Priority Pest Review for Vegetables

Report prepared for
Vegetables New Zealand

March 2023

Market Access Solutionz Ltd

Table of Contents

1. Executive Summary

This report reviews the Vegetable NZ priority pests for the period **1 April 2022 to 31 March 2023**. Pest information from the scientific literature, international databases, MPI's emerging risks system, and the VR&I monitoring risks project has been reviewed in relation to being a biosecurity risk for the fresh vegetable industry, and to inform on the latest research findings.

As an outcome of this review, the following pests are to be noted by Vegetables NZ because of their establishment in Australia and close proximity to New Zealand, or increased concern overseas, and in the case of Fall armyworm and Potato spindle tuber viroid, their detection in New Zealand. These pests are:

- ***Spodoptera frugiperda*** (fall armyworm): there have been 133 detections over the 2022-23 summer across many regions of the North and South Islands, and 217 moths found in traps in Northland during March. Sparta (spinetoram) has been approved for on-label use for control. It remains a regulated organism.
- ***Meloidogyne enterolobii*** (guava root knot nematode): has been detected in Northern Territories and Queensland, Australia, at multiple sites infecting a variety of vegetable crops. Its regulatory status has been updated from 'Not assessed' to 'Regulated'.
- **Potato spindle tuber viroid** (PSTVd): was detected in greenhouse tomatoes in the Nelson-Tasman region in November 2022. A response was initiated, and plants were destroyed.

Overseas, new pests of concern are:

- ***Chloridea virescens*** (tobacco budworm): was added to the EPPO alert list in January 2023, after recent interceptions on fruit and vegetables imported into the EU. It is polyphagous and identified as a potential threat to tomato crops.
- ***Zonosemata electa*** (pepper maggot): was added to the EU quarantine list in 2021. It is a pest of capsicum, eggplant, and occasionally attacks tomatoes.

2. Introduction

Vegetables New Zealand Inc (VNZI) has engaged Market Access Solutionz Ltd to provide technical expertise on priority pests. Some of these pests are, or may become, Sector Risk Organisms under GIA Operational Agreements. Others are identified as pests of concern to VNZI, with their changing distribution and impact monitored to determine whether their significance is increasing. The purpose of the priority pest review is to identify any changes in the risk posed by these priority pests and to identify any new pests that should be added to the priority pest list.

New developments of interest, in particular studies on chemical control and resistance, biocontrol, and other related topics, are highlighted. Key points and recommendations may be noted for some pests. Monitoring of priority pests, and pests of concern (Table 1) is on-going. Although little/no new relevant information was uncovered for some pests, monitoring will continue.

This review of Vegetable priority pests has considered information from the VR&I Monitoring Biosecurity Risks project, scientific literature (e.g., Plant Disease journal), and international databases (CAB abstracts, EPPO RSE monthly reports, NAPPO). MPI's Emerging Risks System have not released a Stakeholder report since November 2021. Enquiries have indicated reports are due for release over the next month or two. At the time of writing, no reports have been released. This indicates the importance for VNZI to continue with its own monitoring.

This report is a summary for the 12-month period from **1 April 2022 to 31 March 2023**.

Table 1: Priority pests for Vegetables NZ

Priority Pests	*Aphis fabae* (black bean aphid) Capsicum chlorosis virus (CaCV) *Contarinia nasturtii* (swede midge) Cucumber green mottle mosaic virus (CGMMV) Cucurbit yellow stunting disorder virus (CYSDV) *Cylas formicarius, Euscepes postfasciatus* (sweet potato weevils) *Diabrotica balteata* (banded cucumber beetle) *Diabrotica speciosa* (cucurbit beetle) *Diabrotica virgifera virgifera* (western corn rootworm) *Epitrix similaris* (flea beetle) *Lygus lineolaris* (tarnished plant bug) *Liriomyza* spp., *Chromatomyia horticola, Phytomyza* gymnostoma (leafminers) *Meloidogyne enterolobii* (root knot nematode) *Spodoptera frugiperda* (fall armyworm) *Tetranychus evansi* (red spider mite) Tomato apical stunt pospiviroid (TASVd)
Other pests of concern	*Candidatus Lineribacter solanacearum* (CLso) Potato spindle tuber viroid (PSTVd) *Scirtothrips dorsalis* (chilli thrips) *Diaprepes abbreviates* (citrus weevil) *Empoasca fabae* (potato leafhopper) *Epitrix* spp. (flea beetles) *Frankliniella ewarti/fusca* (thrips) *Halyomorpha halys* (brown marmorated stink bug, BMSB) *Hauptidia maroccana, Austroasca viridigrisea, Sibovia occatoria* (leafhoppers) *Leptinotarsa decemlineata* (Colorado beetle) *Leucinodes orbonalis* (eggplant fruit borer) Physostegia chlorotic mottle virus (PhCMoV) Pea early browning virus Pea enation mosaic virus *Phaedon brassicae* (brassica leaf beetle) Tomato leaf curl New Delhi virus (ToLCNDV) Tomato leaf curl purple vein virus (ToLCPVV) Tomato torrado virus (ToTV) *Tuta absoluta* (tomato leafminer) *Xiphinema, Longidorus* and *Meloidogyne* spp. (nematodes)

3. Priority Pests

3.1 *Spodoptera frugiperda* – Fall armyworm

Key points:
- Over the 2022-23 summer, there have been 133 detections of fall armyworm across many regions of the North and South Islands, and 217 moths were found in traps in Northland during March.
- Sparta, containing the active ingredient spinetoram, has been approved for on-label use to control fall armyworm.
- The publication of scientific articles on fall armyworm continues at a high rate indicating the significant resources being used to combat the impact of this pest.
- Fall armyworm remains a regulated organism.

S. frugiperda larvae damage to corn. Photo: University of Georgia, Bugwood.org. Creative Commons 3.0

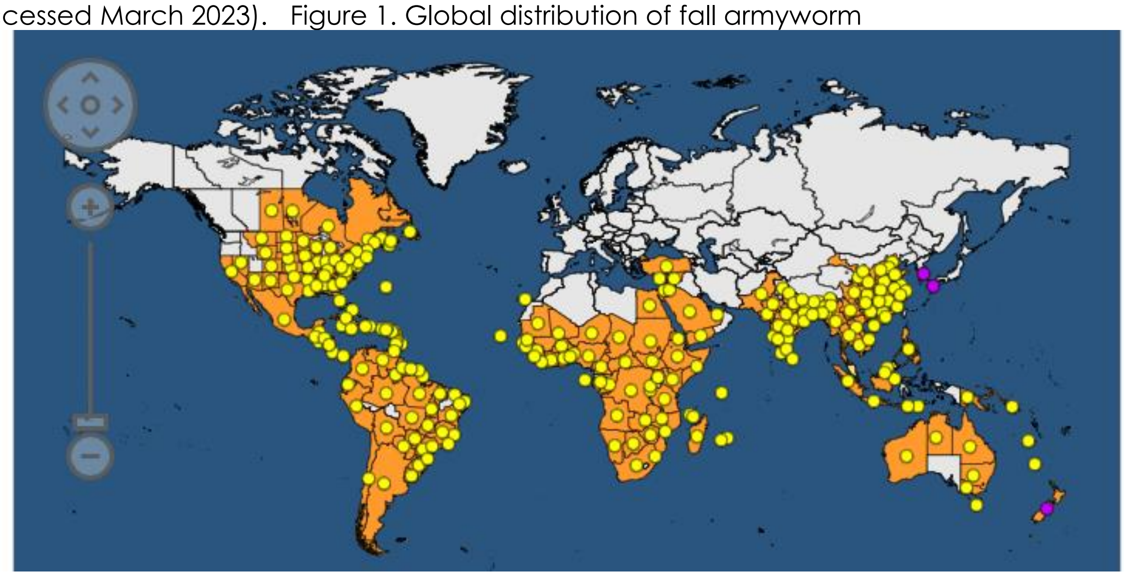
New Zealand: In March 2022, a fall armyworm egg mass was found in an Asian gypsy moth trap in Tauranga, and larvae were detected in maize/volunteer maize on sites scattered across the upper North Island. By the start of summer 2022, there were nine detections in Waikato, Northland and Auckland. At the time of writing, detections over the 2022-23 season had reached 133 (SGRR Update, 24 March), and a total of 217 moths have been found in traps in Northland in the three weeks to 31 March indicating a population build up that could potentially cause damage to autumn crops (SGRR Update, 31 March).

Fall armyworm was reported in the South Island in the West Coast and Golden Bay (SGRR Update, 10 March) and in North Canterbury (SGRR Update, 24 March), and has been detected on ryegrass and clover in harvested maize paddocks (SGRR Update, 31 March). By the start of summer, MPI had placed approx. 250 surveillance traps across maize/corn growing regions which were being checked weekly until the end of March 2023. The response is on-going.

There have also been reports of fall armyworm larvae being parasitised by the parasitic wasp, *Cotesia* spp. which suggests that biocontrol options could be developed. Using international/ Australian guidelines to estimate the economic damage suggests that at whorl stage and above, economic damage will occur when at least 20% of plants have larvae present and/or there are signs of damage on 75% of plants.

New Zealand regulatory authorities have approved on-label use for Sparta (active ingredient spinetoram) to control fall armyworm on maize and corn by both aerial and ground application.

Distribution: The current global distribution of fall armyworm is illustrated in Figure 1 (EPPO, accessed March 2023). Figure 1. Global distribution of fall armyworm



In the last six months, fall armyworm has expanded into Turkey and Cyprus. There have been few other new reports. Fall armyworm has almost global distribution but is not currently present in northern Asia, Russia, northern Canada or continental Europe, but is present in the Canary Islands, Spain. Its survival in northern regions will be influenced by climate.

The publication of articles on fall armyworm has not diminished. In this reporting period there has been a comprehensive review which covers global distribution, host plants, morphology, biology, behaviour patterns, strains, economic impact and damage symptoms (Al-Zyoud et al. 2023). The review also focuses on fall armyworm management, covering monitoring, trapping, cultural and chemical controls, biological control, botanical control (plant extracts), genetically modified crops and host plant resistance. The authors suggest that despite recent efforts to establish IPM strategies, they are still far from being successful.

CABI led a review in which the authors suggest that flying capability and wind patterns have enabled fall armyworm to easily spread across seas/oceans and invade island countries in the Pacific Ocean; and to develop IPM strategies it will be useful to better understand the relationship between infestation, leaf and ear damage and yield loss (Kenis et al. 2022). It also suggests that regional and local forecasting systems should be established to alert growers to seasonal arrivals so action can be taken to minimise yield loss, and that sustainable management methods (biocontrol) are used without over-relying on chemical pesticides.

Other publications have discussed: management (Nyamutukwa et al. 2022; Van den Berg et al. 2022; Tay et al. 2023), biological (Carrizo et al. 2022; Wu et al. 2022b; Chen et al. 2023) and chemical control (Chatterjee et al. 2022; Li et al. 2022c; Szanyi et al. 2022; Omuut et al. 2023), pest biology (Volp et al. 2022) and genetics (Chen and Palli 2022; Ouma 2022), impacts on farmers (in Africa) (Harrison et al. 2022), and management practices in organic farming (Keerthi et al. 2023) are beginning to emerge. Resistance in Bt-maize (Tomé et al. 2022), and the effect on native species (Wu et al. 2022a) have also been discussed. *Spodoptera eridana* (southern armyworm) is also being studied as an emerging crop threat (Weinberg et al. 2022).

Regulatory status: *Spodoptera frugiperda* is a regulated organism. NZ has country freedom status for *S. frugiperda.*

3.2 *Meloidogyne enterolobii* – Guava root knot nematode

Key points:

- *Meloidogyne enterolobii* has been detected in Australia at multiple sites infecting a variety of vegetable crops.
- The regulatory status of *M. enterolobii* has been updated from 'Not assessed' to 'Regulated'.

Galling in sweet potato caused by *M. enterolobii.* Image: Camilo Parada (Ausveg)

Distribution: In October 2022, *Meloidogyne enterolobii*, commonly known as guava root knot nematode (GRKN), was reported in the Northern Territory on various vegetables including *Capsicum* spp., *Cucurbita* spp., cucumber, sweet potato and beans. It is believed to have been present since at least 2021. In December 2022, it was detected in North Queensland. It is unknown if the two detections are linked (EPPO 2023/01 2023).

In other parts of the world, GRKN is reported parasitizing eggplant in Mexico (Salazar-Mesta et al. 2022) where it is widely distributed in the Sinaloa region affecting other vegetable crops such as tomato, chilli, and cucumber (EPPO 2023/01 2023).

GRKN has been eradicated in Louisiana, USA, after being discovered in 2018; quarantine measures have been implemented to prevent its reintroduction; while in Florida, GRKN has been infesting commercial crops of Asian vegetables. In Europe, further finds have occurred in the same locations in Switzerland after first being found in 2008 and eradicated, while in the Netherlands GRKN was found during an export inspection of ornamental *Ficus microcarpa* plants at a production site which were subsequently destroyed (EPPO 2023/02 2023). The global distribution of GRKN is shown in Figure 2.

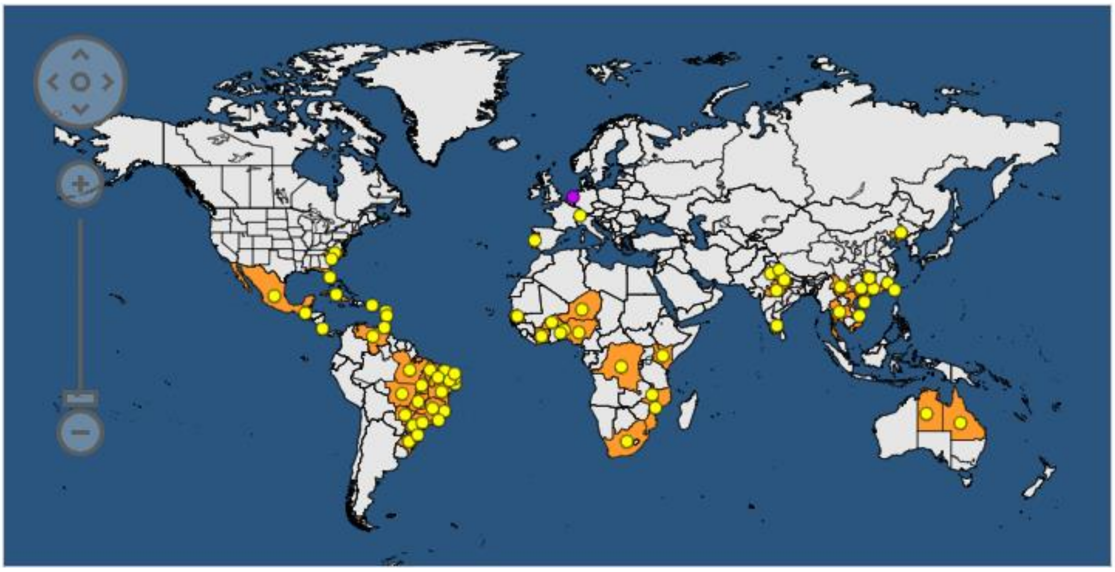


Figure 2: Global distribution of guava root know nematode.

New research: There have been many publications recording a number of detections of GRKN affecting different hosts: ornamental plants (Liang and Chen ; Wu et al. 2021), coffee (Torres-López et al. 2022), Asian vegetables (Bui et al. 2022), sweet potato (Jia et al. 2021; Rezende 2021), carrot and chard (Salinas-Castro et al. 2022), cassava (Oyetunde et al. 2021), guava (Khan et al. 2022), and cotton (Felipe de Barros Souza et al. 2022), and being identified in new regions of the world. A recent review discussed the risk of GRKN to agriculture, its present status and future prospects for management because it poses a major risk due to its widespread distribution and extensive host range (Sikandar et al. 2023). GRKN is recognised as the most virulent root-knot nematode because it can emerge and breed in plants that have resistance to other tropical RKNs. GRKN causes chlorosis, stunting, and reduces yield by producing root galls.

Other publications have investigated: (i) the pathogenicity of GKRN in resistant and susceptible tomato varieties (Gao et al. 2022), (ii) the use of grafting to overcome soilborne pathogens including GRKN (Ragassi et al. 2022), (iii) development of an RT-PCR assay to detect and quantify root-knot nematodes from soil extracts targeting a species complex (*M. incognita, M. javanica, M. arenaria,* and *M. enterolobii*) (Hodson et al. 2022), (iv) biocontrol (Vieira de Carvalho Júnior et al. 2022), (v) a sweet potato potato cultivar that has resistance to *M. incognita, M. javanica* and *M. enterolobii* (Mello et al. 2021), and (vi) cucurbit crop susceptibility to *M. enterolobii* and *M. floridensis* (Bui and Desaeger 2021).

Regulatory status: *Melodogyne enterolobii* is a regulated organism.

3.3 Leafminers - *Liriomyza huidobrensis* (serpentine leafminer), *L. trifolii* (American serpentine leafminer), *L. sativae* (vegetable leafminer)

Outbreaks of *Liriomyza huidobrensis* have been occurring in India on potatoes, and also other cultivated crops such as carrot, beetroot, garlic, beans, and broccoli; and it has been noticed on a cover crop and weed species (EPPO 2023/01 2023). A soilborne entomopathogen, *Metarhizium robertsii,* pathogenic against *L. huidobrensis* pupae, was found to be 80-91% effective, outperforming *Beauveria bassiana* as a biocontrol agent in laboratory studies, and may be a potential BCA in an IPM programme for potato production (Mugala et al. 2022). Other studies have investigated: (i) crop management in the present of *Liriomyza* spp. in a variety of production crops (Hamza et al. 2023), (ii) tomatoes as a protected crop (Jat et al. 2022), (iii) influence of weather on incidence of insects (Kumar and Singh 2022), (iv) parasitoids in Mexico (Valenzuela-Escoboza et al. 2015), (v) identifying melon genotypes with resistance to *L. sativae* (Oliveira et al.), (vi) indoxacarb resistance in *L. trifolii* (Li et al. 2022a), (vii) pathogenicity of soil entomopathogens to *L. huidobrensis* (Mugala et al. 2022), (viii) *L. sativae* susceptibility to insecticides with 'softer chemistry' (Silva et al. 2022), (ix) parasitoids of *Chromatomyia horticola* (pea leafminer) (Katoch et al. 2023), and optimising spinosyn applications for managing *Phytomyza gymnostoma* (onion leafminer) (Nault et al.).

The impact of *L. huidobrensis* in Australia, and insights into the recent invasion have been reviewed (Mulholland et al. 2022; Xu et al. 2022). Due to the recent arrival of *Liriomyza huidobrensis, L. sativae,* and *L. trifolii*, it is unclear how climatic conditions will support or restrict their distribution as they expand into new areas and threaten production area. A forecasting model has been developed to predict future establishment potential in Australia and other regions around the world.

L. huidobrensis is a priority pest for all vegetable product groups, and Biosecurity New Zealand (MPI November 2020).

Liromyza sativae, L. huidobrensis, and *L. trifolii* (left to right). Photo credits: D. M. Firake and G. T. Behere (left), Central Science Laboratory, York (GB) - British Crown (middle and right). https://gd.eppo.int

Regulatory status: *Liriomyza huidobrensis, L. sativae,* and *L. trifolii* are regulated organisms. NZ has country freedom status for *L. huidobrensis*, which is listed as a priority pest by Biosecurity NZ.

3.4 *Aphis fabae* - Black bean aphid

Aphis fabae adults and nymphs. Photo: Jack Kelly Clark, courtesy University of California Statewide IPM Program. Copyrighted by the Regents of the University of California.

Studies of *Aphis fabae* have largely been on bean hosts. The results of these studies include: biocontrol (Francis et al. 2022; Mousavi et al. 2022; Tawfiq and Rana 2022), resistance (Zimba et al. 2022), use of with essential oils for control (Amamri et al. 2021; Khaled-Gasmi et al. 2021; Metwally et al. 2022), the development of resistance to several groups of synthetic insecticides, the use of entomopathogenic fungi as BCAs (Mohammed et al. 2022; Mousavi et al. 2022), biological controls to replace neonicotinoids (Francis et al. 2022); and parasitism by parasitoids (Rasekh et al. 2022). *Aphis fabae* has also been identified as an aphid vector of potato viruses (Sridhar et al. 2022), and as one of a number of aphid vectors of cucumber mosaic virus (Khaled-Gasmi et al. 2023). Publications are also emerging on organic crops investigating the impact of parasitoids on organic bean and beet crops (Ismail et al. 2023).

Regulatory status: *Aphis fabae* is a regulated organism.

3.5 Capsicum chlorosis virus (CaCV)

EFSA has conducted a pest categorisation of CaCV for the EU territory (EFSA Panel on Plant Health 2022). CaCV is reported in Australia, China, India, Iran, Taiwan, Thailand and Hawaii, and is no longer reported in Greece. CaCV infects Solanaceae and several species of other families, including ornamentals, and is transmitted by thrips. CaCV can induce severe symptoms mainly on the leaves and fruit of its hosts making them unmarketable. Plants for planting, plant parts, fruits and cut flowers of CaCV hosts, and viruliferous thrips were identified as the most relevant pathways for the entry of CaCV into the EU.

Studies have investigated: (i) differences in transmission characteristics between whitefly vector species *Bemisia tabaci* MEAM1 and MED (Middle East Asia Minor and Mediterranean species) (Zhang et al. 2022), (ii) effect of elevated temperature on capsicum susceptibility to CaCV infection (Tsai et al. 2022), and (iii) the development of a PCR assay to detect six viruses simultaneously that infect various chilli species and applying the assay in the field (Devi et al. 2022).

Regulatory status: CaCV is a regulated organism. CaCV is also a Priority pest for TomatoesNZ.

3.6 *Contarinia nasturtii* - swede midge

Publications on *Contarinia nasturtii* have discussed: (i) management strategies for its control (Hodgdon et al. 2022a), (ii) the development of pheromones to disrupt mating (Hodgdon et al. 2022b), and (iii) the use of extracts and selenium and silicon compounds for plant protection (Golubkina et al. 2022).

Regulatory status: *Contarinia nasturtii* is a regulated organism.

3.7 Cucumber green mottle mosaic virus (CGMMV)

Publications out of Australia suggest that, based on phylogenetic analysis, the recent incursion was a single event (Kehoe et al. 2022), and highlight: (i) the need to understand virus longevity and infectivity after soil disinfection (Lovelock et al. 2022), and (ii) the importance of proper management of infested properties and the need for on-farm biosecurity. Other publications have discussed the genetic diversity of CGMMV in cucurbits in Pakistan (Asad et al. 2022), and the use of boron as a novel strategy to suppress infection and improve resistance (Bi et al. 2022a; Bi et al. 2022b).

There were no interceptions of CGMMV on cucurbits imported from Australia in 2022 (MAS 2022).

Regulatory status: CGMMV is a regulated organism.

3.8 Cucurbit yellow stunting disorder virus (CYSDV)

Mixed infection of CYSDV and CCYV in cucurbit crops continues to be reported. Mixed infection has recently been reported in Alabama where symptoms were reported as foliar yellowing, leaf mottle and interveinal yellowing with green veins observed on melon, squash, and cucumber plants (Mondal et al. 2021). CYSDV has also been detected in cucurbit crops in India (Krishnan et al. 2022).

Regulatory status: CYSDV is Not assessed.

3.9 *Cylas formicarius, Euscepes postfasciatus* - Sweet potato weevils

Publications on *Cylas formicarius* have focused on (i) control methods using entomopathogenic fungi (Baró et al. 2022) and cultural practices, (ii) pest biology (Chen et al. 2022), and (iii) resistance (Liu et al. 2022). In Japan, sterile insect and male annihilation techniques have been used in combination for the successful eradication of *C. formicarius* (Himuro et al. 2022b; Ikegawa et al. 2022).

The topic of a publication on *Euscepes postfasciatus* has been the biology of male (Himuro et al. 2022c) and female (Himuro et al. 2022a) weevils.

Regulatory status: *Cylas formicarius* and *Euscepes postfasciatus* are regulated organisms.

3.10 *Diabrotica virgifera virgifera* - Western corn rootworm

Western corn rootworm adult. Photo: Winston Beck, Iowa State University, Bugwood.org .

Diabrotica virgifera virgifera (Western corn rootworm) is a known vector of maize chlorotic mottle virus but could also be a potential vector of *Pantoea ananatis* (Krawczyk et al. 2021). *D. virgifera virgifera* is widely distributed in the EU, and is no longer regulated in the EU territory.

The topic of publications on *D. virgifera virgifera* have included: (i) biocontrol, (ii) RNAi for pest management (Darlington et al. 2022), (iii) soil fumigation for control (Bourdon et al. 2022), (iv) pest biology and genetics (Lata et al. 2022; Coates et al. 2023), and (v) modelling insect population dynamics (Jaksons et al. 2022), (vi) using crop rotation to manage insect populations (Furlan et al. 2022), and (vii) assessing maize cultivars for susceptibility to western corn rootworm (Pereira et al. 2022). A review of *D. virgifera virgifira* has also been published.

Regulatory status: *Diabrotica* spp. are regulated organisms. *Diabrotica spp.* are Priority pests for many of the vegetable product groups.

3.11 *Epitrix* spp. - Flea beetle

There have been no relevant publications specifically for the VNZ priority pest, *Epitrix similaris* (flea beetle).

Regulatory status: *Epitrix similaris* is not assessed.

3.12 *Lygus lineolaris* - Tarnished plant bug

Tarnished plant bug. Photo: Ross Ottens, University of Georgia, Bugwood.org .

Lygus lineolaris is polyphagous, affects many vegetable crops, and is a major pest of cotton in the USA. Recent publications have discussed (i) the use of autumnal trap crops for *Lygus lineolaris* combined with insecticide (Dumont and Provost 2022); (ii) biocontrol using *Beauveria bassiana* (Willden et al. 2022) and entomopathogenic fungi (Maniania et al. 2022), and (iii) pest management on cotton host plants (Catchot et al. 2022; Mann et al. 2022).

Regulatory status: *Lygus lineolaris* is a regulated organism.

3.13 *Tetranychus evansi* - Tomato red spider mite

Plant resistance to *Tetranychus evansi* has been the topic of publications (de Souza Marinke et al. 2022), with one study indicating that resistance relies on biochemical reactions linked to bacteria associated with the mites (Ribeiro et al. 2022). Studying olfactory sensing is also helping to understand how spider mites perceive suitable host plants (Hu et al. 2022). There have also been studies on predators (Dayoub et al. 2022) and natural enemies for biocontrol (de Matos et al. 2022), comparing efficacy of different pesticides (Djossou et al. 2021), and plant resistance (de Souza Marinke et al. 2022). The effectiveness of a bioacaricide delivered through irrigation has also been investigated with the aim of incorporating this into an IPM programme (Drabo et al. 2022).

In Benin, *T. evansi* outbreaks have been observed to occur at the end of the rainy season with damage more severe during the dry season (Azandeme-Hounmalon et al. 2022).

Regulatory status: *Tetranychus evansi* is a regulated organism.

3.14 Viroids – PSTVd detection in tomatoes

New Zealand: In mid-late November 2022, PSTVd was detected in greenhouse tomatoes in the Nelson-Tasman region. A response was initiated by Biosecurity NZ, and plants in three greenhouses were removed and destroyed. PSTVd infects a wide range of other plants, including capsicums, dahlias, and chrysanthemums, and has been found in New Zealand on two previous occasions and eradicated.

New research: Most publications on Pospiviroids have focussed on PSTVd which is the type species for the genus, and was first detected in dahlias in Japan (Tsushima and Fuji 2022). Studies have investigated the genome of different potato cultivars (Chi et al. 2022); RNAi mechanisms which may be used to engineer resistance against potato viruses (Jiang et al. 2022); seed transmission of PSTVd through pollen (Yanagisawa and Matsushita 2022); and adjusting soil conditions using biochar as a sustainable PSTVd management practice (Luigi et al. 2022). Detection methods for PSTVd for isolate identification in different countries (Shilpa et al. 2022) (Tsushima and Fuji 2022), and improving the technique for nucleic acid spot hybridisation have also been published (Qiu et al. 2022). An overview of modes of viroid transmission under both natural and experimental situations, and viroid control applications has also been published (Hadidi et al. 2022).

The seed for sowing IHS has been amended to manage a number of viruses and viroids requiring seeds to be sourced from a pest free area or a pest free place of production, or to undergo testing. Capsicum seed require testing for: Pepper chat fruit viroid (PCFVd), PSTVd, Tomato mottle mosaic virus (ToMMV), and ToBRFV, and eggplant seed require testing for PSTVd. Tomato seed are tested for: Columnea latent viroid (CLVd), Tomato chlorotic dwarf viroid (TCDVd), Tomato apical stunt viroid (TASVd), Tomato plant macho viroid (TPMVd), PepMV, PSTVd, Tomato mottle mosaic virus (ToMMV), and ToBRFV.

Regulatory status: CLVd, PepMV, PSTVd, TCDVd, ToBRFV, TASVd, TPMVd, and PCFVd are all regulated organisms. CLVd, PSTVd, TASVd are Biosecurity NZ priority pests.

4. Other pests of concern

4.1 *Leptinotarsa decemlineata* – Colorado beetle

The use of green manure mulch and straw mulch was shown to considerably reduce damage caused by *Leptinotarsa decemlineata*, and is a method being used by farmers who use regenerative practices on their properties (Junge et al. 2022). *Leptinotarsa decemlineata* is a VNZI pest of concern.

Colorado beetle. https://gd.eppo.int

Regulatory status: *Leptinotarsa decemlineata* is a regulated organism.

4.2 Pepino mosaic virus (PepMV)

PepMV is now under long-term management after being detected in April/May 2021 in four commercial glasshouses in Auckland. A response was initiated by Biosecurity NZ. PepMV remains a regulated organism.

Tomato fruit symptoms of PepMV showing uneven ripening and surface 'marbling' (left), healthy with normal appearance (right). Image from DPV411 Fig. 6

Publications on PepMV have been few, and have focussed on gene analysis of PepMV infection (Zarrougui et al. 2022), and PepMV strains (Alcaide et al. 2022). Another study tested an electrolytic disinfection system for inactivating pathogens in hydroponically grown tomatoes, testing for fungi and viruses including PepMV;

the disinfectant was found to inhibit pathogenic fungi and viruses in the recirculating fertigation solutions without causing phytotoxicity (Rodriguez et al. 2022).

Regulatory status: PepMV is a regulated organism.

4.3 *Scirtothrips dorsalis* - Chilli thrips

Scirtothrips dorsalis was found on a *Begonia* sp. plant in a nursery in Denmark in October 2022. After applying eradication measures, no further infestation was detected (EPPO 2023/02 2023). *Scirtothrips dorsalis* continue to be intercepted on the cut flowers/foliage pathway on *Rosa* spp. imported from India to New Zealand (MAS 2023). Imported flowers are normally fumigated, minimising the risk.

Recent publications have discussed: (i) *S. dorsalis* reported on celery in India (EPPO 2022/01 2022); (ii) the use of insecticides for management on mango (Karar et al. 2022); (iii) alternative biocontrol agents such as entomopathogenic fungi to reduce chemical pesticide use (Panyasiri et al. 2022); (iv) the predatory phytoseiid mite, *Amblyseius swirskii* for managing *S. dorsalis* on roses (Schoeller et al. 2022); and (v) the insecticidal effect of botanicals for sustainable management of sucking insects including *S. dorsalis* (Prasannakumar et al. 2022).

Regulatory status: *Scirtothrips dorsalis* is a regulated organism.

4.4 Tomato brown rugose fruit virus (ToBRFV)

Key points:
- ToBRFV continues to spread mainly in the European region.
- Weed species/wild hosts are considered important host species and virus reservoirs.

Distribution: In the EPPO region, ToBRFV has been reported in **Slovakia** (2023/049) in a tomato greenhouse; the seed originated in the Netherlands and the seedlings were grown by an Austrian company. ToBRFV has been reported on tomato and peppers in **Iran** (Esmaeilzadeh and Koolivand 2022), and in tomato in **Slovenia** (Vučurović et al. 2022). An outbreak in tomato in **Norway** (May 2021) was the first report of ToBRFV in the Nordic countries (Hamborg and Blystad 2021); however, an outbreak has since occurred in **Finland** (EPPO 2022/08 2022).

Eradication: ToBRFV has been eradicated from **Estonia** (EPPO 2022/04 2022). Although, ToBRFV was eradicated from the **UK** in Dec 2021 (EPPO RS 2022/018), a new outbreak has occurred (May 2022) which is under eradication (EPPO 2022/05 2022). An outbreak in **Bulgaria** in June 2021 was eradicated in December 2021 (EPPO 2022/07 2022), however, further outbreaks have occurred which are under eradication.

Typical fruit symptoms of ToBRFV. Photo: https://gd.eppo.int. Courtesy: Dr Aviv Dombrovsky

Disease management: In Jordan, ToBRFV has been detected in greenhouses and open fields every year since it was first described in 2015 (EPPO 2022/09 2022). Ongoing outbreaks have raised concerns about the role of weed hosts in disease epidemiology. Analysis of weed species, which were mostly asymptomatic and collected among tomato crops, showed that ToBRFV could be transmitted from the contaminated seeds of *Solanum nigrum* (black nightshade) to seedlings at a low rate (2%). The authors concluded that ToBRFV management strategies should include weed control. Seed transmission of ToBRFV in *S. nigrum* was confirmed with the pathogen able to naturally infect weed hosts which could be a reservoir for primary infection of tomatoes.

Other publications include: (i) new weed hosts identified in the Mediterranean (Salem et al. 2022); (ii) invasive weeds as potential hosts and virus reservoirs in growing areas; (iii) screening wild tomato species for resistance/tolerance to ToBRFV (Kabas et al. 2022); (iv) gene-editing to facilitate ToBRFV resistant plants (Ishikawa et al. 2022); (v) disinfectants for decontaminating clothing and footwear (Ehlers et al. 2022); and (vi) the role of seed transmission in overall disease management (Salem et al. 2021). A multi-year study in Canada evaluated the use of a composting process to deactivate ToBRFV providing a new disposal method for spent stone wool (i.e., rockwool), vines, and other infected organic greenhouse waste (Newswire.com Feb 22, 2023). A severity scale has also been developed for assessing disease severity in leaves and leaflets and the impact of ToBRFV on tomato yield, and estimating yield loss (González-Concha et al. 2023). High-yield ToBRFV-resistant tomatoes are currently being tested in Canada but are at least two years away from entering production (Fresh Plaza. 2023).

A comprehensive review of ToBRFV has discussed tomato and ToBRFV characteristics; diseases that undermine tomato production, in particular viruses; detection and disease management; and breeding as a new control tool (Caruso et al. 2022).

Regulatory status: ToBRFV is a regulated organism. NZ has country freedom for ToBRFV.

4.5 Tomato leaf curl New Delhi virus (ToLCNDV)

Key points:
- ToLCNDV continues to be reported in regions around the world, and has been affecting melon production in Europe for over ten years.
- ToLCNDV is seedborne but not seed transmitted in melon

Distribution: ToLCNDV has been added to EPPO A2 list (pests locally present in the EPPO region), and is reported in **China** for first time (EPPO 2022/11 2022; Li et al. 2022b) representing a potential threat to vegetable production because of the widespread occurrence of its vector, *Bemisia tabaci*. ToLCNDV has been reported in watermelon in **Slovakia** (July 2022) (EPPO 2022/08 2022) where it is under eradication; in zucchini in **Iran** after a survey of symptomatic plants (Ali Ramazani et al. 2022); infecting tomato and cucumber in a greenhouse in **Estonia** (Just et al. 2022); and in peppers in **Tunisia** (Mnari-Hattab et al. 2022).

ToLCNDV was first reported in **France** in 2020 on zucchini and eradicated, but there have been new recent detections in companies producing and trading seeds of zucchini, cucumber and melon, leading to destruction and incineration of plants, and treatment for the vector in outdoor and tunnel-house production of zucchini. In 2023, growers will undertake crop rotation and apply treatments for the vector (EPPO 2023/01 2023).

The use of grafting has been investigated to manage infections in cucurbits, as grafting could provide a faster and more flexible solution as the graft wounding induces tolerance rather than resistance against airborne virus infection (Mastrochirico et al. 2023). The tolerance trait was found to be transmitted to otherwise susceptible and moderately susceptible cucurbit genotypes grafted onto the 'Barattiere' cultivar. Genes in *Cucumis melo* and *Cucurbita moschata* have also been investigated to develop ToLCNDV resistant plants (Román et al. 2023).

ToLCNDV has been affecting melon production in Europe for over ten years and is associated with significant economic losses due to lower yields and cracked non-marketable fruit produced in Spain and other key cucurbit production areas. Resistant cultivars are being bred as chemicals are proving ineffective, leading to resistance (Siskos et al. 2022).

ToLCNDV has been determined to be seed-borne. Fortes showed that ToLCNDV is seedborne but not seed transmitted in melon (Fortes et al. 2022), i.e., the seed has the ability to carry the virus, but it does not necessarily lead to transmission to the next generation. PCR analysis of the floral parts and mature seeds of melon plants revealed that the virus is carried in the seed coat although this does not necessarily lead to transmission to the next generation as the transmission of ToLCNDV from seeds to offspring was not supported by this study. There has, however, been a report from Italy of seed transmission of ToLCNDV in zucchini in experimental settings. MPI was undertaking further evaluation (ERS #7312, 6Nov2020) (MPI 2021a).

Regulatory status: ToLCNDV is a regulated organism.

4.6 *Pantoea ananatis*

Pantoea ananatis causes centre rot in onions and leaf blight in maize, and was reported from Egypt causing bacterial leaf blight in strawberries (Abdel-Gaied et al. 2022). Previous reporting of *P. ananatis* detected in tomato plants, also originated in Egypt (Ashmawy et al. 2020). MPI is actively monitoring *P. ananatis* (MPI 2021b), and have been notified of this new publication. As reported in previous reports, *P. ananatis* has also been identified to be affecting wheat (*Triticum*) in Poland, causing bacterial leaf blight of rice in China, and leaf spot disease of maize in Ecuador (MAS 2021).

P. ananatis is now reported causing bacterial leaf streak in sweet corn in southeast China with disease incidence of 50-70%, previously being reported to cause leaf spot disease in maize grown in Argentina, Ecuador, and China. *P. ananatis* is also causing leaf spot on cucumber in Hainan, China (Lao et al. 2022). As cucumber has a long growth cycle, it is particularly susceptible to bacterial diseases.

In Texas, the characterisation of bacteria pathogens associated with onion reported the pathogens mainly responsible for causing disease were: *Pantoea, Pseudomonas, Burkholderia, Erwinia, Enterobacter,* and *Curtobacterium* (Khanal et al. 2022). Strains of *Burkholderia gladioli, Pseudomonas alliivorans, Pantoea agglomerans, P. ananatis,* and *P. allii* were the first documented cases of these onion pathogens in Texas.

Regulatory status: *Pantoea ananatis* is a regulated organism.

4.7 *Curtobacterium flaccumfaciens* pv. *flaccumfaciens*

In Russia, *Curtobacterium flaccumfaciens* pv. *flaccumfaciens* (CFF) has been reported causing bacterial wilt and blight on sunflower and tan spot on soybean, having previously only been recorded on beans. Disease incidence was 5-20% on sunflower, and 10-40% on soybeans (Tarakanov et al. 2022).

CFF is a priority pest for PVNZ. It is present in Zambia and Australia. Peas or beans were not imported from Zambia in 2022 (MRisks, 2023), however, New Zealand imports large quantities of beans from Australia where CFF is also present (EPPO, https://gd.eppo.int/taxon/CORBFL). CFF was previously reported on Belgium (MRisks, Dec 2022).

Regulatory status: *Curtobacterium flaccumfaciens* pv. *flaccumfaciens* is a regulated organism.

5. New and emerging pests of concern

5.1 *Chloridea virescens* – tobacco budworm

Chloridea virescens (tobacco budworm) was added to the EPPO alert list in January 2023 (EPPO 2023). *C. virescens* is a Lepidoptera from the Americas and is a polyphagous pest of many field crops, in particular cotton, maize, tomato, and tobacco. It was identified in an EPPO study as a potential threat to tomato crops, and has recently been intercepted on fruit and vegetables imported into the EU. In the USA, it generally overwinters in the southern states, but annually migrates northwards and is occasionally found in northern states and southern Canada, surviving in greenhouses or other sheltered locations. It is widespread in the Caribbean, and Central and South America. *C. virescens* is a pest of field crops such as: alfalfa, clover, cotton, flax, soybean, and tobacco. It also attacks fruit and vegetables crops (e.g., asparagus, cabbage, melon, lettuce, pea, cucurbits, tomato and *Vitis* spp.), as well as ornamentals (e.g., chrysanthemum, gardenia, pelargonium, petunia, verbena, zinnia), and weeds or wild plants.

Larvae bore into buds and blossoms, and also feed on tender terminal foliar growth, leaf petioles and stalks. It also feeds on leaves in the absence of other growing plant tissues, and can also feed on fruit, which may become more susceptible to secondary infections by pathogens.

Regulatory status: *Chloridea virescens* is a regulated organism.

5.2 *Zonosemata electa* – pepper maggot

Zonosemata electa (pepper maggot) was added to the EU quarantine list in 2021 (EPPO 2021). It is an occasional pest of capsicum in the Eastern USA and South-Western Ontario, Canada. Its main hosts are capsicum and eggplant, but can also attack tomatoes on rare occasions. This fruit fly has also been reported on wild Solanum, such as *S. capsicoides* and *S. carolinense*.

Regulatory status: *Zonosemata electa* is a regulated organism.

6. References

Abdel-Gaied, T. G., Abd El-Khair, H., et al. (2022). "First report of strawberry bacterial leaf blight caused by <i>Pantoea ananatis</i> in Egypt." Journal of Plant Protection Research 62(2): 207-214.10.24425/jppr.2022.141359 https://doi.org/10.24425/jppr.2022.141359

Al-Zyoud, F., Al-Dawood, A., et al. (2023). "Current Advances in the Fall Armyworm (Spodoptera frugiperda) Management in Crops: A Comprehensive Review." International Journal of Agriculture and Biology 29(1): 9-22.DOI: 10.17957/IJAB/15.1998

Alcaide, C., Donaire, L. and Aranda, M. A. (2022). "Transcriptome analyses unveiled differential regulation of AGO and DCL genes by pepino mosaic virus strains." Molecular Plant Pathology 23(11): 1592-1607.https://doi.org/10.1111/mpp.13249 https://doi.org/10.1111/mpp.13249

Ali Ramazani, M., Ayazpour, K., et al. (2022). "Tomato Leaf Curl New Delhi Virus in Zucchini crops in Iran." Australasian Plant Disease Notes 17(1): 10.10.1007/s13314-022-00458-y https://doi.org/10.1007/s13314-022-00458-y

Amamri, F., Lebbal, S., et al. (2021). "Aphicidal abd repellent activities of plant extracts from Hertia cheirifolia L. and Marrubium deserti de Noe." Agrolife Scientific Journal 10(2): 9-13

Asad, Z., Ashfaq, M., et al. (2022). "Genetic diversity of cucumber green mottle mosaic virus (CGMMV) infecting cucurbits." Saudi Journal of Biological Sciences 29(5): 3577-3585.https://doi.org/10.1016/j.sjbs.2022.02.027 https://www.sciencedirect.com/science/article/pii/S1319562X22001036

Ashmawy, N. A., Shoeib, A. A., et al. (2020). "Pathological, biochemical and molecular characterization of the seed-borne bacteria "Pantoea spp., Xanthomonas spp. and Pseudomonas spp." from solanaceous plants in Egypt. ." Journal of Microbiology, Biotechnology and Food Sciences 10(2): 289-295

Azandeme-Hounmalon, G. Y., Sikirou, R., et al. (2022). "Re-assessing the pest status of Tetranychus evansi (Acari: Tetranychidae) on solanaceous crops and farmers control practices in Benin." Journal of Agriculture and Food Research 10: 100401.https://doi.org/10.1016/j.jafr.2022.100401 https://www.sciencedirect.com/science/article/pii/S266615432200134X

Baró, Y., Schuster, C., et al. (2022). "Characterization, identification and virulence of Metarhizium species from Cuba to control the sweet potato weevil, Cylas formicarius Fabricius (Coleoptera: Brentidae)." Journal of Applied Microbiology 132(5): 3705-3716.https://doi.org/10.1111/jam.15460 https://doi.org/10.1111/jam.15460

Bi, X., Guo, H., et al. (2022a). "Suppression of Cucumber Green Mottle Mosaic Virus Infection by Boron Application: From the Perspective of Nutrient Elements and Carbohydrates." Journal of Agricultural and Food Chemistry 70(39): 12270-12286.10.1021/acs.jafc.2c03069 https://doi.org/10.1021/acs.jafc.2c03069

Bi, X., Guo, H., et al. (2022b). "A novel strategy for improving watermelon resistance to cucumber green mottle mosaic virus by exogenous boron application." Molecular Plant Pathology 23(9): 1361-1380.https://doi.org/10.1111/mpp.13234 https://doi.org/10.1111/mpp.13234

Bourdon, P.-A., Zottele, M., et al. (2022). "Fumigation of three major soil pests (Agriotes lineatus, Diabrotica virgifera virgifera, Phyllopertha horticola) with 3-octanone and 1-octen-3-ol enantiomers." Biocontrol Science and Technology 32(7): 863-876.10.1080/09583157.2022.2057436 https://doi.org/10.1080/09583157.2022.2057436

Bui, H. X. and Desaeger, J. A. (2021). "Host suitability of summer cover crops to Meloidogyne arenaria, M. enterolobii, M. incognita and M. javanica." Nematology 24(2): 171-179.https://doi.org/10.1163/15685411-bja10122 https://brill.com/view/journals/nemy/24/2/article-p171_5.xml

Bui, H. X., Gu, M., et al. (2022). "Meloidogyne spp. infecting Asian vegetable in Central Florida, USA." Nematropica 52(1).https://journals.flvc.org/nematropica/article/view/132098

Carrizo, A. E., del Valle Loto, F., et al. (2022). "Bacillus thuringiensis-Based Bioproduct: Characterization and Performance Against Spodoptera frugiperda Strains in Maize Under Different Environmental Temperatures." Neotropical Entomology.10.1007/s13744-022-00973-8 https://doi.org/10.1007/s13744-022-00973-8

Caruso, A. G., Bertacca, S., et al. (2022). "Tomato brown rugose fruit virus: A pathogen that is changing the tomato production worldwide." Annals of Applied Biology 181(3): 258-274.https://doi.org/10.1111/aab.12788 https://doi.org/10.1111/aab.12788

Catchot, B. D., Gore, J., et al. (2022). "Insecticide Resistance Monitoring of Tarnished Plant Bug (Hemiptera: Miridae) Populations in the Mid-Southern United States." Arthropod Management 26: 31-39.https://doi.org/10.56454/HTUA7872

Chatterjee, D., Lesko, T., et al. (2022). "Sorghum and maize flavonoids are detrimental to growth and survival of fall armyworm Spodoptera frugiperda." Journal of Pest Science.10.1007/s10340-022-01535-y https://doi.org/10.1007/s10340-022-01535-y

Chen, J., Chen, X., et al. (2022). "Belowground Herbivory to Sweetpotato by Sweetpotato Weevil (Coleoptera: Brentidae) Alters Population Dynamics and Probing Behavior of Aboveground Herbivores." Journal of Economic Entomology 115(4): 1069-1075.10.1093/jee/toac098 https://doi.org/10.1093/jee/toac098
Chen, X. and Palli, S. R. (2022). "Development of multiple transgenic CRISPR/Cas9 methods for genome editing in the fall armyworm, Spodoptera frugiperda." Journal of Pest Science.10.1007/s10340-022-01546-9 https://doi.org/10.1007/s10340-022-01546-9
Chen, Y., Long, H., et al. (2023) "Potential of Entomopathogenic Nematode HbSD as a Candidate Biocontrol Agent against Spodoptera frugiperda." Insects 14 DOI: 10.3390/insects14010002.
Chi, S., Zhang, J., et al. (2022). "RNA-seq Profiling Reveals the Transcriptional Response Against Potato Spindle Tuber Viroid in Different Potato Cultivars and Developmental Stages." Potato Research 65(4): 979-990.10.1007/s11540-022-09561-0 https://doi.org/10.1007/s11540-022-09561-0
Coates, B. S., Walden, K. K. O., et al. (2023). "A draft Diabrotica virgifera virgifera genome: insights into control and host plant adaption by a major maize pest insect." BMC Genomics 24(1): 19.10.1186/s12864-022-08990-y https://doi.org/10.1186/s12864-022-08990-y
Darlington, M., Reinders, J. D., et al. (2022) "RNAi for Western Corn Rootworm Management: Lessons Learned, Challenges, and Future Directions." Insects 13 DOI: 10.3390/insects13010057.
Dayoub, A. M., Dib, H. and Boubou, A. (2022). "Distribution and predators of the invasive spider mite Tetranychus evansi (Acari: Tetranychidae) in the Syrian coastal region, with first record of predation by the native Scolothrips longicornis (Thysanoptera: Thripidae)." Acarologia 62(3): 597-607.10.24349/0k8s-gas6 https://doi.org/10.24349/0k8s-gas6
de Matos, S. T. S., Savi, P. J., et al. (2022). "Suitability of spider mites and green peach aphids as prey for Eriopis connexa (Germar) (Coleoptera: Coccinellidae)." Scientific Reports 12(1): 8029.10.1038/s41598-022-12078-8 https://doi.org/10.1038/s41598-022-12078-8
de Souza Marinke, L., de Resende, J. T. V., et al. (2022). "Selection of tomato genotypes with high resistance to Tetranychus evansi mediated by glandular trichomes." Phytoparasitica 50(3): 629-643.10.1007/s12600-022-00984-6 https://doi.org/10.1007/s12600-022-00984-6
Devi, O. P., Sharma, S. K., et al. (2022). "A Simplified Multiplex PCR Assay for Simultaneous Detection of Six Viruses Infecting Diverse Chilli Species in India and Its Application in Field Diagnosis." Pathogens 12(1).10.3390/pathogens12010006
Djossou, R., Azandémè-Hounmalon, G. Y., et al. (2021). "Susceptibility of ten tomato cultivars to attack by Tetranychus evansi Baker & Pritchard (Acari: Tetranychidae) under laboratory conditions." International Journal of Tropical Insect Science 41(1): 425-431.10.1007/s42690-020-00221-9 https://doi.org/10.1007/s42690-020-00221-9
Drabo, E., Waongo, A., et al. (2022). "Effectiveness of combining bioacaricides with sprinkler irrigation to control the red spider mite, Tetranychus evansi Baker and Pritchard (Acari: Tetranychidae), in irrigated tomato crops in Burkina Faso, West Africa." Journal of Entomological and Acarological Research 54(1).https://doi.org/10.4081/jear.2022.10055
Dumont, F. and Provost, C. (2022) "Using Autumnal Trap Crops to Manage Tarnished Plant Bugs (Lygus lineolaris)." Insects 13 DOI: 10.3390/insects13050441.
EFSA Panel on Plant Health (2022). "Pest categorisation of Capsicum chlorosis virus." EFSA Journal 20(6): e07337.https://doi.org/10.2903/j.efsa.2022.7337 https://doi.org/10.2903/j.efsa.2022.7337
Ehlers, J., Nourinejhad Zarghani, S., et al. (2022) "Cleaning of Tomato brown rugose fruit virus (ToBRFV) from Contaminated Clothing of Greenhouse Employees." Horticulturae 8 DOI: 10.3390/horticulturae8080751.
EPPO 2022/01 (2022). EPPO Reporting Service No. 1. Paris, EPPO. 2022-01
EPPO 2022/04 (2022). EPPO Reporting Service No. 4. Paris, EPPO. 2022-04
EPPO 2022/05 (2022). EPPO Reporting Service No. 5. Paris, EPPO. 2022-05
EPPO 2022/07 (2022). EPPO Reporting Service No. 7. Paris, EPPO. 2022-07
EPPO 2022/08 (2022). EPPO Reporting Service No. 8. Paris, EPPO. 2022-08
EPPO 2022/09 (2022). EPPO Reporting Service No. 9. Paris, EPPO. 2022-09
EPPO 2022/11 (2022). EPPO Reporting Service No. 11. Paris, EPPO. 2022-11
EPPO 2023/01 (2023). EPPO Reporting Service No. 1. Paris, EPPO. 2023-01
EPPO 2023/02 (2023). EPPO Reporting Service No. 2. Paris, EPPO. 2023-02
EPPO (2021). "EPPO Reporting. Alert List Zonosemata electa . Added to A1 quaratine list." https://gd.eppo.int/taxon/ZONOEL/categorization
EPPO (2023). "EPPO Reporting. Alert List Chloridea virescens . Added to A1." https://www.eppo.int/ACTIVITIES/plant_quarantine/alert_list_insects/chloridea_virescens
Esmaeilzadeh, F. and Koolivand, D. (2022). "First report of tomato brown rugose fruit virus infecting bell pepper in Iran." Journal of Plant Pathology 104(2): 893-893.10.1007/s42161-022-01094-2 https://doi.org/10.1007/s42161-022-01094-2
Felipe de Barros Souza, C., Galbieri, R., et al. (2022). "Occurrence of a new race of Meloidogyne enterolobii and avirulent M. incognita populations parasitizing cotton in western Bahia state, Brazil." Physiological and Molecular Plant Pathology 121: 101874.https://doi.org/10.1016/j.pmpp.2022.101874 https://www.sciencedirect.com/science/article/pii/S0885576522000893
Fortes, I. M., Pérez-Padilla, V., et al. (2022). "Begomovirus Tomato Leaf Curl New Delhi Virus Is Seedborne but Not Seed Transmitted in Melon." Plant Disease 107(2): 473-479.10.1094/PDIS-09-21-1930-RE https://doi.org/10.1094/PDIS-09-21-1930-RE
Francis, F., Then, C., et al. (2022) "Complementary Strategies for Biological Control of Aphids and Related Virus Transmission in Sugar Beet to Replace Neonicotinoids." Agriculture 12 DOI: 10.3390/agriculture12101663.
Fresh Plaza. (2023). "Canadian testing of high-yield ToBRFV-resistant tomatoes could be two years away." Retrieved 17 March 2023, from https://www.freshplaza.com/oceania/article/9473116/canadian-testing-of-high-yield-tobrfv-resistant-tomatoes-could-be-two-years-away/.
Furlan, L., Chiarini, F., et al. (2022) "Risk Assessment and Area-Wide Crop Rotation to Keep Western Corn Rootworm below Damage Thresholds and Avoid Insecticide Use in European Maize Production." Insects 13 DOI: 10.3390/insects13050415.
Gao, Z., Xue, M., et al. (2022). "Pathogenicity of Meloidogyne enterolobii on the resistant tomato variety VFNT. Acta Phytopathologica Sinica 52(2): 191-202

Golubkina, N., Zayachkovsky, V., et al. (2022) "Prospects of the Application of Garlic Extracts and Selenium and Silicon Compounds for Plant Protection against Herbivorous Pests: A Review." Agriculture 12 DOI: 10.3390/agriculture12010064.
González-Concha, L. F., Ramírez-Gil, J. G., et al. (2023). "Development of a scale for assessment of disease severity and impact of tomato brown rugose fruit virus on tomato yield." European Journal of Plant Pathology 165(3): 579-592.10.1007/s10658-022-02629-0 https://doi.org/10.1007/s10658-022-02629-0
Hadidi, A., Sun, L. and Randles, J. W. (2022) "Modes of Viroid Transmission." Cells 11 DOI: 10.3390/cells11040719.
Hamborg, Z. and Blystad, D.-R. (2021). "First Report of Tomato Brown Rugose Fruit Virus in Tomato in Norway." Plant Disease 106(7): 2004.10.1094/PDIS-10-21-2208-PDN https://doi.org/10.1094/PDIS-10-21-2208-PDN
Hamza, M. A., Ishtiaq, M., et al. (2023) "Management of Vegetable Leaf Miner, Liriomyza Spp., (Diptera: Agromyzidae) in Vegetable Crops." Horticulturae 9 DOI: 10.3390/horticulturae9020255.
Harrison, R., Banda, J., et al. (2022). "Low Impact of Fall Armyworm (Spodoptera frugiperda Smith) (Lepidoptera: Noctuidae) Across Smallholder Fields in Malawi and Zambia." Journal of Economic Entomology 115(6): 1783-1789.10.1093/jee/toac113 https://doi.org/10.1093/jee/toac113
Himuro, C., Honma, A., et al. (2022a). "The female Euscepes postfasciatus refractory period is induced by the male but length is determined by the female." Journal of Insect Physiology 142: 104427. https://doi.org/10.1016/j.jinsphys.2022.104427 https://www.sciencedirect.com/science/article/pii/S0022191022000737
Himuro, C., Kohama, T., et al. (2022b). "First case of successful eradication of the sweet potato weevil, Cylas formicarius (Fabricius), using the sterile insect technique." PLOS ONE 17(5): e0267728.10.1371/journal.pone.0267728 https://doi.org/10.1371/journal.pone.0267728
Himuro, C., Misa, K., et al. (2022c) "Effects of Larval Diet on the Male Reproductive Traits in the West Indian Sweet Potato Weevils Euscepes postfasciatus (Coleoptera: Curculionidae)." Insects 13 DOI: 10.3390/insects13040389.
Hodgdon, E. A., Campbell, A. E. M., et al. (2022a). "Farm-level Losses and Grower Willingness to Try Management Strategies for Swede Midge in Vegetable Crops." HortTechnology 32(5): 471-478.10.21273/HORTTECH05063-22 https://journals.ashs.org/horttech/view/journals/horttech/32/5/article-p471.xml
Hodgdon, E. A., Hallett, R. H., et al. (2022b). "Field tests of candidate pheromone blends show promise for mating disruption of the invasive swede midge (Diptera: Cecidomyiidae)." The Canadian Entomologist 154(1): e37.10.4039/tce.2022.20 https://www.cambridge.org/core/article/field-tests-of-candidate-pheromone-blends-show-promise-for-mating-disruption-of-the-invasive-swede-midge-diptera-cecidomyiidae/B4ECD44C5888F37653C2C6249747DE67
Hodson, A., Celayir, T. and Quiroz Alonso, A. (2022). "A real time PCR assay to detect and quantify root-knot nematodes from soil extracts." Plant Disease.10.1094/PDIS-10-22-2431-RE https://doi.org/10.1094/PDIS-10-22-2431-RE
Hu, Q.-Q., Yu, X.-Y., et al. (2022) "Phylogenetic-Related Divergence in Perceiving Suitable Host Plants among Five Spider Mites Species (Acari: Tetranychidae)." Insects 13 DOI: 10.3390/insects13080705.
Ikegawa, Y., Kawamura, F., et al. (2022). "Eradication of sweetpotato weevil, Cylas formicarius, from Tsuken Island, Okinawa, Japan, under transient invasion of males." Journal of Applied Entomology 146(7): 850-859. https://doi.org/10.1111/jen.13004 https://doi.org/10.1111/jen.13004
Ishikawa, M., Yoshida, T., et al. (2022). "Tomato brown rugose fruit virus resistance generated by quadruple knockout of homologs of TOBAMOVIRUS MULTIPLICATION1 in tomato." Plant Physiology 189(2): 679-686.10.1093/plphys/kiac103 https://doi.org/10.1093/plphys/kiac103
Ismail, M., Visser, B., et al. (2023). "Phenology of the black bean aphid, Aphis fabae, on organic crops and effect of parasitoid communities." Agricultural and Forest Entomology 25(2): 323-335. https://doi.org/10.1111/afe.12554
Jaksons, R., Falkner, K. and Moltchanova, E. (2022). "Modelling the emergence dynamics of the western corn rootworm beetle (Diabrotica virgifera virgifera)." Scientific Reports 12(1): 2340. 10.1038/s41598-022-05032-1
Jat, M., Lal Dangi, N. and Nagarjuna Reddy, K. V. (2022). "Management of leaf miners infesting tomato under protection cultivation." Indian Journal of Entomology 84(1): 181-183 (2022) 84(1): 181-183.10.55446/IJE.2021.256
Jia, L., Wu, H., et al. (2021). "First Report of the Root-Knot Nematode Meloidogyne enterolobii on Sweet Potato in Guangxi Province, China." Plant Disease 106(4): 1308.10.1094/PDIS-08-21-1793-PDN
Jiang, L., Du, Z., et al. (2022) "Advances in RNA-Silencing-Related Resistance against Viruses in Potato." Genes 13 DOI: 10.3390/genes13050731.
Junge, S. M., Leisch-Waskönig, S., et al. (2022) "Late to the Party;Transferred Mulch from Green Manures Delays Colorado Potato Beetle Infestation in Regenerative Potato Cropping Systems." Agriculture 12 DOI: 10.3390/agriculture12122130.
Just, K., Allika, R., et al. (2022). "First report of Tomato leaf curl New Delhi virus infecting tomato and cucumber in Estonia." New Disease Reports 45(2): e12083.https://doi.org/10.1002/ndr2.12083 https://doi.org/10.1002/ndr2.12083
Kabas, A., Fidan, H., et al. (2022). "Screening of wild tomato species and interspecific hybrids for resistance/tolerance to Tomato brown rugose fruit virus (ToBRFV)." Chilean Journal of Agricultural Research 82: 189-196. http://dx.doi.org/10.4067/S0718-58392022000100189
Karar, H., Javed, M. U., et al. (2022). "Comparative efficacy of conventional vs new chemistry insecticides against mango thrips, scirtothrips dorsalis hood (Thripidae: Thysanoptera)." Journal of King Saud University - Science 34(7): 102233. https://doi.org/10.1016/j.jksus.2022.102233 https://www.sciencedirect.com/science/article/pii/S1018364722004141
Katoch, S., Sharma, P. L., et al. (2023). "Demographics and host-kill parameters of Diglyphus horticola Khan against Chromatomyia horticola (Goureau)." Bulletin of Entomological Research 113(2): 230-242.10.1017/S0007485322000499 https://www.cambridge.org/core/article/demographics-and-hostkill-parameters-of-diglyphus-horticola-khan-against-chromatomyia-horticola-goureau/72DD479A5B38B4C68EE6748D08DDA72D
Keerthi, M. C., Suroshe, S. S., et al. (2023). "Bio-Intensive Tactics for the Management of Invasive Fall Armyworm for Organic Maize Production. ." Plants 12: 685. https://doi.org/10.3390/plants12030685
Kehoe, M. A., Webster, C., et al. (2022). "Occurrence of cucumber green mottle mosaic virus in Western Australia." Australasian Plant Pathology 51(1): 1-8.10.1007/s13313-021-00814-z https://doi.org/10.1007/s13313-021-00814-z
Kenis, M., Benelli, G., et al. (2022). "Invasiveness, biology, ecology, and management of the fall armyworm, Spodoptera frugiperda." Entomologia Generalis.10.1127/entomologia/2022/1659

Khaled-Gasmi, W., Hamouda, A. B., et al. (2021). "Natural repellents based on three botanical species essential oils as an eco-friendly approach against aphids." South African Journal of Botany 141: 133-141. https://doi.org/10.1016/j.sajb.2021.05.001 https://www.sciencedirect.com/science/article/pii/S0254629921001708
Khaled-Gasmi, W., Souissi, R. and Boukhris-Bouhachem, S. (2023). "Cucumber mosaic virus epidemiology in pepper: Aphid dispersal, transmission efficiency and vector pressure." Annals of Applied Biology 182(1): 101-111. https://doi.org/10.1111/aab.12798 https://doi.org/10.1111/aab.12798
Khan, M. R., Poornima, K., et al. (2022). "Meloidogyne enterolobii: a threat to guava (Psidium guajava) cultivation." Archives of Phytopathology and Plant Protection 55(17): 1961-1997.10.1080/03235408.2022.2132623 https://doi.org/10.1080/03235408.2022.2132623
Khanal, M., Bhatta, B. P. and Malla, S. (2022). "Isolation and Characterization of Bacteria Associated with Onion and First Report of Onion Diseases caused by Five Bacterial Pathogens in Texas, U.S.A." Plant Disease.10.1094/PDIS-09-22-2206-SR https://doi.org/10.1094/PDIS-09-22-2206-SR
Krawczyk, K., Forys, J., et al. (2021). "Transmission of Pantoea ananatis, the causal agent of leaf spot disease of maize (Zea mays), by western corn rootworm (Diabrotica virgifera virgifera LeConte)." Crop Protection 141.10.1016/j.cropro.2020.105431
Krishnan, N., Kumari, S., et al. (2022). "Occurrence of cucurbit yellow stunting disorder virus causing yellowing disease of cucurbits in India." Crop Protection 158: 106013.https://doi.org/10.1016/j.cropro.2022.106013 https://www.sciencedirect.com/science/article/pii/S0261219422001090
Kumar, S. and Singh, D.-S. (2022). "Incidence of Insect Pests on Tomato Under the Influence of Weather Factors." 40: 1144-1149
Lao, G., Jin, P., et al. (2022). "First Report of leaf spot on Cucumber Caused by Pantoea ananatis in Hainan of China." Plant Disease.10.1094/PDIS-04-22-0819-PDN https://doi.org/10.1094/PDIS-04-22-0819-PDN
Lata, D., Coates, B. S., et al. (2022). "Genome size evolution in the beetle genus Diabrotica." G3 Genes | Genomes | Genetics 12(4): jkac052.10.1093/g3journal/jkac052 https://doi.org/10.1093/g3journal/jkac052
Li, F., Gong, X., et al. (2022a). "Indoxacarb resistance-associated mutation of Liriomyza trifolii in Hainan, China." Pesticide Biochemistry and Physiology 183: 105054.https://doi.org/10.1016/j.pestbp.2022.105054
Li, R., Liu, Y., et al. (2022b). "Occurrence of Tomato leaf curl New Delhi virus in tomato (Lycopersicon esculentum) in China." Plant Disease.10.1094/PDIS-06-22-1427-PDN https://doi.org/10.1094/PDIS-06-22-1427-PDN
Li, X., Wang, Q., et al. (2022c) "Synergistic Effects of Graphene Oxide and Pesticides on Fall Armyworm, Spodoptera frugiperda." Nanomaterials 12 DOI: 10.3390/nano12223985.
Liang, C. C. and Chen, P. A.-O. "First Report of Root-Knot Nematode Meloidogyne enterolobii on Poinsettia 'Luv U Pink' in Taiwan." (0191-2917 (Print))
Liu, X., Wang, Y., et al. (2022). "Natural allelic variation confers high resistance to sweet potato weevils in sweet potato." Nature Plants 8(11): 1233-1244.10.1038/s41477-022-01272-1 https://doi.org/10.1038/s41477-022-01272-1
Lovelock, D., Mintoff, S., et al. (2022) "Investigating the Longevity and Infectivity of Cucumber green mottle mosaic virus in Soils of the Northern Territory, Australia." Plants 11 DOI: 10.3390/plants11070883.
Luigi, M., Manglli, A., et al. (2022). "Effects of Biochar on the Growth and Development of Tomato Seedlings and on the Response of Tomato Plants to the Infection of Systemic Viral Agents." Frontiers in Microbiology 13 https://www.frontiersin.org/articles/10.3389/fmicb.2022.862075
Maniania, N. K., Portilla, M. M., et al. (2022). "Infectivity of Entomopathogenic Fungal Isolates Against Tarnished Plant Bug Lygus lineolaris (Hemiptera: Miridae)." Journal of Insect Science 22(4): 4.10.1093/jisesa/ieac040 https://doi.org/10.1093/jisesa/ieac040
Mann, R., Crow, W. D., et al. (2022). "A Dynamic Threshold Approach for Tarnished Plant Bug (Hemiptera: Miridae) Management in the Midsouthern U.S. Cotton." Journal of Economic Entomology 115(4): 1164-1169. 10.1093/jee/toac062 https://doi.org/10.1093/jee/toac062
MAS (2021). Monitoring Biosecurity Risks to the New Zealand vegetable and arable industries. Update Report. September 2021. Wellington, Market Access Solutionz Ltd
MAS (2022). Monitoring Biosecurity Risks to the New Zealand vegetable and arable industries. Final Report. March 2022. Wellington, Market Access Solutionz Ltd
MAS (2023). Monitoring Biosecurity Risks to the New Zealand vegetable and arable industries. Final Report. March 2023. Wellington, Market Access Solutionz Ltd
Mastrochirico, M., Spanò, R. and Mascia, T. (2023) "Grafting to Manage Infections of the Emerging Tomato Leaf Curl New Delhi Virus in Cucurbits." Plants 12 DOI: 10.3390/plants12010037.
Mello, A. F. S., Silva, G., et al. (2021). "Sweetpotato Genotypes 'CIP BRS Nuti' and 'Canadense' Are Resistant to Meloidogyne incognita, M. javanica, and M. enterolobii." Plant Disease 106(4): 1238-1243.10.1094/PDIS-06-21-1194-RE https://doi.org/10.1094/PDIS-06-21-1194-RE
Metwally, H. M., Ibrahim, S. S. and Sammour, E. A. (2022). "Aphicidal and biochemical effects of emulsifiable concentrate and nanoemulsion of two selected essential oils against black bean aphid, Aphis fabae (Scop.)." Egyptian Pharmaceutical Journal 21(3): 318-327.DOI: 10.4103/epj.epj_40_22
Mnari-Hattab, M., Zaagueri, T., et al. (2022). "First report of tomato leaf curl New Delhi virus infecting pepper in Tunisia." Journal of Plant Pathology 104(2): 821-821.10.1007/s42161-022-01033-1 https://doi.org/10.1007/s42161-022-01033-1
Mohammed, A. A., Ahmed, F. A., et al. (2022). "Molecular identification of two entomopathogenic fungus Clonostachys rosea strains and their efficacy against two aphid species in Iraq." Journal of Genetic Engineering and Biotechnology 20(1): 67.10.1186/s43141-022-00347-y https://doi.org/10.1186/s43141-022-00347-y
Mondal, S., Jenkins Hladky, L., et al. (2021). "First Report of Cucurbit yellow stunting disorder virus and Cucurbit chlorotic yellows virus in Cucurbit Crops in Alabama." Plant Disease 106(2): 776.10.1094/PDIS-05-21-0922-PDN
Mousavi, K., Rajabpour, A., et al. (2022). "Biological and molecular characterization of Cladosporium sp. and Acremonium zeylanicum as biocontrol agents of Aphis fabae in a tri-trophic system." Entomologia Experimentalis et Applicata 170(10): 877-886.https://doi.org/10.1111/eea.13217 https://doi.org/10.1111/eea.13217
MPI (2021a). MPI Emerging Risks System for Biosecurity. 21st Stakeholder Report. 5 September 2020 - 19 March 2021. Wellington, Ministry of Primary Industries. 21st
MPI (2021b). MPI Emerging Risks System for Biosecurity. 22nd Stakeholder Report. 20 March to 20 September 2021. Wellington, Ministry of Primary Industries. 22nd

MPI. (November 2020). "Serpentine leafminer Liriomyza huidobrensis." Retrieved November 2020, from https://www.mpi.govt.nz/biosecurity/priority-pests-diseases/horticultural-pests/serpentine-leaf-miner/.
Mugala, T., Visser, D., et al. (2022). "Entomopathogens from agricultural soil and their pathogenicity against the potato leaf miner, Liriomyza huidobrensis (Diptera: Agromyzidae)." Biocontrol Science and Technology 32(8): 952-970.10.1080/09583157.2022.2070128 https://doi.org/10.1080/09583157.2022.2070128
Mulholland, S., Gopurenko, D., et al. (2022). "First report of the serpentine leafminer Liriomyza huidobrensis (Blanchard) (Diptera: Agromyzidae) and its impacts in Australia." Austral Entomology 61(3): 350-357. https://doi.org/10.1111/aen.12601 https://doi.org/10.1111/aen.12601
Nault, B. A.-O., Sandhi, R. K., et al. "Optimizing Spinosyn Insecticide Applications for Allium Leafminer (Diptera: Agromyzidae) Management in Allium Crops." (1938-291X (Electronic))
Newswire.com. (Feb 22, 2023). "Successful Study Deactivates Tomato Brown Rugose Fruit Virus (ToBRFV) Resulting in Thousands of Tonnes of Greenhouse Waste Diverted From Landfills." Retrieved 17 March 2023, from https://www.newswire.com/news/successful-study-deactivates-tomato-brown-rugose-fruit-virus-tobrfv-21963010.
Nyamutukwa, S., Mvumi, B. M. and Chinwada, P. (2022). "Sustainable management of fall armyworm, Spodoptera frugiperda (J.E. Smith): challenges and proposed solutions from an African perspective." International Journal of Pest Management: 1-19.10.1080/09670874.2022.2027549 https://doi.org/10.1080/09670874.2022.2027549
Oliveira, J. A.-O., Araújo, J. A.-O., et al. "Melon genotypes with resistance to Liriomyza sativae Blanchard (Diptera: Agromyzidae)." (1678-2690 (Electronic))
Omuut, G., Mollel, H. G., et al. (2023). "Genetic analyses and detection of point mutations in the acetylcholinesterase-1 gene associated with organophosphate insecticide resistance in fall armyworm (Spodoptera frugiperda) populations from Uganda." BMC Genomics 24(1): 22.10.1186/s12864-022-09093-4
Ouma, V. (2022). "A new technology to eliminate the fall armyworm." Retrieved 31 October 2022, from https://fr.allafrica.com/stories/202203190164.html.
Oyetunde, A. K., Kolombia, Y. A., et al. (2021). "First Report of Meloidogyne enterolobii Infecting Cassava (Manihot esculenta) Resulting in Root Galling Damage in Africa." Plant Disease 106(5): 1533.10.1094/PDIS-08-21-1777-PDN https://doi.org/10.1094/PDIS-08-21-1777-PDN
Panyasiri, C., Supothina, S., et al. (2022) "Control Efficacy of Entomopathogenic Fungus Purpureocillium lilacinum against Chili Thrips (Scirtothrips dorsalis) on Chili Plant." Insects 13 DOI: 10.3390/insects13080684.
Pereira, A. E., Geisert, R. W. and Hibbard, B. E. (2022). "Maize Inbred Mp708 is Highly Susceptible to Western Corn Rootworm, Diabrotica virgifera virgifera (Coleoptera: Chrysomelidae), in Field and Greenhouse Assays." Journal of Insect Science 22(6): 8.10.1093/jisesa/ieac067 https://doi.org/10.1093/jisesa/ieac067
Prasannakumar, N. R., Rao, V. K., et al. (2022). "Evaluation of insecticidal properties of botanicals for sustainable management of sucking pests of horticultural crops." Journal of Applied Entomology. https://doi.org/10.1111/jen.13092 https://doi.org/10.1111/jen.13092
Qiu, C.-l., Lu, D.-q., et al. (2022). "Improved Nucleic Acid Spot Hybridization Technique for Detection of Potato Spindle Tuber Viroid（PSTVd）." Journal of Northeast Agricultural University (English Edition) 29(1): 26-32
Ragassi, C. F., Costa Ribeiro, C. S. d., et al. (2022). "Bell pepper rootstocks with multiple resistance to soilborne diseases. ." Revista Ceres 69(3): 299-307
Rasekh, A., Shahbazi-Gahrouhi, M. R. and Michaud, J. P. (2022). "The transgenerational consequences of maternal parasitism for aphid life history and suitability for subsequent parasitism." Bulletin of Entomological Research 112(1): 51-57. 10.1017/S0007485321000547
Rezende, J. S., Clark, C.A., Quintino, R.D., Watson, T., (2021). "Screening grain crops for resistance/susceptibility to Meloidogyne enterolobii." Phytopathology 111(S): 123
Ribeiro, F. R., de Almeida Barros, R., et al. (2022). "Tetranychus evansi (Acari: Tetranychidae) and bacteria association: effects on biochemical responses of tomato plants." Phytoparasitica 50(3): 617-628.10.1007/s12600-022-00983-7 https://doi.org/10.1007/s12600-022-00983-7
Rodriguez, M. H., Schmidt, U., et al. (2022) "Electrolytic Disinfection of Irrigation Water for Intensive Crop Production in Greenhouses as Demonstrated on Tomatoes (Solanum lycopersicum Mill)." Horticulturae 8 DOI: 10.3390/horticulturae8050414.
Román, B., Gómez, P., et al. (2023) "Insights into the Key Genes in Cucumis melo and Cucurbita moschata ToLCNDV Resistance." Horticulturae 9 DOI: 10.3390/horticulturae9020231.
Salazar-Mesta, R. J., Carrillo-Fasio, J. A., et al. (2022). "First Report of the Root-Knot Nematode Meloidogyne enterolobii Parasitizing Eggplant in Mexico." Plant Disease.10.1094/PDIS-08-22-1846-PDN
Salem, N. M., Abumuslem, M., et al. (2022) "New Weed Hosts for Tomato Brown Rugose Fruit Virus in Wild Mediterranean Vegetation." Plants 11 DOI: 10.3390/plants11172287.
Salem, N. M., Sulaiman, A., et al. (2021). "Localization and Mechanical Transmission of Tomato Brown Rugose Fruit Virus in Tomato Seeds." Plant Disease 106(1): 275-281.10.1094/PDIS-11-20-2413-RE https://doi.org/10.1094/PDIS-11-20-2413-RE
Salinas-Castro, A., Navarro de la Fuente, L., et al. (2022). "First report of Meloidogyne enterolobii on chard (Beta vulgaris subsp. vulgaris) and carrot (Daucus carota) in México." Journal of Plant Diseases and Protection 129(5): 1263-1268.10.1007/s41348-022-00636-1 https://doi.org/10.1007/s41348-022-00636-1
Schoeller, E. N., McKenzie, C. L. and Osborne, L. S. (2022). "Chilli thrips rose management using an Amblyseius swirskii or Amblydromalus limonicus (Acari: Phytoseiidae) pepper banker plant." Journal of Applied Entomology 146(10): 1281-1292.https://doi.org/10.1111/jen.13066 https://doi.org/10.1111/jen.13066
Shilpa, N., Dhir, S. and Janardhana, G. R. (2022). "Molecular detection and characterization of Potato spindle tuber viroid (PSTVd) infecting Tomato (Solanum lycopersicum L.) in Karnataka State of India." VirusDisease 33(3): 261-269.10.1007/s13337-022-00782-y https://doi.org/10.1007/s13337-022-00782-y
Sikandar, A., Jia, L., et al. (2023). "Meloidogyne enterolobii risk to agriculture, its present status and future prospective for management." Frontiers in Plant Science 13.https://doi.org/10.3389/fpls.2022.1093657
Silva, P. A. F., Siqueira, H. A. A., et al. (2022). "Susceptibility of Liriomyza sativae Blanchard (Diptera: Agromyzidae) populations to reduced risk insecticides." Crop Protection 153: 105880.https://doi.org/10.1016/j.cropro.2021.105880
Siskos, L., Cui, L., et al. (2022). "A new challenge in melon resistance breeding: the ToLCNDV case." Euphytica 218(9): 129.10.1007/s10681-022-03081-1 https://doi.org/10.1007/s10681-022-03081-1
Sridhar, J., Venkateswarlu, V., et al. (2022). "Species Composition and Distribution of the Vector Aphids of PVY and PLRV in India." Potato Research 65(3): 601-617.10.1007/s11540-022-09540-5 https://doi.org/10.1007/s11540-022-09540-5

Szanyi, S., Nagy, A., et al. (2022). "Non-target noctuids from traps with synthetic Spodoptera frugiperda pheromone lure in the Carpathian Basin, Central Europe." Entomologia Experimentalis et Applicata n/a(n/a). https://doi.org/10.1111/eea.13261 https://doi.org/10.1111/eea.13261

Tarakanov, R. I., Lukianova, A. A., et al. (2022). "First report of Curtobacterium flaccumfaciens pv. flaccumfaciens causing bacterial tan spot of soybean in Russia." Plant Disease.10.1094/PDIS-08-22-1778-PDN

Tawfiq, Q. and Rana, S. (2022). "Efficacy of Three Entomopathogenic Fungi Beauveria bassiana, Metarhizium anisopliae and Lecanicillium lecanii Isolates against Black Bean Aphid, Aphis fabae (Scop.) (Hemiptera: Aphididae) on Faba bean (Vicia faba L.). ." Legume Research 45(12): 1572-1579.doi: 10.18805/LRF-706

Tay, W. T., Meagher, R. L., et al. (2023). "Spodoptera frugiperda: Ecology, Evolution, and Management Options of an Invasive Species." Annual Review of Entomology 68(1): 299-317.10.1146/annurev-ento-120220-102548 https://doi.org/10.1146/annurev-ento-120220-102548

Tomé, M. P., Weber, I. D., et al. (2022). "Modeling fall armyworm resistance in Bt-maize areas during crop and off-seasons." Journal of Pest Science.10.1007/s10340-022-01531-2 https://doi.org/10.1007/s10340-022-01531-2

Torres-López, J., López-Buenfil, J. A., et al. (2022). "First report of the root-knot nematode Meloidogyne enterolobii on coffee in Mexico." Indian Phytopathology 75(3): 915-917.10.1007/s42360-022-00511-x

Tsai, W. A., Shafiei-Peters, J. R., et al. (2022). "Effects of Elevated Temperature on the Susceptibility of Capsicum Plants to Capsicum Chlorosis Virus Infection." Pathogens 11(2).10.3390/pathogens11020200

Tsushima, D. and Fuji, S.-i. (2022). "Comparison of two highly sensitive methods to detect potato spindle tuber viroid in Dahlia using quantitative-reverse transcription-polymerase chain reaction assays." Journal of Virological Methods 300: 114401. https://doi.org/10.1016/j.jviromet.2021.114401

Valenzuela-Escoboza, F., Reyes, A., et al. (2015). "Identification of Leaf Miner 1 and Its Parasitoids in Tomato Crops in Northern Sinaloa, Mexico." Southwestern Entomologist 40: 487-492.10.3958/059.040.0305

Van den Berg, J., Brewer, M. J. and Reisig, D. D. (2022). "A Special Collection: Spodoptera frugiperda (Fall Armyworm): Ecology and Management of its World-Scale Invasion Outside of the Americas." Journal of Economic Entomology 115(6): 1725-1728.10.1093/jee/toac143 https://doi.org/10.1093/jee/toac143

Vieira de Carvalho Júnior, O., de Sá, A. V., et al. (2022). "Local Bacillus species as potential biocontrol agents for Meloidogyne enterolobii in melon (Cucumis melo L.)." Biocontrol Science and Technology 32(3): 314-328.10.1080/09583157.2021.1999394 https://doi.org/10.1080/09583157.2021.1999394

Volp, T. M., Zalucki, M. P. and Furlong, M. J. (2022). "What Defines a Host? Oviposition Behavior and Larval Performance of Spodoptera frugiperda (Lepidoptera: Noctuidae) on Five Putative Host Plants." Journal of Economic Entomology 115(6): 1744-1751.10.1093/jee/toac056 https://doi.org/10.1093/jee/toac056

Vučurović, A., Brodarič, J., et al. (2022). "First report of Tomato brown rugose fruit virus in tomato in Slovenia." New Disease Reports 45(2): e12079. https://doi.org/10.1002/ndr2.12079 https://doi.org/10.1002/ndr2.12079

Weinberg, J., Ota, N. and al., e. (2022). "Spodoptera eridania: Current and emerging crop threats from another invasive, pesticide-resistant moth." Entomologia Generalis.10.1127/entomologia/2022/1397

Willden, S. A., Ugine, T. A. and Loeb, G. M. (2022). "The effect of UVB-blocking plastics on the efficacy of Beauveria bassiana and a conventional product against Lygus lineolaris on low tunnel strawberry." Pest Management Science 78(10): 4268-4277 .https://doi.org/10.1002/ps.7046 https://doi.org/10.1002/ps.7046

Wu, C. R., Zhou, H. L., et al. (2021). "First Report of Meloidogyne enterolobii on Ormosia hosiei in China." Plant Disease 106(5): 1534.10.1094/PDIS-09-21-1975-PDN https://doi.org/10.1094/PDIS-09-21-1975-PDN

Wu, P., Shi, K., et al. (2022a). "The effect of invasive fall armyworm abundance on native species depends on relative trophic level." Journal of Pest Science.10.1007/s10340-022-01502-7 https://doi.org/10.1007/s10340-022-01502-7

Wu, S.-S., Tseng, C.-T., et al. (2022b). "Potential of a combination of entomopathogenic fungal strains and a non-ionic surfactant to control the fall armyworm (Spodoptera frugiperda)." Journal of Asia-Pacific Entomology 25(4): 102001.https://doi.org/10.1016/j.aspen.2022.102001

Xu, X., Schmidt, T. L., et al. (2022). "Genome-wide SNPs of vegetable leafminer, Liriomyza sativae: Insights into the recent Australian invasion." Evolutionary Applications 15(7): 1129-1140.https://doi.org/10.1111/eva.13430

Yanagisawa, H. and Matsushita, Y. (2022). "Effect of potato spindle tuber viroid variants and infection stage on seed transmission through pollen." Letters in Applied Microbiology 75(4): 836-843.https://doi.org/10.1111/lam.13756

Zarrougui, N. E., Spanos, T., et al. (2022). "The effect of soil salinity and pepino mosaic virus infection on the expression of tomato defence-related genes." Plant Pathology 71(6): 1304-1312.https://doi.org/10.1111/ppa.13566

Zhang, J.-S., Zhang, Z. and et al. (2022). "Transmission characteristics of Tomato chlorosis virus on Capsicum annuum by adult Bemisia tabaci MEAM1 and MED (Hemiptera: Aleyrodidae)." Acta Entomologica Sinica 65(11): 1452-1458 http://www.insect.org.cn

Zimba, K. J., Sohati, P. H., et al. (2022). "Evaluation of resistance to black bean aphid (Aphis fabae) in selected varieties and mutant genotypes of common bean (Phaseolus vulgaris)." Annals of Applied Biology 181(3): 298-308. https://doi.org/10.1111/aab.12776 https://doi.org/10.1111/aab.12776