Wax of a Whitefly and Its Utilization by a Chrysopid Larva*

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A diagnostic characteristic of insects of the family Aleurodidae (order Homoptera, suborder Sternorrhyncha) is the production of wax in the form of a particulate covering of their bodies. The substance, which is produced by special integumental glands [1] and is often applied by the insects to the leaf surfaces upon which they live, is responsible for the name “whitefly” commonly given these insects. Whiteflies include many agricultural pests. We here report on the chemical nature of the wax of a North American whitefly, and on the use that one of its predators makes of this wax.

The whitefly studied, *Metaleurodicus griseus*, is restricted to the state of Florida (USA), where it occurs on plants of the genus *Eugenia* (Myrtaceae) [2]. The population we studied was located in a patch of coastal hardwood forest on *E. myrtoideas* and *E. axillaris*, near Vero Beach, Indian River County, Florida. Stages in the life cycle are shown in Fig. 1. The adults are covered with fine waxy powder, the eggs with a dense waxy fluff, and the larvae with a loose matting of waxy fibers that extends to their surroundings.

Wax for analysis was collected by swabbing the covering of eggs, and the matting on and around larvae, with a fine glass probe. A sample was analyzed by direct insertion probe on a LKB-9000 mass spectrometer at 70 eV and 20 µA ionizing current. The probe was heated from ambient to 290°C with scans being made every ca. 20°C. Mass measurement was checked by addition of a perflourinated triazine standard to a second specimen of the wax.

As the probe reached 80°C, a series of unsaturated hydrocarbons was observed. Intensities of their molecular ions at m/z 392, 418, and 420 suggested that they were present in the following proportions: C_{25}H_{46} (26%), C_{30}H_{58} (27%), and C_{35}H_{60} (47%). Further heating to 115°C produced a saturated wax identified as triacontanyl decanoate from ions at m/z 173 (decanoic acid + H), 420 (triacontanol - H_2O), and a molecular ion at m/z 592. Further heating from 150 to 200°C produced the much higher homolog triacontanyl octadecanoate similarly identified by ions at m/z 285 (acid + H), 420 (alcohol - H_2O), and a molecular ion at m/z 704. The main component, triacontanyl triacontanoate was detected even in the earliest scans but eluted in a broad peak maximizing at ca. 310°C. This compound was identified by peaks at m/z 453 (triacontanoic acid + H), m/z 420 (triacontanol - H_2O), and a molecular ion at m/z 872. The approximate quantities of each were determined by integrating the areas of the corresponding total ion monitor response: unsaturated hydrocarbons 1.2%, triacontanyl decanoate 12.8%, triacontanyl octadecanoate 17%, triacontanyl triacontanoate 69%.

This wax mixture is clearly different from that reported recently for two other whiteflies, *Bemisia tabaci* and *Trialeurodes vaporariorum* (Homoptera: Aleurodidae) [3] where only triacylglycerols mixed with either 3–7% (*B. tabaci*) or 0.6–1% (*T. vaporariorum*) hydrocarbons were detected. Comparisons are also in order with waxes characterized recently from other homopteran species. We ourselves reported the presence of the 15-ketotetracontanol ester of 11-ketotriacontanoic acid as the main constituent in the wax of the lantern bug *Ce. rogenes auricoma* (Homoptera: Fulgoridae) [4]. This wax was identical to.

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that found previously by Meinwald et al. in *Dactylopius confusus* (Homo-
ptera: Aphididae) [5]. Interestingly, in two other cases the wax esters were also 
composed of identical carbon chain length acids and alcohols. Thus, 
*Drosicha corpulenta* (Homoptera: Margarodidae) contained hexacosanyl 
hexacosanoate [6] and *Anomoneura mori* (Homoptera: Psyllidae) contained 
dotriacontanyl dotriacontanoate (lac-
ceryl lacerrate) [7]. Only in *Ceroplastes pseudoceriferus*, *C. japonicus*, and *C.
rubens* (Homoptera: Coccidae) were complex mixtures noted with acids 
ranging from \( C_{16} - C_{34} \) and alcohols 
from \( C_{24} - C_{34} \) [8]. Use of the same 
carbon chain for both acid and alcohol 
would seem to reflect a certain 
biosynthetic economy in the corre-
ponding species, while species showing 
little homology may find a relatively 
high melting point (82–86°C in our case) 
advantageous.

Field observation of the *Metaleuro-
dicus* populations revealed the presence 
of a green lacewing larva, *Ceraeochrysa 
cincta* (Chrysopidae), that actively 
preyed on the whiteflies. Visual inspec-
tion of some dozens of infected *Eu-
genia* plants produced over a dozen 
of these larvae, as well as a number of 
hatched and unhatched, typically 
stalked, chrysopid eggs. The larvae all 
bore conspicuous white packets on 
their backs, seemingly waxy in nature.

*C. cincta* belongs to a category of 
chrysopid larvae known as “trash carriers”, 
which build dorsal packets from exo-
genous materials, including vegetable 
matter, arthropod remains, and general 
debris [9–13]. Close observation of *C.
cincta* larvae that we took with *Meta-
leurodicus* colonies to a laboratory 
(Archiped Biological Station, Lake 
Placid, Florida) showed that the larvae 
construct their packet from *Metaleuro-
dicus* wax. By use of their curved 
pointed mandibles, which function as a 
fork, they pluck wax from the covering 
of *Metaleurodicus* eggs and larvae, and 
 systematically apply plucking after 
plucking to their back (Fig. 2A–E). 

Chrysopid larvae that we denuded by 
removing their packets with forceps, 
immediately engaged in such loading 
behavior and reconstructed their pack-
et within 0.5–1 h. In feeding, the lar-
vae chose both eggs and larvae (all 
stages) of *Metaleurodicus*. They 
pierced larvae with their mandibles and 
sucked them dry, as chrysopid larvae 
typically do, and fed similarly on eggs, 
which they exposed by first plucking 
away the waxy cover. As they fed, they 
frequently added wax pluckings from 
the prey to their back.

Larvae that we monitored from the 
moment of hatching were noted to engage 
in loading behavior immediately upon 
their descent from the egg. The very 
first time they encountered a source of 
wax, they scooped up some of the ma-
terial and applied it to their back (Fig. 
2A–E).

Dorsal packets may serve chrysopids primarily as defensive shields against 
ants. Ants commonly tend homopteran 
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**Fig. 2.** The chrysopid larva *Ceraeochrysa cincta*: A–C after emergence, descending along egg stalk, D, E shortly after preceding, beginning to load up with wax, F, G) late instar larva, adding wax (from covering of *M. griseus* eggs) to its already well-formed dorsal packet. *Bars* 1 mm.
commonly noted in *Eugenia* in the immediate surround of *Metaleurodicus* colonies.

*C. cincta* larvae had previously been reported only once, from Lignum Vatae Key, Monroe County, Florida, where it was found in association with another wax-producing prey insect, the mealybug *Plocococcus eugeniae*. *C. cincta* was noted to construct a packet from the wax of this insect as well [15].

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