Attract and Kill: combining trap crop and insecticide to control tarnished plant bug in stawberry field.

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Introduction

The tarnished plant bug (TPB) causes severe damages in strawberry field in Quebec. Phytoprotection strategies against the TPB mainly rely on the use of broad-spectrum insecticide such as synthetic pyrethroid [1]. The use of a broad variety of hosts by the TPB provides the opportunity to implement trap crop nearby cultivated plants [2 - 4]. Moreover, the use of trap crop can be combined with repressive methods (e.g. insecticide sprays) to increase its effectiveness [4 - 6]. Swezey et al. [4] reported that combination of trap crop (alfalfa) and vacuums successfully decreased the population of the Western Tarnished plant bugs, *Lygus hesperus* (Hemiptera: Miridae), by about 70 to 90 % in strawberry fields. These authors estimated that vacuuming trap crop reduced expenses in organic strawberry fields by 78 % compared to whole vacuuming practices.

Lygus lineolaris (Palisot de Beauvois) (Hemiptera: Miridae)

- TPB feeds on more than 350 host plants (of which more than 130 hosts have economical importance);
- TPB has 2 to 3 generations a year in Quebec;
- Overwintering as adult in the litter close to autumn/spring hosts.

Objectives

1) Attract and concentrate TPB in trap crop (buckwheat or mustard)

2) Kill TPB with insecticide sprays applied on trap crop

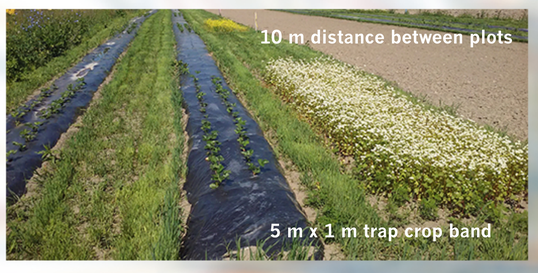
3) Using trap crops to bait overwintering TPB and increase winter mortality

Experimental design

The study was conducted on aexperimental farm in Mirabel (Quebec, Canada) (45.648934°N, -74.090042°E) during 2015 and 2016 summer/ autumn.

Experiment 1

In May (2015 & 2016), 4 blocks of 6 plots were implemented following a randomized complete-block design. For each plot, 2 mounds of 32 Day-neutral strawberry of the variety 'Albion' was planted under plastic mulches (2 rows of 16 plants).



Each plot was treated with one of those treatments:

1) control (no plant crop/ no insecticide);

2) conventional (no plant crop/ insecticide on strawberry plants);

3 & **4**) trap crop (either buckwheat or mustard/ no insecticide);

5 & **6**) trap crop (buckwheat or mustard/ insecticide on trap crop).

Experiment 2

In July 2016, 7 plots of 20 mullein plants were implanted neirby strawberry plants. At the end of October (2016), 30 x 30 x 30 cm cages were installed over 64 mullein plants in order to test the TPB's winter survivorship. Four TPB adults (collected on the field) were put in each cage.

Each cage was treated with one of those treatments:

1) control treatment;

2) bioinsecticide application (*Beauveria bassiana*);

3) hot water;

4) insecticide application (cypermethrin).

Data collection

Experiment 1

TPB population was monitored weekly from beginning of July to September. Four strawberry plants and two mustard or buckwheat plants were beated over a beating sheet. Adults and L4 and L5 nymphs were counted.

In each central row (2), strawberry were collected three time a week. Each fruit were classified undamaged or damaged by the TPB (strawberry damaged for other reason were discarded), and weighted.

Experiment 2

TPB population was monitored weekly by direct observation of three mullein plants by plot (from beginning of September to end of October). The winter survivorship was established by opening the cage in end of April, retriving the individuals and counting the number of TPB still alive.

References

[1] Perera & al. (2005)
[2] Stern et al. (1964)
[3] Stern et al. (1969)
[4] Swezey et al. (2007)
[5] Accinelli et al. (2005)
[6] Badenes-Perez (2006)

Acknowledgement

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Results

Tarnished plant bug population

Dry 2016 season shorten mustard flowering period, and impact TPB population observed on it

TPB population increased on strawberry plant once trap crop's flowering ended

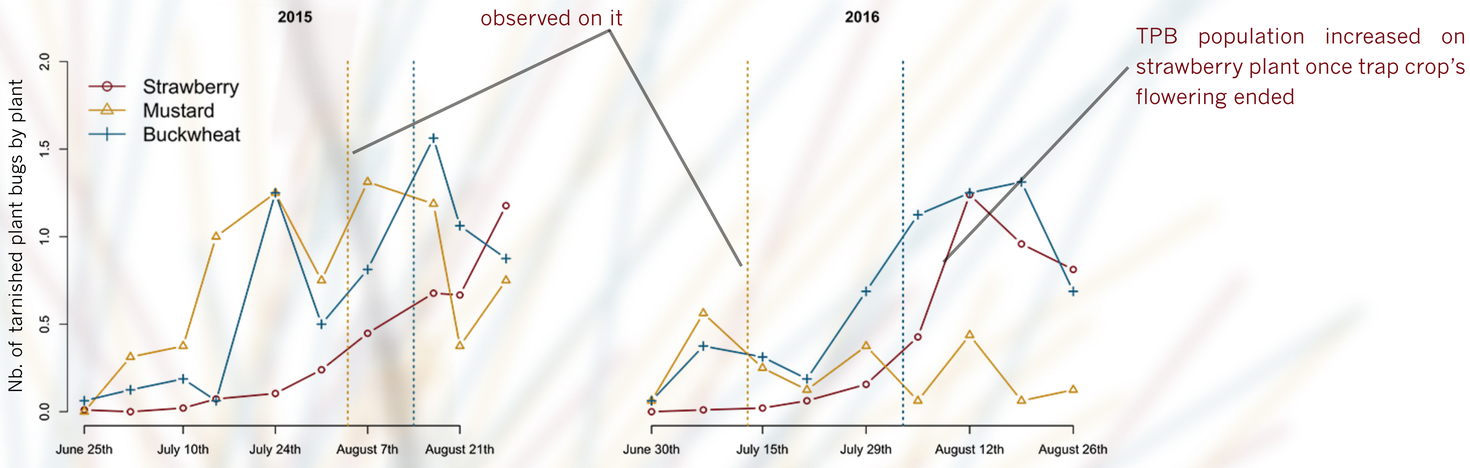

Fig. 1: Mean number of TPB individuals (adults and L4-L5 nymphs) found on hosts (red = strawberry; blue = buckwheat; yellow = mustard) over the 2015 and 2016 seasons. Dotted vertical lines represent the end of buckwheat (blue) and mustard (yellow) flowering period.

Trap crops suscessfully alter TPB distribution, and generate "hot spots"

Insecticide (Cypermethrin) did not reduce TPB population substantially over the season

TPB attracted by trap crops move to nearby strawberry plants later in the season

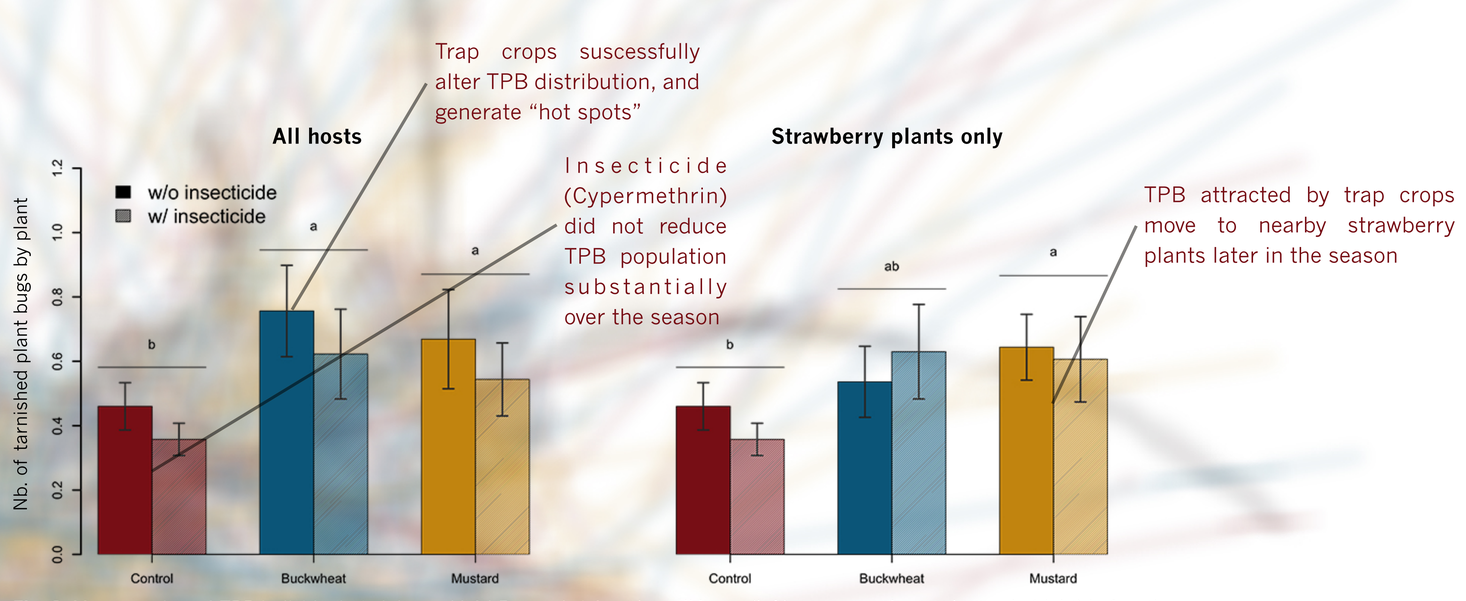

Fig. 2: Mean number of TPB individuals (adults and L4-L5 nymphs) found on all hosts (left) or on strawberry plant only (right) in function of treatments. Plots with trap crop attracted more TPB than plots with strawberry plants alone ($p = 0.02$) (left side). The insecticide sprays had no significant effect on TPB population ($p = 0.12$). TPB were more abundant on strawberry plants close to mustard trap crop than those without nearby trap crop ($p = 0.04$) (right side). The insecticide applications applied directly on strawberry plant did not contribute to create these differences ($p = 0.82$)

Yield

The repressive effect of the insecticide was observed only when it was sprayed directly on strawberry plant

The yield gain in the conventional treatment was yet low due to the short duration of the insecticide effects

Using insecticide on trap crop was ineffective; perhaps because the dosage was not adjusted for these specific plants.

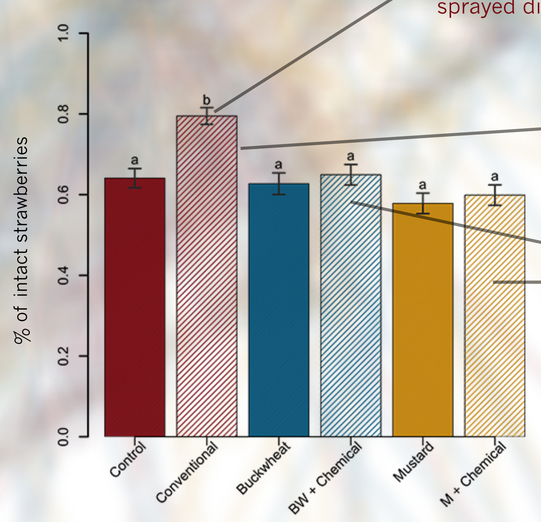

Fig. 3: Percentage of intact strawberries yielded in function of treatments. The interaction between trap crop and insecticides treatments had a significant effect on the proportion of intact fruit ($p = 0.01$).

Autumnal trap cropping & winter survivorship

Pre-overwintering TPB move to mullein plant at the end of the season.

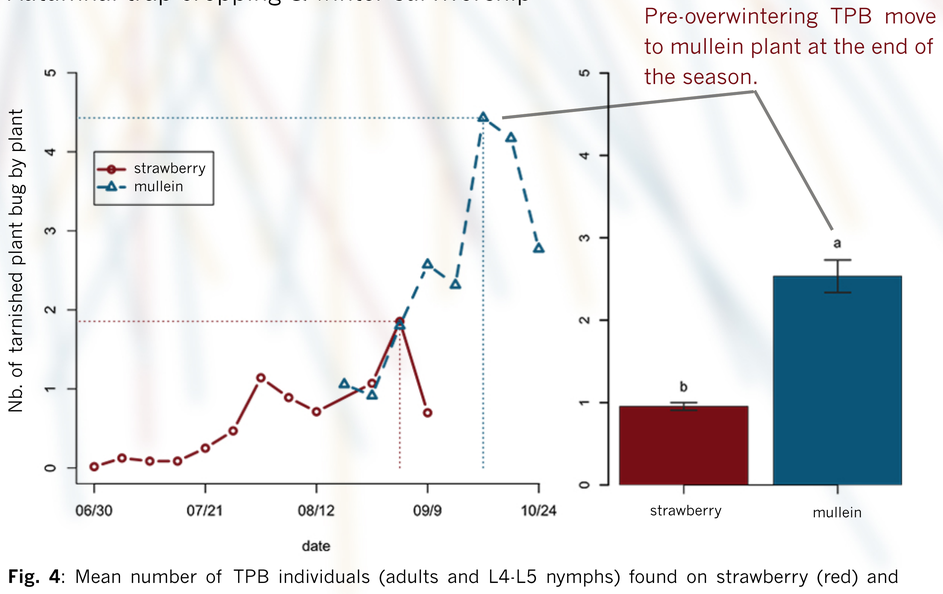

Fig. 4: Mean number of TPB individuals (adults and L4-L5 nymphs) found on strawberry (red) and mullein (blue) plants over the 2016 season (the right figure only included individuals observed from the beginning of August). Significantly more TPB by plant were observed on mullein than on strawberry ($p < 0.0001$).

No TPB exposed to a single autumnal insecticide treatment survived to winter.

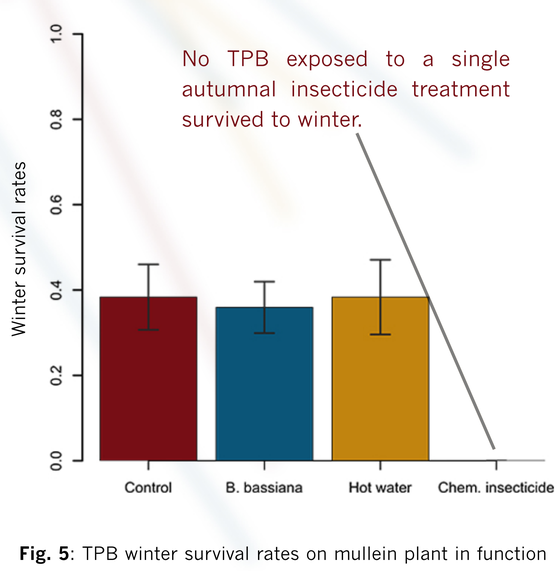

Fig. 5: TPB winter survival rates on mullein plant in function of various repressive treatments (bioinsecticide, hot water and chemical insecticide). There was no statistical differences among the control, the bioinsecticide and the hot water treatments ($p = 0.99$), whereas all individuals in the chemical insecticides treatment died during winter.