Monitoring and Management Tactics for Control of Ambrosia Beetles in NY Apple Orchards
Final Report 2017

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Preventive Treatments against *Xylosandrus germanus* (Black Stem Borer)

In three Wayne Co. sites with known orchard infestations of black stem borer (BSB) – Furber, Hermenet, and Simpelaar – trials were set up using potted 'Harrison.G-935' nursery apple trees inside or alongside of wooded areas directly adjacent to the orchard plantings. The potted trees were flooded to stress them into producing ethanol, so as to attract beetles and promote new attacks. Additionally, individual ethanol lures were attached to each tree to increase their attractiveness to the beetles. On May 11, just as the adult flight was starting, trunks of the potted trees were treated with one of eight candidate preventive trunk treatments:

1 - Lorsban Advanced (chlorpyrifos, Dow AgroSciences), 1.5 qt/100 gal, applied using a Solo AccuPower 416 battery-powered backpack sprayer with a TeeJet 8004 LP flat fan nozzle
2 - SPLAT Verb (verbenone repellent, ISCA Technologies, EPA Reg. No. 80266-20), 35.0 g/tree, applied in a vertical line up the trunk starting just above the graft union using a pre-calibrated caulking gun
3 - Lorsban Advanced followed by SPLAT Verb
4 - SPLAT "A" experimental verbenone-based formulation, 35 g/tree
5 - SPLAT "B" experimental verbenone-based formulation, 35 g/tree
6 - SPLAT "C" experimental verbenone-based formulation, 35 g/tree
7 - Disrupt Micro-Flake VBN (verbenone repellent, Hercon Environmental, EPA Reg. No. 8730-68) 4.0 g/tree, applied by hand with brushed-on Micro-Tac adhesive to the trunk up to 12-15" above the graft union
8 - Lorsban Advanced followed by Disrupt Micro-Flake VBN
9 - Blank flakes
10 - Untreated Check

Each treatment was replicated on 6 trees, which were arranged in 6-tree groupings at each of the sites, with groups of trees separated by a distance of 30 m (one group per treatment per site).

Verbenone, a natural terpene compound found in many plants such as pine trees, is used in the control of bark beetles such as mountain pine beetle and Southern pine bark beetle. It is produced, probably as a defensive mechanism, when the number of insects in an infested tree approaches the maximum that the tree can support, and acts as repellent to other beetles. Because it has demonstrated efficacy in related groups of bark boring beetles, as well as this species, we proposed that it might offer a higher degree of prevention than using insecticide sprays alone. Half of the treated replicates were evaluated for infestations on July 5, after the end of the first adult flight of the season, and the remaining replicates were evaluated near the end of the season, on August 29. Infestations were quantified and assessed by destructive sampling and dissection in the lab, to determine the following classes of infestation in the test trees: # of attack sites/tree, # of trees containing empty galleries, # of trees containing live adults, dead adults, and brood.

The preliminary evaluation revealed no infestations or injury whatsoever at the Hermenet or Simpelaar sites, and only marginal damage in two of the treatments at Furber – 1 damaged tree in the SPLAT Verb treatment, and 1 in the untreated Check. On the date of the final evaluation, only the Furber site showed measurable levels of damage in the different treatments (Table 1); once again, the Hermenet site was without damage, and at the Simpelaar site there were only 2 infested trees, both in the untreated Check.

The results at Furber did show some statistical differences among the treatments. For the number of attack sites (holes) per tree, neither of the plain verbenone treatments (SPLAT Verb or Disrupt Micro-Flake VBN) were significantly different from the Check or the Blank Flakes treatments, and two of the experimental SPLAT formulations, "B" and "C", were the only treatments showing zero damage. Lorsban Advanced, with a low level of attack sites, was statistically comparable to SPLAT "B" and "C"; however, Lorsban in combination with either of the verbenone formulations was no better than any of the other treatments. Lorsban plus the micro-flakes actually had the highest incidence of attack sites.

Results were comparable for the number of sites with empty (aborted) galleries; only SPLAT "B" and "C" had zero incidence for this category of damage. In the category of number of sites containing adults, results were zero for the Lorsban and all of the SPLAT formulations, with some statistical separation among treatments. There were no statistical differences among any of the treatments for number of attack sites containing brood. Many of the infestation category readings had a high level of variability, so results showing statistical differences were not always the lowest mean values. For the entire evaluation, only the SPLAT "B" and SPLAT "C" treatments had zero across all infestation categories.

These results indicate that the SPLAT "B" and "C" formulations definitely had a measurable effect on preventing infestations of black stem borers in the test trees. The composition of these formulations is not currently being disclosed by the manufacturer for proprietary reasons, but it is clear that follow-up trials on these products would be warranted in subsequent seasons. It is not known why the overall infestation levels were so low during the season and among the trial sites, particularly since we were collecting fairly high numbers of adults in our traps set out around the region, including all of the potted tree trial sites (see next section). It can only be speculated that the inordinately long and heavy periods of rainy weather during June and July this year may have somehow interfered with the normal infestation behavior of the local BSB populations. Only the Furber site, where the potted trees were placed in the woods (rather than adjacent to them and along the fence lines, as at the other two sites), showed levels of infestation high enough to generate measurable results among the different treatments.

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Trapping Trials to Determine Occurrence and Timing of *Xylosandrus germanus* (Black Stem Borer) Ambrosia Beetles in NY Orchards, 2017

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In 2017, traps were placed at a total of 30 orchards around the state (Wayne Co., 8 sites; Orleans Co., 5 sites; Geneva, 1 site; Champlain Valley/Capital District, 8 sites; Hudson Valley, 8 sites) to determine the occurrence and timing of BSB. Traps consisted of inverted 1.75-L plastic juice bottles, which had 6 x 10-cm rectangles cut out of each of the sides and were baited in the upper portion of the traps with pouch-style dispensers loaded with 10 ml of 95% ethanol; water with a small amount of dish detergent was placed in the cap was used as a capture medium. The traps were suspended from 1.2-m tall metal garden hangers at a 1-m height; at each site, two traps were placed on an edge of the planting adjacent to a hedgerow, and, in all but the Hudson Valley locations, two additional traps were located in the orchard interiors, ~20–30 m from the orchard edge and in proximity to previously attacked trees, to verify their attractiveness. Traps were checked 1–2 times per week starting in early May, before maximum temperatures of 20°C began to occur, and through the summer. Beetles trapped were collected, sorted and identified.

Results

Beetle activity began in most locations on 3-4 May statewide (corresponding to 96–109 and 102–157 $DD_{10°C}$ among trap sites in the Lake Ontario and ENY regions, respectively), although one adult was captured in the Hudson Valley on 29 Apr. The first peak flight was 17 May in Wayne Co., with over 300 average beetles per edge trap (Fig. 1), and 22-24 May in the other locations around the state. Peak numbers in the highest Orleans Co. sites were about half those seen in Wayne Co. (Fig. 2). All the eastern NY sites recorded relatively low captures throughout the season, with peak numbers of only 13 per trap in the Champlain and 7 per trap in the Hudson Valley (Figs. 3, 4). The first adult flight ended on 31 May in the Hudson Valley, 21-22 Jun in western NY, and approximately 26 Jun in the Champlain. The second summer flight proceeded at much lower levels statewide through August, as has been observed previously, with very few beetles captured after 1 Sep. In the western NY trapping sites, higher numbers of beetles were routinely captured at the orchard edge than in the interior, although appreciable numbers were taken inside the blocks at some of the most heavily populated sites (Fig. 1).

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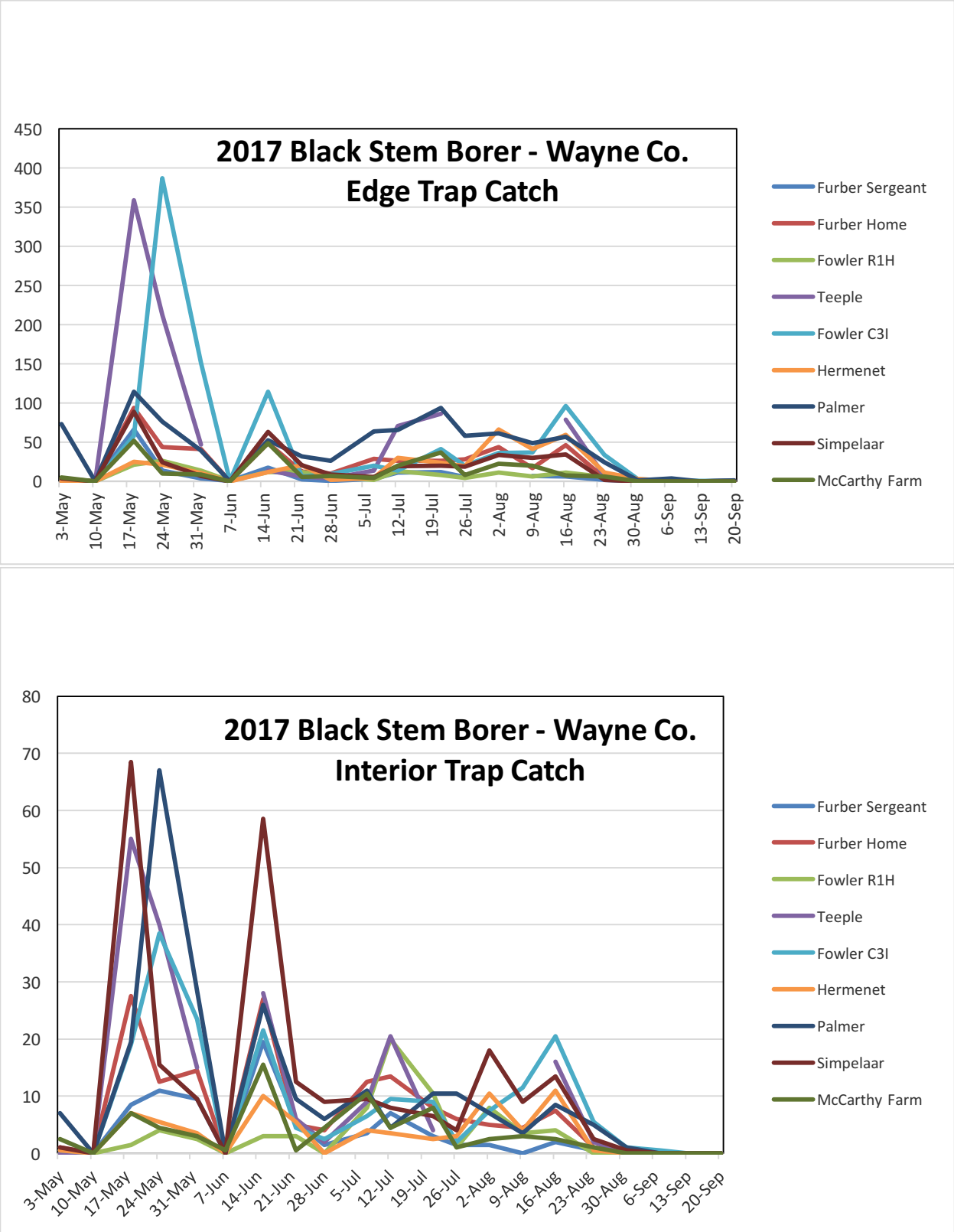

Fig. 1. Trap captures of BSB in the Lake Ontario region, 2017. (Top, captures at the orchard edge; bottom, captures in the orchard interior.)

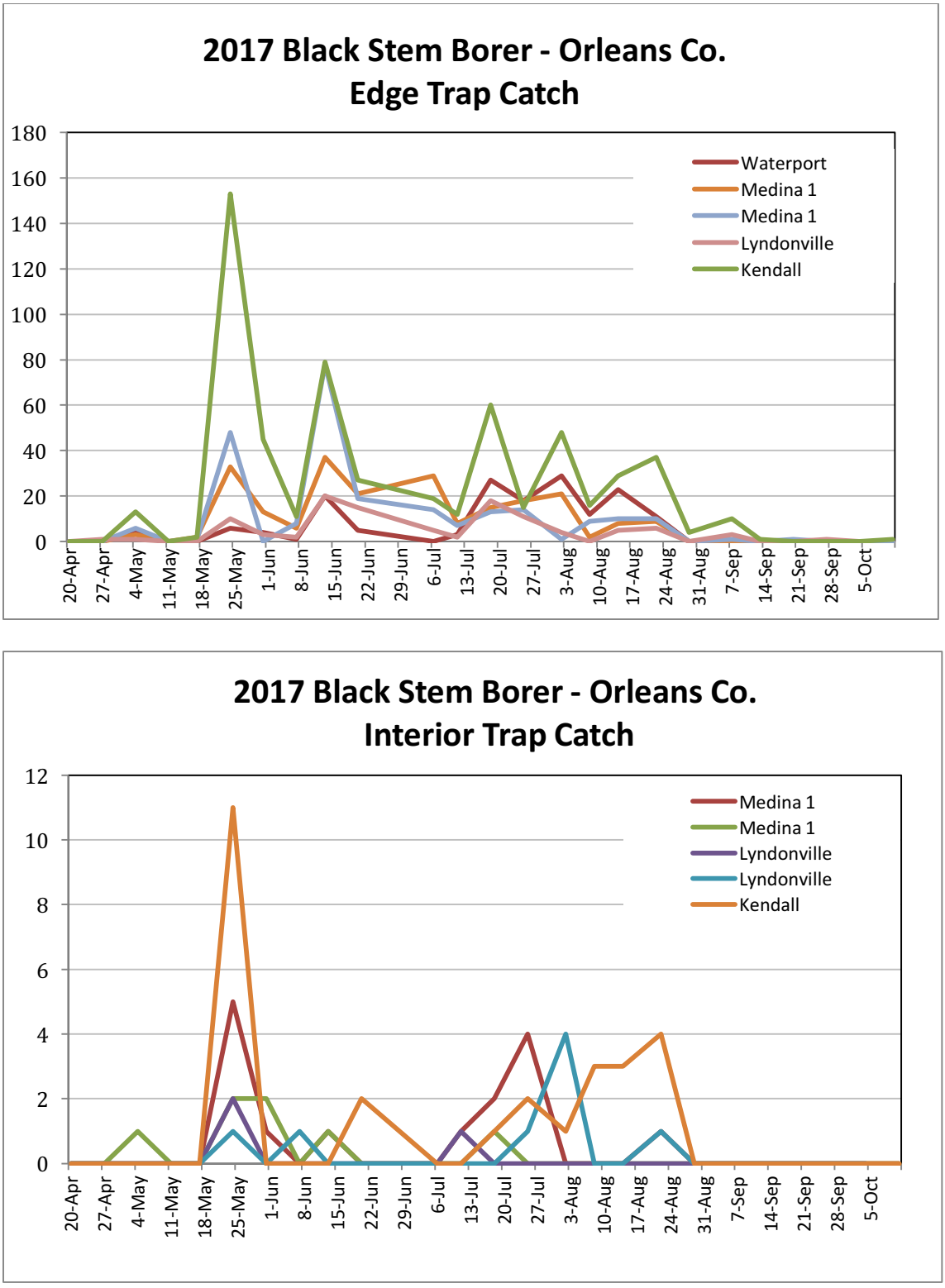

Fig. 2. Trap captures of BSB in Orleans Co., 2017. (Top, captures at the orchard edge; bottom, captures in the orchard interior.)

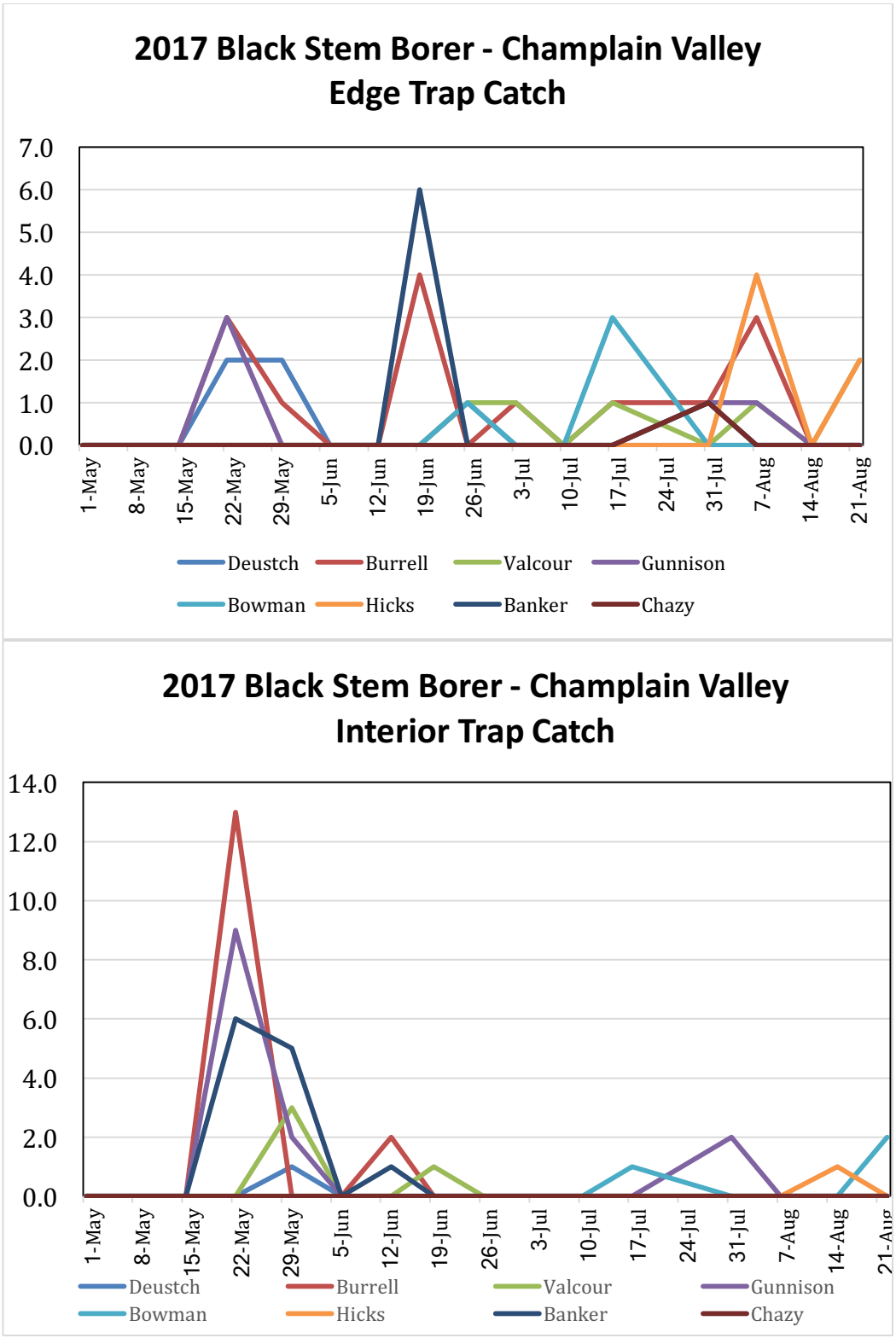

Fig. 3. Trap captures of BSB in Champlain Valley region, 2017. (Top, captures at the orchard edge; bottom, captures in the orchard interior.)

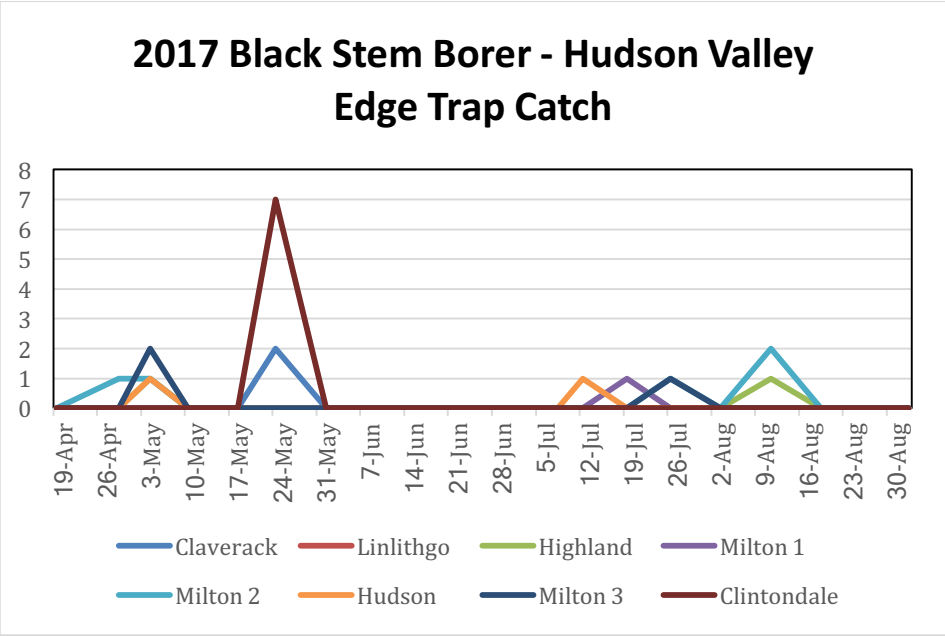

Fig. 4. Trap captures of BSB in Hudson Valley region, 2017

Table 1. Mean (± SE) infestation levels by *X. germanus* in potted apple trees on 29 Aug after a preventive trunk application on 11 May. Sodus, 2017.

Treatment[a]	no. attack sites/tree	no. sites/tree containing empty galleries	brood[b]	adults
Check	1.3 ± 0.9ab	1.3 ± 0.9ab	0.0	0.7 ± 0.7ab
SPLAT Verb	1.0 ± 0.6ab	0.3 ± 0.3ab	0.3 ± 0.3	0.3 ± 0.3ab
Lorsban Advanced	0.3 ± 0.3b	0.3 ± 0.3ab	0.0	0.0b
SPLAT Verb+Lorsban Advanced	2.7 ± 2.2ab	2.3 ± 1.9ab	0.3 ± 0.3	0.0b
SPLAT "A" (XF+V10)	3.7 ± 2.0ab	1.7 ± 1.7ab	0.7 ± 0.7	0.0b
SPLAT "B" (XF+V10M10)	0.0b	0.0b	0.0	0.0b
SPLAT "C" (XF–V10M10)	0.0b	0.0b	0.0	0.0b
Verbenone Disrupt Micro-Flake	5.0 ± 4.5ab	5.0 ± 4.5ab	0.7 ± 0.3	1.3 ± 0.9ab
Verbenone Disrupt Micro-Flake+Lorsban Advanced	5.7 ± 0.9a	4.3 ± 1.5a	0.7 ± 0.7	1.7 ± 0.7a
Blank flakes	2.5 ± 2.5ab	2.5 ± 2.5ab	0.0	2.0 ± 2.0ab

[a] Values within a column followed by the same letter not significantly different at $p < 0.05$ (Student's t test; data transformed using arc-sine sqrt before analysis)