SHORT, NON-REFEREED PAPER

TRAPPING ELDANA: MYTH OR REALITY?

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Abstract

For the past 40 years, *Eldana saccharina* Walker (Lepidoptera: Pyralidae) has been an important sugarcane pest in South Africa. As the world becomes more environmentally conscious, SASRI is working towards the implementation of an area-wide Integrated Pest Management strategy in order to decrease the use of insecticides. To assess the efficiency of this integrated approach, *E. saccharina* infestation levels must be accurately monitored. The method currently used to quantify the number of larvae per field is time consuming and labour intensive, and so a simpler trapping system is being researched to monitor moth populations. To this end, the efficacy of seven trap designs was tested by releasing a known number of females in a netting cage and their capture rate compared. The most efficient was a panel trap originally designed to catch beetles. Using recently acquired knowledge on the chemical ecology of *E. saccharina*, the Panel traps were baited with different volatile compounds known to be emitted by host plants or the moth. Traps baited with 3-hexenyl acetate significantly increased the catching rate of female moths compared to non-baited traps. Future work will test diverse mixtures of compounds to further improve the catch, before conducting field experiments.

Keywords: *Eldana saccharina*, chemical ecology, sugarcane, trap, plant volatiles, pheromone compounds

Introduction

Eldana saccharina Walker (Lepidoptera: Pyralidae) has been an important pest of South African sugarcane for more than 40 years because traditional pest management approaches have not adequately controlled this borer (Conlong, 1997). For this reason, the South African Sugarcane Research Institute (SASRI) is currently implementing an area-wide Integrated Pest Management approach, by combining different methods of control such as habitat management (Conlong and Kasl, 2000; Barker *et al.*, 2006; Ramgareeb *et al.*, 2010; Harraca *et al.*, 2011a) and Sterile Insect Technique (Walton and Conlong, 2008; Mudavanhu *et al.*, 2011; Walton *et al.*, 2011). To assess the effectiveness of these strategies, *E. saccharina* populations must be easily and accurately monitored in the field.

Traps concentrate insects which are sparsely distributed in the air, and are successfully used as detection, monitor, barrier or even control tools (Witzgall *et al*., 2010). SASRI is already using the pheromone trap technique to detect and monitor the incursion of the moth pest *Chilo sacchariphagus* Bojer (Lepidoptera: Crambidae) in the Northern regions of South Africa and Swaziland (Way *et al.*, 2011). From the 1970s to 1990s, Robinson light traps were deployed in South African fields (Atkinson, 1980) and gave practical information about geographical distribution, population abundance and flight activity of *E. saccharina* (Atkinson, 1982; Carnegie and Leslie, 1990, 1991). However, several shortcomings are associated with these light traps including cost, non-selectivity of the catches and the need for a power source. Therefore, several attempts to develop smaller and more affordable traps were researched (Way, 2000; Rutherfiord *et al.*, 2009), but to date no efficient system has been developed. Recent advances in chemical ecology (Ramgareeb *et al.*, 2010; Harraca *et al.*, 2011a,b) are incorporated into the research effort to develop a trap for *E. saccharina*.

Methods

Batches of 30-50 newly emerged females reared in the laboratory were released into netting cages (60% shade net, 2×2×2 m) in the centre of which a trap was positioned. The percentage catch was calculated using the number of moths caught by the trap divided by the number of moths recovered in the netting cage after one night of experiment.

Readily commercially available traps (Insect Science™, South Africa[1]) were tested. The Delta trap, already tested by Rutherford *et al.* (2009), was used as a standard. Its design was modified to create a series of traps which cope better with the particular displacement of *E. saccharina*: instead of hanging, they were placed on top of a pole, a hole allowing the moth to enter the trap from below by walking up the pole (Figure 1b). In a second set of experiments, the Panel trap, similar to the Pennsylvanian trap used by Atkinson (1980) with the light source replaced by an odorant stimulus, was tested in parallel with a yellow Bucket-funnel trap commonly used to catch flies (Figure 1b). The last trap tested in this set was a bundle of dead sugarcane leaves (Figure 1b), as piles of leaf trash were reported to act as a trapping material in the field (Leslie, 1990) and such techniques can be readily used by small-scale growers.

The traps were baited with different odorant stimuli. Natural sex pheromones were released at night by three live males *E. saccharina* placed in a small cage. Six synthetic compounds were also tested individually; vanillin, eldanolide (both sex pheromones compounds of this species), 1,8-cineole, 3-hexenyl acetate (both common compounds emitted by plants), benzaldehyde and decanal (both more general olfactory cues, but also emitted by plants).

Results and Discussion

Females were used in these experiments because they give rise to future infestations, are more inclined to disperse than males and provide better information about the state of a population (Atkinson, 1980, 1981).

Two separate sessions of experiments were done to test the effectiveness of the seven different trap designs baited with the three live males as attractant. Due to the large variations and the small number of replicates, there were no significant differences in catch between the traps. However, the catches of Delta-pole horizontal traps and Panel traps were always higher than those of the standard Delta trap, in the first and second session of experiments respectively (Figure 1a). The percentages of catches in the Delta trap were lower than those obtained by Rutherford *et al.* (2009) with excised male abdomen used as bait. Such poor attraction of live males is similar to the results reported by Atkinson (1980), who did not

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manage to attract either sex of *E. saccharina* in any meaningful quantity when using live males as bait.

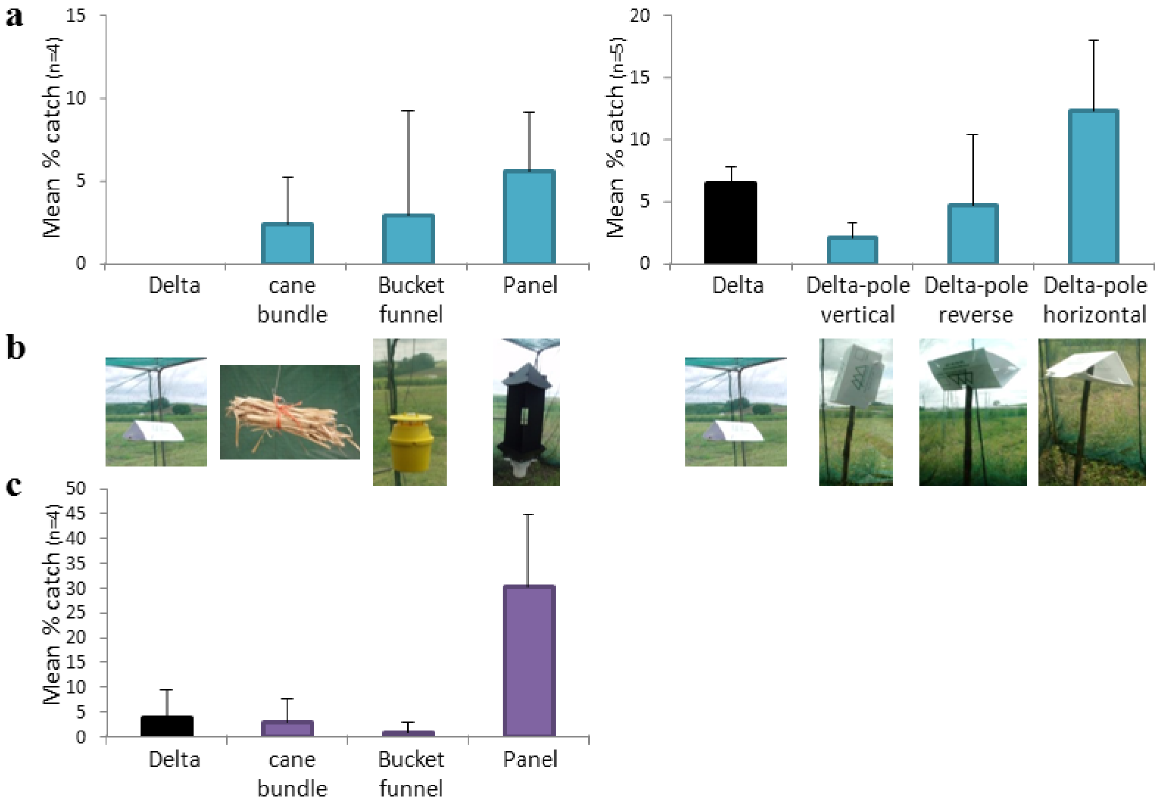

Figure 1. Comparison of percentage female *Eldana saccharina* caught in seven traps (b), baited with three live males (a) or with 3-hexenyl acetate (c). Each graph represents an independent experiment.

To confirm the findings from the second set of experiments, live males were replaced with 3-hexenyl acetate as bait. The Panel trap was again more efficient than the three other trap designs (Figure 1c). Despite this repetition of results, the percentage of catch varied considerably depending on the bait (Figure 1a and 1c), therefore other synthetic compounds were tested in the Panel trap (Figure 2).

The general trend is that decanal did not influence the catch, while fewer moths were caught in Panel traps baited with benzaldehyde or 1,8-cineole (Figure 2). In contrast, more moths were caught when the Panel trap was baited with eldanolide, 3-hexenyl acetate or vanillin. This increase was significant with 3-hexenyl acetate (Wilcoxon signed ranks test, V=443.5, $p<0.05$) but not with vanillin (V=23, $p=0.15$), most probably because of large variations in catch and lower number of replicates (n=35 and 8 respectively; Figure 2). Despite the low catch when using live males releasing their sex pheromones (Figure 1a), the results of attraction with the sex pheromone constituents eldanolide and vanillin (Figure 2) corroborate Rutherford *et al.* (2009), who improved catches in Delta traps using excised pheromone glands. The significant attraction to 3-hexenyl acetate (Figure 2) was unexpected, as this compound is one of the green leaf volatiles released by plants to signal being attacked by herbivores (Reddy and Guerrero, 2004). The repulsive effect of 1,8-cineole is of interest, as this compound is a secondary plant molecule emitted by plants such as *Melinis minutiflora*, which is known to naturally repel *E. saccharina* (Barker *et al.*, 2006; Harraca *et al.*, 2011a).

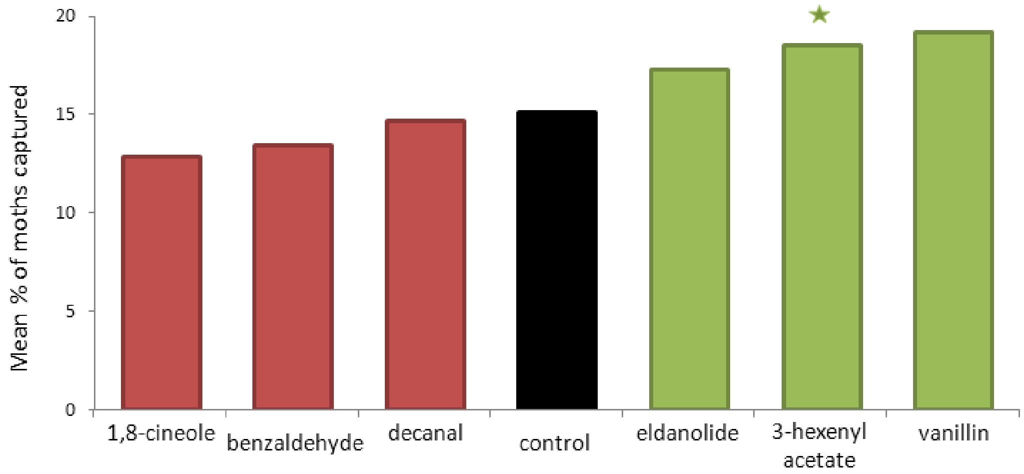

Figure 2. Percentage of female *Eldana saccharina* caught in Panel traps baited with different compounds. The control corresponds to a non-baited Panel trap. The star above the 3-hexenyl acetate bar shows a significant increase in catch compared to the control (Wilcoxon signed ranks test, V=443.5, $p<0.05$).

The percentages of catch by baited Panel traps were higher than those measured with Robinson light traps using the same procedure (unpublished data[2]). Therefore, Panel traps may efficiently replace the Robinson light trap formerly used (Atkinson, 1980), provided confirmation is obtained in sugarcane field trials. Further experiments to improve the bait will continue in the netting cages. Indeed, as reviewed on other moths species by Reddy and Guerrero (2004), a mixture of pheromone and plant compounds (such as 3-hexenyl acetate or benzaldehyde) might synergistically enhance the attraction of *E. saccharina* to the Panel trap. The compounds emanating from attractive *Fusarium* spp. (McFarlane *et al.*, 2009; Ramgareeb *et al.*, 2010) should also be investigated as potential attractive baits. Ultimately, efficient baited traps could become an additional control strategy within the SASRI area-wide Integrated Pest Management programme.

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