Managing spider mites on cherry

HORTICULTURE

Contents

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Introduction

Growing cherries under protection not only improves the consistency of supply but aids fruit quality through the reduction of fruit splitting caused by spring frosts and summer rainfall. However, the dry, warm conditions created are ideal for spider mite proliferation.

Pest mites commonly found on cherry include the two-spotted spider mite (*Tetranychus urticae*) and the European fruit tree red spider mite (*Panonychus ulmi*). *T. urticae* is a widespread species that feeds on several crops, including walnut, strawberry, blackcurrant, gooseberry, raspberry, apple, cherry, pear and plum. *T. urticae* overwinters as adult females, whereas *P. ulmi* overwinters as eggs.

Protected crops (Figure 1) promote the development rate and reproduction of both mites, leading to rapid build-up of populations in early spring. Both pests feed on the underside of the leaves. *P. ulmi* damage first appears as a light speckling before the leaves turn a dull green colour, then brown and finally silvery bronze.

T. urticae produces symptoms of stippling, bronzing and, in severe cases, webbing and eventually early defoliation. It can sometimes cause extensive webbing, which hampers fruit picking. Both of the mites can reduce the leaves' photosynthetic ability, leading to early defoliation. This affects yield and reduces fruit-bud formation for the following year. High populations can build up close to harvest when there are few reliable control options available.

This guide will help growers to identify the mite pests found in cherry and the damage that they cause.

Figure 1. Protection promotes the development rate and reproduction of spider mites

It explains their biology and life cycle and how to monitor crops for their presence. It goes on to offer guidance on the need to gain early control in light of the likely measures required for other pests such as spotted wing drosophila. Useful help on how to implement biological control measures, along with the use of acaricidal sprays, is also provided.

Michelle Fountain
NIAB EMR

Key messages

Spider mites have become a major problem in some tunnel-grown cherry crops (Figure 2). This guide describes how best to manage spider mites in protected cherry, taking account of the conflicting measures which can be necessary to control other pests.

Figure 2. Severe spider mite damage in a tunnel-grown cherry crop

- Prevention and control early in the season will help reduce the likelihood of damage occurring nearer to harvest
- Regular monitoring of pest mites and their predators is essential in managing control strategies
- Start monitoring for pest mites on the dormant buds, spurs and tree bark before flowering, then, after blossom, assess leaves for pest mites and predators
- Introducing and promoting populations of predatory mites from bud burst onwards will help to keep spider mites in check
- If naturally occurring predatory mites are low or absent at the start of growth, the generalist predator, *Amblyseius andersoni*, can be released
- Spray applications to control other pests such as spotted wing drosophila (SWD) can be harmful to predatory mites, so gaining early control with predators is essential, before SWD sprays are required
- If biological control methods are insufficient, it may be necessary to apply crop protection products to gain control

Biology, recognition and life cycle

Two-spotted spider mite (*Tetranychus urticae*) and the European fruit tree red spider mite (*Panonychus ulmi*) are both found damaging UK cherry crops. *Tetranychus mcdanieli* was recorded in Europe in 1981 but is probably currently of minor importance in comparison with the other two.

Two-spotted spider mite

Two-spotted spider mite (*T. urticae*) is considered to be the principal pest and particularly favours the warm, dry conditions created in protected cherry crops.

Adult mites are 0.6mm in length (Figure 3), making them difficult to detect, especially early in the season or if populations in the trees are small. The overwintered form is orange-red, but the reproductive summer form is yellowish green with two dark patches on either side of the body. Eggs are 0.3mm, spherical and translucent, becoming reddish before hatching. Adults have eight legs, but the immature stages have only six.

Figure 3. Adult two-spotted spider mites and their eggs on the underside of a leaf

Figure 4. Diapausing red adult female two-spotted spider mites

It overwinters as a diapausing (red) adult female (Figure 4), quite probably in the cracks and crevices of the trees and the post and wire structure. This allows reproduction and population growth to begin early in the spring, although not usually earlier than February. During the winter, the adult females don't feed or lay eggs and cannot be controlled by acaricides. On outdoor crops, the diapausing females become active in March when they begin to lay eggs (about 30–40 each), after which they die. On hatching, the pest develops through a series of larval and nymph stages before turning into pale green egg-laying adults.

At around 15°C, the life cycle is completed in about 35 days. At 25°C, the cycle speeds up, taking only nine days. Each female produces between 50–100 eggs, depending on the host crop.

Populations increase extremely rapidly as temperatures increase. Hot and dry conditions favour this pest and low humidity contributes to an increase in spider mite numbers. Under tunnels, many eggs are laid and can be found until October, although these will not overwinter.

European fruit tree red spider mite

European fruit tree red spider mite *(P. ulmi)* adults are 0.4mm long with a dark-red oval body (Figure 5). There are conspicuous, pale, long setae (hairs) arising from tubercles (bumps) on the body. The legs are short and pale. Eggs are 0.17mm, dark red in winter and paler in the summer. They are less spherical than *T. urticae* eggs and more 'onion' shaped. The adults have eight legs, but the immature stages have only six.

It overwinters as eggs in the bark of trees (Figure 6), particularly on the smaller branches and spurs. Eggs hatch in April and May, although exact timing varies from orchard to orchard and may be earlier in crops under protection.

P. ulmi often remains under the leaves throughout development and the resulting eggs, which are paler than the red spherical winter eggs, are laid on the underside of the leaves.

Figure 5. Fruit tree red spider mite adults

Development then takes approximately one month. Unlike *T. urticae*, *P. ulmi* does not produce webbing for protection but can produce a single thread for wind dispersal. Overwintering eggs are laid from September but can begin earlier where infestations are heavy.

Figure 6. Fruit tree red spider mite eggs

Crop damage

Spider mites damage cherry yields indirectly by feeding on the leaves, causing stippling, bronzing and eventually early defoliation and bud damage, which affects the following year's yield.

T. urticae feed on the underside of the leaf, sheltered by fine webbing, sucking sap from leaf cells. The damage is seen initially as small patches of pale or yellow spots (like a sprinkling of pepper – Figure 7) on the upper surface of the leaf. If left uncontrolled, damage spreads across the whole leaf, which turns yellow, withers and dies (Figure 8), resulting in premature leaf-fall. Where damage is severe, the spider mites produce a webbing which covers the leaf (Figure 9).

Webbing first appears as patches within the crop but can spread across the whole crop in very severe cases. There will be significant levels of mites both in the webbing and in the surrounding non-webbed crop.

Figure 7. Early symptoms appear as a speckling of yellow spots

Figure 8. Severe damage, exhibiting yellow leaves which are withering and dying

Figure 9. Webbing produced by spider mites covering the leaf canopy

P. ulmi also feeds on the underside of the leaves, with damage first appearing as light speckling. The leaves later develop a dull green colour, then brown and finally silvery bronze. This gives rise to brittle foliage and early defoliation. Heavy infestations can affect yield and fruit-bud formation into the following year.

The damage caused by both pests reduces the photosynthetic ability of the tree, adversely affecting tree vigour and, potentially, yields in subsequent years. In addition, spider mite attack can lead to fruit shrivel and rejection by customers.

Fruit contaminated with extensive webbing is difficult to pick and can lead to higher labour costs.

Monitoring for the pest

Regular inspections of the crop should take place to identify the pest before plant damage begins to occur. Such inspections should begin even before the leaves unfurl. Check the bark and, importantly, the spurs of younger branches. Spider mite adults and eggs are minute and therefore difficult to see with the naked eye. Using a hand lens (x10 or x20 magnification), it is possible to see all stages of *T. urticae* and *P. ulmi* on the spurs and leaves of cherry (Figure 10).

Figure 10. Use of a x10 or x20 hand lens allows all stages of the life cycle to be seen

Figure 11. Inspections should begin in spring, even before new growth develops

Approach to monitoring

- Inspections should commence in spring even before new growth has developed (Figure 11)
- It is recommended that each cherry orchard is examined at least fortnightly, and preferably weekly, for pests and diseases during the growing season
- Check spurs, bark and buds early in the season for overwintering red adults of *T. urticae* and red eggs of *P. ulmi*
- Inspections should aim to cover a representative portion of the orchard at each visit. This is achieved by following a zigzag transect across the crop
- Later in the season, as the crop canopy develops, look over the trees as you approach them. Observe any area, patches of trees or branches within trees that have discoloured leaves (see crop damage section)
- Try to pick out and inspect leaves from trees that look potentially damaged as this will increase the likelihood of identifying the problem
- Pick suspect leaves from the trees and inspect the underside with a hand lens
- While searching for pest mites, make a note of any predatory mites which move much faster over the leaf surface and have longer front legs. This will help you to decide whether an intervention is needed and dictate the control measures used
- If spider mites are identified, but no predators are found, this should be cause for concern and trigger the implementation of control measures

Control

Figure 12. Willowherb acts as an alternative host to two-spotted spider mite, so must be controlled in the vicinity of cherry orchards

Reliable control of spider mites early in the season, particularly in crops where damage occurred in the previous year, will reduce the risk of damaged fruit and foliage nearer to harvest.

Cultural control measures

Ideally, newly received trees should be placed in quarantine and inspected before planting. Where possible, plant new orchards far away from known problem orchards.

As *T. urticae* is known to overwinter in the crevices of crop support structures, consider the type of structures used at planting. For example, *T. urticae* is known to overwinter in support canes, so these are more likely to harbour the pest.

Farm staff that spend time working within the cherry orchards should be trained to recognise early symptoms of leaf damage and report this to the farm management team.

It should be noted that spider mites can be carried on workers' clothing, so thought should be given to which areas farm staff have been working in to minimise spread to other crops.

Both willhowherb (Figure 12) and willow trees are alternative hosts to two-spotted spider mite, so pay particular attention to control of willowherb and choose to plant cherry orchards at some distance from willow trees (Salix species).

Most cherry growers need to implement control measures for spotted wing drosophila (SWD). Some of the sprays used to control SWD (particularly the synthetic pyrethroid products) can be damaging to the naturally occurring and introduced predatory mites which are often used to control *T. urticae* and *P. ulmi.*

It is essential that all cherry growers employ strict levels of hygiene in their orchards to discourage SWD. This involves removing any unharvested and dropped fruits from the crop and treating and disposing of the fruit so that is does not become a source of further SWD populations.

The use of SWD-proof insect mesh netting (Figure 13) around the perimeter of the crop can also reduce the need to apply SWD control sprays. Such mesh should be deployed after blossom to allow pollinating insects to visit flowers. Should SWD sprays be necessary, they should not be applied until white-fruit stage onwards. This will maximise the time available to gain control of spider mite pests and reduce their populations to levels which are not economically damaging before SWD spray programmes begin. It has also been shown that reducing humidity within the crop by crown raising and regular mowing can decrease the incidence of SWD damage.

Biological control measures

Typhlodromus species such as *T. pyri* and *Neoseiulus fallacis* (not commercially available) offer some control of spider mites, but there is often a lag between the population build-up of the pest and the predator, resulting in spider mites overwhelming the trees before the predator can gain control. In addition, *T. pyri* is not common on cherry, probably because the leaves are smooth and hairless and the mite is unable to survive on these surfaces. *Neoseiulus californicus* is effective, although somewhat selective in its feeding habits, but this species is not approved for outdoor use in the UK.

The two most promising and available predatory mites for control of spider mites on cherry trees are *Phytoseiulus persimilis* and *Amblyseius andersoni*. Both are approved for use on outdoor cherry trees.

Phytoseiulus persimilis

Phytoseiulus persimilis will only control *Tetranychus*. Other species such as *A. andersoni* have a broader prey range.

Figure 13. Insect-proof netting around the perimeter of a cherry crop helps to reduce the ingress of SWD into an orchard, reducing the need to use alternative control measures

Figure 14. *Phytoseiulus persimilis* adult among two-spotted spider mite eggs (round). The larger oval egg at the foot of the picture is a *Phytoseiulus persimilis* egg

P. persimilis is a spider mite predator specialist and may have good potential for curative control, but its reliance on spider mites makes it difficult to sustain on trees when the pest is not present. Because *P. persimilis* will only feed on *T. urticae*, other pest mites may persist and increase. In addition, *P. persimilis* does not overwinter in cold winters in the UK.

P. persimilis works best at temperatures above 15ºC but is ineffective above 30°C. Between 15–30°C, *P. persimilis* (Figure 14) reproduces twice as quickly as *T. urticae*. It is capable of very rapid population growth and eats all stages of the two-spotted spider mite (eggs, nymphs and adults). *P. persimilis* is less effective at <60% relative humidity.

P. persimilis has been successfully used for *T. urticae* control for many years and a general guide is that there should be more than one predator per 10 spider mites.

Amblyseius andersoni

Amblyseius andersoni is a commercially available generalist predator (Figure 15) which will feed on many mite species.

It will feed on *T. urticae*, *P. ulmi* and also pollen grains, which is particularly beneficial as its population can increase during peaks in pollen production even when its prey is scarce. It is active at a broader temperature range (6–40ºC) than *P. persimilis*. Since it is effective at lower temperatures, *A. andersoni* can be introduced much earlier in the growing season than other predatory mites. It can be used as a preventive measure to prey on spider mites as they emerge from their overwintering stages. In addition, *A. andersoni* appears to last into the next season.

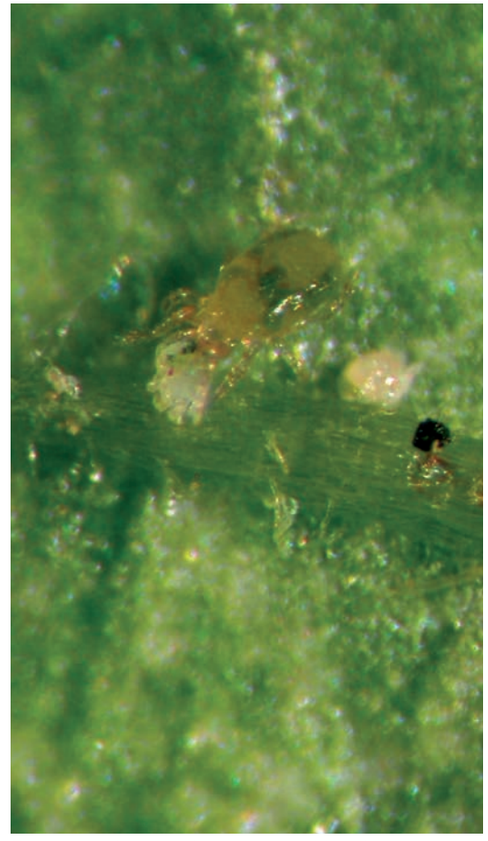

Figure 15. *Amblyseius andersoni* feeding on two-spotted spider mites

Research success using *Amblyseius andersoni*

In AHDB Project TF 219, *A. andersoni* was naturally occurring in all three orchards used in the trials and often overwhelmed any *T. urticae* introduced into the trees for research purposes. Mite populations were almost completely dominated by *A. andersoni*, even in orchards where sprays of lambda-cyhalothrin (Hallmark) had been applied before the trials began. Similar observations have been made in raspberry where *A. andersoni* occurs naturally. Strains of *A. andersoni* have also been shown to be resistant to lambda-cyhalothrin in vineyards over prolonged periods. This predator therefore seems able to tolerate at least some plant protection products.

The researchers working on Project TF 219 deployed Gemini sachets (Figure 16) containing *A. andersoni* in two protected orchards, on every fifth cherry tree. They dispersed evenly on cherry leaves, resulting in uniform numbers of predatory mites on each tree. *A. andersoni* appeared to distribute between trees even in the orchards where branches were not touching.

In the same project in 2016, trials at NIAB EMR aimed to establish the efficacy of *A. andersoni* Gemini sachets to control or prevent *T. urticae* population build-up. The cherry trees were assessed either for preventive control, where Gemini sachets were added before *T. urticae* was introduced, or for curative control, where *T. urticae* was introduced before the Gemini sachets. Both preventive and curative assessments were compared to an untreated control, where only *T. urticae* was introduced to the trees. To provide high populations of the pest, whole potted trees highly infested with *T. urticae* were tied into orchard trees.

Figure 16. Gemini sachet containing *Amblyseius andersoni* introduced to cherry tree to allow release of predators into tree

Although *T. urticae* managed to establish in significant numbers initially, by the final assessment *T. urticae* was reduced in all plots. It was likely that the naturally occurring *A. andersoni* in this orchard halted the population build-up of *T. urticae*.

Other commercial trials have shown promising results using *A. andersoni* Gemini sachets to control spider mites in outdoor apple trees. Commercial trials in the Netherlands using *A. andersoni* at rates of 300–1,200 Gemini sachets/ha gave good control of spider mites in outdoor apple trees. Spider mite populations were also reduced in the year following application.

Research in the Netherlands (Centrale Adviesdienst voor de Fruitteelt) has also demonstrated success at controlling spider mites with releases of *A. andersoni*.

Strategies when employing biological control

It is important to remember when using biological control agents that there is generally a lag phase. Time is needed for the biological control to work. This will depend on the control being used and abiotic factors such as temperature and humidity. Predators are initially hard to find, for the first two weeks, after release. After the predators acclimatise and start to feed and breed, they can be found more easily on cherry leaves. To ensure the predators are alive and well, correct handling and storage are vital from the moment they arrive at the production site.

It is generally best to release the predators into the crops soon after delivery, providing the conditions in the crop are appropriate.

Prevention is better than cure; introduce *A. andersoni* as a preventive measure in the spring even before tunnel covers are in place (Figure 17 – page 14) and long before sprays for SWD begin (generally at white fruit). This way, winter-emerging pest populations will be under control before fruit ripening begins.

A. andersoni is available in a range of delivery systems, including breeding colony sachets where the predator emerges over a number of weeks. Mini sachets are designed to be used in crops where plants do not touch and provide a high number of release points. Water-resistant sachets can be used in outdoor crops and are hooked into the trees. Although *A. andersoni* is also available in bulk bags and tubes, spring releases in cherry orchards are probably best deployed in waterproof slow-release sachets. In AHDB Project TF 219, the introduction of one *A. andersoni* per four leaves appeared to be sufficient to control spider mite in the absence of sprays which may harm the predators. More research is needed on release rates in cherry, but the AHDB project found that one sachet per five trees resulted in an even spread of higher numbers of mites in the treated trees compared with untreated trees.

Should *A. andersoni* introductions be insufficient to gain control early in the season, *Phytoseiulus persimilis* can be used against *T. urticae*, as a curative treatment later in the season when the temperature is over 15°C. Sometimes, only isolated areas of an orchard are badly affected and these can be treated alone. Biological control using *Phytoseiulus* is a numbers game (Figure 18 – page 15).

Training videos instructing staff on how to take delivery of predators and store them are available on the AHDB Horticulture website: horticulture.ahdb.org.uk/videos/tree-fruit

The predator needs to be in the right place (plenty of food) at the right time (optimum conditions) in the right density and if this is achieved, predators will breed well and then spread rapidly.

Monitor the crop weekly after introduction and consider the ratio of pest to predator.

As a general guide, if the ratio of pest to predator exceeds 10:1, then more *Phytoseiulus* should be introduced. Repeated releases at weekly intervals may be necessary to increase numbers to sufficient levels to gain control.

Figure 17. Introduce *Amblyseius andersoni* even before tunnel covers are in place

Typical curative rates for the use of *P. persimilis* are 6/m² for light curative and 20–50/m² for heavy curative control (hotspots only). *Phytoseiulus* tends to win when there are at least several of its eggs on most leaves with spider mites, even with a very high pest level. If predator numbers are building, then, assuming there are no environmental changes that are unfavourable to *Phytoseiulus*, such as temperatures rising above 30°C or dropping below 15°C, it is very capable of beating the spider mite.

The pest is not always distributed evenly throughout the crop but is found in 'hotspots' and the introduction of predators may need to reflect this. When treating these spots, do not place the predators solely in the 'hotspot' as they will largely stay there and consume the pest around it. Instead, apply the predators around the edges of the 'hotspot' to contain any pest migration and allow them to work inwards towards the centre. Some brands of *Phytoseiulus* are sold in smaller bottles of 2,000 mites per bottle to enable a concentrated application over a small area. These are ideal for 'hotspot' work.

If it is clear that crop damage is still likely to occur, despite introducing predatory mites, it may be necessary to apply an acaricide product, before reintroducing *A. andersoni*. Previous spray applications should be considered and 'side effects' data and persistence checked before reintroducing predatory mites. Leave the minimum interval necessary for the harmful effects of previous product applications to decline (Table 1 – pages 18 and 19). Further 'side effects' information can be found on biological-control suppliers' websites.

Figure 18. Populations and numbers of both predator and prey must be assessed when deciding on the numbers of additional predators required to gain control

Chemical control

Very few pest-control products effective against plant-feeding mites are approved for use on cherry. Clofentezine (Apollo 50) is no longer approved for use. Pyrethrins (various products) are damaging to natural enemies in the crop, have a short persistence and have little efficacy against spider mites. Tebufenpyrad (Masai) and abamectin (various products) may be effective at controlling *T. urticae* but have no approval for use on cherry.

Table 1 lists those products currently approved for use on cherry crops which offer direct control of spider mites or incidental control when applied against other pests of cherry.

In choosing a product, careful consideration should be given to the side effects of each on *A. andersoni* and *P. persimilis* predators as this will have a major bearing on the success of biological control being employed.

Where chemical control measures are required, ensure that spray applications are applied to achieve full coverage of the underside of leaves. This will require sprayers to be set up in such a way as to penetrate the crowns of the tree, using sufficient water volume (at least 1,000l/ha). Spray operators should use water-sensitive papers or other spray-deposit technology to ensure the crown of the plant has been reached with good coverage.

It should be noted that certain spray products and adjuvants can give rise to phytotoxicity in cherry. Be guided by the product labels and a BASIS-qualified consultant before applying any crop protection products.

- Hallmark has an EAMU approval to control spotted wing drosophila but is very harmful to predatory mites and has a persistent effect
- Spirodiclofen (Envidor) is approved for use on outdoor cherry for spider mite control and is considered non toxic to *A. andersoni* but is harmful to *P. persimilis*
- Spirotetramat (Batavia) is approved for use on outdoor cherry for aphid control but commercial experience shows that it offers some incidental control of other sucking insect pests such as spider mites
- Both spirodiclofen and spirotetramat are designated IRAC Code 23 so have the same mode of action and should be alternated with products of a different mode of action to avoid the development of pest resistance.
- No more than two applications of IRAC Code 23 products should be used in one season to avoid resistance developing. They should only be applied when necessary and control should rely primarily on the use of predators.

Growers should seek advice from a BASIS-qualified consultant before choosing to apply a crop protection product.

Table 1. Products approved for use on cherry which control spider mites or which offer incidental control when used against other pests

Active ingredient	Product	Approval type	Target pest on label	Mode of action*	Harvest interval	Max. number of applications/year and other information	Side effects on predators**	
							A. andersoni	*P. persimilis*
Lambda-cyhalothrin	Hallmark with Zeon technology	EAMU	Spotted wing drosophila, capsids	3A	7 days	2 applications Approved on outdoor crops only	Very harmful to non-resistant strains. Some strains show tolerance	Very harmful Toxic for 8–12 weeks
Spirodiclofen	Envidor	EAMU	Spider mites	23	21 days	1 application Approved on outdoor crops only Apply no more than 2 sprays of a product with mode of action 23*	Non-toxic	Moderately harmful 25–50% mortality persisting for 1 week
Spirotetramat	Batavia	Full	Black cherry aphid	23	21 days Apply from end of flowering to start of ripening	2 applications Approved on outdoor crops only Apply no more than 2 sprays of a product with mode of action 23*	Unknown	Harmful >75% mortality persisting for 2–6 weeks

*IRAC code – Further details about IRAC (Insecticide Resistance Action Committee) and the full IRAC code list, can be found at http://www.irac-online.org/modes-of-action/. Products with the same Mode of Action should not be applied consecutively

Growers should keep abreast of the changes in approvals and authorisations, which occur continually on horticultural crops such as cherry

**Data on side effects is from the Koppert and Biobest 'side-effects' website (https://www.koppert.com/side-effects and http://www.biobestgroup.com/en/side-effect-manual)

Further information

Useful AHDB project reports

TF 219 Control of spider mite (*Tetranychus urticae*) on protected cherry using the predatory mite *Amblyseius andersoni*

Other useful AHDB publications

Grower Guide – Biocontrol in soft fruit

Biocontrol training video on how to manage predators on taking delivery and introducing *Phytoseiulus* predators for spider mite control – AHDB training video found at: **horticulture.ahdb.org.uk/biocontrol-videos**

Information on the side effects of crop protection products on biological control agents for two-spotted spider mite

Useful information can be found at the following websites:

- **biobestgroup.com/en/side-effect-manual**
- **koppert.com/side-effects**
- **biolineagrosciences.com/products** (Searchable compatibility database on the downloadable Bioline App)

Produced for you by:

AHDB Horticulture
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

T 024 7669 2051
E comms@ahdb.org.uk
W horticulture.ahdb.org.uk
@AHDB_Hort

If you no longer wish to receive this information, please email us on **comms@ahdb.org.uk**

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