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Life table of *Stethorus punctillum* Weise (Coleoptera, Coccinellidae) at different temperatures

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Summary

Life tables of ***Stethorus punctillum*** were constructed at three different temperatures; 20, 25 and 30°C with 70±10 % R.H.

Survival of the females (l_x) was longer at 20°C, but mortality rate increased rapidly as temperature increased to 30°C. The age-spesific fecundity rates, m_x, reached a peak and declined rapidly at 30°C. The peak value of m_x was lower at lower temperatures.

The net reproduction rate (R_o), the mean generation time (T_o), and intrinsic rate of increase (m_x) at 20, 25 and 30°C were 228.0, 50.6, 0.107; 211.7, 31.9, 0.168; and 183.6, 22.9, and 0.227, respectively.

Introduction

Stethorus punctillum Weise was reported to be one of the predators responsible for the decline of tetranychid mite populations to low levels in many parts of the world (Bodenheimer, 1951; Böhm, 1960; Plaut, 1965; Putman and Herne, 1966; Chakurov, 1968; Gambaro, 1974; Mori and Vianello, 1979; Pasqualini, 1980).

S.punctillum was found in association with Hawthorn spider mite, ***Tetranychus viennensis*** Zacher, (Acarina, Tetranychidae) an important pest infesting apple, in apple growing areas of Turkey (Göksu, 1968; Toros, 1974; Yiğit and Uygun, 1982; Aykaç et al., 1983). Laboratory work by Yiğit (1989) demonstrated the biology and feeding capacity of ***S. punctillum.***

Here we present the reproductive ability of ***S.punctillum*** through life tables constructed at different temperatures.

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Material and Methods

Insectary procedures

Tetranychus cinnabarinus Bosid. (Acarina, Tetranychidae) colonized in the laboratory for several generations on bean plants was used as a prey.

The stock culture of *S. punctillum* was started with adult females obtained from apple orchards in the vicinity of Pozaantı, Adana. The beetles were maintained in the laboratory in a glass jar of 1 liter with a screen top. They were provided with an abundant supply of all stages of *T. cinnabarinus* brushed off from bean leaves into the jar through glass funnel as described by Walters (1974).

Both cultures of prey and predators were kept at 25±1°C and 70±10 % R.H. under normal day light conditions.

Experimental procedures

Experiments were conducted on apple leaf surface covered with 2.2x1.8 cm round plexiglass cells one end of which sealed with organdy. Adult *S. punctillum* females were placed individually on apple leaf containing excess amount of mixed stages of *T.cinnabarinus* and confined with the cells open end of which placed down for 24 hours. The females were then removed, as well as all but one egg per cell. The eggs were observed twice a day, and after hatching first instar larvae were transferred to cell enclosures individually. The developing immature beetles were always provided with an abundance of prey by being transferred, when necessary, to cells on another leaf well infested with *T. cinnabarinus.*

The newly emerged female adults were transferred to individual cells containing an abundance of food for a day or so. Each of these was then exposed to a mature male. After 24 h, and when mating had been observed, the females were transferred daily to new cell enclosures described above until their death. The eggs in the vacated cells were reared to the adult stage to obtain female offspring for construction of the life table. Above described procedure repeated at 20, 25, and 30°C temperatures and 70±10 % R.H.

Life tables

Life tables were constructed according to the method of Birch (1948) as given in Howe (1953) and Watson (1964). From the data in the life table, the intrinsic rate of increase was calculated using the formula

$$e^{-r m^x} \cdot {}_1x m_x = 1$$

where e is the base of natural logarithms, x is the age of individuals in days, 1_x is the number of individuals alive at age x as a proportion of one, and m_x is the number of female offspring produced per female in the age interval x.

The net reproduction rate (R_o) was calculated as the sum of the respective $1_x m_x$ columns in the life table. The mean generation time (T_o) was then calculated from the formula

$$T_o = \log_e x R_o / r_m \quad \text{(Laing, 1968).}$$

Results and Discussion

The age-specific survival rate of females, 1_x, and age-specific fecundity rates, m_x, are given in Fig. 1. The survival of females at 20°C was longer than that of obtained at 25 and 30°C, and became shorter with increase in temperature. Age-specific fecundity rate of ***S.punctillum*** reached a peak and declined rapidly at 30°C. There occurred no distrinct peak of m_x at 20°C, and production of offsprings was distributed over a longer time period. The shape of m_x curve at 25°C was similar to that of 30°C but with lower peak value and rather slow decline (Fig 1).

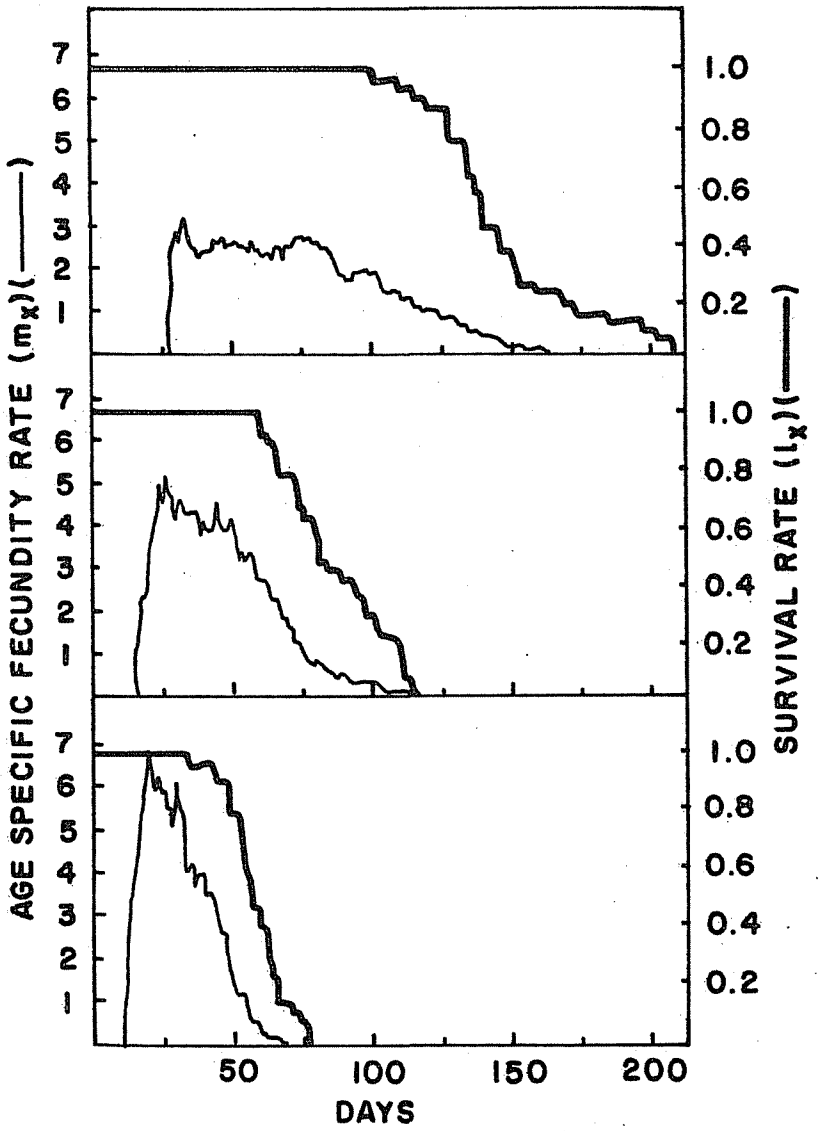

Figure 1. Adult survival (1_x) and age-specific fecundity rate (m_x) of ***Stethorus punctillum***.

The population growth statistics of ***S.punctillum*** at three different temperatures are given in Table 1. The R_0 value, which is the number of female offspring per female produced during the life span, was 228.0, 211.7, and 183.6; and the mean generation time (T_0) was 50.6, 31.9, and 22.9 days at 20, 25, and 30°C temperatures, respectively. The highest intrinsic rate of increase (0.227) was obtained at 30°C. The r_m values for 20 and 25°C were 0.107 and 0.168, respectively (Table 1).

Table 1. The population growth statistics of ***S. punctillum*** at three different temperatures

°C	R_0 (female/female)	T_0 (days)	r_m (female/female/day)
20	228.0	50.6	0.107
25	211.7	31.9	0.168
30	183.6	22.9	0.227

Life table studies of two other ***Stethorus*** species, ***S.madecassus*** Chazeau and ***S. picipes***, by Gutierrez and Chazeau (1972) and Tanigoshi and McMurtry (1977) under physical conditions similar to those of this study, produced intrinsic rates of increase of 0.137 and 0.121, respectively. The net reproduction rate (R_0) and mean generation time (T_0) were 51.57 and 28.8 for ***S. madecassus*** and 103.26 and 38.3 for ***S.picipes***, respectively. ***S. punctillum*** had higher R_0 and r_m values from those of ***S. madecasus*** and ***S.picipes*** at 25 and 30°C in this study. However, a direct comparison of these various parameters for different species may be misleading, especially when considering natural predator-prey interactions in a changing environment (Laing and Huffaker, 1969).

Özet

Stethorus punctillum **Weise(Coleoptera, Coccinellidae)'un farklı sıcaklıklarda yaşam çizelgesi**

Stethorus punctillum'un yaşam çizelgesi 20, 25 ve 30°C sıcaklıklarda ve % 70±10 orantılı nemde oluşturulmuştur.

Yaşam eğrileri (l_x) incelendiğinde, dişi bireylerin 20°C'da daha uzun yaşadıkları, ancak sıcaklığın 30°C'a çıkmasıyla ölüm oranlarının hızla arttığı görülmüştür. Dişi başına bırakılan günlük dişi yavru sayısı (m_x) 30°C'da kısa zamanda tepe noktasına ulaştıktan sonra ani bir düşüş göstermiştir. Diğer sıcaklıklarda m_x değeri daha az olmuştur.

S. punctillum'un 20, 25 ve 30°C sıcaklıklardaki net üreme gücü (R_0), ortalama döl süresi (T_0) ve kalıtsal üreme yeteneği (r_m) sırasıyla, 28.0, 50.6, 0.107; 211.7, 31.9, 0.168; ve 183.6, 22.9, 0.227 olmuştur.

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Literature

Aykaç, K., H. Kıroğlu, T.M. Ergüden, R. Çamlıdere, M.Kılıç, ve T. Çevik, 1983. Karadeniz Bölgesi elma bahçelerinde entegre savaş olanakları üzerinde araştırmalar. Proje A-108 04. Nihai Raporu. Böl. Zir. Müc. Araş. Ens., Samsun, 69 s.

Birch, L.C., 1948. The intrinsic rate of natural increase on an insect population. **J. Anim. Ecol., 17:** 15-26.

Bodenheimer, F.S., 1951. Citrus Entomology in the Middle East. Uitgeverij Dr. W. Junk. S-Gravenhage, Groningen (Holland), 663 pp.

Böhm, H., 1960. Investigations on the enemies of spider mites in Austria. **Pflanzenschutzberichte, 25:** 23-46.

Chakurov, K., 1968. Studies on the dynamics of the numbers of fruit tree spider mites and their predator ***Stethorus punctillum.*** **Rastit. Zasht., 16:** 17-20.

Gambaro, P.I., 1974. L'influenza del ***Typhlodromus italicus*** Chank (Acarina, Phytoseiidae)e dello ***Stethorus punctillum*** Weise (Col., Coccinellidae) sulla dinamica di popolazione degli acari fitofagi des pesco. **Bolletino dei Laboratorio dei Entomologica Agraria "Filippo Silvestri', Portici, 31:** 171-191.

Göksu, E., 1968. Akdiken akarı (***Tetranychus viennensis Zacher***)'nin biyolojisi, mücadelesi, yayılış sahası ve konukçuları üzerinde araştırmalar. **Bitki Koruma Bült., 8:** 194-213.

Gutierrez, Jand J. Chazeau, 1972. Cycles de development et tables de vie de ***Tetranychus neocaledonicus*** Andre (Acarines: Tetranychidae) et d'un de ses principaux predateurs a Madagascar ***Stethorus madecassus*** Chazeau (Coccinellidae). **Entomophaga, 17:** 275-295.

Howe, R.W., 1953. The rapid determination of the intrinsic of increase of an insect population. **Ann. Appl. Biol., 40:** 134-51.

Laing, J.E., 1968. Life history and life table of ***Phytoseiulus persimilis*** Athias-Henriot. **Acarologia, 10:** 578-588.

Laing, J.E., and C.B. Huffaker, 1969. Comparative studies of predation by ***Phytoseiulus persimilis*** Athias-Henriot and ***Metaseiulus occidentalis*** (Nesbitt) (Acarina: Phytoseiidae) on populations of ***Tetranychus urticae*** Koch (Acarina: Tetranychidae). **Res. Popul. Ecol., 11:** 105-26.

Mori P. and G. Vianello, 1979. Integrated control of ***Carpocapsa pomonella*** L. with Diflubenzuron (test results). In: 25 th Anniversary of IOBC/WPRS Proceedings. International Symposium of IOBC/WPRS on Integrated Control in Agricultire and Forestry. Wien, 8-12, October 1979, p. 455-457.

Pasqualini, E., 1980. The role of ***Stethorus punctillum*** in the integrated control of the European red mite in apple orchards. In: Biological Control in Orchards. Biology and Control of Codling Moth. Wye (U.K.) 25-29.3.1980. IOBC-OPRS Bull. p.23.

Plaut, H.N., 1965. On the phenology and control value of ***Stethorus punctillum*** Weise as a predator of ***Tetranychus cinnabarinus*** Boisd. In Israel. **Entomophaga, 10:** 133-137.

Putman, W.L., and D.C. Herne, 1966. The role of predators and other biotic agents in regulating the population density of phytophagous mites in Ontario peach orchards. **Can. Ent., 98:** 808-820 (**Rev. appl. Ent.** (A), 1968, **56:** Abstr. 2224).

Tanigoshi, L. K., and J.A., McMurtry, 1977. The dynamics of predation of ***Stethorus picipes*** (Coleoptera: Coccinellidae) and ***Typhlodromus floridanus*** on the prey ***Oligonychus punicae*** (Acarina: Phytoseiidae, Tetranychidae). Part I. Comparative life history and life table studies. **Hilgardia, 45:** 237-261.

Toros, S., 1974. Orta Anadolu Bölgesinde önemli bitki zararlılarından ***Tetranychus viennensis*** Zacher (Akdiken akarı)'ın morfolojisi, biyolojisi, yayılışı ve konukçuları ile kimyasal savaş imkanları üzerinde araştırmalar. Ank.Üniv. Ziraat Fakültesi Yay.: 514, Bilimsel Araş. ve İnc.: 296. A.Ü. Zir. Fak. Ofset Basımevi, Ankara, 74 s.

Watson, T.F., 1964. Influence of host plant condition on population increase of ***Tetranychus telarius*** (Linnaeus) (Acarina: Tetranychidae). **Hilgardia, 35:** 273-322.

Walters, P.J., 1974. A method for culturing ***Stethorus*** spp. (Coleoptera: Coccinellidae) on ***Tetranychus urticae*** (Koch) (Acarina: Tetranychidae). **J. Aust. ent. Soc., 15:** 49-52.

Yiğit, A. and N. Uygun, 1982. Investigations on the population dynamics of Hawthorn mite, ***Tetranychus viennensis*** Zacher (Acarina: Tetranychidae) and its predators in apple orchards. **Ç.Ü. Ziraat Fakültesi Yıllığı, 13:** 64-69.

Yiğit, A., 1989. Elma ağaçlarında zararlı akdiken kırmızı örümceği, ***Tetranychus viennensis*** Zacher (Acarina, Tetranychidae) ile avcısı ***Stethorus punctillum*** Weise (Coleoptera, Coccinellidae) arasındaki ilişkiler üzerinde araştırmalar. Adana Zirai Mücadele Araştırma Enstitüsü, Araştırma Yayınları Serisi, No: 62, II nolu Mrk. İkmal Md. Ofset Mat., Ankara, 92 s.