Bull. Inst. Zool., Academia Sinica **31**(2): 131-135 (1992)

SHORT NOTE

OLFACTORY RESPONSES OF *DIACHASMIMORPHA LONGICAUDATUS* AND *OPIUS INCISI* TO ANIMAL PLANT HOST RELATED VOLATILE SOURCES[1]

CHIEN-CHUNG CHENG[2,3], AN-LY YAO, LENA WEN-YUNG LEE
and JUI-CHUN CHANG

Institute of Zoology, Academia Sinica,
Nankang, Taipei, Taiwan 11529,
The Republic of China

(Accepted May 30, 1991)

Chien-Chung Cheng, An-Ly Yao, Lena Wen-Yung Lee and Jui-Chun Chang (1992) Olfactory responses of *Diachasmimorpha longicaudatus* and *Opius incisi* to host related volatile sources. *Bull. Inst. Zool., Academia Sinica* **31**(2): 131-135. Larvae of *Dacus dorsalis*, guava, an artificial medium, and the combination of these sources were exposed to the two parasitic wasp species of *D. dorsalis* (*Diachasmimorpha longicaudatus* and *Opius incisi*) in an airflow olfactometer to determine the ability of the two parasitoids to differentiate between the chemical stimuli present in fruit and artificial medium. Result revealed that both parasitoids show the ability to locate the guava host plant. But *D. longicaudatus* was more efficient, as it prefers larvae-infested this may explain the dominant population of *D. longicaudatus* found in fields during the non-fruit season.

Key words: Olfactory response, *Dacus dorsalis*, *Diachasmimorpha longicaudatus*, *Opius incisi*, Airflow olfactometer.

The imported braconids *Diachasmimorpha longicaudatus* (Ashmead) and *Opius incisi* Sily, were released against the oriental fruit fly, *Dacus dorsalis* Hendel, in Taiwan. Both solitary larva parasitoids were found to be established in our study field after releases made from 1987-1988.

Based on a survey of fruit samples, *D. longicaudatus* and *O. incisi* were found to be compatible in finding and ovipositing in guava the major host of *D. dorsalis*, when fruit density was high. However, *D. longicaudatus* dominated *O. incisi* when host density was low, or when guava fruit was scarce.

The present study was conducted to determine the olfactory stimuli used by *D. longicaudatus* and *O. incisi* in their search for hosts.

MATERIALS AND METHODS

All insect colonies were reared and experiments carried out at 25±2°C, 75±10% RH at the Insect Ecology Laboratory, Institute of Zoology, Academia Sinica, Taipei, Taiwan.

Insects: *Dacus dorsalis*, the host insects,

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[1] Paper No. 361 of the Journal Series of the Institute of Zoology, Academia Sinica.
[2] To whom reprints request should be sent.
[3] Present address: Department of Biology, Kao-Hsiung Medical College, Kao-Hsiung, Taiwan.

were reared in a wheat germ medium. Five-to-six day old larvae were confined in 9 cm diameter "sting units" and exposed to parasitoids; details can be found in Greany *et al.* (1976). Five-to-twelve day old female parasitoids were used in the test. Host larvae used were five-to-six days old; 100 individuals were used in each experiment.

Flight tunnel: The flight tunnel was modified by G. Kluge of Siemens from designs described by Miller and Roelofs (1987) and Eller *et al.* (1988). Wind velocity was measured with a Testovent 4300 anemometer; wind speeds were set at 4–5 m/sec for all experiments. Twenty females of the two parasitoid species were placed in a clear plastic cage which was set on a stand 30 cm from the tunnel floor; the cage was in the odor plume 1.3 m downwind from the odor source. Materials for bioassays were placed in 7 cm diameter petri dishes with both sides either covered with organdy material (*i.e.*, artificial diet) or wrapped with organdy net (*i.e.*, guava fruit) and hung in the top 1/3 of the air grid at the upwind end of the flight tunnel (Fig. 1). Test insects were first released from the cage 2 min after the fans were turned on and observed for the following 10 min. All tests were single choice tests; three-to-six replications were made for each experiment.

Odor sources: These sources included host larvae (HL), fresh guava (G), guava and larva (G+L), field infested guava (IG), and host larva feces and oral secretions which were present in the host-fed artificial medium (FM). Fresh medium (M) was also tested as a control to FM. Empty petri dishes (CP) and paper balls imitating guava (CG) were also used as controls, as well as to examine possible visual cues.

Categories of responses: The olfactory responses of parasitoids were categorized as follows:

I. Non-oriented responses:
  (a) No flight—parasitoid did not leave the release site.
  (b) Non-oriented flight—very brief flight immediately after release (or after a brief initial zigzag) which resulted in landing on the ceiling or a wall.

II. Oriented responses:
  (a) Incomplete oriented flight—parasitoid flew toward the source but did not land on odor source.
  (b) Complete oriented flight—parasitoid flew in a sustained direction (or after some wide

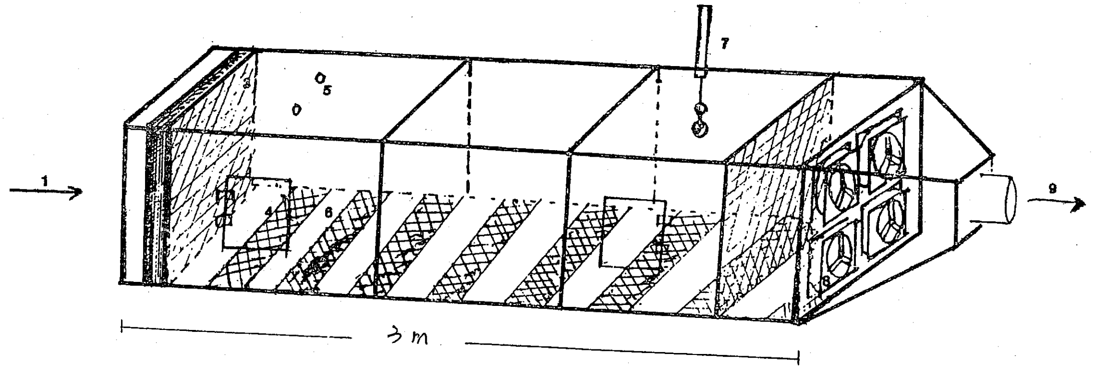

Fig. 1. A sketch of the airflow olfactometer designed by G. Kluge.
(1) air inlet; (2) active carbon; (3) fine screen; (4) operational window; (5) odor source hook; (6) -orange, -black; (7) anemometer; (8) fan; (9) air outlet.

zigzagging) and landed on odor source within 10 min.

RESULTS AND DISCUSSION

The processes involved in locating a suitable host for oviposition have been considered as being a sequence or responses involving several levels of stimuli. Salt (1935) and Laing (1937) divided the proceses which culminate in successful parasitism into two steps: host habitat location followed by host location. Doutt (1959, 1964) considered four steps: host habitat location, host location, host acceptance, and host suitability; Vinson (1975) added host regulation—the ability of the parasitoid to alter its host for the benefit of its its progeny—as a fifth step. More recently, Vinson (1984a) further subdivided the host selection process (the first three stages described by Doutt) into seven sub-categories. Hassell and Southwood (1978), in their review of the foraging strategies of insects, considered a forager as perceiving its environment at several hierarchical levels; these may be classified as the habitat where (in the case of parasitoids) potential hosts may be present, the patch where hosts actually exist, and, finally, the resource itself the actual host. The methods by which foragers locate host patches can show considerable variation. It is common for parasitoids to be attracted to the host's food items and, as a consequence, to encounter the patch almost incidentally. Hubbard (1977) showed that mustard oils emanating from *Crucifera* play an important role in habitat location in *Apanteles blomeratus* (L.), a braconid parasitoid of the large cabbage white butterfly *Pieris brassicae* (L.). Similarly, Read *et al.* (1970) illustrated the importance of these chemicals in habitat selection by another braconid, *Diaeretiella rapae* (Curtis)—a parasitoid of the cabbage aphid *Brevicoryne brassicae* (L.).

Bioassay responses in female *D. longicaudatus* to various host-related sources were most intense for sources where host larvae were present, and somewhat

Table 1
Comparison of olfactory responses of *Diachasmimorpha longicaudatus* and *Opius incisi* toward various odor sources (x±S.D.)(1)

	D. longicaudatus			*O. incisi*			Number of replicates
	Oriented flight		Total	Oriented flight		Total	
Sources(2)	Complete	Incomplete		Complete	Incomplete		
HL	4.3±2.5*	9.0±1.7*	13.3±2.3*^{a}	1.3±1.8	3.2±1.0	4.5±1.8^{b}	6
G+L	4.3±2.4	8.8±2.1	13.2±2.3^{a}	4.0±4.2	8.3±3.1	12.3±3.1^{a}	6
G	0.6±0.9	6.2±1.9	6.8±1.9*^{b}	4.6±3.8	8.6±1.5	13.2±3.8^{a}	5
IG	3.3±2.3	9.3±2.1	12.7±4.0^{a}	3.3±1.2	7.7±3.2	11.0±3.0^{a}	3
M	0	0.6±0.6	0.6±0.6^{c}	0.2±0.5	1.6±2.1	1.8±2.1^{bc}	5
FM	2.3±0.9	4.8±1.7*	7.0±1.4*^{b}	1.3±1.9	1.8±1.5	3.0±1.8^{bc}	4
CP	0	0	0^{c}	0	0	0^{c}	3
CP	0	0	0^{c}	0	0	0^{c}	3

(1) Means in the same column followed by the same letter are not significantly different ($p=0.05$) as determined by Duncan's multiple range test.

(2) Detalis are given in Materials and Methods section.

*: Significant difference between responses of two parasitoids with same given odor source was determined by t-test ($p=0.05$).

less intense for medium containing host feces, oral secretions, and the host plant (Table 1). *O. incisi* were most strongly attracted to the host plant regardless of the presence or absence of hosts (Table 1). Significant difference (*t*-test) were found between the two species in response toward host larvae, fresh guava, and medium containing host feces and oral secretions. These results illustrate that a combination of cues (guava and larvae) are used by both species to locate hosts during the guava fruiting season. The dominant species appearing during the non-fruiting season would be that which could locate host individuals rather than fruit. The present study also affirms the results of a regular of fruit samples showing that *D. longicaudatus* dominates *O. incisi* when not many guavas are avilable in the field. Fresh medium and vision cues play a very minor role, if any, in the host location behavior of both species.

CONCLUSION

While volatile chemicals emanating from host plants may provide an attractant chemical stimuli, it seems likely that any response is probably the effect of a combination of the animal host feces plus changes in the host medium resulting from the presence of oriental fruit fly larvae. It is obvious that both *D. longicaudatus* and *O. incisi* exhibit a strong orthokinetic response to some stimuli. Our results strongly suggest that this chemostimulant may be from guava—particulary guava infected with fly larvae. *D. longicaudatus* dominancy in the field may be explained by its ability to find the host more efficiently than can *O. incisi*, especially during the non-fruit season.

Acknowledgements: We would like to thank Mr. Goetz Kluge of Siemens for designing and modifying the airflow olfactometer. We would also like to thank Dr. Tim Wong of the Tropical Vegetable Research Laboratory, ARS, USDA, Hawaii for providing the stocks of parasitoids. This research was supported in part by (R.O.C.) NSC grant NSC78-0211-B001-48, plus an NSC postdoctoral research fellowship to CCC.

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短　　報

兩種小繭蜂 *Diachasmimorpha longicaudatus* 和 *Opius incisi* 對有關寄主揮發性物質之嗅覺反應

程建中　姚安莉　李文蓉　章瑞駿

在試驗室內藉氣流嗅覺測量儀，測試二種寄生性小繭蜂*Diachasmimorpha longicaudatus*和*Opius incisi*對寄主東方果實蠅*Dacus dorsalis*幼蟲，幼蟲人工飼料，番石榴，果實蠅幼蟲排遺物及其相互組合等，共八種味源之嗅覺反應。結果顯示兩種寄生蜂基本上皆具有找到果實蠅寄主植物番石榴的能力。但*D. longicaudatus*的搜尋更有效率，因其較偏好已被東方果實蠅幼蟲所爲害的番石榴。此一事實或可解釋*D. longicaudatus*在非結實季於田間能成爲優勢族羣的原因。