

# Effect of Vapor-heat on *Tetranychus urticae* (Acarina: Tetranychidae) and *Pseudococcus comstocki* (Hemiptera: Pseudococcidae) on Fresh Winter Pumpkins

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**Abstract:** All developmental stages of two-spotted spider mite, *Tetranychus urticae* KOCH and Comstock mealybug, *Pseudococcus comstocki* KUWANA on fresh winter pumpkins, *Cucurbita moschata* DUCH. were treated by vapor-heat at 47°C for 0, 5, 10, 20, 40, 60 and 120 min. The two-spotted spider mite adult was likely to be the most tolerant to vapor-heat of all developmental stages of the two pests. All stages of the two pests were killed completely by vapor-heat for 120 min. at pumpkin temperature of 47°C.

**Key words:** Vapor-heat, *Tetranychus urticae*, *Pseudococcus comstocki*, winter pumpkin, quarantine treatment

## Introduction

Various pest insects on imported fruits and vegetables are frequently intercepted by quarantine inspection. Those pests are usually fumigated with methyl bromide or hydrogen cyanide. Methyl bromide is facing the prohibition of the production and the limitation of the use in the Montreal Protocol. Other treatments are expected to be developed as alternatives to methyl bromide for the imported fruits and vegetables. Vapor-heat treatment is looked upon one of alternatives to methyl bromide. Imported vegetables and fruits have been frequently infested with mites and mealybugs. Effect of vapor-heat is confirmed on the mortality of the two-spotted spider mite and the Comstock mealybug on pumpkins.

## Materials and Methods

Two-spotted spider mites were incubated for the developmental stages of eggs, larvae, nymphs and adults on kidney bean and winter pumpkins. Eggs, larvae, nymphs and adults were used for the test. The Comstock mealybug were inoculated on the pumpkin and incubated for the development to the second and third instar larvae and female adults. Eggs, larvae and adults were used for the test.

The inside temperature of the vapor-heat treatment chamber (0.12 m<sup>3</sup> in capacity, Sanshusangyo, Inc., model EHK-100 K) was adjusted at 49°C. The temperature of the pumpkin was measured with the thermal sensor (resistance thermometer: Pt100Ω) inserted directly under the skin of the pumpkin. The temperature data were stored in the data logger (manufactured by Grant Instruments Ltd., model SQ1250). Test insects on the pumpkin were treated for 0, 5, 10, 20, 40, 60 and 120 min. for the two-spotted spider mite,

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and for 0, 5, 10, 20, 60 and 120 min. for the Comstock mealybug at the pumpkin temperature of 47°C.

The treated insects were kept in the incubator at 25°C after the treatment. The hatched eggs were counted and the other developmental stages were checked for the mortality after 24 hours. The mortality of untreated control insects was also checked at the same time.

## Results and Discussion

### The two-spotted spider mite

The mortality of the two-spotted spider mite larvae was a little less than 90% even by the exposure to vapor-heat of 0 min. from the time after reaching 47°C at the pumpkin temperature, while the mortalities of the eggs, nymphs and adults in untreated control were 59.5%, 62.2% and 34.3%, respectively (Table 1). The larva was the most sensitive to vapor-heat, while the adult was likely to be the most tolerant to vapor-heat at 47°C. The probit analysis data also showed that the adult was the most tolerant of all stages. The adult stage would be killed completely for 120 min. at pumpkin temperature of 47°C (Table 1).

### The Comstock mealybug

The Comstock mealybug eggs were clearly the most sensitive to vapor-heat of all stages because more than 90% mortality was obtained for 10 min. or more, while the mortalities of the larvae and female adults were only 74.9% and 67.0% respectively for 20 min. All stages would be killed completely for 60 min. at the pumpkin temperature of 47°C (Table 3).

**Table 1.** Mortality of the two-spotted spider mite, *Tetranychus urticae* by vapor-heat treatment at 47°C.

Exposure time (min.)	Eggs		Larvae		Nymphs		Adults	
	Number treated <sup>1)</sup>	Mortality (%) <sup>2)</sup>	Number treated <sup>1)</sup>	Mortality (%) <sup>2)</sup>	Number treated <sup>1)</sup>	Mortality (%) <sup>2)</sup>	Number treated <sup>1)</sup>	Mortality (%) <sup>2)</sup>
0	408	59.5	216	87.2	287	62.2	501	34.3
5	382	71.8	209	89.1	242	71.8	548	59.3
10	388	87.9	248	93.4	229	86.8	395	59.7
20	378	88.2	235	97.5	243	93.5	375	75.9
40	265	91.5	253	99.3	276	98.3	477	89.6
60	267	97	225	100	234	100	537	92.8
120	306	100	218	100	226	100	518	100

<sup>1)</sup> Total number of test insects in 3 replicates.

<sup>2)</sup> Mortality (%) is corrected by Abbott's formula.

**Table 2.** Estimated LT<sub>50</sub> and LT<sub>95</sub> value for all developmental stages of the two-spotted spider mite, *Tetranychus urticae* treated by vapor-heat at 47°C.

Stage	LT <sub>50</sub> (min.) (95%CL)	LT <sub>95</sub> (min.) (95%CL)
Eggs	1.43 (0.87–17.04)	39.84 (22.14–195.71)
Larvae	0.77 (4.72–15.32)	10.85 ( 8.60– 13.89)
Nymphs	2.42 (1.70– 3.12)	20.29 (17.16– 25.11)
Adults	4.54 (1.36– 7.94)	75.25 (40.44–308.82)

**Table 3.** Mortality of the Comstock mealybug, *Pseudococcus comstocki* by vapor-heat treatment at 47°C.

Exposure time (min.)	Eggs		Larvae		Female adults	
	Number treated <sup>1)</sup>	Mortality (%) <sup>2)</sup>	Number treated <sup>1)</sup>	Mortality (%) <sup>2)</sup>	Number treated <sup>1)</sup>	Mortality (%) <sup>2)</sup>
0	2,403	38.0	567	56.5	330	57.0
5	2,009	37.2	548	63.0	359	63.4
10	2,133	91.8	477	73.0	347	69.8
20	1,812	95.9	572	74.9	357	67.0
60	1,430	100	431	100	334	100
120	1,507	100	476	100	334	100

<sup>1)</sup> Total number of test insects in 3 replicates.

<sup>2)</sup> Mortality (%) is corrected by Abbott's formula.

From the result of the mortality data of the two pests, the most tolerant stage to vapor-heat at 47°C was the two-spotted spider mite adult of all stages of the two pests and the adult of the two-spotted spider mite would be killed completely for 120 min. at the pumpkin temperature of 47°C.

## 和 文 摘 要

カボチャに寄生するナミハダニ *Tetranychus urticae* (Acarina:  
Tetranychidae) 及びクワコナカイガラムシ *Pseudococcus*  
*comstocki* (Hemiptera: Pseudococcidae) に対する  
蒸熱殺虫効果

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ニホンカボチャ表面に寄生したナミハダニ及びクワコナカイガラムシに対する蒸熱処理の殺虫効果を調査した。これら 2 種の害虫を蒸熱処理により 47°C で処

理した結果、ナミハダニの成虫が最も耐性が高く、かつ、すべての発育ステージは 120 分間の処理により完全に殺虫された。

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