Diapause Characteristics of Some *Tetranychus* (Acari: Tetranychidae) Mites of Okinawa Island*

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INTRODUCTION

Being apart from the main islands of Japan, the Okinawa (Ryukyu) Islands have a spider mite fauna which is different from that of the main islands (Ehara, 1966, 1995; Gotoh et al., 1996). For example, *Tetranychus okinawanus*, a species recently described (Ehara, 1995), so far has been known only from the Islands (Takafuji et al., 1996; Gotoh et al., 1996). On the other hand, species that are commonly found in the main islands, such as *T. urticae* and *T. kanzawai*, are also known from the Okinawa Islands (Gotoh et al., 1996). The Islands are located in the subtropical region, and therefore the ecological characteristics of the mites, in particular their diapause characteristics, will differ from those in the temperate regions. However, no studies on the diapause have so far been published on the populations from the Islands. We collected and identified 6 species of spider mite from various plants on Okinawa Island, the main island of the group, in August 1995 (Gotoh et al., 1996). This paper reports the diapause characteristics of five species of the genus *Tetranychus*.

MATERIALS AND METHODS

Mite species collected were *T. okinawanus*, *T. piercei*, *T. pueraricola*, *T. urticae* (green form) and *T. kanzawai* (kerria strain) (Table 1). All mite samples were collected on August 2-3, 1995 at 16 sites on Okinawa Island. Mites were put into vinyl bags and kept in an ice-cooled box. More than 30 adult females in each mite sample (except for the *T. kanzawai* population from papaya, in which only 7 individuals were obtained) were transferred onto leaf discs of the kidney bean (*Phaseolus vulgaris* L.) on water saturated cotton in petri dishes (4 cm in diameter), and were reared 1 to 2 generations at 25°C:16L8D to obtain sufficient adult females for the diapause experiment.

To determine the diapause percentage of each population, 20-60 adult females sampled at random from each culture were transferred to 4-6 bean-leaf discs on water-saturated cotton in petri dishes (9 cm diameter) to allow oviposition for 2-3 days at 25°C:16L8D (Goka and Takafuji, 1990). The females were then removed and the offspring were reared to adulthood

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at either 15 or 18°C under a daylength of 9 h. The petri dishes were kept in groups in plastic boxes (25 × 35 × 6 cm) and thus the relative humidity inside the box was maintained to be higher than 70%. Adult females thus obtained were examined about a week after emergence. Females whose body color turned vivid orange were considered to be in diapause.

RESULTS AND DISCUSSION

Table 1 lists the percentages of diapause of the 5 *Tetranychus* species. None of the 4 populations of *T. okinawanus* expressed diapause at all even at 15°C, showing that it has no diapause capacity. The two populations of *T. piercei* did not express diapause at the two temperatures either. Although *T. piercei* had been believed to be distributed only in Okinawa Islands, it was recently collected at two areas of Honshu, one in Aomori, northern Honshu (Goka and Takafuji, 1998), and the populations from the areas have capacity for diapause (Goka, unpublished). It is likely, therefore, that in *T. piercei* a large variation exists in the intensity of diapause.

T. urticae has been believed to have originated from cool climatic zones and to be a diapause species. However, it is now known that the Japanese populations of this species have large variations in the intensity of diapause and populations from the southwestern areas have very weak diapause capacity (Takafuji et al., 1991). Although the 3 populations of *T. urticae* from Okinawa did not express diapause at all at 18°C, some individuals expressed diapause at 15°C, showing they maintain diapause capacity. In Okinawa *T.*

Table 1. The percentages of diapause in five *Tetranychus* species of Okinawa Island, under a daylength of 9h.

Species	Population (Locality)	Host plant	%diapause	
			15°C	18°C
<i>T. okinawanus</i>	Nago	<i>Bidens pilosa</i> var. <i>minor</i>	0 (155)	0 (263)
	Nago	<i>Pueraria montana</i>	0 (210)	0 (114)
	Nago	<i>Sonchus</i> sp.	0 (112)	0 (89)
	Haha	<i>Pueraria montana</i>	0 (356)	0 (226)
<i>T. piercei</i>	Nago	<i>Pueraria montana</i>	0 (458)	0 (605)
	Tamagusuku	<i>Pueraria montana</i>	0 (701)	0 (307)
<i>T. pueraricola</i>	Nago	<i>Pueraria montana</i>	0 (201)	0 (190)
<i>T. urticae</i>	Itoman	Cucumber (greenhouse)	12.6 (375)	0 (358)
	Nakijin	Watermelon (greenhouse)	11.3 (265)	0 (300)
	Nakijin	Watermelon (greenhouse)	2.3 (218)	0 (247)
<i>T. kanzawai</i>	Nago	<i>Prunus persica</i>	0.2 (614)	0.8 (496)
	Nakijin	<i>Boehmeria nivea</i> f. <i>viridula</i>	40.5 (205)	23.8 (558)
	Nakijin	Papaya	31.9 (332)	17.5 (320)
	Nakijin	<i>Dracaena fragrans</i>	11.5 (497)	8.9 (755)
	Haebaru	<i>Vigna catiang</i> var. <i>sinensis</i>	30.3 (350)	6.4 (500)

Numerals in parentheses are the number of individuals tested.

urticae was found only on greenhouse crops and its distribution was limited (Gotoh et al., 1996). Probably the mites would have been artificially introduced recently to Okinawa Island, as was the case in southwestern Honshu.

T. kanzawai has been also thought to be a diapause species, having a much stronger diapause capacity than *T. urticae*. Most populations from Kyushu and southern Honshu show nearly 100% diapause even at 18°C (Takafuji et al., unpublished), whereas populations of *T. urticae* from those areas exhibit a very low diapause percentage even at 15°C. The percentages of diapause varied among the 6 populations studied here, but all showed lower than 50% diapause even at 15°C. In particular, the Nago and the Chinen populations were nearly all non-diapause. Thus the Okinawa populations obviously have much lower capacity for diapause than the populations from mainland Japan.

T. pueraricola, a species newly separated from *T. urticae* (Ehara and Gotoh, 1996), had no diapause capacity. The species is distributed all over Japan and is very common on kudzu vine, *Pueraria lobata*. Gotoh et al. (1996) showed an incomplete reproductive isolation between the population from Okinawa used in this study and the populations from Honshu. We need to study on more populations from different localities for clarifying the diapause feature, as well as the genetic diversity of this species.

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適 要

沖縄産数種 *Tetranychus* 属ハダニの休眠性 高藤晃雄(京大大学院・農学研究科) 後藤哲雄(茨城大・農学部)

沖縄本島から採集した5種の *Tetranychus* 属ハダニの休眠性を調べた。ナンゴクハダニの5個体群はすべて15℃でもまったく休眠発現せず非休眠性であった。ミヤラハダニおよびナミハダニモドキも同様にまったく休眠発現しなかった。カンザワハダニでは個体群によって休眠発現率に変異が大きかったが、いずれも本土の個体群に比べて休眠率が著しく低く、ほぼ非休眠性の個体群もみられた。ナミハダニ(黄緑型)は18℃では休眠発現することはなかったが、15℃ではわずかながら発現し、休眠遺伝子が維持されていた。