Y-TUBE OLFACTOMETER TO DETERMINE THE ATTRACTIVENESS OF PLANT VOLATILES TO WESTERN FLOWER THRIPS

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Summary

In order to test the responses of western flower thrips to plant volatiles we developed a glass Y-tube olfactometer. The Y-tube was placed in an inclining position in a black box with a light source at the ceiling. A gentle flow with clean air in one arm of the Y and odour-loaded air in the other arm was produced. Adult female thrips were released at the base of the Y-tube and walked upwind towards the far end of one of the arms of the Y. This set-up allowed us, on average, to record 25 individual choices within one hour. Thrips were attracted by a solution of geraniol, repelled by pure salicylaldehyde and neither attracted nor repelled by a solution of myrcene.

INTRODUCTION

Western flower thrips, *Frankliniella occidentalis* (Pergande), is a serious pest on many ornamental and vegetable crops (Lewis, 1997). Improvement of monitoring systems as well as chemical and biological control measures is needed in order to detect thrips in an early stage and control them effectively. Attractive volatiles could be used to improve trapping systems and control strategies, for instance in 'lure and kill' systems (Jones & Langley, 1998).

Detection of thrips is commonly done by using coloured sticky traps (Lewis, 1997). Several attempts have been made to improve trapping efficiency using plant odours (Brødsgaard, 1990; Teulon & Ramakers , 1990; Frey et al., 1994). Many of the volatiles tested are flower odours such as p-anisaldehyde, geraniol, eugenol, myrcene, benzaldehyde and salicylaldehyde (Terry, 1997).

Behavioural responses of thrips to volatiles in laboratory assays have been reported using different methods: the Petterson four-arms olfactometer (Pow et al., 1998), a V-shaped olfactometer (Gerin, 1994), an Y-tube olfactometer (Holtmann, 1963), and flight chamber olfactometers (Frey et al., 1994; Hollister et al., 1995). Due to the use of different methods and specific problems of greenhouse and field studies, reports on attractiveness of volatiles are often not comparable and sometimes contradictory.

In order to be able to compare the effects of reported attractants for thrips we developed a simple olfactometer, which allows screening of volatiles in an efficient way.

MATERIAL AND METHODS

Insects

A rearing of *Frankliniella occidentalis* was maintained on potted, flowering chrysanthemum plants, *Dendranthema grandiflora* Tzelev, of the susceptible cultivar 'Sunny Cassa' in a greenhouse at 25° C and 70 % RH. Adult females were collected from

the rearing with an aspirator and starved overnight, only provided with water, in perspex ring cages (Murai, 1990) at room temperature. These insects were used for experiments on the following day.

Olfactometer

The attractiveness of volatiles was assessed using a glass Y-tube olfactometer (internal diameter of 0.5 cm; lengs of arms is 5 cm) modified from Holtmann (1963) and Sabelis & van de Baan (1983) (Figure 1). The set-up was placed in a dark room at 22° C. A tripod held the Y-tube in an inclining position (angle 25° between Y-tube and horizontal plane). The Y-tube was placed in the centre of a black box (36 x 38 x 57 cm), covered inside with black paper in order to avoid visual stimuli. A halogen lamp, attached to the ceiling of the box, illuminated the Y-junction of the olfactometer with 160 lux light intensity. The end tubes of the Y were connected to two Wheaton Micro Kit© adapters made of glass, having attached 4 ml glass-vials, each containing a 1 cm^2 filter paper piece. One µl of the volatile component diluted in paraffin oil (Uvasol, Merck) or pure paraffin oil at the control side were applied on the filter paper pieces 30 min before the first thrips was released, in order to allow the odour to reach a constant release rate. Preliminary assays showed that paraffin oil was not attractive to thrips. The air flow was first purified by passage through wash bottles filled with charcoal pellets and was then led into the vials containing odour-loaded paraffin oil and pure paraffin oil as control. At the base of the Y-tube the air was sucked off by means of a membrane pump, producing an air flow of 5 cm/s in the arms of the Y and 10 cm/s in the base tube. Connections between different parts of the set-up consisted of silicone tubing. The used odour-loaded air was removed from the room.

Bioassay

Individual thrips females were released one at a time within the first cm of the base tube of the olfactometer using a small size aspirator. Activated by the odour-loaded airflow and additionally motivated by the light, thrips started walking upwards the tube. The air suction tube was connected with the glass Y-tube and the time was recorded until the thrips reached the far end of one of the arms of the Y. Incidentally a thrips made no choice within 3 minutes, this was scored as a no-choice. Experiments consisted of 25 choices, no-choices were discarded. After having tested five thrips, the entire set-up i.e. all parts shown in Figure 1, was turned 180° to avoid any positional effects. Between experiments, all parts of the set-up were cleaned with acetone. Data were analyzed with a two-sided binomial test.

RESULTS & DISCUSSION

Thrips walked quickly towards the far end of one of the arms of the Y-tube. Incidentally an individual did not make a choice within the three minute period; in total ten no-choices were recorded in the nine experiments presented. The average duration of one experiment was less than one hour. Flying (jumping) of thrips was seldom seen during experiments.

Female western flower thrips preferred the odour of a 10 % geraniol solution in paraffin oil over pure paraffin oil (Figure 2). Frey et al. (1994) improved trap catches in the laboratory by adding geraniol , but under greenhouse conditions geraniol did not improve trap catches reliably. *Thrips flavus* Schrank, a flower-inhabiting thrips species (Kirk, 1985) and cereal thrips species (Holtmann, 1963) have also been shown to respond positively to geraniol.

There was no preference for a 10 % myrcene solution (Figure 3). Kirk (1985) found in field experiments that undiluted myrcene reduced the catch efficiency of water traps of four flower-inhabiting thrips species, but he suggested that catches might increase at lower concentrations.

The response of thrips to a 10 % solution of salicylaldehyde was not significant (data not shown) but pure salicylaldehyde (filter paper as control) had a repellent effect (Figure 4). In contrast, Roditakis & Lykouressis (1996) found in the field that salicylaldehyde in a mixture with ethanol attracted 40 % more western flower thrips than the control. Morgan & Crumb (1928) reported that cereal thrips species reacted positively to salicylaldehyde.

The present Y-tube olfactometer allows a quick screening of volatiles for attractiveness or repellency to western flower thrips with reproducible results. In the future we will screen a larger number of volatile compounds at several concentrations. The next step will then be to transport the results to greenhouse situations.

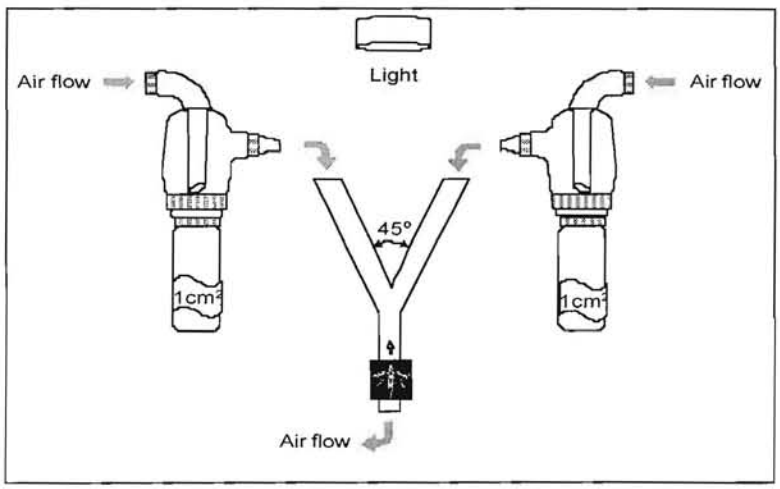

Figure 1. Y-tube olfactometer for recording responses of Frankliniella occidentalis *to volatiles (see Material & Methods for further explanation).*

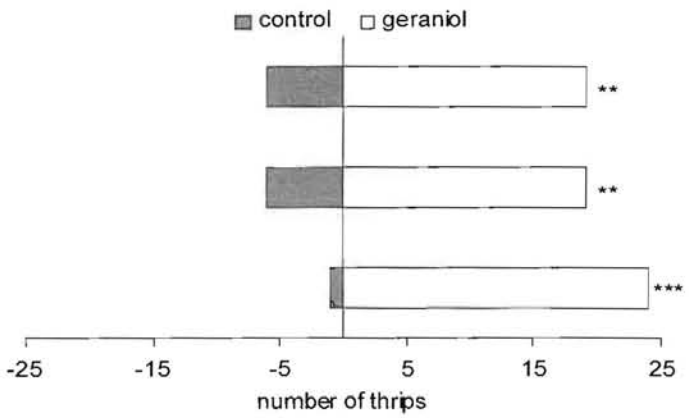

Figure 2. Responses of Frankliniella occidentalis *females in the Y-tube olfactometer to 1 µl 10 % geraniol in three separate experiments (n = 25). **: p<0.01, ***: p<0.001 (two-sided binomial test).*

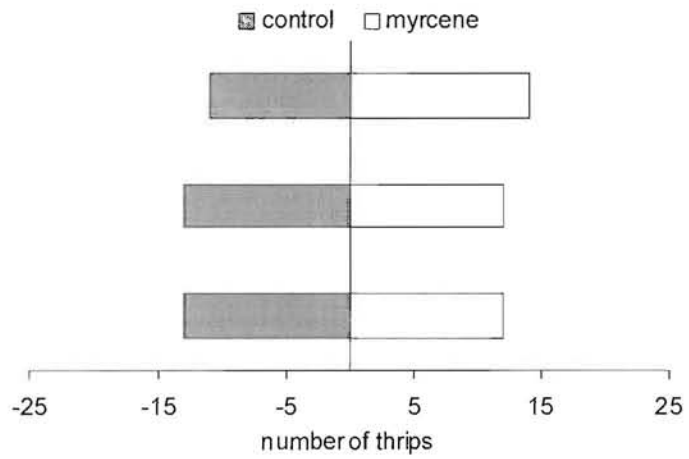

Figure 3. Responses of Frankliniella occidentalis *females in the Y-tube olfactometer to 1 µl 10 % myrcene in three separate experiments (n = 25).*

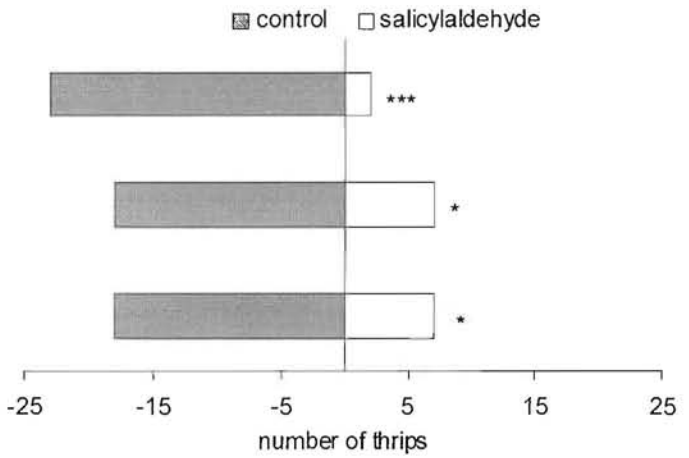

Figure 4. Responses of Frankliniella occidentalis *females in the Y-tube olfactometer to 1 µl pure salicylaldehyde in three separate experiments (n = 25). *: p<0.05, ***: p<0.001 (two-sided binomial test).*

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