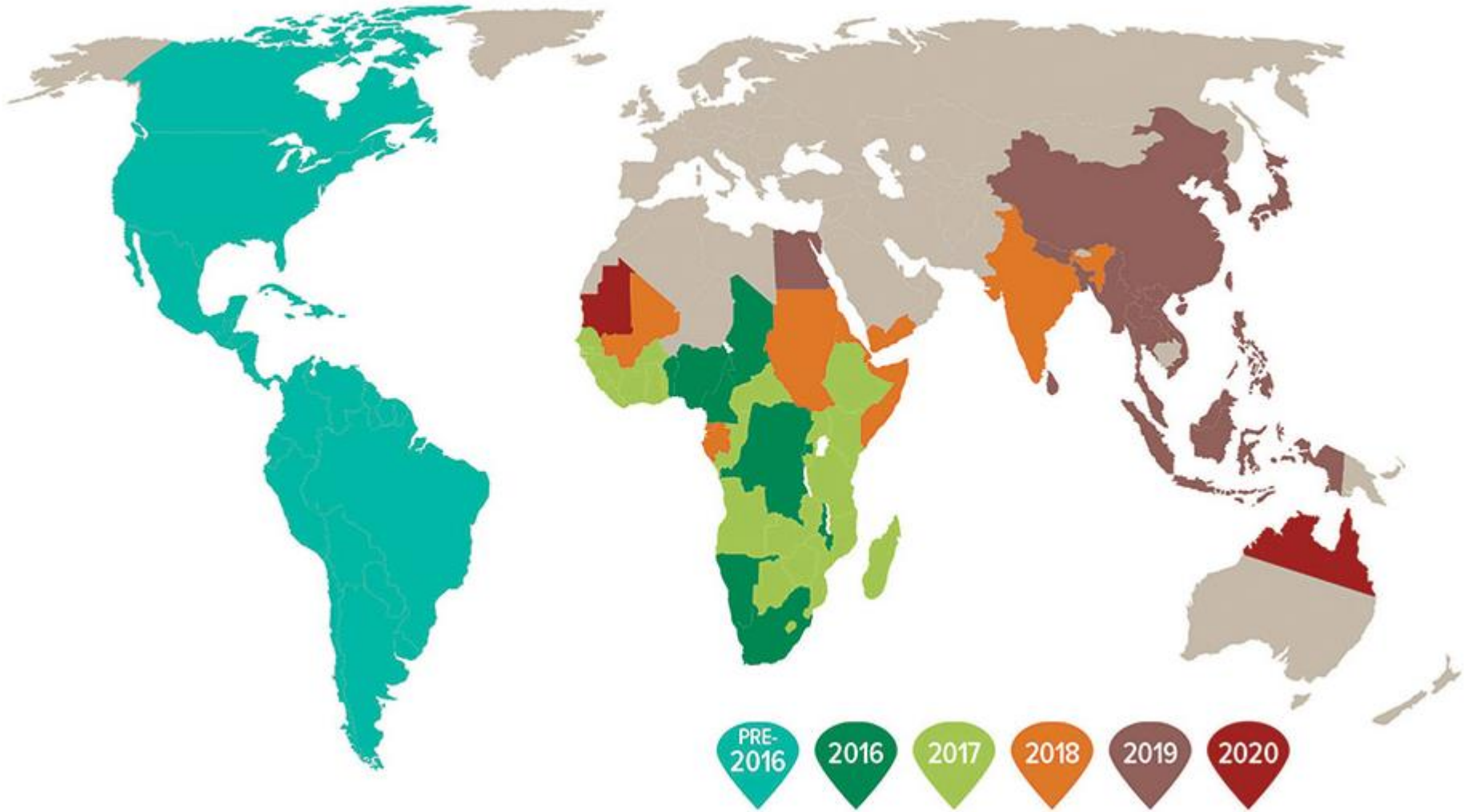
Fall armyworm

Melina Miles DAF Queensland

History and worldwide distribution of Fall Armyworm (FAW)

Figure 1. Map of the worldwide spread of fall armyworm since 2016 (as of 21 April 2020)



SOURCE: ADAPTED FROM FAO

FAW detections and trap locations at 22 July, 2020 (latest = Longreach, June)

Detections

moths

moths & larvae

Trap locations, no detections to date.

FAW trap catches: July-August 2020

District	Location	Week ending 17/07/2020	24/07/2020	31/07/2020	7/08/2020	14/08/2020
North Queensland	Richmond 1	1	0		0	
North Queensland	Richmond 2	0	1		0	
Mackay and Whitsunday	Mackay 3	13	283	444	578	
Mackay and Whitsunday	Mackay 5		32	19	44	
Central Queensland	Longreach 1	0	0	0	0	0
Central Queensland	Emerald 1	6	3	2	1	
Central Queensland	Emerald 5	3	0	1	1	
Central Queensland	Biloela 4	0				
Wide Bay Burnett	Bundaberg 1		17	0	1	4
Wide Bay Burnett	Bundaberg 2		1	0	0	4
Wide Bay Burnett	Bundaberg 3		0	0	0	0
Wide Bay Burnett	Bundaberg 4		0	0	0	0
Wide Bay Burnett	Kingaroy 1	0	0	0	0	0
Wide Bay Burnett	Kingaroy 5	0	0	0	0	0
Wide Bay Burnett	Kingaroy 6	0	0	0	0	0
Darling Downs South West	Mungindi				0	
Darling Downs South West	St George					0
Darling Downs South West	Roma				0	0
Darling Downs South West	Dulacca				0	
Darling Downs South West	Goondiwindi 1	0			0	
Darling Downs South West	Goondiwindi 2	0			0	
Darling Downs South West	Dalby 1		0		0	
Darling Downs South West	Dalby 3		0		0	
Darling Downs South West	Bongeen			0	0	
South East Queensland	Gatton	0	0		0	

Forecasting likely distribution

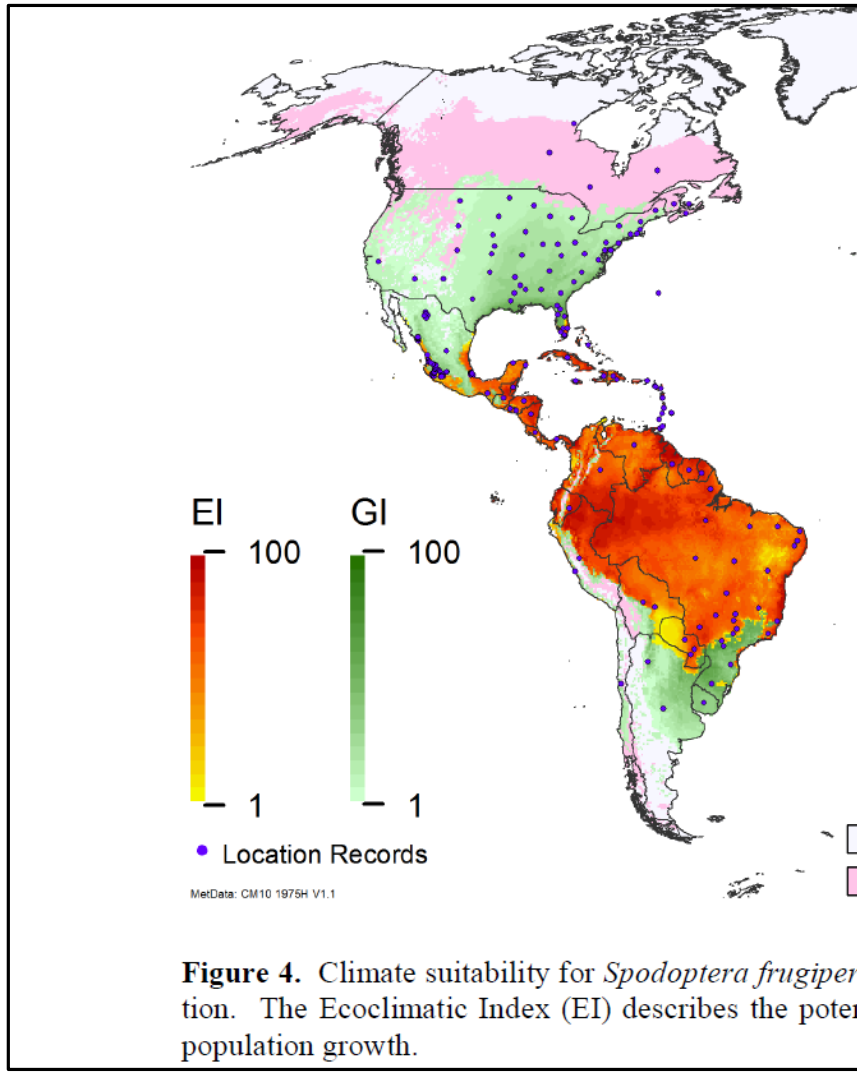
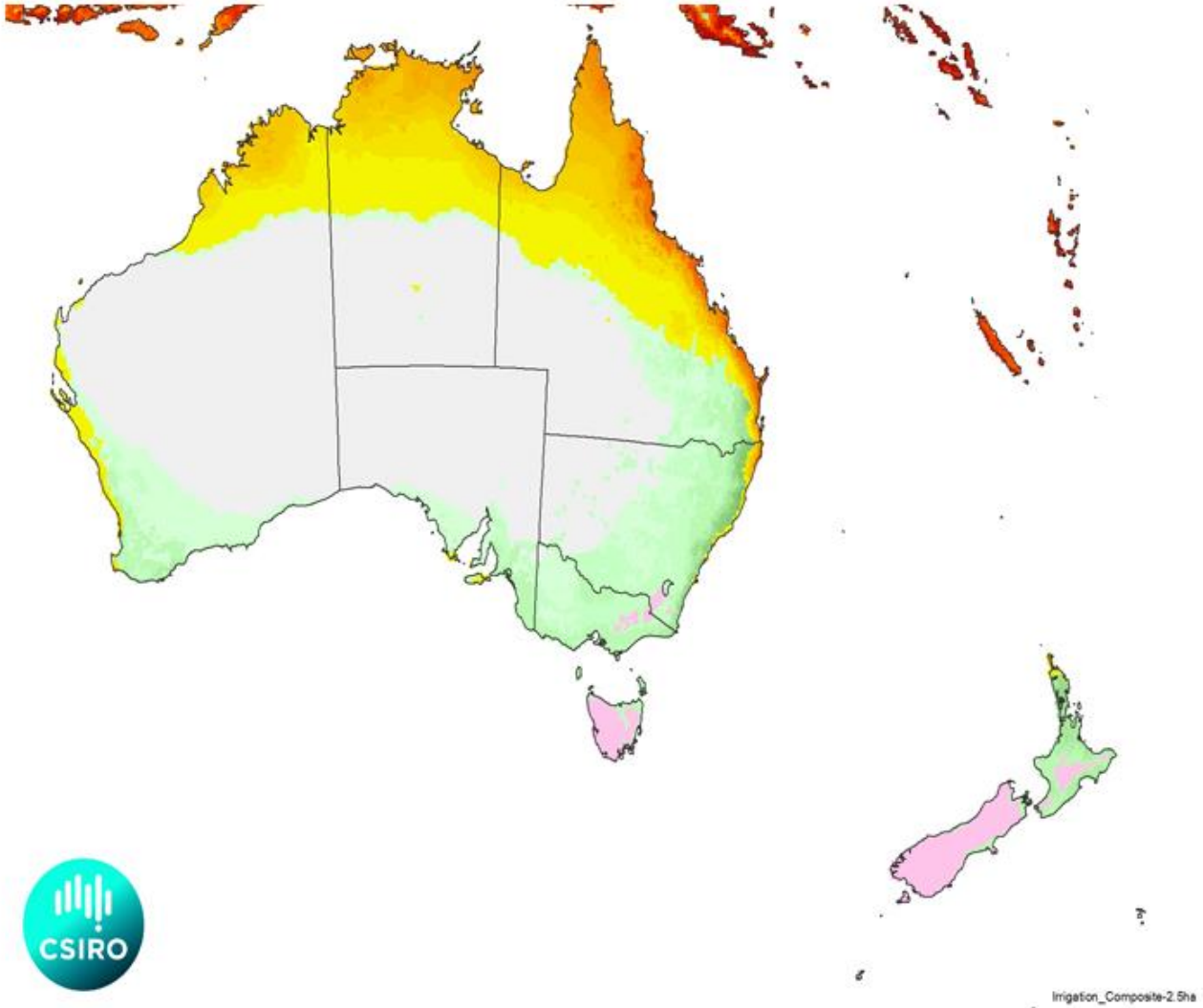


Figure 4. Climate suitability for *Spodoptera frugiper*
tion. The Ecoclimatic Index (EI) describes the poter
population growth.

du Plessis *et al (*2018) *Spodoptera frugiperda*
CLIMEX modelling.



Legend

- Yellow-red shaded: areas indicate relative climatic suitability for establishment of persistent populations.
- The green-shaded: areas indicate climatic suitability for seasonal migration during the warmer months.
- Pink areas: cannot support a full generation of the moth.

The north American experience

USDA conducting research since 1920s
Sporadic, but severe pest of corn, peanuts, sorghum, sweet corn, Bermuda grass (*Cynodon dactylon*) Couch, eggplant, capsicum, pasture.
Significantly fewer commercial crop hosts impacted, than the 350 mentioned in the media.

Persistent pest in south (tropical-subtropical; outbreak pest in northern range (temperate)

Pheromone traps indicate moth activity in the local area
Insecticides and Bt crops mainstay of management
Early planting to avoid higher FAW densities late season

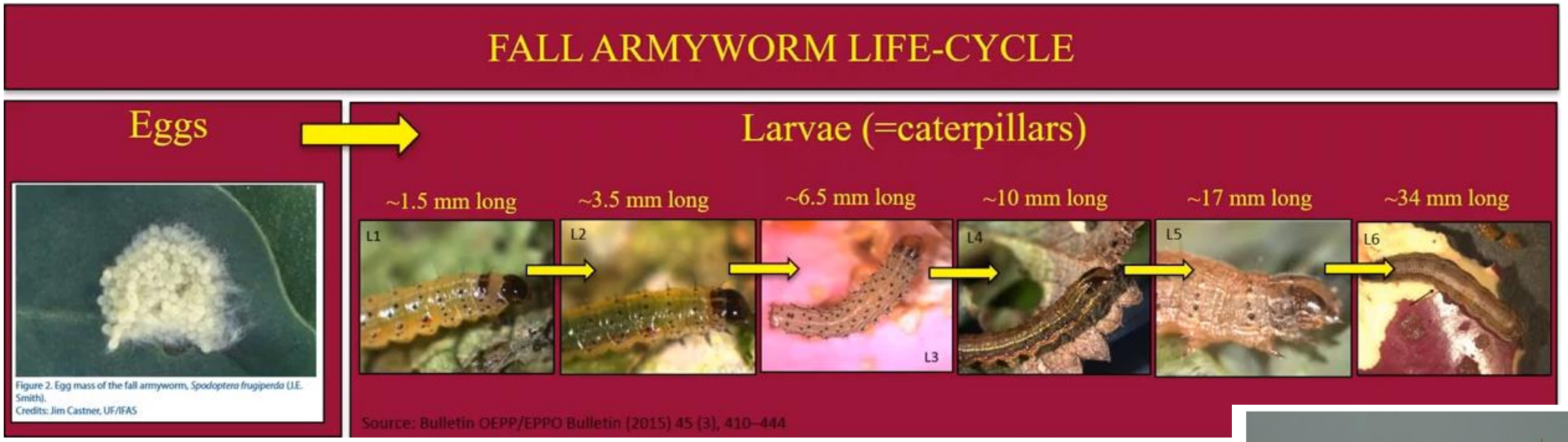
Biological control evident, but not effective enough under high pressure

Spodoptera NPV (Fawligen®) available for use in the US, Africa, Asia.

What does this mean for vegetables in Australia?

- The highest risk is in the tropical and subtropical production areas

- Agronomists will need to:
  - monitor for defoliation, flower/fruit damage
  - Be able to identify FAW and distinguish from other lepidoptera (eggs, larvae)
  - Use pheromone traps as an indication of local activity/arrival – or access trap data
  - Manage FAW along with other pests – a secondary pest?
  - Consider potential phytosanitary requirements for produce – depending on market
  - Be aware of insecticide resistance profile of FAW (data coming for industry)
  - Facilitate natural enemies – particularly egg parasitoids



FALL ARMYWOM LARVAL IDENTIFICATION GUIDE

Early instar caterpillars (stages 1-3)

Early instar larvae are very similar to young caterpillars of other species; DNA confirmation/rearing may be required for conclusive identification. Things to look for, however, are:

1) Overall yellowish/greening colour
2) Length approximately 1.5mm – 6.5mm (covering stages L1-L3)
3) Rows of black dots
4) Developing white lines running down the body
5) Developing pinkish blotches running down side of body (red arrow)

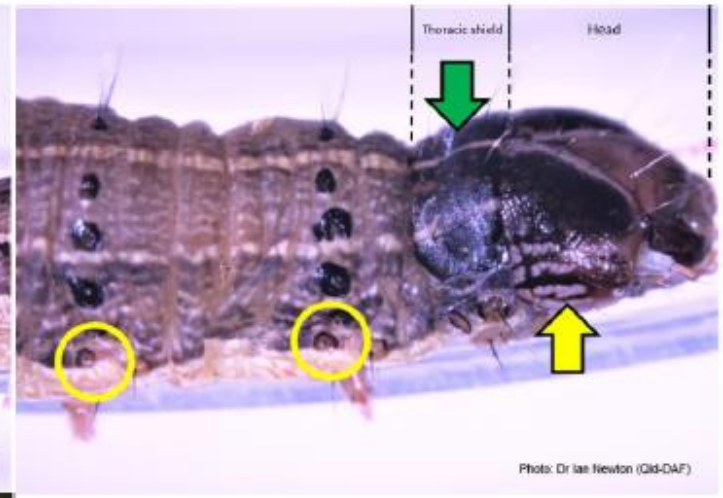
Figure 6. Typical adult male fall armyworm, *Spodoptera frugiperda* (J.E. Smith). Photograph by Lyle J. Buss, University of Florida.

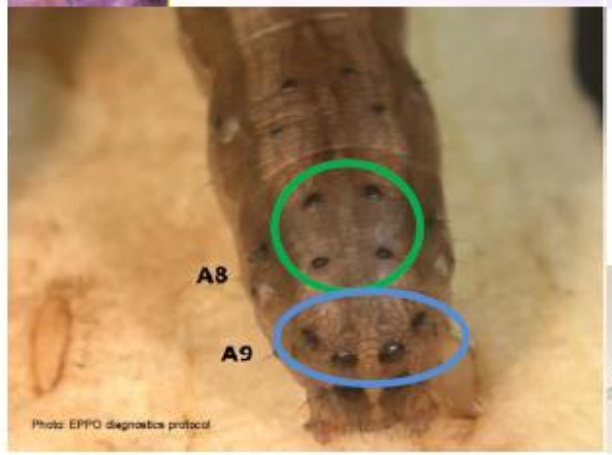
Figure 7. Typical adult female fall armyworm, *Spodoptera frugiperda* (J.E. Smith). Photograph by Lyle J. Buss, University of Florida.

Late instar caterpillars (stages 4-6)

Late instar larvae possess the distinctive fall armyworm characters. These include:

1) Length approximately 10mm – 35mm (covering stages L4-L6)
2) Head with 'mottled' patterning (yellow arrow)
3) Thoracic shield similar colour to the head (green arrow)
4) Body bearing an overall 'granulated' pattern; note colour can vary
5) Roughly defined alternating pale/darker lines running down body
6) Black dots (but different from black blotches of other species, such as *S. litura* or *S. mauritia*)
7) Presence of sclerotized rings around setae at the front and back of the caterpillar (yellow circles; with zoomed-in inset for posterior ring)
8) Black dots on the posterior upper-side of body in a square (abdominal segment 8; green circle) and trapezoid (abdominal segment 9) arrangement (blue circle)





Overall appearance, note that colour may vary from pinkish,

to yellowish, to brownish, to quite dark

Guide prepared by Dr. Mark Schutze (Plant Biosecurity Laboratory) – 19 March 2020

It will take some experience to confidently identify FAW larvae

FAW: young larvae – length 6-9 mm

Top view

Young fall armyworm larvae (6-9 mm). D Visser ARC-VOP Roodeplaat

FAW: mature larvae – length 30-36 mm

Top view

Mature fall armyworms (30-36 mm). D Visser ARC-VOP Roodeplaat

FAW: young larvae – length 6-9 mm

Side view

Young fall armyworm larvae (6-9 mm). D Visser ARC-VOP Roodeplaat

FAW: mature larvae – length 30-36 mm

Side view

Mature fall armyworms (30-36 mm). D Visser ARC-VOP Roodeplaat

Fall armyworm vs *Leucania* sp. armyworm larvae

Spodoptera sp. armyworm larvae

Larger ones are quite different in appearance to FAW

What to look for in sorghum and maize – similar to what might see in broadleaf crops

Egg masses and early instar larvae

Ballooning

Images: D Visser ARC-VOP Roodeplaat

Patches of infested plants

Image: Angus Dagliesh, Brent Wilson

This is NOT FAW damage – CHECK the larvae, don't assume!!

Northern/common armyworm, with multiple larvae per whorl, produce damage very similar to that caused by FAW

Helicoverpa caused this damage. FAW causes very similar damage, just more severe as a result of more larvae per plant. Damage to cobs by FAW (burrowing in the side) may be an issue for fungal and bacterial infection in wetter years, or with overhead irrigation.

Natural enemies observed attacking FAW

Fungus
Nomurea rileyi

entomopathic fungi

Wasp parasitoid
Cotesia sp?

hymenoptera parasitoid

Fly parasitoid

Dipteran parasitoid

Also expect impact from egg parasitoids (*Trichogramma*, *Telenomus?*), *Microplitis* larval parasitoid, ants, minute pirate bugs, earwigs, assassin bugs, predatory shield bugs, spiders, lacewings……

Spodoptera growth stage identification

Showing the actual size of *S. frugiperda* larvae at a given age (days since egg hatch) when reared at 25°C.

Instar	Age days	Size category	Length mm	Actual size	Fawligen timing
1st	0 - 1	Very Small	1 - 2		✔✔
2nd	2 - 3	Small	3 - 4		✔✔
3rd	4 - 5	Medium (small)	5 - 8		✔
4th	6 - 7	Medium (large)	9 - 14		✖
5th	8 - 9	Large	15 - 20		✖
6th	10 - 14	Very Large	21 - 30+		

Helicoverpa Growth Stage Identification

Showing the actual size of *H. armigera* larvae at a given age (days since egg hatch) when reared at 25°C.

Instar	Age (days)	Size category	Length (mm)	Actual size	Vivus Max timing
1st	0 - 2	Very Small	1 - 3		✔✔
2nd	2 - 4	Small	4 - 7		✔✔
3rd	4 - 8	Medium (small)	8 - 13		✔
4th	8 - 11	Medium (large)	14 - 23		✖
5th	11 - 14	Large	24 - 28		✖
6th	14 - 18+	Large (snake)	29 - 40+		

Life stage	Mean development time (days) at constant temperature		
	18°C	26°C	30°C
Egg	6.4	3.0	2.0
1st instar	4.9	2.9	2.7
2nd instar	4.5	2.1	1.9
3rd instar	5.0	2.0	1.4
4th instar	5.2	2.1	1.6
5th instar	6.2	2.3	2.2
6th instar	8.6	3.4	2.0
Egg - adult	71.0	29.0	22.0
Larval mortality (%)	71.0	15.0	4.0

Du Plessis *et al*. 2020. *Insects*: 11, 228

Life stage	Day degree requirements
Egg	35.6
Larvae 1-6	204
Pupa	150
Egg – adult (1 generation)	392

Mean leaf consumption per larva = 3g, ~300 sq cm (sweet corn). DAF 2020

Source: AgBitech Fawligen® and Vivus Max® technical brochure

Vegetable crops impacted by FAW

- finding information on FAW impact on hort crops is difficult. Suggests that issues with FAW are not as significant as they are for sweet corn, sorghum, grasses – where there is a lot of information available.
- But, further incursions of FAW into Australia, over time, may bring different 'strains' which do have a preference for some hort crops.

Crop	Pest status	Where	Damage
Sweet corn	Major, regular	World wide	Defoliation, cob damage
Tomatoes		USA – South, SE	defoliation, fruit damage =fruit drop & rot
Peppers (incl capsicum)		USA	Defoliation, fruit damage (larvae inside fruit)
Eggplant		USA	Defoliation, fruit damage
Lettuce		USA	Head lettuce most vulnerable
Lucerne, grass hay		USA	Establishing crops most vulnerable
Apple, grape, orange, papaya, peach, strawberry, flowers		USA	

Insecticide resistance management

It is possible that FAW has arrived with resistance to insecticides – CSIRO and NSW DPI investigating
- likely to be to older chemistry e.g. SPs, OPs, carbamates.

Increased spraying for FAW increases the risk of resistance development in *Helicoverpa armigera* and other pests
The management of FAW may occur incidentally in crops which are already treated for caterpillar pests regularly.
Managing lepidoptera pests together will be key to the management of both the pests, and insecticide resistance.

Dr Lisa Bird (NSW DPI) suggests the following key principles to guide insecticide use and resistance management

1. Chemical rotation to limit exposure to the same chemical group in consecutive generations of insects. **Achievable given the large number of insecticides with emergency permits for FAW**. *Insecticides with 2 MOA will interfere with your ability to manage resistance through rotation.*
2. Area wide management to limit localised selection pressure to a single generation because insect migration can increase risk of exposing cohorts previously selected for resistance. **Achievable by the use of product windows that do not exceed insect generation time.** *A useful approach to consider for discrete production areas.*
3. Adoption of a one-size-fits-all approach to management of FAW and *H. armigera*, particularly for products at high risk of resistance such as Group 28's and indoxacarb. **Achievable by single use of insecticides within product usage windows, regardless of species.** *Managing lepidoptera pests together will be key.*

1. Chemical rotation to limit exposure to the same chemical group in consecutive generations of insects. **Achievable given the large number of insecticides with emergency permits for FAW**.

Group 1A – methomyl
Group 3A – alpha cypermethrin, gamma cyhalothrin, permethrin
Group 5 – spinetoram (Success Neo®), spinosad (Entrust®)
Group 6 – emamectin benzoate (Proclaim Opti®)
Group 18 – methoxyfenozide (Prodigy®)
Group 22A – indoxacarb (Steward®)
Group 28 – chlorantraniliprole (Altacor®, Coragen®)
Mixed MOA
Group 28+4A – chlorantraniliprole + thiamethoxam (Durivo® seed treatment)

Trade names provided as examples only – not a complete list of available products

Emergency minor use permits

Current at 14 August, 2020)

Hort Innovation has been successful in securing emergency minor use permits from the Australian Pesticides and Veterinary Medicines Authority (APVMA) for use on fall armyworm. Please see details below:

Permit ID	Description	Date Issued	Expiry Date	Permit holder	Link
PER89241	Spinetoram (Success Neo or Delegate) / Fall armyworm / Various crops	6-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89259	Chlorantraniliprole (Coragen, altacor and altacor hort insecticide labels) / Fall armyworm / Various Crops	6-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89263	Emamectin (Proclaim opti insecticide) / Fall armyworm / Various crops	10-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89280	Chlorantraniliprole + Thiamethoxam Durivo insecticide) / Fall armyworm / Various crops as per the registered Durivo label	12-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89278	Indoxacarb (Avatar insecticide) / Fall armyworm / Various crops	13-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89281	Chlorantraniliprole (Coragen or Altacor hort insecticide) / Fall armyworm / Blueberries and avocados	13-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89286	Indoxacarb (Provaunt turf insecticide) / Fall armyworm / Turf production	13-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89284	Spinetoram (Success neo snsecticide) / Fall armyworm / Leek, spring onion, shallot and galangal	16-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89284	Spinetoram (Success neo snsecticide) / Fall armyworm / Leek, spring onion, shallot and galangal	16-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89285	Emamectin (Proclaim opti insecticide) / Fall armyworm / Celery (field), brassica leafy vegetables, leafy beets, silverbeet and spinach (Protected cropping), blueberries (Field and protected cropping)	16-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89290	Chlorantraniliprole (Acelepryn turf insecticide) / Fall armyworm / Turf production	17-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89331	Spinetoram (Success neo insecticide) / Fall armyworm / Bulb onions	23-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89327	Spinetoram (Success neo insecticide) / Fall armyworm / Olives	24-Mar-20	31-Mar-23	Hort Innovation	Download permit
PER89293	Methomyl / Various fruit, nuts, vegetables, turf and non-bearing Ornamentals / Fall armyworm	10-Apr-20	30-Apr-23	Hort Innovation	Download permit
PER89354	Chlorantraniliprole (Altacor/Coragen) / Citrus / Fall armyworm	10-Apr-20	30-Apr-23	Hort Innovation	Download permit
PER89353 Version 2	Chlorantraniliprole (Coragen, altacor hort insecticide) /Rubus spp., tree nuts (except almonds), strawberries, parsley, root and tuber vegetables (except potatoes) / Fall armyworm	5-May-20	31-May-23	Hort Innovation	Download permit
PER89169 V2	Pheromone lure and dichlorvos / Various situations / Fall armyworm	10-Feb-20	28-Feb-23	DAWE	Download permit
PER89705	Indoxacarb (Avatar Evo / Steward EC insecticide) / Sweetcorn / Fall armyworm	24-Jun-20	30-Jun-23	Hort Innovation	Download permit

Current at 14 August, 2020)

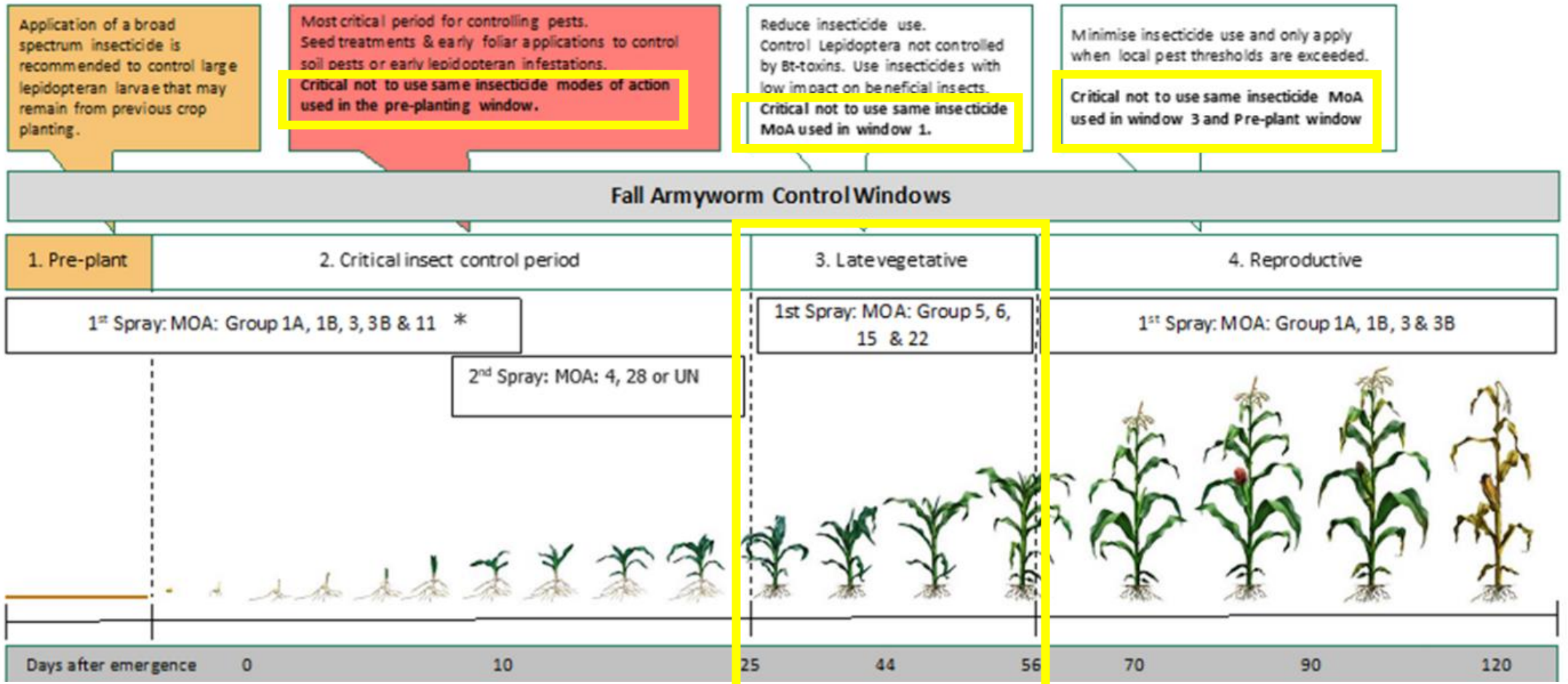
PER89353 Version 2	Chlorantraniliprole (Coragen, altacor hort insecticide) /Rubus spp., tree nuts (except almonds), strawberries, parsley, root and tuber vegetables (except potatoes) / Fall armyworm	5-May-20	31-May-23	Hort Innovation	Download permit
PER89169 V2	Pheromone lure and dichlorvos / Various situations / Fall armyworm	10-Feb-20	28-Feb-23	DAWE	Download permit
PER89705	Indoxacarb (Avatar Evo / Steward EC insecticide) / Sweetcorn / Fall armyworm	24-Jun-20	30-Jun-23	Hort Innovation	Download permit
PER89870	Spinosad (Entrust organic insecticide) / Various vegetables, fruit, herbs and ornamentals / Fall armyworm	21-Jul-20	31-Jul-23	Hort Innovation	Download permit

Plant Health Australia have also secured a permit for fall armyworm that includes sweetcorn that you can access on the APVMA website here.

IRAC
Insecticide Resistance Action Committee
South Africa

This example, for maize in South Africa, illustrates the application of the resistance management principles listed on an earlier slide. Key messages are highlighted.

Application Windows & Example MOA's for Conventional Maize Crop



Windows are 1 generation long to prevent exposure of successive generations to any MOA.

More comprehensive list of crops which now have a permit for one, or more, insecticide options for FAW control.
(Source: InfoPest, 14 August, 2020)

Trade Name	Host	Trade Name	Host
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Adzuki Beans	PER89293- METHOMYL/ FALL ARMYWORM	Cherries
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Almonds	PER85447- ALPHA-CYPERMETHRIN/ FIELD CROP	Chick-peas
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Apples	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Chick-peas
PER89293- METHOMYL/ FALL ARMYWORM	Apples	PER89279- VARIOUS PRODS/ FALL ARMYWORM	Chick-peas
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Apricots	PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Chick-peas
PER89281- CHLORANTRANILIPROLE/ FALL ARMY	Avocados	PER9241- SPINETORAM/ FALL ARMYWORM	Chick-peas
PER89293- METHOMYL/ FALL ARMYWORM	Avocados	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Chinese Broccoli (Gai lan)
PER9241- SPINETORAM/ FALL ARMYWORM	Avocados	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Chinese Cabbages (Napa/Wong bok)
PER9241- SPINETORAM/ FALL ARMYWORM	Bananas	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Chinese Flat Cabbage (Tatsoi)
PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Barley	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Chinese Flow.Cabbage(Choisum)
PER89293- METHOMYL/ FALL ARMYWORM	Beans (except Broad/Soya beans)	PER89293- METHOMYL/ FALL ARMYWORM	Chinese Onion (Rakkyo)
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Beetroot - Leaves	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Chinese Wh.Cabbage (Bok choy)
PER9241- SPINETORAM/ FALL ARMYWORM	Berry Fruits	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Chinese Wh.Cabbage (Pak-choi)
PER 89353- CHLORANTRANILIPROLE/ FALL ARM	Berry Fruits - Rubus spp.	PER89293- METHOMYL/ FALL ARMYWORM	Citrus
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Berry Fruits - Rubus spp.	PER89354- CHLORANTRANILIPROLE/ CITRUS	Citrus
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Blueberries	PER9241- SPINETORAM/ FALL ARMYWORM	Citrus
PER89281- CHLORANTRANILIPROLE/ FALL ARMY	Blueberries	PER9241- SPINETORAM/ FALL ARMYWORM	Coffee
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Blueberries	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Cotton
PER89293- METHOMYL/ FALL ARMYWORM	Blueberries	PER89306- INDOXACARB/ COTTON / FALL ARMY	Cotton
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Brassica (Cole) Vegetables	PER89344- EMAMECTIN/ COTTON/ FALL ARMYWO	Cotton
PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Brassica (Cole) Vegetables	PER9241- SPINETORAM/ FALL ARMYWORM	Cotton
PER89293- METHOMYL/ FALL ARMYWORM	Brassica (Cole) Vegetables	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Cowpeas
PER9241- SPINETORAM/ FALL ARMYWORM	Brassica (Cole) Vegetables	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Cucurbits
PER9241- SPINETORAM/ FALL ARMYWORM	Brassicas - Forage	PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Cucurbits
PER85447- ALPHA-CYPERMETHRIN/ FIELD CROP	Broad (Faba) Beans	PER9241- SPINETORAM/ FALL ARMYWORM	Cucurbits
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Broad (Faba) Beans	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Curled Mustard - Taishona
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Broad (Faba) Beans	PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Eggplant
PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Broad (Faba) Beans	PER89293- METHOMYL/ FALL ARMYWORM	Fennel (Bulb)
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Broccoli	PER85447- ALPHA-CYPERMETHRIN/ FIELD CROP	Field Peas
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Brussels Sprouts	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Field Peas
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Cabbages - Head	PER89279- VARIOUS PRODS/ FALL ARMYWORM	Field Peas
PER89300- AFFIRM INSECTICIDE/ FALL ARMYW	Canola (Rapeseed)	PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Field Peas
PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Canola (Rapeseed)	PER9241- SPINETORAM/ FALL ARMYWORM	Fruit-Assort.Trop.Sub-Trop.-Ined.Peel
PER9241- SPINETORAM/ FALL ARMYWORM	Canola (Rapeseed)	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Fruiting Vegetables
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Capsicums (Sweet peppers)	PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Fruiting Vegetables
PER89293- METHOMYL/ FALL ARMYWORM	Capsicums (Sweet peppers)	PER89293- METHOMYL/ FALL ARMYWORM	Fruiting Vegetables
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Cauliflower	PER9241- SPINETORAM/ FALL ARMYWORM	Fruiting Vegetables
PER89293- METHOMYL/ FALL ARMYWORM	Celeriac	PER89284- SPINETORAM/ FALL ARMYWORM	Galangal (rhizomes)
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Celery	PER89293- METHOMYL/ FALL ARMYWORM	Ginger
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Celery	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Grapes
PER89293- METHOMYL/ FALL ARMYWORM	Celery	PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Grapes
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Cereals - Winter	PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Grapes
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Cherries	PER89293- METHOMYL/ FALL ARMYWORM	Grapes

Trade Name	Host	Trade Name	Host
PER9241- SPINETORAM/ FALL ARMYWORM	Grapes	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Mustard Greens
PER9241- SPINETORAM/ FALL ARMYWORM	Herbs/Spices	PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Nashis
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Indian Mustard Cabbage-Kaichoi	PER85447- ALPHA-CYPERMETHRIN/ FIELD CROP	Navy Beans
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Indian Mustard-Gai choy/Am soi	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Navy Beans
PER89293- METHOMYL/ FALL ARMYWORM	Japanese ginger (Myoga)	PER89279- VARIOUS PRODS/ FALL ARMYWORM	Navy Beans
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Kale	PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Navy Beans
PER9241- SPINETORAM/ FALL ARMYWORM	Kiwifruit	PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Nectarines
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Komatsuma (Spinach Mustard)	PER 89353- CHLORANTRANILIPROLE/ FALL ARM	Nuts
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Leafy Vegetables	PER89327- SUCCESS NEO/ OLIVES / FALL ARM	Olives
PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Leafy Vegetables	PER89293- METHOMYL/ FALL ARMYWORM	Onions
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Leafy Vegetables	PER89331- SUCCESS NEO/ ONIONS/ FALL ARMY	Onions
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Leafy Vegetables	PER89293- METHOMYL/ FALL ARMYWORM	Ornamentals
PER9241- SPINETORAM/ FALL ARMYWORM	Leafy Vegetables	PER9241- SPINETORAM/ FALL ARMYWORM	Ornamentals
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Leafy Vegetables - Asian	PER 89353- CHLORANTRANILIPROLE/ FALL ARM	Parsley
PER89284- SPINETORAM/ FALL ARMYWORM	Leeks	PER89293- METHOMYL/ FALL ARMYWORM	Parsley
PER89293- METHOMYL/ FALL ARMYWORM	Leeks	PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Peaches
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Lentils	PER89279- VARIOUS PRODS/ FALL ARMYWORM	Peanuts
PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Lentils	PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Pears
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Lettuce - Head/Leaf	PER89293- METHOMYL/ FALL ARMYWORM	Pears
PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Lettuce - Head/Leaf	PER89293- METHOMYL/ FALL ARMYWORM	Peas
PER89293- METHOMYL/ FALL ARMYWORM	Lettuce - Head/Leaf	PER89293- METHOMYL/ FALL ARMYWORM	Peas - Snow
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Lupins	PER89293- METHOMYL/ FALL ARMYWORM	Peas - Sugar/Snap (young pods)
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Lupins	PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Peppers
PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Lupins	PER89293- METHOMYL/ FALL ARMYWORM	Persimmons
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Macadamias (Macadamia nuts)	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Pigeon Peas
PER89293- METHOMYL/ FALL ARMYWORM	Macadamias (Macadamia nuts)	PER89311- INDOXACARB/ PIGEON PEAS	Pigeon peas-Trap crops/Refuges
PER9241- SPINETORAM/ FALL ARMYWORM	Macadamias (Macadamia nuts)	PER9241- SPINETORAM/ FALL ARMYWORM	Pistachios (Pistachio nuts)
PER85447- ALPHA-CYPERMETHRIN/ FIELD CROP	Maize	PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Plums
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Maize	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Pome Fruit
PER89366- CHLORANTRANILIPROLE/ FALL ARMY	Maize	PER9241- SPINETORAM/ FALL ARMYWORM	Pome Fruit
PER89390- SPINETORAM/ FALL ARMYWORM	Maize	PER89390- SPINETORAM/ FALL ARMYWORM	Popcorn
PER89293- METHOMYL/ FALL ARMYWORM	Mangoes	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Potatoes
PER9241- SPINETORAM/ FALL ARMYWORM	Mangoes	PER89293- METHOMYL/ FALL ARMYWORM	Potatoes
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Mibuna (Greens)	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Pulses (Grain Legumes)
PER85447- ALPHA-CYPERMETHRIN/ FIELD CROP	Millet/s	PER89279- VARIOUS PRODS/ FALL ARMYWORM	Pulses (Grain Legumes)
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Millet/s	PER89300- AFFIRM INSECTICIDE/ FALL ARMYW	Pulses (Grain Legumes)
PER89390- SPINETORAM/ FALL ARMYWORM	Millet/s	PER9241- SPINETORAM/ FALL ARMYWORM	Pulses (Grain Legumes)
PER89400- METHOMYL/ MILLET / LEPIDOPTERA	Millet/s	PER89293- METHOMYL/ FALL ARMYWORM	Radishes
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Mizuna (Greens)	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Rucola (Rocket)
PER85447- ALPHA-CYPERMETHRIN/ FIELD CROP	Mung Beans	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Rutabaga Greens/Leaves
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Mung Beans	PER89284- SPINETORAM/ FALL ARMYWORM	Shallots
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Mung Beans	PER89293- METHOMYL/ FALL ARMYWORM	Shallots
PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Mung Beans	PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Silverbeet (Chard)

Trade Name	Host	Trade Name	Host
PER89293- METHOMYL/ FALL ARMYWORM	Silverbeet (Chard)	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Vegetables - Legume
PER85447- ALPHA-CYPERMETHRIN/ FIELD CROP	Sorghum	PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Vegetables - Legume
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Sorghum	PER89293- METHOMYL/ FALL ARMYWORM	Vegetables - Legume
PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Sorghum	PER9241- SPINETORAM/ FALL ARMYWORM	Vegetables - Legume
PER89390- SPINETORAM/ FALL ARMYWORM	Sorghum	PER 89353- CHLORANTRANILIPROLE/ FALL ARM	Vegetables - Root
PER85447- ALPHA-CYPERMETHRIN/ FIELD CROP	Soya beans (Soybeans)	PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Vegetables - Root
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Soya beans (Soybeans)	PER89293- METHOMYL/ FALL ARMYWORM	Vegetables - Root
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Soya beans (Soybeans)	PER9241- SPINETORAM/ FALL ARMYWORM	Vegetables - Root
PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Soya beans (Soybeans)	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Vegetables - Stem & Stalk
PER9241- SPINETORAM/ FALL ARMYWORM	Soya beans (Soybeans)	PER9241- SPINETORAM/ FALL ARMYWORM	Vegetables - Stem & Stalk
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Spinach	PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Vetches
PER89293- METHOMYL/ FALL ARMYWORM	Spinach	PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Vetches
PER89284- SPINETORAM/ FALL ARMYWORM	Spring Onions	PER89279- VARIOUS PRODS/ FALL ARMYWORM	Wheat
PER89293- METHOMYL/ FALL ARMYWORM	Spring Onions	PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Wheat
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Stone Fruit		
PER89293- METHOMYL/ FALL ARMYWORM	Stone Fruit		
PER9241- SPINETORAM/ FALL ARMYWORM	Stone Fruit		
PER 89353- CHLORANTRANILIPROLE/ FALL ARM	Strawberries		
PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Strawberries		
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Strawberries		
PER89293- METHOMYL/ FALL ARMYWORM	Strawberries		
PER89295- PERMETHRIN/ SUGARCANE/ FALL AR	Sugarcane		
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Sunflowers		
PER89358- TROJAN/ VARIOUS/ FALL ARMYWORM	Sunflowers		
PER89293- METHOMYL/ FALL ARMYWORM	Swedes		
PER85447- ALPHA-CYPERMETHRIN/ FIELD CROP	Sweet Corn		
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Sweet Corn		
PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Sweet Corn		
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Sweet Corn		
PER89293- METHOMYL/ FALL ARMYWORM	Sweet Corn		
PER9241- SPINETORAM/ FALL ARMYWORM	Sweet Corn		
PER89293- METHOMYL/ FALL ARMYWORM	Sweet Potatoes		
PER89278- AVATAR/ VARIOUS/ FALL ARMYWORM	Tomatoes		
PER89293- METHOMYL/ FALL ARMYWORM	Tomatoes		
PER89279- VARIOUS PRODS/ FALL ARMYWORM	Triticale		
PER89293- METHOMYL/ FALL ARMYWORM	Turf		
PER89286- PROVAUNT/ TURF/ FALL ARMYWORM	Turf - Farms		
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Turnip Greens		
PER89293- METHOMYL/ FALL ARMYWORM	Turnips (Garden)		
PER89259- CHLORANTRANILIPROLE/ FALL ARMY	Vegetables - Leafy - Brassica		
PER89263- PROCLAIM OPTI/ FALL ARMYWORM	Vegetables - Leafy - Brassica		
PER89285- PROCLAIM OPTI/ VARIOUS/ FALL A	Vegetables - Leafy - Brassica		
PER89293- METHOMYL/ FALL ARMYWORM	Vegetables - Leafy - Brassica		