Grower Summary

FV 400

Biology and control of ‘spinach’ mites

Annual report 2013

Project title:	Biology and control of ‘spinach’ mites
Project number:	FV 400
Project leader:	Rosemary Collier, University of Warwick
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Location of project:	Warwick Crop Centre, University of Warwick, Wellesbourne
Industry Representative:	
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Date project completed (or expected completion date):	

[The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.]

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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GROWER SUMMARY

Headline

The pest mite causing damage to outdoor spinach crops was confirmed as *Tyrophagus similis.* This species feeds mainly on material and organisms associated with organic matter in the soil and may damage spinach only as a consequence of its need to avoid adverse soil conditions.

Background

During late summer-autumn 2010, outbreaks of mites caused damage to outdoor spinach crops in southern England. These outbreaks occurred at several locations. The problem has occurred previously but it is sporadic in nature. The aims of this project were to:

1. Confirm the identity of the mites causing damage to spinach crops.

2. Develop a laboratory culturing technique to provide mites for experiments on control

3. Collate and summarise information on the biology of the mites that would be relevant to predicting and controlling infestations

4. Identify potential control methods and test them on a small scale

Summary

Despite the very wet weather in summer 2012, small samples of mites were obtained from field-grown spinach (provided by growers and field-collected by Warwick Crop Centre) on three occasions and these were sent to Fera for identification. All samples contained *Tyrophagus similis*, confirming the identity of this pest.

Attempts to establish a culture and undertake tests on control methods were unsuccessful due to the small number of mites recovered in 2012.

Literature review

A literature review was undertaken and key points are as follows:

Tyrophagus similis appears to be quite widely distributed world-wide and the main studies on it have been undertaken in Japan and the Yemen. In Japan, mites damage spinach grown in greenhouses in particular. The mites penetrate spinach shoots and feed on young leaves. The shoots are readily accessible because they are close to the soil surface. As the plants grow, the damaged leaves show small holes and/or deformation.

Tyrophagus similis is one of a number of species of small arthropods that have an important role in mineral turnover, vegetation succession and decomposition of organic matter. It has been observed to feed mainly on organic fertilizers, plant detritus, small organisms and the dead bodies of soil arthropods. The development of *T. similis* populations on organic wastes and immature composts may be due to their feeding on fungi that occur in these materials. Generally, the growth of fungi is greater on organic wastes and immature composts than on mature ones, because mature composts have already been decomposed by several forms of microorganisms. *Tyrophagus similis* lives in, and on, soil at depths of 0-5 cm and numbers decrease with increasing depth.

The low temperature threshold for development for *T. similis* is 7°C and females can lay several hundred eggs in their lifetime. Egg viability of *T. similis* declined at temperatures above 30 °C, female survival was reduced at temperatures above 35°C, and of *T. similis* maintained at 10, 15, 20 and 25 °C, those maintained at 10 °C had the greatest fecundity during their lifetime.

In Japanese research on spinach crops grown in greenhouses, the *T. similis* population in the soil remained at low levels during the hot season from May to September, increased rapidly in October and November, remained at a high level during the cool season from December to February, and further increased in April. The mites, which were in the soil, infested the spinach plants mostly in late autumn and early spring. The high temperatures in the greenhouses from spring to early autumn were considered to be one of the main causes of population decrease. It was hypothesised that the mites initially increase in number on, or in, cultivated soil that is rich in organic matter and then invade the spinach plants. It seemed likely that the mites use the spinach plants as a shelter from harsh physical conditions in the surface soil (e.g. high temperature and dryness) in the warm season, because few mites inhabited spinach plants during the cool season even when mite density in the soil was relatively high. If this is the case, then the movement of the mites to the

spinach plants might not be primarily to obtain food. It seemed to the Japanese researchers that *T. similis* was more closely associated with the soil than with spinach plants, because it was feeding on and living in various types of organic matter in the soil. If the mites live mainly in the soil, attempts to control the mites by spraying the plants with pesticide might be expected to have a limited effect. In Japan, attempts have been made to control *Tyrophagus similis* with agrochemicals. Such agrochemicals have been used generally after an increase in damage is observed, but in many cases, their effects have been unsatisfactory. This suggests that the chemicals had little direct contact with the mites in both the soil and spinach plants.

Apart from temperature, dryness of the soil surface and tillage after cultivation might reduce mite numbers temporarily. Solar heating and hot water treatment may be effective for controlling *T. similis* in the soil in greenhouses. To effectively control the mites, it may be necessary to keep the temperature above 35 °C for several hours. Cultural approaches to reduce damage to spinach could be by: (1) Reducing the use of organic fertilizers during the mite season, (2) removing plant residues on the soil before cultivation, and (3) reducing the use of immature organic materials, because they increase fungi that are suitable food for *T. similis*. Other mites are certainly likely to be predators of *T. similis,* but an effective biological control system has not been developed.

It is likely that the target for control should be mite populations in the soil rather than the mites in the spinach and there may be many mites in the soil at times when there are none on the spinach plants. Thus, surveying mite numbers in the soil may be of value. This can be done using Tullgren funnels to extract mites from soil samples, although this method is labour-intensive. A Japanese group developed a relatively simple ‘trap’ for monitoring mites in soil. The trap is a piece of folded moistened filter paper containing a small amount of dry yeast. Rather than deploy these traps in the field, the researchers took samples of soil from the field, placed them in polythene bags and then the traps were placed on the surface of the soil in each sample bag. The sample bags were sealed and the traps were checked at intervals and the mites identified and counted. When this approach was compared with the use of Tullgren funnel samples, higher numbers of mites were obtained.

Potential control methods

Potential control methods highlighted by the literature review include:

- Control with pesticides

        - This depends on a suitable active ingredient being available and approved for spinach.
        - The review indicates that the mites may be a difficult target and that soil treatment might be more effective than treatment of the plants (which may be too late). Soil treatment requires an effective method of application.

    - Biological control
        - There might be a suitable control agent available commercially.
        - However, this would be a very expensive, and potentially labour-intensive, way of controlling a sporadic pest.
        - Efficacy has not been demonstrated.

    - Physical control
        - Cultivation may reduce mite populations for one or more reasons.
        - Heating the soil (with black polythene?) may be effective.
        - Irrigation may make the soil environment less hostile at certain times and prevent the mites infesting the spinach plants.

    - Cultural control
        - Management of organic material in the soil may be key.

    - Monitoring
        - Use of the filter paper trap approach may highlight large mite populations.

Financial Benefits

The results of this project will contribute to an understanding of this damaging, but sporadic, pest and identify possible methods of predicting and controlling infestations. The proposed project is complementary to the LINK project submitted by a consortium led by the HDC: Sustainable Crop and Environment Protection - Targeted Research for Edibles (SCEPTRE).

Action Points

- Growers should aim to minimize the amount of partly-degraded organic matter in the soil prior to sowing a spinach crop.