EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
ORGANISATION EUROPEENNE ET MEDITERRANEENNE
POUR LA PROTECTION DES PLANTES

20-25980 (16-22169, 11-17191**,** 11-16944, 10-16303, 10-16131)

This PRA document was modified in 2016 to add the paragraph highlighted in yellow, and in 2021 to clarify the phytosanitary measures recommended

Report of a Pest Risk Analysis for *Epitrix* species damaging potato tubers

This summary presents the main features of a pest risk analysis which has been conducted on the pest, according to EPPO Decision support scheme for quarantine pests.

Pest: ***Epitrix* species damaging potato tubers (*Epitrix similaris, E. cucumeris, E. subcrinita, E. tuberis)***

It should be noted that in 2015, the species present in Portugal and initially identified as *Epitrix similaris* was later described as a new species, named *Epitrix papa*[1]. Because the PRA was based on information available from Portugal at that time, the evaluation made for *E. similaris* is valid for *E. papa*.
The EPPO Working Party in June 2016 agreed that *Epitrix similaris* should no longer be recommended for regulation as a quarantine pest, and that *Epitrix papa* should be listed as an A2 pest, based on the information available in this PRA.

PRA area: EPPO region

Assessors: Expert Working group for PRA for *Epitrix* species damaging potato tubers

First meeting (2010-01-11/14)
- Ms Boavida Conceiçao (Instituto Nacional de Recursos Biologicos, PT)
- Ms Chatot-Balandras Catherine (GERMICOPA, FR)
- Ms Erdogan Pervin (Plant Protection Central Research Institute, TR)
- Ms Fransen Joanne (Plant Protection Service, NL)
- Mr Germain Jean-François (Laboratoire National de la Protection des Végétaux, FR)
- Mr Giltrap Neil (Food and Environment Research Agency, GB)
- Ms Schrader Gritta (Julius Kühn Institut, DE)
- Mr Vernon Robert (Agriculture and Agri-Food Canada, CA)

Second meeting (2010-03-31/04-01)
- Ms Boavida Conceiçao (Instituto Nacional de Recursos Biologicos, PT)
- Ms Chatot-Balandras Catherine (GERMICOPA, FR)
- Mr Giltrap Neil (Food and Environment Research Agency, GB)
- Mr Pfeilstetter Ernst (Julius Kühn Institut, DE)
- Mr Potting Roel (Plant Protection Service, NL)
- Mr Vernon Robert (Agriculture and Agri-Food Canada, CA)

EPPO Secretariat: Ms Petter Françoise, Ms Suffert Muriel

Date: 2010-01-11/14 and 2010-03-31/04-01. The risk management part was reviewed by the Panel on phytosanitary measures on 2010-06-03 for measures on potato tubers. Measures concerning Soil or growing medium attached to rooted host plants (Solanaceae) were elaborated by the Panel on Phytosanitary Measures on 2011-04-07.

[1] Orlova-Bienkowskaja MJ (2015) *Epitrix papa* sp. n. (Coleoptera: Chrysomelidae: Galerucinae: Alticini), previously misidentified as *Epitrix similaris*, is a threat to potato production in Europe. *European Journal of Entomology* **112**(4) DOI: 10.14411/eje.2015.096. http://www.eje.cz/pdfs/eje/2015/04/28.pdf

STAGE 1: INITIATION

Reason for doing PRA:

In Portugal, unusual damage to potato crops (superficial lesions on the tubers) was first observed in 2004 in the northern area of the country (near Porto) (Moreira & Belchior, 2007; Oliveira *et al.*, 2008). In the following years, damage symptoms were reported further south but the causal agent remained unknown. Two North American flea beetles, *Epitrix cucumeris* and *Epitrix similaris* were later identified in fields where tuber damage was observed (Boavida & Germain, 2009). *Epitrix similaris* seems to be responsible for the characteristic type of tuber injury observed since it is consistently associated with crop damage. However, at this point, it still cannot be excluded that other species of *Epitrix* might also be involved because of limited survey and investigational work undertaken together with the difficulties associated with identification to species level (members of this genus are small insects with similar exterior morphology). *E. tuberis* is the species usually associated with such tuber damage in North America but the current distribution and identity of Epitrix causing tuber damage in North America needs further investigations as potato tuber damage is usually attributed to *E. tuberis* without specific identification). The EPPO Working Party on Phytosanitary Regulations decided that a PRA for these 3 species should be performed.
Considering the difficulties of identification in the field and uncertainty about the distribution of the different species, the Expert Working Group decided that this PRA should address *Epitrix* species potentially damaging potato tubers.

Taxonomic position of pest:

Order: Coleoptera, Family: Chrysomelidae, Subfamily: Alticinae

STAGE 2: PEST RISK ASSESSMENT

Probability of introduction
Entry

Geographical distribution:

The great morphological similarity of several *Epitrix* species makes identification in the field very difficult, even by specialists. This has meant that identification to species level has not been regularly undertaken and *Epitrix* species have often been considered together as a pest complex. Data on distribution of individual species is therefore not fully reliable. In addition, systematic surveys on *Epitrix* species in North America have not been performed since Gentner (1944).

Epitrix tuberis
E. tuberis is believed to be native to Colorado (USA), from which it spread to California, Nebraska, New Mexico, Oregon, South Dakota, Washington and Wyoming (USA), and to British Columbia and Alberta (Canada), during the course of the 20th century.
EPPO region: absent
North America: Canada (British Columbia, Alberta, Manitoba, Saskatchewan), USA (California, Colorado, Nebraska, New Mexico, North Dakota, Oregon, South Dakota, Washington, Wyoming) (Arnett, 2000; Bousquet, 1991; Campbell et al., 1989; Fauske, 2003; Gentner, 1944; Seeno & Andrews, 1972; Wallis, 1957; CABI 2007 a)

Epitrix cucumeris
EPPO region: Azores Islands and Northern mainland Portugal (Borges, 2008; Boavida & Germain, 2009)
North America:

- Canada (Alberta, Manitoba, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan),
- USA (at least California, Florida, Indiana, Kansas, Maine, Manitoba, New Hampshire, New Mexico, Nebraska, North Carolina, North Dakota, South Dakota, Vermont, Virginia, New York); (Gentner, 1944; Senanayake & Holliday, 1989, Stewart & Thompson, 1989; Bousquet, 1991; Arnett, 2000; Foster & Obermeyer, 2009).
- Mexico (Durango, Guerrero, Morelos, Puebla, Veracruz) (Furth & Savini 1996, Furth 2006)

Central America and Caribbean: Costa Rica, Guatemala, Dominican Republic, Jamaica, Nicaragua, Puerto Rico (Furth & Savini 1996; CABI, 2007b; Sibaja Chinchilla & Sanabria Ujueta, 2002)

South America: Bolivia, Colombia, Ecuador, Venezuela (Anonymous, 1996; Briceno, 1975)

Africa?: *E. cucumeris* is reported as a pest of *Solanum macrocarpon* in Africa (Bukenya-Ziraba & Bonsu, 2004) but there are no details on its distribution.

Epitrix similaris

EPPO region:

- Portugal (mainly in the North and Centre; *E. similaris* is reported to be widespread in the main potato-growing areas, Boavida & Germain, 2009).
- Spain: a single adult was identified from a field in Xinzo, near the Portuguese border (Boavida & Germain, 2009). Surveys were undertaken by the Spanish NPPO in 2010. As a result *Epitrix similaris* has been found on potato, in several plots located in different areas of the whole region of Galicia..

North America: USA (at least California, Gentner, 1944). *E. similaris* is considered to have originated from North America, but very little data is available on its geographical distribution in its area of origin.

Epitrix subcrinita

EPPO region: absent.

(The report by Rasmussen *et al.* (2003) in Italy and Greece is erroneous).

North America: Canada (British Columbia) (Bousquet, 1991), USA (Arizona (North), California, Colorado, Idaho, Nevada, New Mexico (North), Oregon, Utah, Washington, Wyoming) (Genter, 1994; Arnett 2000; Hoy *et al*., 2008)

South America: Peru (Anonymous, 1996; Alcazar, 1997)

Major host plants or habitats:

Adults of the *Epitrix* species considered in this PRA are reported to feed on a wide range of host plants but Solanaceous plants appear to be preferred (potato, tomato, aubergine, tobacco, *Capsicum* spp., and weeds such as *Datura stramonium, Solanum nigrum)*. It should be noted that foliage feeding does not necessarily imply the plant is a host (i.e. that it allows the pest to lay eggs and larvae to survive). Completion of life cycle of various *Epitrix* species on potato (*Solanum tuberosum)* is well documented but there is little data for other host plant species. *Data on host range is therefore not fully reliable.*

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

The EWG considered that the main pathways are:

-potato tubers for planting with soil and/or plant debris attached coming from countries where the pests occur,

-potato tubers for consumption or processing with soil and/or plant debris attached coming from countries where the pests occur.

Adults spend the winter within the soil, and immature stages of *Epitrix* occur in the soil. As the pest completes one or more life cycles during the

period of crop development, larvae, pupae and adults can be present when tubers are harvested. These pathways should be given priority.

The other pathways are considered to present a lower risk (see Stage 3). They are the following:

- Soil or growing medium attached to rooted host plants from countries where the pests occur
- Soil or growing medium attached to rooted non-host plants from countries where the pests occur
- Natural spread within the EPPO region
- Soil or growing medium as such from countries where the pests occur
- Soil attached to machinery from countries where the pests occur

Washed potato tubers free from soil are an impossible pathway because no life stage of the pest remains in the tuber after harvest.

Establishment

Plants at risk in the PRA area:

Potato and to a lesser extent other Solanaceous crops (e.g. tomato, aubergine)

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

A comparison of climate using CLIMEX shows that climates of countries of the EPPO region are similar to zones where *Epitrix* species occur, and therefore all EPPO countries have a climate suitable for at least one species of *Epitrix*. It should be noted that, as literature for species distribution is not fully reliable, extrapolation of distribution of *Epitrix* species in the EPPO region based on their current distribution should consequently be taken with care.

E. tuberis

This species is present in the north western part of North America, from California (US) to British Columbia (CA). The climate is similar to that in the EPPO region, except in the Mediterranean Basin.

E. cucumeris

The very wide distribution of *E. cucumeris* especially in North America and its establishment in Azores and Portugal indicate that it could readily find suitable climatic conditions in Europe and the Mediterranean part of the EPPO region. One could expect it to establish in all of the potato-growing areas of Central and Northern Europe.

E. similaris

This species is only reported from California but it has been introduced into Portugal where it is present in almost all potato growing areas (Boavida & Germain, 2009). This indicates that the pest can establish in at least the Mediterranean Basin.

E. subcrinita

This species is present in the north western part of North America, from South California (US) to British Columbia (CA), as well as in Peru. The CLIMEX study shows that this pest could find similar climates in the entire EPPO region.

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

Host plants are present both in crops and in private gardens (and as weeds). In some areas, Solanaceous plants are grown outdoors all year round.

Few natural enemies are reported in the area of origin, and they do not occur in the PRA area.

Insecticide armory available in the PRA area is limited compared to that which is available in North America (e.g. in furrow application of granular

systemic insecticides and in-furrow sprays are widely used to control *Epitrix* but are no longer authorized in numerous EPPO countries)

Which part of the PRA area is the endangered area:

All EPPO countries are endangered in relation to at least one of the species considered.

POTENTIAL ECONOMIC CONSEQUENCES

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

Effect on potato

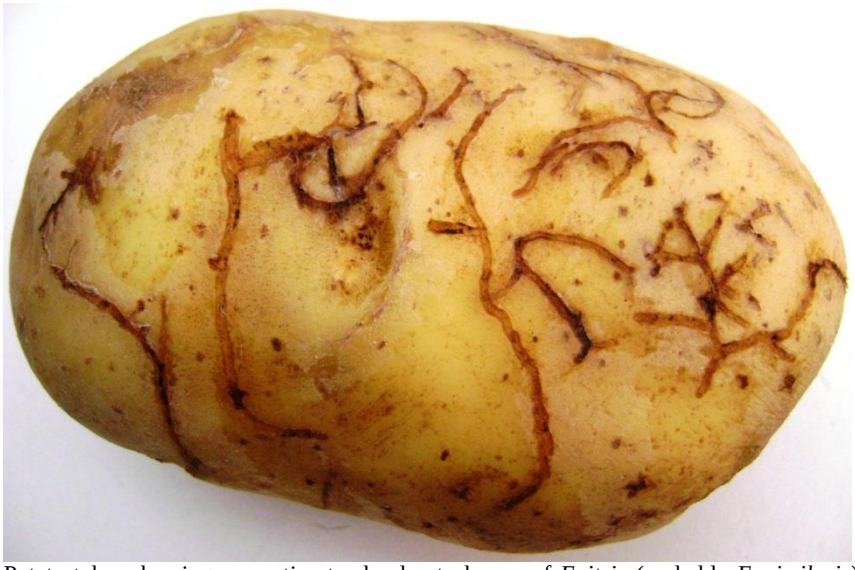
Most of the negative impact is due to the impact on cosmetic quality of tubers, as *Epitrix* damage does not affect gustative quality. Because of quality requirements for tubers to be marketed, this can nevertheless cause lot rejection, and therefore complete crop loss.

For *E. tuberis*, larval feeding cause holes up to 1 cm into the tuber flesh which cause problems in ware potatoes for home (not processed) consumption and processing, particularly chips (Hoy *et al*, 2008). For other *Epitrix* species, damage due to larvae seem more superficial (e.g. *E. subcrinita* burrow just under the peel and seldom penetrate over 0.6 cm), which does not necessarily make the tuber unsuitable for processing but may cause lot rejection for tuber to be marketed for home consumption. All species can transmit or favor pathogen entry which may have an additional negative impact on yield: Ferro & Boiteau (1993) note that "damaged tubers are often invaded by soft rot bacteria or *Fusarium* dry rot fungi".

In Canada, IPM programs are designed to have less than 5% of tubers with symptoms.

Leaf damage can also lead to a yield reduction (up to 15% for *E. cucumeris*, Senanayake *et al*., 1993), in particular if potato plants are already stressed by defoliation due to other pests or by drought.

Potato tuber showing tunnels due to larvae of *E. tuberis*. Vernon, Agriculture Canada (CA)



Potato tuber showing serpentine tracks due to larvae of *Epitrix* (probably *E. similaris*) in Portugal. Boavida (PT)

Effect on other crops

Flea beetles, as a pest complex, are reported as damaging to several crops (e.g. tomato, aubergine, sugarbeet) because of yield losses consecutive to foliar feeding by adults but little data on crop losses is available in the literature.

Describe damage to potential hosts in PRA area:

Damage is expected to be similar to that in North America. Up to now, only damage on potato has been reported from mainland Portugal.

In the Azores (PT) *E. cucumeris* is not considered as a pest of potato or other crops (Borges, pers. comm. 2010).

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

Losses to producers will be closely related to quality requirements of the market which are dependant on potato supplies. According to Rules on inter-European trade in potatoes (RUCIP, 2006), superficial defaults are allowed for ware potatoes within a tolerance of 6% by weight. The EWG considered that much stricter requirements may exist for some markets, in particular for the washed potato tubers sold in supermarkets but no precise level could be retrieved.

Without any control measures, it can be expected that economic damage would be major, as in that which was observed in Portugal and in North America. In Portugal up to 2008, no specific control measures were applied and some potato lots were downgraded as a consequence of *Epitrix* symptoms on tubers, and resulted in complete crop losses, lots of Portuguese potatoes were rejected by clients in Northern Europe (Oliveira *et al.*, 2008; Silva, 2008).

E. tuberis and *E. cucumeris* are quarantine pests in a number of countries worldwide, and their presence in the EPPO region may therefore cause losses in export markets.

Epitrix species are unlikely to be controlled based solely on current usage in potato production. Production costs will increase due to increased crop protection costs (IPM development, monitoring, insecticide sprays). Management in organic production might be challenging. In addition, host plants are present in gardens where no measures are applied.

CONCLUSIONS OF PEST RISK ASSESSMENT

Summarize the major factors that influence the acceptability of the risk from this pest:

Potato and other host plants of *Epitrix* species are widely grown across the EPPO region, both as commercial crops and in gardens. The pests are likely to be moved undetected in soil attached to plants or plant products.

Considering its host plants and its area of origin, it is likely that *Epitrix cucumeris, E. similaris, E. subcrinita* and *E. tuberis* can establish in the EPPO region. Control is possible but will increase production costs in

commercial production. Control in non commercial production will be problematic and will maintain a certain level of population of *Epitrix* species. As *E. tuberis* is a quarantine pests in numerous countries worldwide (as well as *E. cucumeris* to a lesser extent), this may affect export markets.

Estimate the probability of entry:

Epitrix species are present at level causing economic damage in North America and other countries (e.g. Peru). It is likely that the pest can be associated with seed or ware potatoes but the concentration would be much lower on seed than on ware potatoes. Trade of seed potatoes is minimal but an infested lot might move undetected and would be planted in a suitable environment. Import of ware potatoes from countries where the pest occurs is minor, but it is likely that the pest could survive and remain undetected in trade. The transfer to a suitable environment for *Epitrix* associated with ware potatoes is moderately likely, depending on the period of import, and on the handling and packing process in the country of destination.

The other pathways are considered to present lower risk of entry. Concerning plants for planting, the EWG recognized that a risk exists but association and concentration of the pest on the pathway, whilst considered very low, is very difficult to assess because of lack of data.
Concerning soil as such, and soil attached to machinery, the risk is mainly associated with local spread.

E. similaris and *E. cucumeris* have entered the PRA area. It is considered that other *Epitrix* species have a similar probability of introduction.

Estimate the probability of establishment:

Establishment has already occurred in a limited part of the PRA area (Portugal). The overall probability of establishment in other areas is high for the following reasons: hosts are abundant, environment is favourable (suitable climate, no natural enemies), current pest management practices are not expected to prevent establishment. Because of the uncertainty about the current distribution of the different *Epitrix* species, it is not possible to predict with a low uncertainty where each species considered will establish within the PRA area.
The probability of spread is considered high (combination of natural and human spread).

Estimate the potential economic impact:

The potential economic impact in the EPPO region is evaluated as high by the EWG.

Degree of uncertainty

It is not possible to assess *Epitrix* species individually because of the following uncertainties:

- Species distribution and pest status of *Epitrix* species, in particular presence of *E. similaris* in North America, pest status of *E. cucumeris*
- Biology and population dynamics of *Epitrix* species, in particular *E. similaris* (number of generations, capacity of dispersal, adaptability, building of small population)
- Host range, in particular impact in tomato
- Difference of behaviour in North America and Europe.

In addition, there are uncertainties on:

- Origin of the Portuguese outbreak
- Species responsible for damage in Portugal
- Reaction of the potato market, quality requirements in different EPPO countries

OVERALL CONCLUSIONS The pest is an appropriate candidate for the management stage.

STAGE 3: PEST RISK MANAGEMENT

IDENTIFICATION OF THE PATHWAYS

Pathways studied in the pest risk management

- *Potato tubers for planting with soil and/or plant debris attached coming from countries where the pests occur,*
- *Potato tubers for consumption or processing with soil and/or plant debris attached coming from countries where the pests occur*
- *Soil or growing medium attached to rooted host plants from countries where the pests occur.*

The risk exists but cannot be quantified as it is not clear which plants are actually hosts (i.e. allow the pest to complete its life cycle) and there is no detailed data available for plants for planting. It is difficult to know the potential concentration of these pests, the possible association with host, the possibility of transfer, etc. Relevant data on volume of entry is impossible to retrieve.

Other pathways identified but not studied further

- *Soil or growing medium attached to rooted non-host plants from countries where the pests occur.*

Nursery plants (or other plants for planting) may be grown in fields where potatoes or other hosts had been grown previously and consequently soil attached to rooted non host plants may contain dormant adults or pupae. Even non-host plants raised in containers can pose a risk albeit small (e.g. if host weeds grow in the container and attract *Epitrix* adults to feed on foliage and/or lay eggs); EWG considered that it was a very low risk.

- *Natural spread within the EPPO region*:

Scientific data on potential for natural spread is lacking. The EWG considered that human-mediated spread, through the movement of infested ware and possibly seed potatoes, is much more likely to be responsible for the long distance spread of *Epitrix* species.

- *Soil or growing medium as such from countries where the pests occur*

In theory, soil is a pathway for movement of *Epitrix* species. Nevertheless, the volume of soil imported into EPPO countries from outside the region is minimal as EU countries prohibit the import of soil from countries outside the EU and similar restrictions on international movement exists in most other countries in the region (North Africa, CIS countries). There is no data available on the trade of soil between EU countries. Given that the volume of soil moved long distances is likely to be low, the risk presented by this pathway seems to be very low.

- *Soil attached to machinery from countries where the pests occur*

Infested soil attached to machinery may play a role in local spread of the pest. Cleaning of machinery entering infested fields will reduce the risk of spread by this pathway.

IDENTIFICATION OF POSSIBLE MEASURES

Possible measures for pathways

- **Pathway 1:** Potato tubers for planting with soil and/or plant debris attached coming from countries where the pests occur

Measures related to consignments:

No measures identified (the pest is difficult to detect; treatment may damage vitality of seed potatoes)

Measures related to the crop or to places of production:

Production in pest-free areas.

Other possible measures
None

- **Pathway 2:** Potato tubers for consumption or processing with soil and/or plant debris attached coming from countries where the pests occur

Measures related to consignments:

- Treatment: brushing and/or washing of tubers in the country of origin. The EWG considered that such treatment could not be applied in the importing country because of the risk of escape of the pest.

Other treatments may be appropriate but their efficacy against *Epitrix* species should be evaluated (irradiation, fumigation with methyl-bromide, steam treatments, hot water dipping treatments).

- Specific handling and packing methods: Use of new or cleaned and disinfected containers/bags will avoid (re)infestation of the consignment with pests that might remain from previous utilisation. This measure is not sufficient on its own.

Measures related to the crop or to places of production:
Production in pest-free areas.

Other possible measures
None

- **Pathway 3:** *Soil or growing medium attached to rooted host plants from countries where the pests occur*

Measures related to consignments:
Removal of soil or growing medium

Measures related to the crop or to places of production:
Production in pest-free areas and in pest-free places of production (under protected conditions)
Production under screened greenhouse conditions and with appropriate monitoring.

Other possible measures
None

EVALUATION OF THE MEASURES IDENTIFIED IN RELATION TO THE RISKS PRESENTED BY THE PATHWAYS

International trade of potato tubers is already prohibited and/or regulated for a number of pests in most countries of the EPPO region. In countries where *E. tuberis* or *E. cucumeris* are not quarantine pests (e.g. the EU), there are currently no requirements for *Epitrix* species.
Trade between EU countries will be more complicated from areas where the pests are established.
International trade will not be stopped but additional measures will be required that will likely result in some additional costs.
Brushing and/or washing of tubers will have to be done in the exporting country rather than in the importing country because of possible escape of the adults. The safe disposal of infested soil will require special measures that are likely to be prohibitively expensive.

Measures required will result in additional costs (especially for the establishment of Pest Free Areas as surveys, monitoring and inspections will be needed)
Brushing tubers is a measure already in use in some countries for removing excess soil. In such a case there will be no additional cost.

These measures are considered cost-effective compared to the measures needed for an eradication of an outbreak or to the management measures if the pest enters the PRA area and establishes in potato growing areas.

Degree of uncertainty	Uncertainties in the management part are: Efficiency of treatments other than brushing and/or washing to guarantee pest freedom of the consignment. Minimum distance required for a buffer zone for a Pest-free place of production (measure not recommended).

IDENTIFICATION OF POSSIBLE MEASURES

PC= Phytosanitary certificate, RC=Phytosanitary certificate of re-export

Pathway 1: Potato tubers for planting with soil and/or plant debris attached coming from countries where the pests occur	PC and, if appropriate, RC • Production in pest-free areas

Pathway 2: Potato tubers for consumption or processing with soil and/or plant debris attached coming from countries where the pests occur	PC and, if appropriate, RC • Production in pest-free areas or • Treatment

Pathway 3: Soil or growing medium attached to rooted host plants from countries where the pests occur	PC and, if appropriate, RC • Production in pest-free areas or • Production in pest-free places of production (under protected conditions) or • Production under screened greenhouse conditions and with appropriate monitoring or • Removal of soil or growing medium

References

For all Internet references: last accessed in March 2010.

Alcazar J (1997) Principales plagas de la papa: Gorgojo de los Andes, Epitrix y Gusanos de Tierra. Fasciculo 3.6. Centro Internacional de la Papa (CIP), Lima, Peru. 7pp

Anonymous (1996). Inventario Subregional de Plagas y Enfermedades de los Vegetales de importancia economica para el Area Andina. *Gaceta Oficial del Acuerdo de Cartagena***.** Ano XIII - Numero 223

http://faolex.fao.org/docs/pdf/anc60466.pdf

Arnett RH Jr (2000) American Insects. A handbook of the insects of America North of Mexico, 2nd edition, CRC Press (US), 1003 pp.

Boavida C & Germain JF (2009) Identification and pest status of two exotic flea beetle species newly introduced in Portugal: *Epitrix similaris* Gentner and *Epitrix cucumeris* (Harris). *Bulletin OEPP/EPPO Bulletin* **39**, 501–508

Borges PB, coordinator (2008) *Terrestrial arthropods. Biodiversity Database of Azores.* Universidade dos Açores. INTERREG IIIB, http://www.azoresbioportal.angra.uac.pt/pesquisa.php?lang=en&sstr=8

Bousquet Y (1991) Checklist of beetles of Canada and Alaska. Ottawa, Canada: Research Branch Agriculture Canada Publication.

Briceno VA (1975) Lista preliminar de los Chrysomelidae (Coleoptera) de Los Andes Venezolanos; Serie: Agronomia Tropical (Venezuela). (Ene-Feb 1975). v. 25 (1) p. 39-47. http://sian.inia.gob.ve/repositorio/revistas_ci/Agronomia%20Tropical/at2501/arti/briceno_a2.htm

Bukenya-Ziraba R & Bonsu KO (2004) *Solanum macrocarpon* L. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands. http://database.prota.org/PROTAhtml/Solanum%20macrocarpon_EN.htm

CABI (2007a) Crop Protection compendium datasheet for *Epitrix cucumeris*

CABI (2007b) Crop Protection compendium datasheet for *Epitrix tuberis*

Campbell JM, Sarazin MJ, Lyons DB, 1989. Canadian beetles (Coleoptera) injurious to crops, ornamentals, stored products, and buildings. Ottawa, Ontario, Canada: Agricultural Canada. Abstract

Fauske (2003) Common flea beetles of North Dakota. http://www.ndsu.edu/ndmoths/Fleabeetles/List%20of%20flea%20beetles.htm

Ferro DN & Boiteau G (1993) Management of insect pests. in *Potato Health Management*, p 103-116. Rowe RC ed. American Phytopathological Society Press, St. Paul, MN (US).

Foster RE & Obermeyer JL (2009) Vegetable Insects. Purdue Extension. http://extension.entm.purdue.edu/publications/E-74.pdf

Furth DG (2005) The Current Status of Knowledge of the Alticinae of Mexico (Coleoptera: Chrysomelidae). Bonner zoologische Beiträge 54, 209–237

Furth DG, Savini V (1996) Checklist of the Alticinae of Central America, including Mexico (Coleoptera:Chrysomelidae). Insecta Mundi, Vol 10, Nos 1-4, 45-68

Gentner LG (1944) The black flea beetles of the genus *Epitrix* commonly identified as *cucumeris* (Harris) (Coleoptera: Chrysomelidae). Reprinted from *Proceedings of the Entomological Society of Washington* **46** (6), 137-149. http://www.biodiversitylibrary.org/item/54899#10

Hoy CW, Boiteau G, Alyokhin A, Dively G, Avarez JM (2008) Managing insect and mite pests in *Potato Health Management* 2nd Edition, Edited by Dennis A. Johnson. APS, Saint Paul, USA

Moreira J & Belchior A (2007) Estudo comparativo de cultivares de batata em dois modos de fertilização azotada, conduzido em sistema de produção integrada. http://www.drapc.min-agricultura.pt/base/geral/files/realtorio_batata_2007.pdf

Oliveira R, Chatot C & Dedryver C-A (2008) [A new fleabeetle detected in Europe] *Potato Planet* **011**, juillet, 30-34 (in French).

Rasmussen C, Lagnaoui A, Esbjerg P (2003) Advances in the Knowledge of Quinoa Pests. Food reviews International Vol 19, Nos 1&2 pp 61-75, 2003. http://science.melipona.org/PDF/rasmussen2003_1075_quinoapests.pdf

RUCIP (2006) Rules & practices of the inter-European trade in potatoes.

http://www.europatat.eu/_files/downloads/rucip_rules2006_en.pdf

Seeno TN & Andrews FG (1972) Alticinae of California, Part I: *Epitrix* spp. (Coleoptera: Chrysomelidae). *The Coleopterists Bulletin* **26** (2), 53-61.

Senanayake DG, Pernal SF & Holliday NJ (1993) Yield responses of potatoes to defoliation by the potato flea beetle (Coleoptera: Chysomelidae) in Manitoba. *Journal of Economic Entomology* **85** 1527-1533.

Senanayake DG & Holliday NJ (1989) Seasonal abundance of foliage-dwelling insect pests in commercial fields and insecticide-free plots of potato in Manitoba. Canadian Entomologist, 121: 3, 253-265

Stewart & Thomson (1989) The spatial distribution of spring and summer populations of adult potato flea beetles, *Epitrix cucumeris* (Harris) (Coleoptera: Chrysomelidae), on small plots of potatoes. Canadian Entomologist, 121:12, 1097-1101

Sibaja Chinchilla G & Sanabria Ujueta C (2002) Principales plagas de insectos, ácaros y moluscos de cultivos agrícolas y forestales de Costa Rica. Ministerio de Agricultura y Ganaderia. Servicio fitosanitario del estado. http://www.protecnet.go.cr/laboratorios/Plagas.html

Silva N (2008) Nova praga ameaça batata portuguesa. *Frutas, Legumes e Flores*, no. 101, 12-13.

Vernon RS, Thomson D, 1993. Effects of soil type and moisture on emergence of tuber flea beetles, *Epitrix tuberis* (Coleoptera: Chrysomelidae) from potato fields. Journal of the Entomological Society of British Columbia, No. 90:3-10. Abstract

Wallis RL (1957). Seasonal abundance and host plants of the tuber flea beetle in the Rocky Mountain region. Journal of Economic Entomology, 50(4):435-437.