N O T E

Varietal Resistance to *Tetranychus urticae* Koch (Acari: Tetranychidae) in Minnesota Strawberries and Control with Bifenthrin[1]

Suzanne J. Wold and W. D. Hutchison[2]

Department of Entomology, University of Minnesota, 219 Hodson Hall, 1980 Folwell Ave., St. Paul, MN 55108-6125 USA

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The twospotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae), is a common pest of strawberry, *Fragaraia x ananassa* Duchesne (Schaefers 1981, Pest management systems for strawberry insects. *In* D. Pimentel [ed.] CRC handbook of pest management in agriculture. Vol: 3. CRC, Boca Raton, FL), and can severely affect yield (e.g., Wyman et al. 1979, J. Econ. Entomol. 72: 747-753). *Tetranychus urticae* has a rapid rate of development and high reproductive capacity (Sabelis 1985, Reproduction. *In* Helle and Sabelis [eds.] Spider mites: their biology, natural enemies, and control. Elsevier. NY). Hot and dry weather can also promote rapid increases in population density, resulting in economically damaging levels (Schaefers 1981). Control is often limited to the use of miticides (Poe 1973, J. Econ. Entomol. 66: 490), many of which *T. urticae* has become resistant to (Landeros et al. 2002, Southwest. Entomol. 27: 283-289). Another method of control is through the use of resistant varieties. Several different strawberry varieties exhibited various levels of resistance to *T. urticae* (Shanks and Barritt 1980, J. Econ. Entomol. 73: 419-423; Ferrer et al. 1993, J. Hort. Sci. Biotechnol. 73: 531-535; Shanks and Moore 1995, Hort Sci. 30: 596-599). In 2002, we experienced warm, dry conditions that were conducive to *T. urticae* development on a commercial strawberry farm in southeastern Minnesota. We, therefore, evaluated the effect of *T. urticae* feeding on three common strawberry cultivars, and the efficacy of bifenthrin (Brigade™, FMC Corp.) for control of *T. urticae*.

In 2002, we evaluated 'Brunswick', 'Northeaster', and 'Mira' strawberry cultivars for potential mite resistance on an 8-ha strawberry farm, near Mabel, MN (Houston Co.). To our knowledge, mite feeding has not been evaluated previously on these cultivars. Plots measuring 3.04 × 4.75 m were arranged in bearing plantings and replicated three times. Plants were visually sampled on 6, 8, and 13 June in each treatment for *T. urticae* by randomly selecting five leaflets/plot and counting mites using a 10X

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[2]Address all inquiries (email: hutch002@umn.edu).

Table 1. Mean (±SEM) number of *T. urticae*/leaflet observed on 'Brunswick', 'Mira', and 'Northeaster' strawberry, southeastern Minnesota, 2002

	6 June		8 June		13 June	
Variety	*T. urticae*/leaflet	n	*T. urticae*/leaflet	n	*T. urticae*/leaflet	n
Brunswick	27.4 ± 0.3a (5.00)	4	19.9 ± 8.5a (4.18)	4	408.2 ± 43.8a (20.11)	4
Mira	19.8 ± 6.9ab (4.21)	4	9.5 ± 3.7a (2.70)	4	0.0b (0)	4
Northeaster	2.7 ± 1.0b (1.47)	4	1.5 ± 1.2a (0.93)	4	2.5 ± 1.9b (1.89)	4
F	4.18		3.14		88.89	
df	2,3		2,3		2,3	
P	0.07		0.11		0.0001	
LSD Value	(3.25)		(3.18)		(2.03)	

Means within columns followed by the same letter are not significantly different ($P = 0.05$); Fisher's Protected Least significant difference test (LSD). Data were transformed by square root for counts; both untransformed means and transformed means, in ( ), are presented; transformed LSD values, in ( ), are provided.

Table 2. Mean (±SEM) number of *T. urticae*/leaflet on 'Brunswick' strawberry treated with bifenthrin (0.22 kg AI/ha), 2002

Treatment	6 June		8 June		13 June	
	T. urticae/leaflet	n	*T. urticae*/leaflet	n	*T. urticae*/leaflet	n
Treated (1 spray)	24.7 ± 4.5a (4.89)	4	7.5 ± 3.9a (2.35)	4	4.3 ± 3.7b (1.60)	3
Untreated Check	27.4 ± 9.3a (4.99)	4	19.9 ± 8.4a (4.18)	4	444.2 ± 35.2a (21.04)	3
df	3,3		3,3		2,2	
P	0.92		0.17		0.001	
t	0.09		1.52		15.22	

Means within columns followed by the same letter are not significantly different ($P = 0.05$), PROC TTEST (SAS Institute 1995). Data were transformed by square root for counts; both transformed and untransformed means in ( ), are presented.

hand-lens. Data were analyzed using a one-way ANOVA and Fisher's protected least significant difference (LSD) test ($P = 0.05$) (SAS Institute 1995, SAS/STAT User's Guide, release 6.12 edition. Cary, NC).

To assess the efficacy of bifenthrin, plots were established at the same farm site, using a bearing planting of 'Brunswick'. Plots were three rows wide (3.04 × 4.75 m), arranged in a randomized complete block, and replicated three times. Treatments included one application of bifenthrin (0.23 kg AI/ha) (6 June) and an untreated check. Applications were made with a CO_2 pressurized backpack sprayer using a 1.52 m boom with four nozzles, each fitted with an XR-Teejet 8002 flat fan nozzle with no screen. The sprayer was calibrated to deliver 480.76 L/ha at 242 kPa. Plants in each plot were visually sampled for *T. urticae* on 6 June, prior to the application of bifenthrin, and again on 8 and 13 June, by randomly selecting five leaflets and counting mites using a 10X hand-lens. Data were analyzed using the PROC TTEST method (SAS 1995).

Feeding activity by *T. urticae,* in all varieties, was limited primarily to the undersides of the leaves, with the highest infestations resulting in significant webbing and the characteristic "bronze" coloration to the leaves. We did not observe any direct feeding by *T. urticae* on developing berries. Overall, we observed fewer mites on 'Mira' and 'Northeaster', compared with 'Brunswick' (Table 1). By the final sample date (13 June), 'Brunswick' plots had significantly more *T. urticae* (>400/leaflet; $P = 0.001$) than both 'Mira' and 'Northeaster' (Table 1). In the insecticide study, there were significantly fewer *T. urticae* in the bifenthrin treatment than in the untreated check on the final sample date (13 June) ($t = 15.22$, $P < 0.001$) (Table 2).

Many varieties of strawberry have shown resistance to mite feeding (Ferrer et al. 1993, Hort. Sci. 28: 841-844; Shanks and Moore 1995); however, we are not aware of previous research with the varieties in our study. Our results suggest that 'Mira' and 'Northeaster' possess one or more mechanisms for resistance to *T. urticae* and would be excellent candidates for future research on varietal resistance. One application of bifenthrin effectively suppressed the *T. urticae* population to manageable levels (Table 2) and is in agreement with previous *T. urticae* studies on other crops (e.g., Labanowska and Gajek 1993, Acta Hort. 352: 583-585). However, *T. urticae* resistance to bifenthrin has been reported in Australian cotton (Herron et al. 2001, Exp. Appl. Acarol. 25: 301-310), and reliance on one management tactic is not recommended. This research will be useful for the development of a comprehensive strawberry integrated pest management program in Minnesota (e.g., Wold and Hutchison 2003, J. Econ. Entomol. 96: in press).

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