BIOLOGICAL CONTROL OF PHYTOPHAGOUS MITES IN APPLE ORCHARDS

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Noubar J. Bostanian
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Gaétan Racette

▲ A phytoseiid mite attacking a two-spotted spider mite

Finding and identifying mit

MITE PESTS

Are found over the entire leaf surface (both underside and upperside of leaves).

European red mite *(Panonychus ulmi).*
Roughly 0.3 mm. Adults and a red egg.

PREDACIOUS MITES

MITE PREDATORS

Are found mainly along the vein and at the base of the underside of the leaf.

Anystis sp.
Roughly 1 mm. These orange-coloured mites are fast moving and spin in continuous circles when searching for prey. Ostensibly they resemble a small red spider.

Adult feeding on an aphid

PREDATORY BUGS

Found mainly on the underside of leaves.

Hyaliodes vitripennis.
Roughly 4.6–4.9 mm. Adult (on the left) is dark with black lines on the transparent wings; nymph (on the right) is greenish.

VISIBLE WITH 10X HAND LENS

VISIBLE TO THE NAKED EYE

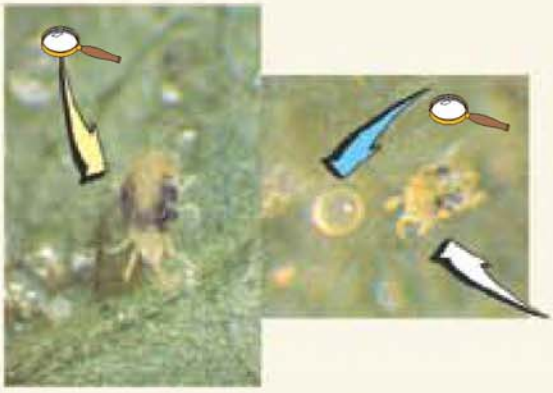
VISIBLE UNDER THE MICROSCOPE

ADULT

EGGS

YOUNG NYMPH

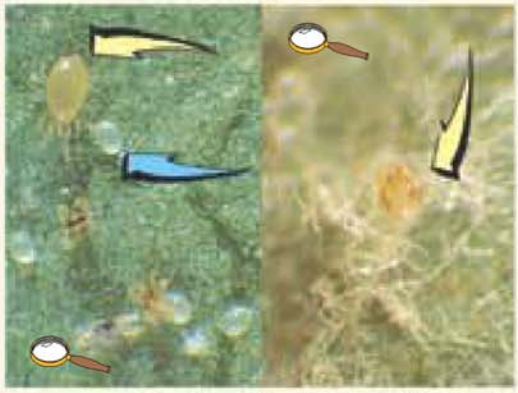
e pests and their predators



Two-spotted spider mite *(Tetranychus urticae).* Roughly 0.3–0.4 mm. Adult has two spots on its back.

Apple rust mite *(Aculus schlectendali).* Close to 0.2 mm. Adult conical in shape, barely visible under a hand lens.

Stigmaeid Mites (*Agistemus fleschneri).* This mite of the family Stigmaeidae measures 0.3–0.4 mm. Adult is yellow-orange with yellow legs. Eggs are round and canary yellow.



Phytoseiid mites *(Amblyseius fallacis and Typhlodromus caudiglans).* These two species, common in Quebec orchards, cannot be distinguished from one another with a hand lens. The teardrop-shaped adults, 0.3–0.4 mm in size, sometimes have brownish marks on the body. They move quickly over the foliage. The eggs are oval in shape.

Balaustium sp.
Roughly 0.8–1.4 mm. Adult light red initially, then burgundy in colour, with a velvety appearance. At first glance, they look like a small red spider. ◀

Blepharidopterus provancheri. Roughly 4.2–4.7 mm. Adult light green with multicoloured iridescence. ◀

To ensure successful biological control:

1. *Use non-toxic pesticides (see table);*
2. *Begin with a small area;*
3. *Choose predacious mites that are resistant to as many synthetic fungicides and insecticides as possible;*
4. *Reduce pest populations before introducing predators;*
5. *Have your orchard monitored by an expert regulary.*

Toxicity of certain pesticides to major predators in apple orchards according to studies and observations carried out in Quebec.

		Active ingredients	Commercial name	Stigmaeids	Phytoseiids
INSECTICIDES	Organophosphates	Azinphos-methyl	APM, GUTHION, SNIPER	●	●
		Diazinon	BASUDIN	☠	☠
		Dimethoate	CYGON	☠	☠
		Methidathion	SUPRACIDE	☠	☠
		Phosalone	ZOLONE	●	●
		Phosmet	IMIDAN	●	●
	Pyrethroids	Cypermethrin	CYMBUSH, RIPCORD	◕	◕
		Deltamethrin	DECIS	◕	◕
		Lambda-cyhalothrin	MATADOR	◕	◕
		Permethrin	AMBUSH, POUNCE	◕	◕
	Carbamates	Methomyl	LANNATE	☠	☠
		Pirimicarb	PIRIMOR	●	●
	Others	*Bacillus thuringiensis*	DIPEL, FORAY	●	●
		Endosulfan	THIODAN, THIONEX	◔	☠
		Imidacloprid	ADMIRE	●	●
		Tebufenozide	CONFIRM	?	●
ACARICIDES		Abamectin	AGRIMEK	?	?
		Clofentezine	APOLLO	☠	●
		Dicofol	KELTHANE	☠	◔
		Formetanate	CARZOL	☠	☠
		Mineral oil	SUPERIOR OIL	●	●
		Pyridaben	PYRAMITE	☠	●
FUNGICIDES		Captan	CAPTAN, MAESTRO	●	●
		Dodine	EQUAL	●	☠
		Flusilazole	NUSTAR	●	●
		Kresoxim-methyl	SOVRAN	●	●
		Mancozeb	DITHANE, MANZATE	☠	☠
		Mancozeb + Dinocap	DIKAR	☠	☠
		Metiram	POLYRAM	●	●
		Myclobutanil	NOVA	●	●
		Sulfur	SULFUR	☠	☠
		Streptomycin	STREPTOMYCIN	?	?
		Thiophanate-methyl	SENATOR	?	?
		Trifloxystrobin	FLINT (Product not registered in Canada)	●	?
THINNERS		Naphtyl-acetic acid	ANA	●	●
		Carbaryl	SEVIN XLR	◔	◔

● = Non-toxic
◕ = Non-toxic. Use up to 15 days after petal fall.
◔ = Non-toxic to certain strains of predators.
☠ = Toxic
? = No data available

Authors : Jacques Lasnier / Noubar J. Bostanian / Martin Trudeau / Gaétan Racette

BIOLOGICAL CONTROL OF PHYTOPHAGOUS MITES IN APPLE ORCHARDS

Biological control is an increasingly used tactic to replace the use of chemical acaricides in apple orchards. In 2003, over 20% of area cultivated with apples in Quebec were not treated with acaricides. Instead, the growers were using predacious mites and other mite predators to control the pest mites.

The move to biological control has been motivated by several factors:

- the high cost of chemical acaricides ($300/ha);
- pest resistance to synthetic acaricides;
- and the growing concern of consumers about the environment and food safety.

In practice, the goal of biological control is to establish sufficient populations of predacious mites and other predatory insects in orchards by:

1. Preserving predators found naturally in orchards (conservation);
2. Seeding predators from outside the orchard whenever required.

Noubar J. Bostanian, Acarologist, HRDC, Agriculture and Agri-Food Canada

The results of our studies show that managing mite pests with predacious mites is very effective. In addition, the establishment of a number of predators in an orchard improves the ecological balance, ensuring long-term stability for the system.

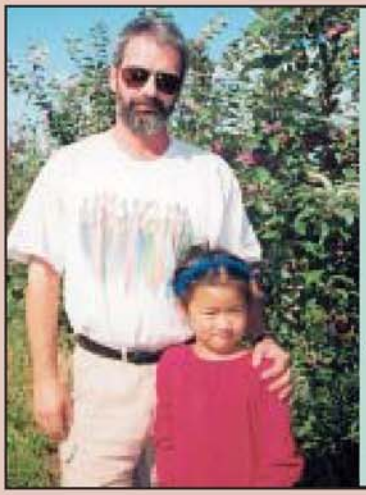
1. Preservation of Naturally Occurring Predators

The first step in a biological control program is to preserve predacious mites and other beneficials already present in the orchard. This simply involves using pesticides that are not toxic to predators (see table). Such an approach allows populations of beneficial insects and mites to survive and prosper naturally in orchards and to control pest mites.

Since predator species in orchards may vary from site to site and even from year to year, it is a good idea to protect as many predatory species as possible. If a given species does not show up one year, then other beneficials take over and control mite pests.

2. Introduction of Predators from Outside the Orchard

Wood pruned in winter (March - April) and on summer (July - August) can be used to transfer, or "seed," predacious mites into an orchard and thus speed up the establishment of populations of these beneficial mites. The pesticide treatment program in the orchard must also be modified. The purpose of seeding is to however, introduce or increase populations of predacious mites in an orchard by transferring beneficial mites from an orchard where they are abundant (donor orchard) to a recipient orchard where predators are not abundant. If the recipient orchard has a large population of mite pests, pest populations must be reduced before the transfer is carried out. If wood pruned in winter is to be used, an acaricide can be applied the summer before; if wood pruned in summer is to be used, the treatment can be done in spring.



Claude Tougas, Dunham

The biological control of mite pests in orchards responds to growing demands of consumers for food safety, while minimizing the negative impacts of synthetic pesticides to the environment. Furthermore, seeding predators by transfering pruned wood is a simple technique that has proven itself in my orchard. It has allowed me to save roughly $300/ha annually on the cost of chemical acaricides.

Resistance among predacious mites to pesticides may vary from orchard to orchard depending on the history of pesticide used. Therefore, it is essential to find out from the owner of the donor orchard whether the products you plan to use are compatible with the predators. In most Quebec orchards where

biological control is practiced, predacious mites are resistant to pyrethroids and several organophosphorus insecticides (see table).

Antoine Tanguay, Rougemont

I have been managing mite pests in my entire orchard with predacious mites for over ten years now. I am getting excellent results. By eliminating the use of chemical acaricides, I have saved around $40 000.

Transfer Technique Using Pruned Wood

1. Select an orchard block that is roughly one fifth of a hectare (one half an acre) for the introduction. The introduced predators will need a certain number of mite pests to feed and reproduce.

2. Find a donor orchard where predacious mites are abundant (i.e., where mite pests were controlled effectively by predators the previous summer).

3. Collect pruned wood from the donor orchard. If you are using winter prunings, select three-year-old wood or older.

4. Transport the pruned wood loose or in bundles and avoid jostling them. Use a closed trailer or pickup to prevent predators from being blown away. In summer, make the transfer quickly to avoid overheating the foliage.

5. In the recipient block, place the bundles vertically against the trunk of the trees at the base. Place four to five bundles around standard trees and one to two bundles around dwarf trees.

Using pruned wood to introduce predacious mites is inexpensive. The main costs involved are handling and transporting the pruned wood.

Conclusion

Higher numbers of mite pests may occur during the first year of biological control. During the second season, however, predator populations will increase, while populations of mite pests will generally be reduced to acceptable levels. Biological control is considered effective when levels of one predacious mite per ten apple leaves is obtained in July (determined by scouting). In order to allow predators to get established and their populations to increase, growers must be prepared to accept an initially higher level of pest mites without resorting to the use of acaricides or toxic insecticides that would kill predators.

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REFERENCES

BOSTANIAN, N.J. and N. LAROCQUE. 2000. Effects of a number of pesticides used in apple orchards on predacious mites. Joint annual meeting. Société d'entomologie du Québec, Entomological Society of Canada, Entomological Society of America. December 3-6, 2000.

BOSTANIAN, N.J. and N. LAROCQUE. 2001. Laboratory tests to determine the intrinsic toxicity of four fungicides and two insecticides to the predacious mite *Agistemus fleschneri* (Summers) (Acari: Stigmaeidae). Phytoparasitica. 29(3): 215-222.

BOSTANIAN, N.J. and G. RACETTE. 1997. Residual toxicity of lambda-cyhalothrin on apple foliage to *Amblyseius fallacis* and the tarnished plant bug. *Lygus lineolaris*. Phytoparasitica. 25(3): 193-198.

BOSTANIAN, N.J., H. THISTLEWOOD and G. RACETTE. 1998. Effects of five fungicides used in Quebec apple orchards on *Amblyseius fallacis* (Garman) (Phytoseiidae: Acari). Journal of Horticultural Science & Biotechnology. 73 (4): 527-530.

CHARBONNEAU, R., J. LASNIER and M. TRUDEAU. 2000. Lutte biologique contre les acariens phytophages des vergers à l'aide d'acariens prédateurs indigènes. CPVQ. Fiche technique VU 036 AGDEX 211/605.

LASNIER J. and R. CHARBONNEAU 1993. Rapport final Entente Canada-Québec sur le Plan Vert, le Défi des Ressources 24-81526706048. Lutte biologique contre les acariens phytophages des vergers à l'aide d'acariens prédateurs indigènes et de bandes-pièges.

LASNIER J. and R. CHARBONNEAU 1995. Rapport final Entente Canada-Québec sur le Plan Vert, le Défi des Ressources 24-81526706072. Lutte biologique contre les acariens phytophages des vergers à l'aide d'acariens prédateurs indigènes.

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