BIOSYSTEMATICS OF *PHYTOSEIULUS PERSIMILIS* ATHIAS-HENRIOT (ACARINA : PHYTOSEIIDAE)

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INTRODUCTION.

One of the most important steps in the implementation of biological control of pest species is the unqualified identification of the beneficial species under consideration as a candidate for introduction into a new environment. As SCHLINGER and DOUTT (1964) have stated, " Systematics is without question the most important fundament to biological control. It is the key to all fields of research related to any biological control problem... " While the ultimate degree of certainty as to identity is not always a prerequisite at the species level if the genus contains only beneficial species, and especially if the species is not yet recognized, the absence of such knowledge could, however, result in duplication of effort. Also, lack of adequate efforts to establish biological differences between morphologically indistinguishable stocks (geographic, ecologic or otherwise) could result in rejection of either one or the other of such stocks as a candidate for introduction. Only after the indentity of the candidate species has been resolved satisfactorily can an intelligent decision be made as to its utilization.

An opportunity to investigate such a case arose recently when we obtained two stocks of a strictly predaceous phytoseiid from widely separate geographic areas. One was obtained in 1965 from the Department of Biological Control of the University of California at Riverside. This stock, labeled " *Phytoseiulus persimilis* Athias-Henriot, " originated in Chile and came to California via Germany and Canada (personal communication from D. A. CHANT). This stock, referred to in this paper as the Chilean stock, has been maintained in our laboratories at Albany and Berkeley since 1965. The other stock was obtained by one of us (CALTAGIRONE) in Sicily in 1966. This stock was collected from pole beans in the environs of Palermo. The Sicilian stock, considered to be *Amblyseius tardi* Lombardini, (LOMBARDINI, 1959), by several Italian entomologists, was sent to the

University of California, Division of Biological Control at Albany in July, 1966. It has been maintained on *Tetranychus urticae* Koch as prey in the quarantine facility at Albany. Slide mounts of this stock revealed it to be a species of *Phytoseiulus* very similar to *P. persimilis*.

In his diagnosis of a new species of *Phytoseiulus* from Brazil, EHARA (1966) compared the males of his species, *Phytoseiulus chanti* Ehara, with the males of LOMBARDINI'S species, and he correctly placed *tardi* as a species of *Phytoseiulus*.

In 1957 an Algerian species was described as *Phytoseiulus persimilis* by ATHIAS-HENRIOT (1957). Collections were from rose, bean and pear, all of which were reported to be infested with a tetranychid, *Tetranychus telarius* (L.) (= *T. urticae* Koch). In 1958 DOSSE described a new species from Chile as *Phytoseiulus riegeli* Dosse. *P. riegeli* was originally collected from water hyacinth, *Eichornia crassipes* Solms., in a greenhouse in the environs of Valparaiso, Chile. GONZALEZ and SCHUSTER (1962) subsequently reported the collection of *P. riegeli* in Chile from apple foliage during 1958. CHANT (1959) provisionally considered *P. riegeli* to be a synonym of *P. persimilis*. ATHIAS-HENRIOT (1959) compared *P. persimilis* with *P. riegeli* and separated the two on the basis of the length to width ratio of the ventrianal plate of the male. Characters for separation of the females were not given. GONZALEZ and SCHUSTER (1962) retained *riegeli* and *persimilis* as distinct species on the basis of the difference in the shape of the cervix of the spermatheca and varying degrees of imbrication of the dorsal scutum.

Investigators who have studied the biotic potential of the Chilean species in laboratories, in greenhouses and under field conditions in a number of countries, refer to this species as either *Phytoseiulus persimilis* or *P. riegeli*.

In general, North American investigators (CHANT, 1961 ; MORI and CHANT, 1966 ; OATMAN, 1965 ; OATMAN and MCMURTRY, 1966 ; OATMAN et al., 1967 ; SMITH et al., 1963) have referred to this species as *P. persimilis*, while European workers (BRAVENBOER, 1963, 1965 ; BRAVENBOER and DOSSE, 1962 ; HUSSEY, 1964 ; HUSSEY and PARR, 1965 ; VOGEL, 1963) have referred to it as *P. riegeli*.

A taxonomic study was made of the Sicilian stock and of *P. persimilis*. Slide mounts of *P. persimilis* were loaned the authors by Madame ATHIAS-HENRIOT of the Laboratoire de la Faune du Sol, Dijon, France. This material included specimens collected in Algeria and southern France. The study revealed no apparent morphological differences of note between the Sicilian, Algerian and French specimens. On the basis of these findings, the Sicilian population is considered to be conspecific with the Algerian and French populations, and is recognized as *Phytoseiulus persimilis* Athias-Henriot. Thus *Phytoseiulus tardi* (Lombardini) is a synonym of *P. persimilis*.

Further comparisons were made between the Sicilian stock and the Chilean stock. The study of slide-mounted larval, protonymphal, deutonymphal and adult stages showed no significant differences and on the basis of morphological characters alone, the Chilean and Sicilian populations are considered to be conspecific.

Because we were concerned with stocks from such widely separated geographic

areas as South America and the Mediterranean basin and because alpha taxonomy alone does not furnish incontestable evidence of conspecificity in the case of morphologically-inseparable, geographically-separated populations, it was decided to make additional studies before synonymizing the Chilean stock. To obtain supporting evidence we decided to run crossbreeding tests between the Chilean and Sicilian stocks. Positive results (i.e., fertility between the two stocks) would support ours and CHANTS' (1959) prior morphological evidence of conspecificity. Negative results (i.e., infertility) would indicate that the Chilean and Sicilian (= Algerian) populations are distinct but closely-related species.

The occurrence of complete fertility between the two stocks, although supplying acceptable evidence that they are of the same species, would not rule out the possibility of the existence of usefully distinct biotypes in *P. persimilis*. MCMURTRY and SCRIVEN (1964) found evidence suggesting the existence of biotypes in the phytoseiid species *Typhlodromus rickeri* Chant.

Although mating behavior, mode of insemination of the female and sex ratios have been investigated for several species of the Phytoseiidae (BALLARD, 1954 ; DOSSE, 1959 ; MCMURTRY and SCRIVEN, 1964 ; PUTMAN, 1962 ; PRASAD, 1967 ; SMITH and SUMMERS, 1949), very little is known of the mechanism of sex determination in this family. Thelyotokous reproduction has beenre ported only for *Amblyseius elongatus* (Garman) (KENNETT, 1958). Although evidence of arrhenotoky in the Mesostigmata was demonstrated as early as 1949 (SKALILY and HAYES, 1949), the first examples of probable arrhenotoky in the Phytoseiidae was not reported until quite recently when HANSELL et al. (1964) found cytological evidence for arrhenotoky in *Phytoseiulus persimilis* Athias-Henriot, *Amblyseius fallacis* (Garman), and *Neoseiulus caudiglans* (Schuster). Egg squashes of each of the three species were found to exhibit two chromosome numbers only, either four or eight, indicating haploid-diploid complements.

Females of most of the species studied to date will not oviposit until mated, and in many, if repeated matings are precluded, oviposition ceases shortly after the last copulation (DOSSE, 1955, 1957 ; PUTMAN, 1962 ; MCMURTRY and SCRIVEN, 1964). This suggests that ovulation requires some stimulus furnished through mating, even though unfertilized eggs may develop as male offspring.

Thus, in attempting to cross-breed the Chilean and Sicilian stocks of *Phytoseiulus* here considered, it was necessary to determine the sex of any offspring which might result from copulation between individuals of the two stocks. For, if arrhenotokous reproduction does, in fact, occur in *P. persimilis*, as indicated by the work of HANSELL et al. (1964), then the mere act of copulation could possibly trigger ovulation and the subsequent oviposition of male eggs, even though the two stocks represented distinct species. If this were the case, and all offspring were found to be male, then absence of fertility between the stocks would be indicated. However, when two species of *Phytoseiulus*, i.e., *P. persimilis* (Sicilian stock) and *P. macropilis* (Banks) (Californian stock), were exposed by us to each other in the laboratory (using virgin females of each species) copulation, but not ovulation, occur-

red. Although this does not prove that copulation or insemination without fertilization between individuals of the same species (or ones other than these) will not stimulate ovulation, this is strongly suggested.

Materials and Methods.

Several techniques for the rearing of phytosciid mites have been developed recently (McMurtry and Scriven, 1964 ; Kamburov, 1966). These techniques employ a liquid or viscuous barrier to prevent the mites' (both predator and prey) escaping from the rearing unit. Although these designs have been used successfully for individual and mass rearing of several phytoseiid species, our attempts to confine individuals of the Sicilian stock of *P. persimilis* by means of various liquid barriers were only partially successful. Species of *Phytoseiulus* are extremely agile, rapidly-running mites, and although several types of rearing units of this design successfully contained a majority of the mites under conditions of mass rearing, when they were teste das individual rearing units many of the mites either escaped or became trapped by the barrier and drowned.

A simple, highly functional rearing cell was developed. It successfully contained the predators and served for both individual and mass rearing. The unit consists of a clear plastic specimen box hinged at one end and closed by means of friction knobs at the opposite end (see figure 1). The outside dimensions of the cell are : length, 2-5/16 inches ; width, 1-5/8 inches ; and depth, 1/2 inch when closed.

The rearing cell was assembled in the following manner : one half of the cell was filled with cotton which was then saturated with tap water. Common white blotter paper was cut to a size slightly greater than the outside dimensions of the specimen box. The paper was placed on the wet cotton and thus functioned as a barrier to penetration of the cotton by the mites, as a source of moisture for the upper half, or rearing area of the cell, and to make the cell escape-proof when closed. Oversaturation of the cotton was avoided to prevent condensation of moisture on the plastic surfaces of the rearing area. The addition of a celery leaflet infested with *Tetranychus urticae* completed the assembly of the cell up to the point of introduction of the predators.

This type of rearing cell permitted rapid examination under a stereoscopic microscope. If the predator(s) could not be located with the cell closed it was easily opened and the celery leaflet inverted for further examination. Usually the predator eggs and immature stages could be readily seen with the cell closed.

Prior to initiation of the crossbreeding study, the Chilean and Sicilian stocks were maintained in separate facilities after their receipt at Albany. The Sicilian stock of *P. persimilis* was reared in the quarantine facility on potted celery plants infested with the two-spotted spider mite, *T. urticae*. The Chilean stock was maintained in a separate building on potted strawberry plants also infested with

T. urticae. At the initiation of the study, a few individuals of each stock were moved to laboratories in separate buildings and held individually in rearing cells. Maintenance of each stock and rearing of individual mites prior to and during the study were carried out by different persons to circumvent the possibility of contamination of one stock by persons of the other. The only intercourse between the two stocks occurred when males of one stock were introduced into rearing cells containing females of the other.

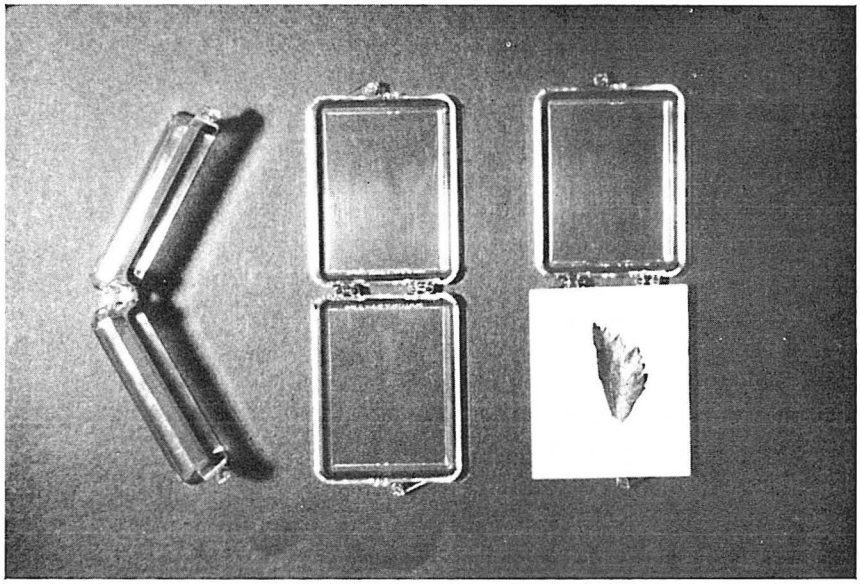

FIG. 1 : Rearing cell for *Phytoseiulus persimilis.*

A stock culture of *Tetranychus urticae,* used as the prey species in the cross-breeding tests, was reared on potted celery plants. The spider mite was allowed to develop high densities, especially of eggs, on a given plant. Before transferring celery leaflets infested with *T. urticae* to the rearing cells they were examined microscopically to insure the absence of *Phytoseiulus.*

The rearing cells in which Sicilian females and Chilean males were paired were held in a cabinet at temperatures of approximately 72 to 80° F. The Chilean female and Sicilian male pairings were held in an isolation room in which the temperature fluctuated between 74 and 80° F. No attempt was made to control the humidity in either the temperature cabinet or the isolation room because the moisture reservoir within the lower half of the rearing cells was sufficient to produce very high relative humidity in the upper, or rearing portion, of each cell. When the blotter paper appeared nearly dry, water was added to the cotton from a plastic squeeze bottle. This was usually required not more than once every three or four days.

Before proceeding with the crossbreeding trials a number of specimens of each stock were reared individually by isolating single eggs in rearings cells furnished with celery leaflets infested with eggs and active stages of the prey. Usually the leaflet was changed at least once during the development of the predator in order to supply fresh prey, especially the egg stage. When each mite reached the adult stage its sex was determined by examination with a stereoscopic microscope at a magnification of 100 X. Four virgin females of the Sicilian stock were held until death while four virgin females of the Chilean stock were held from 21 to 28 days. None of these females produced eggs (see table 1). At the adult age of 37 days one virgin female of the Sicilian stock was placed in a cell with a male of the Sicilian stock. This female produced its first egg within 48 hours and subsequently laid a total of 42 eggs during its final 13 days of life. These results indicate conclusively that under confinement in the laboratory mating is prerequisite to egg production in both the Sicilian and Chilean populations. Oviposition by 20 females reared individually from stock cultures of both the Sicilian and Chilean stocks are given in tables 2 and 3. These females were maintained through 20 days of oviposition (unless death occurred prematurely) for the Sicilian stock and through 22 days for the Chilean stock. Although the Sicilian stock females achieved an average daily egg deposition of 0.25 egg higher than did the Chilean stock females, it is felt that this difference is more likely due to the fact that the results were not obtained under identical conditions of temperature, food quality, etc. rather than to any possible genetic differences. The sex ratio for 247 progeny of 20 females of the Sicilian stock was 3.75 ♀ : 1.0 ♂. The sex ratio for 245 progeny of 20 females of the Chilean stock was 4.1 ♀ : 1.0 ♂ (LAING, 1968).

Crossbreeding tests : Parent Generation.

All females and males employed in these tests were reared individually from isolated eggs. The rearing cells were examined daily for egg deposition except on weekends when they were examined only once. Males were allowed to remain in the rearing cells during the entire oviposition period. Data on the preoviposition period and length of life of the female after oviposition ceased were recorded.

Ten individual crosses were attempted with females of the Sicilian stock and males of the Chilean stock. This cross is referred to as the Sc ♀ x Ch ♂ cross. A second series of ten reciprocal crosses was also attempted. This cross is hereafter referred to as the Ch ♀ × Sc ♂ cross. In the Sc ♀ × Ch ♂ cross the approximate adult ages of the females at the time of introduction of the males ranged from 1 to 6 days. The ages of the males ranged from 2 to 8 days. In the Ch ♀ × Sc ♂ cross the approximate adult ages of the females ranged from 1 to 14 days. The age of the males ranged from 2 to 20 days. In the Sc ♀ × Ch ♂ crosses each day's egg production from each pair was placed in separate rearing cells and allowed to develop to maturity. Of these F^1 offspring, those to be used in attempting to obtain an F^2 generation were individually isolated in separate cells just prior to

attaining maturity. In the Ch ♀ × Sc ♂ crosses each egg produced by each pairing was isolated in a rearing cell. Since oviposition and subsequent development to the adult stage did occur in both crosses, the tests were then continued to determine if the F^1 adults were fertile.

After each female had been in egg production for a few days, enough offspring were on hand to supply males and females for further (F^1) pairings and also furnish data on the sex ratio.

Fertility tests : F^1 Generation.

Since adults of the F^1 generation derived from each parent cross were kept isolated, it was possible to attempt inbreeding between F^1 males and females from each pair of parents. At least one pairing of an F^1 virgin female and an F^1 male was made for each of the ten parent crosses of both the Sc ♀ × Ch ♂ and Ch ♀ × Sc ♂ crosses. The rearing cells were again examined daily for egg production and all eggs were removed to new cells. The males were also allowed to remain in the rearing cells during the oviposition period of the females. The preoviposition periods and female longevities were recorded. Eggs from each pairing were kept separate but were not individually isolated. As the offspring from each of the ten F^1 pairings of both the Sc ♀ × Ch ♂ and the Ch ♀ × Sc ♂ crosses reached the adult stage they were sexed as before.

Fertility tests : F^2 Generation.

Enough F^2 eggs were retained from each of the ten pairings of F^1 adults of both crosses to ensure the presence of both males and females upon attaining maturity. The F^2 adults were then held until F^3 eggs were deposited and hatching occurred.

Results and Conclusions.

In both series of the parent crosses, oviposition commenced in less than 48 hours after introduction of the male with the exception of two females of the Ch ♀ × Sc ♂ cross (see table 5) which began oviposition between 48 and 72 hours. Oviposition was usually slightly lower (2-3 eggs per day) during the first day or two after fertilization of the females, after which it reached a maximum of 3-4 eggs per day by the third or fourth day and then continued at or near the maximum until oviposition ceased or the female died prematurely. Occasionally a female deposited 5 eggs within a 24-hour period, but this was uncommon. Data regarding oviposition by females of both parent crosses are given in tables 4 and 5.

We found no indication of infertility in the eggs produced by either cross. Although a total of 630 eggs was obtained from the ten Sc ♀ Ch ♂ crosses, only 163 individuals of the F^1 generation were sexed. All ten crosses, however, are

represented in this total. The sex ratio is given in table 8. A greater number of individuals of the F^1 generation from the Ch ♀ × Sc ♂ crosses was reared to the adult stage than was the case in the reciprocal crosses. The sex ratio of these F^1 offspring is given in table 9. This ratio is also derived from offspring from all ten pairings.

Results of the pairings of F^1 adults resulting from each of the ten parent crosses of the Sc ♀ × Ch ♂ cross are given in table 6. Results of the F^1 pairings of individuals derived from the ten parent crosses of the Ch ♀ × Sc ♂ cross are given in table 7. As was the case in the parent crosses, the preoviposition period after introduction of the males was not more than 48 hours except in one pairing of the F^1 from the Sc ♀ × Ch ♂ cross (see table 6) and in one pairing of the F^1 Ch ♀ × Sc ♂ cross (see table 7) in which the preoviposition period was between 48 and 72 hours in both cases. Oviposition reached a maximum several days after initiation and continued at approximately the same rate as achieved in the parent crosses during the entire oviposition period. Although the average number of eggs produced per day by all F^1 females of the Sc ♀ × Ch ♂ crosses was slightly higher (see table 6) than the average produced by the parent females (see table 4) a more typical egg production by parent female (10) would have raised the average nearer to that achieved by the F^1 females (see footnote, table 4). Egg production by F^1 females derived from the Ch ♀ × Sc ♂ crosses (see table 7) were very near that achieved by the parent females. Egg deposition by females of both the parent generation and the F^1 generation of the Ch ♀ × Sc ♂ crosses were somewhat lower than that achieved by their counterparts of the Sc ♀ × Ch ♂ crosses.

The differences in egg production by the various females as shown in tables 4, 5, 6 and 7 were not materially different, although certain of the means for reciprocal crossings tested significantly different. However, since the conditions employed in the rearings were somewhat different, this cannot be taken to mean any inherent difference related to vigor or genetic constitution.

The F^2 eggs from the Sc ♀ × Ch ♂ and Ch ♀ × Sc ♂ crosses were placed in groups of 6-12 per cell until all individuals matured. By allowing this number of individuals to develop in one cell, the presence of at least one male was assured. The sex ratio of the F^2 generation derived from the Sc ♀ × Ch ♂ crosses is given in table 10. All ten pairings are represented in this sex ratio. The sex ratio of the F^2 generation derived from the Ch ♀ × Sc ♂ crosses is given in table 11. All ten pairings are represented in this sex ratio.

Although the sex ratios obtained in the F^1 and F^2 generations varied considerably between crosses, it is not felt that they are indicative of basic genetic differences between the two stocks. As stated earlier (p. 568), the sex ratio for offspring from 20 females of the Chilean stock of *P. persimilis* was found to be 4.1 ♀ : 1.0 ♂ and for 20 females of the Sicilian stock it was 3.75 ♀ : 1.0 ♂.

In a side experiment we removed 18 female *P. persimilis* of the Chilean stock from stock plants (strawberry) on which the prey species (*T. urticae*) had been very nearly eradicated by the predator for more than a week. These starved females

were isolated in rearing cells with an abundance of *T. urticae* on celery leaflets. After three days the eggs produced by the female *P. persimilis* were removed to new rearing cells. From a total of 44 eggs reared to the adult stage we found a sex ratio of 1.1 ♀ : 1.0 ♂. After an additional two days the predator eggs were again removed to new rearing cells. From 60 eggs reared to the adult stage we found a sex ratio of 3.6 ♀ : 1.0 ♂. It thus appears that the sex ratio in *P. persimilis* may vary considerably for reasons as yet undetermined and that the variability as expressed in the offspring of the two crosses is not necessarily a result of genetic differences.

The data obtained in this study show conclusively that the two stocks of *Phytoseiulus* derived from widely separated geographic areas were fertile when crossed. Inbreeding of the F^1 generation resulted in fertility as did further inbreeding of the F^2 generation of both crosses. The preoviposition periods and rates of oviposition showed little variation between the two basic crosses. The preoviposition periods, rates of oviposition, and developmental periods of the immature stages also showed little variation in the F^1 and F^2 generations.

Because of the large numbers of mites involved in this study no attempt was made to obtain critical information on the life cycle of the individual mites. The life cycle from egg to adult averaged approximately 5 days for mites of both parent stocks and for mites of the F^1 generation of both crosses under the conditions in our laboratory. This was also the case for the F^2 generation of both crosses. For a critical study of the biology of *P. persimilis*, see LAING (1968).

Comparison of slide mounts of the immature stages of both the Sicilian and Chilean stocks showed a high degree of morphological similarity.

It is thus concluded that the Chilean, Sicilian, southern France and Algerian populations represent segments of one species and that the synonymy of *Phytoseiulus persimilis* should read as follows :

Phytoseiulus persimilis Athias-Henriot.

1. *Phytoseiulus persimilis* Athias-Henriot, 1957 : 347-348 ; Fig. 7.
   Phytoseiulus riegeli Dosse, Chant, 1959 : 109 ; Figs. 285, 286.
   Phytoseiulus tardi (Lombardini), Ehara, 1966 : 129-149. *New synonymy.*

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TABLE 1. Longevity and oviposition of virgin female *Phytoseiulus persimilis* Athias-Henriot of the Sicilian and Chilean stocks.

Stock	Adult Life Days	Eggs Laid No.
Sicilian.		
Female No. 1	54	0
Female No. 2	19	0
Female No. 3	71	0
Female No. 4	37*	0
Chilean.		
Female No. 1	28	0
Female No. 2	24	0
Female No. 3	21	0
Female No. 4	21	0

* This female was placed with a male of the Sicilian stock on the 37th day of adult life. See page 568 for results.

TABLE 2. Oviposition by female *Phytoseiulus persimilis* Athias-Henriot (Sicilian stock) after exposure to males of the Sicilian stock.

No. of Females	Total Days Oviposition	Total No. of Eggs	Eggs Per Day Ave.
20	302	1,123	3.72

TABLE 3. Oviposition by female *Phytoseiulus persimilis* Athias-Henriot (Chilean stock)* after exposure to males of the Chilean stock.

No. of Females	Total Days Oviposition	Total No. of Eggs	Eggs Per Day Ave.
20	373	1,295	3.47

* *P. riegeli* of Dosse.

TABLE 4. Oviposition by female *Phytoseiulus persimilis* Athias-Henriot of the Sicilian stock when mated with male *Phytoseiulus persimilis* Athias-Henriot of the Chilean stock* — Sc ♀ × Ch ♂ cross.

Cross No.	Female adult age when exposed to male Days	Maximum preoviposition period Days	Oviposition period Days	No. eggs produced	No eggs per day Ave.
1	2	1	24	88	3.7
2	2	1	24	93	3.9
3	6	2	24	85	3.5
4	2	2	21	77	3.7
5	4	2	12	35	2.9
6	4	1	5	15	3.0
7	4	2	17	62	3.6
8	3	1	20	65	3.2
9	4	2	26	87	3.3
10	1	1	11	23	2.1 **
Totals :					
10	—	—	184	630	3.42

* *P. riegeli* of Dosse.

** Female became weakened due to accidental immersion in water droplet after third day of oviposition. This female survived an additional 8 days but did not produce more eggs until the fourth day after immersion.

TABLE 5. Egg deposition by female *Phytoseiulus persimilis* Athias-Henriot of the Chilean stock * when mated with male *Phytoseiulus persimilis* Athias-Henriot of the Sicilian stock — Ch ♀ × Sc. ♂ cross.

1	1	2	32	100	3.1
2	1	2	21	78	3.7
3	1	2	26	82	3.1
4	10	1	26	79	3.0
5	14	2	15	53	3.5
6	8	2	4	20	5.0
7	8	3	8	16	2.0 **
8	11	3	12	41	3.4
9	2	2	3	13	4.3
10	10	1	3	11	3.7
Totals :					
10	—	—	150	493	3.29

* *P. riegeli* of Dosse.

** This female produced 14 of her 16 eggs during the first 4 days of oviposition and only 2 eggs during the final 4 days after which she escaped.

TABLE 6. Egg deposition by inbred F^1 females and males of *Phytoseiulus persimilis* Athias-Henriot which originated from the same parent pair of each of the Sc ♀ × Ch ♂ crosses.

Inbred pair No.	Female adult age when exposed to male Days	Maximum preoviposition period Days	Oviposition period Days	No. eggs produced	No. eggs per day Ave.
1	1	2	27	103	3.8
2	3	2	21	79	3.8
3	1	1	23	82	3.2
4	1	2	22	82	3.7
5	2	3	7	26	3.7
6	1	1	21	76	3.6
7	1	2	26	91	3.5
8	1	1	7	25	3.6
9	1	1	10	39	3.9
10	3	1	20	76	3.8
Totals : 10	—	—	184	679	3.69

TABLE 7. Egg deposition by inbred F^1 females and males of *Phytoseiulus persimilis* Athias-Henriot which originated from the same parent pair of each of the Ch ♀ × Sc ♂ crosses.

Inbred pair No.	Female adult age when exposed to male Days	Maximum preoviposition period Days	Oviposition period Days	No. eggs produced	No. eggs per day Ave.
1	1	2	24	84	3.5
2	2	2	28	88	3.1
3	6	2	22	68	3.1
4	4	2	27	86	3.2
5	4	3	23	88	3.8
6	4	2	23	61	2.6
7	3	2	25	71	2.8
8	1	2	32	92	2.9
9	2	2	23	70	3.0
10	1	2	23	89	3.9
Totals : 10	—	—	250	797	3.19

TABLE 8. Sex ratio of F^1 offspring from crosses between Sicilian stock females and Chilean stock males of *Phytoseiulus persimilis* Athias-Henriot.

No. crosses	No. eggs reared to adult stage	No. females	No. males	Sex Ratio ♀ : ♂
10	163	131	32	4.09 : 1

TABLE 9. Sex ratio of F^1 offspring from crosses between Chilean stock females and Sicilian stock males of *Phytoseiulus persimilis* Athias-Henriot.

No. crosses	No. eggs reared to adult stage	No. females	No. males	Sex Ratio ♀ : ♂
10	418	368	50	7.36 : 1

TABLE 10. Sex ratio of F^2 offspring from inbreeding F^1 females and males of *Phytoseiulus persimilis* Athias-Henriot which originated from the same parent pair of each of the Sc ♀ × Ch ♂ crosses.

No. pairings	No. eggs reared to adult stage	No. females	No. males	Sex Ratio ♀ : ♂
10	230	190	40	4.75 : 1

TABLE 11. Sex ratio of F^2 offspring from inbreeding F^1 females and males of *Phytoseiulus persimilis* Athias-Henriot which originated from same parent pair of each of the Ch ♀ × Sc ♂ crosses.

No. pairings	No. eggs reared to adult stage	No. females	No. males	Sex Ratio ♀ : ♂
10	708	608	100	6.08 : 1

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