

KAIROMONES AND THEIR USE FOR MANAGEMENT OF ENTOMOPHAGOUS INSECTS.

XI. Effect of Host Plants on Kairomonal Activity of Frass from *Heliothis zea*¹ Larvae for the Parasitoid *Microplitis croceipes*²⁻⁴

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Abstract—In laboratory experiments conducted to compare the kairomonal activity for *Microplitis croceipes* (Cresson) of frass from *Heliothis zea* (Boddie) larvae fed on different host plants, *M. croceipes* females responded to extracts of frass from larvae reared on cotton or soybeans but not on corn. The lack of response to frass from larvae reared on corn was shown to be a result of a lack of some appropriate chemical(s) in the corn.

Key Words—*Heliothis zea*, Lepidoptera, Noctuidae, *Microplitis croceipes*, Hymenoptera, Braconidae parasitoids, kairomones.

INTRODUCTION

Lewis and Jones (1971) demonstrated that kairomones found in the frass, salivary secretions, hemolymph, and cuticular washes of *Heliothis zea* (Boddie) larvae elicited a host-seeking response from female *Microplitis croceipes* (Cresson), an important larval parasitoid of *Heliothis* spp. The most active compound was identified as 13-methylhentriacontane, although nu-

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²Hymenoptera: Braconidae.

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merous other compounds elicited lesser responses from *M. croceipes* females (Jones et al., 1971). Sauls et al. (1979) demonstrated that diet affects the kairomonal activity, for *M. croceipes*, of frass from *H. zea* larvae and that frass from larvae fed on modified pinto bean diet (Burton, 1969) was significantly less active than frass from larvae fed fresh pea cotyledons.

The fact that diet can affect the release or composition of kairomones has been demonstrated for several insect species. For example, Roth et al. (1978) reported that the tachinid parasitoid *Lixophaga diatraeae* (Townsend) was stimulated to larviposit by frass from *Diatraea saccharalis* (F.) larvae that fed on sugarcane but not by frass from larvae fed a soybean-flour-wheat germ diet. Also, Mohyuddin et al. (1981) found that a Pakistan strain of *Apanteles flavipes* (Cameron) responded strongly (with ovipositor probing) to frass from *Chilo partellus* (Swinhoe) larvae fed corn but weakly to frass from larvae fed sugarcane.

We report here results of tests conducted to evaluate differences in the response of *M. croceipes* females to frass from *H. zea* larvae fed different host plants.

METHODS AND MATERIALS

H. zea larvae were reared on cotton squares (Coker 310), soybean pods (Bragg), corn kernels (Silver Queen), or on CSM diet (Burton, 1970). Larvae were reared from fresh eggs obtained from a laboratory culture and held in 1-oz plastic cups at 26°C and 70% relative humidity. The plant material was changed regularly to ensure freshness. Frass was collected daily from 3rd–5th instar larvae.

The *M. croceipes* used in the bioassays were obtained from a laboratory culture and had been reared according to the methods of Lewis and Burton (1970).

Collected frass was lyophilized, weighed, and homogenized with distilled water (1 g/100 ml) in a blender. The homogenates were then centrifuged at 750 rpm for 7 min and the supernatant decanted for use in the bioassays. A procedure similar to this was used by Sauls et al. (1979). Although some of the identified kairomones are nonpolar compounds, their concentrations in the supernatant should be relative to their original concentration in the frass.

The bioassay used involved exposing individual 2- to 3-day-old mated *M. croceipes* females to spots treated with 4 μ l of an extract on Whatman No. 1 filter paper in the bottom of 150 \times 15-mm Petri dishes. Because the parasitoids are negatively geotactic and positively phototactic, we easily guided them to treated sites by holding the dish in a vertical plane with the test side toward the light (Jones et al., 1971). Responses were scored on a three-point scale. When a parasitoid made an intensive examination of a treated

spot with her antennae, exhibited considerable excitement, and occasionally probed with her ovipositor (positive response) on the first pass, a score of 3 was given. If a positive response was elicited on the second pass, a score of 2 was given, etc. When the parasitoid did not respond after three direct passes over a treated spot, a score of 0 was given (Lewis and Jones, 1971). Each replication consisted of the mean score of 10 parasitoids for each of the tested materials.

RESULTS

The initial series of bioassays was conducted to demonstrate the existence of differences in the kairomonal activity of frass from larvae reared on the different host plants. *Microplitis croceipes* females responded significantly ($P > 0.05$) more strongly to extracts of frass from soybean-fed larvae (score: 1.6a)⁵ and cotton-fed larvae (1.0b) than to extracts of frass from CSM diet-fed or corn-fed larvae (0.3c and 0.0c, respectively) (data from 10 replications).

It is possible the extract of frass from corn-fed larvae might have contained a chemical(s) that inhibited a response to other chemicals in that extract or contained no chemicals that would elicit a response. Thus we conducted another series of bioassays in which the extracts of frass from larvae reared on soybeans and on corn were compared to spots treated with 4 μ l of both extracts. Results (soybean-fed, 0.4a; soybean and corn mixtures, 0.4a; corn-fed 0.0b) (data from 6 replications) showed conclusively that the lack of response to the extract of frass from corn-fed larvae was due to the lack of some appropriate chemical(s) in the frass from corn-fed larvae, not to the presence of any inhibitory chemical(s).

DISCUSSION

The data presented here demonstrate that host plants do influence the kairomonal activity of frass from *H. zea* larvae. It appears that some plants have the necessary chemical constituents while others do not. Whether the chemical(s) is concentrated by the insect as it passes through the digestive system, is chemically altered by the insect, or is mixed with some insect-produced chemical remains to be determined.

Parasitoids are known to exhibit differential responses to various plants (Thorpe and Caudle, 1938; Monteith, 1958, 1967; Read et al., 1970; Taylor and Stern, 1971; Lewis et al., 1972; Mohyuddin et al., 1981); for example, *M. croceipes* females do not generally search in corn or sorghum (Smith et al.

⁵ Means followed by different letters are significantly different ($P > 0.05$) according to Duncan's multiple-range test.

1976; Lewis, unpublished data) but do search in cotton and soybeans. Thus, it is not surprising that corn apparently lacks some chemical(s) important to the host-finding behavior of *M. croceipes*. Altieri et al. (1981) have even demonstrated that extracts of certain weeds can be applied to soybeans to increase rates of parasitization by several species of parasitoids.

The data also provide evidence that segments of insect populations escape attack from some entomophages when they are feeding on some particular host plants. This escape is not only due to a breakdown in host-habitat finding, but also in host finding should a parasitoid stray into the habitat. Changes in the semiochemicals released by insects feeding on different host plants certainly complicate the study of those chemicals and may be the reason for some differences in selection pressures within populations.

The importance of considering food plants when studying kairomones or other semiochemicals and when considering a particular entomophagous insect for use in biological control programs becomes obvious in light of these findings. These results also offer some interesting lines of research for plant breeders.

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