Evaluation of the Predatory Thrips Scolothrips takahashii (Thysanoptera: Thripidae) for Control of Pest Spider Mites Tetranychus urticae (Acari: Tetranychidae)

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Title　: Evaluation of the Predatory Thrips *Scolothrips takahashii* (Thysanoptera: Thripidae) for Control of Pest Spider Mites *Tetranychus urticae* (Acari: Tetranychidae)
(害虫ハダニ *Tetranychus urticae* 防除のための捕食性アザミウマ *Scolothrips takahashii* (アザミウマ目：アザミウマ科) の評価)

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Thesis Summary

Scolothrips takahashii (Priesner) is a beneficial natural enemy native to Japan. It preys on many spider mite species belonging to the Tetranychidae family. In its natural habitat, *S. takahashii* can use herbivore-induced plant volatiles (HIPVs) emitted from spidermite-infested plants to locate and feed on its prey. This predator has potential as a biocontrol agent against the two-spotted spider mite, *Tetranychus urticae* Koch, on strawberry farms, which is difficult to control solely with chemical pesticides due to pesticide resistance. However, the mass-rearing efficiency of *S. takahashii* is not satisfactory, and a measure or device to enhance the establishment and maintenance of *S. takahashii* populations should also be established. In the present study, feasibility of the use of *S. takahashii* in pest management program is assessed with laboratory and field experiments. For this purpose, this study examined the impact of alternative foods on ŧ*S. takahashii* survival, reproduction and rearing efficiency. Furthermore, the study evaluated the methods to attract the predator and facilitate its establishment to incorporate *S. takahashii* into a biocontrol program, with a specific focus on the effect of HIPVs on *S. takahashii*.

In Chapter 1, general information about the bionomics of the two-spotted spider mite *T. urticae* and its damage to crop plants was introduced and summarized. Additionally, its predator *S. takahashii* was also mentioned as a promising biocontrol agent and the current knowledge on it was reviewed. Finally, the need for research on controlling the two-spotted spider mite with biocontrol methods was explained.

In Chapter 2, the impact of plant nectars and alternative foods on the survival and reproduction of *S. takahashii* was examined. Laboratory experiments showed that the presence of flowers extended the survival of *S. takahashii* and that the predator was attracted to the odours of the flowers. Additionally, a food preference test demonstrated that *S. takahashii* exhibited a preference for sugar-rich foods. These results suggested that flowers could be used to enhance the survival of *S. takahashii* when prey spider mites are scarce or not present.

In Chapter 3, the development of *S. takahashii* when feeding on sugars were evaluated in laboratory conditions. The results revealed that sugars helped to prolong the survival of *S. takahashii*. The concentration of sugars was found to be directly related to the survival of the predatory thrips; however, sugar-feeding did not help the thrips complete their life cycle and did not enhance reproduction. Therefore, it is suggested that supplying sugars to the crop plant could assist the survival of *S. takahashii* and help maintain its population when their prey population is low.

In Chapter 4, experiments were designed to determine the effectiveness of herbivore-induced plant volatiles (HIPVs) in attracting *S. takahashii* using the Y-tube olfactometer system. The experiments provided evidence that HIVPs could attract the predator and suggested that applying synthesized HIPV compounds in the field could help establish the *S. takahashii* population early to prevent spider mite infestations and enhance biocontrol efficiency under field conditions. This approach may be used as a new method for using this predator in a biocontrol program, eliminating the need for rearing and releasing S. takahashii into crop ecosystems.

In Chapter 5, the field experiment was finally conducted to identify the attraction effect of 5 synthesis HIPVs on *S. takahashii* and other predators of spider mites. It showed that HIPV baits attracted various beneficial insects, therefore increasing the biodiversity of the insect predator community in the tested location. Thus, application of HIPVs in the field may help biological control of spider mite pests with native natural enemies including *S. takahashii*.

The present study showed that plant nectars and sugar-rich foods can help the predatory thrips *S. takahashii* survive when its prey is scarce. This means that by manipulating flowers or providing high-concentration sugar solutions in agroecosystems, the control of pest mites by *S. takahashii* can be reinforced. For example, in greenhouse conditions, farmers can enhance control efficacy by adding flowering plants to their greenhouse. Furthermore, HIPVs could be used as an attractant to *S. takahashii* and other predators to increase the biodiversity of the insect community and hence to prevent a future invasion of spider mites into the crop field.