Encouraging and preserving beneficials in Strawberry and Raspberry

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Ontario Fruit and Vegetable Convention, Niagara Falls
February 21, 2018

1- KNOW your FRIENDS !

2- ATTRACT / INTRODUCE native beneficials

3- USE the least 'TOXIC' PESTICIDES POSSIBLE

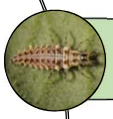
-Landscape effects
-Most attractive plants
-Pests, their Natural Enemies and Strategies
    Lygus bug
    Cyclamen mite
    Thrips
    TSSM (two spotted spider mites)
    SWD (spotted winged drosophila)
    Aphids
• Safer pesticides

Encourage your 'locally grown' Beneficials
'Free workers'

Better adapted
More resistant
to your environment and to pesticides!

Average cost of 1000 native beneficials


***Fallacis*: $13-$25**


Lacewings: $31


***Aphidius*: $63**


***Orius*: $93**

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Landscape heterogeneity

is associated with lower variation of densities of pests and natural enemies

Landscape management for functional biodiversity
IOBC-WPRS Bulletin Vol. 122, 2017
pp. 33-37

Is higher landscape heterogeneity associated with lower variation of abundances of pests and natural enemies?

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SIMPLE Landscape

HIGHER **variation**
of pest and natural
enemy densities

Alfalfa in Strawberry as a trap crop in CALIFORNIA

Sources : Swezey et col., University of California, 2013

Alfalfa (*Medicago sativa*) is a preferred host of the tarnished plant bug (*Lygus* bug).

Using alfalfa as a trap to kill *Lygus* bug with insecticides or to catch and vacuum them.

In a simple landscape

Impact of flower strips

is more significant

because beneficials and pests

need refuges, water and food!

In a complex landscape,

Impact of flower strips
is less significant

because of the crop diversity

crop richness
margin density
landscape patchiness
proportion of woodlands

A review on landscape composition, biodiversity and natural pest control

F.J.J.A Bianchi, C.J.H Booij, T Tscharntke

Published 22 July **2006**.DOI: 10.1098/rspb.2006.3530

IN COMPLEX LANDSCAPES

(compared to simple landscapes)

- Natural enemy populations were higher (74% of studies)
- Pest pressure was lower (45% of studies)

Enhanced natural enemy activity
was associated
with **herbaceous habitats in 80% of cases**
(e.g. fallows, field margins)
and somewhat less often with wooded habitats (71%)
and landscape patchiness (70%)

Responses of Crop Pests and Natural Enemies to Wildflower Borders within an adjacent strawberry crop

Wildflower borders can increase beneficials abundance

- but can also have effects on pest populations and these effects are not well-studied !

With wildflowers borders:

- More predators were captured in strawberry plantations
- Herbivore populations were lower
- Densities of Tarnished Plant Bug (*Lygus lineolaris*) increased
- Densities of Strawberry Sap or 'Picnic' Beetle decreased
- Wildflower borders may support the control of some pests

If the pest is a generalist, its populations may increase within the crop because they can utilize the resources of the wildflower patch.

July 2017; Ellie McCabe, Gregory Loeb and Heather Grab

Ground Beetles
(larvae and adult)

They compared
the effect of plastic mulch and organic mulch (straw) systems
in strawberry cultivation on soil invertebrates
and biological activity in a field study in Germany.

Taxonomic diversity was significantly higher in strawberry fields with organic mulch because of the higher soil moisture (higher microbial activity).

In strawberry fields with plastic mulch, they found a decreased taxonomic richness which decreased with increasing soil temperature.

Schirmel, J., Applied Soil Ecology (**2017**), https://doi.org/10.1016/j.apsoil.2017.11.025

Coriandrum sativum

NOVA-FLORE
il est temps d'inventer le jardin de demain

Achillea millefolium

To establish wild flowering borders

Landscape management for functional biodiversity
IOBC-WPRS Bulletin Vol. 122, 2017
pp. 151-155

- Weed control is the most difficult aspect
- Good viability of seeds and buy varieties separately if possible
  Do not mix plants of different size and growth rate
  - (the less vigorous will disappear!!)
- Extended blossoming periods, plan for flowers all season long
- Different floral structures
- Adequate plant density (10/m^2 for small and 5/m^2 for medium sized plants)

To establish wild flowering borders

Landscape management for functional biodiversity
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pp. 151-155

- Use of mixture of plant species that do not serve as a pest reservoir, except for trap plants
- Start luring beneficials quickly with annuals like *alyssum*, cosmos, zinnias and sunflowers, then add perennials and herbs (dill, parsley, coriander, mint, caraway, fennel…)
- Average cost for a strip flower: 4$/$m^2$ (commercial mix); 1,50$/$m^2$ homemade; perennials are more expensive.
- 1 flower strip every 60 meters for beneficials

A good example from Michigan State University

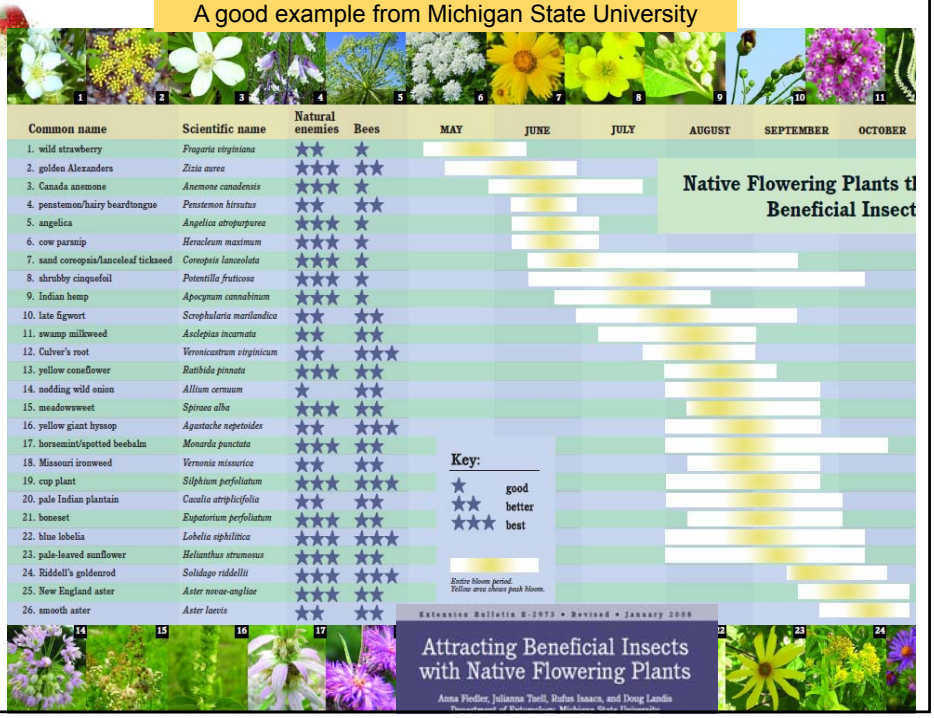

Table 3.—Garden flowers that attract beneficial insects.

Common name/Botanical name*	Predators attracted	Parasitoids attracted
Apiaceae (carrot family)		
Angelica (*Angelica archangelica*)	Lacewings, lady beetles	—
Anise (*Pimpinella anisum*)	—	Wasps
Blue lace (*Trachymene coerulea*)	—	Wasps
Caraway (*Carum carvi*)	Bugs, hover flies (syrphid flies), lacewings	Wasps
Coriander (*Coriandrum sativum*)	Hover flies	Tachinids, wasps
Dill (*Anethum graveolens*)	Hover flies, lady beetles	Wasps
Lovage (*Levisticum officinale*)	—	Wasps
White lace flower, bishop's weed (*Ammi majus*)	Bugs, hover flies, lady beetles	Tachinids, wasps
Yarrow (*Achillea* spp.)	Bugs, lady beetles	Wasps
Asteraceae (daisy family)		
Blazing star, gayfeather (*Liatris* spp.)	Bugs	Wasps
Chamomile (*Anthemis nobilis*)	Lady beetles	—
Coreopsis (*Coreopsis* spp.)	Lacewings, lady beetles	Wasps
Cosmos (*Cosmos bipinnatus*)	Hover flies, lacewings, minute pirate bugs	—
Golden marguerite (*Anthemis tinctoria*)	Lady beetles	Tachinids, wasps
Goldenrod (*Solidago altissima*)	Bugs, lady beetles, soldier beetles	Wasps
Marigold, signet (*Tagetes tenuifolia*)	Minute pirate bugs	Wasps
Mexican sunflower (*Tithonia rotundifolia*)	Hover flies, minute pirate bugs	—
Sunflower (*Helianthus annuus* and *H. debilis*)	Hover flies, lady beetles	Wasps
Tansy (*Tanacetum vulgare*)	Hover flies, lady beetle larvae	Wasps
Brassicaceae (cabbage family)		
Broccoli (*Brassica oleracea*)	Hover flies	Wasps
Candytuft (*Iberis umbellata*)	Hover flies	—
Mustards (*Brassica hirta* and *B. juncea*)	Big-eyed bugs, hover flies, minute pirate bugs	—
Sweet alyssum (*Lobularia maritima*)	Hover flies	Tachinids, wasps
Dipsaceae (scabiosa family)		
Cephalaria (*Cephalaria gigantea*)	Hover flies	Wasps
Pincushion flower (*Scabiosa caucasica*)	Hover flies	Wasps
Scabiosa (*Scabiosa atropurpurea*)	Hover flies	—
Fabaceae (legume family)		
Alfalfa (*Medicago sativa*)	Bees, bugs, lacewings, lady beetles	—
Clover (*Trifolium* spp.)	Bees, bugs, lacewings, lady beetles	—
Hydrophyllaceae (waterleaf family)		
Fiddleneck (*Phacelia tanacetifolia*)	Bees, bugs, hover flies	—
Polygonaceae (buckwheat family)		
Buckwheat (*Eriogonum* spp. and *Fagopyrum* spp.)	Hover flies	—

Umbelliferous

Compositae

TANSY

PNW 550 · July 2001

LYGUS BUG

- No effective biocontrol agents available on the market.
- *Beauvaria bassiana* (Botanigard or BioCeres) will soon be registered for field crops; the strategy will be to apply in early spring on the first generation of *Lygus* because it is more sensitive after overwintering.
- *Lygus* are attracted by many flowers like buckwheat, pigweed (lamb's quarters), mustard, sunflower and Mullein plant !
- Some native parasitoids are active on *Lygus* but not enough to offer a good control : *Peristenus*
- Alfalfa strips work well in California in simple landscapes but don't give good results in our conditions (crop diversity).

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LYGUS BUG

Future research

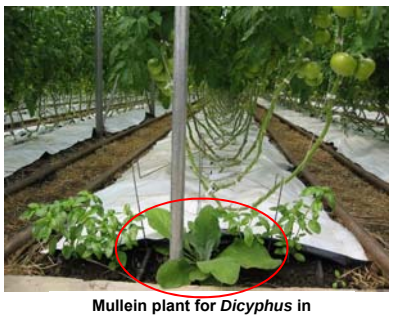
François Dumont, entomologist, CRAM

' Attract and kill' strategy

with a trap plant

(mullein: *Verbascum thapsus*)

or use it as a banker plant system for its predatory bug



Mullein plant for *Dicyphus* in greenhouse tomatoes

-Largely used as a banker plant system for *Dicyphus* in greenhouse tomatoes for many years and easy to grow.

-Mullein plant also attracts *Lygus* in autumn with its predatory bug called 'Damsel Bug' (*Nabis*).

-Should we kill *Lygus* as he hibernates as an adult, or keep *Nabis* active for the next season?

Photos: Liette Lambert

Damsel bug (*Nabis*)

Damsel bugs are more commonly found in field crops such as **alfalfa** and **soybean** than in row crops or orchards.

Grassy fields tend to have more damsel bugs than do broadleaf weed or weed-free fields.

They are also predators of aphids, moth eggs, and small caterpillars, leafhoppers, mites,

Attractive plants:

— Caraway
— Fennel
— Spearmint
— Cosmos “white sensation”
— Goldenrod
— Marigold “lemon gem”
— Alfalfa

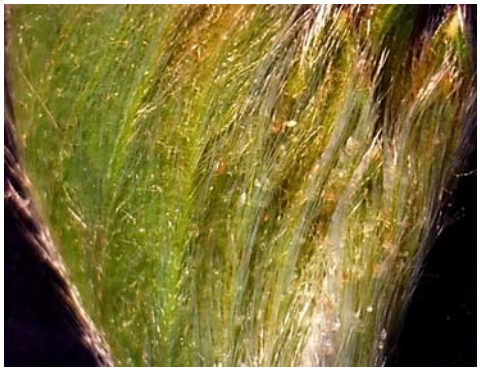
Photos: Liette Lambert

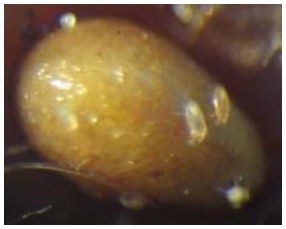
The damsel bug looks like a little praying mantis

CYCLAMEN MITE

Photos: Liette Lambert

CYCLAMEN MITE



Photos: Liette Lambert

CYCLAMEN MITE

Predatory mites tested:

- *-A. swirkii*
- *-A. andersoni*
- *-N. cucumeris*
- *-N. fallacis* In field conditions = the best !

Combined with *Cucumeris* (longer term control), it helps…

Oberon (spiromesifen) is safe and may reduce cyclamen mite populations (on immatures).

Table 1. Miticides (active ingredient and trade name) that have broad and/or cyclamen mite on the label, and activity (translaminar and/or contact).

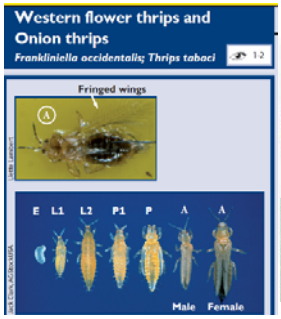
Common Name (active ingredient)	Trade Name	Mites on Label	Activity
Abamectin	Avid	Broad and cyclamen mite	Translaminar and contact
Chlorfenapyr	Pylon	Broad and cyclamen mite	Translaminar and contact
Fenpyroximate	Akari	Broad and cyclamen mite	Contact
Pyridaben	Sanmite	Broad mite	Contact
Spiromesifen	Judo	Broad and cyclamen mite	Translaminar and contact

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

MF-2938 November 2010

THRIPS

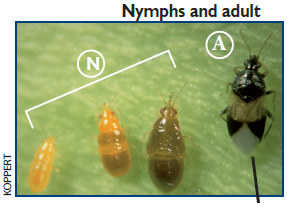
A problem if no predators are active in the field



Photos: Liette Lambert

Predation by adult and nymph

Nymphs and adult



Minute pirate bug *Orius*
(native and commercially available)

- VERY effective predatory bug
- They can also take care of a good number of aphids and mites

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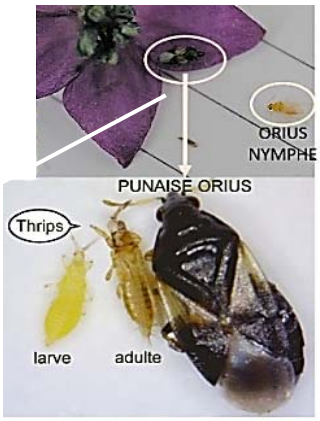
Ornamental Pepper Plants (cv Black Pearl) for *Orius*

For Greenhouse crops



Photos: Liette Lambert

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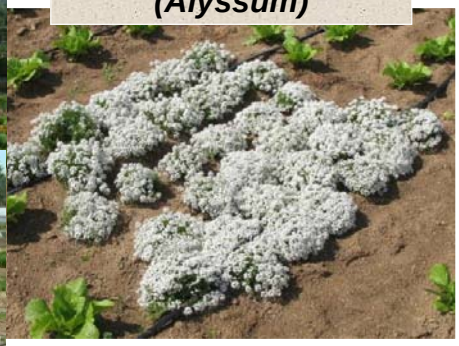
Refuge plants for Orius and hoverflies in SPAIN (Catala)

Source: Cristina Castane, IRTA

***Lobularia maritima* (Alyssum)**



***Calendula officinalis* for hoverflies**

***Alyssum* (seedling) As a banker system for *Orius*:**

1000 to 2000 / acre
Once or twice

***Cucumeris in sachet*:**
2000 sachets / acre

***Cucumeris* harasses thrips which reduces survival and time spent feeding**

Cucumeris

Food source with *Artemia* and *Ephestia* eggs

Alyssum in a ditch

Bran mix with feeder mites
Breeding system with a food source of fungus on bran, which feeds the bran mites, that feed the predatory mites!

Bran mite

DID YOU KNOW THAT
GOOD PREDATORY THRIPS exist !

Photo: University of California

***Aelothrips* sp.**
Black hunter thrips
feed on mites and thrips

Photo: Liette Lambert, MAPAQ

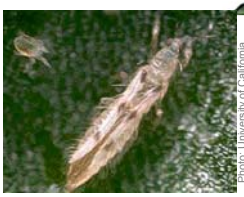


Photo: University of California

Scolothrips sexmaculatus
Sixspotted thrips
Feed on mites

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TSSM
(TWO-SPOTTED SPIDER MITES)

- **The best native**
- **predatory mite is *N. fallacis* !**

- **For use in high tunnels and greenhouses:**
  - ***N. californicus*** **and** ***P. persimilis***

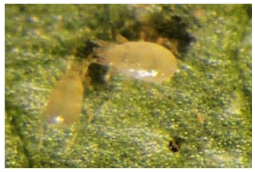

Photo: Biobee

Photos: Liette Lambert

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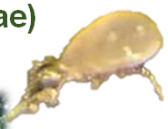
N. fallacis
A predatory mite that overwinters on *Thuja* (arborvitae)

Source: Brian Spencer, Applied BioNomics, BC



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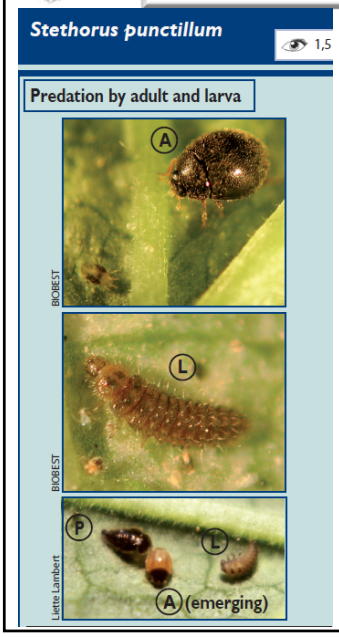
STETHORUS – Tiny ladybug beetle ACTIVE on raspberry in summer



Caulophyllum thalictroïdes Blue Cohosh as a banker plant

Photos: Liette Lambert

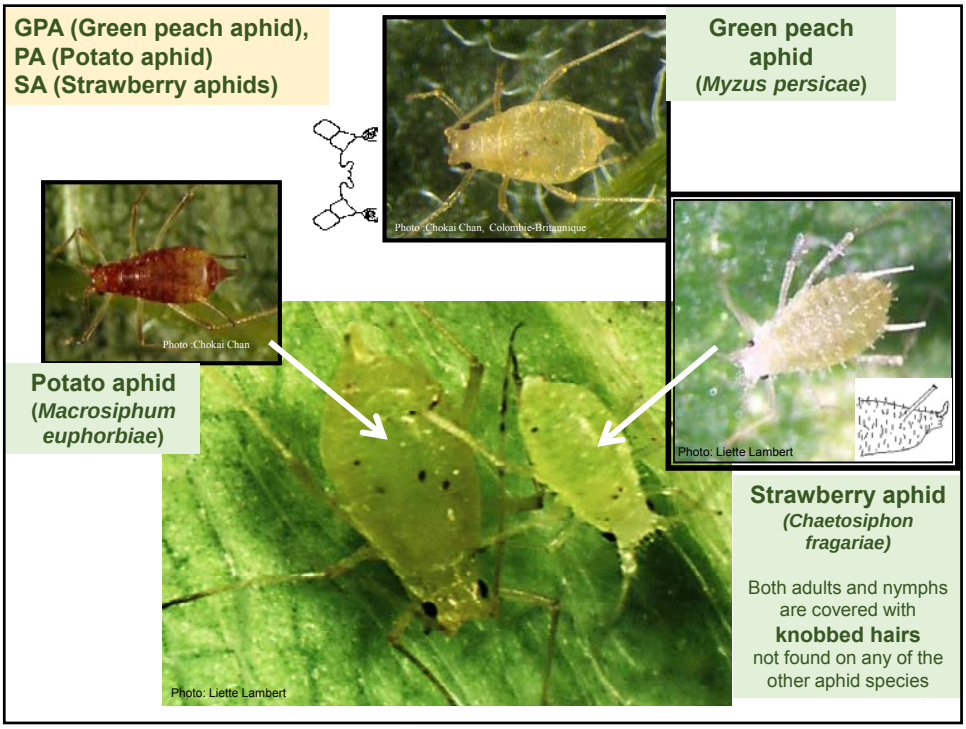
SWD (spotted winged drosophila)

- Natural enemies: LAB evaluation of larval parasitoïds from Japan and China (*Asobora, Ganaspis, Leptopilina*)
- Sterile Insect Technique (SIT) developped and applied for Onion Maggot in South of Montreal.

  Currently in development for SWD (Prisme + IRDA)
- Garlic-based repellent (e.g.: 'Mosquito barrier') applied around the field as a preventive mesure by blueberry growers.
- Exclusion netting (mesh size < 1 mm): used by very few blueberry growers in the field and for raspberry in high tunnels.

Photos: PRISME

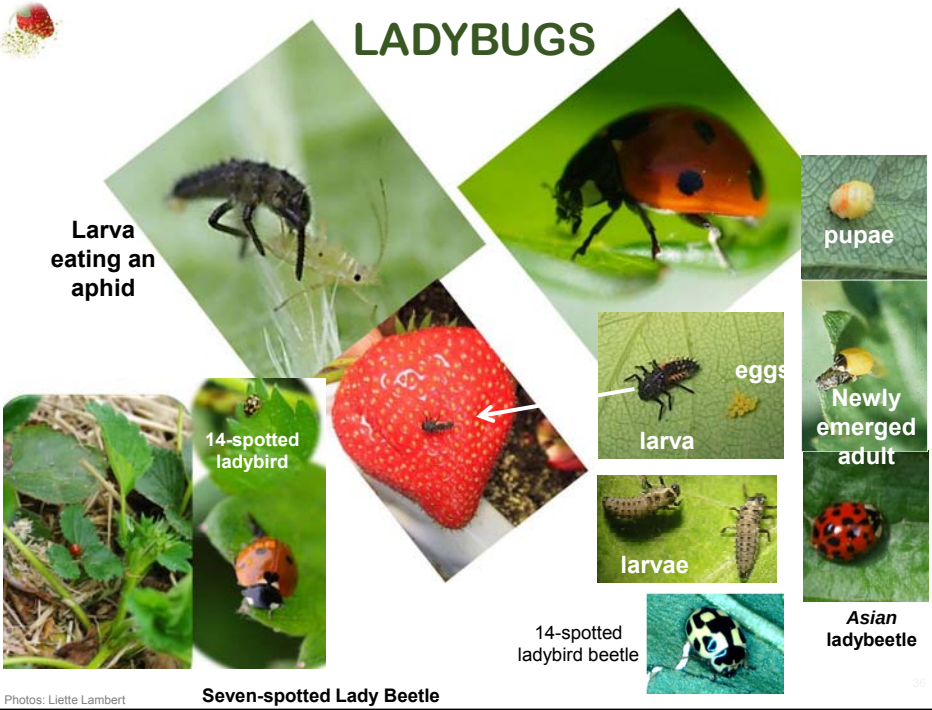
Sterile Insect Technique for Onion Maggot



APHIDS

- **Strawberry aphid** is a virus vector and parasitoïds are not uneffective on this species.
- **Many beneficials are effective +** commercially available:
  - Parasitoïds (*Aphidius*, *Aphelinus)*
  - Green lacewings (*Chrysopa*)
- **Others** not commercially available:
  - Hoverflies
  - Ladybugs (naturally abundant)

LADYBUGS



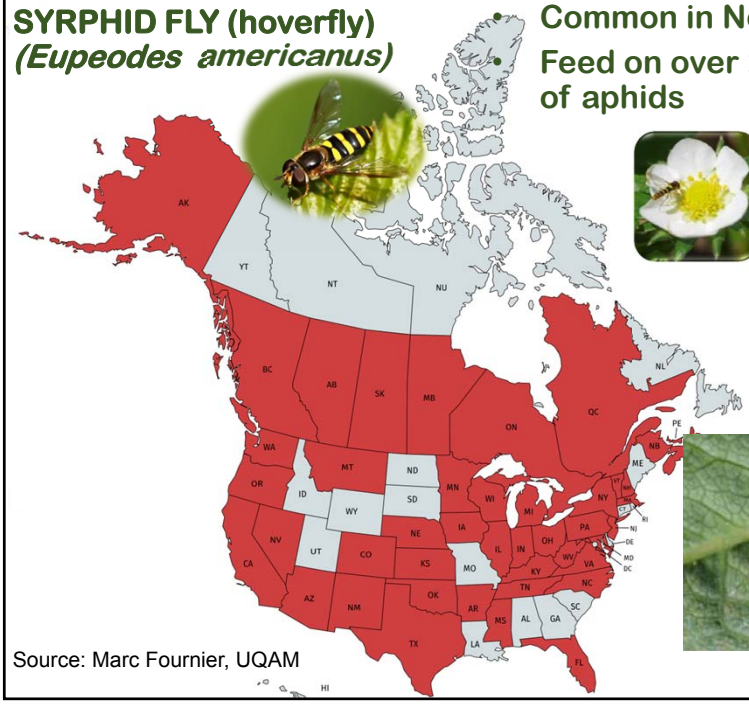
Photos: Liette Lambert

Seven-spotted Lady Beetle

SYRPHID FLY (hoverfly)
(Eupeodes americanus)

Common in North America

Feed on over 25 species of aphids



Source: Marc Fournier, UQAM

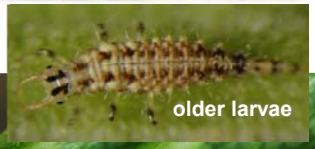
Photos: Liette Lambert

Plants that attract hoverflies

Achillea filipendulina Fern-leaf yarrow
Achillea millefolium Common yarrow
Ajuga reptans Carpet bugleweed
Allium tanguticum Lavender globe lily
Alyssum saxatilis Basket of Gold
Anethum graveolens **Dill**
Anthemis tinctoria Golden marguerite
Aster alpinus Dwarf alpine aster
Carum Carvi Caraway
Chrysanthemum parthenium Feverfew
Coriandrum sativum **Coriander**
Cosmos bipinnatus **Cosmos** white
Fagopyrum esculentum Buckwheat
Foeniculum vulgare **Fennel**
Lavandula angustifolia English lavender
Limonium latifolium Statice
Linaria vulgaris Butter and eggs
Lobelia erinus Edging lobelia
Lobularia maritima **Sweet alyssum - white**
Melissa officinalis Lemon balm
Mentha spicata Spearmint
Monarda fistulosa Wild bergamot
Penstemon strictus Rocky Mt. penstemon
Petroselinum crispum Parsley
Potentilla recta 'warrenii' Sulfur cinquefoil
Potentilla villosa Alpine cinquefoil
Rudbeckia fulgida Gloriosa daisy
Sedum kamtschaticum Orange stonecrop
Sedum spurium & album Stonecrops
Solidago virgaurea Peter Pan **goldenrod**
Stachys officinalis Wood betony
Thymus serpylum coccineus Crimson thyme
Veronica spicata Spike speedwell
Zinnia elegans Zinnia - liliput

Lacewings

Lacewing larvae are sometimes called "aphid lions" due to their hooked jaw and ferocious aphid appetite. They look like little alligators.



Photos: Liette Lambert

Plants that attract lacewings

Achillea filipendulina	Fern-leaf yarrow
Anethum graveolens	**Dill**
Angelica gigas	Angelica
Anthemis tinctoria	**Golden marguerite**
Carum carvi	**Caraway**
Coriandrum sativum	**Coriander**
Cosmos bipinnatus	**Cosmos** white sensation
Foeniculum vulgare	**Fennel**
Helianthus maximilianii	Prairie **sunflower**
Tanacetum vulgare	**Tansy**
Taraxacum officinale	Dandelion

Cereals aphids *(Rhopalosiphum padi)*
Only on MONOCOTS (grasses, maize, asparagus, onion, garlic, leek





Photos: Liette Lambert

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Aphelinus




Photos: Liette Lambert

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« Pesticides are silent killers »…

Avoid persistent pesticides

Use **softer** chemicals

Know the impact of the product

USE

AS LITTLE

TOXIC

PESTICIDES

AS POSSIBLE

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KEEP IN MIND

Pesticides are never totally compatible

"Safe" means that it can kill up to 25% of the population

A pesticide is not safe at all stages

They have INDIRECT EFFECTS
Reduced egg laying and moulting, repellent effect

But…most of the fungicides are compatible

Photos: Lizette Lambert, MAPAQ

Biobest

Available on the App Store

ANDROID APP ON Google play

Natural enemies	
1	= harmless or only slightly harmful < 25% reduction
2	= moderately harmful 25 - 50% reduction
3	= harmful 50 - 75% reduction
4	= very harmful > 75% reduction
	= effect/persistence unknown
Persistence	
d = days, w = weeks	

http://side-effects.koppert.nl/

Toxicity on natural enemies

Class	Toxicity	Mortality
1	Non-toxic	< 25%
1/2	Values ranging between class 1 & 2	
2	Slightly toxic	25-50%
2/3	Values ranging between class 2 & 3	
3	Mod. Toxic	50-75%
3/4	Values ranging between class 3 & 4	
4	Toxic	>75%

https://www.biobestgroup.com/en/side-effect-manual

Compatible pesticides

- **Miticides**:
  - Acramite (bifenazate)
  - Nealta (cyflumetofen)
  - Oberon (spiromesifen) - except *Persimilis*
  - Kanemite (acequinocyl)
  - Apollo (clofentezine)

- **Aphicides**
  - Beleaf (flonicamide) (for lygus and thrips too)
  - Fulfill (pymetrozine) – only safe on predatory mites and some parasitoïds

- **Caterpillars:**
  - Coragen or Altacor (Rynaxypyr = Chlorantraniliprole) (and Japanese beetle)
  - Confirm (Tebunozide)
  - All Btk (*Bacillus thuringiensis var. kurstaki*) (Bioprotec, Dipel)

- ENTRUST, SUCCESS, GF-120 (spinosad) safe on ladybugs, lacewings, predatory mites
- Non residual pesticides like soaps and mineral oil (Purespray Green Oil 13E)

Non compatible pesticides

- **SPINOSYN** (Group 5):
  - DELEGATE (spinetoram)
- **PYRETHROID** (Group 3: PYGANIC, CAPTURE, RIPCORD, UP-CYDE, MAKO, MATACOR, SILENCER, WARRIOR, DECIS)
- **ORGANOPHOSPHATES** (1B: CYGON, LAGON, MALATHION, DIAZINON, LORSBAN, NUFOS, PYRINEX….)
- **CARBAMATES (SEVIN)**
- **IGR (Rimon**: novaluron) (Group 15)
- **Movento** (spirotetramat) - only safe on Lacewings and predatory bugs (*Orius*)
- **Agrimek and Nexter (non compatible miticides)**
- **Neonic (Group 4A) : VERY TOXIC TO POLLINATORS !!!**
  - **ACTARA** (thiamethoxame) – But safe on some predatory mites
  - **CLUTCH** – (clothianidine) - But safe on syrphids and some predatory mites
  - **ASSAIL** (acetamiprid)– But safe on syrphids
  - **ADMIRE, ALIAS** (imidacloprid)

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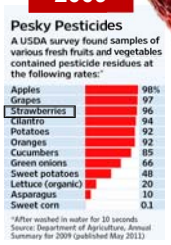
STRAWBERRIES in THE TOP 10 of THE DIRTY DOZEN ? CAN WE CHANGE IT?

2009



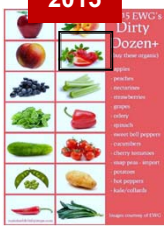
2011

2012

2013

2014

2015



2016

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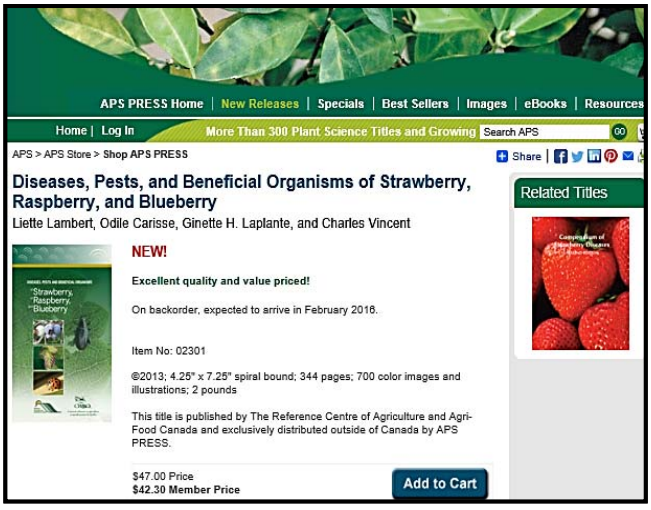

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http://www.craaq.qc.ca/Publications-du-CRAAQ/diseases-pests-and-beneficial-organisms-of-strawberry-raspberry-and-blueberry/p/PPTF0103

Merci

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