Biological Observations on *Tetrastichus giffardianus* (Hymenoptera: Eulophidae), a Gregarious Endoparasitoid of The Mediterranean Fruit Fly and The Oriental Fruit Fly (Diptera: Tephritidae)

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ABSTRACT

Fruits collected from peaches and loquats to estimate field parasitism of the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), and the oriental fruit fly, *Dacus dorsalis* Hendel, showed that the gregarious endoparasitoid, *Tetrastichus giffardianus* Silvestri (Hymenoptera: Eulophidae), was abundant in the Kula area of Maui, Hawaii during June and July 1988. The combined average parasitoid progeny per puparium was 6.4 from the two host species. Parasitoid sex-ratio was independent of host size and averaged 79% females per host puparium.

KEY WORDS: Insecta, *Tetrastichus giffardianus*, parasitoid, sex-ratio.

Tetrastichus giffardianus Silvestri (Hymenoptera: Eulophidae) is a gregarious endoparasitoid of several species of tephritid larvae (Clausen et al. 1965). This wasp was first liberated in Hawaii in 1914 to control the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Willard 1927). The parasitoid was successfully established and reached a maximum efficiency in 1923, parasitizing up to 25.3% *C. capitata* with an overall average of 6.3% during the period 1914-1933 (Willard 1937). Reports on field colonization to control the oriental fruit fly, *Dacus dorsalis* Hendel, in 1950-51 indicated that *T. giffardianus* was established in the Hawaiian Islands but remained in small numbers (Clausen et al. 1965). Recent publications on field parasitism of fruit flies in Hawaii have failed to report this parasitoid (Newell & Haramoto 1968, Wong et al. 1984, Wong & Ramadan 1987), which gives the impression that *T. giffardianus* is no longer present. In this paper we report the presence of *T. giffardianus* in the field and give some observations on its biological attributes.

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TABLE 1. Progeny per host puparium and sex-ratio of *Tetrastichus giffardianus* Silvestri parasitizing *Ceratitis capitata* and *Dacus dorsalis* in the Kula area of Maui, Hawaii during June and July 1988.

Host species	No. Puparia examined	Size of Puparia (mm) Max. length ($\bar{x}$ ± SEM)	Size of Puparia (mm) Max. width ($\bar{x}$ ± SEM)	Position of emergence opening[a] ($\bar{x}$ ± SEM)	Parasitoid progeny/host puparium ♂♂ ($\bar{x}$ ± SEM)	♀♀ ($\bar{x}$ ± SEM)	total ($\bar{x}$ ± SEM)	sex-ratio (%♀♀) ($\bar{x}$ ± SEM)
C. capitata	131	4.15±0.03	1.92±0.02	4.37±0.18	1.51±0.12	5.19±0.22	6.70±0.26	76.79±1.41
D. dorsalis	22	4.70±0.17	2.13±0.07	4.20±0.34	1.18±0.17	4.90±0.55	6.09±0.67	81.35±2.46
Prob. T		<0.05	<0.05	NS[b]	NS	NS	NS	NS

[a]Median segment of host puparium containing the emergence opening of the parasitoid.
[b]NS = not significantly different (Student's t-test).

MATERIALS AND METHODS

Fruit collections of peaches and loquats from the Kula area of Maui during June and July 1988 produced many specimens of a eulophid wasp that was determined by Dr. J. W. Beardsley (Dept. Entomology, Univ. of Hawaii) as *T. giffardianus*. Seven-day-old fruit fly puparia were washed and dried before microscopic examination. Puparia containing immature *T. giffardianus* were sorted by host species using keys developed by Yamada et al. (1962). These pupae were held individually in vials (1.8 g) with cotton stoppers. After parasitoid eclosion, the size of host puparia in millimeters (maximum length and maximum width), median position of emergence opening, parasitoid progeny per puparium (PPP) and the sex-ratio (% females) were recorded. Data were subjected to Student's t-test analysis.

RESULTS AND DISCUSSION

Results are summarized in Table 1. The parasitoid appeared to prefer the anterior one-third of the puparium (fourth segment) for emergence in both *C. capitata* and *D. dorsalis*. Normally, one emergence opening was cut; however, in 5.8% of the samples observed, two emergence openings were made. Usually each host puparium contained both sexes of the parasitoid; however, 8.5% of the puparia examined contained only female offspring, 62.1% contained one male, and in many instances 2 to 6 males per puparium emerged, along with an average of 5 females, from both host species. Maximum total PPP was 15, with an average of 6.0 and 6.7 PPP in *D. dorsalis* and *C. capitata*, respectively. Although there was a significant difference ($P<0.05$) in the size of parasitized host puparia of the two species, with *D. dorsalis* being larger size (max. length : $t = -3.13$, d.f. = 12.6, $P = 0.008$; max. width : $t = -3.27$, d.f. = 116, $P = 0.0014$), PPP and sex- ratio were independent of host size. PPP is an important factor for calculating the number of parasitized hosts attacked by a gregarious parasitoid, where the number of parasitized hosts equals the total number of eclosed *T. giffardianus* divided by the estimated PPP. Rates of parasitism determined by counting puparia with emergence holes could be erroneous due to the presence of other fruit fly parasitoids which cut similar emergence holes, such as the pteromalid pupal parasitoid *Pachycrepoideus vindemiae* Rondani (Pemberton & Willard 1918a).

We report a combined average of 6.4 PPP from both host species. Pemberton & Willard (1918a) reported an average of 8-10 PPP in *C. capitata*. This difference may be due to differences in host fruits, seasons, locations, or a function of competition with the complex of opiinae parasitoids in the field. *T. giffardianus* was reported (Pemberton & Willard 1918b) to consume host puparia rapidly, leaving less chance for opiinae larvae to develop. However, first instar larvae of opiinae species may physically combat some of the *T. giffardianus* larvae, resulting in fewer PPP (Pemberton & Willard 1918b).

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