EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
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Point 7.4

Report of a Pest Risk Analysis for *Leucinodes orbonalis*

This summary presents the main features of a pest risk analysis which has been conducted on the pest.

Pest: ***Leucinodes orbonalis*** (brinjal fruit borer)
PRA area: EPPO region
Assessors: Assessment based on a Dutch PRA (van der Gaag DJ, Stigter H, Lammers JW, van der Straten M, 2005) and on a British PRA (Bishop S, Matthews L, MacLeod A, 2006) completed by a climatic study by EPPO. Pest Risk Management was conducted by Mr Finelli (Italian NPPO) and the EPPO Panel on Phytosanitary Measures in 2011.
Date: The PRA was reviewed by the Panel on Phytosanitary Measures on 2011-11 and on 2012-03.

STAGE 1: INITIATION

Reason for doing PRA: *Leucinodes orbonalis* has been repeatedly intercepted by some EPPO Member countries (EU, Switzerland). As a consequence, both the Dutch and British NPPOs conducted a PRA in order to evaluate the phytosanitary risk represented by the pest. According to Europhyt in the period 2007-2010, 124 interceptions occurred for all EU countries. Most of the interceptions concerned consignments of fruits *S. melongena* and similar species, originating from African or Asian countries, however some infested consignments of *Abelmoschus esculentus, Solanum lycopersicum, Cucurbita* sp. have also been detected.

Taxonomic position of pest: Lepidoptera: Pyraloidea
Species: *Leucinodes orbonalis* (Guenée, 1854)

STAGE 2: PEST RISK ASSESSMENT

PROBABILITY OF INTRODUCTION

Entry

Geographical distribution: **EPPO region:** absent
Africa: Cameroon, Congo, Ethiopia, Ghana, Kenya, Lesotho, Malawi, Mozambique, Nigeria, Rwanda, Sao Tome & Principe, Sierra Leone, Somalia, South Africa, Tanzania, Uganda, Zambia, Zimbabwe.
Asia: Bangladesh, Brunei Darussalam, Cambodia, China (Hubei, Xianggang (Hong Kong)); India (Andaman and Nicobar Islands, Delhi, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal), Indonesia (Java, Sumatra), Japan, Lao, Malaysia (Sarawak, West), Myanmar, Nepal, Pakistan, Philippines, Saudi Arabia, Singapore, Sri Lanka, Taiwan, Thailand, United Arab Emirates, Viet Nam.

Major host plants or habitats: Economic damage is mostly reported on aubergine (*Solanum melongena),* however other *Solanum* species (*Solanum torvum, S. aculeatissimum, S. mammosum* and *S. aethiopicum*) are also considered as main hosts.
Although *L. orbonalis* is able to develop on both potatoes (*Solanum tuberosum*) and tomatoes *(Solanum lycopersicum),* little damage is

reported on these crops. Other minor hosts include *Beta vulgaris* (beetroot), *Capsicum* spp. (peppers), *Ipomoea batatas (*sweet potato), *Ipomoea* spp., *Cucurbita maxima* (pumpkin), *Pisum sativum (*pea), *Pennisetum* spp. (feather grass), *Physalis peruviana* (Cape gooseberry). Finally some *Solanum* weeds are reported as hosts: e.g. *S. nigrum, S. dulcamare, S. violaceum, S. viarum, S. myriacanthum*.

Which pathway(s) is the pest likely to be introduced on:

The main pathways of entry are:

- **Fruits of main hosts *(S. melongena, S. aethiopicum, S. mammosum, S. aculeatissimum*** and ***S. torvum)* from countries where the pest occurs**

L. orbonalis larva bore into fruits. It has been intercepted many times in the UK and the Netherlands on imported fruits (e.g. in 34 lots out of 650 lots between January and October 2005 in the Netherlands). This shows that the pest is very likely to be associated with the fruit, can survive existing cultivation and commercial practice and is very likely to survive during transport and storage. It also shows that infested consignments may be detected during existing import inspection. Nevertheless early infestation may go undetected.

The volume of the import is minimal but has increased over the recent years: in the EU, import of eggplant fruit from countries where the pest is present was about 840 tons in 2004 but reached 2050 tons in 2010. A large proportion comes from Kenya (1100 tons in 2010), and Ghana (500 tons) (Eurostat, 2011). Imports occur all year round. Nevertheless, it should be noted that most of this import occurs in UK (1370 tons in 2010). Major EU countries producing eggplants (Greece, Italy, Romania, Spain, France) do not currently import them from these countries. According to FAOstat (2011), import of eggplants fruits occur in other non-EU Mediterranean countries producing eggplants (e.g. Turkey, Israel, and Morocco). For Turkey and Israel imports are recorded from neighbouring countries whereas for Morocco there is a record of imports from Thailand. No trade data was found on other species (but they may also be imported under the same custom code as eggplant). No report of interception of *L. orbonalis* has been received by EPPO apart from EU countries and Switzerland. In the EU, fruit of *Solanum melongena* are submitted to inspection for *Thrips palmi*, and this has resulted in some detection of *L. orbonalis*. Such requirements do not exist in other EPPO countries.

A key issue for entry is the transfer from infested fruit to a place of production in the PRA area. For fruit directly traded to end consumers or used for processing, the transfer (and therefore the entry) is very unlikely. For infested fruit that are sorted/packed in a site where eggplants are produced, transfer is likely as shown with *Tuta absoluta* in tomato (Potting *et al.*, 2010).

The probability of entry is considered as moderately likely if fruits are sorted/packed in a site where eggplants are also produced, and very unlikely in other cases because the trade volumes are very limited and occurs in Northern European countries. Uncertainty is low.

- **Plants for planting of main hosts *(S. melongena, S. aethiopicum, S. mammosum, S. aculeatissimum and S. torvum)* from countries where the pest occurs**

Any stages of *L. orbonalis* may be associated with plants for planting: eggs may be present on leaves, larvae bore into stems, and pupae may be present in soil attached to the plants for planting. Import of solanaceous plants for planting from third countries other than non-European and Mediterranean countries is forbidden in the EU and many other countries in the PRA area, but not in countries like Turkey or Tunisia. There is no available data on trade of such commodities. Nevertheless the trade from

the area where the pest is present is assumed to be minimal as most seedlings are produced locally in the PRA area. *The probability of entry is therefore considered as very unlikely with a medium uncertainty.*

Other pathways identified but not studied in detailed in the entry section:

- **Fruits or plant parts of other hosts (*Cucurbita* sp., *Solanum* sp., *Capsicum* spp., *Abelmoschus* sp.) from countries where the pest occurs**

There is no much data on association of the pest with these commodities but APHIS reported some interceptions (although there is no detail on the species involved) (Dutch PRA). The USA interception data show that it is possible, but not likely that *L. orbonalis* is associated with *Capsicum* fruit at origin. *Capsicum, S. lycopersicum, Cucurbita* and *Abelmoschus esculentus* fruits represent respectively 1.9%, 0.1%, 0.4% and 0.1% off all *L. orbonalis* interceptions in the USA. The trade of these commodities from the countries where the pest is present to the EPPO region is minimal.

- **Travellers carrying fruits or plants for planting of main hosts from where the pest occurs**

As highlighted in the Dutch PRA, the most of the APHIS interceptions in the USA regard fruits transported by travellers. No specific data have been found for the European interceptions.
In the EPPO region, no regular inspections of travellers are carried out in the different Member States. Considering that people travel more and more and the number of travellers from the areas where *L. orbonalis* occurs could easily increase, the risk of the pest entry is not low.

- **Natural spread**

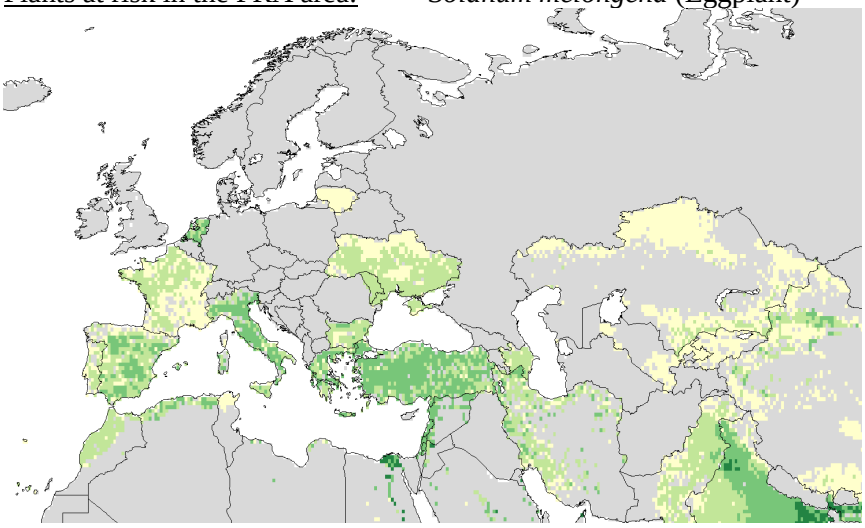
Intercontinental spread from Africa or Asia to the PRA area is not possible. However, this pathway would become a possible pathway of movement within the PRA area following an introduction. Little is known about the natural spread of this pest in its original range.

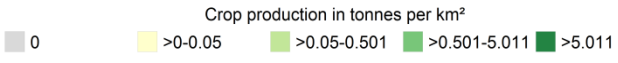
Pathways considered unlikely and not studied

Potato tubers: no life stage of the pest is associated with tubers. Pupae might be present in soil associated with potato tuber (although they are usually at 1-3cm depth in soil). But this pathway seems very unlikely considering that potato is a minor host, and that volume of import is extremely low.

Establishment

Plants at risk in the PRA area: *Solanum melongena* (Eggplant)





Source: Monfreda et al. (2008)

countries	Production 2010 (tonnes)	countries	Production 2010 (tonnes)
Turkey	846998	France	19928
Italy	302551	Bulgaria	10747
Spain	190200	Portugal	7800
Romania	144391	Belgium	7100
Azerbaijan	106087	Republic of Moldova	6981
Jordan	104747	Uzbekistan	4800
Ukraine	79300	Cyprus	2710
Algeria	74300	Hungary	2146
Greece	70900	Serbia	2000
Kazakhstan	63620	Kyrgyzstan	1000
Palestinian Territory	55600	Macedonia (FYR)	900
Netherlands	46000	Malta	755
Israel	45340	Austria	565
Morocco	38001	Lithuania	490
Albania	23641	Tunisia	270

Source FAOStat, 2011

S. melongena (eggplant) is largely grown in the some countries of the PRA area, in particular in the Mediterranean countries (see map and table above for the production in 2000 and 2010 respectively). Eggplant is grown both under protected conditions and outdoor. In Italy, for instance, the main growing area is situated in the south, and Campania and Sicily are the most important producing regions. Usually, during the summer, the crop is grown in open field, while in winter-early spring the crop is grown in protected conditions (Buonocore, Italian NPPO, *pers. comm.*, 2011). Similar growing conditions occurs in other Mediterranean countries such as Morocco (Rahel, Moroccan NPPO, *pers. comm.* 2011), for instance.
Within the EPPO region, *S. aethiopicum*, *S. mammosum*, *S. aculeatissimum* and *S. torvum* are not usually grown.
Minor hosts are also largely cultivated plants such as *Solanum lycopersicum*, *Capsicum* spp., *Solanum tuberosum*, *Beta vulgaris*.
The weeds *Solanum nigrum* and *S. dulcamara* are also widespread in the EPPO region.

Climatic similarity of present distribution with PRA area (or parts thereof):

L. orbonalis is a tropical pest but a climatic study using CLIMEX showed that it may establish in the Mediterranean countries of the PRA area, in particular in the coastal regions of the Mediterranean Basin. However the number of generations per year will probably be lower than at origin.
In addition *L. orbonalis* could develop in heated greenhouses where host plants are cultivated throughout the PRA area.
Note: *L. orbonalis* (probably a special biotype) has been observed overwintering in cold winter conditions up to -6.5°C in West Himalaya (Lal, 1975).

Characteristics (other than climatic) of the PRA area that would favour establishment:

No specific data found.

Which part of the PRA area is the

Mediterranean countries and heated greenhouses where host plants are

area of potential establishment: cultivated throughout the PRA area.

POTENTIAL ECONOMIC CONSEQUENCES

How much economic impact does the pest have in its present distribution:

L. orbonalis causes yield loss, weakens plants and the fruits produced by infested plants may be unsuitable for marketing. Damage is most severe when a substantial population has built up over several generations.

L. orbonalis is usually considered a major pest of eggplant in South-East Asia. However estimates of loss or damage caused by *L. orbonalis* vary considerably: Patnaik (2000) reports that damage to fruit in the field ranges from 47.6% to 85.8%, Mehto *et al.* (1983) report a reduction in yield ranging from 50-60% and Mall *et al.* (1992) report average losses in the field of 13%. Eggplants are intensively sprayed with insecticides in the countries where the pest occurs. *L. orbonalis* is difficult to control since the larvae bore inside fruits and shoots where they cannot be hit by insecticidal sprays. In addition, there is some indication that the pest has developed resistance to some insecticides. Nevertheless mating disruption techniques have been recently developed which may help control.

Damage to other hosts is moderately important. Potato is considered as a host but *L. orbonalis* is not a main pest of potato. Finally, as far as we know *L. orbonalis* is not an important pest on crops other than *Solanum* spp. in its current area of distribution.


Adult. Courtesy: KVN Maes


Larva in aubergine. Courtesy: J. Litsinger

Describe damage to potential hosts in PRA area:

Early indications of attack by *L. orbonalis* are the result of larval feeding on flowers, flower buds and young shoot tips and stems. Final-instar larvae bore into the fruits. Infested fruits are characterized by small entrance holes closed by dried excrement. Wilting may occur in severe infestation.

Damage is expected to be similar to that in the area of origin. There are uncertainties on the number of generations that the pest would complete in the field in the PRA area although it is likely to be lower than at origin.

How much economic impact would the pest have in the PRA area:

Eggplant is an important crop in the area of potential establishment. The level of damage will vary but may be high. Damage to eggplant could be massive in the absence of measures. The pest would cause a direct decrease in yield and the whole fruit harvests may also be unmarketable due to low tolerance for quality defects and presence of larvae in fruit (for consumption or processing).

It is difficult to assess how the current pest management practices will affect impact but introduction of the pest would surely increase control costs. Other lepidopteran pests (*Spodoptera exigua* and *S. littoralis)* occur on eggplants outdoors in the south, and in glasshouses in the north of the EPPO region. Insecticides used again these pests will probably have an effect on *L. orbonalis* but will not be sufficient to control the pest below economic thresholds during the growing season. In open field, 3-4 insecticides are applied during the vegetation period (EPPO PRA on *Keiferia lycopersicella,* 2012). Broad-spectrum insecticides (carbamates, pyrethroids) that are used in the area of current distribution of the pest are not compatible with IPM, which is common practice in the PRA area. IPM strategies will have to be adapted to integrate this new pest, which may take several years. In addition IPM relies on the use of pheromone for monitoring and mass trapping. This will need to be registered before it can

be used by growers in the EPPO region. Control in organic production and in gardens will be difficult.
Occurrence of *L. orbonalis* in the EPPO region could have an effect on export market as it is quarantine pest for the USA and is listed as an A1 pest by several RPPOs (COSAVE, OIRSA, CPPC).

CONCLUSIONS OF PEST RISK ASSESSMENT

Summarize the major factors that influence the acceptability of the risk from this pest:	*L. orbonalis* cause important damage to eggplant. Numerous other host plants are reported. Low levels of infestation are difficult to detect in consignments. The Mediterranean countries are suitable for establishment.
Estimate the probability of entry:	*L. orbonalis* can be moved with host plants for planting or fruit. Import of plants for planting is forbidden in the EU and is assumed to be minimal in other countries. Numerous interceptions of *L. orbonalis* have been reported over the recent years in fruit of several *Solanum* species, in particular eggplant. The probability of entry is considered as moderately likely if fruits are sorted/packed in a site where eggplants are also produced, and very unlikely in other cases. For countries where the import of plants for planting is not forbidden, the probability of entry with this pathway is moderately likely because of the very limited volumes.
Estimate the probability of establishment:	The overall probability of establishment in the Mediterranean countries is considered as to be likely with a medium uncertainty.
Estimate the probability of spread:	The overall probability of spread is estimated as moderately likely with a medium uncertainty. Although little is known about the natural spread in the countries of origin, the pest can easily be spread with infested fruits.
Estimate the potential economic impact:	The potential economic impact in the Mediterranean countries is considered as high with moderate uncertainty.
Degree of uncertainty	Uncertainties are as follows: - Association with plant or plant products other than *S. melongena, S. torvum, S. aethiopicum* - Probability of transfer from fruit to place of production - Limits of the area of potential establishment. Number of generations per year. - Possible control with current management practices in the endangered area. - Possible impact on tomato, potato and Capsicum in the PRA area
OVERALL CONCLUSIONS	It is concluded that *L. orbonalis* poses a risk to the EPPO region and phytosanitary measures should be identified which could substantially reduce the risk.

STAGE 3: PEST RISK MANAGEMENT

IDENTIFICATION OF THE PATHWAYS

Pathways studied in the pest risk management

- Fruits of main hosts *(S. melongena, S. aethiopicum, S. torvum, S. aethiopicum)* from where the pest occurs
- Plants for planting of main hosts *(S. melongena, S. torvum, S. aethiopicum)* from where the pest occurs
- Travellers carrying fruits or plants for planting of main hosts from where the pest occurs

IDENTIFICATION OF POSSIBLE MEASURES

Pathway 1: Fruits of main hosts *(S. melongena, S. aethiopicum, S. mammosum, S. aculeatissimum* and *S. torvum)* from where the pest occurs

- Pest-free area as described in ISPM 4. (checked by pheromone trapping) OR
- Pest-free place of production under screenhouses (checked by pheromone trapping) OR
- Systems approach combining growing under protected conditions, starting from healthy plantlets, monitoring the moth occurrence with traps and visual inspection at the place of production, and treating when necessary. In addition detection of infested fruits during handling and packing, and visual inspection of the consignment by the exporting country before departure of the consignment will reduce the risk of infested fruits further.

Pathway 2: Plants for planting of main hosts *(S. melongena, S. aethiopicum, S. mammosum, S. aculeatissimum* and *S. torvum)* from where the pest occurs

- Pest-free area as described in ISPM 4. (checked by pheromone trapping) OR
- Pest-free place of production under screenhouses (checked by pheromone trapping).
- Systems Approach combining growing under protected conditions, monitoring the moth occurrence with traps and visual inspection at the place of production, and treating with insecticides when necessary.

Pathway 3: Travellers carrying fruits or plants for planting of main hosts from where the pest occurs
Appropriate publicity and random inspections to traveller's luggage could mitigate such a risk. The use of Customs declaration forms to be filled in by the airplane travellers before landing is another possible option.

EVALUATION OF THE MEASURES IDENTIFIED IN RELATION TO THE RISKS PRESENTED BY THE PATHWAYS
The trade in the commodities from outside the EPPO region is limited so impact on trade should be minor.
Measures would have costs linked to monitoring, establishment and maintenance of free places of production/pest free areas. However similar measures are applied against other pests. Production under protected conditions is a standard for the production of plants for planting.
The pest would be difficult to eradicate if introduced and could spread. The possible measures have a lower cost than attempting eradication or of bearing the costs of impacts caused by *L. orbonalis* if it established.

Degree of uncertainty Uncertainties in the management part are:

- Efficacy of existing measures to detect the pest at import
- Rate of natural spread (and consequently the possible size for buffer zone in a PFA)
- The possible use of resistant varieties in the future

IDENTIFICATION OF POSSIBLE MEASURES
PC= Phytosanitary certificate, RC=Phytosanitary certificate of re-export

Pathway 1: Fruits of main hosts *(S. melongena, S. aethiopicum, S. mammosum, S. aculeatissimum* and *S. torvum)* from where the pest occurs	PC and, if appropriate, RC Pest-free area OR Pest-free place of production under screenhouses OR Systems approach
Pathway 2: Plants for planting of main hosts *(S. melongena, S. aethiopicum, S. mammosum, S. aculeatissimum* and *S. torvum)* from where the pest occurs	PC and, if appropriate, RC Pest-free area OR Pest-free place of production under screenhouses OR Systems approach
Pathway 3: Travellers carrying fruits or plants for planting of main hosts from where the pest occurs	Raising awareness and inspection

References

See references in the Dutch and English PRAs.

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