LABORATORY STUDIES ON THE IMMATURE STAGES OF
ATRICHOPOGON WIRTHI (DIPTERA: CERATOPOGONIDAE)

KAI LOK CHAN
Department of Zoology
National University of Singapore
Kent Ridge, Singapore 0511

JOHN R. LINLEY
Florida Medical Entomology Laboratory
University of Florida
200 9th Street S.E.
Vero Beach, FL 32962

ABSTRACT

In the laboratory, at 24-26°C and 90 ± % relative humidity, the immature stages of Atrichopogon wirthi Chan & Linley (Diptera: Ceratopogonidae) were completed in 2-3 weeks. The mean durations (days) of the individual stages were, respectively: egg 3.3, 1st instar 1.7, 2nd instar 2.0, 3rd instar 2.3, 4th instar 4.1, pupa 3.0. The mean overall duration was 16.4 days.

RESUMEN

Se completaron en 2-3 semanas en el laboratorio a 24-26°C y 90 ± % humedad relativa, las etapas inmaduras de Atrichopogon wirthi Chan y Linley (Diptera: Ceratopogonidae). El average de la duración (días) de las etapas individuales fueron, respectivamente: huevo 3.3, 1er estadio 1.7, 2nd estadio 2.0, 3er estadio 2.3, 4to estadio 4.1, y pupa 3.0. El average total de la duración fue de 16.4 días.
We recently described all stages of *Atrichopogon wruthi* Chan & Linley from specimens collected from leaves of the water lettuce, *Pistia stratiotes* L. (Chan & Linley 1988). Sufficient numbers of the immature stages were obtained to allow the complete immature life cycle to be studied in the laboratory. In the literature, comparable information exists for only two other *Atrichopogon* species, *A. geminus* Boesel (as *A. levis*) (Boesel & Snyder 1944) and *A. jacobsoni* (de Meijere) (Drake 1971). In view of this very meager information on the immature biology of the genus, we collected the data here presented.

**Materials and Methods**

*Pistia* plants that yielded immatures of *A. wruthi* were collected from Chinese Farm, a disused aquaculture project adjacent to Old Dixie Highway, about 5 km south of the Florida Medical Entomology Laboratory, Vero Beach, Indian River County, Florida.

All rearing was done in a laboratory maintained at 24-26°C, on cut pieces of *Pistia* leaf placed in petri dishes lined on the bottom with damp paper towel to ensure high humidity (90+% RH). Potential predators, such as dragonfly and beetle larvae, mites and spiders were removed from the leaf surfaces to ensure survival of the *Atrichopogon* immatures. Eggs were transferred to dishes on the pieces of leaf to which they had been attached by ovipositing females. In all, 82 eggs from 18 individual egg batches were hatched and reared. In addition, larvae in various stages were also collected. These were occasionally left on their original leaves, but more usually were transferred to other pieces selected specifically for the presence of an abundant microflora (diatoms, algae, bacteria, fungi), which constitutes the larval food. Every 3-4 days, additional food material was scraped from freshly collected leaves and added to the cultures. The natural food was also supplemented by a 1:1 lactalbumin/brewer's yeast mixture sprinkled very sparingly on the leaf surfaces and replenished every 3-4 days.

Each petri dish containing immatures was examined twice daily, from 0800-1100 hr and again from 1500-1700 hr. Careful notes were kept of developmental progress and behavior, and checks made to ensure the presence of adequate food. Only specimens that successfully completed each stage were included in the final analysis of data. Abnormal or moribund larvae were discarded.

**Results**

The mean durations (days) of the individual immature stages (ranges in parentheses) and of the entire immature developmental period were: egg 3.3 (3-4), 1st larva 1.7 (1-3), 2nd larva 2.0 (1-4), 3rd larva 2.3 (1-4), 4th larva 4.1 (2-7), pupa 3.0 (2.5-4), entire 16.4 (14-20). At 3.3 days, the mean duration of the egg stage was relatively long. After hatching, the durations of the larval stages increased progressively through the instars, with the pupal stage lasting 3.0 days, on average, and the entire immature life cycle requiring 16.4 days under the stipulated laboratory conditions.

The distributions of the developmental periods for each stage are shown in Fig. 1 as the percentages of individuals that daily completed that stage. Hatching of the eggs was distributed over 2 days, most on day 3, the remainder on day 4. Through the larval stages, as the time required to complete each stage became progressively longer, the distributions were spread over more days (respectively 3,4,4 and 6), probably because of differences in the rate and efficiency of feeding among individuals. As would be expected in a non-feeding stage, developmental times among pupae were much more closely grouped (Fig. 1).
Fig. 1. Distributions of times required by A. wirthi to complete each of its immature stages.
DISCUSSION

Although the laboratory environment provided in these studies was certainly more constant than conditions in the field, the mean overall development period of 16.4 days is in close agreement with estimates from field-collected plants. Chan and Linley (in press) recorded the distribution of immature *A. wirthi* on all the leaves taken from individual *Pistia* plants and, from estimates of field age, deduced that the immature life cycle of *A. wirthi* probably required 12-18 days. *Atrichopogon geminus* took 12-13 days under summer laboratory conditions in Ohio (Boesel & Snyder 1944) and *A. jacobsoni* required 24-27 days at 20°C (Drake 1971). Similar immature life cycles are found in the genus *Forcipomyia* of the same subfamily (*Forcipomyiinae*). *Forcipomyia (Dacnoforcipomyia) anabaenae* Chan & Saunders from Singapore took 12-27 days to complete development, averaging 19 days under laboratory conditions (Chan & Saunders 1965). *Forcipomyia (Lasiohela) taiwana* (Shiraki) from Taiwan required 16-18 days to complete the larval stages and 3-5 days for the pupal stage, for an overall oviposition to adult emergence period of 21-26 days (Sun 1965). All these periods are brief and indicate that development is generally relatively rapid in the *Forcipomyiinae* as compared to other genera in other subfamilies.

The rapid growth of *A. wirthi* larvae indicates that their food is abundant on the *Pistia* leaves. Many larvae were seen feeding on the leaf surfaces, almost invariably in areas covered with algae, diatoms, fungi and bacteria. Dissections of the gut contents of several larvae indicated that these organisms were ingested. There appeared to be a particular association between *A. wirthi* and a pyralid caterpillar (and perhaps also a small leafhopper), both of which feed on the *Pistia* leaves. *Atrichopogon wirthi* eggs were not seen on leaves devoid of lepidopteran larvae and were often deposited in close association with fecal pellets left by the caterpillars, or near holes and tracks made by them in the leaf surface. Conceivably, gravid female *A. wirthi* oviposited selectively where nearby fecal material and its associated bacteria will ensure a source of food for the newly hatched larvae.

ACKNOWLEDGMENTS

We thank D. Duzak for assistance in collecting water lettuce plants from the field site. This paper is Institute of Food and Agricultural Sciences, University of Florida Experiment Stations Journal Series No. 9875.

REFERENCES CITED


