Influence of Temperature and Host Plants on the Development and Fecundity of the Spider Mite *Tetranychus urticae (Acarina: Tetranychidae)*

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Abstract

Praslička J., Huszár J. (2004): **Influence of temperature and host plants on the development and fecundity of the spider mite** *Tetranychus urticae* (*Acarina: Tetranychidae*)**.** Plant Protect. Sci., **40**: 141–144.

Temperature plays a key role in the time needed for development of *Tetranychus urticae.* It developed fastest at 35°C (6.50 d) and 30°C (6.93 d), while at 15°C it took 16.23 d. The higher the temperature, the faster the development of the mite. As to host plants involved, *T. urticae* developed fastest on *Phaseolus vulgaris* (9.42 d), followed by *Cucumis sativus* (10.26 d) and *Capsicum annuum* (10.92 d). Fecundity was highest at a temperature of 30°C (89.1 eggs), and lowest at 15°C (58.6 eggs). The fecundity of female mites increased with temperatures up to 30°C, but at 35°C it had decreased (71.08 eggs). The host plant influenced female fecundity to a limited extent; the average on *Phaseolus vulgaris* was 79.28 eggs, 71.48 on *Capsicum annuum* and 71.22 on *Cucumis sativus*.

Keywords: *Tetranychus urticae*; temperature; development; fecundity

The spider mite *Tetranychus urticae* Koch (1836) is abundant on a wide variety of plants grown in greenhouses over the whole year. For example, on *Cucumis sativus* L. crops there are typically 10–15 generations per year (Tymčenko & Jefremovová 1987). Several scientists consider temperature to be a key factor influencing its reproduction and development (Carey & Bradley 1982; Landwher & Allen 1982; Yasuda 1982; Boyne & Hayn 1983; Congdon & Logan 1983; Delrio & Monagheddu 1986; Yaninek *et al*. 1989). Prakash Rao *et al*. (1996) observed the development and fecundity of this mite at temperatures between 20–30°C by three different methods. They recorded substantial differences in development and fecundity within this range of temperatures, and between the methods used. Rising temperatures between 10°C to 30°C was found to increase the preadult development of most *Tetranychid* species in a linear way (Keetch 1971; Gupta *et al*. 1972; Hazan *et al*. 1973; Carey & Bradley 1982; Landwher & Allen 1982; Yasuda 1982; Congdon & Logan 1983; Delrio & Monagheddu 1986; Yaninek *et al*. 1989). The lifespan of the spider mite was reduced at lower and higher temperatures (Herbert 1981; Landwher & Allen 1982; Delrio & Monagheddu 1986). A temperature of 15°C caused shorter oviposition with *T. urticae* (Herbert 1981). The fecundity of various *Tetranychids* reached its maximum within the temperature range of 20–30°C (Rabbinge 1976; Yasuda 1982; Demoraes & McMurtry 1987), but was reduced at lower (Herbert 1981) and higher temperatures (Hazan *et al*. 1973). Other authors discovered an increase (Tanigoshi *et al*. 1975; Congdon & Logan

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1983) or decrease (Boyne & Hayn 1983; Perring *et al*. 1984) in fecundity of the spider mite at higher temperatures.

MATERIAL AND METHODS

Tetranychus urticae was reared on plants of green bean in laboratory conditions at a temperature of 23°C (± 2°C). Development and fecundity of the mite was determined in an air-conditioned box at diverse temperatures (15, 20, 25, 30 and 35°C) and on three host plants (*Cucumis sativus* L., *Capsicum annuum* L. and *Phaseolus vulgaris* L.). The leaf disk method was used; detached leaves were placed on water soaked cotton in a Petri dish (9 cm diameter). The Petri dish was placed onto a plastic cup (9 cm diameter and 5 cm depth) filled with water. Sufficient moisture for the filter paper was supplied by a strip of filter paper (1 cm wide) that was attached to the filter paper at one end while the other reached into the water in the cup via a small hole. For each variant (temperatures, host plants), five Petri dishes were used. To determine the development time of the spider mite, leaves of *P. vulgaris* with 10–15 freshly hatched eggs were used for each variant. We started with the series at 15°C and finished with the series at 35°C. To observe the fecundity of female mites, 10 young female mites were transferred with a soft brush to each combination following the abovementioned temperature sequence. The results were analysed statistically by the Tukey test.

RESULTS AND DISCUSSION

From the results of our experiments it follows that temperature has a decisive impact on the time needed for development of *T. urticae*, whereas the differences between host plants were not significant (Table 1).

Development was fastest at 35°C (6.50 d) and 30°C (6.93 d), averaged on the three hosts. Prakash Rao *et al*. (1996) also found that the length of development of the spider mite at 30°C was 6.7–7.9 days. At other temperatures of our experiments, the development time was 9.27 d at 25°C, 12.06 d at 20°C and 16.23 d at 15°C. Thus, the higher the temperature, the faster the development of the spider mite. The differences in development time between temperatures was confirmed with high detectability in the statistical analyses, except for the differences between 30°C and 35°C. Perring *et al*. (1984) and Delrio and Monagheddu (1986) state that after a certain increase in temperature and reaching a maximum of developments. This statement was confirmed in our experiments as well.

Tetranychus urticae developed fastest on *Phaseolus vulgaris* (9.42 d), followed by *Cucumis sativus* (10.26 d) and *Capsicum annuum* (10.92 d). The largest differences in development time between hosts were recorded at 15°C, the differences at 20–25°C were small, and at 30–35°C they were almost identical. The largest difference in development time was recorded between *P. vulgaris* and *C. annuum* at temperatures of 15, 20 and 25°C; development on *P. vulgaris* was faster by 1.5 days. The difference was further confirmed by statistical analysis. The differences in the development of the mite on different hosts may have been caused by quality, accessibility or actual ratio of nutrients, as indicated by Wermelinger *et al*. (1985).

The influence of temperatures and host plants on the fecundity of *T. urticae* are summarised in Table 2. Fecundity of female mites, as an average

Table 1. Length of the development period of *Tetranychus urticae* as influenced by temperature and host plant (in days)

Development period	Temperature (°C)	*Cucumis sativus*	*Capsicum annuum*	*Phaseolus vulgaris*	Average
Egg into imago	15	16.40 Db*	18.10 De	14.20 Da	16.23 D
	20	12.00 Cab	12.90 Cb	11.30 Ca	12.06 C
	25	9.50 Bab	10.10 Bb	8.20 Ba	9.27 B
	30	6.90 Aa	7.00 Aa	6.90 Aa	6.93 A
	35	6.50 Aa	6.50 Aa	6.50 Aa	6.50 A
Average		10.26 ab	10.92 b	9.42 a	10.20

*detectable differences are indicated by capital letters in temperatures and lower case in host plants

Table 2. Fecundity of female *Tetranychus urticae* at various temperatures and on three host plants

Temperature (°C)	*Cucumis sativus*	*Capsicum annuum*	*Phaseolus vulgaris*	Average
15	58.40 Db*	51.70 Ec	65.70 Da	58.60 D
20	69.80 Cb	62.10 DC	78.00 Ba	69.97 C
25	74.00 Bc	80.20 Bb	89.00 Aa	81.27 B
30	85.00 Ab	89.40 Aab	92.90 Aa	89.10 A
35	68.90 Cb	74.00 Ca	70.20 Cb	71.08 C
Average	71.22 b	71.48 b	79.28	79.99

*detectable differences are indicated by capital letters in temperatures and lower case in host plants

on the three hosts, was lowest at 15°C (58.60 eggs); it rose with rising temperature up to a high and threshold of 30°C (89.10 eggs), whereas at 35°C it was markedly lower (71.08 eggs). The differences in fecundity of female spider mites were further confirmed by statistical analysis. Detectability was recorded for all differences caused by temperature, except for those between 20°C and 35°C. Hazan *et al*. (1973) also recorded lower fecundity of the spider mite at temperatures above 30°C. This phenomenon is connected with a reduced oviposition period at high temperatures (Delrio & Monagheddu 1986). Parallel to our results, Laing (1969) recorded similar female spider mite fecundity in greenhouse conditions at the temperature of 30°C. Contrary to these findings, Prakash Rao *et al*. (1996) recorded the highest fecundity at 20°C (102 eggs).

Fecundity of female spider mites differed even between host plants. The highest fecundity was recorded on *P. vulgaris* at 30°C (92.90 eggs), the lowest on *C. annuum* at 15°C (51.70 eggs). Average fecundity over all temperatures was 79.28 eggs on *P. vulgaris*, 71.48 eggs on *C. annuum* and 71.22 on *Cucumis sativus*. While performing statistical analysis, detectability of differences in fecundity of spider mites was found between the hosts within a specific temperature range. With respect to average fecundity, differences were detectable between *P. vulgaris* on one hand and *C. annuum* and *C. sativus* on the other.

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Súhrn

Praslička J., Huszár J. (2004): **Vplyv teploty a hostiteľských rastlín na vývin a plodnosť roztočca chmeľového** – *Tetranychus urticae* (*Acarina: Tetranychidae*). Plant Protect. Sci., **40**: 141–144.

Pri sledovaní vývinu roztočca chmeľového sme zistili, že teplota má veľmi významný vplyv na dĺžku vývinu roztočca chmeľového. Najrýchlejší vývin bol pri teplote 35 °C (6,50 dní) a pri teplote 30 °C (6,93 dní). Pri 15 °C bola dĺžka vývinu roztočca chmeľového 16,23 dní. Z uvedeného vyplýva, že čím bola vyššia teplota, tým bol rýchlejší vývin roztočca chmeľového. Na sledovaných rastlinách bol najrýchlejší vývin roztočca chmeľového na fazuli záhradnej (9,42 dní), ďalej na uhorke siatej (10,26 dní) a na paprike ročnej (10,92 dní). Najväčšia plodnosť bola zaznamenaná pri teplote 30 °C (89,10 vajíčok), najmenšia pri teplote 15°C (58,60 vajíčok). Plodnosť samičiek so zvyšovaním teploty stúpala až do 30 °C, avšak pri 35 °C bol značný pokles (71,08 vajíčok). Určité rozdiely v plodnosti samičiek boli aj medzi jednotlivými rastlinami, pričom priemerná plodnosť na fazuli bola 79,28 vajíčok, na paprike 71,48 vajíčok a na uhorke 71,22 vajíčok.

Kľúčové slová: roztočec chmeľový; teplota; vývin; plodnosť; živiteľské rastliny

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