



Recommended regulated non-quarantine pests (RNQPs), associated thresholds and risk management measures in the European and Mediterranean region

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Some pests may be present on plants for planting and cause an unacceptable economic impact on the intended use of these plants, even though they are already present in the area. By consequence, these pests may be regulated and then called ‘Regulated Non-Quarantine Pests’ (RNQPs) according to international standards. RNQPs, often not identified as such, are commonly regulated either together with quarantine pests in plant health regulations, or within programmes for the certification of plants for planting through specific requirements for pests and diseases that come in addition to non-phytosanitary requirements. In 2016, Union RNQPs have been introduced in the new EU plant health regulation which shall apply from December 2019. In this context, EPPO agreed to undertake a 2-year project on RNQPs, the EU Quality Pest Project. After having developed a methodology, data were collected through a rapid bibliography of scientific literature, questionnaire responses, exchanges on practical experience within six sector expert working groups, as well as a consultation of EPPO member countries, in order to perform a rapid evaluation of the RNQP status of about 1400 pest-host-intended use combinations. The resulting list of pests fulfilling the RNQP definition is presented in this paper, as well as the main issues discussed on thresholds and risk management measures.

Introduction

Pests are defined as any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products (FAO, 2017a). When pests are absent or not widely distributed in an area, and have a potential economic impact, these pests may be regulated as a quarantine pest to prevent their entry or spread. When pests are already present in an area and carried by plants for planting, which include living plants and parts, seeds, germplasm, intended to be planted, replanted or remain planted, they can be regulated as a regulated non-quarantine pest (RNQP) to prevent unacceptable yield or quality losses on the intended use of those plants. Voluntary approaches may also be developed to ensure the production of higher quality plants for planting to the end-user when there is no interest to enforce minimal common certification standards by the

legislator. In both cases, voluntary or mandatory, tolerance thresholds and associated risk management measures are defined.

In December 2016, Regulation (EU) 2016/2031 (EU, 2016a) on protective measures against pests of plants (hereinafter ‘the new EU Plant Health Regulation’) was published to replace Directive 2000/29/EC (EU, 2000), to be implemented in the following 3 years (EU, 2016b), using the pre-existing IPPC definitions of RNQPs (FAO, 1999, 2016a). Article 36 of the new EU Plant Health Regulation defines RNQPs as pests with a clear taxonomic identity, present in the EU territory, transmitted mainly through specific plants for planting, whose presence has an unacceptable economic impact as regards to the intended use, and where feasible and effective measures are available. [European] Union RNQPs, their respective host plants, and where appropriate, the category of material concerned (Pre-

Basic, Basic, Certified, Non-Certified) as referred to in the EU Marketing Directive on plant reproductive material (EU, 1966a,b, 1968, 1993a,b, 1999, 2002a,b,c,d, 2008, 2014a,b) for a specific sector, tolerance levels and measures, will be listed by means of an implementing act of this new EU Plant Health Regulation. Listing RNQPs and quarantine pests together will therefore avoid any double listing or problem of consistency between different regulations.

In this new EU regulatory context, and for the benefit of the entire region, EPPO agreed to undertake a 2-year project on RNQPs funded by the European Commission: The 'EU Quality pest' Project. This project began in April 2016. Programmes for the certification of plants for planting frequently include specific requirements for pests and diseases, in addition to non-phytosanitary requirements on plant characteristics, varietal identity and purity, quality, packaging, labelling etc. The specification required the assessment of the relevance of the RNQP status of pests and diseases previously listed in EU Marketing Directives on plant reproductive material. Pests and diseases already listed in the 'Fruit plants' Marketing Directive (EU, 2014c) were not included by the European Commission in the project specification because of the recent revision of this Directive. Additional pests, already present and widespread in the EU (from annexes IA and IIA of EU Council Directive 2000/29/EC), were added by the European Commission following recommendations of the Working Group on the Annexes of Council Directive 2000/29/EC – Section I (IIA2 AWG).¹ In total approximately 1400 pest–host combinations were proposed for evaluation.

The first objective of the project was to develop a methodology for rapid evaluation of the RNQP status of these pests (Picard *et al.*, 2017). Subsequently, two questionnaires were produced by the EPPO Secretariat and used to gather information respectively from all EU National Plant Protection Organizations (NPPOs) and EU Stakeholders' associations. Finally, modification of the existing EU risk management measures and thresholds were discussed based on the replies to this questionnaire.

Methodology

The methodology for evaluating the RNQP status of a pest was developed during the first stage of the Project in a group of experts nominated by NPPOs: the Horizontal

Expert Working Group (HEWG). The final methodology was endorsed by the EPPO Working Party on Phytosanitary Regulations in June 2017 and published in Picard *et al.*, 2017.

During the second stage of the Project, six Sector Expert Working Groups (SEWGs), in charge of the practical application of the methodology on specific pest/host/intended use combinations, were established for the following sectors: 'seed potato', 'forestry', 'fruit (including hops) and vine', 'agricultural species', 'vegetable' and 'ornamental'. These groups were composed of 5–9 experts selected from the nominations received, including at least one expert from the HEWG to ensure consistency, as well as experts from non-EU countries. In the case of 'seed potato' and 'forestry' sectors, EPPO has existing Expert Panels covering quarantine pest risks (respectively the 'Panel on Phytosanitary Measures for Potato' and the 'Panel on Quarantine Pests for Forestry'). Experts were selected from the nominations received or from these existing Panels.

Before each SEWG, the EPPO Secretariat collected data on the pest/host combinations to be analysed. Then experts met by video-conference to discuss the methodology and share some preparatory work.

The EPPO Secretariat also developed two questionnaires (the first one for NPPOs of the EU and the second one for EU stakeholders' associations) to evaluate entries not precisely defined in the EU Marketing Directives (e.g. entries corresponding to pests not listed at species level), to gather deregulation proposals, and to propose amendments to the current thresholds/requirements/measures implemented within those Directives or in Annexes of Council Directive 2000/29/EC. These questionnaires were available online. A private link was sent to each NPPO or stakeholder association consulted. The questionnaire addressed to stakeholders was the same as for NPPOs with an additional question on economic impacts. The EPPO Secretariat suggested selecting associations which represent either professionals engaged in production and trade of plants for planting or users (including non-professional users) of plants for planting. The European Commission provided a list of stakeholders to the EPPO Secretariat. The questionnaires gathered respondents' experience with the candidate RNQPs under the current EU regulatory framework, and enabled identification of issues and pests to be addressed as a priority under the new framework. These two questionnaires were key components of the methodology developed, as the work of the SEWGs was highly dependent on the answers to those questionnaires. For each of the submitted entries, a modification of the thresholds (zero tolerance or higher) and associated risk management measures have been recommended when countries or EU stakeholders associations identified that EU requirements were no longer fully appropriate. For the vegetable seedling and the ornamental plant sectors, NPPOs and experts recommended reserving the RNQP status for pest/host combinations where a harmonized approach with the establishment of specific

¹The objective of the Working Group on the Annexes of Council Directive 2000/29/EC – Section II (IIA2 AWG) of the European Commission was to guide the process of risk assessments for a list of relevant harmful organisms and to examine whether it is appropriate for those organisms to be listed under the new EU plant health Regulation as [European] Union quarantine pests, protected zone quarantine pests, Union regulated non-quarantine pests or to be completely deregulated. The IIA2 AWG was asked to prepare, as appropriate, recommendations for the listing of the harmful organisms concerned to the Standing Committee.

tolerances and mandatory risk management measures are absolutely necessary. Provided that the general ‘substantially free from’ requirement (see part 3.2.4.) is maintained in the respective EU Marketing Directives they considered that this is sufficient for most of the pests currently listed in Commission Directive 93/49/EEC (EU, 1993a) and Commission Directive 93/61/EEC (EU, 1993b), and they therefore could be delisted.

The EPPO Working Party on Phytosanitary Regulations and the EPPO Council were kept informed and consulted on the practical application of the methodology. Draft recommendations on the RNQP status, and corresponding risk management measures and thresholds were circulated to NPPOs and EU Stakeholders associations between October and December 2017. NPPOs and EU Stakeholders associations were asked to provide additional data (scientific data or practical experience) for a possible revision of these draft recommendations. The core-HEWG, plus selected experts from the SEWGs met once more by videoconference to check outputs against expert judgment as to which pests qualify as RNQPs, and whether there is evidence of a need to change current risk management measures; ensure harmonization of the approach between the different SEWGs, except where justified by economic and technical differences between the sectors; and resolve any difficult issues identified during the process. The recommendations of the project for the EU were endorsed by the EPPO Working Party on Phytosanitary Regulations in June 2018. The Working Party also agreed that the list of pest/host/intended use combinations may qualify as RNQPs for countries in the EPPO region (other than countries or areas where they are known not to be present or where they qualify as Quarantine Pests).

Results

The list of pest/host/intended use combinations analysed during the Project as fulfilling the criteria for RNQP in the EU, and that may qualify as RNQPs in the EPPO region, is made available in Table 1. A listing as RNQP should only be proposed for pests that are already present and that are not already regulated as quarantine pests in the considered country/area. The ‘intended use’ means the declared purpose for which plants, plant products or other articles are imported, produced or used (FAO, 2017a). It is referring to the sector and sometimes to the category of material (Pre-basic, Basic, Certified, Non-certified) (Picard *et al.*, 2017). This list represents about 300 pest/host/intended use combinations from the approximately 1400 submitted for evaluation within the project. A large number of the combinations were disqualified due to the absence of justification for a listing at a higher level than the species level, or because the general requirement for ‘*substantially free from*’ was seen as sufficient and they were not identified by any EU countries to be listed as RNQPs requiring a specific threshold or risk management measures. In some cases the

assessment was made on the understanding that quarantine pest status for the EU might be withdrawn as part of separate discussions. The project itself does not make any recommendation on changes in quarantine status, only on suitability for RNQP status. This list includes in particular seed-borne pests and seed transmitted pests as defined in ISPM 38 *on the International Movement of Seed* (FAO, 2017b).

The complete list of pest/host/intended use evaluated during the project, data collected for the evaluation of their RNQP status, as well as recommendations for potential associated thresholds and risk management measures in the EU, are available at the following address: <https://rnqp.eppo.int/>

Discussion

Regulated Non-Quarantine Pests are regulated to prevent any unacceptable economic impact on the final intended use of the plants for planting. Contrary to quarantine pests where direct and indirect economic impacts (which in principle may be quantified), and environmental and social impacts (which are harder to quantify) are evaluated, the economic impact of RNQPs mainly concern direct economic impacts at the place of production. More stakeholders are involved in quarantine pests (e.g. environmental associations) than for RNQPs which only concern producers of plants for planting material, retailers and end-users. Therefore it is relevant to involve professional associations more closely in the regulatory process than for quarantine pests. One of the difficulties of the RNQP project was the greater involvement of producer associations for plants for planting (including seeds), in comparison to end-user associations in replies to the questionnaire. Indeed these plant producer associations are better organized on plant health issues, probably because their activity could be more highly affected by the regulatory measures defined on the plants for planting material. However, this lower participation of end-users has been counterbalanced by the fact that most of the experts in the SEWGs were from public or semi-public organizations: NPPO representatives tried to balance the cost of the risk management measures for the producer of the plants for planting material and the economic impact for the end user of this material. They also had information from their relevant inspection organisations, information on actions taken on pest outbreaks and results from any public consultations or meetings with industry bodies or end users.

Recommendation for listing as an RNQP

Particular considerations

The list of pests fulfilling the criteria for RNQP listing was established using the methodology developed in Picard *et al.* (2017). Multiple introductions of pest species can pose an important risk of establishing novel genotypes, cryptic species, or strains, in an area where the pest is

Table 1. List of pest/host/intended use combinations recommended for listing as an RNQP in the EPPO region

Pest	Host	Plants to be regulated
Seed potato		
<i>Alfalfa mosaic virus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting of nuclear stock, other than [true] seeds
<i>Alternaria</i> (anamorphic genus)*	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Athelia rolfsii</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Boeremia</i> (anamorphic genus)*	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
' <i>Candidatus Liberibacter solanacearum</i> '	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
' <i>Candidatus Phytoplasma solani</i> '*	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Cucumber mosaic virus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting of nuclear stock, other than [true] seeds
<i>Dickeya</i>	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Ditylenchus destructor</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Fusarium</i> (anamorphic genus)*	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Geotrichum candidum</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Helicobasidium brebissonii</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Helminthosporium solani</i> †	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Pectobacterium</i>	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Phytophthora erythroseptica</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Phytophthora infestans</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Potato aucuba mosaic virus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting of nuclear stock, other than [true] seeds
<i>Potato leafroll virus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Potato mop-top virus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting of nuclear stock, other than [true] seeds
<i>Potato spindle tuber viroid</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Potato virus A</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Potato virus M</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Potato virus S</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Potato virus V</i> *	<i>Solanum tuberosum</i>	Plants intended for planting of nuclear stock, other than [true] seeds
<i>Potato virus X</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Potato virus Y</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Pythium</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Sclerotinia minor</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Sclerotinia sclerotiorum</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Spongospora subterranea</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Streptomyces</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Thanatephorus cucumeris</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
<i>Tobacco mosaic virus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting of nuclear stock, other than [true] seeds
<i>Tobacco necrosis virus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting of nuclear stock, other than [true] seeds
<i>Tobacco rattle virus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting of nuclear stock, other than [true] seeds
<i>Tomato black ring virus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting of nuclear stock, other than [true] seeds
<i>Tomato mosaic virus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting of nuclear stock, other than [true] seeds
<i>Tomato spotted wilt tospovirus</i> *	<i>Solanum tuberosum</i>	Plants intended for planting, other than [true] seeds
Forest plants		
<i>Dothistroma pini</i>	<i>Pinus</i>	Plants intended for planting, other than seeds
<i>Cryphonectria parasitica</i>	<i>Castanea</i>	Plants intended for planting, other than seeds
<i>Lecanosticta acicola</i>	<i>Pinus</i>	Plants intended for planting, other than seeds
<i>Dothistroma septosporum</i>	<i>Pinus</i>	Plants intended for planting, other than seeds
Fruits (including hops and vine)		
Fruit plants		
<i>Aphelenchoides besseyi</i> *	<i>Fragaria</i>	Plants intended for planting, other than seeds
<i>Arabis mosaic virus</i> *	<i>Rubus, Fragaria</i>	Plants intended for planting, other than seeds
' <i>Candidatus Phytoplasma mali</i> '	<i>Malus</i>	Plants intended for planting, other than seeds
' <i>Candidatus Phytoplasma prunorum</i> '	<i>Prunus</i>	Plants intended for planting, other than seeds
' <i>Candidatus Phytoplasma pyri</i> '	<i>Pyrus</i>	Plants intended for planting, other than seeds
<i>Cherry leaf roll virus</i>	<i>Actinidia</i>	Plants intended for planting, other than seeds
<i>Citrus tristeza virus</i> *‡	<i>Citrus, Citrus hybrids, Fortunella, Fortunella hybrids, Poncirus, Poncirus hybrids</i>	Plants intended for planting, other than seeds
<i>Cryphonectria parasitica</i>	<i>Castanea</i>	Plants intended for planting, other than seeds

(continued)

Table 1 (continued)

Pest	Host	Plants to be regulated
<i>Erwinia amylovora</i>	<i>Cydonia</i> *, <i>Eriobotrya</i> , <i>Malus</i> *, <i>Mespilus</i> , <i>Pyrus</i> *	Plants intended for planting, other than seeds
<i>Phytophthora fragariae</i> *	<i>Fragaria</i>	Plants intended for planting, other than seeds
<i>Plenodomus tracheiphilus</i> *	<i>Citrus</i> , <i>Citrus</i> hybrids, <i>Fortunella</i> , <i>Fortunella</i> hybrids, <i>Poncirus</i> , <i>Poncirus</i> hybrids	Plants intended for planting, other than seeds
<i>Pseudomonas syringae</i> pv. <i>persicae</i>	<i>Prunus persica</i> , <i>Prunus salicina</i>	Plants intended for planting, other than seeds
Raspberry ringspot virus*	<i>Fragaria</i> , <i>Rubus</i>	Plants intended for planting, other than seeds
<i>Spiroplasma citri</i> *	<i>Citrus</i> , <i>Citrus</i> hybrids, <i>Fortunella</i> , <i>Fortunella</i> hybrids, <i>Poncirus</i> , <i>Poncirus</i> hybrids	Plants intended for planting, other than seeds
Strawberry crinkle virus*	<i>Fragaria</i>	Plants intended for planting, other than seeds
Strawberry latent ringspot virus*	<i>Fragaria</i> , <i>Rubus</i>	Plants intended for planting, other than seeds
Strawberry mild yellow edge virus*	<i>Fragaria</i>	Plants intended for planting, other than seeds
Strawberry vein banding virus*	<i>Fragaria</i>	Plants intended for planting, other than seeds
Tomato black ring virus*	<i>Fragaria</i> , <i>Rubus</i>	Plants intended for planting, other than seeds
<i>Xanthomonas arboricola</i> pv. <i>pruni</i> *	<i>Prunus</i>	Plants intended for planting, other than seeds
<i>Xanthomonas fragariae</i> *	<i>Fragaria</i>	Plants intended for planting, other than seeds
Hops plants		
<i>Verticillium dahliae</i> *	<i>Humulus lupulus</i>	Plants intended for planting, other than seeds
<i>Verticillium nonalfalfae</i> *	<i>Humulus lupulus</i>	Plants intended for planting, other than seeds
Vine plants		
<i>Arabis mosaic virus</i> *	<i>Vitis</i>	Plants intended for planting, other than seeds
'Candidatus Phytoplasma solani'*	<i>Vitis</i>	Plants intended for planting, other than seeds
Cherry leaf roll virus	<i>Vitis</i>	Plants intended for planting, other than seeds
Grapevine fanleaf virus*	<i>Vitis</i>	Plants intended for planting, other than seeds
Grapevine fleck virus*	<i>Vitis</i> species and their hybrids, except <i>Vitis vinifera</i>	Plants intended for planting, other than seeds
Grapevine leafroll-associated virus 1*	<i>Vitis</i>	Plants intended for planting, other than seeds
Grapevine leafroll-associated virus 3*	<i>Vitis</i>	Plants intended for planting, other than seeds
<i>Viteus vitifoliae</i>	<i>Vitis</i>	Plants intended for planting, other than seeds
<i>Xylophilus ampelinus</i> *	<i>Vitis vinifera</i>	Plants intended for planting, other than seeds
Agricultural species		
Beet seeds		
- None of the submitted pests qualified for the RNQP Status		
Cereal (including rice) seeds		
<i>Aphelenchoides besseyi</i>	<i>Oryza</i>	Seeds
<i>Claviceps purpurea</i>	<i>Avena nuda</i> , <i>Avena sativa</i> , <i>Avena</i> <i>strigosa</i> , <i>Hordeum vulgare</i> , <i>Phalaris canariensis</i> , <i>Secale</i> <i>cereale</i> , <i>Triticosecale</i> , <i>Triticum</i> <i>aestivum</i> , <i>Triticum durum</i> , <i>Triticum</i> <i>spelta</i>	Seeds
<i>Gibberella fujikuroi</i>	<i>Oryza</i>	Seeds
<i>Ustilago avenae</i>	<i>Avena sativa</i>	Seeds
<i>Ustilago hordei</i>	<i>Avena sativa</i> , <i>Hordeum vulgare</i>	Seeds
<i>Ustilago nuda</i>	<i>Hordeum vulgare</i>	Seeds
<i>Ustilago tritici</i>	<i>Triticum aestivum</i> , <i>Triticum durum</i>	Seeds
Oil and fibre plant seeds		
<i>Alternaria linicola</i>	<i>Linum usitatissimum</i>	Seeds
<i>Boeremia exigua</i> var. <i>linicola</i>	<i>Linum usitatissimum</i>	Seeds
<i>Botrytis cinerea</i>	<i>Linum usitatissimum</i> , <i>Helianthus</i> <i>annuus</i>	Seeds
<i>Colletotrichum lini</i>	<i>Linum usitatissimum</i>	Seeds

(continued)

Table 1 (continued)

Pest	Host	Plants to be regulated
<i>Diaporthe caulivora</i>	<i>Glycine max</i>	Seeds
<i>Diaporthe phaseolorum</i> var. <i>sojae</i>	<i>Glycine max</i>	Seeds
<i>Fusarium</i> (anamorphic genus)	<i>Linum usitatissimum</i>	Seeds
<i>Plasmopara halstedii</i>	<i>Helianthus annuus</i>	Seeds
<i>Sclerotinia sclerotiorum</i>	<i>Brassica napus</i> , <i>Brassica rapa</i> , <i>Helianthus annuus</i> , <i>Sinapis alba</i>	Seeds
Fodder plant seeds		
<i>Clavibacter michiganensis</i> subsp. <i>insidiosus</i>	<i>Medicago sativa</i>	Seeds
<i>Ditylenchus dipsaci</i>	<i>Medicago sativa</i>	Seeds
<i>Ditylenchus gigas</i>	<i>Vicia faba</i>	Seeds
Other (Tobacco)		
<i>Tomato spotted wilt tospovirus</i>	<i>Nicotiana tabacum</i>	Plants intended for planting, other than seeds, of which there shall be evidence that they are intended for sale to professional tobacco production
Vegetable		
Vegetable seeds		
<i>Acanthoscelides obtectus</i>	<i>Phaseolus coccineus</i> , <i>Phaseolus vulgaris</i>	Seeds
<i>Bruchus pisorum</i>	<i>Pisum sativum</i>	Seeds
<i>Bruchus rufimanus</i>	<i>Vicia faba</i>	Seeds
<i>Citrus exocortis viroid</i>	<i>Solanum lycopersicum</i>	Seeds
<i>Clavibacter michiganensis</i> subsp. <i>michiganensis</i>	<i>Solanum lycopersicum</i>	Seeds
<i>Columnnea latent viroid</i>	<i>Solanum lycopersicum</i>	Seeds
<i>Ditylenchus dipsaci</i>	<i>Allium cepa</i> , <i>Allium cepa</i> <i>Aggregatum</i> types <i>Allium porrum</i>	Seeds
<i>Ditylenchus gigas</i>	<i>Vicia faba</i>	Seeds
<i>Potato spindle tuber viroid</i>	<i>Capsicum annuum</i> , <i>Solanum lycopersicum</i>	Seeds
<i>Tomato apical stunt viroid</i>	<i>Solanum lycopersicum</i>	Seeds
<i>Tomato chlorotic dwarf viroid</i>	<i>Solanum lycopersicum</i>	Seeds
<i>Xanthomonas axonopodis</i> pv. <i>phaseoli</i>	<i>Phaseolus</i>	Seeds
<i>Xanthomonas euvesicatoria</i>	<i>Capsicum</i> , <i>Solanum lycopersicum</i>	Seeds
<i>Xanthomonas fuscans</i> subsp. <i>fuscans</i>	<i>Phaseolus</i>	Seeds
<i>Xanthomonas gardneri</i>	<i>Capsicum</i> , <i>Solanum lycopersicum</i>	Seeds
<i>Xanthomonas perforans</i>	<i>Capsicum</i> , <i>Solanum lycopersicum</i>	Seeds
<i>Xanthomonas vesicatoria</i>	<i>Capsicum</i> , <i>Solanum lycopersicum</i>	Seeds
Vegetable plants		
<i>Botrytis allii</i> [§]	<i>Allium cepa</i> , <i>Allium cepa</i> <i>Aggregatum</i> types	Plants intended for planting
' <i>Candidatus</i> Phytoplasma solani' [§]	Solanaceae	Plants intended for planting, other than seeds
<i>Citrus exocortis viroid</i>	<i>Solanum lycopersicum</i>	Plants intended for planting, other than seeds
<i>Clavibacter michiganensis</i> subsp. <i>michiganensis</i>	<i>Solanum lycopersicum</i>	Plants intended for planting
<i>Columnnea latent viroid</i>	<i>Solanum lycopersicum</i>	Plants intended for planting, other than seeds
<i>Ditylenchus dipsaci</i>	<i>Allium cepa</i> , <i>Allium cepa</i> <i>Aggregatum</i> types, <i>Allium fistulosum</i> [§] , <i>Allium porrum</i> [§] , <i>Allium sativum</i> , <i>Allium schoenoprasum</i> [§]	Plants intended for planting
<i>Fusarium</i> (anamorphic genus)	<i>Asparagus officinalis</i>	Plants intended for planting
<i>Helicobasidium brebissonii</i>	<i>Asparagus officinalis</i>	Plants intended for planting
<i>Leek yellow stripe virus</i> [§]	<i>Allium porrum</i> , <i>Allium sativum</i>	Plants intended for planting

(continued)

Table 1 (continued)

Pest	Host	Plants to be regulated
<i>Onion yellow dwarf virus</i>	<i>Allium cepa</i> <i>Aggregatum</i> types, <i>Allium sativum</i>	Plants intended for planting
<i>Potato spindle tuber viroid</i>	<i>Capsicum annuum</i> , <i>Solanum lycopersicum</i>	Plants intended for planting, other than seeds
<i>Pseudomonas syringae</i> pv. <i>lachrymans</i> [§]	<i>Cucumis sativus</i> , <i>Cucurbita pepo</i>	Plants intended for planting
<i>Stromatinia cepivora</i>	<i>Allium cepa</i> , <i>Allium cepa Aggregatum</i> types, <i>Allium fistulosum</i> , <i>Allium porrum</i> , <i>Allium sativum</i>	Plants intended for planting
<i>Tomato apical stunt viroid</i>	<i>Solanum lycopersicum</i>	Plants intended for planting, other than seeds
<i>Tomato chlorotic dwarf viroid</i>	<i>Solanum lycopersicum</i>	Plants intended for planting, other than seeds
<i>Tomato spotted wilt tospovirus</i>	<i>Capsicum annuum</i> , <i>Lactuca sativa</i> , <i>Solanum lycopersicum</i> , <i>Solanum melongena</i>	Plants intended for planting, other than seeds
<i>Tomato yellow leaf curl virus</i>	<i>Solanum lycopersicum</i>	Plants intended for planting, other than seeds
<i>Verticillium dahliae</i>	<i>Cynara scolymus</i>	Plants intended for planting
<i>Xanthomonas euvesicatoria</i>	<i>Capsicum</i> , <i>Solanum lycopersicum</i>	Plants intended for planting
<i>Xanthomonas gardneri</i>	<i>Capsicum</i> , <i>Solanum lycopersicum</i>	Plants intended for planting
<i>Xanthomonas perforans</i>	<i>Capsicum</i> , <i>Solanum lycopersicum</i>	Plants intended for planting
<i>Xanthomonas vesicatoria</i>	<i>Capsicum</i> , <i>Solanum lycopersicum</i>	Plants intended for planting
Ornamentals		
<i>Aculops fuchsiae</i>	<i>Fuchsia</i>	Plants intended for planting, other than seeds
<i>Arabis mosaic virus</i> [§]	<i>Rosa</i>	Plants intended for planting
<i>Bemisia tabaci</i> [‡]	<i>Euphorbia pulcherrima</i> , <i>Hibiscus rosa-sinensis</i>	Plants intended for planting, other than seeds
' <i>Candidatus</i> Phytoplasma mali'	<i>Malus</i>	Plants intended for planting, other than seeds
' <i>Candidatus</i> Phytoplasma prunorum'	<i>Prunus</i>	Plants intended for planting, other than seeds
' <i>Candidatus</i> Phytoplasma pyri'	<i>Pyrus</i>	Plants intended for planting, other than seeds
' <i>Candidatus</i> Phytoplasma solani'	<i>Lavandula</i> , <i>Solanaceae</i> [§]	Plants intended for planting, other than seeds
<i>Chrysanthemum stunt viroid</i> [*]	<i>Chrysanthemum</i>	Plants intended for planting, other than seeds
<i>Citrus exocortis viroid</i> [*]	<i>Citrus</i>	Plants intended for planting
<i>Citrus tristeza virus</i> (European isolates) [*]	<i>Citrus</i> , <i>Citrus</i> hybrids, <i>Fortunella</i> , <i>Fortunella</i> hybrids, <i>Poncirus</i> , <i>Poncirus</i> hybrids	Plants intended for planting, other than seeds
<i>Cryphonectria parasitica</i>	<i>Castanea</i>	Plants intended for planting, other than seeds
<i>Ditylenchus destructor</i> [§]	<i>Crocus</i> <i>Gladiolus</i> , <i>Hyacinthus</i> , <i>Iris</i> , <i>Tulipa</i>	Flower bulbs and corms intended for planting
Miniature cultivars and their hybrids intended for planting		
<i>Ditylenchus dipsaci</i>	<i>Allium</i> <i>Camassia</i> , <i>Chionodoxa</i> , <i>Crocus flavus</i> Weston 'Golden Yellow' [*] , <i>Galanthus</i> , <i>Galtonia candicans</i> , <i>Hyacinthus</i> [*] , <i>Hymenocallis</i> , <i>Muscari</i> , <i>Narcissus</i> [*] , <i>Ornithogalum</i> , <i>Puschkinia</i> , <i>Scilla</i> , <i>Sternbergia</i> , <i>Tulipa</i> [*]	Plants for planting (including seeds and bulbs) Bulbs and corms intended for planting
<i>Dothistroma pini</i>	<i>Pinus</i>	Plants intended for planting, other than seeds
<i>Dothistroma septosporum</i>	<i>Pinus</i>	Plants intended for planting, other than seeds
<i>Erwinia amylovora</i>	<i>Amelanchier</i> , <i>Chaenomeles</i> , <i>Cotoneaster</i> , <i>Crataegus</i> , <i>Cydonia</i> [*] , <i>Eriobotrya</i> , <i>Malus</i> [*] , <i>Mespilus</i> , <i>Photinia davidiana</i> , <i>Pyracantha</i> , <i>Pyrus</i> [*] , <i>Sorbus</i>	Plants intended for planting, other than seeds
<i>Impatiens necrotic spot tospovirus</i> [*]	<i>Begonia</i> , <i>Impatiens New Guinea</i> hybrids	Plants intended for planting, other than seeds
<i>Lecanosticta acicola</i>	<i>Pinus</i>	Plants intended for planting, other than seeds

(continued)

Table 1 (continued)

Pest	Host	Plants to be regulated
<i>Meloidogyne</i> [§]	<i>Rosa</i>	Plants intended for planting, other than seeds
<i>Opogona sacchari</i>	Arecaceae (Palmae), <i>Beaucarnea</i> , <i>Bougainvillea</i> , <i>Crassula</i> , <i>Crinum</i> , <i>Dracaena</i> , <i>Ficus</i> , <i>Musa</i> , <i>Pachira</i> , <i>Sansevieria</i> and <i>Yucca</i>	Plants intended for planting, other than seeds
<i>Phytophthora</i> [§]	<i>Begonia x hiemalis</i> , <i>Citrus</i> , <i>Euphorbia pulcherrima</i> , <i>Pyrus</i>	Plants intended for planting
<i>Phytophthora fragariae</i> [§]	<i>Fragaria</i>	Plants intended for planting, other than seeds
<i>Plasmopara halstedii</i>	<i>Helianthus annuus</i>	Seeds intended for planting
<i>Plenodomus tracheiphilus</i> [*]	<i>Citrus</i> , <i>Citrus</i> hybrids, <i>Fortunella</i> , <i>Fortunella</i> hybrids, <i>Poncirus</i> , <i>Poncirus</i> hybrids	Plants intended for planting, other than seeds
Potato spindle tuber viroid	<i>Capsicum annuum</i>	Plants intended for planting
<i>Pratylenchus</i> [§]	<i>Rosa</i>	Plants intended for planting
<i>Pratylenchus penetrans</i> [§]	<i>Lilium</i> , <i>Narcissus</i>	Plants intended for planting
<i>Pseudomonas syringae</i> pv. <i>persicae</i>	<i>Prunus persica</i> , <i>Prunus salicina</i>	Plants intended for planting, other than seeds
<i>Puccinia horiana</i> [*]	<i>Chrysanthemum</i>	Plants intended for planting, other than seeds
<i>Rhynchophorus ferrugineus</i>	<i>Areca catechu</i> , <i>Arenga pinnata</i> , <i>Bismarckia</i> , <i>Borassus flabellifer</i> , <i>Brahea armata</i> , <i>Brahea edulis</i> , <i>Butia capitata</i> , <i>Calamus merrillii</i> , <i>Caryota maxima</i> , <i>Caryota cumingii</i> , <i>Chamaerops humilis</i> , <i>Cocos</i> <i>nucifera</i> , <i>Copernicia</i> , <i>Corypha</i> <i>utan</i> , <i>Elaeis guineensis</i> , <i>Howea</i> <i>forsteriana</i> , <i>Jubea chilensis</i> , <i>Livistona australis</i> , <i>Livistona</i> <i>decora</i> , <i>Livistona rotundifolia</i> , <i>Metroxylon sagu</i> , <i>Phoenix</i> <i>canariensis</i> , <i>Phoenix dactylifera</i> , <i>Phoenix reclinata</i> , <i>Phoenix</i> <i>roebelenii</i> , <i>Phoenix sylvestris</i> , <i>Phoenix theophrasti</i> , <i>Pritchardia</i> , <i>Ravenea rivularis</i> , <i>Roystonea regia</i> , <i>Sabal palmetto</i> , <i>Syagrus</i> <i>romanzoffiana</i> , <i>Trachycarpus</i> <i>fortunei</i> , <i>Washingtonia</i> .	Plants intended for planting, other than seeds, having a diameter of the stem at the base of over 5 cm
<i>Spiroplasma citri</i> [†]	<i>Citrus</i> , <i>Citrus</i> hybrids, <i>Fortunella</i> , <i>Fortunella</i> hybrids, <i>Poncirus</i> , <i>Poncirus</i> hybrids	Plants intended for planting, other than seeds
Tomato spotted wilt tospovirus	<i>Begonia x hiemalis</i> [*] , <i>Capsicum</i> <i>annuum</i> [*] , <i>Chrysanthemum</i> [*] , <i>Gerbera</i> , <i>Impatiens New Guinea</i> <i>hybrids</i> [*] , <i>Pelargonium</i> [*]	Plants intended for planting, other than seeds
<i>Verticillium</i> (anamorphic genus) [§]	<i>Rosa</i>	Plants intended for planting
<i>Viteus vitifoliae</i> [§]	<i>Vitis</i>	Plants intended for planting, other than seeds
<i>Xanthomonas arboricola</i> pv. <i>pruni</i> [*]	<i>Prunus</i>	Plants intended for planting, other than seeds
<i>Xanthomonas euvesicatoria</i>	<i>Capsicum</i>	Plants intended for planting
<i>Xanthomonas gardneri</i>	<i>Capsicum</i>	Plants intended for planting
<i>Xanthomonas perforans</i>	<i>Capsicum</i>	Plants intended for planting
<i>Xanthomonas vesicatoria</i>	<i>Capsicum</i>	Plants intended for planting
Others (perfume use)		
'Candidatus <i>Phytoplasma solani</i> '	<i>Lavandula</i>	Plants intended for planting, other than seeds

[§]Evaluation based on EPPO PM4 Standard (EPPO, 2018).

[†]Uncertainty about the availability of effective measures.

^{*}As non-European populations/isolates of this pest are already regulated under the quarantine status in the European Union, it is recommended for the EU that this entry is restricted to the European populations/isolates.

[§]Recommended for a listing as an RNQP with only a requirement for absence of visual symptoms on the traded material.

already present, with possibly higher incidence or other host responses (Atallah *et al.*, 2010; Short *et al.*, 2015; Choudhury *et al.*, 2017). However, in the methodology developed, it was clarified that the RNQP concept should not be aimed at protecting an area from the introduction of a pest.

General requirements on pests

Pests, diseases or symptoms evaluated during the project were already listed either under plant health regulations or under mandatory certification/marketing regulations. Some of these pests currently in the EU Marketing Directives were not recommended for listing as RNQPs. This poses a question about the possibility to maintain requirements on such symptoms in the future within EU certification schemes. According to ISPM 16 *Regulated Non-Quarantine Pests: concept and application* (FAO, 2016a), not all pests mentioned in a certification programme are necessarily RNQPs. These programmes may include tolerances for pests, diseases or symptoms whose technical justification has not been demonstrated (FAO, 2016a). These ‘remaining’ pests, diseases or symptoms cannot be regulated at import under the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), which requires scientific evidence for determining the appropriate level of phytosanitary protection. However, these pests, diseases or symptoms could be regulated at import, in line with the WTO Agreement on Technical Barriers to Trade (TBT Agreement), to comply with minimum quality marketing standards that are already legally required in the importing country (e.g. in EU Marketing Directives). It seems coherent to regulate these ‘remaining’ quality pests, symptoms and diseases together with a common general requirement of absence of symptoms on the traded material, as is done the current ‘substantially free from’ general requirement in EU Marketing Directives (see 3.2.4).

Additional work needed

Because the project mainly focused on pests already listed in EU regulations, the list of pests to be considered for the RNQP status is not exhaustive. Complementary work by EPPO and/or by the European Commission will be necessary to obtain an enlarged and consistent list of recommended RNQPs for the EU and the EPPO region. This work could be added later on by the evaluation of other pests collected in the replies to the RNQP questionnaire and/or identified as priorities by the Sector Expert Working Groups, other pests coming from the EPPO A2 list (pests present in the EPPO Region and recommended² for the quarantine pest status), other pest/host/intended use combinations coming from EPPO PM 4 Standards, as well as

²A pest can be recommended for the quarantine pest status in the EPPO region and can be at the same time a good candidate for the RNQP status in an EPPO country where it is present.

additional pests (broad analysis by sector, pests listed on the International Seed Testing Association (ISTA) website, pests on which an alert has been given in the past etc.).

Priorities for additional RNQP listings in the future identified during the process include *Phytophthora* species for the Forest plants for planting, *Raspberry leaf blotch virus* on Raspberry, *Grapevine pinot gris virus* on *Vitis* as well as *Tilletia* species for the Cereals.

Recommended thresholds

The different experts and stakeholders had very different understandings of terms such as ‘zero tolerance’ and ‘substantial freedom’. One of the challenges the project had to address was the different terminology and approach used by risk managers and legislators in the quarantine and the certification sectors. Experts concluded that the concept of a tolerance level and threshold itself was not sufficient. Indeed, it can be recommended to tolerate a level of symptoms, a level of pest presence (which may require testing) or a level of risk of pest presence (e.g. by defining a failure rate, see 3.2.3). Therefore, during the project, tolerance levels and thresholds always referred to the practical associated risk management measure. Pest infestation thresholds were recommended by experts either at zero tolerance (of symptoms, of pest in the lot etc.) or at a higher level, in line with ISPM 21 (FAO, 2016b).

The definition or modification of current tolerance thresholds could have important consequences on the production of plants for planting material in the EU as well as on their international movement. Therefore, the economic impact and the risk of lot rejection should be balanced. Moreover these thresholds have to be scientifically justified according to the SPS Agreement (WTO, 1994).

Zero tolerance thresholds

A zero-tolerance threshold does not guarantee a total absence of the pest in the concerned lot. Indeed programs for detecting infestation can never certify that there is absolutely no contamination, even if no diseased seedlings are observed or tested in a large sample (Shu Geng *et al.*, 1983; Kuan, 1988).

A zero-tolerance threshold may be either associated with a visual examination or by testing of the plants, and the finding may result in very different measures (e.g. roguing of the plant, of the whole lot, of all plants at the site of production, additional testing, treatments etc.). Therefore a zero tolerance level may cover different and non-comparable situations.

For example,² a zero tolerance level was recommended for *Tomato spotted wilt tospovirus* (TSWV) on *Begonia x hiemalis*. For this pest/host combination visual examination was not considered as being fully reliable when symptoms were already observed on the production site. Even if the symptomatic plants have been rogued out, asymptomatic plants from the same production site should be tested for

the presence of the virus, using available techniques such as ELISA and RT-PCR (EPPO, 2004).

For the eriophyid mite *Aculops fuchsiae* on *Fuchsia*, on which a zero tolerance was also recommended, experts agreed that the pest is usually revealed by plant symptoms and proposed a measure based on visual examination. Experts commented that chemical treatment may not provide an effective control if mother plants are infested. Moreover repeated treatments are needed (e.g. 3 sprays with 4 days interval) and difficulties were noted in their effective application. However the treatment option was proposed as an option if accompanied along with an additional inspection.

All the RNQP candidates currently listed under Council Directive 2000/29/EC can be considered as being already regulated with a zero-tolerance threshold. In the replies to the questionnaire, NPPOs were often reluctant to define thresholds at a higher level than zero for these pests (except when regulation was not considered to be justified anymore, but in those cases deregulation was proposed). This is justified by the high economic impact foreseen in case of infestation by these pests.

Tolerance thresholds higher than zero

As for the zero-tolerance thresholds, nonzero-tolerance thresholds can be misunderstood if not associated with precise risk management measures: when the tolerance threshold is exceeded, alternative options including roguing, treatments or approved physical techniques may be authorized in the described risk management measures. However, sometimes experts considered that ways of achieving a threshold may be left to the producers and therefore no specific mandatory risk management measures were recommended: it was the case for *Claviceps purpurea* on *Avena nuda* where no more than 1 (for pre-basic or basic category) or 3 (for certified category) sclerotia or fragments should be found in a representative sample of the seed lot (size specified in the EU Marketing Directive).

A good quality-control program can only be developed with an understanding of the level of infestation permitted. Nonzero phytosanitary thresholds may derive from experience with official control programmes, experience from certification schemes, history of imports, and data regarding interactions between the plant, the pest and the growing conditions (FAO, 2016b). Such inoculum thresholds should be determined by correlation between seed infestation level established by field testing and field disease damage observed during designed experiments (Kuan, 1988). However most of the time such experimental data are missing and these tolerance levels were not sufficiently based on scientific evidence (De Hoop, 2011). As differences in climate, agronomic production density, vector populations may influence the optimal threshold to be defined (Kuan, 1988), it is more difficult to recommend a specific nonzero phytosanitary threshold for a large area such as the EU territory or the EPPO region. Gabrielson (1988)

recommended establishing such thresholds for the average conditions of the area in which the crop will be grown, but this would suggest that in many areas the threshold may not be optimal. For the EU, most thresholds defined in the Marketing Directives are minimum requirements and, for national production, stricter thresholds can usually³ be applied.

In absence of adequate experience and data for the setting of thresholds, extrapolation was sometimes proposed. Indeed, according to Stace-Smith & Hamilton (1988), assigning a virus to an established virus group such as 'severe virus symptoms' or 'mild virus symptoms' for seed potatoes may give predictive value in estimating an inoculum threshold.

The tolerance thresholds are either expressed as an infestation level in the field or in the harvested plant/seed lot. The decision to apply a threshold in the field rather than in the lot should be based on the biology of the disease, the ease and reliability of seeing symptoms in the field or of sampling and testing the lot, the relation between level of field and lot infestation, the availability of curative treatments available etc.

In the field: Tolerance levels in the field are usually expressed as number of affected/symptomatic plants per surface unit seen during field inspections at appropriate times. Such inspections should consist of the examination of a representative sample of the plants in each crop which is sufficient to statistically detect that tolerance level to a high degree (normally 95% probability);

In the lot: Tolerance levels in the lots are usually expressed as percentage of infected plants (e.g. seeds, tubers) based on visual examination or testing of a representative sample of a lot. Sometimes the tolerance level referred to the number of sclerotia (or fragments) found in this representative sample of the seed lot. This corresponds to the direct test/examination of a seed sample (Shu Geng *et al.*, 1983).

Failure rate

The tolerance level may be associated to a failure rate. This is the case for the *Leek yellow stripe virus* on *Allium sativum* plants where it is recommended that no more than 10% of the plants should have shown symptoms of the pest in the field after an inspection at appropriate time, with those plants rogued out immediately, and not more than 1% of plants showing symptoms seen in a final inspection. Therefore, if more than 1% of plants are observed to be symptomatic at the final inspection, no further removal is allowed and the whole stock is considered as failed.

'Substantially free from' requirement

All pests currently listed in the EU Marketing Directives for the ornamental sector (EU, 1993a, 1998) and for the

³It is not the case for all EU marketing directives. For instance, article 17.2 of Directive 2008/90/EC (EU, 2008), does not allow more stringent requirements at national level.

vegetable plants sector (EU, 1993b) require that plants for planting at the point of marketing have to be ‘*substantially free from*’ pests (at least on visual inspection). These Marketing Directives also require that any material showing visible signs or symptoms of these pests at the stage of the growing crop shall be treated properly and immediately upon their appearance or, where appropriate, shall be eliminated. Experts from these two SEWGs agreed that the most appropriate wording for the ‘*substantially free from*’ requirement should be the ‘*absence of visual symptoms on the traded material*’. In general, absence of visual symptoms of any pests impairing quality, during the whole production stage, is not an appropriate requirement because these pests are present and a few infestations might be observed. Other Marketing Directives have equivalent general requirements such as ‘*practically free from*’ (Fruit plants sector (EU, 2014c)) or ‘*lowest possible level*’ (Vine plant sector (EU, 1968), Cereal seed sector (EU, 1966b); Fodder plant seed sector (EU, 1966a); Beet seed sector (EU, 2002a); Oil and Fibre plants sector (EU, 2002d)). Some pest/host/intended use combinations were evaluated as fulfilling all the criteria for the RNQP status but the ‘*absence of visual symptoms on the traded material*’ was considered to be sufficient. Therefore these combinations were considered as eligible for RNQP status across the EPPO region (where they are not quarantine pests), but without the need to list them separately where (as in the EU) there is a generally applicable requirement for ‘substantial freedom’ understood as the freedom of the traded material from visible symptoms. Experts recommended not using the term ‘*substantially free from*’ in the risk management measures associated with the recommendation for an RNQP listing.

Thresholds and organic farming

Other challenges to pest control, such as organic farming, are faced in the EU and the EPPO region. The development of the organic production surface area has followed very

different trajectories across the EU (VTI, 2011) and the EPPO region, but the total size of the certified organic production has now increased greatly, representing 11 000 000 ha in 2015 for the EU (6.2% of the total utilized agriculture area (UAA) of the EU) compared to 105 000 ha in 1985 (0.1% of the total UAA) (Brzezina *et al.*, 2017). This led some countries and their experts to ask for specific thresholds to comply with organic specifications. Indeed, on the one hand thresholds may need to be lower for organic production because of reduced control options in the resulting crop; on the other hand it may be more difficult to produce propagating material with those lower levels. Finally, experts always recommended avoiding making distinctions between organic and non-organic production, recommending alternative risk management measure options that complied with this specific end use. However, considering that the threshold should be directly linked to the acceptability of the economic impact, and that the economic value of organic production may be higher than the value of conventional production, this issue may be further considered in the future.

Recommended risk management measures

Regulated non-quarantine pests are either regulated in the context of mandatory certification schemes with traceability requirements and measures depending on the category of material (e.g. for Pre-Basic, Basic, Certified material), or regulated with identical options applying to all categories of plants for planting. According to ISPM 21, phytosanitary measures on RNQPs should be proportionate to the assessed pest risk and applied alone or in combination to ensure that the tolerance levels of RNQPs are met (FAO, 2016b). For their acceptability at national level these measures should be feasible and cost-effective. For their acceptance at international level, these measures should not restrict trade more than necessary.

Table 2. Example: Risk management measures recommended on TSWV for the ornamental sector

Pest	Host	Intended use	Recommended risk management measures
<i>Tomato spotted wilt tospovirus</i>	<i>Begonia x hiemalis</i> , <i>Capsicum annuum</i> , <i>Chrysanthemum</i> , <i>Gerbera</i> , <i>Impatiens</i> <i>New Guinea hybrids</i> , <i>Pelargonium</i>	Ornamental sector	(A) The site of production has been subjected to a monitoring regime and appropriate treatments to ensure effective suppression of populations of relevant thrips vectors (<i>Frankliniella occidentalis</i> and <i>Thrips tabaci</i>); AND (B) (a) No symptoms of <i>Tomato spotted wilt tospovirus</i> have been observed on plants at the site of production during the current growing period; or (b) Any plants at the production site showing symptoms of <i>Tomato spotted wilt tospovirus</i> during the current growing period have been rogued out and a representative sample of the plants to be marketed has been tested and found free from <i>Tomato spotted wilt tospovirus</i> .

When ‘OR’ or ‘AND’ is written in capitals this separates 2 sections of options. When ‘or’ or ‘and’ is not in capitals they separate only one option from another.

Phytosanitary measures available for international movement of seeds are described in ISPM 38 (FAO, 2017b). More generally, risk management measures available for RNQPs are described in ISPM 21 (FAO, 2016b). These different types of measures have been used in the EU Marketing Directives on plant reproductive material as well as in annex IV.A of Council Directive 2000/29/EC. When recommending measures, these should be clear enough to identify the plants to be rejected, destroyed or treated. Indeed a zero tolerance threshold may imply rejection of only infested/symptomatic plants, or rejection of the whole lot. Different options may be proposed for achieving the same level of assurance – pest free place of production or site or testing, for example.

Some considerations discussed during the SEWGs on the risk management measures are presented below.

Pest free areas, pest free places of production, pest free production sites (incl. growing plants under specially protected conditions)

All these zonal considerations may be taken into account when defining specific requirements for RNQPs. Areas of low pest prevalence, as defined in ISPM 22 (FAO, 2016c), could be an option according to ISPM 21 (FAO, 2016b). However, this concept was never used in the options proposed by the experts during this project and this concept has not been used so far in EU regulations. Indeed, a major difficulty would be to define what should be the maximum specified pest level in the area. Nevertheless it could be noted that for the management of TSWV on ornamentals (incl. *Begonia x hiemalis*, *Gerbera* and *Pelargonium*), it was recommended, in addition to other measures, that effective suppression of populations of relevant thrips vectors (*Frankliniella occidentalis* and *Thrips tabaci*) with appropriate treatments is

carried out. This measure should result in low vector prevalence in the production site (see Table 2).

When evaluating the risk management measures, experts were careful to ensure the practicality of the defined measure. In the past, a large number of pests regulated under Council Directive 2000/29/EC were regulated for a whole place of production irrespective of the pathway of the pest or its occurrence in surrounding areas. A place of production is defined in ISPM 5 as ‘any premises or collection of fields operated as a single production or farming unit’ (FAO, 2017a). However since the establishment of these EU regulations, many farms in the European Union have increased in size (Gimes, 2015). Therefore there is nowadays a significant impact of regulating pests for a whole place of production rather than just for the production site [e.g. a field or glasshouse], which is ‘a defined part of a place of production, that is managed as a separate unit for phytosanitary purposes’ (FAO, 2017a), especially when risk of infestation by contact or machinery can be expected, managed and prevented.

Requirements for freedom from a RNQP on a whole place of production during a previous growing period would usually be a disproportionate requirement for an RNQP, especially in absence of alternative options, due to the severe economic impacts on the marketing of all host plants if any infestation were found. Any infestation, however small, would prohibit marketing of all host plants from the whole place of production for the whole of the next growing period, even though the pest is present (by definition for a RNQP) in the surrounding area.

The measures developed during the project only apply to EU internal movement of plant for planting material. The pest free area option was not always proposed: For some specific pests it was considered that the pest was too widespread in the European Union to propose this as a realistic option.

Table 3. Example: Risk management measures recommended for *Citrus exocortis viroid* on *Solanum lycopersicum* for the vegetable sector

Pest	Host	Intended use	Recommended risk management measures
<i>Citrus exocortis viroid</i>	<i>Solanum lycopersicum</i>	Vegetable sector	Seeds: (a) The seeds have been produced from mother plants which have been maintained in isolation from other potential sources of infection, including host plants which may be latently infected; and (b) No symptoms of <i>Citrus exocortis viroid</i> have been observed on mother plants at the site of production since the beginning of the last complete cycle of vegetation, or if symptoms have been seen, then the symptomatic plants have been tested and found free from <i>Citrus exocortis viroid</i> . Plants: (a) The plants have been grown from seed that meet the requirements laid down; and have been maintained in isolation from other potential sources of infection, including host plants which may be latently infected; and (b) No symptoms of <i>Citrus exocortis viroid</i> have been observed on plants at the site of production since the beginning of the last complete cycle of vegetation.

When ‘OR’ or ‘AND’ is written in capitals this separates 2 sections of options. When ‘or’ or ‘and’ is not in capitals they separate only one option from another.

For example, *Citrus exocortis viroid* (CEVd) was recommended for the RNQP status on *Solanum lycopersicum* seeds and plants. However experts did not propose the Pest free area option: they considered that this option was not reliable because CEVd may be present on ornamentals and other plants that are widely grown and marketed in the area (Table 3).

When referring to import requirements in the EU, it should be noted that the current EU Marketing Directives allow either an EU procedure for EU-wide equivalence for specified Non-EU-countries to import seeds and plant reproductive material, or a national procedure, as long as no EU-wide equivalence exists. Phytosanitary imports requirements for RNQPs should be set up in accordance with the International plant protection convention (FAO, 1999) for the 183 contracting parties: They shall follow the ‘*Principle of equivalence*’ (if different phytosanitary measures with the same effect are identified, they should be accepted as alternatives) and the ‘*principle of non-discrimination*’ (Phytosanitary measures in relation to import should not be more stringent than those applied within the importing country). In this context, the Pest free area option should always be further considered as an additional possible equivalent option at import. The phytosanitary certificate which accompanies plants for planting at import should conform the current phytosanitary requirements of the importing country, including phytosanitary measures for RNQPs.

Isolation distance, buffer zone and immediate vicinity

The EU Marketing Directive for fruit reproductive material (EU, 2014c) requires Basic mother plants and Basic

material grown in fields to be isolated from potential sources of infestation by aerial vectors, root contact, machinery, grafting tools and any other possible sources. The isolation distance of the fields referred to is set out by the responsible official body dependent on national or local conditions and climate. Council Directive 2000/29/EC (EU, 2000) refers, for specific pests, to the production of plants in a buffer zone, or defines measures for infested plants in the field of production or its immediate vicinity. These concepts of ‘*isolation distance*’, ‘*buffer zone*’ and ‘*immediate vicinity*’ refer, at different scales, to isolation from host plants and/or defined pests. Isolation or indoor production may sometimes be the only way to prevent any re-infestation by natural spread of a pest already present in the area, as defined for ‘*Candidatus Phytoplasma prunorum*’ on *Prunus* for the fruit sector (see Table 4). In the context of certification, isolation from plants of the same family is also necessary to prevent cross pollination and therefore guarantee a varietal purity standard.

Inspection of the facilities, fields, consignments or lots

Risk management measures were developed based on an inspection, i.e. ‘*official visual examination of plants [...], to determine if pests are present [...]*’ (FAO, 2017a), with sampling and testing in the case of suspicion. This may be based on symptoms on the plant or only the presence of the vector. Examination or confirmation could be performed by the producer if authorized by the NPPO. The term ‘*Official*’ is interpreted as ‘*Established, authorized or performed by a NPPO*’ (FAO, 2017a). For example, *Prunus* mother plants have to be inspected and found free from symptoms of ‘*Candidatus Phytoplasma prunorum*’ (see Table 4).

Table 4. Example: Risk management measures recommended for ‘*Candidatus Phytoplasma prunorum*’ on *Prunus* for the fruit sector

Pest	Host	Intended use	Recommended risk management measures
‘ <i>Candidatus Phytoplasma prunorum</i> ’	<i>Prunus</i>	Fruit sector	<p>Non-certified material:</p> <p>(A) Derived from mother plants which have been inspected and found free from symptoms of ‘<i>Candidatus Phytoplasma prunorum</i>’. In the case of <i>Prunus domestica</i> rootstocks, it should derive from mother plants that have been tested within the previous 5 years and found free from the pest;</p> <p>AND</p> <p>(B) (a) Plants produced in areas known to be free from ‘<i>Candidatus Phytoplasma prunorum</i>’;</p> <p>or</p> <p>(b) Site of production found free from ‘<i>Candidatus Phytoplasma prunorum</i>’ over the last complete growing season by visual inspection and any symptomatic plants in the immediate vicinity rogued out and destroyed immediately;</p> <p>or</p> <p>(c) No more than 2% of plants in the site of production showing symptoms during inspections at appropriate times during the last growing season, and those plants and any symptomatic plants in the immediate vicinity rogued out and destroyed immediately, and a representative sample of the remaining asymptomatic plants in the lots in which symptomatic plants were found has been tested and found free from ‘<i>Candidatus Phytoplasma prunorum</i>’.</p>

When ‘OR’ or ‘AND’ is written in capitals this separates 2 sections of options. When ‘or’ or ‘and’ is not in capitals they separate only one option from another.

Table 5. Example: Risk management measures recommended for *Arabis mosaic virus* on *Vitis* for the vine sector

Pest	Host	Intended use	Recommended risk management measures
<i>Arabis mosaic virus</i>	<i>Vitis</i>	Vine sector	<p>Based on visual examination carried out at least twice during the last growing season at appropriate times for the expression of symptoms.</p> <p>Non-certified ('standard'): not more than 5% [reduced from current 10%] of plants showing symptoms of nepoviruses (<i>Arabis mosaic virus</i>, Grapevine fanleaf virus and Cherry leaf roll virus) and not more than 10% of plants showing any virus symptoms and all plants showing symptoms rogued out and destroyed within 2 weeks</p> <p>Pre-basic ("initial"), Basic, Certified: additional measures (in addition to non-certified) could include an isolation distance from other vines, a periodic testing of mother plants, a soil testing for virus vector nematodes, and a rest period from host plants of the virus before planting</p>

Seed or crop treatment: chemical treatment, physical treatment (heat treatment, including hot water treatment), biological treatment, other treatments

A 'treatment' is defined in ISPM 5 as an 'official procedure for the killing, inactivation or removal of pests, or for rendering pests infertile or for devitalization' (FAO, 2017a). In the new EU plant health Regulation, a treatment can be also non-official. During the SEWGs, experts only discussed possible official treatments.

Seeds may be treated to eliminate an infestation by a pest. For example, in case of infestation by *Plasmopara halstedii*, experts agreed that treating seeds of *Helianthus annuus* could be an appropriate option. For 'Candidatus *Phytoplasma solani*' on *Vitis* plants, experts recommended keeping an option for hot water treatment according to EPPO PM 10/18 (EPPO, 2012). In that case, no additional measures are recommended.

Occasionally it was recommended that plants or seeds should be treated, even if not infested by a specific pest, either as a precaution or to protect the seedlings growing from the seeds from exposure to pests in the environment.

For example, in areas where *Bemisia tabaci* is known to occur, experts recommended the inclusion of an option requiring the absence of *Tomato yellow leaf curl* disease symptoms accompanied with appropriate treatment against *B. tabaci*, even if this vector was not detected in the production site (see Table 2).

Soil requirements

Requirements for soil or growing media may be established for soilborne pests. Requirements may include sampling and testing or treatment of the soil or growing medium (including sterilisation of the growing media), or specific requirements (incl. production in soil-free growing media,

Table 6. Example: Risk management measures recommended for *Clavibacter michiganensis* subsp. *insidiosus* on *Medicago sativa* for the fodder plant seed sector

Pest	Host	Intended use	Recommended risk management measures
<i>Clavibacter michiganensis</i> subsp. <i>insidiosus</i>	<i>Medicago sativa</i>	Fodder plant seed sector	<p>(A) The seeds originate in areas known to be free from <i>Clavibacter michiganensis</i> spp. <i>Insidiosus</i>; OR</p> <p>(B) (a) The crop has been grown on land on which no previous <i>Medicago sativa</i> crop has been present during the last 3 years prior to sowing; and (b) No symptoms of <i>Clavibacter michiganensis</i> ssp. <i>insidiosus</i> have been observed during field inspection at the place of production or on any <i>Medicago sativa</i> crop adjacent to it, during the last complete cycle of vegetation; OR</p> <p>(C) (a) The crop belongs to a variety recognised as being highly resistant to <i>Clavibacter michiganensis</i> ssp. <i>insidiosus</i>; and (b) The content of inert matter does not exceed 0.1% by weight.</p>

When 'OR' or 'AND' is written in capitals this separates 2 sections of options. When 'or' or 'and' is not in capitals they separate only one option from another.

maximum percentage of inert material etc.). The EU Fruit Marketing Directive (EU, 2014c) imposes different requirements for some soil virus-vector pests on soil depending on the category of material. Experts mentioned such risk management measures for the *Arabid mosaic virus* on *Vitis* for Pre-basic, Basic or Certified material (see Table 5).

Cultural practices (e.g. roguing, pest and vector control, hygiene, requirement on the preceding crop)

Because of possible indirect economic impact from the preceding crop, rotation was sometimes considered in the recommended risk management measures. In the case of *Clavibacter michiganensis* subsp. *insidiosus* on *Medicago sativa*, experts recommended to include in the risk management measures an option consisting in the growing of the crop on land on which no previous *Medicago sativa* crop had been present during the last 3 years prior to sowing (see Table 6).

Sampling and testing

Inspection may not be sufficient to determine if a regulated pest is present below a certain threshold and other forms of examination may be needed (e.g. laboratory testing). A test is defined in ISPM 5 and EU Regulation 2016/2031 as an ‘official examination, other than visual, to determine if pests are present or to identify pests’. Sampling and testing should be done at the most appropriate period of the year, taking into account the climatic conditions, the growing conditions of the plant, the biology of the pest concerned and the performance of the test. This could consist of testing an individual plant, testing a certain proportion of plants with/without specification of the testing frequency, random testing with/without specification of the testing frequency. Seed treatment may influence the sensitivity of testing (FAO, 2017b).

For example, because *Prunus domestica* was considered to be asymptomatic when infected by ‘*Candidatus* Phytoplasma prunorum’, experts recommended that such rootstocks should derive from mother plants that have been tested within the previous 5 years and found free from the pest (see Table 4). Indeed, such rootstocks may be used on *Prunus armeniaca* and Japanese plums (*P. salicina*) which are known to be particularly impacted by the pest. More generally, experts discussed the ratio cost/benefit of a more systematic testing of Conformitas Agraria Communitatis (CAC) mother *Prunus* plants for this pest: This would allow detection of asymptomatic plants. However, this was counterbalanced by the difficulty of testing (testing of the roots would be more reliable, but not practical) and by the risk of re-infestation in case of high vector pressure. No consensus was reached within the core-HEWGplus on the added value of a more systematic testing, in the context of the RNQP status.

Resistance

The use of resistant varieties was sometimes proposed in this project as an option for the recommended risk

management measures. For example, for *Clavibacter michiganensis* subsp. *insidiosus* on *Medicago sativa*, an option could consist of the use of a variety recognised as being highly resistant to this pest, with additional requirements (see Table 6). However, experts agreed that it was not always possible to know, according to the variety description, if a variety is resistant to a specific pest.

All these measures have been combined to develop risk management measures for RNQPs during the project and have been proposed to the European Commission as well as to the EPPO countries who can decide how to apply these recommendations. They are available in the corresponding summary sheets.

Conclusion

The EPPO Project on RNQPs consisted of developing and applying a relevant methodology to approximately 1400 pest/host combinations with the objective of recommending a list of RNQPs to the EU and to receive endorsement of the recommendations by the EPPO Working Parties on Phytosanitary Regulations and the EPPO Council. Modification of existing EU risk management measures and thresholds were also discussed based on the replies to questionnaires from NPPOs and stakeholders. These evaluations are also available at <https://rnqp.eppo.int/recommendations/>.

During the Project, tolerance levels were often proposed based on practical national experience. In the future, the EUPHRESKO network for phytosanitary research coordination and funding (Giovani *et al.*, 2015; Euphresco, 2018) could serve to collect more harmonized and therefore more usable data to define and revise these thresholds.

Acknowledgements

These recommendations were delivered under a project funded by the European Commission, DG Health and Food Safety under the contract SANTE/2016/G1/SI2.726941: Review of the EU regulated quality pests and development of risk assessment for a list of Union Quality Pests to be established by the European Commission in the frame of the new EU Regulation on protective measures against pests of plants (‘EU quality pest project’). The authors would like to thank all participants of the SEWGs who did not participate in the writing of this article M. Albakri, F. Alonso Arce, P. Bouillon, Y. Brans, V. Cockerell, G. Csoka, M. Delos, F. Faggioli, M. Glavendekic, C. Hemetsberger, B. Hoppe, L. Jacob, C. Jeffries, D. Jurc, P. Kapitola, H. Kortemaa, H-J. Krauthausen, O. Kulinich, A. Lagkouranis, P. Lentjes, T. Levi, S. Milusheva, N. Ponserrre, M. Rubesova, PG. Sanchez, M. Schenk, L. Sigillo, J. Soellinger, R. Steffek, K. Szabo, K. Teixeira, L. Till, J. Van Ruiten, MM. Virscek, K. Visser, MC. Vives Garcia, B. Waterink. The authors would also like to thank F. Petter and M. Muriel for wise advice and support, as well as EPPO administrative and IT support.

Recommandations sur les Organismes Réglementés Non de Quarantaine (ORNQ), seuils de tolérance et mesures de gestion du risque associées, dans la région Euro-méditerranéenne

Certains organismes nuisibles peuvent être présents sur les végétaux destinés à la plantation et causer un impact inacceptable sur l'usage prévu de ces végétaux, quand bien même ils sont déjà présents dans la zone. Par conséquent, ces organismes peuvent être réglementés, et on les appelle alors 'Organismes Réglementés Non de Quarantaine' (ORNQ) conformément aux normes internationales. Des ORNQ, souvent non-identifiés en tant que tels, sont communément réglementés, soit avec des organismes de quarantaine dans les réglementations sur la santé des végétaux, soit au sein de programmes de certification des végétaux destinés à la plantation avec la définition d'exigences particulières vis-à-vis d'organismes nuisibles ou de maladies qui s'ajoutent à des exigences non-phytosanitaires. En 2016, les ORNQ de l'Union ont été introduits dans la nouvelle réglementation UE pour la santé des végétaux, laquelle est applicable à partir de décembre 2019. Dans ce contexte, l'OEPP a accepté d'entreprendre un projet de 2 ans sur les ORNQ, le Projet UE dit sur les Organismes de Qualité. Après avoir développé une méthodologie d'évaluation, des données ont été collectées à l'aide d'une rapide bibliographie de la littérature scientifique, des réponses à un questionnaire, des échanges d'expérience pratique au sein de six groupes d'experts sectoriels, ainsi qu'à travers une consultation des pays membres de l'OEPP, et ce afin de réaliser une rapide évaluation du statut d'ORNQ pour environ 1400 combinaisons d'organismes nuisibles/espèces hôtes/usage prévu. La liste résultante des organismes nuisibles répondant à la définition d'un ORNQ ainsi que les principaux sujets de discussion abordés quant aux seuils de tolérance et aux mesures de gestion du risque sont présentés dans cet article.

Рекомендуемые регулируемые некарантинные вредные организмы (РНКВО), связанные с ними пороговые значения и меры по управлению риском для Европейского и Средиземноморского региона

Некоторые вредные организмы могут присутствовать на посевном и посадочном материале и оказывать экономически неприемлемое воздействие на предполагаемое использование этих растений, даже несмотря на то, что они уже присутствуют в зоне. В результате такие вредные организмы могут быть подвергнуты регулированию и затем, согласно международным стандартам, считаться регулируемыми некарантинными вредными организмами (РНКВО). РНКВО, часто не определяемые как таковые, обычно регулируются либо вместе с карантинными вредными

организмами в фитосанитарных регламентациях, либо в рамках программ сертификации посевного и посадочного материала через определенные требования, предъявляемые к вредным организмам и заболеваниям, вызываемым вредными организмами, в дополнение к нефитосанитарным требованиям. В 2016 г. Концепция РНКВО была введена в новые регламентации по карантину растений ЕС, которые вступают в силу с декабря 2019 г. В этой связи ЕОКЗР согласилась предпринять двухгодичный проект по РНКВО, называемый «Проект ЕС по вредным для качества организмам». После разработки методологии был проведен сбор данных посредством оперативного поиска научной литературы, ответов на вопросники, обмена практическим опытом в рамках экспертных рабочих групп по шести секторам, а также консультаций с государствами-членами ЕОКЗР, с тем чтобы произвести быструю оценку статуса РНКВО для почти 1400 комбинаций «вредный организм/хозяин/предполагаемое использование». В статье представлен полученный таким образом список вредных организмов, соответствующих определению РНКВО, а также рассматриваются основные вопросы в отношении мер управления риском и пороговых значений.

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