BIOLOGICAL CONTROL

Population Parameters of *Spalangia endius* Walker (Hymenoptera: Pteromalidae) on Pupae of *Musca domestica* L. (Diptera: Muscidae)

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Parámetros Poblacionales de *Spalangia endius* Walker (Hymenoptera: Pteromalidae) Sobre Pupas de *Musca domestica* L. (Diptera: Muscidae)

RESUMEN - Se determinó el incremento poblacional potencial del parasitoide *Spalangia endius* Walker (Hymenoptera: Pteromalidae) sobre pupas de *Musca domestica* L. (Diptera: Muscidae) en condiciones de laboratorio, en oscuridad a 27°C y 50 ± 10% HR. Se colocaron individualmente 30 hembras con menos de 12h de emergidas sobre 15 pupas de *Musca domestica* L de menos de 24h de edad, renovándolas diariamente. La supervivencia preimaginal fue del 90,3 %. La longevidad de los adultos fue estimada en 8,3 días en promedio con una tasa neta de reproducción de 24,549; tasa intrínseca de crecimiento natural de 0,119; tasa finita de crecimiento de 1,126; tiempo generacional medio de 28,162 días y tiempo de duplicación de 5,849 días. Estos valores de los parámetros indican el alto potencial de *S. endius* comparadas con otras especies congenéricas.

PALABRAS CLAVE: Tabla de vida, parasitoide de pupas, tasa intrínseca de crecimiento

ABSTRACT - The potential increase of the parasitoid *Spalangia endius* Walker was determined under laboratory conditions at 27°C, 50 ± 10% RH. and 24h darkness. Thirty <12h-old females of the parasitoid were individualized with 15 *Musca domestica* L. pupae <24h old. Survival of *S. endius* immature was 90.3 %. Adult females mean longevity was estimated in 8.3 days with a net rate of reproduction of 24.549; intrinsic rate of natural increase of 0.119; finite rate of increase of 1.126; mean generation time of 28.162 days; and duplication time of 5.849 days. These values indicate the high potential of *S. endius* as a parasitoid of *M. domestica*, as compared to other congeneric species.

KEY WORDS: Life table, pupal parasitoid, intrinsic rate of increase

The microhymenopteran *Spalangia endius* Walker is a well-known parasitoid of *Musca domestica* L. pupae (Morgan *et al*. 1976) and is used to control this dipterous in confinement animal production system.

Life tables are an important component in estimating the vital statistics of an insect population. This methodology has been used to study population dynamics of a particular species (Southwood 1995), to select natural enemies (Janssen & Sabelis 1992) and to evaluate the impact of a beneficial insect on an insect-pest (Bellows *et al.* 1992). In order to evaluate the possibility of success of a parasitoid release in rural facilities to control sinanthropic dipterans, Morgan *et al*. (1989) carried out laboratory studies towards determination of parameters such as: daily fecundity and adults survival and mortality rates, among others. Several authors (Morgan *et al*. 1989, Morgan *et al*. 1991, Costa *et al*. 1995) obtained population parameters of congeneric species such as *Spalangia cameroni* Perkins and *S. gemina* Boucek and studied their use as control agents.

The objective of this research work was to construct fertility life tables of *S. endius* in order to obtain population parameters.

Materials and Methods

The present study was carried out in the insectary of domestic fly of the IMYZA (INTA Castelar, Buenos Aires, Argentina. Thirty <12h *S. endius* females from a mass rearing were used. These females were individually placed into 15 cm x 1.5 cm cotton-plugged glass tubes, without any food, together with 15 pupae of *M. domestica*. Selection of pupae was performed when the presence of the larval cuticle of the third instar was evident in the pupary formation. These pupae, which were selected by their white color indicating the beginning of pupation, were maintained in incubators at 29 ± 1ºC temperature and 60% to 70% RH. Under these conditions, the fly pupae became purplish-brown in color within 24h after pupation started. The environmental conditions for the life table assay were: 27 ± 1ºC temperature and 50 ± 10% RH. Fly pupae were daily replaced until death of all parasitoid females. Before sexation, the progenies of parasitoides and flies emerged from non-parasitized pupae were computed. For each female the following parameters were obtained: longevity, pre-oviposition period and daily number of male and female descendents.

Facing the difficulty in obtaining information on parasitoid development inside the host pupa, the overall percentage of survival of immature stages was estimated by subtracting the number of flies emerged, the number of parasitoids emerged and the number of naturally dead pupae from the total pupae offered. Data on this parameter were obtained by performing observations on 50 pupae daily taken from the same mass rearing used for the assays previously described.

Based on the data obtained, a fertility life table was built for each cohort (Southwood 1995) where x represents the average point of the age interval, lx is the life expectancy of the age x expressed on a base of 1,000 females, mx is the specific fertility or number of females per female born in the age x, and finally lxmx represents the total number of females produced in the age x.

The population parameters computed were: net rate of reproduction (R_o), which represents the total number of females produced in one generation; intrinsic rate of population increase (r_m), which expresses the innate-capacity of increasing in number; mean generation time (T), which is the mean extent of one generation; finite rate of increase (λ), which is the number of times that the population increases per unit of time; and time of duplication (D), which represents the time that a given population needs to duplicate itself in number.

The mean longevity of adult females was estimated based on the Weibull distribution, determining a function in which the values estimate a survival curve as a function of time (Sgrillo 1982).

The confidence intervals of each population parameter estimated with α=0.05, which are indispensable for comparing among cohorts, were computed by the "jackknife" method (Hulting *et al*. 1990, Thomazini & Berti Filho 2000).

Results and Discussion

The percent survival of immature stages of *S. endius* on *M. domestica* was 90.3%. The value for this parameter was lower for *S. endius* than for *S. cameroni* (97.5%) and *S. gemina* (96.5%) (Morgan *et al*. 1989). The pre-oviposition time varied from >24h to six days, being 3 the most frequent value. The fertility curve (Fig. 1 and Table 1) reaches its maximum value at the 7th day and at that age more than 50% of descendents had already been produced, followed by a decreasing trend.

The survival curve followed the Weibull distribution (Sgrillo 1982) with χ^2 = 4.81(n.s.) estimating the mean longevity in 8.3 days. All females were dead at the 18th day (Fig 2). Morgan *et al*. (1976) found that 50% of females died at 4.5 days and the maximum longevity was nine days. This difference is probably due to either the different rearing conditions or racial characteristics. In the case of *S. gemina* that percentage was reached at 17.3 days and all females were dead after 20 days (Morgan *et al*. 1991).

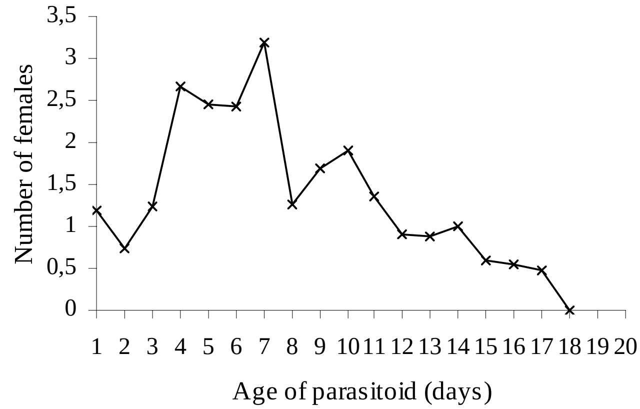

Figure 1. Mean number of females produced by females of the parasitoid *S. endius* on pupae of the fly *M. domestica*. (27ºC temperature and 50 ± 10% RH)

Table 1. Fertility life table of 30 females of the parasitoid *S. endius* on pupae of the fly *M. domestica* at 27ºC temperature and 50 ± 10% RH.

x	lx	mx	lxmx
0.5	1,000	-	Immature
:	:	-	stages
21.5	909	1.300	1,182
22.5	909	0.800	727
23.5	879	1.414	1,243
24.5	879	3.034	2,667
25.5	879	2.793	2,455
26.5	879	2.759	2,425
27.5	818	3.889	3,181
28.5	697	1.826	1,273
29.5	576	2.947	1,697
30.5	424	4.500	1,908
31.5	364	3.750	1,365
32.5	303	3.000	909
33.5	273	3.222	879
34.5	273	3.667	1,001
35.5	242	2.500	605
36.5	212	2.571	545
37.5	182	2.667	485
38.5	000	0.000	000

x = average point of the age interval, in days
lx = life expectancy of the age x expressed as a fraction of 1,000 females
mx = specific fertility per age (number of female descendents per female)
lxmx = number of females born at the age x

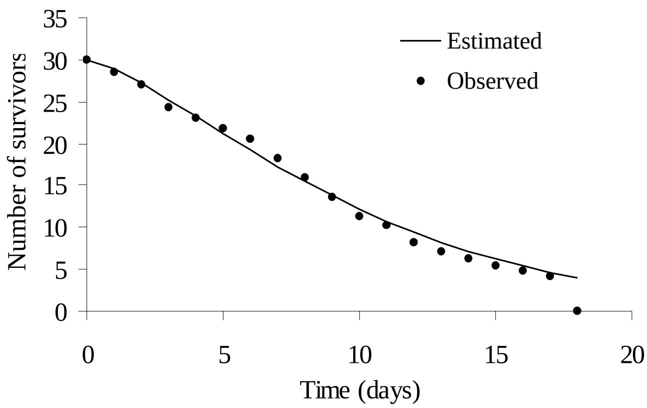

Figure 2. Survival curve, observed and estimated (Weibull: a = 10.774; b = 1.374) of *S. endius* females on pupae of *M. domestica*. (27ºC temperature and 50 ± 10% RH)

The number of times that a population of *S. endius* multiplies per generation (R_o) was 24.55, which indicates that in average a female can produce other 24 to 25 new females in each generation (Table 2). In other congeneric species, Morgan *et al*. (1991) found a R_o of 40 for *S. gemina*, while Costa (1995) found a figure of 64.14 for this parameter in the same species. On the other hand, the R_o calculated for *S. cameroni* was 13 females/female/generation (Morgan *et al.* 1989). The population of *S. endius* herein studied would be at an intermediate point between the two species cited, as far as R_o is concerned, even considering that the discrepancy found in *S. gemina* could indicate a high variability of this parameter within the same species.

Table 2. Population parameters (± SE) for the parasitoid *S. endius* on pupae of the fly *M. domestica*, calculated from data on 30 parasitoid females and estimated by the "jackknife" method. (27ºC temperature and 50 ± 10% RH)

R_0	r_m	λ	T	D
24,549	0,119	1,126	28,162	5,849
± 4,372	± 0,071	± 0,008	± 0,676	± 0,354

R_0 = net rate of reproduction expressed in females/female/generation.
r_m = innate-capacity of increase in number or intrinsic rate of increase
λ = finite ratio of increase
T = average generation time
D = time of duplication, in days

Southwood (1995) points out that the parameter r_m is the rate of increase per individual or the intrinsic rate of natural increase in an environment where the fecundity and the survival are maximal, in the absence of external mortality factors. On the other hand, the bigger is the r_m value, the bigger will be the potential of a species in reproducing and increasing in number within a given environment. This is also the most important parameter obtained from a life table since it allows the comparison of the potential increase among species. In that particular case it facilitates the evaluation of a parasitoid concerning its use in strategies where biological control is included (Jansen & Sabelis 1992). The r_m value was 0.119 (Table 2), which was higher than the figure of 0.09 found for *S. gemina* at 25ºC temperature and 70% RH (Costa 1995). The finite rate of increase (λ), which is the number of times that the population is multiplied per unit of time is another important parameter obtained from a life table and is also used for comparisons among species or races of parasitoids. This ratio was 1.126, being higher than that of 1.1 found with *S. gemina* (Costa 1995). The mean time among generations (T) was 28.16 days, sensibly lower than that of 43.57 days found for *S. gemina* (Costa 1995). The higher r_m and lower T indicate that *S. endius* possesses a high potential of population increase as compared to *S. gemina*.

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Literature Cited

Bellows, T.S. Jr., R.G. Van Driesche & J.S. Elkinton. 1992. Life tables construction and analysis in the evaluation of natural enemies. Annu. Rev. Entomol. 37: 587-614.

Costa, V.A. 1995. Efeito da temperatura na biologia de *Spalangia gemina* Boucek, 1963 (Hynenoptera: Pteromalidae) parasitoide pupal de *Musca domestica* L. (Diptera: Muscidae).Tese de doutorado, ESALQ-USP, Piracicaba, 67p.

Hulting, F.L., D.B. Orr & J.J. Obrycki. 1990. A computer program for calculation and statistical comparison of intrinsic rates of increase and life tables parameters. Fla. Entomol. 73: 601-612.

Janssen, A. & M.W. Sabelis. 1992. Phytoseiid life-histories, local predator-prey dynamics and strategies for control of tetranichid mites. Exp. Apl. Acarol. 14: 233-250.

Morgan, P.B., E. Berti Filho & V.A. Costa. 1991. Life story of *Spalangia gemina* Boucek (Hynenoptera: Pteromalidae), a fast-breeding microhymenopteran pupal parasitoid of moscoid flies (Diptera: Muscidae). Med. Vet. Entomol. 5: 277-281.

Morgan, P.B., H. Hoyer & R.S. Patterson. 1989. Life story of *Spalangia cameroni* Perkins (Hynenoptera: Pteromalidae), a microhymenopteran pupal parasitoid of moscoid flies. (Diptera: Muscidae) J. Kansas Entomol. Soc. 62: 381-386.

Morgan, P.B., R.S. Patterson & G.C. Labrecque. 1976. Host parasitoid relationship of the house fly, *Musca domestica* L. and the protolean parasitoid *Spalangia endius* Walker. (Diptera: Muscidae and Hynenoptera:

Pteromalidae). J. Kansas Entomol. Soc. 49: 483-488.

Sgrillo, R.B. 1982. A distribuição de Weibull como modelo de sobrevivência de insetos. Ecossistema 7: 9-13.

Southwood, T.R.F. 1995. Ecological methods. 2nd. ed., London, Chapman & Hall, 524p.

Thomazini, M.J. & E. Berti Filho. 2000. Tabela de vida de fertilidade de *Muscidifurax uniraptor* Kogan & Legner (Hymenoptera: Pteromalidae) em pupas de *Musca domestica* L. (Diptera: Muscidae). An. Soc. Entomol. Brasil 29: 715-721.

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