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Manipulation and Exploitation of Diapause for Pest Management

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Diapause is a genetically determined and endocrine mediated dormancy that occurs at a specific developmental stage and the expression of diapause is subject to both environmental and genetic factors or Periods of arrest in the ontogenic (origin and development of organisms) development. It is an important adaptation in many insect species enabling them to sustain in regions which would otherwise be unfavorable for permanent habitation, and to maintain high numbers in an environment which might otherwise support only a low population. The term 'diapause' was applied by Wheeler to egg stage of grasshopper, *Conocephalus ensiferum*

Manipulation of diapause for pest management by:

Population modeling: An understanding of the seasonal distribution of pest species is, of course, essential for generating predictive models that will accurately define an insect's period of destructive activity. Such calculations necessitate knowledge of the environmental cues that initiate diapause and the dynamics of the diapause state, including the factors required to terminate diapause.

For example, successful modeling of spring emergence of the gypsy moth requires detailed knowledge of the chilling requirement needed to capacitate development, as well as the thermal units required to complete development prior to egg hatch. Such information is critical for designing effective control strategies and for anticipating shifts in emergence patterns that may be associated with climate change.

Cryopreservation: Maintaining insect stocks has become an economic as well as a logistical burden for researchers around the world. This challenge has become much more intense recently with the development of so many new mutants and genetically transformed lines of *Drosophila melanogaster*, as well as insects of medical, veterinary and agricultural importance. A good technique for cryopreservation thus is a top priority for the insect community.

Foundational studies of insect hormones: It should be evident from the above section on hormonal manipulation that we already know quite a bit about the hormonal control of insect diapause, but what may not have been obvious is that much of the early work on insect endocrinology was based on diapause models**.**

Pharmacological prospecting: Traditionally, the pharmaceutical industry has relied primarily on medicinal plant compounds that can be easily harvested in high quantities, but with recent progress in molecular biology, it has suddenly become possible to produce compounds of medical interest that are normally produced only in small amounts by insects and other animals. Insects use an array of interesting compounds for defense against bacteria, viruses and fungi, and thus offer a potentially valuable resource for pharmacological prospecting.

Ex: Cecropin (*Hyalophora cecropia*)
Alloferons (*Calliphora vicina*)

Managing domesticated species: Bumble bees and solitary bees play a huge role as pollinators in greenhouses and field crops, respectively. Much of this pollination is dependent on commercial pollination services that rely on domesticated strains of bees, and because both bumblebees and solitary bees have a diapause (adult queens of bumble bees and pupae of solitary bees), commercial producers of these bees must understand how this diapause is environmentally regulated and be able to produce active bees at the correct time of the year. Similarly, the commercial silk moth, *B. mori* and the many wild species of silk moths that are currently being promoted for silk production, have diapauses that growers must understand and be able to manipulate.

Exploitation of diapause traits for pest management: The knowledge of diapause is very essential to understand the seasonal biology of insect species and such information is required for the development of effective pest management.

Adult diapause in the apple blossom weevil, *Anthonomus pomorum*, When overwintering beetles terminate diapause in the spring, they are attracted to warm sites during the first few days of activity. Thus, by providing a warm shelter in the apple orchard it is possible to attract large numbers of beetles during the first 2–4 days after diapause has been broken. Such shelter traps thus offer a valuable tool for monitoring populations of this pest species in the apple orchards.

The codling moth responds to short day length by entering a larval diapause, and interestingly, adult females that have been through diapause as larvae retain their mobility following gamma radiation much better than females that did not go through larval diapause Such a discovery has obvious and important implications for application of the sterile insect technique (SIT) for this species. By using females that have gone through diapause, it is possible to irradiate the moths without a loss in mobility, thus producing competitive individuals that can be released in a SIT program.

Conclusion

By understanding energy utilization mechanism of insects during diapause we can identify one of the critical dimensions defining the limits of insect survival in the seasonal environment. Such information could be helpful in explaining current species distribution and surely it also helps us in designing a suitable management strategy for a particular pest.

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