

BIOLOGICAL STUDIES ON *PARACHEYLETIA BAKERI* (ACARINA: CHEYLETIDAE)

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The female of *Paracheyletia bakeri* Ehara was first described by Ehara (1962) on *Hibiscus rosa-sinensis* L. at Hokkaido University in Japan. In the United States, it is associated with certain Florida citrus insects and mites and has been found in the litter under Florida citrus trees and occasionally on citrus leaves infested with scale and mites. On several occasions, *P. bakeri* has decimated laboratory cultures of Tetranychidae and Tenuipalpidae (Muma 1964).

Several studies were therefore made to obtain more biological information about this cheyletid and to establish its importance as a predator of spider mites that attack citrus. These included laboratory studies of the general biology and controlled experiments to determine the life cycle, food consumption, longevity, and fecundity of the species.

METHODS

All studies were conducted in the laboratory at 75-85°F. Small pieces of blotting paper were placed in micro-syracuse dishes which were covered with a second micro-syracuse dish to form holding cages.

Leaves heavily infested with host mites were brought in from the field, and the areas with the heavier infestations were cut into small pieces and placed in the holding cages so the predator could readily locate the prey, and the observer could easily renew the food.

The initial (parent) female, collected from a citrus tree at Lake Alfred, Florida, and all other females used in the studies were preserved and later identified by M. H. Muma of the Citrus Experiment Station at Lake Alfred, Florida. All stages were individually isolated in holding cages surrounded by water barriers. At no time during the tests was more than one predator present in a single dish. Since only 4 individuals were reared from the original female in the first haploid generation, the data are limited to the second, third, and fourth haploid generations.

Observations were made under a binocular dissecting microscope at least twice daily and more frequently when conditions warranted. All data were recorded at each observation, and statistical analyses were made from the compilations.

The six-spotted mite, *Eotetranychus sexmaculatus* (Riley), the citrus red mite, *Panonychus citri* (McGregor), the Texas citrus mite, *Eutetranychus banksi* (McGregor), an acarid, *Tyrophagus* sp., two phytoseiids, *Typhlodromalus peregrinus* (Muma) and *Amblydromella rickeri* (Chant), and crawlers of yellow scale, *Aonidiella citrina* (Coquillett) were provided as food for the predators.

IDENTIFICATION

Paracheyletia bakeri, as noted, was described by Ehara (1962); supplementary data were given by Muma (1964). Ehara's original description is cited below.

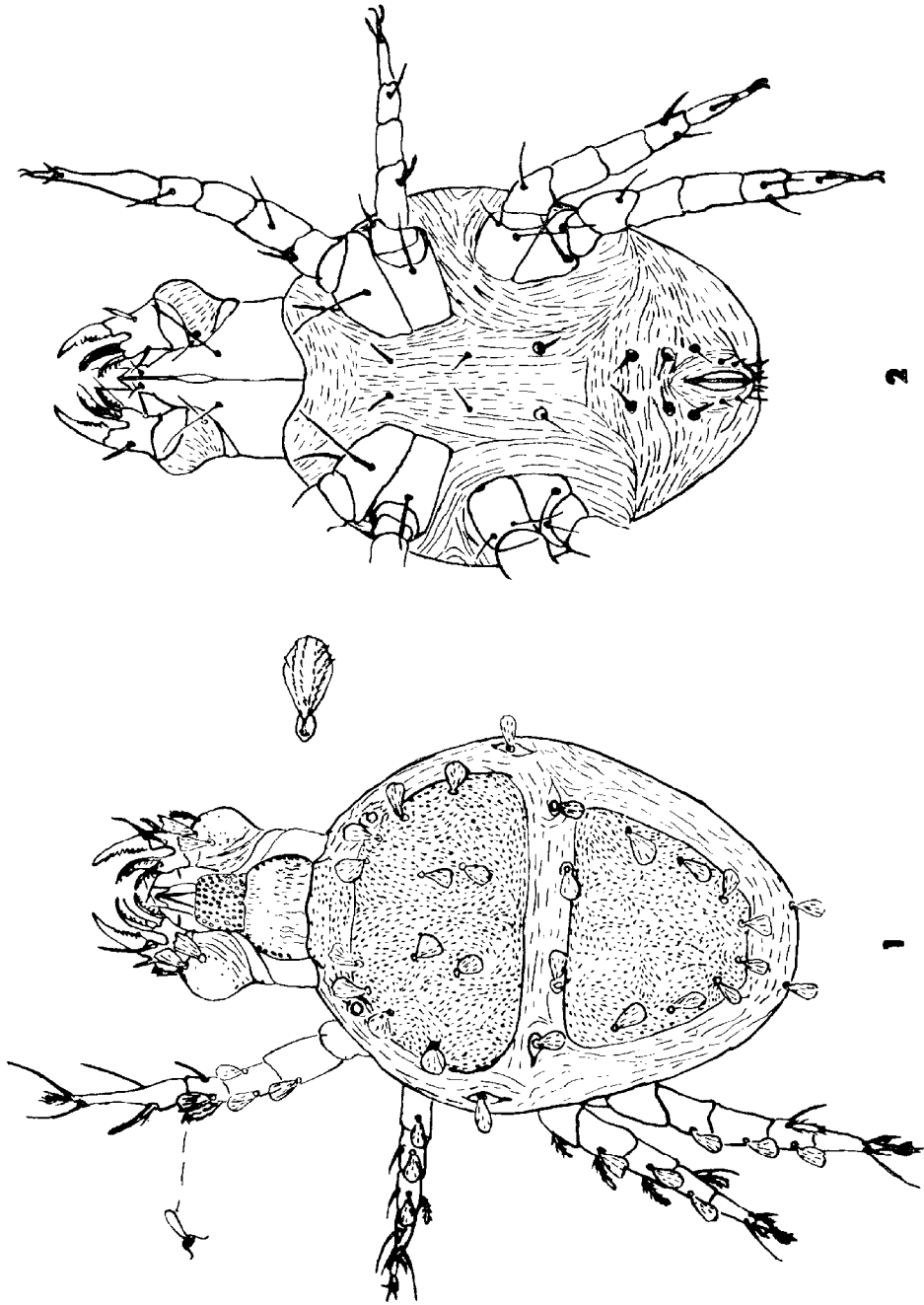


Fig. 2.—*P. bakeri* Ehara ♀ ventral view.

Fig. 1—*Paracheyletia bakeri* Ehara ♀ dorsal view.

Female: (Fig. 1 and 2 drawn by T. D. Kanavel from original drawings by M. H. Muma and S. Ehara) Body oval from above, 290μ long, including rostrum 400μ long, and 230μ wide. Rostrum reaching tarsus of palpus, covered with shield which is punctate-striate behind the peritreme and is tuberculate-punctate anterior to the peritreme. Palpi short, robust; palpal femur strongly swollen on outer margin, sparsely tuberculate-punctate dorsally, with squamiform, serrate dorsal seta; genu with similar dorsal seta adjoining proximal margin of segment; tibia with lanceolate, finely pectinate dorsal seta; claw with 6-8 teeth proximally; tarsus with 2 comblike setae and 2 sicklelike setae; outer comblike seta subequal in length to tibial claw, with about 18 teeth; inner comblike seta shorter, with about 23 teeth. Coxae I-II and III-IV a little separated. Genu I with minute, clavate dorsodistal sensory seta; tibia I with small, clavate dorsodistal sensory seta usually covered with squamiform, serrate dorsal seta of segment; tarsus I with long, blunt dorsoproximal sensory seta arising from strong tubercle. Tibia II with minute, clavate dorsodistal sensory seta; tarsus II with slender, rodlike dorsal sensory seta on middle of segment. Peritreme consisting of 4-6 segments, each segment dilated distally. Dorsum of body with 2 ill-defined shields, a propodosomal and hysterosomal widely separated from each other; propodosomal shield punctate-striate, with a pair of eyes and 6 pairs of squamiform, serrate setae; hysterosomal shield punctate-striate, with 4 pairs of squamiform, serrate setae. Integument striate, with 4 pairs of squamiform, serrate seta: 1 pair median, 1 pair mediolateral, 1 pair lateral, 1 pair caudal; median and mediolateral pairs forming a transverse row between propodosomal and hysterosomal shields, each seta of the 2 pairs set in minute, finely punctate-striate plate; setae of lateral pair each also set in minute, possibly similar plate. Venter striate, with 4 pairs of simple setae: 1 pair between coxae I, 1 pair about at level of posterior edges of coxae II, 1 pair between coxae IV, 1 (posteriormost) pair anterior to genito-anal region.

Male. Not known.

Deutonymph. Propodosoma as in female. Hysterosoma similar to females of *Cheletomimus* Oudemans: with 2 small, punctate-striate shields, each carrying a single, squamiform, serrate seta; anterior to shields is located a transverse row of 4 similar setae; behind the shields a row of 2 similar setae; finally 3 pairs of similar posterior setae.

Holotype. Female, Sapporo (greenhouse of the Botanical Garden, Hokkaido University) 5-11-1958 (on *Hibiscus rosa-sinensis*), S. Ehara leg. The types are preserved in the Zoological Institute, Faculty of Science, Hokkaido University, Sapporo, Japan.

LIFE CYCLE

The life cycle data for the species obtained when 3 species of tetranychids were used as food are presented in Table 1. The cycles were quite similar, but the larval and first nymphal stadia lasted slightly longer when Texas citrus mites were used as food.

Eggs: The following measurements were obtained from 15 eggs: minimum length 0.118 mm; maximum 0.135 mm; mode 0.135 mm; and mean 0.133 mm. Minimum width 0.090 mm; maximum 0.125 mm; mode 0.090 mm; mean 0.097 mm.

TABLE 1.—LIFE CYCLE OF *Paracheyletia bakeri* EHARA
IN THE LABORATORY, 75-85° F.

| Host | Stage | No. Individuals | No. days to develop | | |
|-------------------|-----------|--------------------|---------------------|------|------|
| | | | Min. | Max. | Mean |
| Six-spotted mite | Egg | 51 | 4 | 9 | 6.2 |
| | Larvae | 24 | 5 | 7 | 5.8 |
| | 1st nymph | 20 | 4 | 6 | 5.0 |
| | 2nd nymph | 17 | 5 | 7 | 5.4 |
| | Total | | 18 | 29 | 22.4 |
| Citrus red mite | Egg | 18 | 5 | 7 | 6.2 |
| | Larvae | 18 | 4 | 7 | 5.9 |
| | 1st nymph | 18 | 4 | 7 | 5.0 |
| | 2nd nymph | 18 | 5 | 7 | 5.3 |
| | Total | | 19 | 28 | 22.4 |
| Texas citrus mite | Egg | 6 | 6 | 8 | 6.5 |
| | Larvae | 6 | 5 | 7 | 6.5 |
| | 1st nymph | 6 | 5 | 7 | 6.2 |
| | 2nd nymph | 6 | 5 | 6 | 5.3 |
| | Total | | 21 | 28 | 24.5 |

The eggs were white, oblong, and covered with a fine network of silk. Silk spinning was observed many times: soon after the egg was laid, the mite, moving backward and forward, covered the egg with a fine network of silk. This silk was a fine thread that appeared to be coming from the underside of the rostrum. It was stretched from side to side over the egg. The palpi were used to manipulate the silk.

The embryo was visible through the eggshell just before emergence. This eggshell was very thin, and after the hatching process, it shriveled and was hard to identify. Eggs were laid singly, but as many as 4 or 5 were found in a group near the parent when food was abundant. Eggs hatched in 4 to 9 days (Table 1).

Larvae: The following measurements were obtained from 6 larvae: minimum length, including rostrum, 0.150 mm; maximum 0.165 mm; mode 0.165 mm; and mean 0.163 mm. Minimum width 0.090 mm; maximum 0.105 mm; mode 0.090 mm; and mean 0.095 mm.

The general appearance of the larvae resembled that of the adult. The body was semitranslucent, except for the rostrum which was brown at the extreme tip. Larvae were distinguished from nymphs and adults by having only 3 pairs of legs instead of 4.

Newly emerged larvae found resting places under or beside trash. They began to feed almost immediately on larvae, nymphs, or adult host mites. However, in most cases they were unable to hold any adult prey because of its size and superior strength. At no time were they observed feeding on eggs. Larval feeding habits were very similar to those of the adult.

After feeding, the color of mites varied from light lemon yellow to pink, depending on the host consumed. The larval stadium lasted 4 to 7 days (Table 1).

First instar nymphs: The following measurements were obtained from 6 first instar nymphs: minimum length, including rostrum, 0.80 mm; maximum 0.210 mm; mode 0.195 mm; and mean 0.198 mm. Minimum width 0.105 mm; maximum 0.135 mm; mode 0.120 mm; and mean 0.120 mm.

The appearance was quite similar to that of the adult. The body color of feeding specimens became light salmon pink to light red, depending on the prey. The feeding habits were similar to those of the adult. There was a broad white stripe on the center of the dorsum extending nearly to the posterior end of the mite. The tip of the rostrum was brown. On several occasions, the actual process of moulting was observed. Moulting involved transverse and longitudinal ruptures: the transverse rupture occurred near the scapular groove; the longitudinal rupture occurred at the middle of the transverse rupture and ran backward to the posterior end. Sometimes the longitudinal rupture ran forward through the transverse rupture which split the cast skin into 2 pieces. From numerous observations of old cast skins, moulting was the same in all stages. The first nymphal instar lasted 4 to 7 days (Table 1).

Second instar nymphs: The following measurements were obtained from 6 second instar nymphs: minimum length, including rostrum, 0.270 mm; maximum 0.300 mm; mode 0.300 mm; and mean 0.290 mm. Minimum width 0.135 mm; maximum 0.165 mm; mode 0.165 mm; and mean 0.155 mm.

The appearance was similar to that of the adult. The body was salmon pink to red, depending on the prey, with a white stripe as in the first instar nymph. The tip of the rostrum was brown. The feeding habits were similar to those of the adult. The second nymphal instar lasted 5 to 7 days (Table 1).

Adults: Including the rostrum, the adult measured about 0.4 mm long and 0.23 mm wide. It was oval in outline, plump in profile, and bright in appearance. Color varied from salmon pink to dark red, depending on the food. The broad white stripe was present on the adult as in the nymphal stages. The legs were a light flesh color. The tip of the rostrum was brown.

Paracheyletia bakeri ambushes its prey while resting beside or under clumps of trash and will attack prey much larger than itself. This process was observed many times under the binocular microscope. As the prey approached, the predator turned to face it and seized it at the nearest point, usually a leg. The powerful palpi held the prey, and the beak was inserted. Then the pharyngeal muscles contracted and relaxed very rapidly, and the abdomen gradually became distended with prey haemolymph. This process required 5 to 10 minutes.

No reference to males was made by Ehara or Muma. See section on fecundity in this paper.

FOOD CONSUMPTION AND LONGEVITY

Daily food consumption records were kept on 10 mites from time of last moult to death. Five were fed six-spotted mites; another 5 were fed citrus red mites.

The predators were first isolated in holding cages, and the host mites were then counted and placed in a micro-syracuse dish with the predator.

Each day the consumed mites and the live mites were counted and removed, and fresh host mites were added.

Cheyletids fed six-spotted mites consumed a minimum of 2, a maximum of 14, a mode of 7, and a mean of 6.8 hosts daily; the average number consumed per female over 71 days was 475.4. *Paracheyletia bakeri* fed citrus red mites consumed a minimum of 3, a maximum of 12, a mode of 6, and a mean of 6.2 hosts per day; the average number consumed per female over 65 days was 395.8.

Texas citrus mites, yellow scale crawlers, acarids, and phytoseiids were also used as food. Though numerous observations were made, no accurate accounts of consumption and longevity were kept. The cheyletids did develop readily.

Thirty-nine adult females lived a minimum of 27, a maximum of 92, a mode of 61-70, and a mean of 62.2 days.

No starvation tests were conducted.

FECUNDITY

The reproductive rate of the species was determined in the laboratory. Virgin females of the second, third, and fourth haploid generations were isolated throughout the studies. Egg laying began 1 to 6 days after the last moult. The total egg production of 39 females was 2523 eggs, a mean total per female of 65.

TABLE 2.—COMPARATIVE FECUNDITY OF *Paracheyletia bakeri* EHARA FED CITRUS RED MITES, SIX-SPOTTED MITES, AND TEXAS CITRUS MITES.

| Host | No. Cheyletids | Total eggs laid | Daily egg production | | Mean totals/female | |
|-------------------|----------------|-----------------|----------------------|------|--------------------|---------------------|
| | | | Max. | Mean | Eggs laid | Days of oviposition |
| Citrus red mite | 18 | 1177 | 5 | 1.2 | 65.4 | 56.3 |
| Six-spotted mite | 15 | 1021 | 5 | 1.3 | 68.1 | 54.4 |
| Texas citrus mite | 6 | 325 | 3 | 1.1 | 54.1 | 48.2 |

Tests were conducted to determine whether the fecundity of the cheyletid varied with the type of food consumed. Prey species used were citrus red mites, six-spotted mites, and Texas citrus mites. Results of these studies are presented in Table 2. Viability of eggs laid was high. Only 1 of 111 eggs observed failed to hatch.

Although a large number of cheyletids of this species were observed, none were males. Females reproduced parthenogenetically during this study.

SUMMARY

Paracheyletia bakeri fed and reproduced on the mite species and yellow scale crawlers that were offered as food. This predator is considered a

general feeder. Females, in the presence of abundant food, lived an average of 2 months and laid an average of 65 eggs. *P. bakeri* is a negligible factor in the biological control of spider mites on citrus, and has never been found in large numbers on citrus trees. Parthenogenetic reproduction of *P. bakeri* has not been reported previously.

ACKNOWLEDGMENT

We are grateful to M. H. Muma for advice and encouragement during this study and for criticism of the manuscript.

LITERATURE CITED

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