

cyclase-membrane complex. In addition, we found that epinephrine stimulation of adenylyl cyclase activity was inhibited by endotoxin.

Others¹⁶ have obtained results which conflict with those presented here. They found no increase in cyclic-AMP with endotoxin alone, but observed an augmentation of the epinephrine response. In their model, however, endotoxin was injected in vivo and homogenates made. Our in vitro system, in contrast, permits the endotoxin to interact in a controlled amount directly with the membrane.

It is possible that endotoxin could block epinephrine binding to the receptor unit. This appears unlikely, however, because endotoxin, even at 1 mg/ml concentrations, does not interfere with the binding of norepinephrine to isolated fat cell membranes (K. KORITZ, unpublished data). It was not possible to perform this experiment with epinephrine, but a similar lack of interference with epinephrine binding may be inferred.

A possible explanation for endotoxin inhibition of adenylyl cyclase responsiveness to epinephrine is an interaction of endotoxin with membrane phospholipids. The lipid portion of the membrane is necessary for adenylyl cyclase activity since solubilized preparations of adenylyl cyclase are unresponsive to hormonal stimulation^{8,17}. Furthermore, hormone responsiveness in these solubilized preparations can be restored by the addition of specific phospholipids^{11,17}.

Endotoxin-phospholipid interaction may be explained by the three-component model of the adenylyl cyclase system¹³. In this model, an intermediate phospholipid moiety (transducer) functions between the hormone receptor on the external surface of the plasma membrane and the catalytic unit (adenylyl cyclase) on the internal surface of the plasma membrane. Interruption of hormonal induction through transducer alteration may explain how endotoxin stimulates adenylyl cyclase activity and blocks epinephrine stimulation of that enzyme.

Evidence for an interaction of endotoxin with the transducer segment of the membrane-enzyme complex comes from our study of endotoxin inhibition of sodium fluoride activation of adenylyl cyclase. This activation is postulated to occur at the transducer (phospholipid moiety) level¹⁸. As previously stated, endotoxin has an affinity for the phospholipid portion of cell membranes^{3,4}. Since endotoxin interfered with the sodium fluoride activation of purified mouse liver membrane adenylyl cyclase, it is probable that the toxin could act at the transducer level, which may be the phospholipid moiety of the membrane-enzyme complex.

¹⁶ M. W. BITENSKY, R. E. GORMAN and L. THOMAS, Proc. Soc. exp. Biol. Med. 138, 773 (1971).

¹⁷ G. S. LEVEY, J. biol. Chem. 246, 7405 (1971).

¹⁸ W. P. WICKS, Ann. N.Y. Acad. Sci. 185, 152 (1971).

The Choice of Oviposition Sites by the Lady Bird Beetle *Adalia bipunctata* (L.)

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Summary. *Adalia bipunctata* females lay eggs on brussels sprout leaves in presence or absence of aphids, but the latter furnish an additional stimulus. The glass walls of the jar attracted the adults to lay eggs on it to some extent. Presence of cemented eggs did not hinder the oviposition of the adults on the brussels sprouts leaves.

It was previously known that the odour of aphids was the most important component of the stimulus pattern for the oviposition of many aphidophagous insects¹⁻³. Other authors^{4,5} reported that many coccinellid egg batches occurred on uninfested plant stems.

The aim of the present work is to assess the role of the host plant as well as other substrates on the oviposition behaviour of *Adalia bipunctata*, in the presence or absence of aphid stimulus.

Methods. Single pair of newly emerged *A. bipunctata* adults was confined in a glass jar, 1 kg capacity with muslin cloth roof. A brussels sprouts leaf cemented with 100 aphids (*Myzus persicae*) was offered daily to the adults in the cage. Another cage containing one pair of adults offered 2 plant leaves, one of them cemented with 100 aphids and the other leaf was free from aphids. The petioles of all leaves offered were wrapped with moistened cotton to prevent their wilting. The cages were illuminated from above with fluorescent lamps (2400 Lux) for 16 h day length.

In another experiment 80 *A. bipunctata* newly laid eggs were marked with red colour, cemented on a brussels sprouts leaf and offered daily to a pair of adults (40 eggs/individual⁶). In another cage, 1 pair of adults were offered daily 2 plant leaves, one of them cemented with 80 eggs and the other leaf free from eggs.

These experiments were repeated 10 times. The number of eggs laid on the plant leaves as well as of those laid elsewhere in the jar were recorded throughout the life of each female. The relative suitability of the different substrates for oviposition was compared with that of the brussels leaves which were taken as the standard. This was calculated as $\frac{T - S}{T + S} \times 100$ where *T* and *S* being the number of eggs laid on the other substrates and the standard substrate respectively⁷. Values above or below zero reflected greater or lesser preference for the other materials with regard to the standard.

Results. 1. Oviposition site selection in the presence of aphids. The relative suitability of the different substrates for oviposition was compared with that of the brussels sprouts plant leaves. The data in Table I showed that the plant leaves elicited a higher ovipositional response,

¹ S. BOMBOSCH, XVth int. Congr. Zool. London (1958), p. 896.

² R. D. HUGHES, J. Anim. Ecol. 32, 393 (1963).

³ R. A. SUNDBY, Entomophaga 11, 395 (1966).

⁴ C. J. BANKS, Br. J. Anim. Behav. 5, 12 (1957).

⁵ A. F. G. DIXON, J. Anim. Ecol. 28, 259 (1959).

⁶ N. Z. DIMETRY, Entomophaga 19, 445 (1974).

⁷ R. C. MEHTA and K. N. SAXENA, Entomologia exp. appl. 13, 10 (1970).

Table I. Ovipositional responses of *A. bipunctata* to different substrates in presence of aphid stimulus

Substrate	Oviposition in presence of 1 plant leaf				Oviposition in presence of 2 plant leaves			
	Average No. of eggs laid per single female	Egg distribution (%)	ROR ¹	ROR ²	Average No. of eggs laid per single female	Egg distribution (%)	ROR ¹	ROR ²
Plant leaf with aphids	765 ± 87.4	73.06	1.00	0.00	488 ± 32.5	44.20	1.00	00.00
Plant leaf without aphids	—	—	—	—	396 ± 26.2	35.88	0.812	—10.41
Glass	173 ± 22.5	16.52	0.226	—63.11	136 ± 16.4	12.31	0.279	—56.41
Muslin	99 ± 18.4	9.46	0.129	—77.08	76 ± 10.3	6.88	0.156	—73.04
Moistened cotton	10 ± 3.5	0.96	0.013	—97.41	8 ± 0.6	0.73	0.016	—96.77

ROR¹, expressed as the rate between the percentage of eggs on the test and that on the standard substrate. ROR², The relative ovipositional response.

Table II. Ovipositional responses of *A. bipunctata* females to different substrates in presence of *Adalia* eggs and in absence of aphid stimulus

Substrate	Oviposition in presence of 1 plant leaf				Oviposition in presence of 2 plant leaves			
	Average No. of eggs laid per single female	Egg distribution (%)	ROR ¹	ROR ²	Average No. of eggs laid per single female	Egg distribution (%)	ROR ¹	ROR ²
Plant leaf with eggs	531 ± 35.26	62.39	1.00	00.00	318 ± 23.6	38.64	1.00	00.00
Plant leaf without eggs	—	—	—	—	357 ± 28.9	43.37	1.15	+ 5.77
Glass	278 ± 22.17	32.67	0.523	—31.27	120 ± 15.7	14.58	0.37	—45.2
Muslin	40 ± 12.89	4.70	0.075	—85.98	28 ± 8.5	3.41	0.08	—83.8
Moistened cotton	2 ± 1.08	0.24	0.004	—99.24	00.00	00.00	00.0	—100.0

ROR¹, ROR² as in Table I.

especially when infested with aphids, followed by the sides of the glass jar and muslin roof. The cotton piece wrapping the leaf stalk hardly elucidates a response. It was also noticed that the females lay more eggs on the plant leaves infested with aphids, but at a considerable distance from them (Table I).

2. Oviposition site selection in presence of *A. bipunctata* eggs and absence of aphids. Table II showed that the adults preferred to lay the majority of their eggs on plant leaves in the absence of aphid stimulus and the plant ranked the first between the other possible substrates in the cage. The presence of cemented *A. bipunctata* eggs did not hinder the oviposition of the adults, but they preferred to lay more eggs on plants free from cemented eggs. The glass attracted the females to lay their eggs on it. The decrease in the total number of eggs laid in the absence of aphids and in the presence of *A. bipunctata* eggs is due to the low nutritive value of eggs and not due to the ovipositional behaviour of the adult females⁶.

Discussion. Although most aphidophagous coccinellid species lay their eggs close to aphids, yet *A. bipunctata* laid freely on uninfested brussels sprouts plant leaves. The ovipositional response of females to the plant leaves may be due to their physical or chemical characters. IPERTI⁸ attributed the choice of the adults to the higher humidity of the plant and to the roughness of the substrate. The higher humidity present in the moistened cotton piece did not attract the adults to lay their eggs on it.

Field observations⁴ clarified that many egg batches of *A. bipunctata* occurred on uninfested plant stems. The

lady bird beetle's eggs were also present on uninfested plant leaves close to infested ones⁵. These data agree with the results of the present study which certify the importance of the host plant as an ovipositional site. Therefore, *A. bipunctata* adults may be termed primarily plant seeking or phytozetic⁹.

The selection of the glass sides of the cage to lay their eggs on may be attributed to their attraction towards light⁸.

The tendency of the adults to lay their eggs in presence of cemented *A. bipunctata* eggs shows that eggs do not hinder oviposition of the coccinellid. This is in agreement with Chandler's⁹ work on syrphidae, who showed that the presence of syrphid eggs on a suitable host plant did not influence subsequent oviposition on that plant.

⁸ G. I. IPERTI, in *Ecology of Aphidophagous Insects* (Ed. I. HODEK; Academia, Prague 1966), p. 121.

⁹ A. E. F. CHANDLER, *Ann. appl. Biol.* 61, 415 (1968).