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Population Trends of Two Spotted Spider Mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) on Cotton Nearby Soil and Asphalt Road

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Abstract: The two spotted spider mite (TSSM), *Tetranychus urticae* Koch (Acari: Tetranychidae) is one of the most important pests on cotton crops in Amik plain of Turkey. The sampling were taken from forty-eight an irrigated cotton crop fields to describe affectability of dusty condition for the TSSM' population density. The population densities of two spotted spider mite were 1.72, 1.75, 4.39 and 2.65 times higher on cotton nearby soil road than asphalt road. Therefore, the dusty conditions can bring about increasing population of TSSM on cotton plants. Due to the dusty conditions, their beneficial insects were not affected on their population density. The decreasing of dusty condition can be reduced population density of TSSM and increase affectability of their beneficial insects.

Key words: The two spotted spider mite (TSSM), *Tetranychus urticae* Koch (Acari: Tetranychidae), dusty conditions, cotton, Amik plain

INTRODUCTION

The cotton, *Gossypium hirtsutum* L., is one of the most significant industrial crops, approximately planted 1.280.090 hectares and yielded 3.390.999 tons in Turkey (Anonim, 2004). The two spotted spider mite (TSSM), *Tetranychus urticae* Koch was the first described by Koch in 1936, is about 0.5 mm long with an oval shaped body which varies in color from greenish-yellow to brown and red-orange (Osborne *et al*., 1999; Wilkerson *et al*., 2005). There are generally two large black spots one on either side of the body and so the common name (Wilkerson *et al*., 2005). The life cycle of the tetranychid mites includes the following stages: egg, larva, protonymph, deutonymph and adult (Huffaker *et al*., 1969; Laing, 1969; Mitchell, 1973; Helle and Sabelis, 1985; Borror *et al*., 1989; Walter and Proctor, 1999). The TSSM is arrhenotokous parthenogenesis (Laing, 1969; Brandenburg and Kennedy, 1987). The fertilized eggs will result in female offspring, whereas unfertilized eggs will produce male offspring (Brandenburg and Kennedy, 1987). The female TSSM can develop from egg to adult in approximately 6.5 days at 30°C (Sabelis, 1981) and lay an average 38 eggs per individual in five days (Laing, 1969).

The two spotted spider mite (TSSM) is considered as an economical pest on many cultivated crops (Van de Vrie *et al*., 1972; Helle and Sabelis, 1985; Borror *et al*., 1989; Olkowski *et al*., 1991; Beers *et al*., 1993; Cranshaw, 1998; Flint, 1998; Walter and Proctor, 1999; Zhang, 2003; Wilkerson *et al*., 2005). The plants are affected in several ways from TSSM. Therefore, the TSSM damages are classified as direct and indirect (Brandenburg and Kennedy, 1987). Direct effects contains stippling, webbing, defoliation, leaf burring and due to extreme outbreaks of TSSM and death plants. Indirect effects of mite feeding may include decreased photosynthesis and transpiration. These combinations of effects often reduce the amount of yields on the host plant (Huffaker *et al*., 1969). The population density of two spotted spider mite can be affected by different environmental conditions

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(Helle and Sabelis, 1985; Thomas, 2001; Guerena and Sullivan, 2003). Therefore, the survival, developmental time and reproduction of TSSM are mostly influenced by temperature (Helle and Sabelis, 1985; Thomas, 2001), under hot, dry (Helle and Sabelis, 1985), dusty condition (Guerena and Sullivan, 2003), humidity (Sabelis, 1981). The purpose of this was to evaluate the population trend of two spotted spider mite (TSSM), *T. urticae* on cotton crops planting by asphalt and soil road in Amik Plain of Turkey.

MATERIALS AND METHODS

The sampling were carried out irrigated cotton plants planting nearby soil and asphalt road in Amik plain of Turkey. The sampling were taking 9, 19, 31-August and 2, 14-September 2006. They were taking 48 irrigated cotton crop fields; twenty-four located by soil road, the later twenty-four located by asphalt road. Twenty-five leaves were randomly taking for each cotton field. They were then replaced into paper bags and then carried into laboratory and put into refrigerator. A thousand and two hundreds cotton' leaves were taking all sampling plots. Then each of them was examined under stereomicroscopic and counted all stages of two spotted spider mite (except their eggs). Significant differences of planting irrigated cotton crops by asphalt road versus by soil road were performed by Duncan tests ($p<0.05$) (SAS, 1998).

RESULTS AND DISCUSSION

The TSSM is one of the most important pests on cotton crops in Amik plain of Turkey. Their population densities can be influenced by various environmental conditions. In this study, the sampling were taken forty eight different cotton fields. A thousands two hundred leaves were evaluated to learn affectability of soil and asphalt road for the two spotted spider mite population densities (Table 1-4). For example, on 9, 19 and 31 August and 2 September sampling, the population densities of the two spotted spider mite were significantly the higher on cotton plants nearby soil road than planted nearby asphalt road ($F = 4.992$, $df = 7, 192$, $p = 0.0001$; $F = 10.898$, $df = 7, 192$, $P = 0.0001$; $F = 5.308$, $df = 19, 480$, $P = 0.0001$; $F = 2.921$, $df = 7,192$ $p = 0.006$, respectively) (Table 1-4). Overall results also indicated that the TSSM' populations were 1.72, 1.75, 4.39 and 2.65 times higher cotton planted nearby soil road than asphalt road. However, the population densities of TSSM were not significantly higher and even lower than asphalt roads. This result might be an insecticide application and localities of cotton fields. Due to them, the later sampling, the population densities of TSSM were no significant differences between soil road and asphalt road ($F = 0.283$, $df = 3,96$, $p = 0.838$) (Table 5).

Table 1: Evaluation population density of *Tetranychus urticae* on cotton crops in Hatay

	No. *T. urticae* (Mean±SE)/25 leaves[y]
Places[w]	9-August
NSR	9.28±1.77a
NSR	8.24±1.10ab
NSR	5.64±0.74bc
NAR	5.28±0.12bc
NAR	3.84±0.71c
NSR	3.76±0.83c
NAR	3.44±0.88c
NAR	3.12±0.53c

[y]: Means followed by the same letter(s) in a column do not differ significantly ($p<0.05$, Duncan). [w]NSR = Nearby Soil Road and NAR = Nearby Asphalt Road)

Table 2: Evaluation population density of *Tetranychus urticae* on cotton crops in Hatay

Places[w]	No. *T. urticae* (Mean±SE)/25 leaves[y]
	19-August
NSR	9.84±1.26a
NSR	5.00±0.82b
NSR	3.52±0.57b
NAR	3.52±0.54b
NSR	3.36±0.61b
NAR	3.24±0.52b
NAR	2.92±0.52b
NAR	2.72±0.54b

[y]: Means followed by the same letter(s) in a column do not differ significantly ($p<0.05$, Duncan). [w]NSR = Nearby Soil Road and NAR = Nearby Asphalt Road

Table 3: Evaluation population density of *Tetranychus urticae* on cotton crops in Hatay

Places[w]	No. *T. urticae* (Mean±SE)/25 leaves[y]
	31-August
NSR	1.84±0.50a
NSR	1.48±0.44ab
NSR	1.12±0.38bc
NSR	1.04±0.36bcd
NAR	0.88±0.28bcd
NSR	0.44±0.22cdef
NSR	0.64±0.24cdef
NSR	0.64±0.30cdef
NAR	0.40±0.21cdef
NAR	0.28±0.15def
NSR	0.32±0.16def
NAR	0.12±0.88ef
NSR	0.12±0.09ef
NAR	0.08±0.08f
NSR	0.08±0.08f
NAR	0.00±0.00f
NAR	0.00±0.00f
NAR	0.00±0.00f
NAR	0.00±0.00f
NAR	0.00±0.00f

[y]: Means followed by the same letter in a column do not differ significantly ($p<0.05$, Duncan); [w]NSR = Nearby Soil Road and NAR = Nearby Asphalt Road

Table 4: Evaluation population density of *Tetranychus urticae* on cotton crops in Hatay

Places[w]	No. *T. urticae* (Mean ±SE)/25 leaves[y]
	2-September
NSR	1.12±0.43a
NSR	1.12±0.40a
NAR	0.68±0.35ab
NSR	0.52±0.27ab
NAR	0.24±0.18b
NAR	0.12±0.12b
NAR	0.00±0.00b
NSR	0.00±0.00b

[y]: Means followed by the same letter in a column do not differ significantly ($p<0.05$, Duncan); [w] NSR = Nearby Soil Road and NAR = Nearby Asphalt Road

Table 5: Evaluation population density of *Tetranychus urticae* on cotton crops in Hatay

Places[w]	No. *T. urticae* (Mean ±SE)/25 leaves[y]
	14-September
NSR	1.60±0.21a
NSR	1.52±0.42a
NAR	1.32±0.36a
NAR	1.12±0.38a

[y]: Means followed by the same letter in a column do not differ significantly ($p<0.05$, Duncan); [w]NSR = Nearby Soil Road and NAR = Nearby Asphalt Road

The TSSM is significantly economical pest of many cultivated crops (Zhang, 2003; Wilkerson *et al*., 2005). Previously several researchers mentioned that survival, developmental time and reproduction of TSSM were greatly influenced by environmental factors: temperature, under hot, dry, dusty condition, humidity, host plants and waster stressed plants. For example, the development of TSSM population density might vary with different conditions; temperature (Van de Vrie *et al*., 1972; Mitchell, 1973; Sabelis, 1981; Helle and Sabelis, 1985; Thomas, 2001), humidity (Sabelis, 1981), host plant, leaf age (Watson, 1964; Van de Vrie *et al*., 1972; Karban and Carey, 1984; Brandenburg and Kennedy, 1987), hot and dry weather (Helle and Sabelis, 1985), dusty conditions (Flint, 1998; Guerena and Sullivan, 2003) high level of nitrogen (Mattson, 1980; Brandenburg and Kennedy, 1987). In this studies also indicated that the increasing dusty conditions resulted in higher TSSM population on the cotton plant.

The reason of the increasing might be beneficial insect affectedness on TSSM populations. The natural enemies that contain Thysanoptera, Coleoptera, Hemiptera, Neuroptera, Diptera, Acarina and Araneida (Brandenburg and Kennedy, 1987) affects population density of TSSM on various cultivars. The most of research has been conducted with phytoseiid mite predators (Brandenburg and Kennedy, 1987). Therefore, phytoseiid mite predators controlled TSSM on strawberry (Laing and Huffaker, 1969), cucumber (Gould, 1971), tomato (French *et al*., 1976) under the greenhouse or growth chambers conditions. The environmental condition may affect the population density of beneficial insects on the cultivated crops. Therefore, for example, the temperature has been affected prey consumption, generation time, oviposition and longevity of *Phytoseiulus persimilis* Athias-Henriot (Sabelis, 1981; Shaw, 1982). In addition, the consumption of TSSM increased when the temperature increases (Pruszynski, 1976). In this study indicated that increasing dusty condition cause to increase population density of TSSM on cotton crops. Therefore, this result supported previous studies conducted by Flint (1998) and Guerena and Sullivan (2003). For those studies also reported that the dusty conditions often cause to increase the mite population on cultivated crops. Guerena and Sullivan (2003) suggested that keeping down dust along roads sides to decrease population densities of TSSM on cotton fields.

In conclusion, the two spotted spider mite populations were significantly 1.72, 1.75, 4.39 and 2.65 times higher cotton planted nearby soil road than asphalt road due to the dusty conditions. In addition, dusty condition may reduce an affectability of their beneficial insects. The decreasing of dusty condition can increase an affectability of their beneficial insects.

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