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Feeding Stimulants of the Beetles Attacking the Polygonaceous Plants

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Summary

The effects of (*Z*)-11-eicosenyl acetate, octadecyl acetate and their related substances on the feeding of 4 species of beetles attacking the polygonaceous plants were investigated. The feeding of *Gallerucida nigromaculata* BALY, *G. bifasciata* MOTSCHULSKY and *Galerucella vittaticollis* BALY was stimulated by (*Z*)- and (*E*)-11-eicosenyl acetate and eicosanyl acetate, but *Gastrophysa atrocyanea* MOTSCHULSKY was not stimulated by these substances. The feeding of these 4 species was not stimulated by octadecyl acetate. These results indicate that insect on the same host are not always stimulated by identical substances.

Recently we found the acetates of (Z)-11-eicosenol and octadecanol in the larval defensive secretion of Polygonaceae-feeding leaf beetle, *Gastrophysa atrocyanea* MOTSCHULSKY (1). These compounds were firstly detected in insects. We investigated the physiologically activity of these compounds. During the investigation, it emerged that (Z)-11-eicosenyl acetate acted as a feeding stimulant for Polygonaceae feeding leaf beetle, *Gallerucida nigromaculata* BALY. These findings prompted this investigation of the effects of (Z)-11-eicosenyl acetate, octadecyl acetate and their related substances on the feeding of 4 species of bettles which feed on polygonaceous plants.

Materials and Methods

Insect: *Gallerucida nigromaculata* BALY which feeds on plants of the family Polygonaceae were selected from a laboratory culture maintained exclusively on *Rumex obtusifolius* leaves. *Gallerucida bifasciata* MOTSCHULSKY and *Gastrophysa atrocyanea* MOTSCHULSKY whose host ranges are restricted to the Polygonaceae were collected at the larval stage from *R. obtusifolius* and reared on leaves of the same plant until adult. *Galerucella vittaticollis* BALY which feeds on polygonaceous plants and strawberry, *Fragaria chiloensis*, were selected from a laboratory culture maintained on *R. obtusifolius* leaves.

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Bioassay: The effects of respective substances as feeding stimulants were examined in the choice trial test in which nibbling by adult insects on filter papers moistened with test substances was compared with that on papers treated with control substances. The testing chamber was composed of plastic petri dish 9 cm in dia. and 1.5 cm in height. Three 7 cm in dia. filter papers immersed with 2 ml water were placed on the bottom of the petri dish, and a doughnut-like plastic disc (3 cm I.D and 7 cm O.D) was put on the papers. The two pieces of 2 cm square filter papers moistened with the test substance were placed oppositely on the doughnutlike disc, and control papers immersed in solvent only were placed opposite and equidistant between those.

Filter papers for the assay were prepared as follows: The papers were first adsorbed each with 0.075 ml of hexane dissolving test substance. Control papers were treated similarly with the same amount of hexane only. After evaporating off the solvent, each filter paper was moistened with 0.075 ml of water.

The insects for assay previously starved in a moist dish were introduced into the test chamber and allowed to feed on filter papers. Because the insects used in these assays were different in physique and food consumption, test conditions were differed with species as follows: *G. nigromaculata* and *G. vittaticollis* (starvation period, 24 hrs; test duration, 24 hrs; number of released insects, 20); *G. bifasciata* and *G. atrocyanea* (starvation period, 8 hrs, test duration, 24 hrs; number of released insects, 15). Comparisons were made at 3 concentration levels of 0.1, 0.01 and 0.001 M. Tests were replicated 5 times.

The degrees of feeding stimulation were judged by the differences in the condition of the test filter papers nibbled by insects from that of the control papers and expressed by a graded number of the symbol "S". The symbol "N" was used to indicate no stimulative effect and the symbol "In" to indicate feeding inhibition of the insects by test substance.

Results and Discussion

Effects of (*Z*)-11-eicosenyl acetate, octadecyl acetate and their related substances on the feeding of leaf beetles are summarized in Table 1. (*Z*)-11-eicosenyl acetate was served as a feeding stimulant to *G. nigromaculata*, *G. bifasciata* and *G. vittaticollis*, but not to *G. atrocyanea*. The isomer of (*Z*)-11-eicosenyl acetate, (*E*)-11-eicosenyl acetate and eicosanyl acetate acted as feeding stimulants to the former three species, while they did not have a stimulative effect to *G. atrocyanea*. It is interesting to noitce that both (*Z*) and (*E*) isomers exhibit stimulative effects at same concentrations and eicosanyl acetate lacking unsaturated conjugation also exhibit a stimulative effect. Octadecyl acetate and (*Z*)-9-octadcenyl acetate did not show any stimulative effects on the feeding of the four species, but rather acted as deterrents of feeding at 0.1 and even at 0.01 M. As mentioned above, C_{20}-acetate ((*Z*)-11-eicosenyl acetate, (*E*)-11-eicosenyl acetate and eicosanyl acetate)

TABLE 1. *Effects of (Z)-11-eicosenyl acetate and Related Substances on the Feeding of Polygonaceae-feeding leaf beetles.*[a]

Compound	Concentration	Feeding response			
		G. nigromaculata	G. bifasciata	G. vittaticollis	G. atrocyanea
(*Z*)-11-Eicosenyl acetate	0.1	SS	SS	SS	N
	0.01	S	S	S	N
	0.001	N	N	N	N
(*E*)-11-Eicosenyl acetate	0.1	SS	SS	SS	N
	0.01	S	S	S	N
	0.001	N	N	N	N
Eicosanyl acetate	0.1	SS	SS	SS	N
	0.01	S	S	S	N
	0.001	N	N	N	N
Octadecyl acetate	0.1	In	In	In	In
	0.01	In	In	In	In
	0.001	N	N	N	N
(*Z*)-9-Octadecenyl acetate	0.1	In	In	In	In
	0.01	In	In	In	In
	0.001	N	N	N	N

a : See the text for explanation of symbols "S", "N" and "In".

was active to stimulate feeding at 0.1 and 0.01 M, and C_{18}-acetate (octadecyl acetate and (Z)-9-octadecenyl acetate) was inactive at same concentrations. It may be concluded that the differences of feeding response to C_{20}-acetate and C_{18}-acetate were based on those of carbon numbers.

In a previous paper, Matsuda and Matsumoto (2) showed that organic acids acted as feeding stimulants of the *G. atrocyanea*, *G. nigromaculata* and *G. bifasciata* did not show any stimulative effect for *G. vittaticollis*. (Z)-11-eicosenyl acetate and related substances acted as feeding stimulants of *G. bifasciata*, *G. nigromaculata* and *G. vittaticollis*, while they did not cause stimulative effect of *G. atrocyanea*. These facts indicate that insects with the same host ranges are not always stimulated by identical substances.

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References

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