

biodiversity

SUCCESS STORIES

No. 2 March 2014



Edited by
BioGenRes - Italian Network of Genetic Resources
www.biogenres.it



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PUBLISHED BY

BIOGENRES (ITALIAN NETWORK OF GENETIC RESOURCES), AS A PART OF THE CISIA PROJECT (INTEGRATED KNOWLEDGE FOR SUSTAINABILITY AND INNOVATION OF *MADE IN ITALY* AGRIFOOD) FUNDED BY THE ITALIAN NATIONAL RESEARCH COUNCIL, DEPARTMENT OF BIO-AGRIFOOD SCIENCES (CNR-DISBA).

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Sweeten our crops. Sustain a high diversity of beneficials through “sweet food” from plants

Dr. Roberto A. Pantaleoni, Institute of Ecosystem Study, CNR-ISE

A sweet tooth overhangs the terrestrial ecosystems, it is nursed by plants constantly producing pollen and nectar and indirectly honeydew and honey. Truly the “green” Earth is “a land flowing with milk and honey” for myriads of species: from lizards to bees, from birds to flies, from man to ants, through marsupials, beetles, bats and so on. This sweet plant-provided food is the powerful basis of pollination and of many other multi-trophic interactions.

Plants provide nectar and pollen to attract pollinators, in addition plants provide food as a protection strategy attracting predators that can act as bodyguards. The frequent presence of extrafloral nectaries is a direct evidence of this strategy. A wide range of predaceous insects (and other arthropods), in any developmental stages, requires sweet plant-provided food as a needful part of their diet.

The role of sweet food in plant-herbivore-carnivore interactions is important in biological pest control practices. Biological control workers had the awareness in a long time that in agroecosystems the absence of non-prey food sources could constrain the effectiveness of natural enemies and that adding food sources could enhance the effectiveness of biological control programs. Three approaches have been developed to manage the sweet food sources in modern monocultures: i) the diversification of the landscape (intercropping, uncultivated margins, etc.); ii) food sprays or other artificial food supplements; iii) crop varieties producing extra-floral nectar (e.g. cotton varieties with extra-floral nectaries).



An adult of *Hypochrysa elegans* is eating
(by Claudio Labriola)

A terminological issue

In scientific English, there are terms to indicate the nectar-feeder (nectarivorous or nectar-feeding), the pollen-feeder (pollenophagous or pollen-feeding), and also the honeydew-feeder (if we are satisfied with the term honeydew-feeding), but there is no general term to indicate a mixed diet of nectar, pollen and honeydew (if not also honey). Unfortunately a strict specialization on nectar or pollen is not a rule.

So e.g., in order to define the adult lacewings belonging to the genera that are not predaceous, we had to write “nectar and pollen-feeding adults” (ignoring the indeed very important honeydew). This is a very inelegant convoluted wording and we miss the simple Italian word “glicifago” of Greek derivation (γλυκός sweet + φαγος feeder) that means feeder on sweet food (similar words exist in the other Romance languages).

Even in English the use of the word *glyciphage* (and its derivatives *glyciphagous*, *glyciphagy*) would be more clear, precise and concise in order to indicate the diet of the several hundreds of thousands of species which feed generically on some or all of the sweet plant-derived foods.

The green lacewings (Neuroptera Chrysopidae) are a paradigmatic group of beneficials that needs sweet food. Whereas the diet of adults is based in many genera on non-prey food, the larvae are considered only predaceous. The fact that the larvae ingest sweet liquids has been well known but this behavior was commonly considered occasional, and overall required in order to survive during periods without prey. Only recently some authors found out that extra-floral nectar provides nutritional benefits enhancing the growth and fasting the development of the lacewing larvae.

Laboratory studies, in which a solution of fructose was been available to newly-hatched larvae, demonstrate as this behavior has a more complex adaptive reason. Actually, fructose solution is never refused by larvae, it has a significant effect on reducing mortality and it is able to ‘cover for’ the absence of a protein source for at least 24 hours. Development times are shorter if fructose is given. The sugar gives a necessary, important energy supply in some particularly delicate moments of the development cycle. Especially at the post-hatch time when the larva has to face great difficulties in searching for, attacking and overpowering prey.

Probably similar needs are shared with other groups of beneficials regarded as exclusively predaceous, so the influence of the sweet tooth in agroecosystems is probably wider than believed.