

Pest Risk Analysis For *Helcystogramma convolvuli*

STAGE 1: PRA INITIATION

1. What is the name of the pest?

Helcystogramma convolvuli Walsingham Sweetpotato Leaf Roller¹
Lepidoptera Gelechiidae Black leaf folder²

Synonyms: *Brachmia convolvuli* Walsingham 1908 (Zhang, 1994)³
Lecithocera emigrans Meyrick (Zhang, 1994)
Lecithocera convolvuli (Zhang, 1994 referring to a paper by
Visalakshi and Johnson (1968) summarised in the Review of
Applied Entomology, Volume 60)

2. What is the reason for the PRA?

This PRA was initiated after *H. convolvuli* was intercepted three times in the UK in November and December 2003; UK interceptions of *H. convolvuli* to date are listed in Table 1.

Date received	Genus/species	Life stage(s) detected	Host	Country of origin
31/07/2003	<i>Helcystogramma convolvuli</i>	1 live immature	<i>Manihot</i> ⁴	Gambia
20/11/2003	<i>Helcystogramma convolvuli</i>	1 live immature	<i>Ipomoea</i> leaves	Gambia
20/11/2003	<i>Helcystogramma convolvuli</i>	1 live immature	<i>Ipomoea</i> leaves	Gambia
17/12/2003	<i>Helcystogramma convolvuli</i>	1 live immature	<i>Ipomoea</i> leaves	Gambia
22/03/2004	<i>Helcystogramma</i> spp. ⁵	1 live immature, 1 dead immature	<i>Ipomoea</i> leaves	Sierra Leone

3. What is the PRA area?

The PRA considers the whole EPPO region concentrating on the European and Mediterranean area, i.e. EPPO west of the Ural mountains, although there are records of *H. convolvuli* from some small parts of this region (see 4).

¹ Used by the AVRDC World Vegetable Centre (Website 2).

² In Amalin *et al.*, 1991 under the synonym *Brachmia convolvuli*.

³ In some texts, the descriptions of *H. convolvuli* and *B. convolvuli* differ, particularly with respect to colour, suggesting that *B. convolvuli* may be a different species. It is recognised that colour is not a reliable characteristic and that the differences may be due to intraspecies variation, but as yet there is no definitive explanation for the differences (S. Martins, CSL, *pers. comm.*).

⁴ *Manihot* is not a recognised host for *H. convolvuli*; this may have been an 'incidental' find, or the consignment may have been contaminated with *Ipomoea*.

⁵ The larva died during rearing so it is not possible to confirm the species, but given the characteristic markings it was almost certainly *H. convolvuli*.



STAGE 2: PEST RISK ASSESSMENT

4. Does the pest occur in the UK, EPPO or EU region or does it arrive regularly as a natural migrant?

The Natural History Museum (NHM), London, has received specimens of *H. convolvuli* from the Canary Islands and Madeira (S. Martins, CSL, *pers. comm.*), but it is unclear whether they came from established populations in these countries, or were intercepted in trade.

5. Is there any other reason to suspect that the pest is already established in the UK, EPPO or EU region?

No.

6. What is the pest's EU Plant Health Directive status?

Not listed.

7. What is the pest's EPPO Status?

Not listed.

8. What are its host plants?

H. convolvuli is known to feed exclusively on Convolvulaceae (Klaus Sattler, Natural History Museum, *pers. comm.*). Documented hosts are sweet potato (*Ipomoea batatas* Lamk) (Amalin *et al.*, 1991; Meyrick, 1921; The Natural History Museum, 2004; Zhang, 1994; Websites 1, 2), *Convolvulus arvensis* (field bindweed), *Merremia quinquefolia* (rock rosemary) and *Ipomoea aquatica* (water spinach) (The Natural History Museum, 2004).

In Mauritania, *H. convolvuli* has been captured in stabilised dunes, with populations of Convolvulaceae (including *Calystegia soldanella* or sea bindweed and *Cressa cretica* or rosin weed), its probable host plants, and *Tamarix* (Nel *et al.*, 1996).

H. convolvuli is occasionally recorded incorrectly from *Solanum tuberosum* (potato), e.g. in the Natural History Museum's HOSTS database (Robinson, G.S., Ackery, P.R., Kitching, I.J., Beccaloni, G.W. & Hernández, L.M. 2002. HOSTS - a database of the hostplants of the world's Lepidoptera.

<http://www.nhm.ac.uk/entomology/hostplants/index.html>) This is as the result of confusion between potato and sweet potato (K. Sattler, BMNH, *pers. comm.*); *H. convolvuli* is not known to be a pest of potato.

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

The bulk of the world's sweet potato production (92%) is in Asia and the Pacific islands; 89% of this is grown in China (Chalfant *et al.*, 1990). However, some production does occur within the EPPO region, albeit on a smaller scale (Table 2).

Table 2: Sweet potato production within the EPPO region in 2002

Country	Sweet potato production 2002 (MT)*
Portugal	22,000
Spain	21,000
Italy	15,000
Morocco	6,000
Greece	2,000

*FAO, 2002

Sweet potatoes originating from Spain are available on the UK market from January to April and from September to December (Seaton, 2004).

Since 2000, sweet potatoes have also been grown on a small scale in the UK. The first commercial UK crop of sweet potatoes was planted in May 2000 at Barfoots of Botley (Website 4), West Sussex; the crop consisted of 110,000 slips (shoot cuttings) imported from the USA (Domero ref. 50851/2001). Horticultural Research International (HRI) also investigated the commercial potential of sweet potatoes in the UK in trials carried out on a Lincolnshire farm. When the plants, variety 'Red Skin', were given some early protection, yields of around 10kg per plant could be achieved (Website 3).

Sweet potatoes require a minimum temperature of 12°C. In the UK, the recommended planting time is mid to late May for a September harvest. While the crop grows well in polytunnels, it can be grown in some areas outdoors with the help of a plastic mulch (Jupe, 2002). Sweet potatoes are currently listed among the crops grown by Barfoots of Botley on their sites across South Hampshire, the Isle of White and West Sussex (Website 10). Pertwood Farm, Wiltshire also sells sweet potatoes; they are marketed via the Pertwood Organic Co-operative, a workers' co-op which markets organic vegetables from Lower Pertwood and other farms in the area (Website 9).

Exotic Farm Produce estimate that the UK market for sweet potatoes - already in excess of 6,000 tonnes and worth over £3 million a year - is growing by 10% per annum (Jupe, 2002). Therefore, it is reasonable to assume that more UK growers may begin to view sweet potatoes as a commercial proposition in future.

I. batatas is the only commercially grown host of *H. convolvuli*. However, *C. soldanella* is of environmental importance as a notable plant of sand dune ecosystems found in Ramsar wetland sites, e.g. Gibraltar Point, Lincolnshire (Website 12) and is described as 'rare' or 'scarce' in some areas of the UK, e.g. Northern Ireland (Website 10) and Dorset (Website 11). Somewhat contradictory to this, it is also listed in 'The Global Compendium of Weeds' along with other hosts of *H. convolvuli* - *C. cretica*, *C. arvensis*, *M. quinquefolia* and *I. aquatica* (Website 7)! *I. aquatica* is an invasive species that poses a serious threat to waterways in the Southern United States and has federal listing as a prohibited plant and noxious weed. It forms



impenetrable masses of tangled vegetation which obstruct water flow in drainage and flood control canals, displace native plants and create stagnant water conditions that are ideal breeding grounds for mosquitoes (Website 8).

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

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

11. What is the pest's present geographical distribution?

Primarily Asia and Africa. There are records from the Caribbean, Oceania, the Middle East and the EPPO region, but it is not clear whether these relate to established populations or interceptions in trade.

North America:	Absent, no records
Central America & Caribbean:	Barbados (Meyrick, 1921; Zhang, 1994, S. Martins, <i>pers. comm.</i>)
South America:	Absent, no records
Europe:	Absent, no records
Africa:	Aden (Yemen) (S. Martins, <i>pers. comm.</i>), Canary Islands (Spain), Comoro Islands, Madeira (Portugal) (S. Martins, <i>pers. comm.</i>); Mauritania (Chott-Bull; Nel <i>et al.</i> , 1996) ⁶ ; Namibia (two sites in North Central Namibia; Website 1); Rodrigues Island (Mauritius) (S. Martins, <i>pers. comm.</i>); East Africa (Kenya, Uganda, Sudan) (S. Martins, <i>pers. comm.</i>).
Asia:	Hong Kong (NHM, 2004); India (Kerala) (Visalakshi and Johnson, 1968; Zhang, 1994); Philippines (Pangasinan, Tarlac, Cam.Sur, Albay, Leyte, La Union, Quezon, Baguio, Sorsogon and Laguna provinces, (Amalin <i>et al.</i> , 1991).
Oceania:	Java (S. Martins, <i>pers. comm.</i>); West Malaysia (NHM, 2004)

NB. The reports from S. Martins are based on information supplied by the NHM. According to the NHM, *H. convolvuli* is also present in West and South Africa, but these records could relate to finds in Mauritania and Namibia, respectively, as referenced above and have therefore not been listed separately.

12. Could the pest enter the PRA area?

Yes, *H. convolvuli* could enter the PRA area on imported produce. To date, there have been four confirmed interceptions of living *H. convolvuli* in the UK and one find strongly suspected to be *H. convolvuli* (Table 1). No other EC countries have notified finds of *H. convolvuli* to the European Commission (A. MacLeod, CSL, *pers. comm.*). Larvae of *H. convolvuli* are cryptic in habit, feeding within leaf folds and could go unnoticed on imported produce, although they produce fairly conspicuous frass and feeding damage.

13. Could the pest establish outdoors in the PRA area?

Unlikely. If mature larvae, or pupae, were imported into the PRA area on produce (all immature stages occur on foliage), pupation may be completed and winged adults could disperse; some of the specimens intercepted in the UK were mature larvae (Martins and Malumphy, in prep.). However, Martins and Malumphy (in prep.) consider that there is a low risk of *H. convolvuli* establishing via this pathway because:

⁶ One female moth found on 19th November 1995, the first record for Mauritania.



1. Sweet potato foliage has a short shelf life and is usually consumed or processed soon after it is imported.
2. As the youngest sweet potato leaves are usually harvested, most of the *H. convolvuli* larvae present are likely to be early instars; they are unlikely to complete their development before the produce is consumed or processed⁷.
3. *H. convolvuli* larvae have only been intercepted in small numbers (in the UK), which even if they do reach adulthood, may be insufficient to start a viable population.

Establishment might result if sweet potato foliage infested with *H. convolvuli* was disposed of in an area where *C. arvensis* (field bindweed), or other weed hosts (see 8), were prevalent, e.g. a private garden. However, this is unlikely in northern temperate Europe because *H. convolvuli* is a tropical and subtropical species. The greatest risk of establishment is in regions of the PRA area where temperatures are more conducive to the development of the pest, e.g. Greece, Italy, Morocco, Portugal and Spain, and especially where winters are warm, as this will increase the number of potential generations.

14. Could the pest establish in protected environments in the PRA area?

Unlikely; the main host plant, *I. batatas* is usually grown outdoors. Sweet potatoes can be grown in polytunnels, e.g. in the UK (see 9), and the higher temperatures under protection may favour pest development, but the reasons given in 13 above, mean that it is unlikely that a pathway to such sites exists.

15. How quickly could the pest spread within the PRA area?

Winged adults are capable of unassisted dispersal (Martins and Malumphy, in prep.). The distance they can cover is unknown, but is presumably influenced by wind speed and direction. The unintentional transport of caterpillars in trade may also aid the spread of *H. convolvuli*.

16. What is the pest's potential to cause economic and/or environmental damage?

Unclear; it is difficult to distinguish its role as a physically conspicuous pest from its capacity to reduce crop yield and/or quality. *H. convolvuli* became a common pest of sweet potato in the Indian State of Kerala in the 1960s. The eggs are laid on the lower leaf surface and the first-instar larva forms a tunnel of silk along the leaf vein and feeds underneath on the surface tissue. In the second instar, the larva moves to the upper leaf surface, folds the leaf by spinning threads from margin to margin and feeds within the fold until the green tissues are consumed, when it moves to another leaf. Attack is most severe during the summer (Visalakshi and Johnson, 1968).

Attacked leaves are conspicuous as they are folded (flat) along the midrib. The caterpillars do not eat holes throughout but instead leave transparent windows in the leaf ('skeletonization') (Websites 1,15). In severe cases, rolled leaves are brownish and dried. Unrolled leaves have chewed surfaces with

⁷ The young leaves are rich in proteins and most vitamins, and make good food (Website 5). Sweet potato foliage can also be used as an animal feed (Website 6).



extensive frass (Website 2). The larval stage is the only one that damages the sweet potato plant (Website 15).

Although disfiguring, the damage caused by *H. convolvuli* may not cause significant yield losses; sweet potato can reportedly lose a lot of leaf area without noticeable reduction in tuber yield (Website 1) and defoliation late in the season will have less of an impact on yield than defoliation in the earlier stages of growth (Website 13). Chalfant *et al.* (1990) state that even severe defoliation has only a temporary effect on root yields for which the plant compensates by a longer period of growth. As a general rule, defoliation must exceed 50% before yields are reduced (Website 13). In trials in Missouri, manual defoliation at 65 days after transplanting did not significantly affect yield, but there was a trend towards lower marketable yield with moderate (33%) and severe (67%) defoliation (Website 14). As there is evidence that large-scale infestations do occur, some yield losses could be expected. Intensive sampling of sweet potato agroecosystems in 14 provinces of the Philippines found that *H. convolvuli* was a dominant pest species in both the wet (Oct 24th-30th, 1988) and dry (Feb 13th-24th 1989; Feb to April 1990) seasons. It was considered 'widely distributed', having been encountered in 'almost all the sampling sites'; a total of 11 specimens were collected in the wet season and 84 in the dry season (Amalin *et al.*, 1991). In Namibia, the pest has only been observed at two locations (large sweet potato fields are not yet common): Epalela Vegetable Garden, on the west bank of Olushandja Dam in the Omusati region and in Tsumeb at the Extension office garden, but every sweet potato plant was reportedly infested at both sites (Website 1).

In addition, *H. convolvuli* could cause environmental damage in coastal habitats as it feeds on *C. soldanella*, a plant of sand dune ecosystems 'scarce' in parts of the UK. All other recognized hosts of *H. convolvuli* are listed in the 'Global Compendium of Weeds' (see 8). Indeed, *H. convolvuli* has been suggested as a potential biological control agent for bindweeds (*C. arvensis*) as it damages the leaves throughout the growing season (Toth *et al.*).

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

H. convolvuli is not recorded as a vector of plant pathogens.

STAGE 3: PEST RISK MANAGEMENT

18. What are the prospects for continued exclusion?

Good. *H. convolvuli* has been intercepted infrequently in the UK and the risk of establishment following the import of immature life stages on produce is considered low (see 13).

19. What are the prospects of eradication?

Variable depending on how widely the pest is distributed when it is first found, and where it is found. In northern Europe, temperatures will assist any eradication efforts, as outdoor populations are unlikely to overwinter. In the Mediterranean, eradication is likely to be more difficult. The larvae of *H.*



convolvuli are cryptic in nature and will therefore be difficult to control with contact-acting insecticides and the potential for residual populations to exist on weeds, e.g. bindweed, may prolong eradication attempts.

20. What management options are available for containment and control?

Destruction of infested crops, plus weed hosts in the field and field margin, would be the most effective method of ensuring eradication of the pest. At present there are no pesticides approved for use on sweet potatoes in the UK, given the crops 'new' status. Insecticides approved for the use of caterpillars on other crops include contact-acting products containing deltamethrin (e.g. 'Decis') and stomach-acting products containing the active ingredients *Bacillus thuringiensis* var. *kurstaki* ('DiPel DF') or teflubenzuron ('Nemolt'). However, contact-acting products are unlikely to be effective since both first and second instars of *H. convolvuli* are protected in some way; the first instars feed within a silken tunnel and the second instars within folded leaves. Stomach-acting products are relatively slow-acting and are best targeted at the young instars. However, they need to come into contact with the pest in order to be consumed and, hence, may also be ineffective against this particular species. Off-label approvals for the use of appropriate chemicals on sweet potato could be submitted to the Pesticides Safety Directorate, but as all approvals for edible crops must be authorised by the Advisory Committee on Pesticides, this would be a lengthy process.

No records of biological control agents for *H. convolvuli* were found in the literature.

CONCLUSION OF THE PEST RISK ANALYSIS

Although sweet potatoes are now being grown on a small scale in the UK, *H. convolvuli* is considered a minor threat to UK production because it has a tropical and subtropical distribution and is therefore unlikely to naturalise outdoors. In addition, it enters the UK infrequently and in small numbers on produce, from which there is a low risk of it dispersing to commercial crops. Establishment in other parts of northern temperate Europe is also very unlikely.

Establishment of *H. convolvuli* is most likely in countries around the Mediterranean, where temperatures are more conducive to its development, although the literature suggests that a reduction in sweet potato yield is only sustained where the pest establishes in very high numbers. However, given that eradication of *H. convolvuli* with insecticides is likely to be difficult because of its cryptic habit and residual populations could occur on weeds, these EPPO member states may wish to carry out their own PRAs to further define the risks for their climatic region.

UNCERTAINTIES AND FURTHER WORK

Section of PRA	Uncertainties	Further work that would reduce uncertainty
Taxonomy	It is unclear whether <i>B. convolvuli</i> is a separate species, or a synonym of <i>H. convolvuli</i> .	Taxonomic studies are required to determine whether <i>B. convolvuli</i> is a separate species.
Pathway	Uses of sweet potato foliage within the PRA region, processing and waste disposal methods are unknown.	Contact importers, processors and end-users to determine whether a pathway to commercial crops exists.
Distribution	It is unclear if some records of <i>H. convolvuli</i> relate to established populations or interceptions in trade.	Contact countries from which <i>H. convolvuli</i> has been reported to gain further information.
Hosts	The extent to which other Convolvulaceae, e.g. <i>Ipomoea purpurea</i> (morning glory), are affected is unknown.	Experimental feeding studies could be carried out.
Establishment	The suitability of the climate in Mediterranean countries where sweet potatoes are more widely grown is unknown.	'Climex' could be used to identify regions of the PRA area in which <i>H. convolvuli</i> could establish, based on its current distribution.
Spread	There are no references to the rate of natural dispersal in the literature.	Experimental flight studies could be carried out with adult moths.
Impact	The relationship between defoliation and yield loss in sweet potatoes.	Experiments to ascertain the relationship between larval density and yield loss could be carried out.
Management	Susceptibility of the larvae to contact and stomach-acting insecticides in a field situation.	Insecticide efficacy tests would identify products for which UK off-label applications could be prepared.

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