MONITORING STINK BUGS AND ASSESSING AN ATTRACT-AND-KILL STRATEGY TO REDUCE FRUIT DAMAGE IN APPLE ORCHARDS OF QUEBEC, CANADA

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INTRODUCTION

- Recent years have shown an increase in stink bug populations and damage within apple orchards of Quebec (Canada).
- This is not attributable to the brown marmorated stink bug (BMSB) who just established in a few cities as of yet (1).
- Few options are currently available in Canada to control stink bugs in Canadian fruit crops and the most effective products are also those with the greatest impact on beneficials (2-3).

Objectives:

1. Acquire knowledge on the seasonal abundance and species composition of stink bugs in apple orchards of Quebec, using pheromone traps and beating trays;
2. Adapt and test an attract-and-kill strategy based on the knowledge acquired;
3. Be better prepared for the arrival of BMSB in fruit crops

MATERIALS AND METHODS

Seasonal abundance and species composition (2019-2020)
Trials conducted in 4 apple orchards
with 5 replicates in each orchard

Monitoring tools :

- Pyramidal traps (AgBio) baited with specific or multi-species lures (Trécé)
- Beating trays (1 X 1 m)

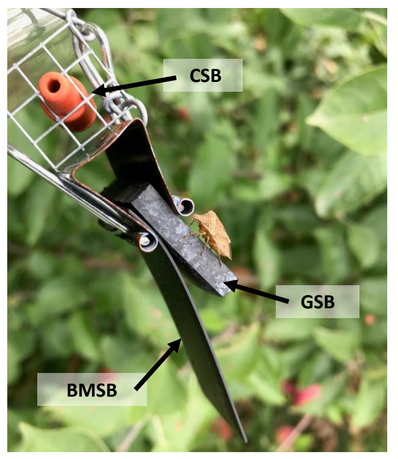
Lures used in traps :

- **CSB** : specific lure for Brown Stink Bug, *Euschistus* spp.
- **GSB** : specific lure for Green Stink Bug, *Chinavia hilaris*
- **BMSB + GSB** : dual lures for BMSB, *H. halys*
- **CSB + GSB + BMSB** : multi-species lures for BMSB, Brown and Green Stink bugs
- **Control** : unbaited traps

Attract-and-kill strategy (2021):
Trials conducted in 4 apple orchards with two plots (0.7-2.0 ha) within each orchard:
1) Attract-and-kill (AK)
2) Control (no specific treatment targeting stink bugs)

AK strategy:

- Oversized yellow sticky traps (2.5m high) baited with high dose of attractant (3 x CSB+GSB+BMSB)
- Traps made of 4 double-sided adhesive coated plastic panels (Olson products inc.) arranged in cross pattern and placed over trays filled with soapy water
- Deployed every 30 m at the periphery of the orchard (5-10 m from peripheral apple trees) from June to September



Multi-species lure in the top of a pyramidal trap


Pyramidal trap (h=1.2m)


Attract-and-kill trap (h=2.5m)

RESULTS

Seasonal abundance and species composition

- A total of 20 different species of stink bugs were identified from sampled sites.
- The brown stink bug, *E. servus euschistoides,* was largely predominant in the 4 sites regardless of the monitoring techniques used (Table 1) and throughout the season (Fig. 1).
- Predatory species (mostly *Podisus maculiventris)* were captured mainly by tree beating and represented about 2.4% of all individuals captured.
- Although their monitored numbers peaked in August and September, *E. servus* was present from the start of the season and oviposited in the orchard. (Fig. 1)

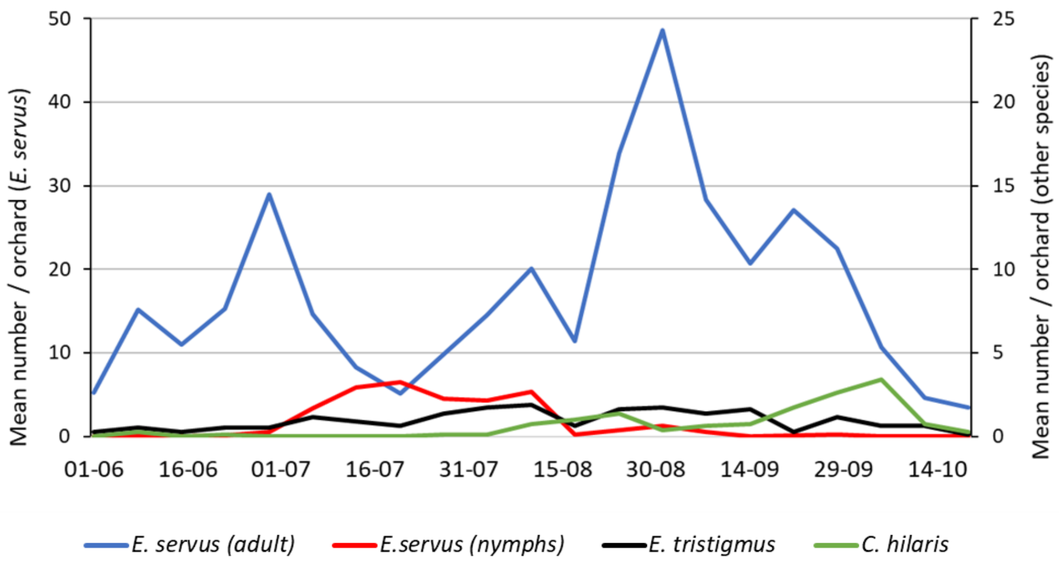
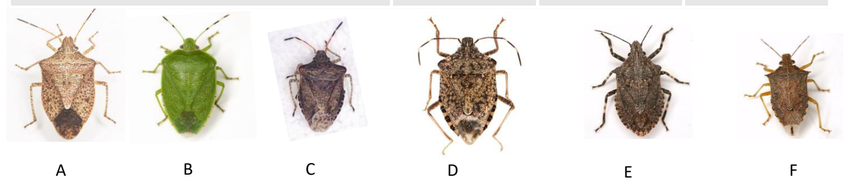


Figure 1 Seasonal abundance of native phytophagous stink bugs captured in pheromone-baited pyramidal traps and beating trays in four apple orchards in 2019-2020.

Table 1 Relative importance (%) of stink bug species captured in the four study orchards according to the monitoring tool.

Species	2019-2020		2021
	Pyramidal traps	Beating trays	AK traps
Euschistus servus euschistoides [A]	91,8	79,6	85,2
Chinavia hilaris [B]	1,8	7,1	12,4
Euschistus tristigmus [C]	4,7	4,2	1,6
Halyomorpha halys [D]	0,6	0	0,2
Brochymena spp [E]	0,1	6,6	0,04
Podisus spp [F]	0,5	2,4	0,4
Other species	0,8	0,5	0,3


A B C D E F

Attractiveness of specific and multi-species lures

- Trécé's multi-species lures (CSB + GSB + BMSB) caught the highest numbers of species and the highest numbers of *E. servus* and this combination was thus chosen for attract-and-kill trials in 2021 (Table 2).

Table 2 Cumulative mean number ± SE of stink bugs captured by pyramidal traps baited with different lures in 2019-2020.

Lure	*E. servus*	*E. tristigmus*	*C. hilaris*	*H. halys*
2019				
CSB+GBS+BMSB	22.7 ± 3.4 a	0.7 ± 0.2 a	0.05 ± 0.1 a	0,2 ± 0,1 a
CSB	15.7 ± 2.8 b	0.6 ± 0.1 a	0.05 ± 0.0 a	0 a
GSB	2.9 ± 0.7 c	0.2 ± 0.1 ab	0.10 ± 0.1 a	0 a
Control (unbaited)	1.1 ± 0.2 c	0.0 ± 0.2 b	0.05 ± 0.1 a	0 a
2020				
CSB+GBS+BMSB	30.4 ± 3.4 a	1.0 ± 0.3 ab	0.9 ± 0.2 a	0.1 ± 0.1 ab
CSB	19.0 ± 2.4 b	1.8 ± 0.6 a	0.4 ± 0.2 ab	0 b
GSB+BMSB	7.6 ± 1.9 c	0.3 ± 0.1 c	0.6 ± 0.3 ab	0.3 ± 0.1 a
Control (unbaited)	2.4 ± 0.8 c	0.6 ± 0.3 bc	0.1 ± 0.1 b	0 b

Means followed by the same letter are not significantly different (Kruskal-Wallis, α = 0,05)

Attract-and-kill strategy (AK)

- AK traps captured a large number of stink bugs during the season (equivalent to 10 000 individuals /ha of orchard). They were almost exclusively adults (Table 3), which were mainly collected in trays under the traps rather than on the sticky surface itself.
- The proportion of fruit injured by stink bugs at harvest was reduced by half in two of the four sites (Fig. 2). Overall, the reduction of damage averaged 25% but did not translate into a statistically significant effect.

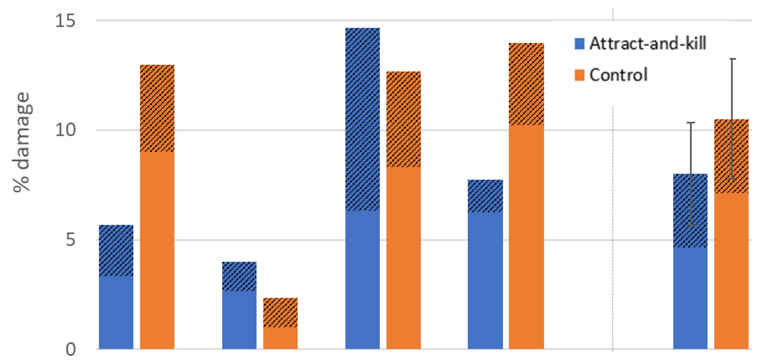


Figure 2 Percentage ±SE of fruit damage observed at harvest in AK and control blocks
Hatched area: portion of stink bug damage observed which does not downgrade the fruit.

Table 3 Total number ±SE of individuals collected per AK trap in 2021

Species	Total number / trap		Total number / ha
	Adults	Nymphs	
E. servus	890 ± 124	2,9 ± 1,0	10 260 ± 2337
C. hilaris	117 ± 46	1,2 ± 0,8	1 205 ± 488
E. tristigmus	15 ± 8	0	140 ± 51
H. halys	2 ± 0	0	20 ± 5
Brochymena spp	0,4 ± 0,3	0	4 ± 4
Podisus spp	7 ± 4	0	84 ± 44
Other species	3 ± 1	0	33 ± 4

CONCLUSION

- Adapted from trials carried out in the United States (4-5-6) and in Italy (7-8) targeting BMSB, the attract-and-kill strategy tested in this project was intended to manage the currently dominant species *E. servus* in addition to other native and exotic species present in Quebec.
- Although a statistically significant effect on fruit damage was not demonstrated in this trial, given the few options currently available the use of AK traps remains an option to be considered as a means of protection against stink bugs (on suitable sites) and/or as a monitoring method.
- Evaluation of the proposed strategy over larger areas (and of its cumulative effect over several years) should be looked at in future studies.
- Several measures could also be considered to optimize the method and improve its economic feasibility. For example, installing traps later in the season, when stink bug populations are higher and when damage most frequently evolves towards economic damage, could reduce costs by half.

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