

Spinach Crown Mite



National Vegetable
Extension Network

T A S M A N I A
VICTORIA - NORTHERN,
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Spinach crown mites live in the topsoil; they thrive in a cool, moist environment. They feed mainly on partly decomposed organic material and on fungi living off decomposing material. They also feed on young spinach leaves which are close to the soils surface. Leaves become distorted which reduces the marketability of the crop.

The national distribution and identity of the mites in Australian spinach crops has not been confirmed. Effective, product based control methods are currently limited.

Based on laboratory studies, high risk conditions for *Tyrophagus similis*, which is identified as spinach crown mite in some countries, include:

- High levels of fresh organic matter – Spinach mites are more abundant in soil that contains large amounts of fresh organic matter which is a food source for them.
- Moderate temperatures – Based on laboratory studies, the mites' reproduction rate is greatest at temperatures around 10°C; below about 7°C development ceases. This mite is most active at temperatures between 20 and 25°C; survival declines at temperatures above 35°C (Kasuga and Amano, 2000).
- High relative humidity (RH) – *T. similis* was most abundant at RH above 90%. This RH may occur near the soil surface of a dense, irrigated spinach crop for most of its growth, certainly once the canopy closes.
- Low light intensity – The multiplication of *T. similis* slows down as light intensity increases (Al-Safadi, 1990, Abstract)

“If you suspect spinach crown mites are affecting your crop, check the crown of plants with a hand lens for eggs or mites or ask your adviser to do this.”

Actions for growers

- **Rotation - Avoid rapid rotations.** Populations of spinach crown mite will increase if spinach crops are grown in rapid rotations.
- **Remove failed crops – Remove crop residues if a spinach crop is not harvested.**
- **Residue breakdown - Crop residues should break down before sowing spinach; products are available that can speed up breakdown.**
- **Fallow - Use a six-week fallow gap prior to spinach crops.**
- **Plant health - Reduce the mite's ability to damage the crop by making sure the crop is never stressed, e.g. over- or under-fertilised, too dry or too wet.**
- **Manage timing of organic amendments - During high risk periods reduce the use of organic amendments. Note that timing of high risk periods will depend on your location, crop rotation, management practices and the weather.**
- **Use organic amendments that are well-matured – using immature, not fully decomposed, organic material provides a food source for spinach mites.**
- **Minimise use of broad spectrum insecticides and miticides – Reducing or minimising the use of broad spectrum insecticides and miticides will allow predatory insects and mites to increase in numbers.**
- **Do not rely on miticides – Options are limited, effects are uncertain and once crop damage has occurred, spraying does not prevent crop losses.**

Spinach Crown Mite

Spinach crown mites prefer a cool moist environment, living predominantly in the top 5 cm of the soil profile. The mites feed on young spinach leaves, as well as emerging plants. The damaged leaf cells die while cells in surrounding tissue continue to grow, resulting in leaf distortion. The mites release a toxin into the plant which contributes to the distortion of the leaves. The damage becomes visible as the leaves unfold.



Figure 1: Distorted leaves caused by spinach crown mites (Image: S.Grigg, source: Horticulture Australia Ltd, 2014)

The identity of the mites in Australian spinach crops has not been confirmed

In UK spinach crops, mites were recently confirmed as *Tyrophagus similis* (Elliot and Jukes, 2014). In the USA, spinach crown mite is often described as a *Rhizoglyphus* which is a similar species to *T. similis*. *Rhizoglyphus* are sometimes referred to as bulb mites because some species can cause damage to bulb plants e.g. onion, leek and garlic. Identification of mite species can be challenging as the taxonomy of mites is either not well studied and/or has been revised (Fan and Zhang, 2007b).

It is currently unconfirmed which species of mite is/are causing damage to spinach in Australia.

Spinach crown mite is distributed world-wide

Spinach crown mite occurs world-wide, occurring in spinach crops grown both outdoors and in greenhouses. Populations of *T. similis* have been found on a wide range of crops including but not limited to: alfalfa, beans, pasture, cucumber, tomato and capsicum (Al-Safadi, 1987, Zhang, 2003, Fan and Zhang 2007a).

In Australian spinach crops, spinach crown mites have so far been reported in Tasmania and Victoria.

Life cycle of spinach crown mite

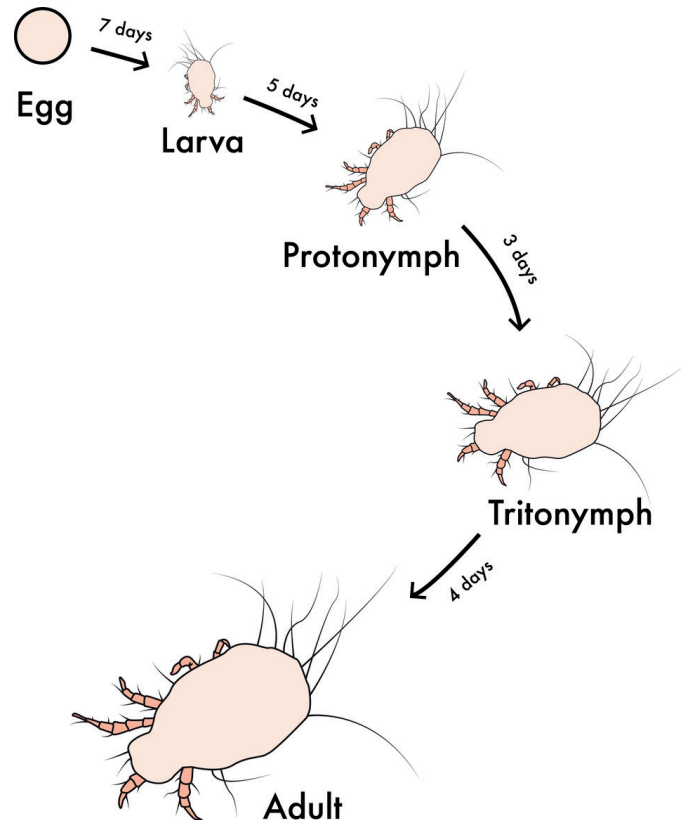


Figure 2: Life cycle of *T. similis* at 20°C, using data for number of days from Kasuga and Amano, (2000). Note that the life cycle is shorter at 25°C (refer to graph on page 3). Diagram by Jonathan Lucas.



Figure 3: Adult spinach crown mite showing setae on the posterior end, USA. (Image: J. Allen, source: <https://uconnladybug.wordpress.com/2015/04/17/deformed-spinach-could-be-crown-mites/>)



Figure 4: Spinach mite eggs inside folded young leaves, USA (Image: J. Allen, source: <https://uconnladybug.wordpress.com/2015/04/17/deformed-spinach-could-be-crown-mites/>)

Temperature

The life cycle of spinach crown mite is temperature-dependent. Mite development ceases at about 7°C (Kasuga and Amano, 2000). Females show limited survival at 35°C and higher temperatures. Egg to adult development can be completed in fewer than 10 days at 25°C.

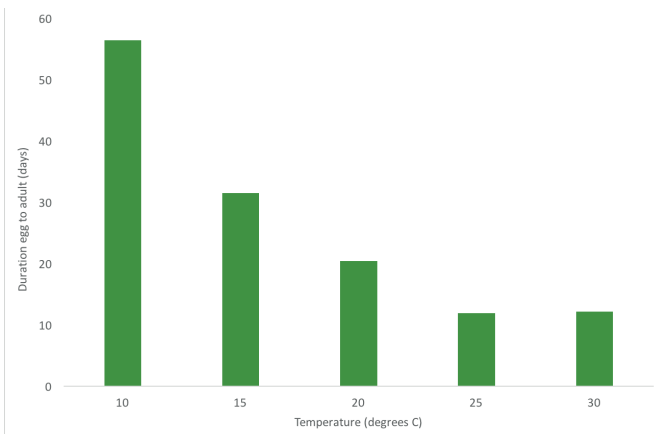


Figure 5: Duration of egg to adult of *Tyrophagus similis* (data from Kasuga and Amano, 2000)

Humidity

T. similis females show limited survival at 53% and 66% relative humidity compared to higher humidity 76%, 87% and 100% (Zhang, 2003).

Pesticides options are limited

There are very limited pesticide options currently registered for use in Australian spinach. Research has been conducted overseas using a number of chemicals and has shown that spraying plants is not very effective due to the location of mites deep within the crown. In addition, if sprays are applied once damage has been noticed, it is too late to prevent crop loss. If pesticides were developed, they would need to be used together with a monitoring program to allow for timely application. The soil has been suggested as the main target for control rather than the spinach crop (Elliot and Jukes, 2014). Cause for concern is the short lifecycle and high reproductive potential of the mites, making resistant populations a risk.

Is biological control possible?

There may be other mites that will predate spinach crown mite, but these have not been confirmed or developed. Research in laboratory conditions in Japan has shown the predatory ability of some mites (Saito and Takaku, 2013).

Bio-mitocides may provide some preventative control, but this has not been confirmed. A bio-miticide based on *Beauveria bassiana* (strain ATCC 74040) has been trialled on spinach in Italy, and was applied to the soil (Sannino et. al., 2016, Abstract). This type of product requires consideration of the stage of pest (e.g. it may be only effective on early life stages of mites), compatibility with fungicides and of humidity (humidity may influence effectiveness).



Figure 6: Spinach leaves damaged by crown mite feeding (Image: J. Allen, source: <https://uconnladybug.wordpress.com/2015/04/17/deformed-spinach-could-be-crown-mites/>)

Remaining questions

We still have a lot to learn about spinach crown mite in Australian production systems, including:

- Which mite species are causing damage to Australian spinach crops?
- Does the intensity of soil cultivation affect mite populations or incidence of damage by mites? (Research in Japan has shown that reduced tillage allowed a population of spinach mite to increase (Saito, 2015))
- Does irrigation management influence mite populations or incidence of damage by mites?
- What effect does the combination of: partly decomposed organic matter, cultivation and climate, have on risk of spinach mite damage?
- Would trapping be effective for predicting risk? Soil baiting and trapping methods have been developed in Japan (Kasuga et al, 2005) but have not been tested in Australia and thresholds are yet to be developed.
- Which crops and cover crops are potential hosts of spinach crown mite?
- Is there an association between spinach crown mite and soil borne diseases e.g. root rots caused by *Pythium*, *Rhizoctonia* and *Fusarium*?
- What is the best way to manage cover crop residues and organic soil amendments to reduce the risk of spinach mite? Cover crops, use of compost and reduced tillage help to improve soil health but they may increase the risks of increasing spinach mite populations, unless the improvement of soil biodiversity provides control, once established.

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