Reproductive parameters of *Tetranychus urticae* (Acari: Tetranychidae) on three leguminous plants

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Abstract

The two spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) has a broad range of host plants including field crops, greenhouse crops, ornamentals and fruit trees. However, the spider mite does not accept all plants to the same degree because of differences in nutritive and toxic constituents. In this study, Population growth parameters of this mite were studied on Common bean (*Phaseolus vulgaris*), Vetch (*Vicia ervilia*) and Soybean (*Glycine max*) under laboratory condition (25 ± 1°C, 65 ± 5% R.H. and a photoperiod of 16 L: 8 D hours). For this, a cohort of 100 eggs of the mite was separately placed on the leaves of each plant in Petri dish. As soon as adult mite emerged, male and female mites were coupled on each plant and daily oviposition rate of females was recorded until death. Reproductive parameters were calculated as Carey and standard error of the parameters was estimated using jackknife procedure. The highest and lowest value of generation time was 13.53 and 11.93 days on soybean and bean, respectively. Also, the net reproductive rate was the highest on bean 7.34 female/female/generation and the lowest on vetch 4.02female/female/generation. Furthermore, intrinsic rate of natural increase on bean, vetch and soybean was 0.16, 0.11 and 0.13female/female/day, respectively. Comparison of the reproductive parameters of the *T. urticae* on these three host plants revealed that bean was the most susceptible host plant to this pest.
Key words: Population growth parameter, Common bean, Vetch and Soybean

چکیده

پارامترهای جدول زندگی کنه تارتن دولکه‌ای (Acari: Tetranychidae) *Tetranychus urticae* روی سه گیاه لگومینوز

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کنه تارتن دولکه‌ای روی طیف وسیعی از محصولات زراعی، گلخانه‌ای، زینتی و درختان میوه فعالیت می‌کند. به هرحال، به دلیل تفاوت‌های موجود در ترکیبات شیمیایی گیاهان، کنه‌های تارتن به یک میزان به همه گیاهان خسارت نمی‌زنند. در این مطالعه پارامترهای رشد جمعیت کنه تارتن دو لکه‌ای روی لوبیا، *Phaseolus vulgaris*، ماشک، *Vicia ervilia* و سویا، *Glycine max*، در شرایط آزمایشگاهی (دمای ۱±۲۵ درجه سلسیوس، رطوبت نسبی ۵±۶۵ درصد و دوره نوری ۱۶ ساعت روشنایی و ۸ ساعت تاریکی) مطالعه شد. بدین منظور یک همزادگان از صد تخم روی برگ‌های هر گیاه در ظرف پتری به صورت جداگانه قرار گرفت. به محض ظهور کنه‌های بالغ، افراد نر و ماده روی هر گیاه جفت شدند و تخم‌ریزی روزانه تا مرگ آخرین فرد ثبت شد. پارامترهای رشد جمعیت پایدار از روش کری و خطای استاندارد آن‌ها، از روش جک نایف محاسبه شد. بیشترین و کمترین مقدار مدت زمان طول یک نسل (T) به ترتیب روی سویا۱۳/۵۳ روز و روی لوبیا ۱۱/۹۳ روز محاسبه گردید. همچنین بیشترین نرخ خالص تولید مثل (R_0) روی لوبیا ۷/۳۴ ماده/ماده/نسل و کمترین مقدار این پارامتر روی ماشک ۴/۰۲ ماده/ماده/نسل ثبت شد. علاوه بر این، نرخ ذاتی افزایش طبیعی جمعیت (r_m) به ترتیب روی لوبیا ۰/۱۶، روی ماشک ۰/۱۱ و روی سویا ۰/۱۳ ماده/ماده/روز محاسبه شد. مقایسه پارامترهای رشد جمعیت کنه *T. urticae* روی این سه گیاه نشان داد که گیاه لوبیا در مقایسه با دو گیاه دیگر نسبت به این آفت حساس‌تر است.

واژگان کلیدی: پارامترهای رشد جمعیت، لوبیا، ماشک و سویا

Introduction

The two-spotted spider mite, *Tetranychus urticae* Koch is one of the economically most important pests on 200 host plant species both in open field and greenhouse (Boom *et al*., 2003; Sedaratian *et al*., 2011; Leeuwen *et al*., 2010). Moreover, host plant quality can affect life history parameters of *T. urticae* (Adango *et al*., 2006) and as a result the two-spotted spider mites do not accept all plants to the same degree because of chemical traits such as toxins, secondary metabolites and morphology of a leaf surface (Boom *et al*., 2003; Adango *et al*., 2006). Generally, the herbivore experiences plants with different quality and move from the poor duality plants more rapidly (Adango *et al*., 2006). Such behavior can be used in IPM programs such as intercropping to decrease pest population and to grow biopesticides for using against *T. urticae* in leguminose farms. In the present study, we determined whether life history parameters of *T. urticae* vary among three leguminose crops.

Materials and methods

Plants

The seeds of common bean, *Phaseolus vulgaris*, Vetch, *Vicia ervilia* and Soybean, *Glycine max*, were obtained from Agricultural and Natural Resource Research and Education Center of Markazi Province, Arak. They were planted in plastic pots (15 cm diameter × 10 cm height) filled with fertilized field soil. The plants were placed individually into a greenhouse room.

Two-spotted spider mite

The two-spotted spider mite, *T. urticae* was originally collected from infested beans (*Ph. vulgaris*) in Varamin, vicinity of Tehran, Iran in 2010. Prior to the experiments, the offspring of this colony were reared for two generations on the above-mentioned plants in a growth chamber at 25±1ºC, 60±5% R.H. and a photoperiod of 16:8 h (L:D).

Population growth parameters

At the beginning of experiments, to determine the life table parameters of this mite on each of the three plants, ten pairs of both sexes of *T. urticae* were transferred from colony into leaf discs (10 cm diameters) of each plant. After 24 h, a cohort of 100 eggs were collected from the leaf discs and were used for experiments. The collected eggs were then transferred individually into leaf discs (5cm diameters), cut from each plants. These leaf discs were placed with the upper surface facing down on a cotton layer in Petri dishes, in which a 5 mm diameter hole was drilled in bottom of Petri dish. The leaf margin was surrounded by a cotton strip to prevent the escape of mites. The prepared Petri dishes were kept in tray and water was added daily to the tray. All the transferred eggs and subsequent stages were carefully checked every day. After adult emergence, females were coupled with males. Daily observations were made under a stereomicroscope to determine female fecundity and survivorship of individuals until the death of the last female. These experiments were carried out at 25±1ºC, 60±5% and a photoperiod of 16:8 h (L:D) in a growth chamber.

Data analysis

Six parameters including net replacement rate (R_0), intrinsic rate of natural increase (r_m), intrinsic birth rate (b), intrinsic death rate (d), cohort generation time (T) and doubling time (DT) were calculated as described by Carey (1993).Variances and standard error were determined using the jackknife method of Meyer *et al.* (1986).

Results and Discussion

Life table parameters are presented in Table 1. These results showed that parameters such as intrinsic rate of natural increase (r_m) and net reproductive rate (R_0) of *T. urticae* were the highest (7.34 female/female/ generation and 0.16 female/female/ day) on Bean and the lowest (4.02 female/female/ generation and 0.11 female/female/ day) on Vetch, respectively. The value of generation time was the highest (13.53 days) on soybean and the lowest (11.93 days) on bean. In a study, Adango *et al*. (2006) stated that the host plant had substantial effects on the intrinsic rate of natural increase (r_m), the net reproductive rate (R_0), female progeny and the survival of the adult stage. Life table parameters are beneficial methods for understanding the impact of external factors such as temperature and host plant on the growth, survival, reproduction and increase rate of an insect population (Bellows *et al.*, 1992). Several studies have shown that the development and fecundity of *T. urticae* alter on different cultivars of host plants (Adango *et al*., 2006; Sedaratian *et al*., 2011; Khanamani *et al*., 2012). Comparison of the reproductive parameters of the *T. urticae* on these three plants revealed that bean was the most susceptible plant to this pest. This differential suitability of host plants to the mite is an important factor to consider in IPM programs for *T. urticae*. For example, intercropping of *Ph. vulgaris* and *G. max* could be used to break the spread of *T. urticae* within a vegetable field.

Table 1. Population growth parameters of *Teranychus urticae* on three leguminose plants.

Host plant	Net reproductive rate (R_0) (female/female/generation)	Intrinsic rate of natural increase (r_m) (female/female/day)	Generation time (T) (day)	Doubling time (DT) (day)	birth (female/female/day)	death (female/female/day)
Bean	7.34	0.16	11.93	4.14	0.22	0.05
Soybean	6.52	0.13	13.53	4.99	0.23	0.09
Vetch	4.02	0.11	12.66	6.29	0.21	0.10

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