Recommendation of a Pathway Approach for Regulation of Plants for Planting

A Concept Paper from the IUFRO Unit on Alien Invasive Species and International Trade*

Issue: A Pathway Approach Is Needed

Many forest pests have been introduced into new locations on plants for planting. Mounting scientific evidence suggests that the current pest-by-pest regulatory approach and reliance on inspection to detect pests is untenable in today's global marketplace. Much recent experience demonstrates the need to curtail the introduction of plant pests that are present in an exporting territory but not yet known to science. Therefore, the forest entomology and pathology science community recommends a pathway approach to regulating nursery stock, similar to that adopted for wood packaging material (WPM). Best management practices effective at preventing known pests will significantly reduce the risk of introducing unknown pests as well.

Introduction and Scope

There are three problems with the current phytosanitary regulatory approach: 1) It relies on inspection, but the volume of world trade has expanded far beyond inspection capacity. 2) It focuses on addressing the risks associated with known quarantine organisms, but most pests introduced on plants for planting are previously unknown or unpredictably aggressive pests. 3) Article VI.2 of the IPPC prohibits requiring phytosanitary measures against unregulated pests.

The limitations of current measures were accepted long ago to prevent the misuse of phytosanitary concerns as artificial barriers to trade. In the ensuing years, however, it has become evident that WPM and plants for planting routinely provide pathways for unanticipated pests. With the adoption of ISPM-15 (FAO, 2002), the exchange of known and unknown pests via WPM has been significantly reduced. A similar pathway approach to nursery stock is indicated.

Rationale

The current host-by-host and pest-by-pest approach to regulating nursery stock is not providing adequate protection to natural resources. Pest-based risk assessments can only evaluate the risks of known pests, and subsequent regulations mitigate the associated risks. This approach offers only haphazard protection to prevent the entry of unknown risky organisms.

Only 7% of the fungal species thought to exist are known (Crous and Groenewald, 2005). Thus we can predict at best only 7% of the likely fungal associations with imported plant material. We are unable, therefore, to predict what the other 93% of the fungi associated with imported plant material might do in a new environment. Consequently, the probability of detecting and identifying unknown organisms, and then evaluating them effectively to recognize those that pose a specific risk to an area, is extremely low. Nor can we rely on known fungi presenting signs or symptoms at the time of shipment to allow proper identification. Due to the short time and the intense conditions of production in nurseries, this is particularly the case with root invading fungi, e.g., Phytophthoras. Furthermore, pathogens that remain symptomless in plants, such as viruses or bacteria, pose a significant risk. Even known organisms that are present and not economically or environmentally important in one territory can be significant in another where environmental conditions or missing coevolution favour the pest over the host. Notorious examples are the causal organisms of Dutch elm disease (*Ophiostoma novo-ulmi*), white pine blister rust, (*Cronartium ribicola*), or chestnut blight (*Cryphonectria parasitica*).

Many introduced forest insects were also unknown to science prior to introduction, e.g., the horse-chestnut leaf miner *Cameraria ohridella,* the silver fir woolly adelgid *Dreyfusia nordmannianae* in Europe, the hemlock woolly adelgid *Adelges tsugae* in North America or the erythrina gall wasp *Quadrastichus erythrina* in Mauritius and Hawaii. Others were known, but their importance was underestimated based on their behaviour in their original territory.

All but one of the significant invertebrate plant pests established in Great Britain after 1970 were introduced on ornamentals (Smith et al., 2005). In US-Mexico border cargoes, 75% of the insect interceptions were associated with ornamental palms (Work et al., 2005). Another paper reported that 29% of the pests detected in cargo and baggage at the U.S. border between 1984 and 2001 were found in plant parts. The only category of goods with a higher detection rate was cut flowers (McCullough, et. al., 2006). Plants for planting are undoubtedly one of the main pathways of introduction for Sternorrhyncha bugs, small sap-feeding insects such as aphids, scales and psyllids, which travel inconspicuously on their host plant (Roques and Auger-Rozenberg, in press).

The Application of a Pathway Approach

Analysis of pest interceptions on wood packaging materials demonstrated that a wide range of pests (including known quarantine pests as well as non-quarantine pests) were moving with the wood packaging pathway. ISPM 15 was developed in order to address the risks associated with these pests. It was assumed that most unknown pests would also be eliminated by the same treatments imposed to mitigate the known quarantine pests. Certification systems were developed by NPPOs who assumed the responsibility to ensure application of measures that met the international standard. Importing NPPOs are justified in returning shipments that contain any wood-inhabiting pests, regardless of their regulatory status. This departure from previous blacklist norms is acceptable, even though it cannot be determined whether pests are present because the WPM was not properly treated, or if the treatment failed to kill the pest, or if the WPM became infested after treatment. This approach strengthens protection against previously unknown pests.

Justifications for a Pathway Approach to Plants for Planting

Plants for planting have provided just as many introductions of previously unknown forest pests as WPM. Consider a few examples of current quarantine organisms, the phytosanitary rules under which these organisms entered new territories, and the impacts caused by their entry. These examples are only a few of many which demonstrate the need for a pathway approach for plants for planting.

Phytophthora ramorum. Recent population genetics studies show that this pathogen, which causes serious tree losses in California and plant mortality in European and North American nurseries, was introduced to those areas on imported nursery stock (Kelly et al, 2005). Furthermore, the population occurring in California is distinctly different from that in Europe, suggesting that the parent pathogen occurs in a third, as yet unknown location. NPPO's could not foresee the introduction of the pathogen until it was well established on two continents. In this case, the introduction of this new exotic pest has necessitated eradication programs, the application of new regulatory controls to prevent movement within territories and substantial research efforts to control impacts where it occurs. Estimates of the cost of phytosanitary activities related to regulating and controlling the impact of the disease in the United States exceed $50 million USD. The U.S. pest risk assessment reports that "*If the oaks and possibly other species in the Eastern deciduous forests prove susceptible to the pathogen, the potential threat to commercial timber production in the United States is in excess of $30 billion*".

Phytophthora kernoviae. The origin of this newly detected pathogen is not certain, despite its recent detection in a New Zealand soil sample. Risk assessments undertaken today could conclude, based on the aggressiveness of the disease in the United Kingdom, that *P. kernoviae* is a risk to areas where it does not occur, but these data were not available until the population had established and spread beyond the likely range of possible eradication. This is not to conclude that the process of risk assessment is flawed, but rather that the process does not account for unknown risks, primarily because the process is a quantification of scientific knowledge of only known pests.

Red gum lerp psyllid. *Glycaspis brimblecombei* is believed to have been introduced into California, U.S. and Mexico on imported or smuggled plants for planting or plant products in the early 1990's. In areas of Australia, where this pest is ubiquitous, damage is relatively restricted and, until 1998, the pest remained undetected in California. However, when damage to eucalyptus along a freeway in Los Angeles County became noticeable, scientists began to examine the cause. Since this time, natural spread of the insect has resulted in significant damage to eucalyptus in 25 Mexican states. Red gum lerp psyllid and numerous other psyllids represent organisms that in native environments are usually benign, but in new territories cause a significant impact. Until this potential impact is tested or witnessed it is unlikely that these organisms would appear on the regulatory radar screen.

Aphids. Several conifer aphids of the family Adelgidae, such as the hemlock woolly adelgid (*Adelges tsugae*), and the silver fir woolly adelgid (*Dreyfusia nordmannianae*) have been most probably introduced on nursery stock from Asia to North America and Europe, respectively, in the 19th and 20th centuries (McClure and Sheah, 1999). None of them was known in their region of origin at the time of introduction. The first species now devastates unique forest ecosystems in Eastern North America, whereas the latter is a serious pest of fir forests and Christmas tree plantations in Europe. In the 1980's, other conifer aphids (*Pineus boerneri*, *Cinara cupressivora*, *Eulachnus rileyi,*), all benign or unknown in their area of origin, began to ruin pine and cypress plantations in East Africa (Day et al., 2002).

Scale insects. Despite increasing regulations in plant trades, new introductions of alien *Sternorrhyncha* are on the increase, mainly because of the expansion of the ornamental trade. For example, the cycad aulacaspis scale (*Aulacaspis yasumatsui)* has been introduced, in the last 10 years, to Florida, Hawaii and Guam, on imported cycads (Howard et al., 1999). The lobate lac scale (*Paratachardina lobata* subsp. *Lobata*), a polyphagous species of Asian origin, was recently imported, most probably on infested plants, to Florida (Pemberton, 2003). Both species are becoming major pests of ornamental trees, but they also threaten the survival of rare and endangered native species. Again, before their introduction, these two species were not recognised as serious pests, and had never been the subject of a PRA.

Gall wasps. Not only *Sternorrhyncha* are introduced on plants for planting. For example, several gall wasps and leaf miners have recently been moved on this pathway to invade new regions. Since 2004, the erythrina gall wasp (*Quadrastichus erythrina*), a species of uncertain origin, has suddenly been found in many Pacific rim countries. In Hawaii, it is seriously threatening endemic trees (Heu et al., 2006). The chestnut gall wasp (*Dryocosmus kuriphilus),* a harmless insect in its region of origin (China), was found in 1940 in Japan, and in 1974 in the USA, where it was illegally imported into USA on smuggled budwood. In these regions, it has become the most severe insect pest of chestnut. It was recently discovered in Italy, France and Slovenia (Bosio, 2004; DSF, 2006; Seljak, 2006).

Leaf Miners. The citrus leaf miner (*Phyllocnistis citrella*), originally an Asian species, was discovered in several nurseries in Florida in 1993. It was found in the Mediterranean basin in 1994, where it has since spread rapidly. It is also spreading in Central and South America and has been reported from southern Africa and West Africa (CABI, 2005). In all these countries, it has become a major pest of citrus production. Nursery stock is also known to be one the dispersion pathways of the horse-chestnut leaf miner (*Cameraria ohridella*) in Europe (M. Kenis, unpublished).

Longhorned beetles. The bonsai trade is also an important pathway for invasive forest pests. Between 1995 and 2005, European NPPOs reported nearly twice as many pest interceptions on bonsai trees as on timber (Roques and Auger-Rozenberg, in press). Interceptions on bonsai trees include mainly aphids and scale insects, but also wood borers. The bonsai trade is known to be responsible for the introduction of at least one major tree pest in France, Italy and USA in recent years: the citrus longhorned beetle *Anoplophora chinensis* (Hérard et al., 2005).

Examples such as those mentioned above are only a few of the previously unknown or insignificant pests believed to have been imported in plants for planting. Risk assessments necessarily focus on evaluating the risks of known pests, and regulations stem the entry of these pests, but can offer little protection to prevent the entry of unknown risky organisms.

Conclusion and Recommendations

The international science community has come to recognize the risks associated with plants for planting, just as they did for solid wood packaging materials. There is ample evidence that plants for planting represent a similarly risky pathway. On these grounds we support regulatory systems that ensure importation of plant material free of all quarantine and regulated non-quarantine pests and practically free of non-regulated pests.

Production programs that rigorously control known pests will have the additional value of reducing the incidence of unknown pests. The presence of any plant pests above thresholds established in the systems approach is used as an indication of system failure. It can also indicate the presence of plants for planting purchased outside the system.

A "systems approach" requires that the place of production should develop and implement approved integrated pest management practises, such as pre-export treatments, preventive measures to ensure cleanliness of growing media associated with plants, sanitary practices for waste management, effective diagnostic procedures, inspections at growing sites, and clean packing practices. Propagative material should be obtained from certified stock source. Critical control points should be identified for monitoring, and genus-specific molecular or serological tests conducted to assess presence of indicator pests, such as *Phytophthora* species.

Importing countries should develop pre-certification programs and/or appropriate quarantine procedures to prevent entry and establishment of plant pests. The quarantine procedures could include inspection at the border, treatment and testing supplemented by quarantine periods. The primary aim of the quarantine period is to allow disease symptoms to develop on the plants so that the presence of associated unwanted organisms will be detected.

An IPPC standard for plants for planting should attempt to mitigate risks from unknown as well as known pests. A systems approach taking into consideration good management practices employed by exporting countries, that limits the occurrence of all plant pests, is recommended.

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Definitions

Plants Living plants parts thereof, including seeds and germplasm.

Plants for Planting Plants intended to remain planted, to be planted or replanted

Plant Products Unmanufactured material of plant origin (including grain) and those manufactured products that, by their nature or that of their processing, may create a risk for the introduction and spread of pests.

Pest Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products

Quarantine pest A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled.

Regulated non-quarantine pest A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party.

practically free Of a consignment, field, or place of production, without pests (or a specific pest)in numbers or quantities in excess of those that can be expected to result from, and be consistent with good cultural and handling practices employed in the production and marketing of the commodity [FAO, 1990; revised FAO, 1995]

Non –regulated pest A pest that is present in importing country, not officially controlled, not a regulated non-quarantine pest and has no potential to vector another regulated pest .

* IUFRO is a non-profit, non-governmental international network of forest scientists. IUFRO promotes global cooperation in forest-related research and enhances the understanding of the ecological, economic and social aspects of forests and trees. It disseminates scientific knowledge to stakeholders and decision-makers and contributes to forest policy and on-the-ground forest management.

IUFRO Unit 7.03.12 focuses on Alien Invasive Species and International Trade. It has been established to focus specifically on global forestry issues related to the unwanted international movement of alien invasive species, including fungi, insects, nematodes, and plants.

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