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Influence of temperature and relative humidity on the development of *Amblyseius alstoniae* (Acari: Phytoseiidae)

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ABSTRACT

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Reproduction and development of *Amblyseius alstoniae* Gupta is significantly affected by temperature and relative humidity (RH), optimum being a temperature of 25°C and RH of 70%. At this combination, the viability of eggs, fecundity and daily egg production were higher, oviposition period and longevity were of longer duration, and mortality was minimal. Increase or decrease in these temperature and RH levels leads to a drop in fecundity, longevity and oviposition period and an increase in mortality. Longevity of females is always greater than that of males, irrespective of temperature and RH. Female:male ratio decreases with increase in temperature, irrespective of RH.

INTRODUCTION

The predatory mite *Amblyseius alstoniae* commonly occurs in the biotic environment of the phytophagous mite, *Bravipalpus phoenicis* (Geijskes), which infests citrus, grapevine and guava (Sadana, 1985). Laboratory observations also revealed heavy predation of *B. phoenicis* by *A. alstoniae*. Thus, this mite offers potential as a biological control agent. Therefore, it is desirable to study its biology for mass-rearing.

METHODS

Development of *A. alstoniae* was studied in the laboratory at temperatures of 20, 25 and 30 ± 1°C, each in combination with a relative humidity (RH) of 50, 70 and 90 ± 3%, which was maintained after the method of Buxton and Mellanby (1934). In each experiment, one gravid female was released in a colony of *B. phoenicis* maintained on excised leaf discs (2 cm^2) of guava placed

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over moist cotton pad in a petridish (15 cm diameter). Various parameters recorded include daily egg count, duration of various developmental stages, oviposition period, longevity and fecundity.

RESULTS

Development of *A. alstoniae* was fast at high temperature with moderate RH compared with low temperature with low or high RH. It is evident from the data in Table 1 that the duration of different developmental stages increased with increase or decrease in RH level from 70% at each temperature considered. Knisley and Swift (1971) observed decrease in developmental duration of *A. umbraticus* when the RH was increased from 65 to 90% at 25°C. Kumari (1984) reported that, in *A. finlandicus,* the developmental period increased as RH increased from 50 to 90% at 25 and 35°C, remained unchanged at all RH levels at 30°C, and increased both above and below 70% RH at 20°C. The average developmental period of female and male of *A. alstoniae* was maximum at 20°C/90% RH and at 20°C/50% RH, and minimum in both cases at 30°C/70% RH (Table 1).

Female:male ratio (♀:♂) decreases with increase in temperature irrespective of relative humidity (Table 2), as also reported earlier (Tanigoshi et al., 1975; Sharma and Sadana, 1984). This observation is supported by the fact that ♀:♂ ratio of *A. finlandicus* is higher in winter (Sadana and Sharma, 1988). This is in contrast to the findings of Ma and Laing (1973), however, who reported low ♀:♂ ratio at 16.4°C, increasing at 25° and 30°C.

Maximum oviposition period was recorded at an optimum temperature of 25°C and RH of 70%, above and below which it decreased (Table 2). In *Phytoseiulus persimilis* it is the reverse, being higher at 20°C than 26°C (McLanahan, 1968). Further, in *A. fallacis,* there is no difference at 26.7 and 30°C (Smith and Newsom, 1970).

For daily egg production, 25°C and 70% RH were found to be the optimum, as also in *A. finlandicus* (Kumari, 1984). Fecundity is also highest at 25°C and 70% RH (Table 2), above or below which it drops. However, in *A. swirski,* higher fecundity is reported at elevated temperature (Yousef et al., 1982).

Longevity was maximum at an optimum temperature of 25°C and RH of 70%, above and below which it decreased (Table 1). Longevity of the female is always greater than that of the male, irrespective of temperature and RH.

Mortality from egg to adult is minimal at RH of 70% and temperature of 25°C. It decreases with increase or decrease of RH and temperature, being significantly greater at 20°C than at 30°C. However, Kumari (1984) observed no mortality at the egg stage in *A. finlandicus* at 20°C and 25°C, at various levels of RH.

TABLE 1

Developmental duration of *A. alstoniae* (in days) at different combinations of constant temperature and relative humidity when fed upon adult *B. phoenicis*

Temp./RH regimen	Developmental period				Total		Longevity (in days)	
	Incubation	Larval	Protonymphal	Deuto-nymphal	Female	Male	Female	Male
20°/50%	2.68±0.04 (22)**	4.00±0.03 (18)	8.47±0.04 (17)	11.47±0.03 (17)	25.91±0.08 (12)	26.80±0.14 (5)	11.40±0.16 (5)	4.60±0.20 (5)
20°/70%	2.43±0.03 (23)	3.55±0.02 (18)	7.27±0.04 (18)	9.20±0.04 (18)	25.30±0.09 (13)	21.80±0.34 (5)	12.40±0.05 (5)	7.80±0.14 (5)
20°/90%	3.16±0.03 (25)	4.57±0.03 (19)	7.73±0.04 (19)	10.90±0.03 (19)	26.35±0.06 (14)	25.80±0.14 (5)	11.60±0.16 (5)	5.40±0.20 (5)
25°/50%	1.50±0.03 (17)	3.53±0.03 (15)	7.40±0.03 (15)	10.0±0.05 (15)	22.70±0.09 (10)	22.20±0.08 (5)	(5)	7.40±0.20 (5)
25°/70	1.33±0.02 (18)	3.23±0.02 (17)	6.40±0.03 (17)	8.52±0.03 (17)	19.66±0.05 (12)	19.40±0.05 (5)	16.20±0.02 (5)	9.40±0.06 (5)
25°/90%	1.59±0.02 (22)	4.55±0.03 (20)	6.60±0.03 (20)	9.80±0.05 (20)	22.13±0.12 (15)	23.80±0.23 (5)	13.60±0.16 (5)	6.60±0.16 (5)
30°/50%	1.00±0.00 (20)	2.50±0.03 (15)	5.35±0.03 (15)	7.60±0.04 (15)	16.70±0.11 (10)	16.50±0.20 (5)	11.20±0.09 (5)	4.40±0.20 (5)
30°/70%	1.00±0.00 (17)	2.21±0.03 (14)	3.78±0.03 (14)	5.64±0.04 (14)	12.88±0.10 (9)	12.20±0.19 (5)	11.80±0.08 (5)	6.40±0.20 (5)
30°/90%	1.00±0.00 (19)	2.71±0.05 (14)	5.57±0.03 (14)	7.92±0.04 (14)	17.33±0.11 (9)	17.00±0.21 (5)	11.00±0.18 (5)	3.80±0.14 (5)

*Mean ± SE.
**Number of observations.

TABLE 2

Oviposition period, fecudnity, mean daily rate of egg production (eggs day^{-1}) sex-ratio and percentage mortality of *A. alstoniae* at constant temperature and relative humidity combinations

Temp./RH regimen	Eggs (n)		Adults emerged (n)	Mortality, (egg to adult) (n)	Oviposition period (days)	Fecundity	Eggs day^{-1} ($\bar{x}$)	Sex-ratio (♀:♂)
	Examined	Hatched						
20°/50%	26	22	17	34.61	8.80±0.08* (5)**	13.40±0.09 (5)	1.52	4:1
20°/70%	23	23	18	21.73	10.2±0.08 (5)	15.80±0.08 (5)	1.54	4.33:1
20°/90%	29	25	19	34.48	8.60±0.09 (5)	13.20±0.14 (5)	1.53	4.67:1
25°/50%	17	17	15	11.76	11.60±0.09 (5)	20.20±0.14 (5)	1.74	3.33:1
25°/70%	18	18	17	5.50	14.20±0.08 (5)	28.40±0.34 (5)	2.00	3.67:1
25°/90%	22	22	20	9.09	11.20±0.08 (5)	17.20±0.08 (5)	1.53	3.75:1
30°/50%	21	20	15	28.57	8.60±0.09 (5)	11.80±0.36 (5)	1.37	3.33:1
30°/70%	17	17	14	17.64	9.60±0.09 (5)	14.40±0.20 (5)	1.50	3:1
30°/90%	19	19	14	26.31	8.50±0.09 (5)	10.40±0.09 (5)	1.22	3:1

*Mean ± SE.
**No. of observations.

DISCUSSION

It is evident that a temperature of 25 °C with 70% RH was the most suitable combination for rapid development and reproduction of *A. sistoniae.* Under this regimen, viability of eggs, fecundity and daily egg production were higher, and the oviposition period and longevity of longer duration, whereas mortality was minimum.

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