NAPPO
North American Plant Protection Organization
Organización Norteamericana de Protección a las Plantas
MEXICO - USA - CANADA

DD 08: Likelihood of Establishment

Prepared by the members of the Expert Group on Likelihood of Establishment of the North American Plant Protection Organization (NAPPO), with the collaboration of additional experts from the United States.

Likelihood of Establishment

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Likelihood of Establishment Discussion Paper

1. Background and Introduction

In 2016, the NAPPO Executive Committee approved a project for an expert group (EG) to develop additional guidance on analysis of Likelihood of Establishment (LoE) as part of pest risk analysis (PRA). The initial project goal was to provide **harmonized conceptual guidance** on assessing LoE when conducting PRA. The guidance could be developed either as a new Regional Standard for Phytosanitary Measures (RSPM) or as an Annex to RSPM 40 (Pest Risk Management).

The EG was charged with the following tasks:

- Consider existing standards that address concepts of pest risk assessment, risk management, classification of commodities according their risk e.g., as ISPMs 2, 11, 14, 32; RSPM 40.
- Review and discuss existing national and regional guidance for assessing the likelihood of pest establishment. Specifically consider guidance that emphasizes the role of evidence, i.e., of pest biology or ecological requirements for assessing likelihood of establishment.
- Review existing guidance from other regions for pest risk assessment and pest risk management of low mobility pests or for specific pests in low risk pathways.
- Describe key criteria that can be used to evaluate likelihood of establishment (e.g. what specific information / criteria are needed to determine whether a pest has low mobility, or what set of conditions is necessary for the organism to establish).

The EG deliberated on the above-mentioned tasks during three conference calls. After reviewing the relevant standards and existing guidance on PRA and LoE, the EG determined that existing guidance adequately describes the process. The EG noted, however, that there may be issues with **inconsistent interpretation** of the existing guidance, which may cause issues with over-estimation of risk, or otherwise lead to PRAs that do not fully reflect the actual risk posed by a particular pest.

Therefore, the EG proposed an alternative approach to the project which would be to provide a discussion document on **interpretation of existing guidance** in standards on evaluation of the LoE in PRAs. The EG further agreed that where possible, it would be useful to provide examples that illustrate different approaches on how LoE has been evaluated.

While the discussion document provides guidance for the NAPPO region, the EG also believes that the document could be a valuable contribution to the international plant health community, so that other regions and International Plant Protection Convention (IPPC) contracting parties can benefit from the compiled information and guidance. Additionally, the discussion document may serve as reference material for the new IPPC Supplement to ISPM 11: Guidance on Likelihood of Establishment (Priority 4), approved by the Commission on Phytosanitary Measures (CPM) (2016) for inclusion in the IPPC work program.

2. Interpretation of PRA elements with focus on evaluating LoE

2.1 Pest listing

Different approaches to developing pest lists are used in PRAs. For example, a narrow approach to listing pests would include pests only associated with the plant part being exported – for example the fruit - but would not list pests associated with roots, leaves, or woody parts such as branches. A broad approach to pest listing would include pests associated with all plant parts (roots, leaves, stems, branches and fruit). Pests that are NOT associated with the plant part being exported are listed for transparency, but are not subject to further assessment (or phytosanitary measures) since they are unlikely to be associated with the pathway. Only those pests that are associated with the plant part being exported need to be further assessed to determine their Likelihood of Establishment.

2.2 Type of commodity and intended use

The type of commodity will affect Likelihood of Establishment. For example, plants that are planted in the environment have a higher likelihood of placing pests into areas where the pests may be able to survive. In

contrast, some pests associated with fruit for consumption would be unlikely to move from the commodity into an environment where they could establish.

Quarantine pests that are associated with commodities to be consumed, processed, or destroyed such as fruit (e.g. apples, pears – *Carposina sasakii,* Lepidoptera: Carposinidae), vegetables (e.g. asparagus spears - *Copitarsia decolora* eggs [Lepidoptera: Noctuidae], leeks, onions – *Acrolepiopsis assectella* [Lepidoptera: Acrolepiidae]), or grain (various stored product pests), have low or negligible LoE – see ISPM 32 (*Categorization of Commodities According to their Pest Risk*). This is because pests associated with commodities for consumption or processing have limited opportunities of finding conditions that would enable their survival and establishment as reproducing populations.

It may be appropriate to consider diversion from intended to unintended use for some commodities, for example, planting a commodity intended for consumption. However, evidence of this diversion from intended to unintended use after importation must be documented. If the pest risk changes as a result of diversion, this risk should be documented and quantified.

EXAMPLES where the type and intended use of commodity affects Likelihood of Establishment

LoE likely - Commodity used for propagation

- Imported corn or soybean seeds may pose a risk because certain seed borne pathogens have documented high rates of seed transmission (such as some viruses) and they could be transmitted to a new environment via this pathway.
- Quarantine species of armored scales (Diaspididae) present on plants for planting; these pests may pose a risk because they are being introduced into the environment via the plants for planting pathway and they could establish in the new environment via this pathway.

LoE low or negligible - Commodity used for consumption or processing

- The United States considers that some commodities, like corn or soybeans that are imported for oil production have negligible risk because the commodity is processed, therefore destroying any pests that may be present.
- The United States considers scale insects (Coccoidea) on fruit for consumption to be negligible risk because they are highly unlikely to move away from the fruit before it is consumed.

LoE low or negligible - Commodity used for destructive analysis

- Pests potentially associated with small seed lots used for research, breeding or evaluation purposes that remain confined in growth chambers, laboratories, greenhouses or screenhouses and are never planted.

2.3 Elements of likelihood of establishment

Below is a list of the main factors to consider when evaluating Likelihood of Establishment - see also ISPM 11 (*Pest Risk Analysis for Quarantine Pests*):

2.3.1 Availability, quantity and distribution of hosts in the PRA area

Interpretation - Consider whether hosts and alternate hosts are present and how abundant or widely distributed the may be.

EXAMPLES to assist in interpretation of availability, quantity and distribution of hosts

LoE likely - Hosts available and widespread

- Chestnut trees and chestnut blight (*Cryphonectria parasitica)* in North America.
- Ash trees and ash dieback (*Hymenoscyphus fraxineus*) in Europe.
- Cactus moth (*Cactoblastis cactorum* [Lepidoptera: Pyralidae]) has 107 host species of the cactus genus *Opuntia* sp. (51 species of *Cylindropuntia* and 56 species of *Platyopuntia*), which include cultivated and wild species.

LoE unlikely - Tropical pest, affecting only tropical crops, enters a country with a temperate climate

- Citrus greening for Canada; no citrus production in Canada.

LoE unlikely - A pest may have a host range limited to only a few hosts with narrow or restricted geographic distribution. In such cases, unless the pest is directly introduced into that environment, it would be unlikely to establish

- Creosote bush grasshopper, *Bootettix argentatus* (Orthoptera: Acrididae), feeds only on creosote bush, *Larrea tridentata.*

2.3.2 Environmental suitability

Interpretation - Suitability of the habitat, including favorable outdoor or indoor environment, in relation to the biology and life cycle of the pest. Environmental suitability includes pest arrival in the country of destination at a suitable time of the year.

EXAMPLES to assist in interpretation of environmental suitability

LoE likely - Outdoor environment is suitable for pest establishment

- *Adoxophyes orana* (Lepidoptera: Tortricidae), is widespread throughout Europe from the southern Mediterranean to Finland, which resemble a diverse range of similar habitats in North America.
- The United States considers that species of *Ralstonia solanacearum race 3 biovar 2* would be able to survive in a range of bioclimatic conditions. Therefore, it is considered that – at least for climatic conditions – this pest could establish if it entered on certain pathways.
- *Drosophila suzukii* (Diptera: Drosophilidae) tolerates very cold winters, therefore it could survive and establish in places with these conditions.
- *Lobesia botrana* (Lepidoptera: Tortricidae). The optimum developmental temperature for the species is 28-30°C, with a minimum of 8°C and maximum of 34°C. Therefore, its establishment is likely in places with wide range of temperatures.

LoE likely - Indoor environment suitable for pest establishment

- *Tuta absoluta* (Lepidoptera: Gelechiidae) in tomato glasshouses in England.

LoE unlikely - Unsuitable climatic or environmental conditions

- Stored product pests such as khapra beetle, *Trogoderma granarium* (Coleoptera: Dermestidae), lesser grain borer, *Rhyzopertha dominica* (Coleoptera: Bostrihidae), southern cowpea weevil, *Callosobruchus chinensis* (Coleoptera: Bruchidae), are tropical in origin and can only survive if the storage area is heated.
- Pests arriving on imported commodities from the southern into the northern hemisphere during winter in the northern hemisphere. The United States initially allowed entry of avocados for consumption from Mexico into northern states during the winter months as an additional safeguard against the establishment of Tephritid fruit flies (Diptera: Tephritidae) that could follow this pathway. The rationale was that even if fruit flies were infesting the avocadoes, they would not survive the winter climatic conditions in the northern states.
- *Phytophthora cinnamomi'*s spread in the Northeastern United States is restricted by cold temperatures but it is widespread in more southern locations below the 40th parallel north latitude.
- *Alternaria triticina*, a pest of wheat in tropical and subtropical areas. The host is grown in North America but environmental suitability for the pest in temperate areas of North America is likely low.
- Sorghum ergot (*Claviceps africana*) is a pathogen primarily distributed by wind and rain. Sclerotia can contaminate seed during harvest. However, sclerotia can be effectively removed during the seed conditioning process and their absence confirmed by microscopic examination of official samples. Some NPPOs have tested seed by PCR and obtain false positives because this approach will detect DNA associated with spores (dead-end pathway) contaminating the seed surface.

- Vectored seed borne pathogens (Stewart's wilt, high plains virus). Seed production practices keep transmission levels usually below levels of detection. Absence of vectors in countries that would import this seed would further reduce LoE.

2.3.3 Other Pest Characteristics

Interpretation – Biological characteristics which enable the pest to reproduce and effectively adapt in a new environment (parthenogenesis, self-crossing, minimum population number needed for establishment, number of generations per year, resting stage, creating resistance structures [spores, cysts], genotypic and phenotypic variability), and association with vectors.

EXAMPLES of other pest characteristics

LoE likely - Highly adaptable and invasive pests

- Asian gypsy moth, *Lymantria dispar* (Lepidoptera: Lymantriidae), has adaptation characteristics amenable to a higher LoE. Egg masses are long-lived, and tolerant of extreme temperatures and moisture.

LoE likely - Polyphagous pests

- Brown marmorated stink bug (*Halyomorpha halys*, Hemiptera: Pentatomidae) and light brown apple moth (*Epiphyas postvittana*, Lepidoptera: Tortricidae). Both species are highly polyphagous.
- Many species of Tephritid fruit flies have broad host ranges, with potentially hundreds of suitable hosts. If such fruit flies are able to enter an area, there is a reasonable likelihood that they would find suitable hosts.

LoE likely - Parthenogenic species

- Several species of aphids (Hemiptera: Aphididae).

LoE likely - Species with facultative diapause

- Codling moth, *Cydia pomonella* (Lepidoptera: Tortricidae), can forgo diapause altogether if environmental conditions are suitable. Also, when diapause is induced, a certain proportion of diapausing larvae remain in diapause regardless of the onset of favorable conditions.

LoE likely – Highly adaptable pests

- *Verticillium dahliae* on spinach and lettuce mosaic virus. Both these pests can rapidly develop new races, and seed companies are constantly developing new lines that possess genetic resistance to new strains/races. Both of these pests are cosmopolitan and occur in all production areas throughout the world.

LoE unlikely – Species that need a minimum of one male and one female to establish populations

- Internal-fruit feeding insects such as *Carposina sasakii* (Lepidoptera: Carposinidae), *Grapholita inopinata*, and *G. molesta* (Lepidoptera: Tortricidae). A single larva in a fruit is not enough to start an incipient population in a new location.
- Mango seed weevils (*Sternochetus mangiferae* [Coleoptera: Curculionidae]) do not fly; in addition, typically only one seed weevil will emerge from one mango fruit. Therefore, effective reproduction would require that at least two infested mangos located in close proximity to one another, from which a male and female emerge simultaneously and in close proximity to a mango tree.

2.3.4 Pest mobility

Interpretation – Highly mobile pests have a higher likelihood of establishment than those with lower mobility. Also, consider whether a vector, needed for dispersal of a pest, is already present in the PRA area.

EXAMPLES to assist in interpretation of pest mobility

LoE likely - Pest highly mobile

- Certain Tephritid (fruit flies) are strong flyers and can travel several kilometers in search of a suitable host or mate.
- *Maconellicoccus hirsutus* (pink hibiscus mealybug, Hemiptera: Pseudococcidae). The eggs, stadium 1 nymphs and males can be wind-blown and colonize new hosts.
- Rust spores can spread across continents and survive radiation and extreme climatic conditions.

LoE likely - Pest has effective vector

- Dutch elm disease (*Ophiostoma ulmi* and now mainly *Ophiostoma novo-ulmi*) in North America became devastating after a more effective vector, the European elm bark beetle (*Scolytus multistriatus*, Coleoptera: Scolytidae) was introduced.

LoE unlikely – Low mobility pests

- Scale insects (family Diaspididae) on avocado. Diaspidid scale insects, due to their extremely low mobility, would be unlikely to move from avocado fruit to another host in a new area. In this case, no phytosanitary measures are justified to mitigate for the scale insects. However, those same scale insects could be subject to phytosanitary measures if they were present on plants for planting.
- Blueberry maggot (*Rhagoletis mendax*, Diptera: Tephritidae) and *Lobesia botrana*, Lepidoptera: Trotricidae). There are historical records of large frosts killing-off hosts and larvae resulting in un-infested fruit for the next couple of years, indicating very low immigration, even from neighboring fields.
- Giant African land snail species (Achatinidae) and the European brown garden snail (*Cornu aspersa*, Helicidae) have low mobility. If accidentally introduced into a new habitat, they cannot move quickly to colonize a large area. Hence the likelihood of establishment is low as individuals can easily be contained and controlled.

2.3.5 Cultural practices and control measures

Interpretation. Production practices – from planting through harvest, processing and shipping – may impact whether the pest is present and if the pest is likely to end up in an environment where it could establish. ISPM 32 (*Categorization of Commodities According to their Pest Risk*) outlines how commodities may be handled or processed and describes the level of risk associated with commodities that undergo different processes. This information may also need to be considered when evaluating LoE.

Industry sanitation practices associated with handling and quality purposes may result in exclusion of some external pests and contaminants. In addition, pest management practices such as routine activities that are in place for other pests, such as a broad-spectrum pesticide applications, can reduce the risk posed by another pest in a particular pathway.

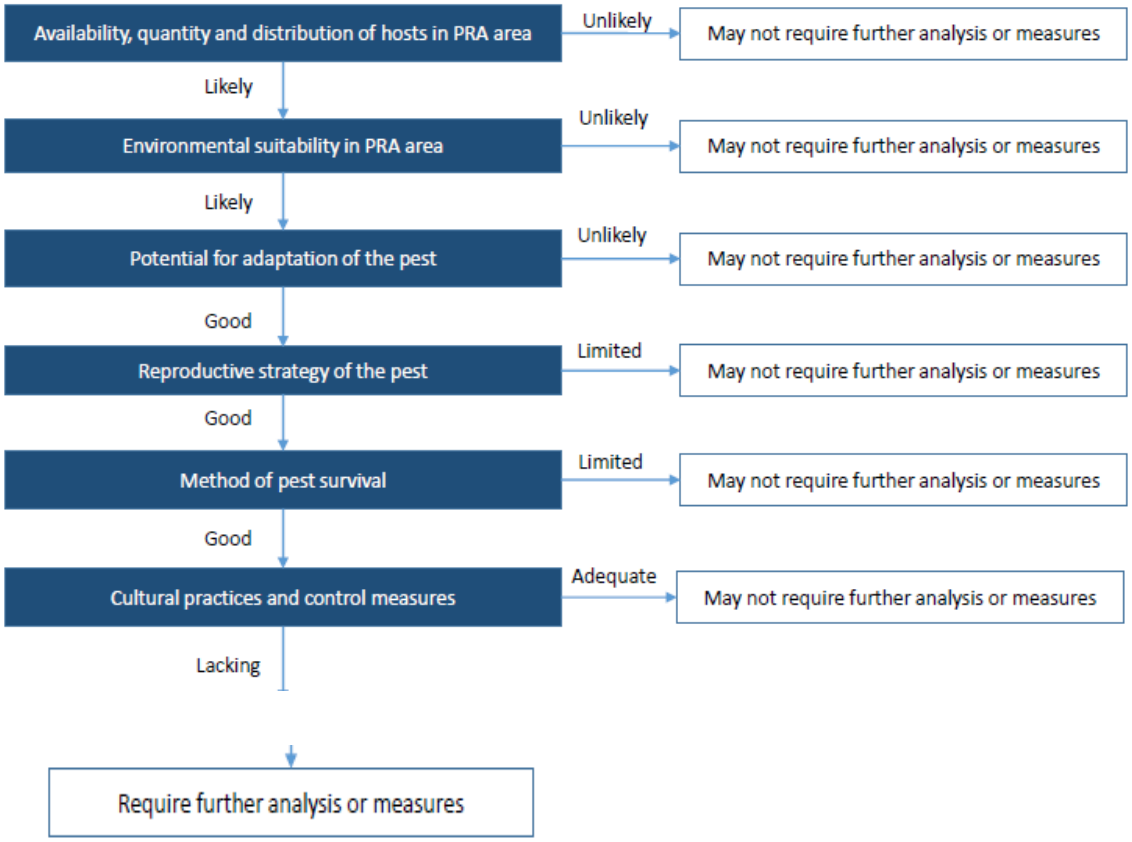
EXAMPLES to assist in interpretation of cultural practices and control measures.

Low LoE

- Mango fruit are washed to remove sticky tree sap that has dripped onto the fruit when harvested in the field. This routine post-harvest practice removes pests that might be attached to the mango fruit.
- *Erwinia uzenensis*, reported on European pear in Japan, is managed in Japan by existing control measures for the more virulent species *E. amylovora*, which is present in North America. Not considered as a quarantine pest for Canada.
- *Trogoderma granarium*, establishment in the Canadian grain silo system is low because the system is maintained separately from other grains imported from abroad and therefore no cross-contamination occurs.
- In some parts of Japan and China fruit bagging is a cultural practice which provides a physical barrier between the fruit and its environment. Historically, it has been used to improve visual quality and to prevent damage by diseases, pests and birds, and also to protect fruit from direct contact with pesticides and fungicides. However, the effectiveness of bagging has only been

1 demonstrated for some types of pests such as internal feeding insects. However, it may exacerbate
2 damage caused by other organisms such as mites (precludes predators) and diseases.

3. Flowchart that will assist in the analysis of Likelihood of Establishment



4. References

IPPC International Standard for Phytosanitary Measures #11. Pest Risk Analysis for Quarantine Pests.

IPPC International Standard for Phytosanitary Measures #32. Categorization of Commodities According to their Pest Risk.

NAPPO Discussion Document 07. 2016. Diversion from Intended Use (October 2016).