

Regulatory Role of Homeotic Genes in Lepidopteran Proleg Development*

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The basic body plan of the insect consists of three tagmata namely head, thorax and abdomen. Each thoracic segment bares a pair of appendages and abdominal segments in adult insects lack such a feature quite often. Prolegs are appendages that develop in the larval abdomen of Lepidoptera, Mecoptera and Symphyta of Hymenoptera. The limited distribution of proleg-baring species raises the question whether prolegs are homologous structures or convergent traits.

To address this issue we tried to analyze the molecular mechanisms underlying the proleg development in a lepidopteran species, *Bombyx mori*. Prolegs of *Bombyx* are segmented and bare crochets at their tips. Their ventro-lateral position is in line with the thoracic legs and *Dll* expression is detected at their tips during embryonic development where the expression domains of *wg* and *dpp* are overlapped. These observations suggest geometrical information in developing prolegs in *Bombyx* is carried by the same genetic network as *Drosophila* legs and prolegs of *Bombyx* are likely serially homologous to the thoracic legs.

The development of appendages in abdominal segments in insects is suppressed by the expression of the homeotic genes, *Ubx*, *abd-A* and *Abd-B* in this tagma, and permissive expression of *Dll* in proleg-baring segments that is achieved by the "clearance" of *abd-A* expression is thought to result in the development of lepidopteran prolegs (Warren *et al.*, 1994). Strange enough, the *abd-A* null mutant strain of *Bombyx*, *E^{Ca}*

animals fail to develop any prolegs (Ueno *et al.*) and this is phenocopied by knocking down *abd-A* expression by injecting dsRNA for *abd-A* into the embryo (Tomita and Kikuchi, 2009). Moreover, *Dll* expression remains to be detected in the proleg primodial region in *E^{Ca}* embryos. Knocking-down *Dll* made no effects on proleg development while gnathal appendages and thoracic legs are greatly reduced. Abd-A protein was accumulated at the proleg primodial regions and this trend is conserved among the genetic mutants that develop extra prolegs. This strong expression of Abd-A is observed only in the sixth abdominal segment of the embryo of a Geometridae species (*Milionia basalis*) which bares prolegs only on A6 segment. These results strongly suggest that during the development of abdominal prolegs of Lepidoptera *abd-A* plays promotive, rather than suppressive role and *Dll* expression is dispensable.

References

- Tomita, S. and A. Kikuchi (2009) *Abd-B* suppresses lepidopteran proleg development in posterior abdomen. *Developmental Biology*, **328**, 403-409.
- Ueno, K., C. C. Hui, M. Fukuta and Y. Suzuki (1992) Molecular analysis of the deletion mutants in the E homeotic complex of the silkworm *Bombyx mori*. *Development*, **114**, 555-563.
- Warren, R. W., L. Nagy, J. Selegue, J. Gates and S. Carroll (1994) Evolution of homeotic gene regulation and function in flies and butterflies. *Nature*, **372**, 458-461.