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Short communication

An inexpensive olfactometer and wind tunnel for *Trichogramma chilonis* Ishii (Trichogrammatidae: Hymenoptera)

A.M. Ranjith*

Department of Entomology, College of Horticulture, Kerala Agricultural University, KAU P.O. 680 656, Trichur, Kerala.

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Abstract

A simple detachable, inexpensive, acrylic four-arm olfactometer, which provides a controlled odour plume for conducting free choice tests and a simple wind tunnel set up, which can be used to track and measure upwind movements of specific odours are described. Both devices were tested with *Trichogramma chilonis* Ishii, the egg parasitoid of rice leaf folder, *Cnaphalocrocis medinalis* Guen in the laboratory. These devices can also be used for monitoring the responses to olfactory cues of other small insects as well.

Keywords: Parasitoids, Host odour perception, Volatiles, Kairomones.

Insects respond to different olfactory cues like volatiles from plants (e.g., phytophagous insects), host odours (e.g., parasitoids and predators), and pheromones for mate searching and aggregation. Olfactometer and wind tunnels are often used to monitor the responses of insects to odour cues. Multiple arm olfactometers like Y-tube, U-tube, four-arm, or six-arm olfactometer are generally used to detect and measure insect responses to multiple odour cues. Specific behavioural responses like antennal movements and other taxis are monitored in wind tunnel studies (Noldus and van Lenteren, 1985). They are also of use in wind tunnel bioassay experiments, to test the ability of insects to detect and settle on plants (Mensah et al., 2005).

Four-armed olfactory chambers (Vet et al., 1983; Bakchine et al., 1990) provide a relatively unconfined central area in which organisms move freely and into which four olfactory treatments or controls can be introduced. Many of these, however, do not permit a stream of directed, steady flow of odours to the test insects, in turn requiring expensive flow meters, valves, and mass and volumetric gas flow controllers. Therefore, designing a simple and inexpensive olfactometer assumes significance. This paper describes the fabrication of such a detachable, acrylic four-arm olfactometer, which can provide a controlled odour plume and indicate insect olfactory responses, especially the preference or non-preference in multiple-choice tests. Design of a simple wind tunnel set up to measure the positive taxis to selected host odour in no-choice situations is also demonstrated. Both devices were tested in experimental studies evaluating the oriented responses of *Trichogramma chilonis* Ishii, the egg parasitoid of the rice leaf folder, *Cnaphalocrocis medinalis* Guen (Shajna, 2006).

Fabrication of acrylic olfactometer

Non-absorbent, transparent acrylic sheet of 2 mm thickness was used for constructing the olfactometer. The design consisted of a central rectangular chamber (20 x 20 cm base and 30 cm height) with four arms extending from the four sides (Fig. 1). A 20 x 20 cm acrylic sheet formed the base plate. From the centre of each face of the chamber, at 50 mm height, a 50 mm square hole was cut. Into this, a 50 x 50 x 500 mm rectangular acrylic tube, which formed the odour arm, was inserted. A small acrylic rim at the connecting

*Author for correspondence: Phone 91 487 2370822; Fax 91 487 2371931; Email<amranjith@yahoo.co.in>.

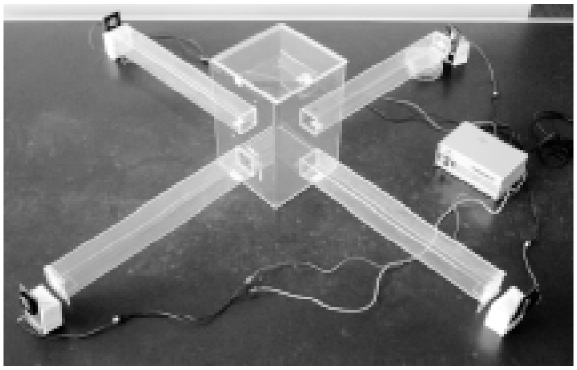

Figure 1. The olfactometer when it is set up.

end provided support to keep the tube in position. This also prevented the tube from being pushed inside. The distal end of the odour arm was closed with a removable acrylic sliding door. In experimental studies, moth scales, moth scale extracts, plant materials, or other semiochemical emanating substances could be placed at the distal end through this window. The opening can then be closed using a sliding door, netting, or cloth to suit the specific needs. An acrylic support at the distal end keeps the rectangular tube in position. The top of the central chamber was closed with an acrylic lid (20 x 20 mm) having a retaining rim. This lid is removable and has a central 5 mm hole to allow air movement. Trichocards were placed at the bottom of the chamber in a petri-plate. During the setup, Vaseline was smeared at the connecting inlets of each arm to prevent air entry from outside.

A small axial flow fan (DC 12V, 3.5 cm dia) was installed at each of the four distal openings of the arms to provide uniform airflow. The axial fan was screwed on to an acrylic sheet and housed on a wooden base in such a way to direct the airflow towards the inside of olfactometer. The odour resource was kept at the distal end of each arm. This setup allowed the insects to receive airflow bathing the olfactory cues from the odour source and travel upwind in response to the volatiles. To avoid contaminants in the air plume, the unit was inserted into a laminar flow chamber; alternately, this can be placed in any other air chamber with filtered air. In such cases, the arms can be detached to make it uni/bi/tri directional to suit the dimensions of the chamber. Further, the whole unit also can be dismantled and the components stored, when not in use (Fig. 2). The olfactometer design described in this paper was used to record the number of *T. chilonis* moving towards the source at definite time intervals, the number of insects retained, and the distance travelled per unit time in response to different odour cues (Shajna, 2006).

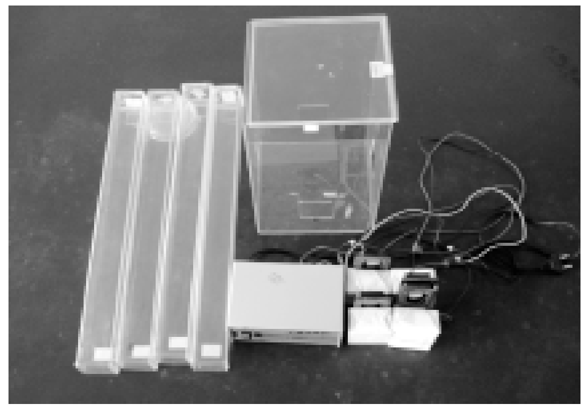

Figure 2. Olfactometer in knocked down condition.

Wind tunnel

When the most favoured odour cues and other host responses are fixed by the free choice tests involving multiple odours, it becomes necessary to evaluate the distance travelled by the insect in unit time, or the maximum distance travelled, and other taxis. For this, the response to the single selected odour becomes necessary. A wind tunnel (Fig. 3) was designed to monitor the maximum distance travelled by *T. chilonis* in response to specific selected single odours such as

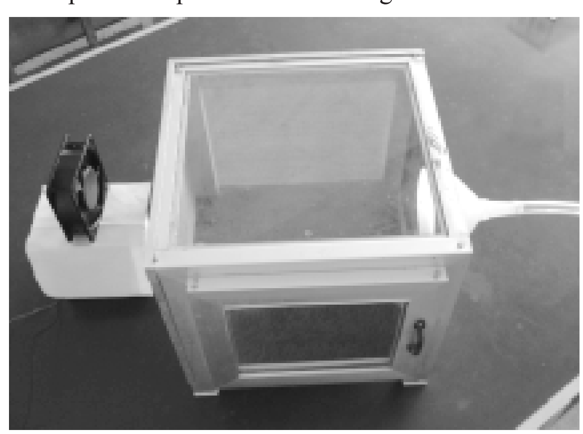

Figure 3. Wind tunnel set up at the host chamber.

moth scale extracts (MSE) of its host *C. medinalis* in different solvents like hexane, acetone, or ether. This instrument can also be used to evaluate the individual sources like leaves of specific susceptible/tolerant rice varieties involved in the tritrophic attraction in the host-pest-parasitoid systems.

The device consists of a host odour chamber, an inflow fan, a sieve screen, an inlet funnel, and a tube serving as tunnel. The host odour chamber was of size 35 x 35 x 35 cm. A round hole (10 cm dia) was cut in a hylam sheet, which formed one side of the chamber. The opposite side was provided with an aluminium mesh screen. The other four sides including the base can be covered with hylam sheet or glass. We used a prefabricated box with aluminium screen sides. The round hole was closed with a plastic funnel, to which the small transparent tube was fitted. All sides other than the air inlets and funnel outlet were covered by transparent polyester film during the setup.

MSE or host plant leaves can be kept in the host chamber emanating the semiochemicals. To channel the air plume bathing the semiochemical to the egg parasitoids by forced airflow, an industrial fan (Sunon A2175 HBL 0.25A) was installed. Airflow to the inside was controlled using a variable speed regulator. The semiochemical chamber and airflow fan may be kept in a laminar flow chamber to exclude outside odour contamination. The air bathing the odour plumes from the hosts travels through the plastic tube and escapes.

In the experimental study, insect movement was recorded by releasing *T. chilonis* in the egg cards from the distal end of a 15 mm dia transparent tube (Shajna, 2006). The trichogrammatids from the egg cards travelled upwind through the tube and tried to reach the host odour. This way, a field situation was simulated and their probable movement in the field studied. It was seen that the trichogrammatids moved upwind in the air plume in response to the different kairomones and the distance travelled in unit time gave a signal for comparing the attractiveness of individual semiochemicals. The length and diameter of the transparent tube can be changed to suit the individual needs of specific insects.

The models described in this paper are inexpensive compared to the commercial models, which would cost around Rs. 50 000 (US$ ~ 1250). The olfactometer model described herein do not cost more than Rs. 1900; and for the wind tunnel, it may be approximately Rs. 2000 (US$ ~ 50). Scientists in the developing country laboratories with limited financial resources would find it particularly useful to fabricate these devices for experimental applications. It must however, be noted that these are preliminary designs and there is considerable scope for further refining it. Although both the olfactometer and the wind tunnel have been presently used to evaluate the odour cues of *T. chilonis* only, it can, however, be used for monitoring odour perception by other small insects too, implying its potential for wider applications.

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