CONSERVATION OF NATURAL ENEMIES

Notes

I. Conservation of natural enemies:

A. Absolutely essential if biological control is to work at all. This process involves manipulation of the environment to favor natural enemies, either by removing or mitigating adverse factors or by providing lacking requisites.

B. Conservation of natural enemies works best in insect habitats which may lack only certain key requisites and it is with these habitats that adversity may be favorably modified for effectual action by natural enemies.

C. To a large extent, the efficacy of natural enemies depends upon the degree of permanence, stability, and general favourability of environmental conditions. Departures from the natural environment, whether intentional or incidental, by influencing entomophagous species, are often reflected in the degree of depredation caused by injurious arthropods.

II. Environmental modifications may be made to increase natural enemy effectiveness. These modifications include:

A. Construction of artificial structures;
B. Provision of supplementary food;
C. Provision of alternative hosts;
D. Improvement of pest-natural enemy synchronization;
E. Control of honeydew-feeding ants; and
F. Modification of adverse agricultural practices.

III. Construction of artificial structures.

A. This has been done to increase the densities of predaceous insects, birds, and insectivorous vertebrates such as shrews, mice, squirrels, etc.

B. The best known example of using artificial structures to enhance predaceous insect populations was that of using "nesting shelters" for protection of *Polistes* wasps around tobacco fields in North Carolina for control of the tobacco hornworm, *Manduca sexta*.

IV. Provision of supplementary food.

A. Adult natural enemies often need nectar and pollen as a source of nourishment and moisture.

B. In nature these requisites are provided by a variety of plants. However, in agro-ecosystems many of these plants are considered weeds and are removed.

C. Interplanting of certain crops has been used to provide nectar and pollen sources for natural enemies. It is known that coccinellid species such as *Hippodamia* shift over to pollen when aphids become scarce. Unfortunately they cannot reproduce on a diet of only pollen. The late Kenneth Hagen, University of California, Berkeley, conducted many studies on providing supplementary food sources by spraying solutions of sugar/honey and yeast hydrolysate directly on crops.

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V. Provision of alternative hosts.

A. Fundamentally, alternate hosts reduce conditions of asynchrony between preferred hosts and their non-specific parasites and predators.

B. The secondary manifestations of this function are:

1. Damping of extreme oscillations in natural enemy and host densities;
2. Maintaining functional natural enemy populations during low density periods of preferred hosts;
3. Providing suitable overwintering hosts;
4. Facilitating maximum natural enemy distribution; and
5. Reducing natural enemy cannibalism and combat.

C. In many cases this has been attempted through the concept of intercropping host plants of the pest and/or alternate hosts thus preventing total destruction of the habitat at harvest time. In New Jersey, intercropping of peaches and strawberries leads to better control of the oriental fruit moth, *Grapholitha molesta*, by the braconid parasite *Macrocentrus ancylivorus*. The parasite normally overwinters in alternative hosts such as the strawberry leaf roller which occurs on strawberries.

VI. Improvement of pest-natural enemy synchronization.

A. Occasionally, the effectiveness of an entomophagous species is reduced or lost because it becomes partially or wholly separated from its host in time or space. Usually this can only be rectified by manipulation of the environment.

B. In control of scale pests in California achieving synchronization of natural enemises and parasites has been a great difficulty. When citrus orchards are fumigated for control of the black scale, *Saissetia oleae*, all parasitoids are eliminated. This problem is reduced by the growth of pepper and olive trees around the orchards which act as a host for the black scale and provide a safe environment for the effective parasites. Use of English ivy as a ground cover in citrus provides an alternative plant host for the California red scale and Oleander scale and allows *Aphytis* spp. to build up in orchards.

VII. Artificial infestation or inoculation of crops with pests has been used to augment effective natural enemies.

A. The best example was with the cyclamen mite, *Steneotarsonemus pallidus*, on strawberry. Early inoculation of this species allowed its predator (*Typhlodromus reticulatus*) to build up prior to it reaching economic levels.

VIII. Control of Honeydew-feeding ants.

A. Ants often protect honeydew producing organisms such as aphids, mealybugs, and scales from attack by natural enemies. Control of ants (usually with pesticides) often leads to more effective biological control.

B. In Hawaii, an excellent example of this is with the *Dysmicoccus* mealybugs (the pink and gray pineapple mealybugs) that infest pineapple and that are tended by the big-headed ant, *Pheidole megacephala*. Use of

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ant baits eliminate the ants, and allow the mealybugs' natural enemies to attack them.

K. Modification of adverse agricultural practices.

A. This involves an extremely large area. Some of the main areas where modifications may take place are in:

1. Cultivation and Dust Buildup. Many natural enemies which overwinter in the soil or pupate there may be destroyed through cultivation practices. Dust accumulation on foliage can interfere with the searching activities of natural enemies. Small amounts of dust can kill parasites such as *Aphytis* spp.
2. Use of Clean Culture (elimination of weeds). This can result in the elimination of valuable alternative hosts and supplementary sources of nourishment for natural enemies. Elimination of cruciferous weeds in cabbage-growing areas in South Africa reduces alternate hosts for the Diamondback Moth. The weeds serve to maintain the pest for the natural enemies and thus maintain the natural balance in the area. In some areas burning of harvest residue (i.e., sugarcane, wheat) can destroy natural enemies which develop on hosts remaining in the residue.
3. Mowing (harvest). Mowing of large contiguous acreages of alfalfa in California adversely affects most of the beneficial insects inhabiting the fields. Use of strip farming can reduce destruction of natural enemies of the spotted alfalfa aphid.
4. Chemical pesticides. Use of pesticides can result in the disruption of favourable natural enemy-pest balances. Resulting outbreaks of pests may be classified as to the mechanism of increase. These are:

   a. Pest Resurgences: characterized by an abnormally rapid return of a pest to economic abundance after initial suppression by a pesticide which also destroyed the pest's natural enemies (which provided only partial control).
   b. Pest Upsets (Secondary Pest Outbreaks): characterized by the rise to economic prominence of an insect which is relatively unaffected by a pesticide treatment for another insect pest, but whose normally efficient natural enemies are affected.

5. Usually the best way to improve these situations is by employing a selective pesticide which kills the pest but not the natural enemies. Selectivity may be derived several ways:

   a. Physical (= Ecological) Selectivity: results from differential exposure of pests and natural enemies to a pesticide.

      - Preservation of natural enemy resevoirs outside of treated areas
      - Differential susceptibility of developmental stages of natural enemies
      - Distinctive seasonal life histories and habits of natural enemies
      - Distinctive physical features of pesticides and their applications

   b. Physiological Selectivity: results from physiological differences in susceptibilities of pests and associated natural enemies to a

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pesticide. Such physiological differences in the natural enemy may be inherent or a product of laboratory or field selection.

QUESTIONS

1. What types of environmental modifications could one do to conserve natural enemies?
2. How does a pest resurgence differ from a secondary pest upset?
3. What is the difference between physiological pesticide selectivity and ecological pesticide selectivity?
4. How does dust impact natural enemies?

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