Pest risk analysis in Europe - how can risks of invasive alien species be assessed and managed?

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ABSTRACT

Pest risk analysis (PRA) is a tool used in plant health to assess risks of quarantine pests or other organisms harmful to plants and to identify options for their management. Standards of the International Plant Protection Convention (IPPC) and the European and Mediterranean Plant Protection Organisation (EPPO) are available to facilitate the procedure of PRA. Recent amendments of these standards allow a better analysis of risks posed by plant pests to biodiversity and the environment. By this, the regulation of species that threaten biodiversity (invasive alien species) can be technically justified according to the Sanitary and Phytosanitary Agreement under the World Trade Organisation. At present, in particular risks of invasive alien plants are in the focus of adapting PRA in Europe. There are several differences between the assessment and management of pests directly harmful to cultivated plants and pests threatening biodiversity or the uncultivated environment. In many cases, the identification of (potential) invasiveness is very difficult. For the assessment of economic importance of environmental risks, several methodologies are provided that differ from the conservative economic assessment. In contrast to the "traditional plant pests", which are introduced unintentionally, alien plants are usually introduced intentionally. Planting them into intended habitats usually does not pose any problems, only very few species spread into unintended habitats and have adverse effects. For selection of management options a differentiated approach is necessary, including the prohibition of introduction of significantly risky plants and the obligation for specified requirements to restrict their spread. Options and difficulties for assessing and managing invasive alien species will be discussed by means of different examples.

INTRODUCTION

In phytosanitary systems, pest risk analysis (PRA) focuses on the question, whether the assessed organism should be regulated. As a basic requirement for PRA, the criteria for the definition of ‘plant pest’ (IPPC, 1997) have to be satisfied concerning the relevant organism. Subsequently, the risk of introduction and spread of this pest is assessed and – if appropriate – options for measures are evaluated. Since the existence of such PRAs, impacts on the environment were considered basically but not studied in detail, and until recently, effects of plant pests on wild flora, habitats and ecosystems have not been in the focus. But a closer look at the scope of the International Plant Protection Convention (IPPC) reveals, that the Convention's aim is the protection of plants, without any restriction. Also habitats and ecosystems are protected from the consequences that the introduction of plant pests may

have, as they are essential for the survival of plants. Thus, the IPPC is also applicable to invasive alien species harmful to plants - but what is the difference between these invasive alien species and quarantine pests?

By definition (CBD, 2002), invasive alien species are non-indigenous organisms that threaten biodiversity. Consequently, an organism, that solely poses a risk to crops/cultivated plants is not an invasive alien species and does not fall into the scope of the CBD. But an organism, that does not have any adverse effect on crops or cultivated plants, can be considered a quarantine pest (definition: IPPC, 1997), as long as there is a direct or indirect effect on other plants (ICPM, 2001). An organism threatening biodiversity via an impact on plants fulfils both the definition for an invasive alien species and a quarantine pest. This is based on the IPPC interpretation that 'economic importance' in the definition for quarantine pest includes environmental importance. Accordingly, all relevant threats to biodiversity as a consequence of the introduction and spread of organisms directly or indirectly harmful to plants are covered by the IPPC (see also International Standard on Phytosanitary Measures (ISPM) No. 5, Supplement No. 2, 2003).

To provide a tool for the conduction of PRA on an internationally harmonized basis, the IPPC has adopted two pest risk analysis standards in 1996 (ISPM No. 2 "Guidelines for pest risk analysis") and 2001 (ISPM No. 11: "PRA for Quarantine Pests"). Both are focussing mainly on the unintentional introduction of pests of cultivated plants. Based on these standards, the European and Mediterranean Plant Protection Organization (EPPO) developed a risk assessment scheme in 1997, and a risk management scheme in 2000. These EPPO standards were designed as user-friendly schemes to facilitate the conduct of PRA, but, since they are based on the IPPC Standards, PRAs done with these schemes also provide technical justification for the regulation - as far as necessary - of these organisms by states in the EPPO region. This is in accordance with the SPS-Agreement (1994) of the World Trade Organization.

Following the activities of the Convention on Biological Diversity (CBD) and the IPPC (see e.g. Schrader and Unger 2003), ISPM No. 11 and the EPPO standards have been revised to address the effects of quarantine pests on biodiversity and environment in detail. The revision of ISPM No. 2 has started recently. A supplement to ISPM No. 11 was adopted in 2004 as ISPM No. 11: "Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms" (supplementary text concerning environmental risks is marked by "S1"). It was developed following statements of the Interim Commission on Phytosanitary Measures concerning invasive alien species (ICPM, 2001). By this, also "risks affecting uncultivated/unmanaged plants, wild flora, habitats and ecosystems within the PRA area" are included into the standard, and it is clarified that “the full range of pests covered by the IPPC extends beyond pests directly affecting cultivated plants. The coverage of the IPPC definition of plant pests includes weeds and other species that have indirect effects on plants" (ISPM No. 11, 2004). This article will provide an introduction to the assessment and management of invasive alien species in the framework of plant health.

ENVIRONMENTAL RISK ASSESSMENT

From a traditional pest, it is usually known before that it is able to cause damage, at least

somewhere and under certain conditions. In particular for alien plants, the potential to cause damage is much more difficult to evaluate and to quantify. One of the challenges to assess the risks of alien plants is the identification of the plant's potential for invasiveness. The assessment of the consequences of the establishment and spread of a plant pest affecting uncultivated/unmanaged plants or wild flora is quite different from that of a plant pest affecting cultivated plants. Also, the approach to the economic impact assessment is different. Unintentional introduction, the traditional pathway for plant pests, is in this context less important than intentional introduction. In particular for alien plants for planting, the assessment of their entry is not relevant, but it is important to look at the pathway from the intended to the unintended habitat and the probability of establishment in the unintended habitat.

Assessment of establishment and spread

Several points or questions in the PRA standards deal with the assessment of establishment and spread of an introduced organism, considering climatic and other abiotic factors that would affect pest establishment, possible prevention of establishment by competition from existing species in the PRA area or by natural enemies, likelihood of eradication or control of the species after introduction, adaptability of the pest, speed of natural and human assisted spread, and how often the pest has been introduced into new areas outside its original range. The reproductive strategy and duration of life cycle of the assessed species is another important point, taking into account characteristics which would enable the pest to reproduce effectively in a new environment, such as self fertility, short life cycle, number of generations per year, resting stage, vegetative propagation, etc.

Assessment of invasiveness

In particular in the case of alien plants, it is necessary to find out if the assessed organism has intrinsic attributes that indicate that it could cause significant harm to plants or plant communities. Attributes, which could be relevant for invasiveness are a broad ecological amplitude, the ability to build up a persistent seed bank and to produce many seeds or vegetative propagules, and a high competitive strength. Important questions are if the species is invasive in its native range or elsewhere , if the propagules are highly mobile or if the plant does benefit from cultivation or browsing pressure, and if there is a likelihood of building up monospecific stands etc. The prediction of invasiveness of an assessed plant will probably in many cases be the most difficult point in the whole PRA. Several publications deal with the prediction of invasiveness and the related difficulties (e.g. Kolar and Lodge 2000, Williamson 2001, Heger and Trepl 2003). The success of a plant in invading a certain area will also depend on the invasibility of the unintended habitat, so this will have also to be assessed.

Consequences of establishment and spread

An important part of PRA is the assessment, which effects or consequences the establishment and spread of a pest would have in the considered area. At first, direct effects or primary consequences have to be evaluated. For environmental risks, important consequences would be for example the reduction of the abundance of keystone plant species, of plant species that are major components of ecosystems or of endangered native plant species. Also, protection

of other plant species against significant reduction, displacement or elimination is provided, though endangered species receive more attention than just “normal" species because of their status.

Keystone plant species, which are "responsible" for the existence of an ecosystem of a certain type, and species that are major components of ecosystems are of particular relevance, because any reduction of their abundance will certainly change the habitat or ecosystem that is dependent on them, or even cause the ecosystem to collapse. The effect of such species is disproportionately large compared to the species‘ abundance. An important keystone species in European forests is *Pinus sylvestris*. In the forest biocenosis it can play a critical role, it has relationships with many plants and animals and it affects resource availability (Chapin et al., 1997). *P. sylvestris* is very susceptible to the pinewood nematode *Bursaphelenchus xylophilus* (Evans et al. 1996). Another keystone species is the European beech, *Fagus sylvatica*. Experiments and detection in the natural environment have shown that this species is susceptible to *Phytophthora ramorum* (Brasier et al., 2002, EPPO, 2005). Research on both of these invasive alien species is currently done in different EU projects, adding valuable information to the assessment of risks and to economic (including environmental) impacts.

Examples for indirect pest effects or secondary consequences relate to significant effects on plant communities, significant effects on designated environmentally sensitive or protected areas, significant changes in ecological processes and of the structure, stability or processes of an ecosystem (including further effects on plant species, erosion, water table changes, increased fire hazard, nutrient cycling, etc.), effects on human use (e.g. water quality, recreational uses, tourism, animal grazing, hunting, fishing), or costs of environmental restoration. If for example *Robinia pseudoacacia* is invading certain habitats it may have a significant effect on the whole plant community, because ecological processes may be affected by an accumulation of nutrients due to a nitrogen enrichment in the soil caused by this tree species. This has a significant negative impact on nutrient-poor soils, which often are habitats for endangered plant species. A different kind of example is the damage which could be caused by the aquatic plant *Crassula helmsii*. Its vegetative growth leads to dense mats which can block ponds and drainage ditches. The mats can be dangerous to pets, livestock and children who mistake them for dry land.

Assessment of economic consequences

For a valuation of the environment, the supplement of ISPM No. 11 provides different methodologies, including the consideration of "use" and "non-use" values. "Use" values can be separated into consumptive (e.g. fishing in a lake) and non-consumptive (e.g. using forests for leisure activities). "Non-use" values can be divided into option value (value for use at a later date), existence value (knowledge that an element of the environment exists), and bequest value (knowledge that an element of the environment is available for future generations). For the assessment of these values, methods exist referring to market-based approaches, surrogate markets, simulated markets, and benefit transfer. It is also possible to base the assessment on non-monetary valuations (number of species affected, water quality), or expert judgement, if it follows documented, consistent and transparent procedures.

Pathways

With the supplemented ISPM No. 11, it is not only possible to assess the risk of unintentional introductions of e.g. seeds or other propagules contaminating imported commodities, but also of intentional introductions of plants for agriculture and forestry or for horticultural and other ornamental purposes. In the case of imports of such plants for planting, an assessment of the probability of entry would be redundant, as the movement of the plant into a country and subsequently into a certain area is intended. Instead, it is very important to consider the pathway(s) from the intended habitat, e.g. the garden, the field, the park, to the unintended habitat. It is very likely and often even promoted, that the plant establishes in the intended habitat, but its escape into an unintended habitat and its subsequent establishment and spread may not be desirable and may cause severe problems. Though this will not be the case for most plants, there is still a risk which can be expressed by the "tens rule" (Williamson ??? ergänzen), which states that 10 % of introduced species spread, 10 % of these establish, and 10 % of the established species cause problems (= 0.1%). PRA is very important to identify these few species.

ENVIRONMENTAL RISK MANAGEMENT

Uncertainty

The level of uncertainty is often greater in the assessment of environmental risks than in risks to cultivated plants, due to the lack of information, additional complexity associated with ecosystems, and variability associated with pests, hosts or habitats. Generally, phytosanitary measures are intended to account for uncertainty and should be designed in proportion to the risk. For the identification of management options (see below) it is important to consider the degree of uncertainty. In case of intentional introduction of plants with a high level of uncertainty regarding pest risk it may be more appropriate not to take phytosanitary measures at import, but to apply surveillance or other procedures after entry. Also, the phenomenon of "time lag" has to be considered - some invasive species, especially plants, only show invasive behaviour after a certain time.

Management

In particular management options for intentionally introduced plants are different from management options for traditional pests. ISPM No. 11 does not give detailed guidance on how to proceed with invasive or potentially invasive plants. In the framework of EPPO, it is therefore currently discussed to develop a standard for the import of alien plants. Important points to consider are: the raising of public awareness, the surveillance after planting, the preparation of control or emergency plans if a plant is found outside its intended habitat and spreads to an unacceptable degree, the restriction on import, sale, holding, and on planting (including authorization of intended habitat, prohibition of planting in unintended habitat, required growing conditions for plants), the notification before import, restrictions on movement (e.g. prevention of movement to specified areas), the obligation to report findings.

CONCLUSIONS

For all organisms threatening plants or plant products directly or indirectly the revised IPPC

and EPPO standards on PRA provide the necessary elements for a substantial risk analysis. The experience for their application and implementation with regard to environmental risks has yet to be increased. European plant protection organisations should follow the revised IPPC PRA standard and are encouraged to make use of the adapted EPPO PRA scheme for the assessment and management of invasive alien species.

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The IPPC-Standards are available at the IPPC website (International Phytosanitary Portal): www.ippc.int., the EPPO-Standards at the EPPO homepage (www.eppo.org).