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Paramjit Kaur

Department of Entomology
Punjab Agricultural University,
Ludhiana, India

Frank G Zalom

Department of Entomology
University of California, Davis,
USA

Counteraction effect between *Tetranychus urticae* Koch and *Eotetranychus lewisi* (McGregor) on strawberry

Paramjit Kaur and Frank G Zalom

Abstract

The competitive interaction of *Tetranychus urticae* Koch and *Eotetranychus lewisi* (McGregor) on strawberry was studied at different temperatures (15, 20 and 25 °C). The results showed that the *T. urticae* was dominant on *E. lewisi* on strawberry. The total population emerged of *T. urticae* (2.33 at 15 °C; 89.00 at 20 °C; 101.00 at 25 °C) was more as compared to *E. lewisi* (1.67 at 15 °C; 14.67 at 20 °C; 19.67 at 25 °C) on strawberry. In contrast to strawberry, the population of *E. lewisi* was found to be significantly dominant on *T. urticae* on castor bean leaf. The population of *T. urticae* was 5.13, 6.07 and 1.39 times greater than *E. lewisi* at 25, 20 and 15 °C, respectively on strawberry. Three conclusions were made from the recorded competitive interactions between these mites: the preferred host for *T. urticae* is strawberry; *E. lewisi* can survive better than *T. urticae* at low temperatures if a favourable host is available, and *T. urticae* is dominant compared to *E. lewisi* on strawberry. *E. lewisi* completed its life cycle on strawberry leaves and it increased in abundance, so its pest status potential in strawberry cultivation was confirmed.

Keywords: Dominance, Interaction, Lewis mite, Strawberry, Two-spotted spider mite

1. Introduction

The spider mites, *Tetranychus urticae* Koch and *Eotetranychus lewisi* (McGregor) (Acari: Tetranychidae) are a cosmopolitan phytophagous species and the most destructive within the family of the Tetranychidae. *T. urticae* is a key pest of strawberry. ^[1] This species can cause a severe reduction in strawberry yield. ^[2] *E. lewisi* has been considered a major pest of greenhouse poinsettias and a minor pest of citrus. ^[3] This mite had occasionally observed on strawberries, but its population remains low as compared to *T. urticae*, the dominant mite pest of strawberries. However, in recent years *E. lewisi* populations have increased relative to *T. urticae*. A hypothesis to the increase in *E. lewisi* may be that the biological and chemical control techniques used to suppress *T. urticae* may have indirectly released *E. lewisi* from competition, thereby allowing their populations to increase. ^[4] Both the mites look similar in their general appearance. But, comparing adult females, Lewis mites are smaller than two-spotted spider mite and have several small spots on their body while two-spotted spider mite have a single dark spot on either side of the body. The damage caused by both tetranychid mites is similar. They cause chlorosis and bronzing of the leaves, webbing and reduction in fruit production at high mite densities. So, it is necessary to understand their interaction when they share the same host. The interspecific competition occurs when individual of the new species interfere with the existing species that shares the same resource. The individuals of one species may directly affect individual of other species that share the same host through competition for food. Therefore, the present study was planned to understand the competitive interaction of *T. urticae* and *E. lewisi* on strawberry in comparison to castor bean (a traditional host for *E. lewisi* in the area) at different temperatures. The reviewed literature revealed that there is very negligible information available for the competitive interaction of both the mite species on strawberry at different temperatures. The basic idea for the present study was to investigate the dominance and the interaction of both mite species on strawberry if the population of both tetranychid mites coincides and what will be their pest status at different temperatures.

Correspondence

Paramjit Kaur

Department of Entomology
Punjab Agricultural University,
Ludhiana -141004, India

2. Materials and Methods

2.1 Mites and Experimental Arena

The culture of *T. urticae* and *E. lewisi* was reared in laboratory of Department of Entomology, University of California, Davis, USA. The study was conducted in the months from September to October in 2012. All strawberry leaves used for the experiments were collected from organic field and castor beans were raised in the laboratory. The leaves were dipped in water containing a drop of dish detergent, rinsed several times with water, and examined under a stereozoom microscope to assure that no other mites were present. For the conduct of experiments, the leaves were cut and placed on water saturated filter paper (Whatman™ - 90 mm) in Petri dishes. The leaves were changed as often as needed to provide adequate food for the mites.

2.2 Competitive interaction of *T. urticae* and *E. lewisi* on strawberry

The dominance of *T. urticae* and *E. lewisi* was studied on strawberry at three temperatures (15, 20 and 25 °C). Ten gravid female adults of both the mites were placed onto a whole clean detached castor bean and strawberry leaf under the stereozoom microscope. To study the dominance of both mite species of strawberry, we used castor bean; a traditional host for *E. lewisi* in the area for the comparative population growth on both the hosts. Mites were removed from the leaves after 72 hours after getting maximum number of eggs. Observations were made daily to record the development of both the mite species. On the day of adult emergence, number of adults (both males and females) of both the mite species of strawberry and castor bean were counted with mite counter. The per cent survival of both the mite species on strawberry and castor bean was also observed at three temperatures.

2.3 Statistical Analysis

The recorded data were subjected to analysis of variance (ANOVA) using Completely Randomized Design (CRD) and the mean values of emerged male, female and total of population, per cent survival of both mite species on castor bean and strawberry at three temperatures were compared.

3. Results and Discussion

3.1 Competitive interaction of *T. urticae* and *E. lewisi* on strawberry at 15, 20 and 25 °C

The population of *T. urticae* emerged on strawberry leaves were found to be significantly dominating on *E. lewisi* at 20 and 25 °C. At 15 °C, the total population of both mite species (female and male adults emerged) was found to be significantly at par. The total number of female and male adults emerged of *T. urticae* (2.33 at 15 °C; 89.00 at 20 °C; 101.00 at 25 °C) was more as compared to *E. lewisi* (1.67 at 15 °C; 14.67 at 20 °C; 19.67 at 25 °C) on strawberry at all temperatures (Table 1). The population of *T. urticae* was 5.13, 6.07 and 1.39 times greater than *E. lewisi* at 25, 20 and 15 °C on strawberry leaf (Fig. 1).

3.2 Competitive interaction of *T. urticae* and *E. lewisi* on castor bean at 15, 20 and 25 °C

In contrast to strawberry, the population of *E. lewisi* was found to be significantly dominant on *T. urticae* on castor bean leaf at all the temperatures (Table 2). The number of adults (females and males) of *E. lewisi* (16.66 at 15 °C; 43.66 at 20 °C; 50.67 at 25 °C) at all temperatures was more as

compared to *T. urticae* (1.33 at 15 °C; 10.00 at 20 °C; 17.33 at 25 °C) on castor bean. The *E. lewisi* population was found to be 2.92, 4.36 and 12.52 times more than *T. urticae* at 25, 20 and 15 °C, respectively on castor bean leaf.

3.3 Survival of *T. urticae* and *E. lewisi* on castor bean and strawberry at 15, 20 and 25 °C

The per cent survival of *T. urticae* was found to be significantly more as compared to *E. lewisi* at 20 and 25 °C on strawberry. However, this statement is in contrast on castor bean, as the maximum per cent survival was observed in *E. lewisi* as compared to *T. urticae* at lowest temperature (Table 3).

In the present study, we estimated which mite species will dominate on the same host if they are present simultaneously. The dominance of any mite species depends upon the availability or preference of the host. As *E. lewisi* favours the castor bean and *T. urticae* is a key pest of strawberries but at present many growers noticed infestation of *E. lewisi* on strawberry fields and confused with *T. urticae*. Our results indicate that both the mite species can live together and complete their life cycle on strawberry simultaneously. We observed the apparent difference in population level of *T. urticae* and *E. lewisi* on strawberry in comparison to castor bean. The population of *T. urticae* was dominant on *E. lewisi* on strawberry while the inverse was true for castor bean. Weeks and Hoffman^[5] investigated the effect of competition between two pest earth mite species, *Penthaleus major* Dugés and *Halotydeus destructor* Tucker. They concluded that suppression of one mite species from pastures may result in another species increasing in relative abundance. The findings of Umina and Hoffman^[6] also corroborate with our results and stating that the competition is a significant factor which can influence the abundance of mites on a host. The results of other authors suggested that the competition between two mite species on tomato had an effect on the population dominance. The population of *Tetranychus evansi* Baker & Pritchard was suffered from competition with *T. urticae* on tomato, but that *T. urticae* was found to get profit from the presence of *T. evansi* on the same host. The population of *T. evansi* reached much higher levels on tomato plants when present alone.^[7]

The interaction between spider mite, *Tetranychus truncatus* Ehara and *Bemisia tabaci* (Gennadius) on cowpea was studied by other authors. They observed that the spider mites had a greater effect on whitefly behavior. They concluded that spider mites won out in competition with whitefly on same host.^[8] Howell and Daugovish^[4] studied the population dynamic of *T. urticae* and *E. lewisi* on strawberry and concluded that the population of *T. urticae* was 1.5 and 3.5 times greater than *E. lewisi* on strawberry by the 8th and 12th day, respectively. After the 12th day, the population of *E. lewisi* began to decrease and *T. urticae* populations continued to increase. Moreover, field observations in Spain showed that *T. evansi* invasion replaced *T. urticae*.^[9] The interspecific interaction of spider mite, *T. urticae* and aphid, *Myzus persicae* (Sulzer) on tomato, beans and pak choi was studied. The results indicate that spider mite population was found to be decreased when aphids were present on same host. The pak choi was least preferred by spider mites, however, on tomato and pak choi, aphid population was found to get profit in means of fecundity in the presence of spider mites.^[10]

Table 1: Comparative development of *T. urticae* and *E. lewisi* on strawberry at 15, 20 and 25 °C

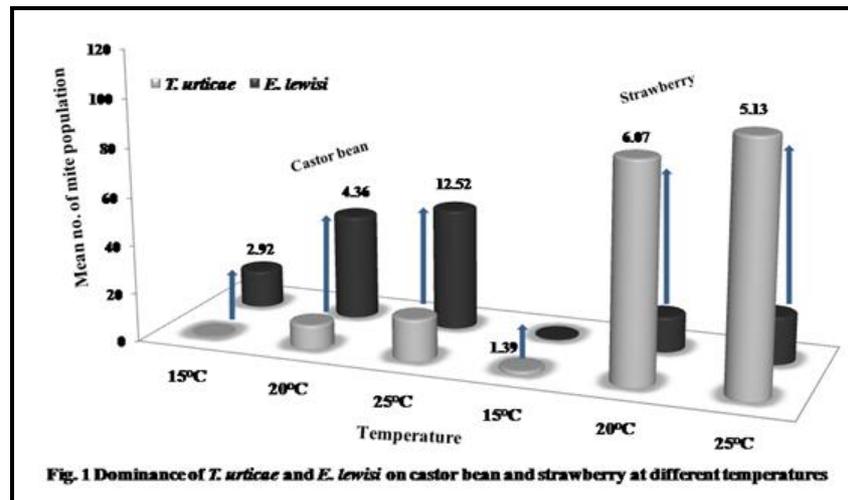
Mites	Mean number of mite population at temperatures (°C)								
	15			20			25		
	Females	Males	Total	Females	Males	Total	Females	Males	Total
<i>T. urticae</i>	1.5 (1.58)	0.83 (1.34)	2.33 (1.67)	72.33 (8.55)	16.66(4.18)	89.00 (9.47)	80.66 (9.03)	20.33(4.59)	101.00 (10.09)
<i>E. lewisi</i>	1.17 (1.46)	0.5 (1.22)	1.67 (1.46)	11.33 (3.49)	3.33 (2.07)	14.67 (3.93)	17.33 (4.25)	2.33 (1.82)	19.67 (4.52)
CD (0.05%)	NS			(1.07)	(0.99)	(1.21)	(1.04)	(1.02)	(1.15)

Table 2: Comparative development of *T. urticae* and *E. lewisi* on castor bean at 15, 20 and 25 °C

Mites	Mean number of mite population at temperatures (°C)								
	15			20			25		
	Females	Males	Total	Females	Males	Total	Females	Males	Total
<i>T. urticae</i>	0.83 (1.34)	0.5 (1.22)	1.33 (1.34)	7.33 (2.79)	2.66 (1.86)	10.00 (3.20)	13.00 (3.70)	4.33 (2.26)	17.33 (4.23)
<i>E. lewisi</i>	13.83 (3.82)	2.83 (1.90)	16.66 (4.12)	30.66 (5.51)	13.00 (3.56)	43.66 (6.49)	34.66 (5.96)	15.66(4.05)	50.67 (7.17)
CD (0.05%)	(1.04)	NS	(0.95)	(2.65)	NS	NS	(1.12)	(1.26)	(1.60)

Table 3: Comparative survival of *T. urticae* and *E. lewisi* on castor bean and strawberry at 15, 20 and 25 °C

Host	Mean% Survival			
	Temperatures (°C)			
	Mites	15	20	25
Castor bean	<i>T. urticae</i>	53.33 (46.90)	73.33 (58.98)	80.00 (63.90)
	<i>E. lewisi</i>	93.33 (81.11)	93.33 (81.11)	90.00 (74.96)
CD (0.05%)		(25.15)	NS	NS
Strawberry	<i>T. urticae</i>	90.00 (25.15)	93.33 (77.68)	96.66 (83.82)
	<i>E. lewisi</i>	73.33 (63.90)	73.33 (58.98)	70.00 (56.97)
CD (0.05%)		NS	(18.13)	(19.85)

**Fig. 1** Dominance of *T. urticae* and *E. lewisi* on castor bean and strawberry at different temperatures

4. Conclusion

The three conclusions were made from the observed competitive interactions between these mites: the preferred host for *T. urticae* is strawberry; *E. lewisi* can survive better than *T. urticae* at low temperatures if a favourable host is available, and *T. urticae* is dominant compared to *E. lewisi* on strawberry. *E. lewisi* was shown to complete its life cycle on strawberry leaves and increase in abundance, so its pest status potential in strawberry cultivation was confirmed.

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