Plant & Food Research
Rangahau Ahumāra Kai

PFR SPTS No. 20414

# Potato tuber moth spray efficacy trials

MacDonald F, Barraclough E, Guo L

January 2021

## Confidential report for:

Potatoes New Zealand Incorporated



**PUBLICATION DATA**

MacDonald F, Barraclough E, Guo L. January 2021. Potato tuber moth spray efficacy trials. A Plant & Food Research report prepared for: Potatoes New Zealand Incorporated. Milestone No. 88883. Contract No. 38701. Job code: P/337012/01. PFR SPTS No. 20414.

**Report prepared by:**

Frances MacDonald
Researcher, Applied Entomology
January 2021

**Report approved by:**

Libby Burgess
Science Group Leader, Applied Entomology
January 2021

# Contents

# Executive summary

## Potato tuber moth spray efficacy trials

MacDonald F, Barraclough E, Guo L
Plant & Food Research, Auckland

January 2021

In March of 2020, The New Zealand Institute for Plant and Food Research Limited (PFR) collected potatoes from a site in the Pukekohe region that was heavily infested with potato tuber moth, *Phthorimaea operculella* (Lepidoptera: Gelechiidae) (PTM). A colony was established from this collection and was continuously maintained to provide larval and adult life stages for bioassays that commenced in October 2020 and were completed in late December 2020. Testing was conducted to establish baseline data on the efficacy of nine insecticides against PTM. Two methods of testing were employed, residue and direct spray. Overall mortality was significantly higher in the larval testing for both methods than the adult life stages. Karate Zeon® was the least effective insecticide for both larval and adult life stages. Results indicate that synthetic pyrethroid (SP) products are losing efficacy against PTM.

### For further information please contact:

Frances MacDonald
Plant & Food Research Auckland
Private Bag 92169
Auckland Mail Centre
Auckland 1142
NEW ZEALAND

Tel: +64 9 925 7000
DDI: +64 9 926 3521
Email: Frances.Macdonald@plantandfood.co.nz

# 1 Introduction

In the Pukekohe region during the 2019/20 potato growing season, potato tuber moth (PTM) negatively affected many crops, resulting in substantial crop losses estimated at up to 40%, as reported by Potatoes New Zealand Incorporated (PNZ). The hot, dry weather conditions over this growing period were ideal for PTM, and it is likely that these temperatures created localised extra generations of the insect pest. Additionally, this weather caused a lot of soil in the field to crack which enabled PTM easier access than usual to the potato tubers. Some spray programmes designed to manage the PTM populations were insufficient to control numbers, adding to the risk of insecticidal resistance in some populations. The PNZ Technical Panel, responsible for determining research priorities for the potato industry, requested that The New Zealand Institute for Plant and Food Research Limited (PFR) investigate the efficacy of a range of chemical sprays currently used in the Pukekohe area to control PTM.

# 2 Methods

## 2.1 Insect handling

### Direct sprays

For adult direct spray assays, six sets of approximately five moths were aspirated from rearing cages (Figure 1A) into glass vials to provide 30 individuals for testing per insecticide. Moths were then cooled to 14°C to slow down movement until ready for transfer into a 60mL “spraying” pot. All pots used in all assays for this study were of this volume. Immediately prior to transfer the moths were chilled at 4°C for 30 sec to induce immobility. After receiving the direct spray, moths were then transferred into “clean” pots each containing a clean 4-cm potato leaf disc. The pots were covered individually with mesh kept on with plastic lids, each bearing a 2 cm diameter hole to provide ventilation and prevent a fumigant effect.

For larval direct spray assays, approximately five larvae were collected from potato leaves and potatoes using a fine brush and placed into a “spraying” pot. Sets of six pots completed a treatment or insecticide of approximately 30 individuals. After receiving the direct spray, larvae were transferred into “clean” pots each containing a clean 4-cm potato leaf disc. The pots were covered individually with mesh kept on with plastic lids, each bearing a 1 cm diameter hole to provide ventilation and prevent a fumigant effect.

### Leaf residue

For adult residue assay six sets of approximately five moths were aspirated from rearing cages into glass vials to provide 30 individuals for testing per insecticide. Moths were then cooled to 14°C to slow down movement until ready for transfer. Immediately prior to transfer, moths were chilled at 4°C to induce immobility for 30 sec and then transferred to “treated” pots, each containing an insecticide-treated leaf disc. The pots were covered individually with mesh kept on with plastic lids, each bearing a 2 cm diameter hole to provide ventilation and prevent a fumigant effect.

For larval residue assays, approximately five larvae were collected from potato leaves and potatoes using a fine brush and placed directly into a “treatment” pot, each containing an insecticide-treated potato leaf disc. Each pot was covered with mesh kept on with a plastic lid bearing a 1 cm diameter holes to provide ventilation and prevent a fumigant effect. Sets of six pots completed a treatment or insecticide with approximately 30 individuals. Methodology was adapted from protocols as described by Gardner-Gee et al. (2013).

## 2.2 Sprays assessed

Nine sprays and a water control were tested in the residue assays, all with 100 mL/250 L Du-Wett® surfactant added (Tables 1 and 2). Seven sprays and a water control were used in the direct spray assays (Metafort® and Pyrinex® were excluded from direct spraying assays because of their high hazard rating).

Table 1. Sprays selected by Potatoes New Zealand for testing.

| Spray and year of registration in NZ | Active ingredient | Insecticide group and IRAC chemical group | Mode of action | Rate tested |
|---|---|---|---|---|
| Control | Water | — | — | — |
| Karate Zeon® (1988) | Lambda-cyhalothrin 250 g/L | Synthetic pyrethroids (3) | Contact, ingestion | 100 mL/250 L |
| Metafort 60SL® (2000) | Methamidophos 600 g/L | Organophosphates (1B) | Contact, ingestion, plant systemic | 1 L/250 L |
| Pyrinex® 500EC (2005) | Chlorpyrifos 500 g/L | Organophosphates (1B0 | Contact, ingestion, vapour, non-systemic in plant | 1 L/250 L |
| Venom® | Bifenthrin 100 g/L | Synthetic pyrethroids (3) | Contact and ingestion, not systemic in plant | 500 mL/250 L |
| Mavrik® Aquaflo (2005) | Tau-fluvalinate 240 g/L | Synthetic pyrethroids (3) | Contact and ingestion, not systemic in plant | 750 mL/250 L |
| Benevia® | Cyantraniliprole 28 100 g/L | Diamides (28) | Primarily ingestion and also contact, feeding cessation, local systemic activity | 500 mL/250 L |
| Coragen® | Chlorantraniliprole 28 200 g/L | Diamides (28) | Ingestion and also contact, feeding cessation, local systemic activity | 100 mL/250 L |
| Uphold® | Spinetoram 120 g/L | Spinosyns (5) | Contact and ingestion, feeding cessation | 500 mL/250 L |
| Tripsol® 2018 | Acrinathrin 22.5g/L Abamectin 12.6 g/L | Synthetic pyrethroids (3) Avermectins (6) | Primarily contact, plus ingestion, repellence of adults | 500 mL/250 L |

Table 2. Label claims for insecticides.

| Product | Specified for potatoes | Specified for PTM | Specified activation to spray |
|---|---|---|---|
| Karate Zeon® | yes | yes | When adults are seen |
| Metafort 60SL® | yes | yes | When mining observed in leaves (larvae) |
| Pyrinex® 500EC | no | no | N/A |
| Venom® | no | no | N/A |
| Mavrik® Aquaflo | yes | no | N/A |
| Benevia® | yes | yes | When mining (larvae) observed or first sightings of moths |
| Coragen® | yes | yes | When mining (larvae) observed or first sightings of moths |
| Uphold® | yes | no | N/A |
| Tripsol® | yes | no | N/A |

All insecticides and controls were mixed with Du-Wett® before application, as a spreader was necessary for wetting of the leaf or insect even when not specified on the label.

All insecticides were mixed to the mL per hectare recommended on the product label. The water volume rate per hectare was 250 L as agreed by PNZ in consultation with growers who use differing water volume rates depending on the life stage of the crop. All insecticides were tested at the label rate except for Karate Zeon® where a higher rate was of interest. Karate Zeon® was tested at this higher rate of 100 mL/250 L, and at the label rate of 40 mL/500 L. insecticides were mixed on the morning of each use and kept continuously mixed by a magnetic stirrer during experimental use.

## 2.3 Direct spray assays

Two direct spray assays were conducted, one with adult PTM, and the other with larval PTM. For the adult assay, moths between 1 and 7 days old were used. Approximately five moths (between 5 and 10) were placed in a small plastic "treatment" pot (60 mL, 50 mm diameter opening, 32 mm diameter base, 45 mm high) covered in 2.5 mm mesh to prevent escape. Moths were sprayed through the mesh using a Burkard Potter spray tower calibrated to deliver 2 mg/cm$^2$ through the mesh to the bottom of the pot. This coverage rate was chosen to match the coverage rate used by the International Organisation for Biological and Integrated Control (IOBC) in their standards for testing pesticides against beneficial insects (Candolfi et al. 2000). It must be noted that IOBC tests are residue tests, but 2 mg/cm$^2$ is considered to provide a good coverage short of run-off.

A Potter spray tower (Figure 1B) is an apparatus that delivers a fine, even spray over a 9 cm diameter area, at known amounts and pressures, such that a chosen coverage amount can be repeatedly applied with low variability (Potter 1952).

Potato leaf material was sourced from plants grown at PFR's Mt Albert Research Centre in a glasshouse. The potato seed was Agria.

Figures 1A-E: A PTM colony cage B: Potter tower C: Residue testing D: Potato leaves E: sample pots

Six pots each containing five moths were sprayed per insecticide, giving a total of approximately 30 moths per chemical plus the control pots as described in 2.2. Pots were kept at 24°C in a 16:8hr L:D light cycle.

Mortality of individuals was recorded at 24, 48 and 72 h, except for the treatments Benevia® and Coragen® that were recorded beyond 72 h to 144 h for adult testing due to the different mode of action of these chemicals. On Days 4–6, water was provided to moths in all treatments in the form of wet cotton wool placed against the top of the mesh, to enable good survival of the control insects for the 6 days of monitoring.

In the larval assay, second and small third instar larvae were sprayed in pots using the same method but without mesh and with the Potter spray tower calibrated to deliver the same spray coverage without mesh. Larvae were sprayed in six pots of five larvae. Larvae were given a clean potato leaf to feed on and mortality was monitored at 24, 48 and 72 h. Unlike the adult testing using Benevia® and Coragen®, recording beyond 72 h was not necessary as there was 100% mortality by this time. The

hole in the lid was reduced to 1 cm diameter to further prevent drying of the potato leaf discs in the larval assays.

## 2.4 Residue assays

Two residue assays were conducted, one with adult PTM and one with larval PTM. For the adult assay, fresh potato leaf discs were cut and dipped/swished in the insecticides and controls for approximately 5 sec before being removed and held to drip for a further 5 sec (Figure 1C and 1D), to approximate the spray coverage of run-off conditions in the field. Discs were then laid on a metal rack until completely dry. All insecticides and controls were mixed with Du-Wett® spreader to enable full wetting of the leaf. The entire inside of a sample pot was also filled with spray and left inverted on a metal rack for the spray to run off and dry. Five adults were then introduced onto the leaf in a pot and mesh and a ventilated lid placed over the top. The holes of the lids were reduced to 1 cm diameter for larval assays to prevent drying of the leaf discs. Pots were kept at 24°C in a16:8hr L:D light cycle (Figure 1E). Mortality was recorded at 24, 48 and 72 h except for the Coragen® and Benevia® treatments using adults where recording was done beyond 72 h to 144 h for adult testing due to the different mode of action of these chemicals. On Day 4–6, water was provided to moths in all treatments in the form of wet cotton wool placed against the top of the mesh, to enable good survival of control insects for the 6 days of monitoring. Potato leaf material was sourced from plants grown at the PFR Mt Albert Research Centre in a glasshouse. The potato seed was Agria.

## 2.5 Statistical analyses

Statistical analyses were performed with the aims of investigating differences between each insecticidal treatment and its corresponding control. Protocol measures were applied to limit variability, but variables between days of trials make treatments, life stages and assay types less meaningful to compare between. All analyses were conducted using SAS version 9.4 (SAS Institute Inc 2011) and R version 4.0.3 (R Core Team 2020).

The number of PTM surviving after 24–144 h was fitted using logistic regression, with rare events (100%, 0% survival) being adjusted by Firth correlation (Firth D, 1993). Significant differences were identified at the 95% confidence level.

Survival percentages presented are the raw means adjusted for natural death in the control treatments using Abbott's correction (Abbott 1925), i.e. the percentage death presented is attributable to the insecticide. Logistic regression analyses were used to identify which survival percentages were significantly different from the corresponding controls.

# 3 Results

Results from the residue and direct spray assays are summarised in Table 3. The Appendix at the end of this report contains more detailed results for individual insecticides.

Karate Zeon® was ineffective against adult PTM at the label rate (40 mL/ha) for both residue and direct testing. At the higher rate (100 mL/ha) there was significant survival of between 34-42% for both methods. The higher rate was somewhat effective with both methods against larvae but left survivors (4-31%) at 72 h by which time a synthetic pyrethroid (SP) is expected to have caused mortality. This result suggests resistance to the active ingredient lambda-cyhalothrin in this PTM population.

Mavrik® Aquaflo, another SP, was not effective against adults using either method with survival between 80-87%, but did kill larvae within 48 h in residue exposure assays. In direct spray assays, 6% of larvae survived after 72 h.

Venom®, another SP, was very effective against larvae in both methods of testing; however, it was effective against adults in residue testing only, with 15% adult survival in the direct spray tests at 72 h.

The organophosphates (OPs) were very effective. Metafort 60SL® and Pyrinex® 500EC both killed all adults and larvae in residue testing within 48 h. Metafort 60SL® also has systemic activity and therefore is useful for mining larvae. Only residue testing was conducted for these two insecticides.

Benevia® and Coragen® had 100% mortality with both methods when tested on larvae. Both testing methods showed that these agents were much less effective against adults, with between 11% and 43% surviving.

Uphold® and Tripsol® achieved 100% mortality for both methods and both life stages of PTM.

Table 3. Percentage survival of potato tuber moth (PTM) larvae and adults in residue and direct spray assays, at 24–144 h after exposure to insecticide treatment. Survival values are raw means, adjusted for control survival. Values in bold red are where survival was not significantly different from control survival at the 95% confidence level in the statistical analysis.

| | | | % survival (raw means), adjusted for control survival | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Spray and rate** | **PTM stage** | **Assay type** | **24 h** | **48 h** | **72 h** | **96 h** | **120 h** | **144 h** |
| Karate Zeon® 40 mL/500 L | Adults | Residue | **100** | **91** | **83** | — | — | — |
| | | Direct | **79** | **76** | 67 | — | — | — |
| Karate Zeon® 100 mL/250 L | Adults | Residue | 43 | 30 | 34 | — | — | — |
| | | Direct | **94** | **78** | 42 | — | — | — |
| | Larvae | Residue | 64 | 7 | 4 | — | — | — |
| | | Direct | 56 | 36 | 31 | — | — | — |
| Metafort 60SL® 1 L/250 L | Adults | Residue | 0 | — | — | — | — | — |
| | Larvae | Residue | 0 | — | — | — | — | — |
| Pyrinex® 500EC 1 L/250 L | Adults | Residue | 3 | 0 | — | — | — | — |
| | Larvae | Residue | 0 | — | — | — | — | — |
| Venom® 500 mL/250 L | Adults | Residue | 7 | 0 | — | — | — | — |
| | | Direct | **60** | 25 | 19 | — | — | — |
| | Larvae | Residue | 0 | — | — | — | — | — |
| | | Direct | 3 | 0 | — | — | — | — |
| Mavrik® Aquaflo 750 mL/250 L | Adults | Residue | **93** | **97** | **87** | — | — | — |
| | | Direct | **113**[a] | **102**[a] | **80** | — | — | — |
| | Larvae | Residue | 13 | 0 | — | — | — | — |
| | | Direct | 24 | 10 | 6 | — | — | — |
| Benevia® 500 mL/250 L | Adults | Residue | — | 61 | 58 | 52 | 40 | 14 |
| | | Direct | — | **65** | 35 | 39[b] | 16 | 16 |
| | Larvae | Residue | 30 | 0 | — | — | — | — |
| | | Direct | 30 | 17 | 0 | — | — | — |
| Coragen® 100 mL/250 L | Adults | Residue | — | **88** | **89**[b] | **77** | 57 | 43 |
| | | Direct | — | 36 | 28 | 31 | 18 | 11 |
| | Larvae | Residue | 0 | — | — | — | — | — |
| | | Direct | 37 | 7 | 0 | — | — | — |
| Uphold® 500 mL/250 L | Adults | Residue | — | 4 | 0 | — | — | — |
| | | Direct | 51 | 14 | 0 | — | — | — |
| | Larvae | Residue | 4 | 0 | — | — | — | — |
| | | Direct | 3 | 0 | — | — | — | — |
| Tripsol® 850 mL/250 L | Adults | Residue | 65 | 7 | 0 | — | — | — |
| | | Direct | 8 | 0 | — | — | — | — |
| | Larvae | Residue | 0 | — | — | — | — | — |
| | | Direct | 0 | — | — | — | — | — |

[A] Mean death in the control was higher; [b] corrected survival is higher than previous day due to higher control death on that day.

# 4 Discussion

Some of the insecticides caused little mortality in adult PTM and their use in a sustainable management programme needs to be reconsidered with this field population, and possibly others in the Pukekohe region. As expected, based on previous research (Walker et al. 2008), adult survival rates when exposed to Karate Zeon® were high, suggesting resistance to this insecticide is still prevalent in PTM. Other SPs tested also appear to have control failure. Analysed data from these assays highlight Benevia® as having potential as a useful tool in an Integrated Pest Management (IPM) programme to control PTM larvae. These results obtained under laboratory conditions may differ from the level of mortality in the field, especially larval results where larvae in the crop are likely to be located inside the plant. Efficacy may also be less under field conditions because of variability in spray coverage. In addition, incapacitated individuals which were considered survivors in these assays, may, or may not go on to die in the field. However, these results represent a best-case kill scenario and indicate whether PTM is physiologically affected by the insecticides, and also indicate comparative efficacy among the sprays. The OPs were highly effective. Metafort 60SL® and Pyrinex® 500EC killed all adults and larvae in residue testing within 48 h. Metafort 60SL® in addition is systemic and therefore useful for mining larvae. Notably, survival was higher in direct testing than residue testing with the SP insecticides.

# 5 Recommendations

A review of the use of synthetic pyrethroids for control of PTM adults is recommended. Further research into insecticidal efficacy with other field populations of PTM in the Pukekohe region would be useful to identify the spread of resistance also. Identifying to what extent there is resistance using range finding assays would be of benefit in addition to testing the label rate of products. Priority to conducting field studies to replicate a more “on-farm” setting to test insecticides with an IPM emphasis could provide useful tools with an applied approach.

# 6 Acknowledgements

Many thanks to Graham Walker (PFR MARC) for contextual feedback on assay results.

# 7 References

Abbott WS 1925. A method of computing the effectiveness of an insecticide. Journal of Economic Entomology. 18: 265-267.

Candolfi MP, Blumel S, Forster R, Bakker FM, Grimm C, Hassan SA, Heimbach U, Mead-Briggs MA, Reber B, Schmuck R, Vogt H 2000. Guidelines to evaluate side-effects of plant protection products to non-target arthropods. Gent: International Organization for Biological and Integrated Control of Noxious Animals and Plants, West Palearctic Regional Section (IOBC/WPRS).

Firth D 1993. Bias reduction of maximum likelihood estimates. Biometrika 80.1: 27-38.

Gardner-Gee R, Puketapu A, MacDonald F, Connolly P 2013. Effect of selected oils and insecticides on beneficial insect species. Report prepared for Potatoes New Zealand, SFF11-058.

Potter C 1952. An improved laboratory apparatus for applying direct sprays and surface films, with data on the electrostatic charge on atomized spray fluids. Annals of Applied Biology. 39(1): 1-28.

R Core Team 2020. R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing.

SAS Institute Inc 2011. Base SAS 9.4 Procedures Guide. Cary, NC, USA.

Walker G, Cameron P, MacDonald F, Hartnett D, Wallace A 2008. Assessment of resistance in potato tuber moth (*Phthorimaea operculella*) from Pukekohe and Waikato potato crops to organophosphate and synthetic pyrethroid insecticides. Crop and Food confidential report no 2227, a short report for Horticulture New Zealand.

# Appendix

Plots of raw means and standard errors for all assays for each insecticide.

## Karate Zeon® (lambda-cyhalothrin), label rate 40 mL/500 L

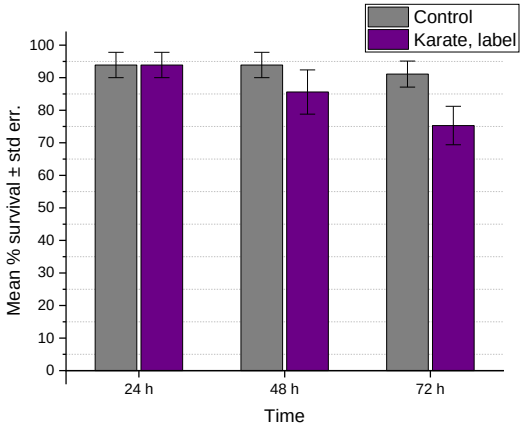


Figure A1. Survival of adult PTM in residue assays after 24 h, 48 h and 72 h.

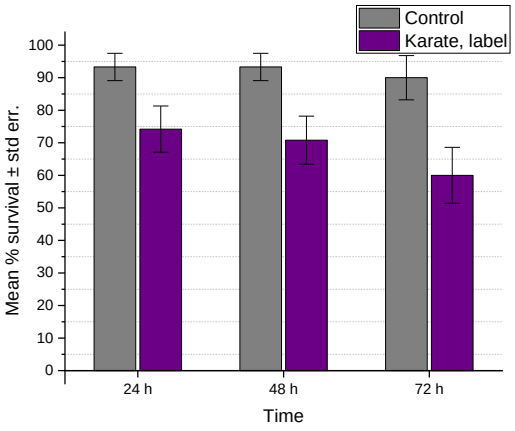


Figure A2. Survival of adult PTM in direct spray assays after 24 h, 48 h and 72 h.

# Karate Zeon® (lambda-cyhalothrin) 100 mL/250 L

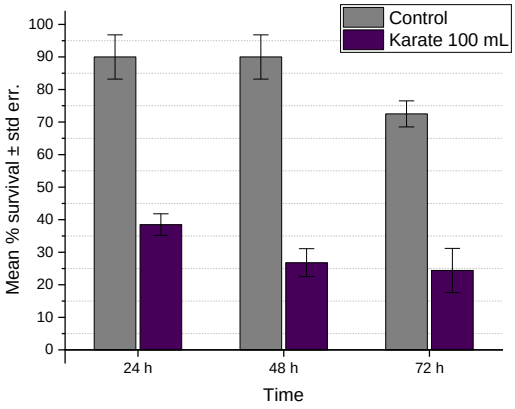


Figure A3. Survival of adult PTM in residue assays after 24 h, 48 h and 72 h.

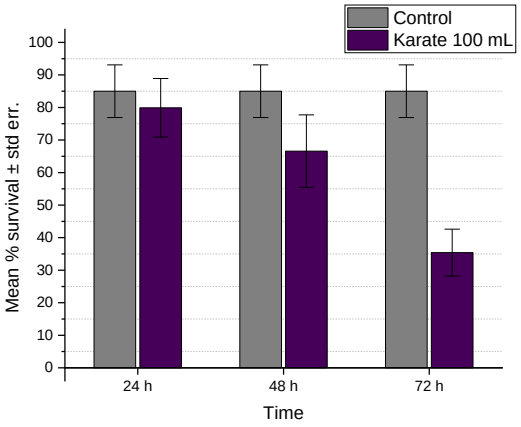


Figure A4. Survival of adult PTM in direct spray assays after 24 h, 48 h and 72 h.

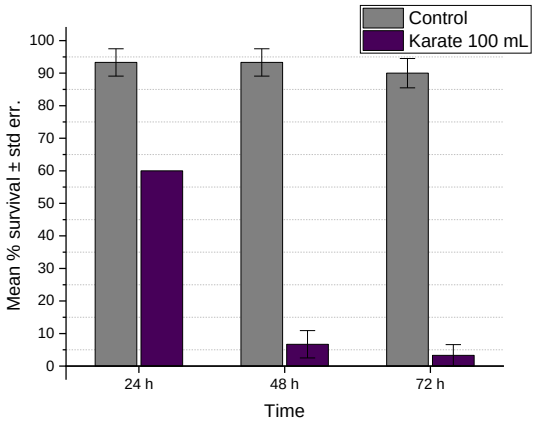


Figure A5. Survival of larval PTM in residue assays after 24 h, 48 h and 72 h.

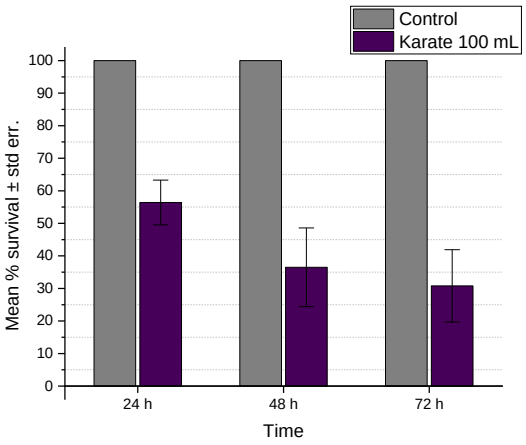


Figure A6. Survival of larval PTM in direct spray assays after 24 h, 48 h and 72 h.

# Metafort® 60SL (methamidophos) 1 L/250 L

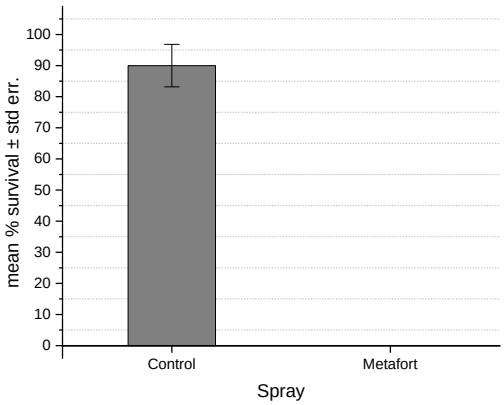


Figure A7. Survival of adult PTM in residue assays after 24 h.

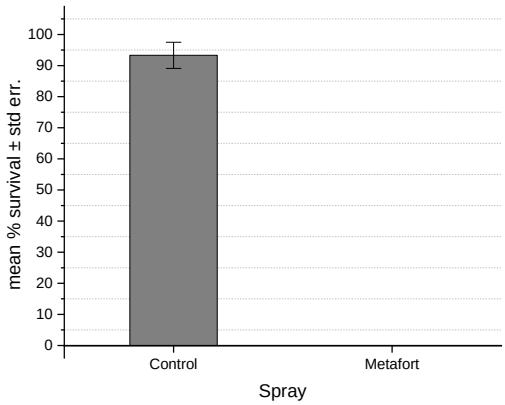


Figure A8. Survival of larval PTM in residue assays after 24 h.

# Pyrinex® 500EC (chlorpyrifos) at 1 L/250 L

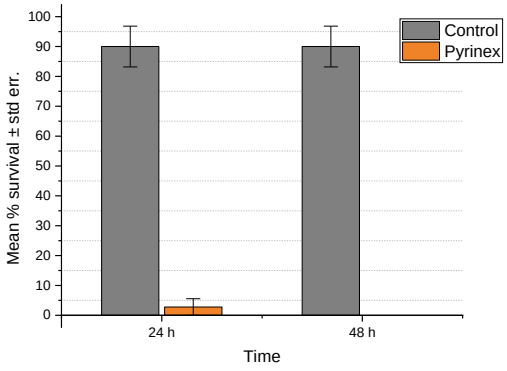


Figure A9. Survival of adult PTM in residue assays after 24 h and 48 h.

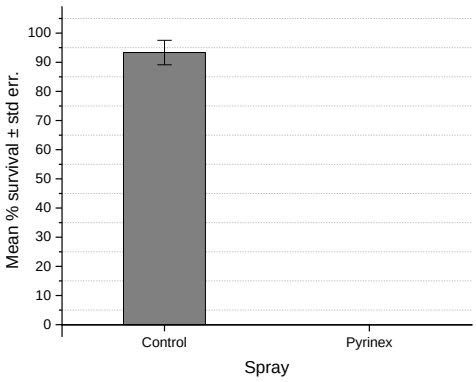


Figure A10. Survival of larval PTM in residue assays after 24 h.

# Venom® (bifenthrin) 500 mL/250 L

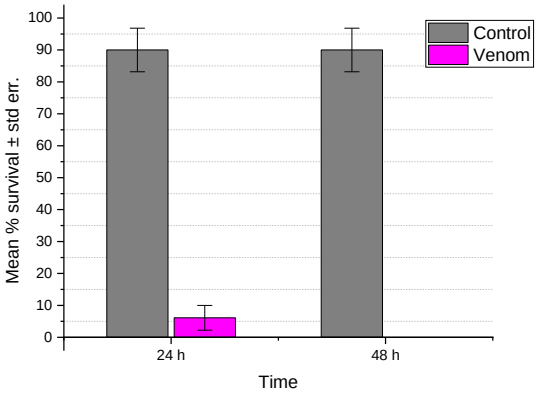


Figure A11. Survival of adult PTM in residue assays after 24 h and 48 h.

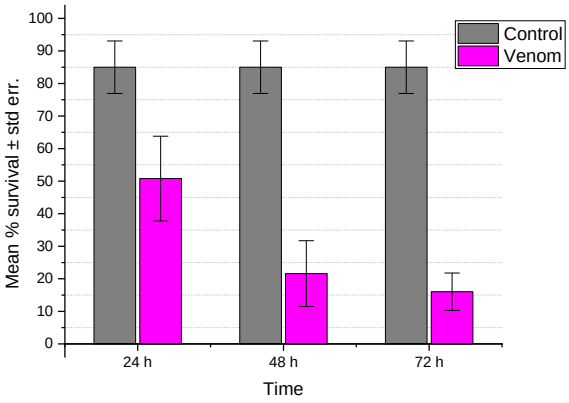


Figure A12. Survival of adult PTM in direct spray assays after 24 h, 48 h and 72 h.

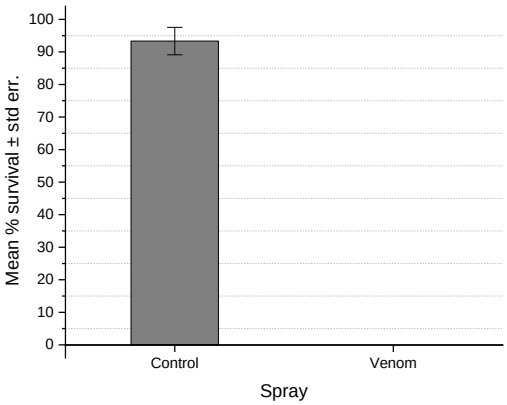


Figure A13. Survival of larval PTM in residue assays after 24 h.

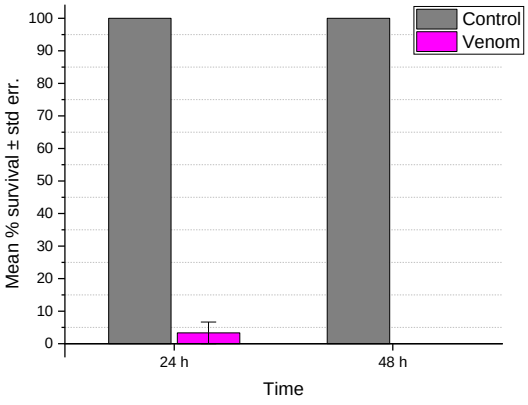


Figure A14. Survival of larval PTM in direct spray assays after 24 h and 48 h.

# Mavrik® Aquaflo (tau-fluvalinate) 750 mL/250 L

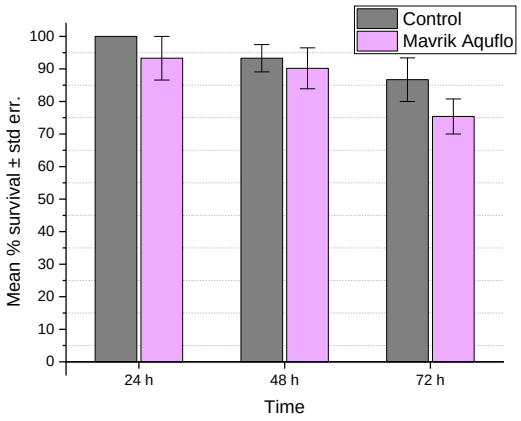


Figure A15. Survival of adult PTM in residue assays after 24 h, 48 h, and 72 h.

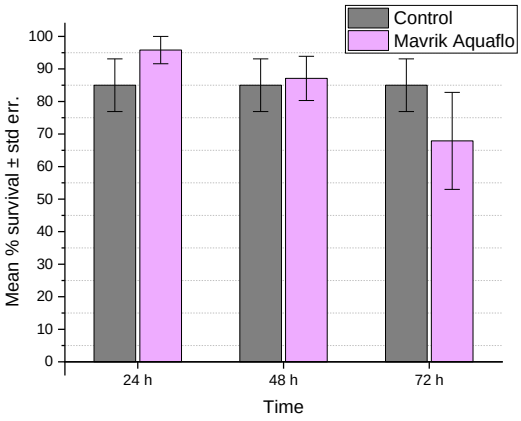


Figure A16. Survival of adult PTM in direct spray assays after 24 h, 48 h and 72 h.

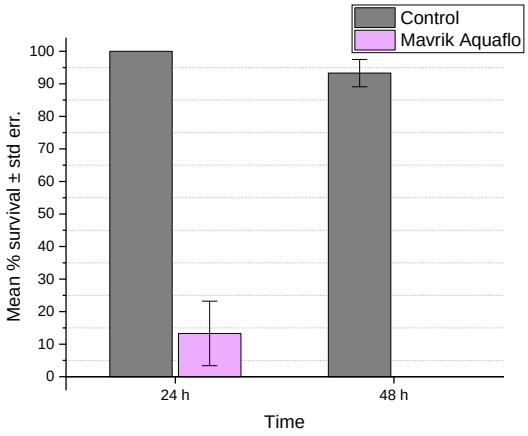


Figure A17. Survival of larval PTM in residue assays after 24 h and 48 h.

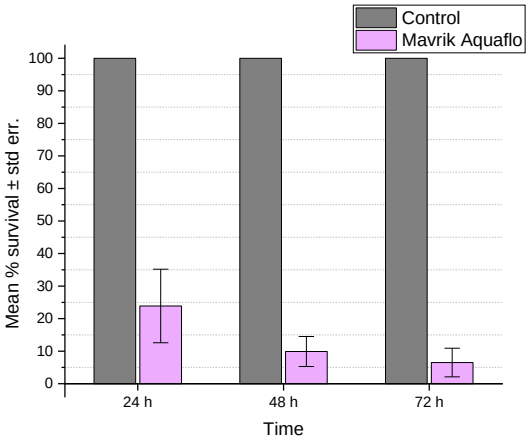


Figure A18. Survival of larval PTM in direct spray assays after 24 h, 48 h and 72 h.

# Benevia® (cyantraniliprole) 500 mL/250 L

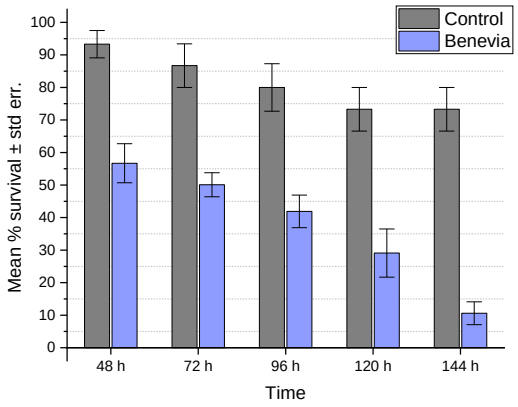


Figure A19. Survival of adult PTM in residue assays after 2–6 days.

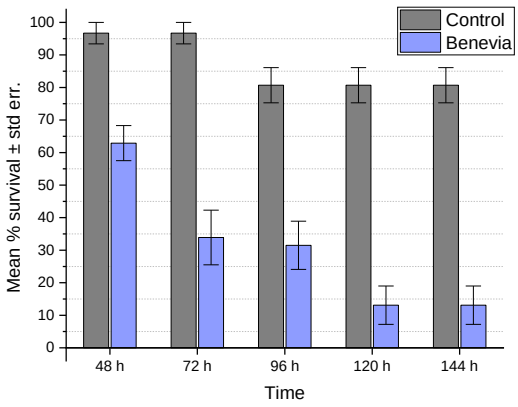


Figure A20. Survival of adult PTM in direct spray assays after 2–6 days.

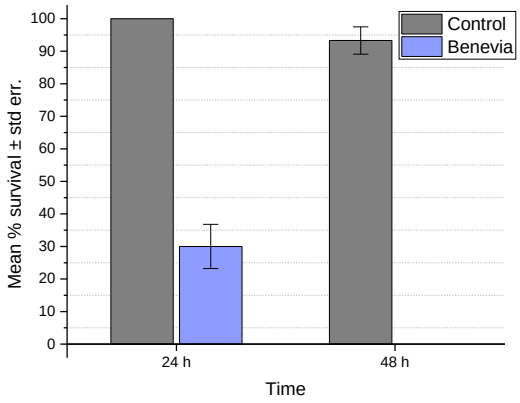


Figure A21. Survival of larval PTM in residue assays after 24 h and 48 h.

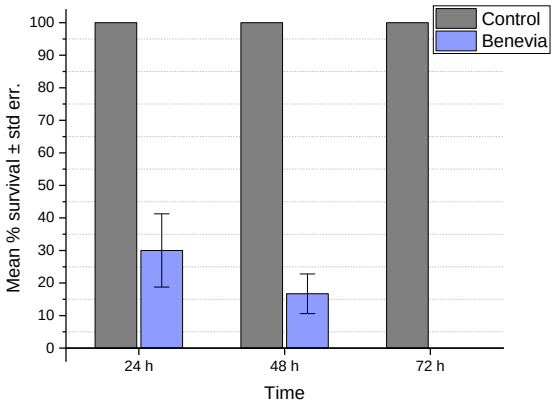


Figure A22. Survival of larval PTM in direct spray assays after 24 h, 48 h and 72 h.

# Coragen® (chlorantraniliprole) 100 mL/250 L

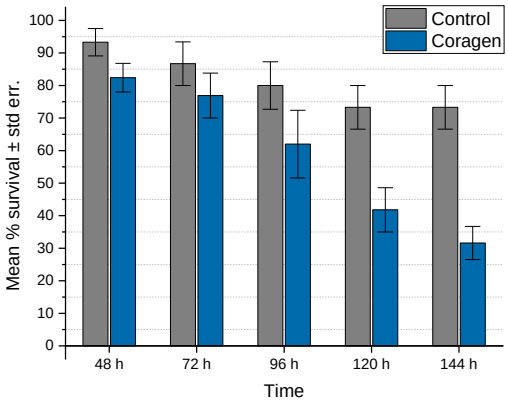


Figure A23. Survival of adult PTM in residue assays after 2–6 days. No 24-h reading.

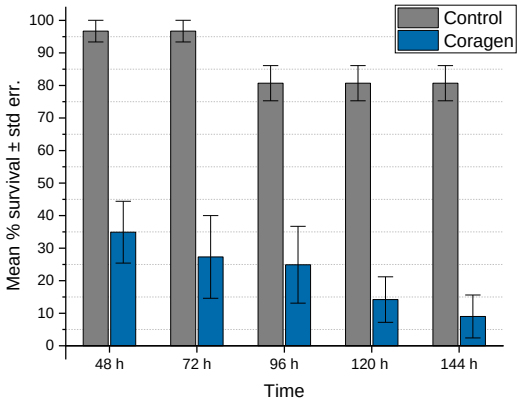


Figure A24. Survival of adult PTM in direct spray assays after 2–6 days. No 24-h reading.

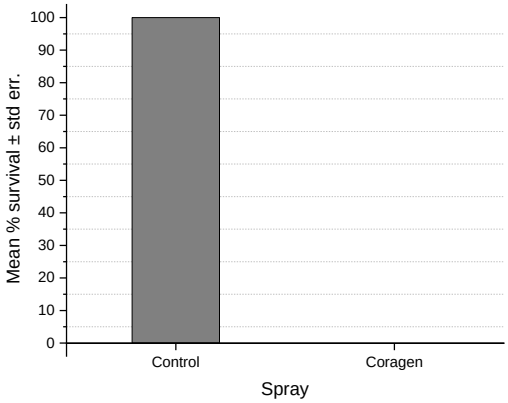


Figure A25. Survival of larval PTM in residue assays after 24 h.

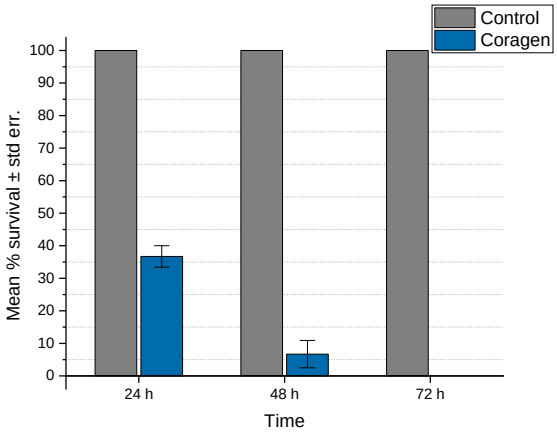


Figure A26. Survival of larval PTM in direct spray assays after 24 h, 48 h, and 72 h.

# Uphold® (spinetoram) 500 mL/250 L

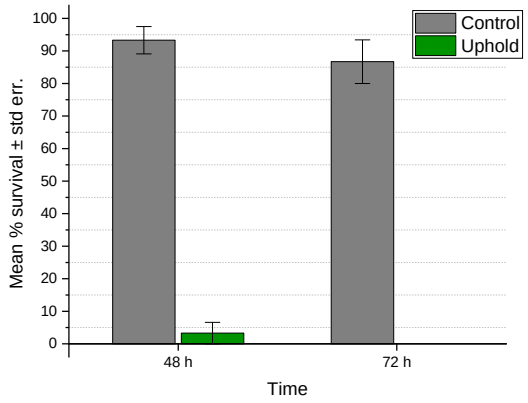


Figure A27. Survival of adult PTM in residue assays after 48 h and 72 h. No reading at 24 h.

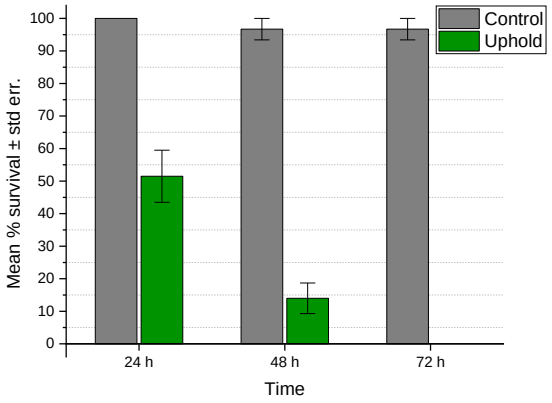


Figure A28. Survival of adult PTM in direct spray assays after 24 h, 48 h and 72 h.

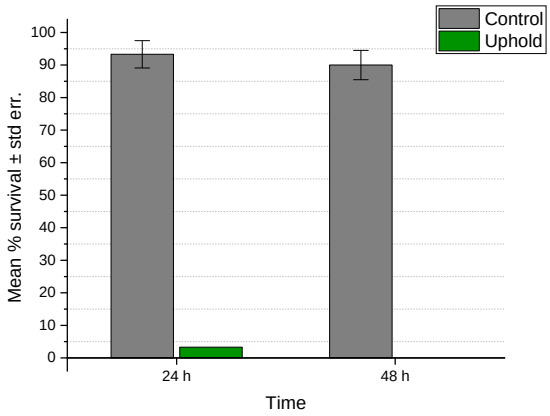


Figure A29. Survival of larval PTM in residue assays after 24 h and 48 h.

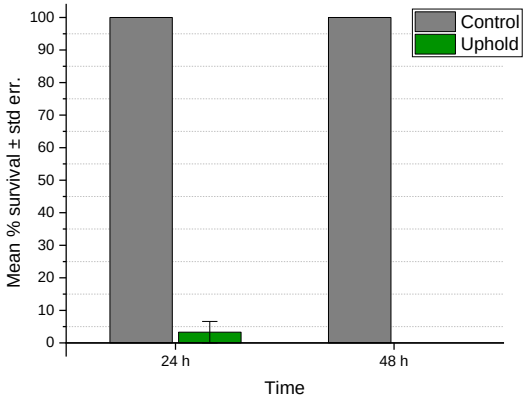


Figure A30. Survival of larval PTM in direct spray assays after 24 h and 48 h.

# Tripsol® (abamectin + acrinathrin) 850 mL/250 L

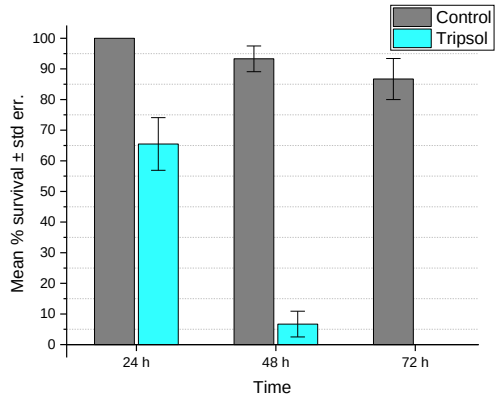


Figure A31. Survival of adult PTM in residue assays after 24 h, 48 h and 72 h.

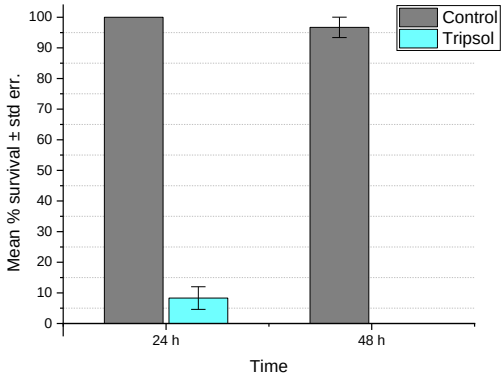


Figure A32. Survival of adult PTM in direct spray assays after 24 h and 48 h.

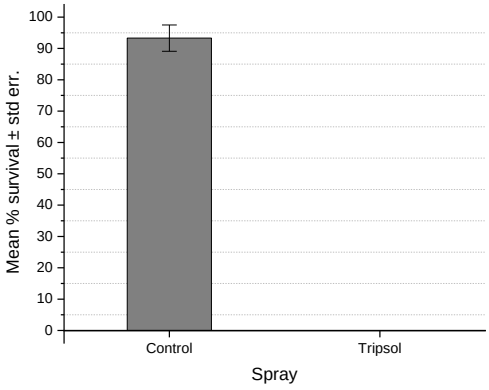


Figure A33. Survival of larval PTM in residue assays after 24 h.

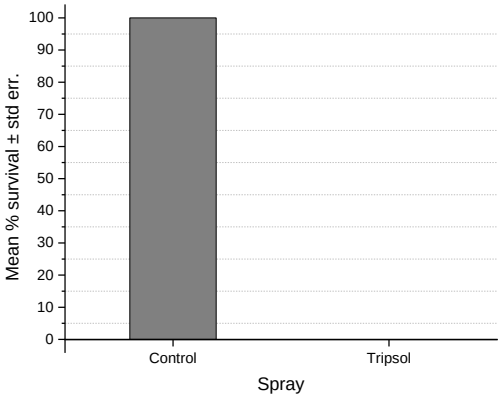


Figure A34. Survival of larval PTM in direct spray assays after 24 h.

A smart green future. Together.