

# Fera Pest Risk Analysis for *Aceria kuko*



## ABSTRACT/ SUMMARY

*Aceria kuko* is an eriophyoid mite native to south-east Asia. It has been found entering the UK for the first time on prohibited solanaceous plants for planting. The known host range of *A. kuko* is quite narrow, but, in addition to *Lycium chinense* (goji berries), does include the commercially important *Capsicum annuum* (peppers) and the common native weed *Solanum nigrum* (black nightshade). *Aceria kuko* may pose a potential threat to other widely grown Solanaceae such as *Solanum lycopersicum* (tomatoes) and *Solanum tuberosum* (potatoes); however these are not confirmed hosts. The 'goji berry' plants on which the mite entered the UK have been widely distributed by mail order and it is unknown how many of these are still growing and harbouring this mite. Continued publicity concerning the recent illegal importation of 'goji berry' plants and potential pests they may carry is recommended, as is the destruction of any of these plants which are located.

## STAGE 1: PRA INITIATION

### 1. What is the name of the pest?

*Aceria kuko* (Kishida, 1927)  
(Acari: Eriophyidae)

Synonyms:

*Eriophyes kuko* Kishida, 1927  
*Aceria tjyingi* (Manson, 1972): Huang, 2008  
*Eriophyes tjyingi* (Manson, 1972): Kuang, 1983  
\**Aceria parawagnoni* (Kuang, 1983): Huang, 2008  
*Eriophyes parawagnoni* Kuang, 1983  
\**Aceria paramacrodonis* (Kuang, 1988): Huang, 2008

References: Huang, 2008a and Huang, 2008b

\*Huang's synonymy of these species with *A. kuko* is not universally accepted (Dr. Xiao-Feng Xue, Department of Entomology, School of Plant Protection, Nanjing Agricultural University, *pers. comm.* 2009).

It has been suggested that *Aceria pallida* Keifer, 1964: Kuang, 1983 is also a synonym of *Aceria kuko* (Huang, 2008b). However, there are clear morphological differences, as noted by Manson (1972), that together with geographical and host differences suggest this to be unlikely (Ostoja-Starzewski, *pers. comm.* 2008).

### 2. What is the pest's status in the Plant Health Directive (Council Directive 2000/29/EC<sup>1</sup>)?

This pest is not listed in the EC Plant Health Directive.

<sup>1</sup> [http://europa.eu.int/eur-lex/en/consleg/pdf/2000/en\\_2000L0029\\_do\\_001.pdf](http://europa.eu.int/eur-lex/en/consleg/pdf/2000/en_2000L0029_do_001.pdf)

### 3. What is the recommended quarantine status of the pest in the lists of the European and Mediterranean Plant Protection Organisation (EPPO<sup>2</sup>)?

EPPO List: A1 regulated pest list  A2 regulated pest list  Action list  Alert list

This pest is not listed as a quarantine pest by EPPO.

### 4. What is the reason for the PRA?

In April 2008 the UK plant health authorities became aware that substantial numbers of prohibited 'goji berry' plants, described as *Lycium barbarum* L., were being distributed in the UK via mail order sales. These plants originated in China, were landed and erroneously cleared in the Netherlands and distributed by a company based in Guernsey in the Channel Islands. *Lycium barbarum* is a member of the Solanaceae and as such entry into the EU from third countries, including China, is prohibited under Annex IIIA of Council Directive 2000/29/EC. In July, August and September 2008 samples of severely distorted leaves were received by Fera (previously CSL) diagnosticians from three geographically distinct areas of the UK, all from 'goji berry' plants purchased in 2007 or earlier in 2008. At least one of these is believed to have been rooted and grown overwinter outdoors in a garden vegetable plot. The cause of the distortion was identified as the non-indigenous *Aceria kuko* (Kishida) and the current pest risk analysis was initiated to establish whether this eriophyoid mite could present a risk to the UK.

### 5. What is the PRA area?

The PRA area for this pest is the UK, due to the recent interceptions and widespread distribution of potential hosts by trade. Although details of these interceptions have been widely circulated by the UK NPPO, no other EU member state has notified similar findings.

## STAGE 2: PEST RISK ASSESSMENT

### 6. What is the pest's present geographical distribution?

The present geographical distribution of this pest is believed to be limited to south-east Asia. It has been suggested that *Aceria kuko* is synonymous with *Aceria pallida*, a species found in North America as well as China, but the morphological, geographical and host differences cast some doubt on this. Information on this species has consequently not been included in this PRA. Hong *et al.* (2006) suggest that *Aceria kuko* may be invasive in China. Only one other previous report outside south-east Asia is known, an interception by the Dutch plant health authorities on *Lycium chinense* imported from Japan in 1987 (Anon., 1987). The findings in 2008 represent the first reports in the UK.

<sup>2</sup> <http://www.eppo.org>

**Table 1: Distribution of *Aceria kuko***

North America:	USA? = <i>A. pallida</i> (Hong, <i>et al.</i> , 2006; Huang, 2008b)
South America:	No records
Europe:	No records
Africa:	No records
Asia:	China (mainland provinces of: Beijing, Hebei, Guangxi, Jiangsu, Ningxia and Shanghai), Japan, South Korea, Taiwan
Oceania:	No records

References: Hong, *et al.*, 2006; Huang, 2008a; Huang, 2008b; Manson, 1972; Yiwongu, 2006.

### 7. Is the pest established or transient<sup>3</sup> in the PRA area?

No.

### 8. Is there any reason to suspect that the pest is already established in the PRA area?

Yes. It is now known that large numbers of 'goji berry' plants were imported to the UK from China in 2007 and 2008 (CSL, unpublished data). A small proportion was sent directly to UK nurseries, but the majority (approx. 84,000) were dispatched from a company in Guernsey to over 27,000 mail order customers across the UK. The samples of distorted leaves sent to Fera (formerly CSL) were from three different locations in England: York in North Yorkshire, Selsey in West Sussex and Reading in Berkshire. It is believed that the plants from Berkshire, at least, were growing outside during the 2007 – 2008 winter and that symptoms from the mite did not appear until 2008, implying that the mite had successfully overwintered outside. It is highly likely that other 'goji berry' plants from the same source were also carrying the mite *Aceria kuko* and that this pest may be widely distributed across private gardens and allotments in the UK.

### 9. What are the pest's host plants?

Most eriophyoid mites have a limited host range. The following have been documented as hosts of *Aceria kuko*: *Lycium chinense* Miller (goji berry, or wolfberry), *Solanum nigrum* L. (black nightshade), and *Capsicum annuum* L. (sweet pepper) (Kim, 1968). Laboratory investigations have shown successful transfer to *C. annuum* ('bell boy') but transfer to tomato ('moneymaker'), petunia ('crown mix') and tobacco ('white burley') (also in the Solanaceae family) was unsuccessful (Ostoja-Starzewski, 2008; Ostoja-Starzewski, *pers. comm.* 2008).

The plants imported into the UK were described as *Lycium barbarum* L., the fruit of which is also commercially known as goji berry. It has not been possible to confirm whether the plants are indeed this species, and hence an additional host, or whether they are the closely related and not easily distinguishable *Lycium chinense*. In China *L. chinense* tends

<sup>3</sup> Transience: presence of a pest that is not expected to lead to establishment (ISPM 5).

to be grown in the south and is usually shorter than the northern grown *L. barbarum* (Wikipedia, 2008). *Aceria kuko* is known to be found in both north and south China.

## 10. What hosts are of economic and/or environmental importance in the PRA area?

*Capsicum annuum* (peppers) are grown commercially under protection in the UK, with 68.7 ha cropped in England in 2007 (Defra, 2008a), and the species has also been recorded growing in the wild (Preston *et al.*, 2002). This is, however, a relatively small crop compared to other solanaceous species grown in the UK:

- Total glasshouse area of tomatoes cropped in England in 2007 was 144.5 ha (Defra, 2008a).
- Total area of potatoes grown in UK in 2007 was 140,000 ha (UK Agriculture, 2009).

The import of solanaceous plants for planting into the EU from countries outside Europe and the Mediterranean is prohibited due to the economic importance of the Solanaceae family and the risk that such imports may introduce plant pests, particularly viruses and viroids. However, neither potatoes nor tomatoes are known to host the mite *Aceria kuko*.

Two *Lycium* species, *L. barbarum* and *L. chinense*, grow wild in hedges and on waste ground in the UK. The two species are difficult to distinguish and some floral distribution maps refer to *Lycium spp.*, but both are believed to be distributed throughout the British Isles from south Cornwall to northern Scotland, with concentrations around the coasts and in central and eastern areas of England and Wales. (BSBI, 2009; Preston *et al.*, 2002). Both species are also grown as garden plants and hedging shrubs. *L. chinense* is a confirmed host as is *S. nigrum* (black nightshade), an annual weed found widely on cultivated and waste land in England and Wales (Preston *et al.*, 2002). The presence of both these known hosts in the wild environment suggests the possibility of these plants acting as a reservoir for the mite.

## 11. If the pest needs a vector, is it present in the PRA area?

No vector is required. This is a free-living organism.

## 12. Describe the pathway(s) considered by this PRA<sup>4</sup>

The pathway being considered is entry into the UK on imported plants for planting. The host range of *Aceria kuko* is limited to members of the Solanaceae family. The importation of solanaceous plants intended for planting is prohibited from third countries other than European and Mediterranean countries and any trade in this commodity is in contravention of the European Plant Health Directive.

**13. How likely is the pest to enter the PRA area<sup>5</sup>?**

Very unlikely       Unlikely       Moderately likely       Likely       Very likely

Given that the pest has been intercepted entering the PRA area, entry cannot be rated as very unlikely. However the specific pathway is known: the pest entered the EU on 'goji berry' plants imported from China, was cleared in error in the Netherlands and distributed by mail order from the Channel Islands. This trade is already prohibited.

In the event that such trade does occur again the most likely hosts for the mite would be the 'goji berry' plants themselves, grown in private gardens or allotments. Transfer to other hosts is likely to be limited to solanaceous host plants in the vicinity, such as home grown peppers. A potential risk exists for transfer to solanaceous plants of unknown host potential such as potatoes, aubergines and tomatoes. There is also a possibility of transfer to wild or weed hosts such as other *Lycium* plants or *S. nigrum* and other wild solanaceous may be potential hosts. Transfer from this pathway to commercial crops of sweet peppers, tomatoes or potatoes is unlikely unless commercial growers or nearby gardeners have also made purchases of these 'goji berry' plants and their private gardens are in the vicinity of the commercial growing area.

**14. How likely is the pest to establish outdoors in the PRA area?**

Very unlikely       Unlikely       Moderately likely       Likely       Very likely

There are no data available as to the temperature extremes for the survival or development of *Aceria kuko*, but in Korea the mites have been observed to be active at summer temperatures of 25-35°C (Kim, 1968). Kim (1968) also reported mite activity at temperatures below 0°C. These temperature ranges would suggest that survival outdoors in the UK is likely. In summer 2008 the mite was found on 'goji berry' plants growing outdoors in the UK, at least some of which were purchased in Autumn 2007 and were rooted outside (CSL, unpublished data). The pest, therefore, appears to have survived outside in south-east England during the 2007 – 2008 Winter.

According to Kim (1968), *Aceria kuko* overwinters as adults within the galls they form on leaves. The 'goji berry' plants which entered the UK were dormant and foliage free, which suggests that in common with many other eriophyoid mites, they may also overwinter under bud scales or in bark crevices and hence go unnoticed. 'Goji berry' plants are perennials and relatively winter hardy (hence their wide distribution in England and Wales), and therefore could form a potential source of infection for many years. The widely distributed weed *S. nigrum* may also provide a potential reservoir for the pest.

**15. How likely is the pest to establish in protected environments in the PRA area?**

Very unlikely       Unlikely       Moderately likely       Likely       Very likely

<sup>5</sup> Pest entry includes an assessment of the likelihood of transfer to a suitable host (ISPM No. 11, FAO, Rome).

Again, while no temperature extremes for the survival of *Aceria kuko* are available, activity has been observed in Korea at temperatures that are not uncommon in protected environments (25-35°C). *Aceria kuko* has also been observed forming leaf galls and foliar distortion on *Capsicum annuum* plants under glasshouse conditions of 25°C and 65% humidity (Ostoja-Starzewski, 2008). With the availability of concentrations of known hosts in protected environments in the UK (*Capsicum annuum*) there appears to be no reason why *Aceria kuko* could not establish under protection in the PRA area.

#### 16. How quickly could the pest spread<sup>6</sup> within the PRA area?

Very slowly  Slowly  Moderate pace  Quickly  Very quickly

Initial spread of infested plants by human activity (such as mail order) can allow rapid dispersal around the PRA area. Local spread from these initial infestation sites is likely to be slower, however, and limited to movement to other hosts in the same garden or allotment and nearby wild growing host species, if they exist. New infestation sites are most likely to occur through inadvertent transport on cuttings shared between gardeners, dispersal by birds, bees or other insects and natural wind dispersal. There is evidence that eriophyoid mites disperse passively on air currents (Sabelis & Bruin, 1996).

#### 17. Which part of the PRA area is the endangered area?

From the entry pathway and possibilities for establishment and spread, the endangered area of the UK appears to be private gardens, greenhouses and allotments in which 'goji berry' plants may have been planted and where there may be other known or potential hosts. There is also a possibility of wild growing and weed host species acting as a reservoir from which reinfestation of a garden or infestation further afield may occur.

Commercially, *Aceria kuko* poses the biggest threat to peppers (*Capsicum annuum*), which are grown under protection in the UK, but spread to these and other protected solanaceous crops is unlikely due to the hygiene measures at such commercial sites. Also unlikely is the exposure of field grown potatoes to the mites unless gardeners, including growers themselves, have planted 'goji berry' plants in the vicinity. Commercial growers are generally well aware of the risks of growing ornamental Solanaceae (Defra, 2008b).

#### 18. What is the pest's economic, environmental or social impact within its existing distribution?

Very small  Small  Medium  Large  Very large

There is no known data regarding the pest's impact in its existing distribution, but Hong *et al.* (2006) have included *Aceria kuko* in their list of invasive eriophyoid mites of economic importance in mainland China and only in China are *Lycium barbarum* and *Lycium*

<sup>6</sup> ISPM No 5. defines spread as the expansion of the geographic distribution of a pest within an area. Note that just because an organism can move or be transported quickly, does not mean that it will spread quickly, i.e. it also has to establish.

*chinense* commercially cultivated to a significant level (Wikipedia, 2008). Photos of damage to *L. chinense* plants have been published in papers from China, with blister like galls appearing on both the upper and lower surfaces of leaves (Huang, 2008) and the mites are known to be associated with the leaf veins and to cause extensive damage to the leaf tissue (Chinone, 1968; Kim, 1965). Such damage may reduce the ability of a plant to photosynthesise and lower yields. There are no records of *Aceria kuko* infesting *Capsicum annuum* L. (pepper) or other crops in China (Dr. Xiao-Feng Xue Department of Entomology, School of Plant Protection, Nanjing Agricultural University *pers. comm.* 2008).

#### 19. What is the pest's potential to have economic, environmental or social impacts in the PRA area?

Very small  Small  Medium  Large  Very large

There is no evidence to suggest this mite can infest major solanaceous crops such as tomatoes and potatoes, though the potential for this, and the vectoring of plant pathogens (see below), should not be ruled out as only a limited number of plant species and cultivars have been investigated as potential hosts to date. The ability of *Aceria kuko* to cause severe galling and leaf distortion to peppers indicates that damage to an economically important crop in the UK is possible. Acaracides are used in protected pepper crops in the UK, largely for *Tetranychus urticae* (two-spotted spider mite), but it is unknown whether these would control *A. kuko* and only around a third of the area grown in 2007 was treated (Garthwaite *et al.*, 2009). Damage to garden / allotment grown 'goji berry' plants has already been observed in the UK.

Due to incomplete knowledge regarding the biology and host range of *A. kuko* the potential impacts of this pest have been rated as medium with reference to the importance of the crops rather than real evidence of damage.

#### 20. What is the pest's potential as a vector of plant pathogens?

Some eriophyoid mites are known to transmit viruses (Cloyd, 2004), but there are no known records of *Aceria kuko* doing this.

Solanaceous plants, including *Lycium spp.*, have the potential to be infected with pathogens considered to pose a significant threat to UK tomato and potato production. On discovery of the prohibited import of 'goji berry' plants into the UK a limited number were tested for a range of quarantine viruses and viroids by Fera (known at the time as CSL). No quarantine pathogens were found. A common non-quarantine virus, cucumber mosaic virus (*CMV*), was detected in some samples. This virus affects a number of hosts, including ornamentals, cucumbers, tomatoes and peppers.

**STAGE 3: PEST RISK MANAGEMENT**

**21. If not already present in the PRA area, how likely is the pest to continue to be excluded from the PRA area?**

**Outdoors:** Very likely  Likely  Moderately likely  Unlikely  Very Unlikely

The import of solanaceous plants for planting from third countries outside of Europe and the Mediterranean is prohibited and there is no known risk of *Aceria kuko* being transported on the unrestricted goji berries or seeds. *Aceria kuko* may already be present outdoors in the UK, but further exclusion of this pest now the pathway is known is likely as there should be greater scrutiny of the source of plants entering the UK in this manner, limiting the probability of entry in the future. In response to the finding of these 'goji berry' plants the Dutch are issuing additional warning instructions to all their inspectors and importing companies.

**In protection:** Very likely  Likely  Moderately likely  Unlikely  Very Unlikely

It is possible that some of the 'goji berry' plants recently imported to the UK have been kept under protection in gardens or allotments, but again further exclusion of *Aceria kuko* now the pathway is known is likely. Due to the limited connections between amateur and commercial growers there are no known pathways from the current introductions, and continued exclusion from protected crops is very likely.

**22. If the pest enters or has entered the PRA area how likely are outbreaks to be eradicated?**

Very likely  Likely  Moderately likely  Unlikely  Very unlikely

All known illegally imported 'goji berry' plants at nurseries and garden centres were withdrawn from sale and held pending destruction or re-export (Defra, 2008b). Most of those that were sold by mail order between May and October 2007 and during April 2008, however, have not been traced, individual plants only coming to light through queries from the public after plant health and media publicity. A letter was sent out to customers who bought directly from a mail order company and this did mention the Defra technical note, but did not require customers to contact the plant health service. Others, who purchased plants via a newspaper, were not contacted. The large numbers involved and potentially widespread distribution suggests that if *Aceria kuko* is present on other plants, and the owners have no knowledge of the potential risk to other solanaceous species, the plants are likely to be still growing and may constitute a risk for the pest establishing. Without knowledge of the locations of all the 'goji berry' plants distributed in the UK it cannot be guaranteed that the pest is eradicated.

Where outbreaks of this mite have been located the 'goji berry' plants have been either sent to CSL laboratories or destroyed and nearby solanaceous plants also checked and in some cases voluntarily destroyed by the owners as a precaution. There is no reason to suggest that these outbreaks have not been eradicated.

### 23. If eradication is not possible, what management options are available for containment and control?

- Plant Health authorities continuing to carry out surveillance and publicity to supplement publicity and advice already distributed through Defra and the gardening media.
- The destruction of any 'goji berry' plants found to have been illegally imported continues to be recommended due to the potential threat of this and any other pests the plants may be carrying.

### 24. Conclusion

*Aceria kuko* is a non-native plant pest, which has entered the UK on prohibited imported plants. Whilst the probability of this pest being excluded from the UK from now on is high given the publicity on the nature of its entry, and action taken by relevant NPPO's there is no guarantee that all 'goji berry' plants which may have potentially been carrying this, and other non-native pests, have been destroyed and there is the possibility of this pest establishing at a local level in gardens and allotments.

Continued publicity is recommended as not all traders or recipients of the mail order 'goji berry' plants may be aware of the prohibition on solanaceous plants for planting from countries outside Europe and the Mediterranean or in any event be aware that this is the source of these particular plants. Greater awareness of this and the gall symptoms caused by the mite *Aceria kuko* would be helpful in eradicating any outbreak that may occur. A Plant Pest Notice (Ostoja-Starzewski, 2008) has been issued and is available at: <http://www.defra.gov.uk/fera/plants/publications/plantHealth/documents/PPN55.pdf>.

This is not the only potentially invasive pest which has entered the UK via internet/mail order sales and the profile of risks associated with this pathway in general is being raised.

**FURTHER WORK THAT WOULD REDUCE UNCERTAINTIES**

<b>Area of PRA</b>	<b>Uncertainties</b>	<b>Further work that would reduce uncertainty</b>
<b>Taxonomy</b>	Clarification required	Recommend a review of the species and in particular clarification on its relationship to <i>Aceria pallida</i> .
<b>Pathway</b>	Has the pathway for entry now been closed?	The planned follow up with the distributors in the Channel Islands and the Netherlands. Also the planned SOP to deal with internet/mail order issues.
<b>Distribution</b>	<p>If <i>Aceria kuko</i> is synonymous with other species, as suggested, its current distribution may have to be revised.</p> <p>The UK distribution of the imported goji berry plants and the proportion which may have been carrying this pest is unknown.</p>	<p>Recommend a review of the species and in particular clarification on its relationship to <i>Aceria pallida</i>.</p> <p>A follow up of all the goji berry plants which were distributed by mail order.</p>
<b>Establishment</b>	There is little data on the environmental conditions favouring the survival and development of <i>Aceria kuko</i> .	Further experimental studies on the species and translation of those papers that do exist to English.
<b>Spread</b>	How far may <i>Aceria kuko</i> be carried by the wind?	Field studies of the distribution and spread.
<b>Impact</b>	Economic importance	Data on the economic importance of <i>Aceria kuko</i> to goji berry production in China.
<b>Management</b>	Were the plants at nurseries destroyed or re-exported?	Clarification regarding the disposal of those plants held.

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