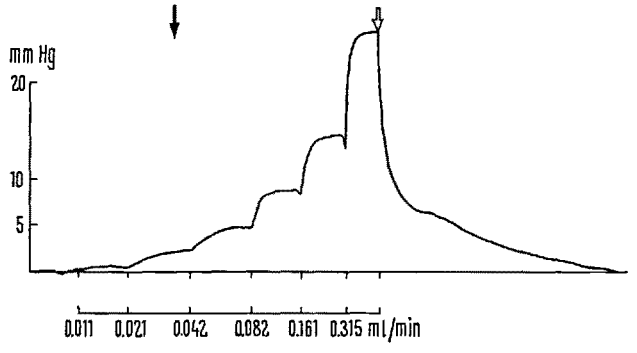
Exponent *a* was found to fluctuate about 1, wherefore single parameter straight lines were fitted to the P and F values. The *b* regression coefficients were averaged for each site of measurement and compared by analysis of variance using weighted average with the sum of squares as weights. The dimension of the regression coefficients equals that of the resistance expressed as mmHg/ml/min. The resistance of the thoracic duct to flow was calculated as the difference between the regression coefficients for the intestinal lymphatic trunk and for the cervical lymphatic trunk. Transection of the lymphatic efferent to the lymph node during perfusion was not followed by a fall in pressure in the afferent lymphatic, proving that it is the node which resists the flow: the resistance of the lymph node equals its regression coefficient.

The regression coefficient for the intestinal lymphatic trunk differed significantly from that for the cervical lymphatic trunk, and both differed from ∅ ($p < 0.01$) (Table). The resistance of the thoracic duct was 0.233 mmHg/ml/min.

Site of measurement	Regression coefficient (mmHg/ml/min)	
Intestinal lymph trunk	0.401 ± 0.063	(7)[a]
Left cervical lymph trunk	0.167 ± 0.044	(13)
Submandibular lymph node	51.4 ± 8.1	(7)
Mediastinal lymph node	152 ± 114	(3)
Periportal lymph node	113 ± 30	(6)
Popliteal lymph node	34.7 ± 5.9	(11)

[a] Arithmetic mean and S.E.; number of dogs in parenthesis.



In situ perfused popliteal lymph node: flow-to-pressure curve. ↓: transection of the efferent lymphatic was not followed by a fall in pressure; ⇓: interruption of perfusion reduced pressure to zero.

The resistance of the lymph node was roughly 100 times that of the thoracic duct (Table). Transection of the afferent lymphatic or interruption of perfusion reduced pressure to zero (Figure). No rupture of a perfused lymphatic was seen. When lymph nodes were perfused with 0.1–0.3 ml/min of fluid, the flow-to-pressure curve deflected towards the flow axis; that is, the resistance of the lymph nodes fell, as has already been observed by other workers[3].

Lymph flow so copious as to exceed the transport capacity of the lymphatic trunk is hardly conceivable in the organism; the less so as the lymph trunks are capable of transporting 10–20 ml/min, i.e. 2–3 times the total amount of the capillary filtrate (0.25% of the cardiac output)[4,5].

From this it seems to follow that functional (dynamic) insufficiency of the lymph circulation[6] develops not in the lymphatic trunk, but before it[7,8]. The extent to which lymph nodes obstruct lymph flow depends on the rate of flow: nodale resistance remains the same as long as the afferent lymphatic flow does not exceed 0.1–0.3 ml/min. The great resistance of lymph nodes to flow might explain the substantial increase in the pressure within the lymphatics in the leg during active or passive movement and why perinodal oedema develops when lymph flow substantially increases.

Résumé. Les ganglions lymphatiques perfusés sur place résistent à l'élévation du débit lymphatique; cette résistance peut favoriser le dévéloppement de l'œdème local.

M. PAPP, G. B. MAKARA and B. HAJTMAN

Institute of Experimental Medicine, Hungarian Academy of Sciences, Budapest VIII (Hungary), 19 October 1970.

[3] N. L. BROWSE, R. L. DOIG and D. SIZELAND, J. Physiol., Lond. *208*, 77P (1970).
[4] E. M. LANDIS and J. R. PAPPENHEIMER, *Handbook of Physiology*, Sect. 2 (Eds. W. F. HAMILTON and PH. DOW; Am. Physiol. Soc., Washington, D.C. 1963), vol. 2, p. 987.
[5] M. PAPP, G. B. MAKARA, B. HAJTMAN and L. CSÁKI, Gastroenterology *51*, 524 (1966).
[6] I. RUSZNYÁK, M. FÖLDI and GY. SZABÓ, *Lymphologie, Physiologie und Pathologie der Lymphgefässe und des Lymphkreislaufes* (Akadémiai kiadó, Budapest 1969).
[7] M. PAPP and G. B. MAKARA, Acta physiol. hung., Suppl. *32*, 99 (1967).
[8] M. PAPP, G. B. MAKARA and B. HAJTMAN, Orv. Hetil. *109*, 2057 (1968).

Evidence of Phagostimulants in Cotton Leaves Eliciting Feeding of *Spodoptera littoralis* Bois

The cotton leaf worm *Spodoptera littoralis* Bois is polyphagous, but it prefers some of its hosts to the others. Studies on the feeding and growth of the insect on 27 species of host plants belonging to 16 families[1] show that 8 were refused, 5 were eaten to some extent and 14 were normally accepted and fully supported growth. Of the favorable host plants, cotton (*Gossypium barbadense* L.) is heavily attacked by the larvae. The results also confirmed that the acceptance by the larvae of the host plants is due probably to chemical rather than purely physical factors and hence chemical senses must be involved in the host plant finding.

Histological and behavioural studies show that the larvae bear chemoreceptors on the mouth parts. Following techniques of successive amputation of different parts confirm that the olfactory receptors are located on the antennae and maxillary palps, while the gustatory receptors are mainly localized on the labrum epipharynx. Successive amputation of the antennal and maxillary palpal segments exerted no effect on the discriminative ability of the larvae towards non-olfactory compounds like sugars and salts. The operated larvae were able to accept sucrose and reject ammonium chloride like normal individuals when they were allowed to drink drops of

these solutions ($^1/_2 M$). On the other hand, the amputation of these appendages greatly reduced the sensitivity of the larvae towards the olfactory compounds like ethyl alcohol. This was tested by evaporating 1 cm^3 of the alcohol in a tightly covered glass jar. The operated larvae together with marked control individuals were introduced into the jar. The normal individuals showed characteristic movements of the head and mouth parts, while the operated individuals showed no reaction. Larvae with amputated labrum epipharynx, however, showed almost no discrimination to either sucrose or ammonium chloride, but they were highly sensitive to the olfactory compounds. This reaction is probably due to the elimination of the gustatory receptors on the labrum epipharynx.

These results which confirm the larval sensitivity to chemicals suggest that its feeding behaviour on plants probably involve some reactions to chemotactic stimuli that function as feeding stimulants. To investigate this relation with the cotton plant (*G. barbadense*), fresh leaves were dried at 50 °C and then ground to a powder. A known weight of the powdered leaves was subjected to successive extraction in the following order: a) petroleum ether; b) ether; c) chloroform; d) ethyl alcohol. Extraction in each solvent lasted for about 30 h till exhaustion. A bioassay for the different extracts was carried out. For this purpose, a basic medium composed of 2 g agar, 0.5 g cellulose and 40 cm^3 hot water was prepared and then poured into Petri dishes to cool. From this gelled medium round discs, 18 mm in diameter were cut out and transferred as required to Petri dishes 9×2 cm, where they were placed at equal distances apart in a circle, the centre of which was the centre of the dish. The extract to be tested was then applied topically to the disc, thus representing a feeding station. The distribution of the feeding stations was randomized to the extent that feeding stations with the same extract were never placed adjacent to each other.

Egg masses of *S. littoralis* were taken from the standard laboratory culture a few hours before hatching, and a single mass was placed in the centre of each dish which was then covered with a glass lid and sealed with wax. The dishes were incubated for 24 h at 30 °C. The hatched larvae which settled on each disc with a tested extract as well as on the control discs were counted. The data obtained from 20 replicates show that the petroleum ether extract is most attractive for the larvae (Table I).

When chlorophyll and other pigments were removed from this extract with Fuller's earth, the filtrate proved on bioassay to be as attractive to the larvae as before removing the pigments.

Following this, the filtrate was evaporated and the residue was subjected to steam distillation till no more odour was detected in the distillate. The distillate was shaken with successive portions of ether, dehydrated with anhydrous sodium sulphate and distilled off leaving a yellowish brown volatile oil. This volatile oil fraction was bioassayed using the arena previously described[2]. Observations were made at successive intervals of 10 min for 1 h period. The data obtained show that this volatile fraction is highly attractive to the newly hatched larvae (Table II).

The remaining non volatile fraction (lipid) was extracted by shaking with ether, dehydrated with anhydrous sodium sulphate and distilled off. Bioassay of this fraction, following the method of agar food stations as already described, revealed that it is attractive to the larvae. So, the lipid residue was saponified with N/2 alcoholic KOH by refluxing on a boiling water bath for 6 h. The solution was evaporated and the residue was treated with about 100 ml of H_2O. The unsaponifiable matter was extracted by shaking with successive portions of ether. The combined ether extract was washed with distilled water until free from alkalinity. Ether was dehydrated over anhydrous sodium sulphate and distilled off (Fraction A). The mother liquor was rendered acidic with dilute sulphuric acid and the free liberated fatty acids were extracted with ether, the ether washed with water till free from acidity, dehydrated as mentioned before and distilled off (Fraction B). A bioassay of both fractions A and B following the same techniques revealed that the unsaponifiable matter (Fraction A) contains the attractive ingredients to the larvae (Table III).

Further studies on the constituents of both the active volatile and non-volatile fractions are now in progress aiming to isolate and identify the active phagostimulants.

Generally, this study gave convincing evidence for the presence of 2 stimulants with diverse chemical characteristics in the cotton leaves, one is a volatile fraction and the other is non-volatile. These stimulants are of deciding efficiency in eliciting the feeding response of *S. littoralis*. Two fractions in mulberry leaves, which stimulate feeding of *Bombyx mori*, were isolated[3]. The possible existence of an attractant in the cotton flower buds for the boll weevil was also mentioned[4,5].

Table I

	No. of larvae settled
Control	141
Petroleum ether	497
Ether	123
Chloroform	91
Ethyl alcohol	187

Table II

No. of larvae settled	Side with volatile fraction	Side with no odour
(20 replicates)	110	51

Table III

No. of larvae settled	Control	Fraction A	Fraction B
(10 replicates)	54	1225	96

Zusammenfassung. Baumwollblätter enthalten mindestens eine volatile und eine nicht volatile (unverseifbare) lipophile Komponente. Diese wirken auf Larven von *Spodoptera littoralis* attraktiv und stimulieren das Fressen.

H. S. Salama, A. M. Rizk and A. F. Sharaby

National Research Centre, Plant Protection Laboratory, Dokki (Cairo, U.A.R.), 4 August 1970.

[1] H. S. Salama, N. Dimetri and S. Salem, Z. ang. Ent., in press.
[2] V. B. Wigglesworth, Parasitology *33*, 67 (1941).
[3] J. K. Nayar and G. J. Fraenkel, Insect Physiol. *8*, 505 (1962).
[4] J. C. Keller, F. G. Maxwell and J. N. Jenkins, J. econ. Ent. *56*, 110 (1963).
[5] P. A. Hedin, A. C. Thompson and J. P. Minyard, J. econ. Ent. *59*, 181 (1966).