

Intraguild predation of *Adalia bipunctata* by *Harmonia axyridis*



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1. *Harmonia axyridis* Pallas (Coleoptera, Coccinellidae)

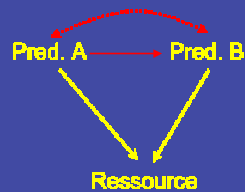
- Ladybird native of the Far East
- Characteristics : voracity, high fecundity and broad spectrum of prey, ...
- Introduction : North America (1916 – 1982), France, Greece, Portugal, ..., and Belgium (1997), but banning in Switzerland !
- Environmental risk scale (ERBIC) : 101 out of 125
- Negative impacts on North American entomofauna:
 - structure modification
 - Oregon : dominant species (LaMana & Miller, 1996)
 - Virginie :
 - Decline of *Coccinella septempunctata*
 - Dominance of ladybird guild (Brown, 2003)
 - Michigan : decline of two species : *Brachicantha ursina* (F.) et *Cycloneda munda* (Say) – and augmentation of *Chilocorus stigma* (Say) (Colunga-García & Gage 1998).

1. *Harmonia axyridis* Pallas (Coleoptera, Coccinellidae)

- Negative consequences on north american entomofauna
 - Reduce abundance of other aphidophagous organisms : *Aphidoletes aphidimyza* (Diptera, Cecidomyiidae) (Brown, 1999)
 - Stress monarch butterfly population (Koch *et al.*, 2003)
- Why ?
 - Good colonizer and very competitive species (Adriaens *et al.*, 2003) :
 - wide trophic niche
 - phenotypic plasticity for several life history-traits
 - strong dispersal capacities
 - intraguild predator >< *Coccinella septempunctata*, *Chrysoperla carnea*, ...

2. IntraGuild Predation IGP

- What ?
 - IGP = Competitor + Predation or Parasitism
 - « Eating of species that use similar resources and are thus potential competition »



3. Prey for *H. axyridis* and *H. axyridis* prey

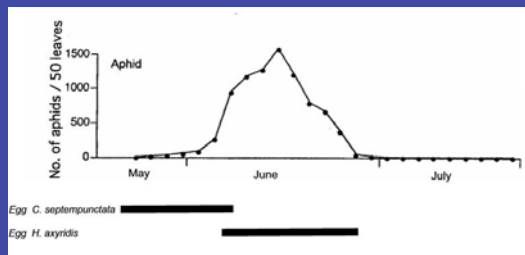
		Labo	Field
Predators			
<i>Adalia bipunctata</i>	Coccinellidae	P - E, L, P	?
<i>Adonia variegata</i>	Coccinellidae	P - E	?
<i>Chrysoperla carnea</i>	Chrysopidae	P - E	?
<i>Coccinella septempunctata</i>	Coccinellidae	P - L	P - L
<i>Coccinella septempunctata bruckii</i>	Coccinellidae	P - L, P	P - L
<i>Coleomegilla maculata</i>	Coccinellidae	P - E, L	Niche diff.
<i>Cycloneda sanguinea</i>	Coccinellidae	P - E, L	?
<i>Epiplatys balteatus</i>	Syrphidae	P - L	?
<i>Phyllobrotica</i>	Coccinellidae	P - L	?
<i>Propylaea japonica</i>	Coccinellidae	P - L	?
<i>Propylaea quatuordecimpunctata</i>	Coccinellidae	P - E	?
Other			
<i>Danaus plexippus</i>	Nymphalidae	P	?
<i>Vanessa cardui</i>	Nymphalidae	P	?

P = prey for *H. axyridis*; p = *H. axyridis* as a prey;

E = Egg; L = Larva; N = Nymph

4. Is *H. axyridis* a top predator ?

- Aphid and ladybird phenology in Japan (after Yasuda & Katsuhira, 1997) :



5. Aim of the study

To determine the potential of intraguild predation of a native aphidophagous *Adalia bipunctata* by *Harmonia axyridis*.

Two experimental approaches :

- Experimentation in Petri dish
=> to study predation behavior of *H. axyridis* towards *A. bipunctata* and inversely
- Experimentation in semi-field conditions
=> to simulate presence of 2 predators on a same resource

6. Experimental plan

Tests in Petri Dish

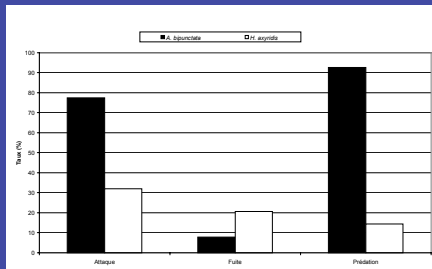
- to put together larva L4 - starved during 24h - with eggs, L1, L2, L3, L4
- 30 minute behavior observation according to Yasuda *et al.* (2001) ethogramme, 20 repetitions
- Mortality observation after 30 minutes and 24 h

Tests in semi-field condition

- 5 broad bean plants, cylindrical cages
- 5 repetitions with
 - 5 L2 *A. bipunctata* + 5 L2 *H. axyridis*
 - 5 ou 10 L2 *H. axyridis*
 - 5 ou 10 L2 *A. bipunctata*
 - control : aphids

7. Results : Petri dish test – on the whole

Attack and predation rate of *H. axyridis* on *A. bipunctata* are significantly superior ($\chi^2= 41, 5472$; $P < 0,0001$ and $\chi^2= 122,6619$; $P < 0,0001$) than opposite situation.



7. Results : Petri dish test – rate according to stade

- **Attack rate** : not difference for eggs ($\chi^2= 0,2133$; $P= 0,6442$).
- **Escape rate** : higher for *H. axyridis*.
- **Predation rate** : not difference for eggs ($\chi^2=3,1373$; $P= 0,0765$).

7. Results : Petri dish test – mortality rate

- Mortality after 30 minutes and 24 h :
 - Egg : no mortality difference
 - Larval stage : mortality significantly superior for *A. bipunctata*

7. Results : Petri dish test - discussion

- Egg stage : same vulnerability
- Larval stage of *H. axyridis* : less vulnerability => dorsal spines as a physical protection ?

7. Results : semi-field test

- *A. bipunctata* (Ad): mortality increase significantly with *H. axyridis* presence in comparison with 5 or 10 *A. bipunctata* ($\chi^2= 33,3333$; $P= <0,0001$ and $\chi^2= 19,8990$; $P= <0,0001$) .
- *H. axyridis* (Ha): no mortality difference with *A. bipunctata* presence in comparison with 5 *H. axyridis*

8. Conclusions

These experiments show that :

- this exotic species can easily attack the native ladybird, *Adalia bipunctata* ;
- in Petri dish and without any other food, *H. axyridis* behaves as an intraguild predator of *A. bipunctata*.
After 30 minutes, in presence of *H. axyridis*, the mortality of 3 first larval stage of *A. bipunctata* more than 80 % and after 24 h, all larval stage and egg are killed;
- in semi-field test : *A. bipunctata* can be a prey for *H. axyridis* in conditions of food limitation.

Thus, this new exotic species can be an important source of mortality for this native ladybird species !