

## Host-plant selection by *Spodoptera littoralis*, a laboratory and field study

M. M. Sadek,<sup>1</sup> B. S. Hansson<sup>2</sup> and P. Anderson<sup>3</sup>

<sup>1</sup>Department of Zoology, Faculty of Science, Assiut University, Assiut 71516, Egypt

<sup>2</sup>Max Planck Institute for Chemical Ecology, Department of Evolutionary Neuroethology, Hans-Knoell-Strasse 8, D-07745 Jena, Germany

<sup>3</sup>Department of Plant Protection, Swedish University of Agricultural Sciences, Box 44, 230 53 Alnarp, Sweden

The selection of an oviposition site by a female insect is a critical decision, as the fitness of the progeny depends mainly on that decision. Accordingly, females are expected to lay their eggs on hosts that ensure the best performance for their offspring. However, such a positive correlation between adult host preference and offspring performance does not always exist. There are many cases where adults choose hosts on which the larvae exhibit a slow growth rate and attain lower body size. This can be explained by ecological factors which may shape the adult behavior (Thompson, 1988) or by the type of food the larvae have experienced. According to the “Hopkins' host selection principle” (HHSP) (Hopkins, 1917), adult insects may show an enhanced preference for the host species upon which they themselves have developed as larvae, regardless of the nutritional quality or other benefits supplied by these host species. While some authors have reported observations supporting the HHSP, many studies have not found any direct correlation between larval food and adult host preference (Barron, 2001).

*Spodoptera littoralis* Boisduval (Lepidoptera: Noctuidae) is a highly polyphagous pest widely distributed in the temperate regions and Mediterranean countries. Anderson et al. (1995) have shown that potato extract is deterrent to the egg-laying *S. littoralis* moths when they have no prior experience of potato. However, moths from a culture raised on a potato-based diet are not deterred by the potato extract, suggesting that the larval food has enhanced the acceptance of an otherwise unfavorable oviposition site (Anderson et al., 1995). Whether these observations imply the presence of an induction of host preference in *S. littoralis* or just reflect an enhancement of oviposition site acceptance, was not known. We have therefore conducted field experiments in which we reared the insects on either alfalfa or cotton in the laboratory throughout the whole larval period. Pupae were also kept in the lab until a few days before adult emergence when we transferred them to the field and placed them at the border between cotton and alfalfa plants. Collecting the egg batches on each crop, we found that “cotton-reared” insects have laid substantially more egg batches on cotton than on alfalfa, whereas “alfalfa-reared” moths have laid more egg batches on alfalfa than on cotton, indicating that there is a host preference induction in *S. littoralis* depending on the larval experience.

Some of the possible mechanisms behind this induction have been studied. Among these mechanisms is the “chemical legacy”, a trace of chemicals from the larval environment that accompany an insect to the adult stage (Barron, 2001). However, it has been suggested that the induced behavioral change could be acquired in the early imaginal rather than the preimaginal stage (Barron and Corbet, 1999). To address the question of when the induced preference is acquired we carried out some field experiments using a field of cotton and alfalfa. We reared *S. littoralis* on alfalfa leaves from the first instar larva to the late last instar. Shortly before pupation, however, we

transferred these late larvae to the cotton side of the field and let them pupate in the soil where cotton grew. On the first day of adult emergence, we transferred the newly emerged moths to the border between alfalfa and cotton. Those moths have laid substantially more egg batches on alfalfa than on cotton plants. In another experiment, we have reversed the situation, rearing the insects on cotton leaves until shortly before pupation when we transferred them to the alfalfa side. They pupated there and remained in alfalfa soil until emergence, after which the adults were transferred to the border between the two crop plants. The result was that remarkably more egg batches were laid on cotton than on alfalfa plants.

Two major conclusions have been drawn from the above mentioned experiments: 1) *Spodoptera littoralis* moths do have an induced host preference depending on larval experience, supporting the HHSP, and 2) the effect of a “chemical legacy” carried from the environment during the period from egg hatching to the late last larval instar may outweigh the effect of experience acquired from the environment at the very late larval period, the whole larval period, or the very early adult stage.

### **References:**

- Anderson, P., Hilker, M., and Löqvist, J. (1995). Larval diet influence on oviposition behavior in *Spodoptera littoralis*. *Entomol. Exp. Appl.* 74: 71-82.
- Barron, A. B. (2001). The life and death of Hopkin’s host-selection principle. *J. Insect Behav.* 14: 725-737.
- Barron, A. B. and Corbet, S. A. (2000). Behavioural induction in *Drosophila*: Timing and specificity. *Entomol. Exp. Appl.* 94: 159-171.
- Hopkins, A. D. (1917). A discussion of C. G. Hewitt’s paper on “Insect Behaviour.” *J. Econ. Entomol.* 10: 92-93.
- Thompson, J. N. (1988). Evolutionary ecology of the relationship between oviposition preference and performance of offspring in phytophagous insects. *Entomologia Experimentalis et Applicata* 47: 3-14.