Factsheet 08/05

Hardy Nursery Stock

Horticultural Development Council

Bradbourne House
East Malling
Kent ME19 6DZ
T: 01732 848383
F: 01732 848498
E: hdc@hdc.org.uk

The biology and control of two-spotted spider mite in nursery stock

John Buxton, ADAS

Two-spotted spider mite can damage nursery stock grown outdoors and under protection leading to reduced plant vigour and a subsequent decline in plant quality. This factsheet provides guidance on how to minimise this pest through an integrated approach of reliable crop monitoring, cultural, biological and chemical control measures.

Introduction

Although spider mite can damage nursery stock grown outdoors, particularly when summer temperatures are high, the recent trend of growing under protection has led to it becoming a serious and widespread pest on many HNS nurseries across the UK. This is mainly due to the warmer conditions associated with crops grown under glass or in polythene tunnels that enable spider mite development and spread to be very rapid.

An integrated strategy that combines cultural and biological control with minimal use of acaricides can enable good levels of spider mite control to be achieved. Regular crop monitoring is an essential part of this strategy however as low mite levels can easily be overlooked leading to rapid population increases and associated plant damage before action can be taken.

1 Two-spotted spider mite adults and nymphs easily identified by two large dark spots on the upper body

Species of spider mite

The most common species of spider mite found on nursery stock in the UK is the two-spotted mite *(Tetranychus urticae)* which is the focus of this factsheet.

However, there are two other spider mites which growers should learn to identify and distinguish from the two-spotted mite. The differences between them can easily be seen using a x10 hand lens. The mites are:

The fruit tree red spider mite *(Panonychus ulmi)* that occurs mainly on outdoor tree crops, such as Malus, Sorbus and Cotoneaster. This can be identified by its brownish red colour and the long hairs (setae) visible on the upper body which arise from white tubercules.

The citrus red mite *(Panonychus citri),* which has been uncommon until recently but appears to be growing in importance. It has so far damaged a range of plants under protection, including Ilex crenata, Choisya, Skimmia, Prunus laurocerasus, and Elaeagnus, and its host range appears to be increasing. It can be identified by its brownish red colour and the presence of long hairs or setae. However, unlike the fruit tree red spider mite, these hairs do not have white spots at their base.

2 The fruit tree red spider mite *(Panonychus ulmi)* is brownish red in colour, has long dorsal hairs and white tubercules

3 The citrus red spider mite *(Panonychus citri)* is brownish red in colour, has long dorsal hairs and tubercules the same colour as its body

Major host plants of two-spotted spider mite

The two-spotted spider mite has a number of host plants including herbaceous perennials, climbers, shrubs and trees. Table 1 lists some of the most common species affected.

Weeds, such as willowherb and willow, are also susceptible to attack.

Table 1 Host plants of two spotted spider mite

Herbaceous perennials/climbers	Shrubs	Trees
Clematis	Aralia	Acer negundo ‘Flamingo’
Digitalis	Buddleia	Laburnum
Euphorbia	Ceanothus	Prunus
Geum	Choisya	Sorbus
Lavatera	Crinodendron	
Lonicera	Euphorbia	
Meconopsis	Hydrangea	
Hydrangea	Lavatera	
Penstemon	Potentilla	
Phormium	Rose	
Wisteria	Sambucus	
	Spirea	

Plant damage, mite dispersal and distribution

Spider mites feed by rasping the lower leaf surface with their mandibles. Plant sap is then sucked out, leading to many small pale or yellow spots over the leaf.

As damage increases the leaf may turn yellow and eventually the whole plant may die. With experience, and using a x10 magnifying hand-held lens, this damage can easily be recognised and distinguished from that caused by other pests, such as leafhopper and thrips. Typically, the individual white spots due to leafhopper damage are much larger compared to those associated with spider mite damage. Also leafhoppers can usually be found on the lower leaf surface when this type of damage is seen. Thrips damage is easily distinguished by the presence of black faecal spots on the white damaged areas.

When damage is severe, mite numbers build up so much that they deplete their food source; large numbers of mites then gather on the end of shoots and are visible as pale brown balls. The associated webbing is sticky; allowing mites to be spread just by staff touching infested plants. Mites may also be spread on silk threads from outdoor hosts, such as willow herb and willow, or on air currents, entering glasshouses or tunnels through the vents.

On a few plant species, the feeding of two-spotted spider mite causes an extreme reaction, leading to complete leaf yellowing in a short space of time and, if left untreated, the death of the plant. The best example of this phenomenon is on Crinodendron. Batches of this plant should be monitored especially carefully if plant quality is not to be reduced.

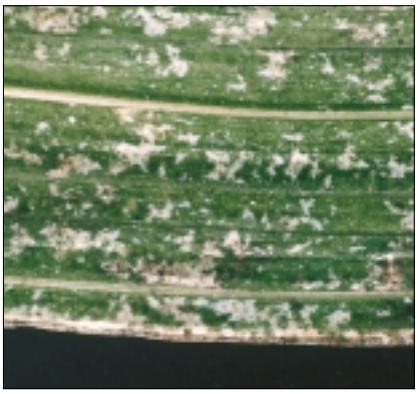
4 Characteristic yellow leaf spots on Aralia due to two-spotted spider mite damage

5 Two-spotted spider mite damage to Euphorbia

6 Pale brown balls of mites on Choisya leaf tips and associated sticky webbing that enables mites to be spread easily on clothes

7 Extreme leaf yellowing and loss of plant quality on Crinodendron caused by spider mite feeding

8 Leafhopper damage – typically the individual white spots where damage has occurred are much larger than those caused by spider mite



9 The presence of black faecal spots on the white damaged areas is indicative of thrips damage

Biology and life cycle

The two-spotted spider mite lays eggs in the spring, summer and autumn. When food is scarce during the winter months it hibernates, though if conditions remain favourable it will continue to lay eggs all winter

.

Winter

Mites overwinter as hibernating females which are brick red in colour. They hide in the rim of pots, underneath pots, on plant debris, or on the glasshouse structure. During this time they do not feed or lay eggs and cannot be controlled by acaricides.

Spring

When temperatures and daylength increase in spring, the hibernating females become active and will lay eggs, after which they die. Two-spotted mite eggs are round and translucent.

The eggs hatch into larvae, then moult to become nymphs, and finally develop into summer adults which are characterised by two large dark spots on the upper body. Both males and females are produced with the female being larger and less active than the males.

All active stages feed on the lower leaf surface causing the damage described earlier. Silken thread or webbing is often copiously produced by the mites and can easily be seen with a hand-held lens.

Summer

Breeding continues throughout the summer with the speed at which the mites develop being directly related to temperature. In cool conditions (15ºC) the life cycle takes about 35 days to complete while at 25ºC it takes as little as 9 days. In warm summers therefore, spider mite development and population build up can be extremely rapid.

Relative humidity (RH) is also an important factor influencing population build up and in general, low humidity contributes to an increase in spider mite numbers. However, even in areas where %RH is high, such as propagation houses, spider mites can still damage nursery stock.

The type of host plant does not significantly affect the duration of the life cycle but it can dramatically affect population build up. On susceptible plants, such as Choisya, the number of summer eggs laid by the female mites will rise substantially compared with other plants. For example, trials have shown that the mean total number of eggs produced by each female increases from 12 on Ceanothus to around 86 on Choisya.

Autumn

In early autumn egg laying continues but the declining day length and temperatures trigger hibernation. The female mites become orange red and seek sheltered places to hide. This process starts around mid September in unheated tunnels or glasshouses. However, if the growing structure is heated, and/or supplementary lighting is used, breeding may continue all year round as hibernation is just a method that enables mites to survive adverse conditions.

10 With practice, the round, translucent eggs of the two-spotted spider mite can be detected with a x10 hand lens

11 As day length declines and the temperature falls, female two-spotted spider mites become orange-red and seek sheltered places in which to hibernate

Control strategy

Integrated pest management (IPM) methods which use biological control in combination with cultural control and where necessary acaricides, have proved to be an effective and sustainable strategy for spider mite control.

However, skill and training is needed to ensure that IPM techniques work well and growers should nominate at least one member of staff to specialise in IPM on the nursery. In particular, training in crop monitoring and accurate record keeping of pest populations is vital as it forms the backbone of a successful IPM programme.

1 Crop monitoring

Monitoring is essential for the effective control of two-spotted spider mite. If monitoring is done correctly it should reduce the risk of population build up and crop damage, as corrective action can then be taken in good time.

Methods

As there are no traps available to help carry out crop monitoring, the only reliable method is to visually check known host plants. A x10 magnifying hand lens should be used to inspect the undersides of leaves for the presence of the pest.

Tapping plants over a white card or tray can also be effective and may provide a more rapid method of determining spider mite infestation.

Alternatively, a practiced eye can soon pick out the tiny white speckles on the leaves that are a tell-tale sign of spider mite infestation.

A good knowledge of the plant species and the varieties likely to be affected by two-spotted spider mite is vital when monitoring crops (Table 1). There is no set pattern to be followed but susceptible crops should be examined in detail even when no obvious signs of infestation are present, inspecting the leaf undersides (a minimum of 10 leaves per plant) and looking for spider mites.

Frequency

Monitoring should be done on a weekly basis particularly between April and October.

Pest thresholds

There are no set thresholds for two-spotted spider mite on nursery stock plants, but as a guide, when using *Phytoseilus persimilis* for biological control (which should be used as a routine), if the ratio of prey: predator exceeds 10:1 then corrective action should be taken. In other words, if there is on average less than one predator per 10 spider mites, then corrective action is likely to be needed.

2 Cultural control

Cultural control in the form of nursery hygiene should never be overlooked. It is important to have an end-of-season clean up that includes disinfecting pots, glasshouse and/or polytunnel structures with an approved biocide product, for example Jet 5. If possible, also replace any capillary matting and tidy up the production site. This will help prevent spider mite build up in the following season as well as reduce disease incidence.

Removing weeds, particularly willow herb and willow, from the ground around the production beds and under benches at the beginning of the season, and at intervals thereafter, is also a good hygiene measure.

There are few other cultural measures growers can take other than increasing humidity but whilst it may reduce the build up of spider mites, it can lead to other problems such as botrytis. Venting polytunnel and glasshouses and circulating air with the help of fans can reduce summer temperatures and help slow spider mite development.

One other measure that can easily be carried out is to group spider mite susceptible plant species together in the same tunnel or tunnels. This not only aids monitoring, but makes the distribution of predatory mites such as *Phytoseiulus* much easier and less time consuming.

3 Biological control agents

Using biological controls as the main component of the IPM programme reduces reliance on pesticides and minimises the possibility of spider mite populations developing resistance to such chemicals.

The range of biological control agents currently available in the UK are listed in Table 2 overleaf with information on which spider mite development stages are controlled, application rates and recommendations for optimising performance.

4 Chemical control

If the spider mite population grows too rapidly for the predator to control, or there is a sudden outbreak of spider mite and a hotspot of infestation occurs, an acaricide can be used to bring the pest population back under control. In order to keep the IPM programme running, it is best to use an acaricide that does not kill the predators.

However, in some situations growers may prefer to rely on acaricides, or at the end of the season use them as a clean up measure to reduce the population carry over to next season. Table 3 below lists all approved acaricidal products for use on ornamentals in the UK.

Combining biological and chemical control

Most biological control programmes for two-spotted spider mite rely predominantly on the use of *Phytoseilus persimilis* which enables excellent control to be achieved. It is introduced weekly at $2/m^2$ – $5/m^2$ from week 16 until around week 40, as a preventative measure. If monitoring of crops shows that levels of spider mite are low, this rate can be reduced, but each case must be considered on an individual basis.

Application rates should be increased to $10 – 20/m^2$ (curative rate) for several weeks if spider mite numbers are seen to increase, or when the ratio of spider mite to predator reaches around 10:1. Further monitoring will then show whether this action has succeeded in reducing the spider mite levels.

Alternatively, an IPM compatible acaricide such as Torq can be applied, sometimes as a spot spray rather than an overall spray, to bring the spider mite numbers down. If an acaricide is used and then biological control is restarted, always check the product label for details of the interval needed between acaracide application and the safe reintroduction of predators. This interval varies between products and

some acaricides (eg Talstar) are totally incompatible with biological control as they are both broad spectrum in action and persistent on foliage. Further details on the interval needed can be found in literature produced by biocontrol companies.

Typically, the other biocontrol agents are then used as a supplement to *Phytoseilus*. For example, *Amblyseius californicus* is often introduced early in the season before spider mites become established and is particularly useful during periods of high summer temperatures if *Phytoseilus* is proving less effective. Introduction rates for *Amblyseius* are governed by the licence and range from 2–5/m^2, according to the number of prey. Monitoring predator numbers should be carried out weekly, as for *Phytoseilus*.

Feltiella acarisuga is a useful supplement to both the predatory mites described above, especially for hot-spot treatments. The midge is supplied as pupae in cartons, which should be placed in a shady area near to the spider mite infestation.

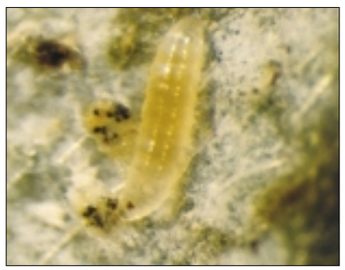
The ladybird *Stethorus punctillum* is now available on a limited scale from several commercial suppliers, and can also be considered for use as a supplement to *Phytoseilus persimilis* during the summer months. However, practical experience is currently lacking and, as it is expensive, small-scale use is recommended until more is known about its effectiveness in nursery stock.

Table 2 Biological control agents currently marketed in the UK for two-spotted spider mite control

Control agent	Type	Description	Pest range controlled	Spider mite stages controlled	Use outdoors	Use under protection	Application rate		Application frequency	Optimising performance	Comments
							Preventative	Curative			
Phytoseilus persimilis	Predatory mite	Pale red pear-shaped mites	Spider mites only	Nymphs and adults	Can work well, particularly in summer	Very effective	2–5/m^2	10–20/m^2	Weekly intervals from week 16 to 40 as a preventative measure particularly where TSSM has caused problems in the past	Plants need to be touching as it has limited dispersal over the crop. Works best at 15–25ºC. Between 20–25ºC it develops more rapidly than its prey. Less effective at the tops of plants where high temperatures and low %RH prevail.	Most widely used predator and excellent control can be achieved. It is sold with a carrier such as vermiculite and is applied by shaking a bottle over the infested area of the crop.
Amblyseius californicus	Predatory mite	Pale straw coloured mite	Spider mites, small insects	Nymphs and adults	Untried. Naturally occurring outdoors in some locations in the UK	Very effective; able to feed on alternative prey when spider mites scarce	Governed by licence but usually 2–5/m^2	10/m^2	Monitoring should be weekly to assess numbers	Works best during the summer months as more tolerant of high temperatures and low humidity than *Phytoseilus.* Can be introduced preventatively and can establish on alternative prey (eg Collembola) when spider mite numbers are low	Can only be used under licence, which is obtained by the supplier, as it is not considered a native species.Can survive even when spider mite numbers are low. It is sold with a carrier such as vermiculite and is applied by shaking a bottle over the infested area of the crop.
Feltiella acarisuga	Predatory midge	Small delicate flies which are nocturnal and rarely seen. Creamy yellow or pale orange larvae. White pupal cocoons.	Spider mites only	Eggs, nymphs and adults	Untried but often occurs naturally outdoors when spider mite numbers are high	Very effective on existing spider mite colonies and is particularly useful for hot-spot infestations where a corrective pesticide is not desirable	0.5/m^2	5/m^2	Usually only once or twice per season	The cartons that contain the female midges as pupae, should be placed in a shady area near to the spider mite infestation. Adult midges emerge, mate and can fly to locate areas of mite infestation.	Female midges are attracted to spider mite colonies by chemical stimuli. This midge can therefore occur spontaneously wherever colonies of spider mites are present.
Stethorus punctillum	Predatory ladybird	A grey or black ladybird about 1.2–1.5 mm in length. The larvae are grey.	Spider mites only	Eggs, nymphs and adults	Not likely to be effective	Use in hot spot infestations under protection	2/m^2	4/m^2	As needed	Only works when high numbers of spider mites have built up.	Not suitable for use as a preventative measure as they disperse immediately if numbers of prey are too low. They come in a tube containing active adult beetles.

12 *Phytoseilus persimilis* is an effective and most widely used predator for two-spotted spider mite control in nursery stock, characterised by a pale red, pear-shaped body

13 *Amblyseius californicus* is an extremely useful supplement to *Phytoseilus* particularly in high summer temperatures



14 The creamy yellow larvae of *Feltiella acarisuga* feed on spider mite eggs, nymphs and adults

15 The adult midges of *Feltiella acarisuga* will fly to locate spider mite infestations and are a useful supplement to predatory mites in an IPM programme

16 *Stethorus punctillum* is very efficient at locating colonies of spider mites and can be used as a supplement to *Phytoseilus* in the summer. Use sparingly until its effectiveness in HNS is established

Table 3 Acaricides approved for use in the UK for spider mite control

Product	Active Ingredients	Chemical Group	Stages Controlled			Use outdoors	Use under protection	Compatible with IPM	Comments on mode of action and use
			Eggs	Nymphs	Adults				
Granular									
Temik	Aldicarb	Oxime Carbamate		✓	✓	✓	✓	No, unless used 4 weeks or more before predators introduced	Very toxic material that is applied to compost surface. Needs an interval of four weeks between application and marketing. SOLA 1932/2000.
Foliar sprays									
Dynamec	Abamectin	Macro cyclic lactone		✓	✓		✓	✓	Contact and residual. Translaminar effects. Surface residue decays rapidly so predatory mites can recolonise rapidly (5–7 days) after application
Talstar	Bifenthrin	Pyrethroid		✓	✓	✓	✓	No, harmful to beneficial insects for several weeks	Contact and residual. Very broad spectrum.
Apollo	Clofentazine	Tetrazine	✓	✓ (young)		✓	✓	✓	Needs careful timing in early spring to coincide with summer egg laying period. Magenta colour leaves a deposit on treated leaves.
Masai	Tebufenpyrad	Mitochondrial inhibitor	✓	✓	✓	✓	✓	✓	Mitochondrial inhibitor. Safe to introduce predatory mites within 5 days of treatment.
Torq	Fenbutatin oxide	Organotin		✓	✓		✓	✓	Contact and ingestion. Safe to predatory mites even when over sprayed. Works best at temperatures above 15ºC.
Oberon	Spiromesifen	Ketoenole	✓	✓	✓		✓	✓	New active so no resistance likely. Slow acting as inhibits lipid synthesis. SOLA 1718/2004.
Agri 50	Alginate polysaccharide	Physically acting		✓	✓	✓	✓	✓	A product that suffocates the mite. Contact acting product so must hit the mites to be effective. Under leaf coverage is vital.
Eradicoat	Naturally derived polymers	Physically acting		✓	✓	✓	✓	✓	Contact acting product so must hit the mites to be effective. Under leaf coverage is vital.
Majestik	Naturally derived polymers	Physically acting		✓	✓	✓	✓	✓	Contact acting product so must hit the mites to be effective. Under leaf coverage is vital.
Certis spraying oil	Oil based	Refined petroleum oil	✓	✓	✓	✓	✓	✓	Contact acting product so under leaf coverage essential. For use on oil-tolerant plants only.

- **The Long Term Arrangements for Extension of Use (LTAEU) allow extrapolation of use from a label approval or SOLA to use on an ornamental crop at grower's own risk. However, use must be in a similar manner and rate as that specified on the label or Specific Off-Label instructions; be cautious as some treatments may prove to be phytotoxic.**
- **Always follow label recommendations, including rate of use, and check the range of ornamentals listed which can be safely treated.**
- **Contact the Pesticide Safety Directorate Information Service (01904 640500 or visit www.pesticides.gov.uk) or seek other professional advice if in doubt about which products are permissible on HNS or how to use them correctly.**
- **Important – Growers must always check the current approval status of products listed in this factsheet before intended use as this could have changed since it was produced.**

Resistance management of spider mites

As mites can complete many generations (up to 12 a year) there is always the potential of selecting for resistance if the same acaricide is used too frequently.

In order to reduce this risk, it is very important to rotate between different chemical groups and to always follow the resistance management strategy outlined on the product label. This should specify the maximum number of treatments a crop can undergo in a year.

The exact nature and level of resistance in UK spider mite strains is not well documented. However, work at research institutes during the past five years has shown some resistance to Torq, Masai, Apollo and Talstar. Dynamec, Temik, and Oberon are still fully effective as far as is known.

Products such as Majestik, Agri 50 and Spraying Oil are physically acting products which work by coating the spider mites and suffocating them and are unlikely to encounter resistance. However, single-site acting products such as Masai, which act on only one enzyme site, are very vulnerable to the development of resistance.

The resistance level is not constant however and if one strain has not been exposed to a particular acaricide for some time, then the resistance may be lost enabling that acaracide to become effective again.

Table 4 Risk of two-spotted spider mite developing resistance to acaricides currently approved for use in the UK

Product	Mode of action	Risk of resistance	Resistance found
Temik	Anti-cholinesterase	Low	No
Dynamec	GABA inhibitor	Moderate	Not in the UK
Talstar	Nerve inhibitor	High	Yes
Apollo	Ovicide	High	Yes
Masai	Mitochondrial inhibitor	High	Yes
Torq	Organotin inhibitor	High	Yes
Oberon	Chitin synthesis inhibitor	Low	No
Agri-50	Physical multi-site	Low	No
Eradicoat	Physical multi-site	Low	No
Majestik	Physical multi-site	Low	No
Spraying Oil	Physical multi-site	Low	No

How to avoid the development of resistance

- Where possible use non-chemical control methods (eg biological).
- Do not use rates below those recommended on the product label.
- Rotate products where the likelihood of resistance developing is moderate to high (see Table 4).
- Restrict chemical treatment to hot spots of pest activity whenever possible.

Spray application methods

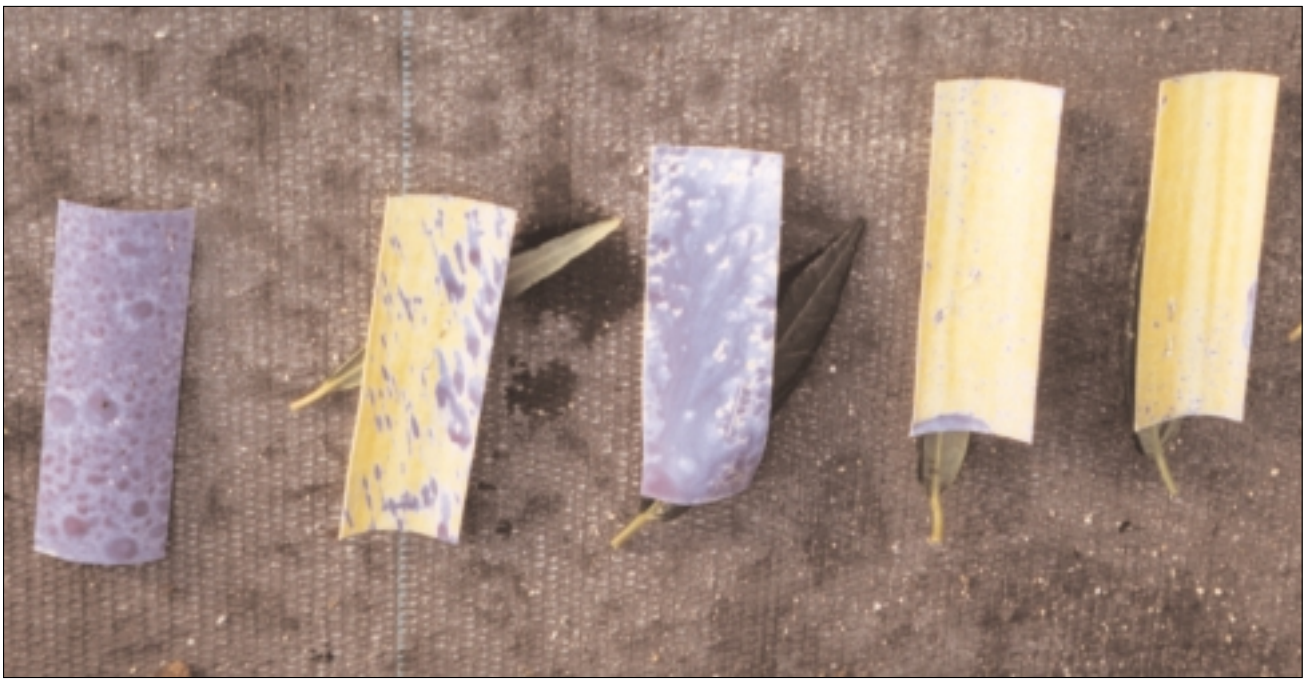
As spider mites inhabit the lower leaf surface they are difficult spray effectively.

High volume sprays are should be used and water volumes should be between 500 and 1,500 litres/ha, depending on crop height and density. Cone nozzles attached to a spray lance are often used fed by a trailer-mounted sprayer.

To achieve the best coverage there should be enough spray pressure to move the leaves, so that the underside leaf coverage is improved, though excess spray and run-off should be avoided. Water-sensitive paper available from Spraying Systems UK Ltd, can be used to check that the underside of the leaves have been adequately covered. This is stapled to the leaves in strategic areas and shows even the smallest droplets as blue spots on the paper.

Where a dense crop is grown in a bed system, spray coverage may also be significantly improved if a spray boom with a width equal to that of the bed is used.

Motorised knapsack sprayers are also often used, especially if only small areas require treatment.



17 Water sensitive paper is useful to determine spray coverage with spray droplets appearing as blue spots

Action points by month

As the damage caused by the two-spotted spider mite to nursery stock can lead to unsaleable plants, it is essential to employ a strategy that takes into account all possible control measures. An action calendar, which highlights the tasks to be considered at specific times of the year, is given in Table 5.

Table 5
Calendar of action points for effective control of two-spotted spider mite

Month	Action needed
January	Plan an IPM programme for the coming year, incorporating lessons learnt from the previous year. Be prepared to amend this programme weekly depending on the results of crop monitoring.
February	Consider grouping susceptible plant species together on the production site as this will greatly simplify the application of control measures.
	Train staff to recognise mites and their damage symptoms – tiny white or yellow speckles or leaf yellowing, depending on host plant species.
March	Start monitoring protected crops for eggs, mites and mite damage. Use a good hand-held lens to check the undersides of leaves. Check areas in particular that have been the subject of infestations in the past. Consider using Apollo 50 SC (Clofentazine) if eggs are seen. This will not be needed if spider mite numbers were very low the previous last autumn.
	Ensure a number of staff are trained in the timely introduction and management of appropriate biological control agents.
April	Commence a preventative programme for crops under protection involving weekly or fortnightly introductions of *Phytoseilus persimilis* at a rate of 2–5 per m^2. Monitor crops on a weekly basis.
May	Continue monitoring protected crops weekly. Increase predator introduction rates or apply a spot spray if more than five spider mites per leaf are found.
	Start a preventative programme for spider mite control on outdoor crops.
June/July/August	Monitor susceptible crops regularly as a routine measure. Rates of predator introduction are normally highest in this quarter.
	Venting polytunnels and glasshouses or circulating the air with fans can help to reduce the temperature and slow spider mite development.
	Consider using *Amblyseius* to supplement *Phytoseilus* as it is less sensitive to hot, dry conditions.
	If localised hot spots are found, consider using either *Feltiella* or *Stethorus.*
	Consider using a corrective acaricide; or increasing the rate of *Phytoseilus* if more than 5 spider mites per leaf are found. Pay close attention to spray coverage when applying acaricides, especially on the underside of leaves. In some circumstances, such as crops grown in beds, a boom applicator will give the best results. Careful selection and rotation of products should be practised, in order to avoid resistance build up.
September	Continue IPM programme until around week 38–40 (under protection).
	Ensure spider mite numbers are as low as possible in unheated crop areas before the end of September to prevent mites hibernating.
	Consider using an acaricide as past of the end of season clean up if spider mite numbers have been high. At this stage it need not be compatible with biological control agents.
October	In heated structures ensure spider mite numbers are as low as possible and if need be use an acaricide to clean up production areas.
November	Complete the end of season nursery clean up.
December	Review success of IPM programme with staff and/or your consultant.

Further information

A colour handbook, Biological Control in Plant Protection by Neil Helyer, Kevin Brown, Nigel D Cattlin, is available. Published by Manson Publishing Ltd (020 8905 5150) ISBN 1-874545-28-6

Alford, D V (1991) A colour Atlas of Pests of Ornamental Trees, shrubs and flowers. Published by Wolfe press, ISBN 0 7234 16435.

'Knowing and recognising' by M Malais and W Ravensberg. Published by Reed press, ISBN 90 5439 126 X.

Additional information:

August 2005

Design and production: HDR Visual Communication