Development and commercialization of mass trapping for control of Eggplant borer, Leucinodes orbonalis in South Asia

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This paper describes collaborative research conducted in an effort to develop a mass trapping technology for control of eggplant shoot and fruit borer, L. orbonalis, as part of an IPM package of technologies. While the concept of using pheromones for pest management is by no means new, their use for controlling lepidopterous pests by mass trapping is innovative. Apart from the health and environmental benefits that are expected to accrue from adopting pheromones for control of L. orbonalis it was anticipated that farmers and consumers’ choices would be respected because the control technology does not require farmers to change the varieties they grow in order to produce a good crop. Having developed an attractive, long-lasting lure and low-cost, efficient trap for catching male L. orbonalis (Cork et al., 2001, 2003) the question remained whether sufficient male moths could be trapped to have an effect on mating and hence fruit and shoot damage by their progeny. Nevertheless, before that question could be resolved it was important to establish parameters associated with the deployment of traps that would ensure that catch per unit time and area was maximised. In particular, the number of traps per unit area (traps per ha) and the location of traps in a crop (e.g. height above ground level) had to be optimized.

An early trial conducted in November 2000 in Jessore (4 replicates, 24 nights) in collaboration with researchers from BARI demonstrated that trap height was important for catch and that crop height was the optimal height for trap placement. Similarly, the effect of trap density on total catch was assessed by conducting a trial in Jessore (3 replicates over 30 nights) in which the number of traps per unit area within a matrix of traps with 10 m spacing was varied. The results showed that for trap densities of 3 to 6 per 100 m² there was no significant difference in catch but that the maximum number of moths
caught per unit area was the same for between 4 and 6 traps per 100 m², although 3 traps per 100 m² caught significantly fewer male moths. Thus, it was established that 4 traps per 100 m² at crop height would catch an optimal number of male moths given the efficiency of the current water trap and attractiveness of the 99 : 1 blend of (E)-11-16:Ac and (E)-11-16:OH dispensed from a polyethylene vial loaded with 3 mg of pheromone.

Given the problems encountered during attempts to get farmers in South Asia to adopt mating disruption for control of yellow stem borer, Scirpophaga incertulas in rice (Cork, 1998) the decision was taken early in our research to develop a form of mass trapping for control. Thus, it was assumed that farmers dissatisfied with the performance of insecticides would be more receptive to adopting a new control technology that allowed them to see the insects killed, ‘seeing is believing’. Nevertheless, it initially proved impossible to convince farmers to stop applying insecticides. Thus, in the first replicated (3 x 0.5 ha) farmer-field mass trapping trails conducted in Jessore, Bangladesh in 2001 a series of ‘best bet’ trials were conducted in which insecticide applications were allowed in both mass trapped and farmers’ practice treatments. Given the longevity of the brinjal crop and the overlapping nature of generations of L. orbonalis it was apparent that progeny emerging from the crop would provide a significant threat to the effectiveness of the mass trapping strategy and so infested shoots were also removed by hand and destroyed.

Brinjal crops in two physiological stages of development were chosen for the trials, a mature crop that already had an average of 50% fruit damage (Figures 1a-b) and a young crop (Figures 2a-b) still in the vegetative stage of development when mass trapping was imposed. Despite the high initial fruit damage in the mature crop, within two weeks of implementation of the trial fruit damage was reduced to 35% in mass trapped plots but had increased to 55% in insecticide-treated plots (Figure 1b). In the immature crop the mass trapped plots sustained an average of 20% fruit damage over the trial period but in the insecticide-treated plots fruit damage levels continued to increase, attaining 45% damage after nine weeks of installing traps in the mass trapped plots (Figure 2b) (Cork et al., 2003).

On the basis of the excellent results from the 2001 field trials farmers were persuaded not to use insecticides enabling replicated trials to be conducted to compare IPM, IPM + farmers’ practice and farmers’ practice alone, where the farmers’ practice consisted of daily insecticide applications
Figs. 1 & 2. Mass trapping trials in mature (Figs. 1) and immature (Figs. 2) brinjal fields Jessore, Bangladesh 2001. Pheromone trap catch (a) and fruit damage (b).

Fig. 2. Percent fruit damage in replicated IPM field trials, Jessore, Bangladesh (July 2002 to Jan. 2003)
and IPM consisted of mass trapping and removal of infested shoots.

Fruit harvesting began 10 weeks after transplanting, 6 weeks after installing the IPM regime. From the first fruit harvest, damage caused by *L. orbonalis* was significantly less in IPM plots than farmers’ practice plots up to harvest 9 when fruit damage levels in all treatment plots decreased significantly (Figure 3) due to falling night-time temperatures. IPM plus farmers’ practice plots showed fruit damage levels intermediate between IPM and farmers’ practice plots up to harvest 14, and differences in mean percentage damaged fruits between treatments were statistically significant for most harvests.

Despite the decrease in percentage fruit damage in farmers’ practice plots, by harvest 10 the crop was in such a poor condition, because of the excessive use of insecticides, that the farmers uprooted the brinjal plants one month before those in IPM plots, which in part accounted for the dramatic difference in yield obtained between IPM and non-IPM treatment plots. Overall fruit yield was the same in IPM and IPM plus farmers’ practice treatment plots but almost three times higher than farmers’ practice plots. In addition, the yield of healthy fruit from IPM plots was almost four times higher than the farmers’ practice plots even though the difference in average percent healthy fruit between IPM and Farmers’ practice treatment plots was 69.7%, suggesting that the number of fruits produced and harvested in IPM plots was significantly greater than insecticide-treated farmers’ practice plots.

Data presented in this paper demonstrates that mass trapping for control of brinjal fruit and shoot borer, *L. orbonalis* has been successfully developed and scientifically validated. Farmers have been broadly impressed with the technology and will adopt providing they have access to good quality products at an acceptable price. Analysis of farmer production costs and marketable value of produce suggests that there is a cost-benefit of 1:1.75 associated with the adoption of mass trapping in Bangladesh (Rashid et al., in press) despite the high density of traps currently required. The final impact of this technology at the farmer level has yet to be determined but it is anticipated that the foresight shown by the UK, DFID to fund a project purely to promote adoption of the technology will greatly assist the process and should be acknowledged and commended. It is only through such donor initiatives that SMEs will be persuaded to take up the technology and create a viable and sustainable market that can compete with traditional pesticide producers. As a direct result of this project’s efforts eight SMEs have now come forward to
produce pheromone traps and lures for use in control of *L. orbónalis* by mass trapping in India and Bangladesh.

In a separate development a Society entitled the ‘South Asia Society for the Advancement of Pheromone Technology’ has been created. This Society will act to represent pheromone producers and is mandated with the task of raising the quality of products marketed and promoting awareness of the uses of pheromone-based products for pest monitoring and control throughout the region.


