.07	0.11	0.09
21/03/2007 14:07:51.090	0.15	0.12	-0.1	0.1	0.07	0.07	0.1	0.09
21/03/2007 14:16:51.090	0.14	0.12	-0.1	0.1	0.07	0.06	0.1	0.08
Calibration (°C)	0.14	0.12	-0.1	0.09	0.07	0.07	0.11	0.10

Calibration for data loggers for large scale cold disinfestation trial

LOGGER KV0624007								
DATE / TIME	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
26/03/2007 12:10:50.090	0.07	0	0.22	0.36	0.1	0.04	0.32	0.15
26/03/2007 12:20:50.090	0.04	-0.02	-0.12	0.11	0.04	0.01	0.09	0.01
26/03/2007 12:30:50.090	0.03	-0.02	-0.13	0.11	0.04	0.01	0.09	0.01
26/03/2007 12:40:50.090	0.04	-0.02	-0.13	0.11	0.04	0.01	0.09	0.01
26/03/2007 12:50:50.090	0.03	-0.02	-0.13	0.11	0.04	0.02	0.09	0.01
26/03/2007 13:00:50.090	0.03	-0.02	-0.13	0.11	0.04	0.02	0.09	0.01
26/03/2007 13:10:50.090	0.04	-0.02	-0.13	0.11	0.04	0.03	0.09	0.01
Calibration (°C)	0.04	-0.02	-0.07	0.15	0.05	0.02	0.13	0.03

Calibration for data loggers for large scale cold disinfestation trial

LOGGER KV0445002								
DATE / TIME	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
02/05/2007 08:51:42.090	0.03	-0.01	-0.14	0.12	0.06	0.21	-0.01	0.02
02/05/2007 09:01:42.090	0.02	-0.01	-0.14	0.12	0.06	0.18	-0.04	0.03
02/05/2007 09:11:42.090	0.02	-0.01	-0.13	0.12	0.06	0.19	-0.02	0.04
02/05/2007 09:21:42.090	0.02	0	-0.13	0.12	0.06	0.19	-0.01	0.04
02/05/2007 09:31:42.090	0.02	0	-0.12	0.13	0.06	0.2	0	0.05
02/05/2007 09:41:42.090	0.02	0	-0.12	0.13	0.06	0.2	0.01	0.06
02/05/2007 09:51:42.090	0.02	0.01	-0.11	0.14	0.07	0.21	0.02	0.07
Calibration (°C)	0.02	0.00	-0.13	0.13	0.06	0.20	0.00	0.04

Table 44: PLUMS: Data logger statistics for large scale trials at 1°C (replicate 1)

Plums large scale trial at 1°C Replicate 1 (ANGELENO)								
Logger KV0529008	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	UNDER	355.0	355.0	355.0	355.0	355.0	355.0	355.0
Average temp (°C)	UNDER	1.2	1.4	1.2	1.2	1.3	1.2	6.7
no. readings above 1.5°C	UNDER	78	3	90	3	8	5	10
no. readings below 0.5°C	UNDER	0	0	0	0	0	0	0
Total number of readings	UNDER	703	703	703	703	703	703	703
Time > 1.5°C (hrs)	UNDER	39	1.5	45	1.5	4	2.5	5
Time < 0.5°C (hours)	UNDER	0	0	0	0	0	0	0
% time > 1.5°C	UNDER	11.0	0.4	12.7	0.4	1.1	0.7	1.4
% time < 0.5°C	UNDER	0	0	0	0	0	0	0
% time within 0.5°C - 1.5°C	UNDER	89.0	99.6	87.3	99.6	98.9	99.3	98.6

Table 45: PLUMS: Data logger statistics for large scale trials at 1°C (replicate 2)

Plums large scale trial at 1°C Replicate 2 (ANGELENO)							
LOGGER KV0624007	CH1	CH2	CH3	CH4	CH6	CH7	CH8
Total treatment time(hrs)	354.5	354.5	354.5	354.5	354.5	354.5	354.5
Average temp (°C)	1.3	1.5	1.1	1.3	1.3	1.2	1.4
no. readings above 1.5°C	16	593	10	21	11	8	57
no. readings below 0.5°C	0	0	0	0	0	0	0
Total number of readings	710	710	710	710	710	710	710
Time > 1.5°C (hrs)	8	296.5	5	10.5	5.5	4	28.5
Time < 0.5°C (hours)	0	0	0	0	0	0	0
% time > 1.5°C	2.3	83.6	1.4	3.0	1.6	1.1	8.0
% time < 0.5°C	0	0	0	0	0	0	0
% time within 0.5°C - 1.5°C	97.7	16.4	98.6	97.0	98.4	98.9	92.0

Table 46: PLUMS: Data logger statistics for large scale trials at 1°C (replicate 3)

Plums large scale trial at 1°C Replicate 3 (ANGELENO)								
LOGGER KV0624007	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	353.5	353.5	353.5	353.5	353.5	353.5	353.5	353.5
Average temp (°C)	1.7	1.3	1.2	1.2	1.2	1.5	1.5	1.4
no. readings above 1.5°C	687	19	16	1	5	314	241	65
no. readings below 0.5°C	0	0	0	0	0	0	0	0
Total number of readings	708	708	708	708	708	708	708	708
Time > 1.5°C (hrs)	343.5	9.5	8	0.5	2.5	157	120.5	32.5
Time < 0.5°C (hours)	0	0	0	0	0	0	0	0
% time > 1.5°C	97.2	2.7	2.3	0.1	0.7	44.4	34.1	9.2
% time < 0.5°C	0	0	0	0	0	0	0	0
% time within 1.5°C - 0.5°C	2.8	97.3	97.7	99.9	99.3	55.6	65.9	90.8

Table 47: NECTARINES: Data logger statistics for large scale trials at 1°C (replicate 1)

Nectarines large scale trial at 1°C Replicate 1 (Arctic Snow)								
LOGGER KV0624007	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	350.5	350.5	350.5	350.5	350.5	350.5	350.5	350.5
Average temp (°C)	1.0	1.0	0.9	0.9	1.0	1.1	1.0	0.9
no. readings above 1.5°C	0	3	4	0	3	0	0	8
no. readings below 0.5°C	0	0	0	0	0	0	0	0
Total number of readings	702	702	702	702	702	702	702	702
Time > 1.5°C (hrs)	0	1.5	2	0	1.5	0	0	4
Time < 0.5°C (hours)	0	0	0	0	0	0	0	0
% time > 1.5°C	0.0	0.4	0.6	0.0	0.4	0.0	0.0	1.1
% time < 0.5°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% time within 1.5°C - 0.5°C	100.0	99.6	99.4	100.0	99.6	100.0	100.0	98.9

Table 48: NECTARINES: Data logger statistics for large scale trials at 1°C (replicate 2)

Nectarines large scale trial at 1°C Replicate 2 (Arctic Snow)								
LOGGER KV0624007	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	353.0	353	353	353	353	353	353	353
Average temp (°C)	1.0	1.1	1.1	0.9	0.9	1.0	1.0	1.1
no. readings above 1.5°C	3	0	0	0	6	6	1	0
no. readings below 0.5°C	0	0	0	1	0	0	0	0
Total number of readings	707	707	707	707	707	707	707	707
Time > 1.5°C (hrs)	1.5	0	0	0	3	3	0.5	0
Time < 0.5°C (hours)	0	0	0	0.5	0	0	0	0
% time > 1.5°C	0.4	0.0	0.0	0.0	0.8	0.8	0.1	0.0
% time < 0.5°C	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
% time within 1.5°C - 0.5°C	99.6	100.0	100.0	99.9	99.2	99.2	99.9	100.0

Table 49: PLUMS: Data logger statistics for large scale trials at 3°C (replicate 1)

Plums large scale trial at 3°C Replicate 1 (Angeleno)								
LOGGER KV0445002	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	351.0	351.0	351.0	351.0	351.0	351.0	351.0	351.0
Average temp (°C)	3.2	3.3	3.2	3.1	3.5	3.2	3.0	3.1
no. readings above 3.5°C	0.0	18.0	1.0	0.0	252.0	18.0	0.0	0.0
no. readings below 2.5°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total number of readings	703.0	703.0	703.0	703.0	703.0	703.0	703.0	703.0
Time > 3.5°C (hrs)	0.0	9.0	0.5	0.0	126.0	9.0	0.0	0.0
Time < 2.5°C (hours)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% time > 3.5°C	0.0	2.6	0.1	0.0	35.9	2.6	0.0	0.0
% time < 2.5°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% time within 2.5°C - 3.5°C	100.0	97.4	99.9	100.0	64.1	97.4	100.0	100.0

Table 50: PLUMS: Data logger statistics for large scale trials at 3°C (replicate 2)

Plums large scale trial at 3°C Replicate 2 (Angeleno)								
LOGGER KV0529008	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	353.5	353.5	353.5	353.5	353.5	353.5	353.5	353.5
Average temp (°C)	3.2	3.2	3.3	3.2	3.3	3.2	3.2	3.4
no. readings above 3.5°C	3	0	0	0	0	4	0	6
no. readings below 2.5°C	0	0	0	0	0	0	0	0
Total number of readings	708	708	708	708	708	708	708	708
Time > 3.5°C (hrs)	1.5	0	0	0	0	2	0	3
Time < 2.5°C (hours)	0	0	0	0	0	0	0	0
% time > 3.5°C	0.4	0.0	0.0	0.0	0.0	0.6	0.0	0.8
% time < 2.5°C	0	0	0	0	0	0	0	0
% time within 2.5°C - 3.5°C	99.6	100.0	100.0	100.0	100.0	99.4	100.0	99.2

Table 51: PLUMS: Data logger statistics for large scale trials at 3°C (replicate 3)

Plums large scale trial at 3°C Replicate 3 (Angeleno)								
LOGGER KV0445002	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	354	354	354	354	354	354	354	354
Average temp (°C)	3.0	3.1	3.1	3.1	3.1	2.9	2.9	3.0
no. readings above 3.5°C	0	6	0	3	3	0	3	0
no. readings below 2.5°C	0	0	0	0	0	0	9	0
Total number of readings	709	709	709	709	709	709	709	709
Time > 3.5°C (hrs)	0	3	0	1.5	1.5	0	1.5	0
Time < 2.5°C (hours)	0	0	0	0	0	0	4.5	0
% time > 3.5°C	0.0	0.8	0.0	0.4	0.4	0.0	0.4	0.0
% time < 2.5°C	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0
% time within 2.5°C - 3.5°C	100.0	99.2	100.0	99.6	99.6	100.0	98.3	100.0

Table 52: PLUMS: Data logger statistics for large scale trials at 3°C (replicate 4)

Plums large scale trial at 3°C Replicate 4 (Angeleno)								
LOGGER	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	357.5	357.5	357.5	357.5	357.5	357.5	357.5	357.5
Average temp (°C)	2.8	2.7	2.8	2.8	3.1	3.0	2.8	2.9
no. readings above 3.5°C	0	2	3	3	2	0	0	0
no. readings below 2.5°C	6	12	0	0	0	1	23	0
Total number of readings	716	716	716	716	716	716	716	716
Time > 3.5°C (hrs)	0	1	1.5	1.5	1	0	0	0
Time < 2.5°C (hours)	3	6	0	0	0	0.5	11.5	0
% time > 3.5°C	0.0	0.3	0.4	0.4	0.3	0.0	0.0	0.0
% time < 2.5°C	0.8	1.7	0.0	0.0	0.0	0.1	3.2	0.0
% time within 2.5°C - 3.5°C	99.2	98.0	99.6	99.6	99.7	99.9	96.8	100.0

Table 53: PLUMS: Data logger statistics for large scale trials at 3°C (replicate 5)

Plums large scale trial at 3°C Replicate 5 (Angeleno)								
LOGGER KV0445002	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	353.0	353	353	353	353	353	353	353
Average temp (°C)	2.9	2.9	3.0	2.9	3.0	2.9	2.8	3.0
no. readings above 3.5°C	4	7	7	8	7	7	7	7
no. readings below 2.5°C	2	12	12	15	14	24	27	20
Total number of readings	707	707	707	707	707	707	707	707
Time > 3.5°C (hrs)	2	3.5	3.5	4	3.5	3.5	3.5	3.5
Time < 2.5°C (hours)	1	6	6	7.5	7	12	13.5	10
% time > 3.5°C	0.6	1.0	1.0	1.1	1.0	1.0	1.0	1.0
% time < 2.5°C	0.3	1.7	1.7	2.1	2.0	3.4	3.8	2.8
% time within 2.5°C - 3.5°C	99.2	97.3	97.3	96.7	97.0	95.6	95.2	96.2

Table 54: NECTARINES: Data logger statistics for large scale trials at 3°C (replicate 1)

Nectarines large scale trial at 3°C Replicate 1 (Arctic Snow)								
LOGGER KV0624007	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	362.0	362	362	362	362	362	362	362
Average temp (°C)	3.1	3.3	3.2	3.1	3.1	3.2	3.1	3.2
no. readings above 3.5°C	0	7	0	0	1	0	3	1
no. readings below 2.5°C	0	0	0	0	0	0	0	0
Total number of readings	725	725	725	725	725	725	725	725
Time > 3.5°C (hrs)	0	3.5	0	0	0.5	0	1.5	0.5
Time < 2.5°C (hours)	0	0	0	0	0	0	0	0
% time > 3.5°C	0.0	1.0	0.0	0.0	0.1	0.0	0.4	0.1
% time < 2.5°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% time within 2.5°C - 3.5°C	100.0	99.0	100.0	100.0	99.9	100.0	99.6	99.9

Table 55: NECTARINES: Data logger statistics for large scale trials at 3°C (replicate 2)

Nectarines large scale trial at 3°C Replicate 2 (Arctic Snow)							
LOGGER KV0529008	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	362.5	362.5	362.5	362.5	362.5	362.5	362.5
Average temp (°C)	3.2	3.1	2.9	2.9	3.1	3.2	3.2
no. readings above 3.5°C	2	2	0	0	1	2	5
no. readings below 2.5°C	0	0	0	2	0	0	0
Total number of readings	726	726	726	726	726	726	726
Time > 3.5°C (hrs)	1	1	0	0	0.5	1	2.5
Time < 2.5°C (hours)	0	0	0	1	0	0	0
% time > 3.5°C	0.3	0.3	0.0	0.0	0.1	0.3	0.7
% time < 2.5°C	0.0	0.0	0.0	0.3	0.0	0.0	0.0
% time within 2.5°C - 3.5°C	99.7	99.7	100.0	99.7	99.9	99.7	99.3

Table 56: NECTARINES: Data logger statistics for large scale trials at 3°C (replicate 3)

Nectarines large scale trial at 3°C Replicate 3 (Arctic Snow)								
LOGGER KV0445002	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Total treatment time(hrs)	357.5	357.5	357.5	357.5	357.5	357.5	357.5	357.5
Average temp (°C)	2.9	2.8	2.9	2.8	3.1	2.8	2.9	3.0
no. readings above 3.5°C	0	2	3	3	2	0	0	0
no. readings below 2.5°C	0	0	0	0	0	13	7	0
Total number of readings	716	716	716	716	716	716	716	716
Time > 3.5°C (hrs)	0	1	1.5	1.5	1	0	0	0
Time < 2.5°C (hours)	0	0	0	0	0	6.5	3.5	0
% time > 3.5°C	0.0	0.3	0.4	0.4	0.3	0.0	0.0	0.0
% time < 2.5°C	0.0	0.0	0.0	0.0	0.0	1.8	1.0	0.0
% time within 2.5°C - 3.5°C	100.0	99.7	99.6	99.6	99.7	98.2	99.0	100.0

Table 57: NECTARINES: Data logger statistics for large scale trials at 3°C (replicate 4)

Nectarines large scale trial at 3°C Replicate 4 (Arctic Snow)						
LOGGER KV0529008	CH2	CH3	CH4	CH6	CH7	CH8
Total treatment time(hrs)	354.5	354.5	354.5	354.5	354.5	354.5
Average temp (°C)	3.2	3.1	3.1	3.2	3.2	3.1
no. readings above 3.5°C	0	1	4	1	2	6
no. readings below 2.5°C	0	0	0	0	0	0
Total number of readings	710	710	710	710	710	710
Time > 3.5°C (hrs)	0	0.5	2	0.5	1	3
Time < 2.5°C (hours)	0	0	0	0	0	0
% time > 3.5°C	0.0	0.1	0.6	0.1	0.3	0.8
% time < 2.5°C	0	0	0	0	0	0
% time within 2.5°C - 3.5°C	100.0	99.9	99.4	99.9	99.7	99.2

