

Israel Journal of Entomology Vol. VI, 1971

Failures to Induce Diapause In an Acaricide-Susceptible
Strain of the Carmine Spider Mite¹

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Abstract

An acaricide-susceptible strain of the carmine spider mite, *Tetranychus cinnabarinus* (Boisduval), was held for 5 generations at: - a) a constant temperature of 18° C and a photoperiod regimen of 10 h photophase, 14 h scotophase, b) a diurnal regimen of 10 h photophase at 22° C and 14 scotophase at 12° C, c) a diurnal regimen of 8 h photophase at 14° C, 16 h scotophase at 8° C. The mites, examined daily for changes in color, duration of development and oviposition, did not undergo diapause at the three regimen tested, nor did they show any signs of possible incipience of diapause.

The carmine spider mite, *Tetranychus cinnabarinus* (Boisduval), is a major pest of fruit trees and truck crops in Israel (Avidov & Harpaz, 1969). Conflicting reports are found in the literature as to whether this mite undergoes diapause or not. In mites of the *T. telarius* (L) complex (to which *T. cinnabarinus* belongs) diapause occurs only in adult females, being manifested by a change in body color to orange (due to the deposition of 'diapause fat'), by a cessation in feeding and by discontinued oviposition (Lees, 1953). Boudreaux (1956) induced diapause in females of the red (carmine) form of *T. telarius* sensu lato (which he named *cinnabarinus*),

¹ Supported in part by a grant from the United States Department of Agriculture, under P.L.

480 and by grants from the Research Foundation of the General Federation of Labor in Israel

by rearing this mite at a temperature of 58°F and a photoperiodic regimen of eight hours photophase. Van de Bund and Helle (1960) reported that in the Netherlands, females of T. urticae (Koch) (the green form of the T. telarius complex) underwent diapause while this was not evident in T. cinnabarinus females. Hussey and Parr (1958) found that photoperiod, temperature, and nutrition induce the green form (T. urticae) but not the carmine form (T. cinnabarinus) to undergo diapause. From this they concluded that the red form which occurs in Great Britain is distinct from the one described as T. cinnabarinus by Boudreaux (1956). Dosse (1966)

found that in the mountains of Lebanon, at a height of 1500m, mites of the green form, which he identified as T. urticae, hide in the clefts of apple tree bark in the form of diapausing winter females. At a 1000m altitude, part of the red T. cinnabarinus population showed diapause behavior to varying degrees, with the other part continuing the egg laying process (i.e. not entering diapause). No diapausing females of T. cinnabarinus were found in the coastal plain of Lebanon.

Helle (1962) and Saba (1961) reported that insecticide-susceptible strains of T. urticae in Western Europe underwent diapause, while the resistant strains of this mite did not. A number of T. cinnabarinus strains differing in their acaricide-resistance pattern were reported from Israel by Tahori & Raccah (1970). Some strains were highly resistant, whereas two were completely susceptible to the acaricides tested. It was therefore of interest to establish if an acaricide-susceptible local strain might be induced to enter diapause.

Materials and Methods

The acaricide-susceptible Amirim strain (Tahori & Raccah, 1970) of the carmine spider mite (identified as Tetranychus cinnabarinus (Boisduval) by H.B. Boudreaux, personal communication, 1968) was used in the experiments. Mites were reared in greenhouse cages on beans (Phaseolus vulgaris) of the variety Brittlewax, as described by Tahori & Raccah (1970).

Experiments were conducted in three series with the following temperatures and photoperiod regimens:

- A) Constant temperature 18°C, 10 h photophase (60 Lux light intensity), 14 h scotophase. This regimen was chosen because Dubynina (1965) obtained diapausing females of the green form of the T. telarius complex under these conditions. It was thus of interest to see if the strain under investigation could be induced to enter diapause under similar conditions.

- B) A diurnal regimen of 10 h photophase (100 Lux) at 22° C and 14 h scotophase at 12° C. These temperatures prevail in the Upper Galilee (Amirim) during September–November (Ashbel, 1944), the period during which diapause induction might be expected to occur.

- C) A diurnal regimen of 8 h photophase (100 Lux) at 14° C, 16 h scotophase at 8° C. This regimen was chosen as Boudreaux (1956) obtained diapausing females of T. cinnabarinus when the mites were held under 8 h photophase at 58° F (= 14.4° C). Lower temperatures could not be tested as the mites become lethargic below 8° C (Avidov and Harpaz, 1969).

To initiate the experimental cultures, a fresh bean leaf was put on filter paper placed on cotton wool in a petri dish. Adult female mites (100-150) were transferred to the bean leaf, allowed to oviposit for 24 h, and then destroyed. The hatching mites were placed under the respective temperature and photoperiod regimens and examined daily under a binocular microscope for changes in color, duration of development, and oviposition. Leaves were replaced as they yellowed. Mites were observed for five continuous generations since Dubynina (1965) reported that the incidence of diapause in T. urticae increased during five consecutive generations.

Results and Discussion

The duration of mite development from egg to adult is shown in Table I. The duration of development of males was similar to that of females or differed by about one day. The average number of eggs laid by T. cinnabarinus females during five generations is given in Table II.

The experiments of series C were repeated 3 times at approximately monthly intervals, the mites being continuously held under the conditions of this regimen including their subsequent oviposition. All mites which reached adulthood were individually placed on fresh bean leaves in petri dishes. In the first two experiments (of this series) mortality was very high and only two females oviposited. In the last experiment twelve females were obtained, of which three died three days after reaching the adult stage. The remaining females exhibited the usual red color, showed normal feeding behavior and deposited 22.2 eggs/female during more than four weeks. The preoviposition period was 5 - 15 days.

Table I. Duration of development of female T. cinnabarinus under 2 experimental conditions

Regimen	<u>Length of development in days</u>							
	Egg	Larva	Larva quiescent stage	Proto- nymph	Protonymph quiescent stage	Deutonymph	Deutonymph quiescent stage	Total
A range	7 - 10	1 - 3	1 - 3	1 - 2	1 - 2	1 - 3	2 - 3	18 - 21
average	9,3	2,04	2,08	1,6	1,8	1,8	2,3	19,3
B range	9 - 12	1 - 2	1 - 2	1 - 2	2	1 - 2	1	20 - 22
average	11,8	1,3	1,9	1,9	2	1,4	1	21,3

A: 10L + 14 D at 18°C

B: 10L at 22°C
14D at 12°C

Table II. Average number of eggs per T. cinnabarinus female in a population held for 5 consecutive generations under 2 experimental conditions

Generation	No. of females obtained		No. of males obtained						No. of eggs			Eggs/females			
	A	B	R	E	G	I	M	E	N	A	B	A	B	A	B
F ₁	53	62	52	61	61	426	944	8.0	15.3						
F ₂	9	75	11	70	70	755	7.7	10.0							
F ₃	22	100	22	99	191	931	8.7	9.3							
F ₄	14	15	13	16	131	125	9.3	9.0							
F ₅	50	27	45	25	455	475	10.3	17.0							

A: 10L: 14D at 18°C

B: 10L at 22°C, 14D at 12°C

The experiments were discontinued after about one week, as no obvious change was discernible in the mites. Thus the number of eggs reported in this Table does not reflect the potential egg-laying capacity of the mites under the experimental conditions and is of comparative value only.

This investigation forms part of a study concerning acaricide-resistant and -susceptible strains of T. cinnabarinus (Tahori & Raccach 1970, Raccach and Tahori 1970, Raccach & Tahori, 1971). It was intended to explore whether the findings of Saba (1961) and Helle (1962) that insecticide-susceptible strains of T. urticae, the green form of the T. telarius complex, underwent diapause while resistant strains did not, were applicable to the closely related T. cinnabarinus. Under all experimental conditions tested, our susceptible strain did not exhibit signs of diapause. Our data thus seem to support the opinions of Van de Bund and Helle (1960) and of Hussey and Parr (1958) that females of T. cinnabarinus (the red form of the T. telarius complex) do not undergo diapause.

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