

Life Cycle of *Carpophilus humeralis* F. (Coleoptera: Nitidulidae) in Puerto Rico^{1, 2}

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ABSTRACT

Carpophilus humeralis F. is one of the main pests on pineapple in Puerto Rico. This insect has high population densities because of a high reproductive potential, each female under laboratory conditions, lays about 542 eggs over a two month period, averaging 9 eggs per day; short larval period (18 days); longevity of adults (2.5 months); and abundance of ripe fruit in pineapple fields as sites for constant reproduction.

INTRODUCTION

The nitidulid beetles of pineapple in Puerto Rico are commonly called "obrerros." They are very small, 0.5 to 4.1 mm in length. They are very abundant in the pineapple fields of the northern part of Puerto Rico. The most damaging species is *Carpophilus humeralis*. This species is a serious problem to the pineapple canning industry of the Land Authority of the Commonwealth of Puerto Rico at Barceloneta. This insect can penetrate the fruit processing and canning areas contaminating the canned products. In addition, infestation of ripe fruits in the field by adults and larvae caused premature rotting and loss of more than 30% of fruits.

Schmidt⁴ studied the biology of *C. humeralis* in the pineapple fields of Hawaii and found that this insect contaminates the pineapple cannery; the larval period lasts 2 to 21 days, with three larval instars; highest mortality occurs during its larval stages and that the pupal stage lasts 5.5 days; females have a longer life cycle than males; feeding is on organic matter in decomposition; and females lay an average of 15 eggs per day. The abundance of this insect was correlated with the presence of ripe fruits in the field. Other works on the biology of *Carpophilus* spp. have been carried out on various crops and under different conditions.

The family Nitidulidae is cosmopolitan in distribution. Its members are found principally infesting ripe and rotting fruits. The distribution and hosts of most of the species in Puerto Rico are unknown, although

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⁴ Schmidt, C.T., 1935. Biological studies on the nitidulid beetles found in pineapple fields. *Ann. Entomol. Soc. Amer.* 28(2): 476-511.

most of them are on rotten fruits. Wolcott⁵ reported various species of this family in different crops and fruits, but he did not mention any nitidulid species in pineapple. Pennock and Gandía⁶ reported this species for the first time in pineapple fields in Puerto Rico.

MATERIALS AND METHODS

Laboratory investigations were done using a bioclimatic chamber with daily temperatures ranging from 19.7 to 29.7° C and a photoperiodic cycle of approximately 12 hours. The temperatures used represent the maximum and minimum average temperatures of the northern part of the island where most of the pineapple is grown and where most of the field work and observations were done.

Plastic cups 16.5 cm in height × 11.4 cm in width were used as rearing containers for doing biological studies. Each cup was filled with sterile soil and 5 cm × 2 cm chunks of fresh pineapples. Chunks were changed periodically as soon as they started rotting.

To study the different larval stages the following rearing artificial diet was used: 101 ml crushed pineapple chunks, 6.75 g granulated agar, 0.3 g methyl-p-hydroxybenzoate, 0.75 g streptomycin and 1 ml 37% formalin. The pineapple pulp was boiled in order to get rid of excess of water, then the methyl-p-hydroxybenzoate, streptomycin and formalin was added and macerated for 5 minutes. Granulated agar was added to 300 ml of boiling water and mixed in a Waring blender for three minutes. The pineapple pulp was added to the agar mixture and the other ingredients then macerated for 5 minutes and put in cups of 30 ml capacity.

Ten insect couples were used for study of the life cycle, a couple was introduced on each rearing container. Each couple was observed daily until eggs and/or larvae were observed, then each couple was removed from the rearing cups after 24 hours. Larval samples were taken daily. The larvae were separated into two groups: larvae reared in artificial diet and larvae reared in pineapple chunks. The life cycle was observed and studied with the rearing cups. The complete larval stages were studied in the artificial diet. Pupae of both sexes were separated from both rearing media to study their reproductive capacity, oviposition and longevity of adults.

Ten males and 10 females of *C. humeralis* were selected to study the oviposition. A couple of this species was used and introduced in each rearing cup. The number of eggs laid daily on the pineapple chunks was observed daily up to the end of its reproductive life or until its death.

⁵ Wolcott, G. N., 1948. The insects of Puerto Rico. J. Agr. Univ. P.R. 32(1-4): 1-975.

⁶ Pennock, W. and Gandía, H., 1975. Effect of slip size, slip storage and time of planting on yield of Red Spanish pineapple in Puerto Rico. J. Agr. Univ. P.R. 59(3): 141-164.

The longevity of males and females was obtained from the data of the oviposition studies. The presence of predators, parasites and diseases was determined by periodical field observations.

RESULTS AND DISCUSSION

The average longevities of the immature stages of *C. humeralis* were: egg-2 days; larva (active period)-5 days; prepupa-5 days and pupa-6 days. The immature stage lasted an average of 18 days. The prepupal period was characterized by the migration of the larva into a proper place to pupate.

The egg measured 1.2 mm in length by 0.3 mm in width, with a beige color and cigarette shaped (Plate I, fig. 1.)

The third larval instar measured 8.0 to 10.0 mm in length and beige in color, with dark brown, prognathous head and well-developed thoracic legs. The pronotal plate with 8 to 18 setae around its margin. The meso- and metanotal plate each with two long setae and one short. The caudal segment is sclerotized and dark brown. Each urogomphi as large as the distance between them. The accessory dorsal spine very conspicuous and the lateral accessory spine small (figs. 2, 3, 4). The third larval stage moves into the soil where the pupa develops inside an earth-cell (the larvae need humid soil for pupating and emerging as adult).

The pupa is of a beige color (fig. 5) and measures from 3.0 to 4.5 mm in length by 2.0 to 2.5 mm in width. Each abdominal segment has a pair of lateral protuberences. The eyes and elytra of the pupa on its fifth day turn in color from brown to black in a few hours, emerging the next day.

The size of adults varies according to the sex, the males measure from 3.4 to 4.1 mm in length and from 1.8 to 2.2 mm in width. The adults are black with a light-brown dot in the exterior basal part of the elytra (fig. 6). These dots are not easily seen. The prothorax is rectangular with the anterior portion narrower than its base. The tarsi are pubescent, their formula, 5-5-5. It has a capitate antenna and chewing mouth parts. The last three abdominal segments are exposed behind the elytra. The male has in the distal part of the fourth abdominal sternite, a pair of small appendages and a ventral depression on its last abdominal segment (figs. 7, 8). The female lacks these modifications.

Mating is frequent, the male climbs the female on its dorsal side. This process may last about ten minutes. No parthenogenesis was observed. Under laboratory conditions no preference was found regarding time of day for mating. Each one of the 10 females laid an average of 6 eggs per day with a maximum of 14 eggs per day and a minimum of 3 eggs per day. The average eggs laid by a female was 542, with a maximum of 765 and a minimum of 72. The average reproductive life of a female was 61.9 days (table 1).

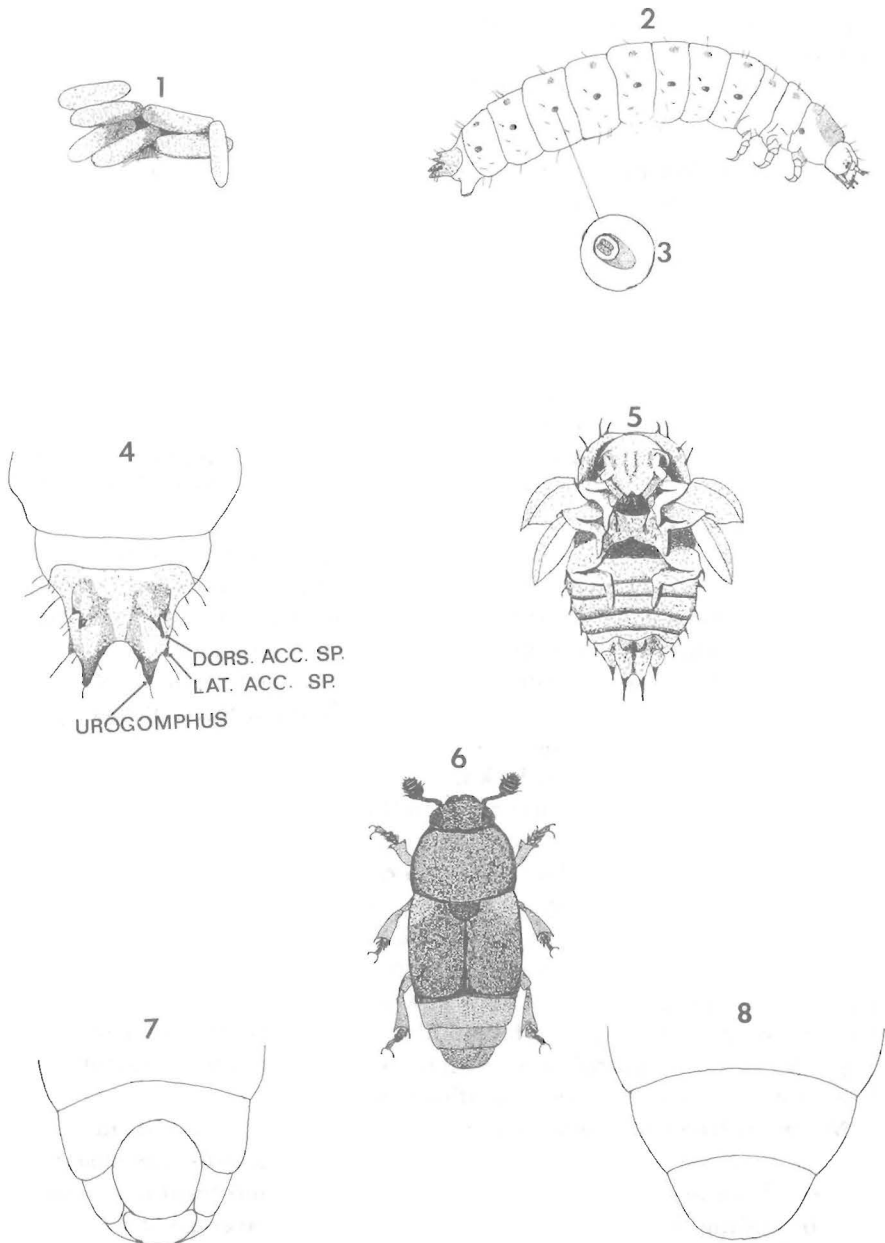


Plate I.—1. Eggs. 2. Larvae. 3. Bilabiate abdominal spiracle. 4. Dorsal view, larval last abdominal segment (dors. acc. sp. = dorsal accessory spine, Lat. acc. sp. = lateral accessory spine). 5. Pupae. 6. Adult. 7. Male last abdominal segments, ventral view. 8. Female last abdominal segments, ventral view.

Under laboratory conditions the average life of the male was 73.4 days, with a maximum of 122 and a minimum of 33 days. The average duration of female life was 79.2 days with a maximum of 125 and a minimum of 29 days. When compared with the males the females lived slightly longer.

No diseases, insect predators or parasites were observed affecting *C. humeralis* during the course of this investigation. Only mites of the family Eviphididae were observed. These mites are found in compost, humus and soil, some are predators in their habitats and phoretics of arthropods found on these habitats. They are predators of eggs and larvae of insects in their immature stages. A few nitidulids were observed with these mites on their body, no sign of attack was found, the relation was probably phoretic.

TABLE 1.—*Oviposition and longevity data of Carophilus humeralis F. under laboratory conditions*

Pair number	Oviposition			\bar{x} Eggs Days	Longevity	
	Pre. ¹	Ovi. ²	Total ³		Females	Males
					Days	
1	9	96	863	9	105	122
2	5	82	839	11	94	82
3	9	70	574	8	79	80
4	4	25	77	3	29	40
5	3	31	437	14	85	51
6	5	63	254	4	68	85
7	6	80	679	8	90	86
8	8	40	531	13	61	48
9	6	105	965	9	125	111
10	6	27	107	4	56	33
Total	6.0	61.9	542	8	79.2	73.4
Maximum	9	105.0	965	14	125.0	122.0
Minimum	3	25.0	77	3	29.0	33.0

¹ Preoviposition: days before starting laying eggs.

² Oviposition: days laying eggs.

³ Total number of eggs laid during female reproductive life.

RESUMEN

Carpophilus humeralis F. tiene una serie de características que le permiten mantener una densidad poblacional alta en los piñales del norte de Puerto Rico. Estos son: gran potencial reproductivo, cada hembra bajo condiciones de laboratorio depositó un promedio de 542 huevos durante su vida reproductiva (2 meses); un promedio de 6 huevos por día; una etapa larval corta (18 días); 3. los adultos viven alrededor de 2.5 meses y es en esta etapa cuando se lleva a cabo la función de reproducirse y colonizar otras siembras, y medioambientes favorables, por la abundancia de frutas maduras en los piñales.