



Optimum thermal regimes for adult storage of *Scymnus coccivora* Ayyar (Coleoptera: Coccinellidae)

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ABSTRACT: Adults of *Scymnus coccivora* Ayyar (Coleoptera: Coccinellidae) were stored in five different temperature regimes of 5, 10, 15, 20 and 29°C along with 50 per cent honey as adult food, and the per cent survival and fecundity at weekly interval were recorded during September – October 2004 in the weather condition of $31.9 \pm 2.2^\circ\text{C}$ and 68.8 ± 7.1 per cent relative humidity at Insectary, Department of Agricultural Entomology, Agricultural College and Research Institute, Madurai. The adult survival was 81.7 and 31.7 per cent on 35th and 56th day after storage, respectively when stored at 15°C. Adults of *S. coccivora* drawn from 20°C continued to lay eggs for up to 49 days which were 28.4, 23.4, 18.0, 15.4, 12.7, 7.4 and 4.0 eggs/female on 7, 14, 21, 28, 35, 42 and 49th day after storage, respectively. Temperature at 20 and 15°C were favourable for the storage of adults with survival for prolonged period while 5 and 10°C were detrimental to survival and fecundity.

KEY WORDS: Fecundity, longevity, *Scymnus coccivora*, survival, thermal requirement

INTRODUCTION

Scymnus spp. (Coleoptera: Coccinellidae) are potent and indigenous predators of a wide range of mealybugs, aphids and scales at all stages of the development (Gautam, 1988; Singh, 1993; Jayaraj and Gautam, 1993). Hence, utilization of *Scymnus coccivora* Ayyar as biocontrol agent of coccids and aphids is worthwhile. Immature survival will have a profound influence on the reproductive numerical response of a predator. Preserving immature stages and adults of coccinellid predators without affecting their predatory capabilities in commercial insectaries is one of the bottlenecks, which does not permit their effective utilization for pest management. Skill and knowledge on the reaction of the predators to wide temperature range

are to be made readily available to biological control researchers and commercial bio-control laboratories. Hence the thermal requirements of the predators are to be worked out. Several studies have reported the survival and fecundity of immature stages of coccinellids in various temperature regimes including *Chilocorus* spp. (Hatting and Samways, 1993), *Sticholotis madagassa* Weise (Jalali and Singh, 1990), *Scymnus nubilus* Mulsant (Jayaraj, 1994), *Cryptolaemus montrouzieri* Mulsant (Manjula, 1998) and *Chilocorus nigrita* (Fabr.) (Ponsonby and Copland, 1995; Pandian *et al.*, 2002). In the present study, the adults of *S. coccivora* were exposed to various temperatures for identifying the optimum temperature for development.

MATERIALS AND METHODS

Ten pairs of freshly emerged adults of *S. coccivora* were confined in a glass tube of 7.5 x 3.5 cm size along with 50 per cent honey soaked cotton as adult food. They were stored at 5, 10, 15, and 20°C temperature regimes and compared with room temperature of 29°C. Refrigerator and BOD incubator were used to maintain 5 and 10°C and 15 and 20°C, respectively throughout the experimental period.

The laboratory experiments were carried out at Insectary, Department of Agricultural Entomology, Agricultural College and Research Institute, Madurai during September – October 2004 in the weather condition of $31.9 \pm 2.2^\circ\text{C}$ and 68.8 ± 7.1 per cent relative humidity. Each treatment was replicated thrice and eight such sets for each temperature were stored to find out the influence of temperature on the survival and fecundity of *S. coccivora* at weekly interval from storage (Sharma *et al.*, 1990). Adults were drawn at weekly interval up to 8th week from storage and per cent adult survival was recorded. Five pairs of adults were

selected from the adults surviving after exposure to different temperatures and introduced into a cage (30 x 30 x 30 cm) size containing mealybug infested pumpkin and 50 per cent honey. Observations on the fecundity were made. Data were statistically analyzed in randomized block design after following arcsine-transformation to percentage values by adding 0.5 to all values.

RESULTS AND DISCUSSION

Influence of temperature on the survival of *S. coccivora*

The results indicated that 15, 20 and 29°C were favorable for the storage of adults with survival for prolonged period while 5 and 10°C were detrimental to adults. At 14 days after storage, only 15.0 and 48.4 per cent of adults survived at 5 and 10°C, respectively, and none survived beyond 35 days after storage at these temperatures, while it was 100.0, 98.4 and 95.0 per cent at 15, 20 and 29°C, respectively (Table 1). The survival after 35 days of storage was more than 60.0 per cent (81.7, 68.4 and 63.4%, respectively at 15, 20 and 29°C), which

Table 1. Per cent survival of *S. coccivora* exposed to five different temperatures

Temperature (°C)	Adult survival at different days							
	7	14	21	28	35	42	49	56
5	26.50 (30.98) ^c	15.00 (22.78) ^c	10.00 (18.43) ^d	5.00 (12.92) ^c	0.00 (0.45) ^d	0.00 (0.45) ^d	0.00 (0.45) ^d	0.00 (0.45) ^d
10	52.50 (46.43) ^b	48.40 (44.05) ^d	28.00 (31.94) ^c	16.70 (24.12) ^d	5.00 (12.92) ^c	0.00 (0.45) ^d	0.00 (0.45) ^d	0.00 (0.45) ^d
15	100.00 (89.54) ^a	100.00 (89.54) ^a	91.70 (73.25) ^a	90.00 (71.56) ^a	81.70 (64.67) ^a	68.40 (55.92) ^a	43.00 (40.97) ^a	31.70 (34.26) ^a
20	100.00 (89.54) ^a	98.40 (85.62) ^b	90.00 (71.56) ^a	78.35 (62.27) ^b	68.40 (55.76) ^b	53.40 (46.92) ^b	41.50 (40.10) ^b	21.50 (27.62) ^b
29	100.00 (89.54) ^a	95.00 (77.08) ^c	86.70 (68.61) ^b	80.00 (63.43) ^c	63.40 (55.74) ^b	45.00 (42.13) ^c	33.40 (35.27) ^c	18.40 (25.36) ^c
Mean	75.80 (60.53)	71.34 (57.7)	61.30 (51.52)	54.10 (47.3)	43.70 (71.37)	33.40 (35.26)	23.60 (29.04)	14.4 (22.22)

Figures in parentheses are arcsine-transformed values ($x + 0.5$).

Means followed by same letter(s) are not significantly different by DMRT ($P=0.05$).

Table 2. Fecundity of *S. coccivora* after storage at different temperatures

Temperature (°C)	Fecundity (eggs/female) at different days							
	7	14	21	28	35	42	49	56
5	0.00 (0.45) ^c	0.00 (0.45) ^d	0.00 (0.45) ^d	0.00 (0.45) ^d	0.00 (0.45) ^d	0.00 (0.45) ^d	0.00 (0.45) ^c	0.00 (0.45)
10	6.00 (14.17) ^d	3.60 (10.93) ^c	0.00 (0.45) ^d	0.00 (0.45) ^d	0.00 (0.45) ^d	0.00 (0.45) ^d	0.00 (0.45) ^c	0.00 (0.45)
15	17.40 (24.60) ^c	16.70 (24.09) ^b	12.40 (20.56) ^b	8.70 (17.12) ^c	5.40 (13.36) ^c	0.00 (0.45) ^d	0.00 (0.45) ^c	0.00 (0.45)
20	28.40 (32.16) ^b	23.40 (28.88) ^a	18.00 (25.10) ^a	15.30 (23.05) ^a	12.70 (20.85) ^a	7.40 (15.71) ^a	4.00 (11.53) ^a	0.00 (0.45)
29	29.70 (33.00) ^a	23.30 (28.88) ^a	14.70 (22.52) ^c	12.40 (20.52) ^b	10.40 (18.75) ^b	5.00 (12.92) ^b	3.60 (10.93) ^b	0.00 (0.45)
Mean	16.30 (23.78)	13.40 (21.46)	9.10 (17.47)	7.30 (15.64)	5.70 (13.77)	2.50 (9.04)	1.60 (7.08)	0.00 (0.45)

Figures in parentheses are arcsine-transformed values ($x + 0.5$).

Means followed by same letter(s) are not significantly different by DMRT ($P=0.05$).

declined to at 43.0, 41.5 and 33.4 and 31.7, 21.5 and 18.4 per cent at 49 and 56 days after storage at the same temperatures, respectively.

Influence of temperature on the fecundity of *S. coccivora*

Data on the fecundity of adults drawn from storage in five different temperatures for eight weeks showed that 20 and 29°C did not affect the fecundity, recording 28.4 and 29.7 eggs/ female, seven days after storage as compared to 17.4, 6.0 and 0.0 eggs/ female at 15, 10 and 5°C, respectively (Table 2). Adults drawn from 20 and 29°C continued to lay eggs for up to 49 days, which were 28.4, 23.4, 18.0, 15.4, 12.7, 7.4 and 4.0 eggs/ female and 29.7, 23.4, 14.7, 12.4, 10.4, 5.0 and 3.6 eggs/ female during 7, 14, 21, 28, 35, 42 and 49 days after storage, respectively. Adults drawn from 5°C laid no egg and the same stopped beyond 14 days at 10°C.

Influence of temperature on survival of *S. coccivora* after storage

For the survival of adults after removal from storage, 20, 29 and 15°C were favourable while 5 and 10°C were detrimental to adults. At seven days

after storage, only 6.5 and 13.4 per cent of adults survived at 5 and 10°C, respectively, and none survived beyond 28 days after storage at the same temperatures. The survival was around 60.0 per cent after storage of adults at 20 and 29°C (66.7 and 65.0 %), while it was 31.7 per cent at 15°C from seven days after storage. After storage of adults at 20 and 29°C, statistically non-significant decrease in survival was observed up to 21 days (51.7 and 41.7%, respectively). The survival after 35 days of storage was around 30.0 per cent (38.4 and 31.7%, respectively) at 20 and 29°C while it was less than 12 per cent at 15°C (11.7%). At 49 and 56 days after storage, the survival rate declined to reach 13.4 and 3.0, 10.0 and 0.0 and 0.0 and 0.0 per cent at 20, 29 and 15°C, respectively (Table 3).

Scymnus coccivora survived for a period of 35 days (60.0%) when stored at 15°C followed by 20 and 29°C, whereas 5 and 10°C completely affected the survival and fecundity after removal from storage. Though 15°C was favourable for adult survival, it drastically reduced the fecundity by 75.0 per cent, after removal from storage. Conversely, storing at 20 and 29°C supported both survival and fecundity of adults. Such differences in fecundity,

Table 3. Per cent survival of *S. coccivora* after storage at different days

Temperature (°C)	Survival after storage at different days							
	7	14	21	28	35	42	49	56
5	6.50 (14.77) ^d	5.00 (12.92) ^c	1.50 (7.03) ^c	0.00 (0.45) ^c	0.00 (0.45) ^c	0.00 (0.45) ^c	0.00 (0.45) ^c	0.00 (0.45) ^b
10	13.40 (21.43) ^c	11.70 (20.00) ^d	5.00 (12.92) ^d	0.00 (0.45) ^c	0.00 (0.45) ^c	0.00 (0.45) ^c	0.00 (0.45) ^c	0.00 (0.45) ^b
15	31.70 (34.30) ^b	26.70 (31.11) ^c	23.40 (28.89) ^c	18.00 (25.10) ^c	11.70 (20.00) ^c	5.00 (12.92) ^d	0.00 (0.45) ^c	0.00 (0.45) ^b
20	66.70 (54.75) ^a	58.40 (49.80) ^a	51.70 (45.97) ^a	46.70 (43.10) ^a	38.40 (34.24) ^a	20.00 (26.56) ^b	13.40 (21.43) ^a	3.00 (9.97) ^a
29	65.00 (53.73) ^a	53.40 (46.92) ^b	41.70 (40.00) ^b	36.70 (37.28) ^b	32.70 (26.64) ^b	18.40 (12.92) ^a	10.60 (18.43) ^b	0.00 (0.45) ^b
Mean	35.70 (36.66)	31.00 (33.83)	24.70 (29.76)	20.30 (26.76)	16.40 (23.85)	8.70 (17.12)	1.60 (12.67)	0.60 (0.44)

Figures in parentheses are arcsine-transformed values ($x + 0.5$).

Means followed by same letter(s) are not significantly different by DMRT ($P=0.05$).

development and longevity among the ladybird beetles at varied temperatures have been reported earlier for *S. nubilus* by Jayaraj (1994). The present finding is also supported by Jalali and Singh (1990) and Manjula (1998) who suggested 15 and 25-30°C as optimum thermal requirement for prolonged storage with high fecundity of *S. madagassa* and *C. montrouzieri*, respectively. Similarly, Pandian *et al.* (2002) reported that the optimum temperature regimes for the storage of adult of *C. nigrita* were 15, 20 and 29°C in which the adult had higher survival rate during storage (100, 100 and 96.7%, respectively) while 5 and 10°C were detrimental to adults. Hence, it can be concluded that 15 and 20°C are considered as optimum thermal requirement for storing of adults of *S. coccivora* for a period of 10 - 15 days and three weeks without affecting survival and fecundity, respectively. This technique would be useful in the laboratory rearing as well as planning field release by storing large numbers of predators during non-availability of the host insects.

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