CC/NUMBER 40
OCTOBER 1, 1984

This Week's Citation Classic™

Lees A D. The control of polymorphism in aphids.
Advan. Insect Physiol. 3:207-77, 1966.
[Agricultural Research Council Unit of Insect Physiology, Zoological Dept., Univ. Cambridge, England]

This paper reviewed work on aphid polymorphism, concentrating particularly on the complex of environmental factors, such as photoperiod, temperature, food, degree of crowding, etc., that control the seasonal production of sexual and parthenogenetic morphs and the development of winged and wingless females. [The *SCI*® indicates that this paper has been cited in over 125 publications since 1966.]

A.D. Lees
Insect Physiology Group
Agricultural Research Council
Imperial College Field Station
Silwood Park
Ascot, Berkshire SL5 7PY
England

July 20, 1984

"If I remember correctly, I was invited to write this review by Sir Vincent (then Professor) Wigglesworth, who was both an editor of this journal and director of the Agricultural Research Council (ARC) Unit of Insect Physiology of which I had been a member since 1945. The group was based in the Zoological Department of the University of Cambridge. The proposition attracted me as I had just completed several relevant papers and still found myself with unpublished work in my notebooks. The editors of this admirable periodical allowed their authors some license in discussing personal views, and I was able to develop these lines of inquiry in my article, as well as review the voluminous literature as a whole.

"Before working with aphids (then, as now, attracting a considerable amount of research interest because of their role as virus carriers), I had become intrigued by the responses of insects and mites to length of day (photoperiodism), at that time a near prerogative of Danilevskii[1] and his Leningrad school. Photoperiodic responses had already been demonstrated in aphids by Marcovitch,[2] Shull,[3] and Bonnemaison,[4] but this seemed like an ideal opportunity to adopt a more physiological approach. The first useful discovery was that photoperiod acts maternally as a switching mechanism that commits the embryos growing in the abdomen of the pregnant mother to develop either as short-day, egg-laying oviparae or as the long-day, parthenogenetic forms. The progeny sequence could indeed be 'read' as the photoperiodic history of the mother. Using this information and a suitable optic fibre technique, I was able to show that the light receptors and clock were brain-centered. Their precise whereabouts still elude discovery. Apart from the attractions of photoperiodism as a physiological puzzle, there were a number of other gaps in our knowledge of aphid polymorphism. One of these, discussed in the paper, concerned the environmental factors responsible for triggering a further morphological change, namely, the production of winged and wingless females. Bruce Johnson[5] and I[6] had just shown independently that the tactile stimulation resulting from the jostling behaviour of aphids when grouped together played an unexpectedly important part in this response.

"If the review has been of use, I attribute this to a fortuitous resurgence of interest among both insect physiologists and applied entomologists. Of course, many lines of research, briefly touched on in the review, have since been greatly opened up. Photoperiodism and the role of hormones are two of these.[7] As far as I am aware, this particular paper had no immediate influence on my career, but as I was later elected to a fellowship of the Royal Society, I assume that the aphid work may have had something to do with this. Equally important from my point of view, it has enabled me to continue work with another ARC Insect Physiology Group, this time at Silwood Park, Imperial College, in the University of London, and even to continue research on aphid clocks during my present state of semiretirement.

"During tea, Wigglesworth once likened research opportunities to a pail full of fresh milk. As cream rises to the surface it can be skimmed off. But on standing, fresh cream appears that can then be harvested by the diligent dairymaid. It is perhaps time for another skimming from the capacious bucket of aphid polymorphism. The excellent recent reviews of polymorphism physiology have focused on rather different fields, namely, the almost ubiquitous control exercised by juvenile hormone[8] and caste development in social insects."[9]

1. **Danilevskii A S.** *Photoperiodism and seasonal development of insects.* Edinburgh: Oliver & Boyd, 1965. 282 p.
2. **Marcovitch S.** The migration of the Aphididae and the appearance of the sexual forms as affected by the relative length of daily light exposure. *J. Agr. Res.* 27:513-22, 1924.
3. **Shull A F.** The effect of intensity and duration of light and of duration of darkness, partly modified by temperature, upon wing-production in aphids. *Wilhelm Roux Arch. Entwicklungsmech. Org.* 115:825-51, 1929.
4. **Bonnemaison L E.** Contribution à l'étude des facteurs provoquant l'apparition des formes ailées et sexuées chez les Aphidinae. *Ann. Épiphyt.* 2:1-380, 1951. (Cited 85 times since 1955.)
5. **Johnson B.** Wing polymorphism in aphids. II. Interaction between aphids. *Entomol. Exp. Appl.* 8:49-64, 1965.
6. **Lees A D.** The production of the apterous and alate forms in the aphid *Megoura viciae*, with special reference to the role of crowding. *J. Insect Physiol.* 13:289-318, 1967. (Cited 60 times.)
7. **Hardie J.** A hormonal basis for the photoperiodic control of polymorphism in aphids. *Ciba Foundation Symp.* 104:240-52, 1984.
8. **Nijhout H E & Wheeler D E.** Juvenile hormone and the physiological basis of insect polymorphism. *Quart. Rev. Biol.* 57:109-33, 1982.
9. **de Wilde J & Beetsma J.** The physiology of caste development in social insects. *Advan. Insect Physiol.* 16:167-246, 1982.

 ©1984 by ISI® CURRENT CONTENTS®