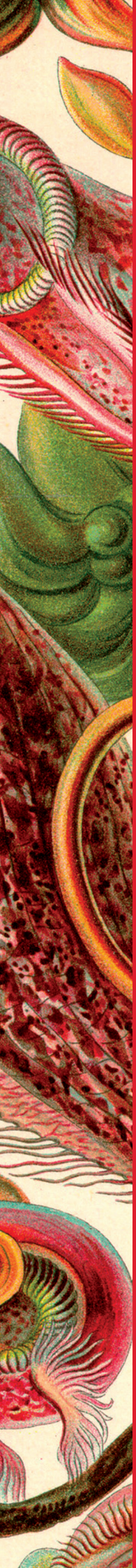

IMPLEMENTATION REVIEW AND SUPPORT SYSTEM (IRSS)

Food and Agriculture Organization of the United Nations

International Plant Protection Convention

APR
2023

ENG

Study on the use of International Plant Protection Convention diagnostic protocols

Implementation Review and Support System survey on the use of International Plant Protection Convention diagnostic protocols

Funded by the European Union

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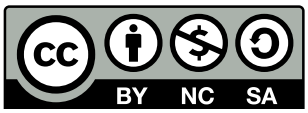

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Contents

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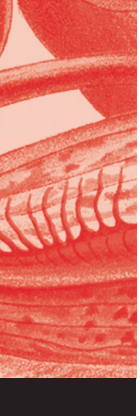
Report prepared by Natalia Sherokolava, consultant on phytosanitary diagnostic protocols.



Abbreviations

CP	contracting party
DP	diagnostic protocol
EPPO	European and Mediterranean Plant Protection Organization
CAHFSA	Caribbean Agricultural Health and Food Safety Agency
COSAVE	Southern Cone Regional Plant Health Committee
IC	Implementation and Capacity Development Committee
IPPC	International Plant Protection Convention
IRSS	Implementation Review and Support System
ISPM	International Standard for Phytosanitary Measures
NPPO	national plant protection organization
RPPO	regional plant protection organization
TPDP	Technical Panel on Diagnostic Protocols

1. Executive summary

In 2016, the Commission on Phytosanitary Measures adopted a recommendation on the importance of pest diagnosis. The recommendation stresses the importance of pest diagnosis in underpinning many activities involved in the implementation of the International Plant Protection Convention (IPPC).

The recommendation encourages regional plant protection organizations (RPPOs) and contracting parties (CPs) to share knowledge and expertise, and support laboratory capacity in diagnostic protocols (DPs). This is helping to raise the profile of pest diagnosis in the IPPC, which is crucial to prevent the introduction and spread of plant pests. Encouraging national plant protection organizations (NPPOs) to maximize the utilization of DPs as official procedures to adequately fulfil their obligations under the IPPC is essential.

A survey was conducted within the framework of the Implementation Review and Suppot System (IRSS) by ''IPPC Observatory'' on IPPC Diagnostic Protocols, under the remit of the Implementation and Capacity Development Committee (IC).

The questionnaire was intended for the IPPC official contact points to determine the level of use of IPPC diagnostic protocols and identify implementation challenges. The survey was also carried out in order to learn about and analyse how to improve the production and use of IPPC DPs.

A total of 27 CPs, from almost all FAO regions participated in the survey, representing a wide diversity of attitudes on this issue.

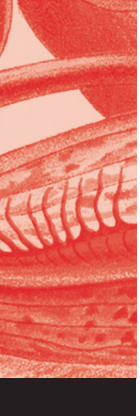
Up to November 2021, 30 IPPC diagnostic protocols for regulated pests are adopted. From the 27 respondents, more than 92 percent of contracting parties are utilizing them, within officially accredited national laboratories. This is mainly for pest detection, surveillance, and meeting declarations in export certifications. The majority of respondents are utilizing DPs more than once a year. More than 88.5 percent of the adopted IPPC DPs are relevant, however 42 percent claim they are relevant but not utilized.

Almost 21 percent of respondents indicated that the existence of the national and regional DPs was a limiting factor to utilize IPPC DPs. However, this factor could have a positive effect if the NPPOs or RPPOs would be able to share their DPs in order to develop new protocols for a wider range of users.

Lack of technical expertise and capacity building limitations accounted for 21 percent and 15 respondents were reported. Diagnostic activities require continual training and professional development of staff. Addressing these limitations at national, regional and international levels could be useful to strengthen CPs' diagnostic capacities.

English versions of DPs are widely used by 46 percent of respondents within CPs, although 20 percent are using English versions in combination with ones in Spanish, French and Russian.

This study presents the results of the survey, reflects the data received from respondents, and illustrates the analysis and recommendations for optimizing the use of diagnostic protocols.



2. Introduction

In accordance with the IPPC, phytosanitary measures must be technically justified. Technical justification of phytosanitary measures, in many cases, are based on accurate and reliable diagnosis. Diagnostic services of CPs are therefore essential for the fulfilment of obligations and responsibilities under the IPPC. All CPs[1] are encouraged to make efforts to establish an efficient control system for regulated pests. The IPPC Secretariat coordinates the development of international standards to assist CPs in implementing the provisions of the convention at the national level.

NPPOs should develop DPs as official procedures to adequately fulfil their obligations under the IPPC. While performing well-established routine tests, phytosanitary diagnostic laboratories may face challenges under difficult circumstances and while performing their duties, such as in cases where a pest is identified by a laboratory for the first time, detection of an organism unexpectedly found in a new host, or in a consignment originating in a country where the pest is declared absent. Sometimes there is a need for interpretation results deviations. Developing procedures for detection and identification of new unknown pests requires time and expertise which laboratories may not have.

Considering the fact that NPPO laboratories use a variety of diagnostic methods, which can lack the minimum requirements for reliable and harmonized diagnosis, in order to enhance the mutual recognition of diagnostic results by NPPOs, CPs have agreed on the need to harmonize diagnostic procedures by elaboration of international DPs. For this purpose, the IPPC Technical Panel on Diagnostic Protocols (TPDP) was established.[2] The key purposes for the TPDP besides developing accurate and reliable pest diagnosis is to consolidate capabilities, are to share knowledge on methods for diagnosis of regulated pests and to harmonize methods to facilitate international safe trade.

The IPPC DPs include various methods of detection and identification of regulated pests, describe the process of finding an organism either in symptomatic or asymptomatic material, and contain methods that are appropriate for a range of circumstances, including the first finding of an organism in a country or laboratory and routine diagnosis of common pests. DPs include several alternative methods, where they are available, to take into account the different levels of expertise and facilities of different laboratories.

DPs for specific regulated pests are included as annexes to ISPM 27 (*Diagnostic protocols for regulated pests*), which is referred to in the International Standards for Phytosanitary Measures (ISPMs). As of the start date of the IRSS survey on the use of IPPC DPs, November 2021, 30 DPs have been adopted.

[1] www.ippc.int/en/countries/all/list-countries

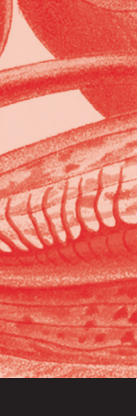
[2] www.ippc.int/en/core-activities/standards-setting/expert-drafting-groups/technical-panels/technical-panel-diagnostic-protocols

3. Survey objectives

The overall goal of the survey was to learn about and analyse the situation regarding the production and level of use of DPs developed and adopted by the IPPC. This is to identify challenges related to the implementation of DPs by IPPC contact points and to provide recommendations leading to the improvement of producing a DP list of topics to finally maximize the efficiency of using DPs. The following objectives were set:

- Analyse the implementation level of the IPPC DPs by IPPC CPs.
- Identify potential problems or difficulties relating to their implementation.
- To improve the use of DPs.
- Identify topic opportunities for the development of new DPs.
- Provide recommendations for the efficient use of the DPs.

Limitations were faced in this study to capture a detailed panoramic image for addressing the situation worldwide. This included that the sole language used in the release of the survey was English which limited the opportunity for non-English speaking countries to respond or share their story. Also, there was a short period allocated for feedback to be provided, which was at the end of the year, when vacations were taking place, and this had a significant impact in attracting and enabling higher levels of participation. The questionnaire was sent only to contracting parties and didn't include regional plant protection organizations which could have represented more regions with solid experience in diagnostic protocols utilization, and this was accounted as a limiting factor for the study. Only one kind of questionnaire platform was utilized, the Microsoft® platform, which may not be common in or the standard for some countries. The questionnaire was distributed electronically, and it is possible that a range of countries may encounter problems with internet connections, or their infrastructure may not be well developed. All these limitations had a challenging impact and reduced the number of respondents.



4. Methodology

In order to prepare for this study and fulfil its objectives, a questionnaire covering the most important aspects of IPPC DPs was considered and distributed to all IPPC official contact points. On the basis of this, the following tasks were performed:

- collecting information through a dedicated developed online questionnaire and distribution to CPs;
- widening the scope of resources by studying the RPPO and NPPO websites and also extracting relevant information from available publications;
- analysing the information collected regarding the frequency of use of the DPs (by whom, in what circumstances, what language versions, the reasons limiting their use, etc.);
- establishing recommendations for increasing the effectiveness of the use of the DPs and providing lessons learned for future considerations in survey design.

The main basis of the methodology of this survey is the analysis of the information received from the participants. This is in addition to a wide range of information resources from the official IPPC, RPPO and NPPO websites. TPDP reports were also used as a support tool in the preparation of the questionnaire and the compilation of obtained data for analysis.

The questionnaire was developed jointly by a consultant and the IPPC Secretariat, taking into account the recommendations of the TPDP, which was then reviewed by the IC subgroup on IRSS. The questionnaire consisted of 17 questions, which generally described the main provisions in the diagnosis of regulated pests (see Annex 1 and Annex 2).

The questionnaire was sent out and shared with IPPC official contact points. The MS Forms platform was used to share this survey.

At the initial stage of the study, there were some difficulties in obtaining answers from the CPs. Possible reasons for the low level of responses could have been that it was close to the end of the year, which was a period of high workload for the NPPOs and that a short time frame was allocated for responses. Considering the low response rate, the questionnaire was resent and direct contact with some NPPOs was undertaken to serve as a reminder. The questionnaire was also translated into Russian with the aim of encouraging Russian speakers to respond and then sent to Russian-speaking countries.

In spite of all the measures taken, only 27 of the 184 CPs took part in the survey. However, the diversity of countries represented in the survey in terms of geographical location and level of development of diagnostics offered a wide overview of the general situation with issues related to phytosanitary diagnostics.

5. Survey findings

5.1. IMPLEMENTATION LEVEL OF THE INTERNATIONAL PLANT PROTECTION CONVENTION DIAGNOSTIC PROTOCOLS

5.1.1. Geographical analysis on the use of diagnostic protocols

A total number of 27 CPs, representing almost all FAO regions, except the Near East, responded to the questionnaire. The countries that participated in the survey have different levels of development of phytosanitary diagnostic capabilities. This makes it possible to get different points of view on the topic and to identify potential problems and ways to improve the use of IPPC DPs.

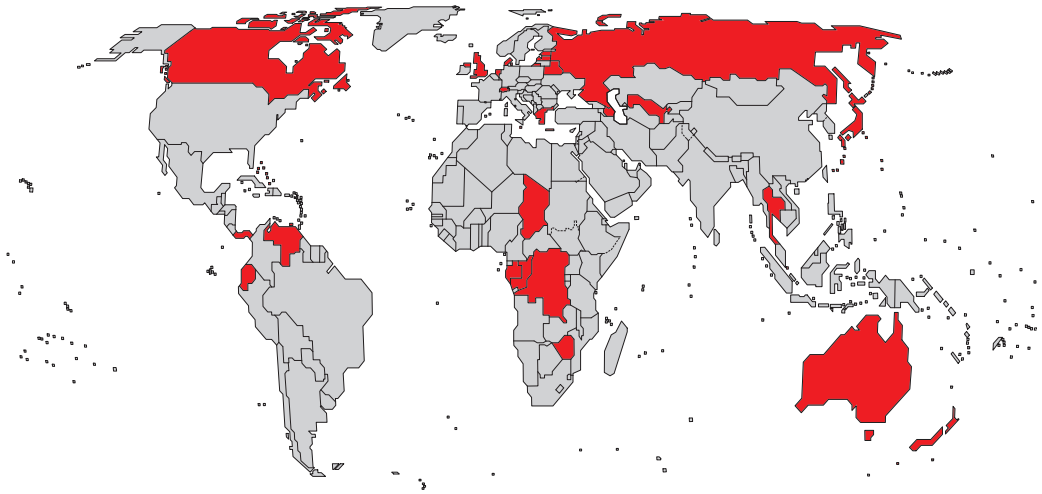
The map below (Figure 1) illustrates the geographic location of the responding countries, which entails the diversity of regulated pests and the specificity of the regions in terms of diagnostic capabilities.

The Asian region is represented by four countries that are located in very different climatic zones, ranging from temperate to tropical. Participants from five countries in the African region, which are mainly located in the equatorial and subequatorial zones, took part in the survey. The European region is represented by eleven countries, eight of which are members of the European and Mediterranean Plant Protection Organization (EPPO) activities. From Latin America and the Caribbean, four countries from the equatorial and subequatorial zones were represented. From North America, one country was represented, and the Southwest Pacific was represented by two countries.

5.1.2. Overview on the use of diagnostic protocols

Regarding the survey's main question, which was whether the NPPO uses the IPPC DPs or not, 25 out of 27 participants answered in the affirmative, which represented 92.6 percent of the total number of respondents. Two CPs responded that their NPPO does not use the IPPC DPs.

Figure 1. Geographic location of the responding countries



List of the IRSS study on use of Diagnostic Protocols participants.
Australia, Azerbaijan, Bahamas, Belarus, Canada, Chad, Congo, Democratic Republic of Congo, Denmark, Ecuador, Estonia, Gabon, Greece, Japan, Latvia, Malta, Netherlands, New Zealand, Panama, Russian Federation, Singapore, Switzerland, Thailand, United Kingdom of Great Britain and Northern Ireland, Uzbekistan, Venezuela (Bolivarian Republic of), Zimbabwe.

Source: UN. 2022. Map of the world, modified with data from the IPPC.

Figure 2. Number of survey participants according to FAO regions

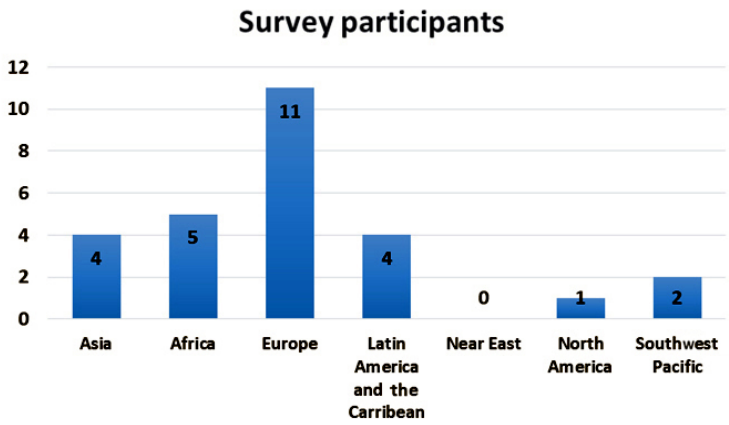
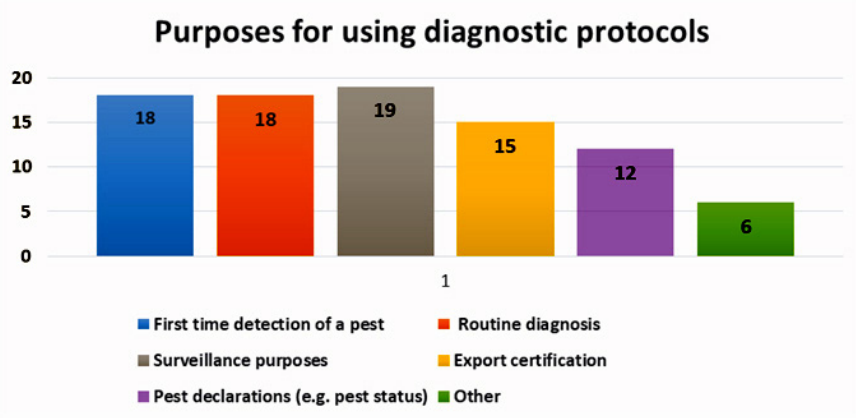


Figure 3. Purposes for using diagnostic protocols



On one hand, a high percentage of CPs utilize DPs in their routine work, but several factors contribute to preventing the efficient utilization of them, for example, the difference in terminology in phytosanitary diagnostics, in which related disciplines can play a useful role in evaluating the development of DPs. Another factor is that the greater part of NPPOs utilize English versions of DPs while other UN language translations are not available in many countries (this conclusion does not take into account the Near East region as it was not represented in this study). The results of the study indicate that strengthening training in diagnostics, exchanging reference materials, and extending proficiency-testing programmes, would raise the likelihood of DPs being utilized and make them more accessible.

5.1.3. Purposes for using diagnostic protocols

In accordance with the IPPC, phytosanitary measures carried out by NPPOs must be technically justified.

Most of these measures relate to accurate and reliable diagnosis. Therefore, diagnostics are relevant in various circumstances such as import inspection, surveillance, export certification and others. A question on the purpose of using DPs was included in the survey in order to determine the scope of IPPC DP use.

This question was answered by 25 respondents, where two of the participants said they did not use DPs. There are 19 NPPOs using DPs for the purpose of surveillance, 18 for routine diagnosis and first-time detection of pests, 15 for export certification and 12 for pest declaration. Figure 3 illustrates the types of use of IPPC DPs by respondents.

Figure 4. Diagnostic protocols users

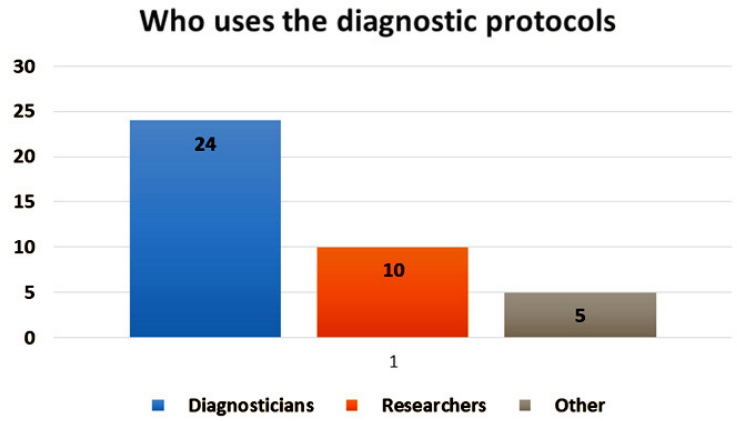
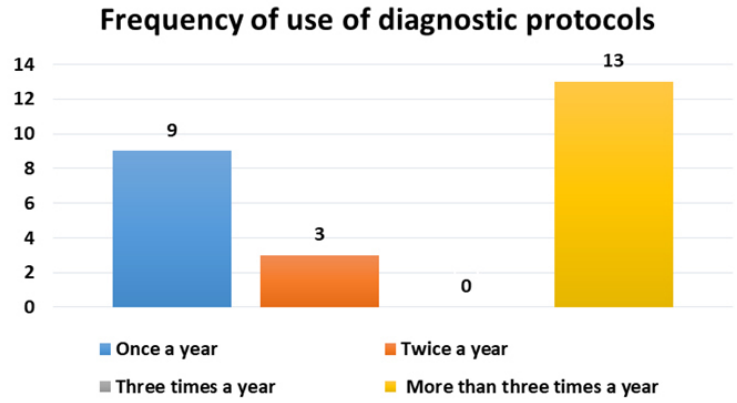


Figure 5. How often are IPPC DPs used



In addition, six respondents noted other circumstances including:

- specific diagnosis and interception of pests in import shipments;
- when reporting;
- for import interceptions;
- as a reference for developing standard operating procedures, and sampling and test protocols;
- not directly used for diagnosis, but referred to for developing national diagnostic protocols;
- using the IPPC DPs only indirectly, regional protocols are used more often and of course, there is a link between regional protocols and IPPC DPs (in this case in the EPPO region).

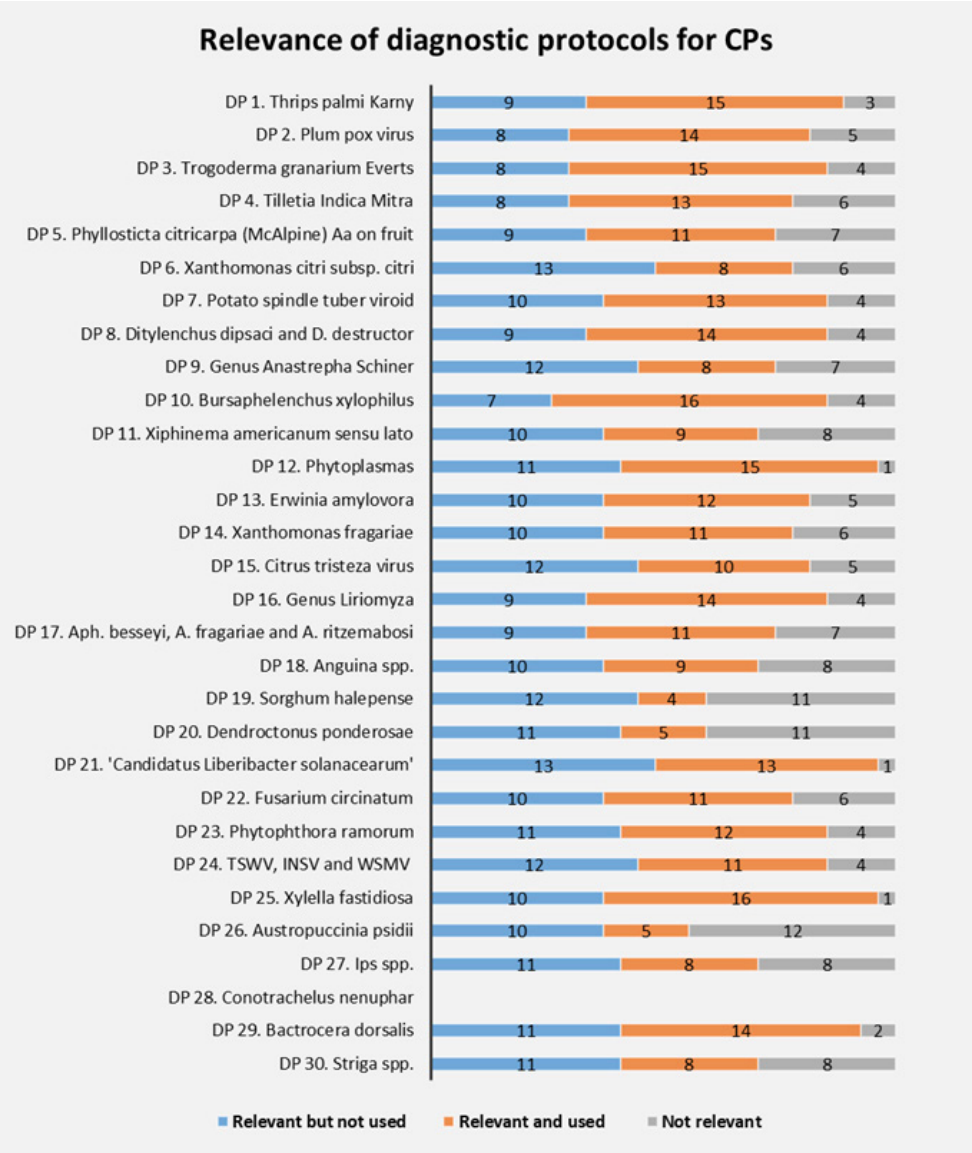
The results of the study confirmed that IPPC DPs are widely used for different purposes under different circumstances.

5.1.4. Who uses diagnostic protocols

At the start of the programme on the development of IPPC DPs, it was supposed that diagnosticians would use the DPs more in order to help phytosanitary laboratories adequately perform their duties. However, the survey showed that DPs are used more widely by researchers and other NPPO staff.

An absolute majority (24 out of 25 countries that use DPs) indicated that diagnostic laboratory staff use them. Ten CPs responded that researchers also use

Figure 6. Number of survey participants' responses for each of the three categories of DPs



DPs. Five survey participants mentioned that other professional categories could use them in their work.

Other minor uses for DPs were illustrated in different groups such as:

- plant professionals trained by CABI;
- food safety agency staff;
- risk analysts;
- NPPO staff.

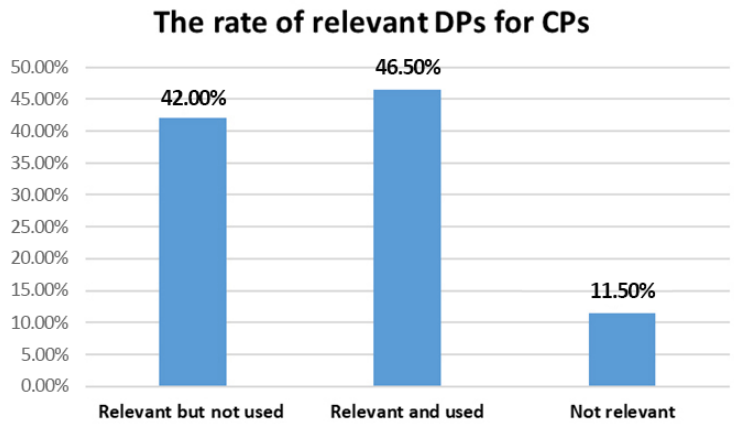
5.1.5. How often diagnostic protocols are used

25 survey participants answered this question. As can be seen from the results, 9 CPs responded that they use the DPs once a year, three of them use DPs twice a year and 13 use them more than three times a year. Therefore, 64 percent of NPPOs use DPs more than once a year, which demonstrates that DPs are actively used. To add a comments on the use of the DPs webpage on IPP.

5.1.6. Relevance of diagnostic protocols for contracting parties

In response to the question about the relevance of DPs, all 27 survey participants expressed their view regarding 30 adopted IPPC DPs. The questionnaire represented three main categories of relevance to CPs for DPs. The results show that a high number

Figure 7. Percentage of the three groups of DPs in relation to relevance for CPs



of DPs are relevant to and used by CPs in their activities. While 46.5 percent agreed with this statement, 42 percent of respondents deemed DPs relevant, but said they were not used. The remaining 11.5 percent of survey participants responded that DPs are not relevant.

The reasons for the irrelevance can differ. They may depend on the specifics of countries in international trade or the potential of a pest's ability to acclimatize to a particular area. A pest's relevance is determined primarily by its ability to cause great damage to certain crops and its economic impact. The ability to use different methods determines the level of the diagnostic laboratory and the likelihood of using particular DPs. The level of phytosanitary diagnostics in a country may influence the relevance of DPs for NPPOs.

The adopted DPs included in the survey are devoted to the detection and identification of pests belonging to different systematic groups. Among them, nine DPs on insects and mites, five on bacteria, five on fungi, five on nematodes, four on viruses and viroids, and two on invasive plants. The diagnosis of different groups of pests requires different methods and therefore different equipment. For example, microscopy is mainly used to identify insects and plants. To diagnose microorganisms (fungi, bacteria, viruses, etc.) modern molecular and serological techniques are required.

The results of the responses to the question about the relevance of pests and, respectively, DPs for CPs are presented in Figure 4 and Annex 2. The figures show the number of survey participants' responses for each of the DPs.

The data obtained in the survey reflects the range of the DP's usage. The highest interest from countries relates to *Bursaphelenchus xylophilus* and *Xylella fastidiosa* (16 out of 27 CPs indicated that these pests are relevant to them, and DPs on these pests are used). *Thrips palmi*, *Trogoderma granarium* and phytoplasmas are noted in the same category by 15 CPs. Also, of great interest as relevant and used are DPs on Plum pox virus, *Ditylenchus dipsaci* and *Ditylenchus destructor*, Genus *Liriomyza, Bactrocera dorsalis* (14 indications each) and *Tilletia Indica*, Potato spindle tuber viroid, and *Candidatus* Liberibacter solanacearum (13 indications each).

In the "relevant and used" category, the lowest rated are *Sorghum halepense* (four indications), D*endroctonus ponderosae* and *Austropuccinia psidii* (five indications each).

The highest level of interest was for the three protocols – phytoplasmas, *Candidatus Liberibacter solanacearum*, and *Xylella fastidiosa*. Twenty-six out of 27 respondents answered for each of these that they were either relevant and used or relevant but not used. Even if DPs are not currently in use for these, they are important to CPs and could be used in the future.

Regarding the lowest level of interest, 12 CPs marked as not relevant DPs on *Austropuccinia psidii* and 11 CPs marked the same for *Dendroctonus ponderosae* and *Sorghum halepense*.

46.5 percent of DPs are relevant and used by CPs, 42 percent are relevant but not used and only 11.5 percent are not relevant. In general, all countries, independent of the level of phytosanitary diagnostics, expressed the relevance of most of the adopted DPs.

6. Proposals from contracting parties for further development of diagnostic protocols and procedures related to phytosanitary diagnostics

6.1 IPPC CALL FOR TOPICS

Responding to the question of whether the NPPOs were aware that the IPPC has a call for topics to develop new DPs, eight (30 percent) out of 27 respondents answered no, and 19 (70 percent) participants responded yes. This advocates for a further promotion of the Call for topics

6.2. OPPORTUNITIES FOR DEVELOPMENT OF NEW DIAGNOSTIC PROTOCOL TOPICS

One objective of this study was to investigate potential opportunities for the development of new DP topics of interest and to optimize their implementation by CPs. The questionnaire verified these points by asking the CPs to discuss their experiences and share views on a potential list of topics for regulated pests of interest. Suggestions were given on 14 new topics including 50 new pests related to diagnostics. This list of pests included a wide range of harmful organisms covering all pest species.

6.2.1. Opportunities for developing new diagnostic protocols for regulated pests

With the goal of creating a priority list of pests for the development of new DPs, countries were invited to share their experiences and provide proposals.

Among the 24 responses received on this issue, almost all participating countries considered the continued development of new DPs as essential. Depending on the region, NPPOs vary in their needs to diagnose certain groups of harmful organisms. For example, in the northern regions there are pests and diseases of woody forest, ornamental plants, and greenhouses, whereas in southern countries there are pests of various tropical crops. A wide range of harmful organisms related to fungi, bacteria, viruses, viroids, phytoplasmas, nematodes, molluscs, and arthropods were proposed for new DPs. It should be noted that more than 45 percent of respondents indicated pathogenic viruses, viroids and phytoplasmas; those countries that need a strengthening of their diagnostic systems suggested viruses that infect banana, cassava and other tropical crops, which are very important to them.

In total, about 50 new pests and pest groups were proposed for the development of new DPs. A complete list of proposals is presented in Annex 3. The full list includes the names of the pests as they were provided by the participants in their responses without any changes or adjustments.

Several countries share a common interest for ten pests, which were highlighted as important pests of interest. This list can offer the baseline for pest priorities when developing a new list of topics for pests. The dedicated pest list is presented in Table 1.

Some respondents suggested a further improvement of DPs for some harmful organisms for which DPs have already been developed: *Xylella fastidiosa*, Thrips palmi, Plum pox virus, *Bursaphelenchus xylophilus*, Citrus Tristeza Virus.

Banana bunchy top virus, *Ralstonia solanacearum* race 2 (pathogen of banana), Cassava brown streak virus, and Lethal yellowing of coconuts palms are pests that have a significant damaging impact on very important crops in areas where they are prevalent. The significance of these crops is that they are economically important for local livelihoods and global trade. The survey data shows that these countries have some problems with diagnostics and are not all able to undertake diagnostic research and development on their own. Review the infrastructure and build capacity of staff to support diagnostic laboratories in these countries can result in enhancing their capacities for diagnosis.

It is also important to note that many countries are concerned with economically important plant pathogens such as *Fusarium oxysporum f. sp. cubense* tropical race 4, and Tomato brown rugose fruit virus, which are emerging pests today for different regions.

Table 1. A dedicated list of pests proposed by several CPs

No	Proposals for new DPs	Number of indications
1	*Fusarium oxysporum* f. sp. *cubense* R4T	8
2	Tomato brown rugose fruit virus	8
3	*Spodoptera frugiperda*	4
4	Fruit flies	4
5	Banana bunchy top virus	3
6	*Candidatus Liberibacter asiaticus*	3
7	Rose rosette virus	2
8	Lethal yellowing phytoplasma	2
9	*Tuta absoluta*	2
10	*Synchytrium endobioticum*	2

6.2.2. Potential opportunities for dedicated International Standard for Phytosanitary Measures topics supporting the implementation of IPPC diagnostic protocols

About half of those surveyed suggested various topics related to diagnostic problems for the development of special procedures. The diagnostic services of CPs are interesting not only for DP topics, but also for a wide range of other topics related to diagnostic activities. Fourteen countries shared their experiences and provided proposals for improvement. See Annex 4 for a complete list of country proposals.

Proposals can be classified into several groups:

- **Organizational issues** – general requirements for phytosanitary diagnostic laboratories, procedures for waste management in phytosanitary laboratories, development of the list of equipment for conducting all types of phytosanitary analysis, specific procedures for the collection and preservation of samples during shipment, guidelines for the management of plant health collections, capacity building in the field of diagnostics and implementation of standards.
- **Development of detection and identification methods** – pest specific guidelines for visual inspection of consignments with its diagnostic protocol, sampling for specific pests, protocols for the detection of phytopathogenic fungi in seeds, general detection and morphologic identification of weed seeds, soil testing for fungi such as *Verticillium*, seed born testing methodologies for different pests, such as fungi and bacteria.
- **Development and use of molecular diagnostic tools** – high-throughput sequencing (HTS) technologies and bioinformatics analyses, next-generation sequencing (NGS) or deep sequencing, quality assurance for next-generation sequencing, determination of detection thresholds in molecular testing, diagnostic standards for groups of pests. In planning the priority list of pests, the TPDP recognized the usefulness of creating generic diagnostic protocols for a genus if it includes several species of pests.
- **Validation and verification** – method validation and protocol verification, PCR method validation, calculation of measurement uncertainty in semi-qualitative tests, e.g. enzyme-linked immunosorbent assay (ELISA).

With the development of laboratory techniques, NPPOs are expanding their capacity to deal with new pests, including microorganisms. In this situation, the implementation of IPPC DPs raises a wide range of issues related to diagnostics. The main challenges for laboratories are to ensure the quality of analyses and the reliability of results. Proposals presented in Annex 4 reflect what laboratories need to do, in order to comply with current trends and for the successful implementation of the DPs.

7. Languages used by national plant protection organizations

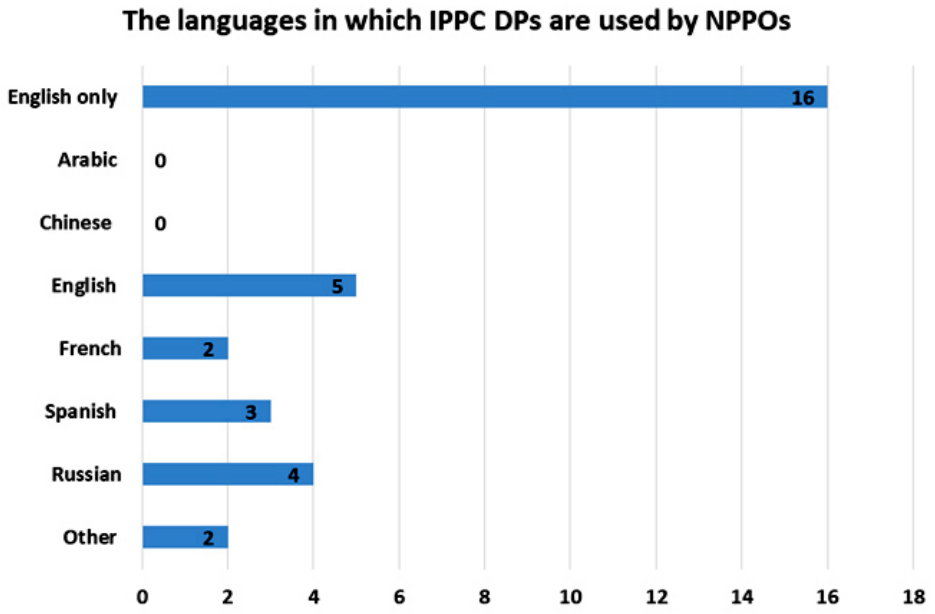
When analysing the question about language versions of DPs used by NPPOs, 25 responses were taken into account because the two remaining NPPOs stated that they do not use IPPC DPs at all. Sixteen respondents answered that they only use versions of DPs in English. This represents 64 percent of the total number of responses.

One NPPO uses a mixture of DPs in French and English, one in Spanish and English, and three in Russian and English, representing almost 20 percent of the total number of responses. In general, English versions of the protocols are used by 84 percent of the survey participants.

Two NPPOs use only Spanish, one only French and one only Russian translations of DPs, representing 16 percent of the total number of responses.

There were no respondents from the countries where the Chinese and Arabic languages are spoken. Two CPs indicated that in addition to English they use versions in Azerbaijani and German. These countries translate the protocols into their respective languages by themselves.

Figure 8. Number of NPPOs using the DPs in the different languages



8. Potential difficulties faced contracting parties to implement IPPC diagnostic protocols

8.1 FACTORS LIMITING THE USE OF IPPC DIAGNOSTIC PROTOCOLS

One of the most frequently mentioned limiting factors for the use of DPs was that most of the adopted DPs are not relevance for the NPPOs, which was noted by 11 out of 27 respondents. Six respondents pointed to outdated DPs as a limiting factor. It is important to note that the CPs who gave these answers represent all FAO regions. This allows us to conclude that it is very important for CPs to adopt DPs.

The existence of the national or regional DPs is considered as a limiting factor by 11 respondents, among them 8 CPs from the European region. All of these countries are EPPO members, and experts from seven of them work in EPPO expert groups on the development of DPs. EPPO has been conducting a programme for the development of DPs for regulated pests since 1998, as of November 2021, 136 DPs have been developed.

At present, there are ten RPPOs covering the different regions of the world. RPPOs produce regional standards for their members. The development of a DP is a complex procedure that requires a lot of technical and expert resources. Not all RPPOs have a DP development programme like EPPO, but some of them, such as the Caribbean Agricultural Health and Food Safety Agency (CAHFSA) and the Southern Cone Regional Plant Health Committee (COSAVE), publish IPPC and EPPO DPs on their websites, or provide links to the IPPC website, which demonstrates their interest in the IPPC DPs.

Very important factors complicating the use of DPs are a lack of technical expertise and unavailability of equipment and consumables. Nine CPs indicated these as limiting factors. One CP noted a lack of financial resources. All of the countries that answered in this way are geographically located in the tropical and subtropical zones, where a wide range of pests can establish.

The unavailability of the relevant language version and outdated DPs were mentioned as a limiting factor. Other limiting factors are:

- lack of an accredited and equipped phytosanitary laboratory and qualified personnel;
- extemporaneous availability of financial resources, no relevant adopted DP for mollusc pests (e.g. African giant snail);
- a revision of an IPPC DP as a rule only leads to adding new protocols but not removing the old ones.

Figure 9 illustrates the proportion of limiting factors for the implementation of DPs, as indicated by the survey participants.

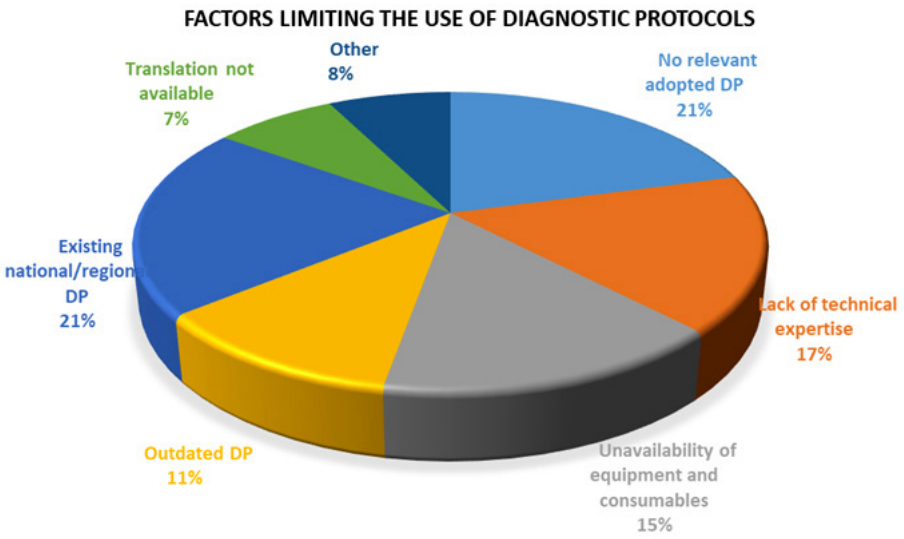
The reasons restricting the use of DPs are important. They can be classified into groups based on different causes, which can be dealt with in different ways. Twenty-one percent of participants indicated a lack of adopted DPs as a limiting factor, implying that new DPs are needed. The same category could also include outdated DPs (11 percent). A lack of availability of translations was indicated by 7 percent of respondents. All of these reasons should be taken into account when considering the further development of IPPC DPs.

Twenty-one percent of participants noted the existing national and regional DPs as a limiting factor for their use. However, this factor could have a positive effect if NPPOs or RPPOs would share their current DPs in order to develop new ones for a wider range of users.

Lack of technical expertise was reported by 17 percent of CPs. Diagnostic activities require permanent training and professional development of staff. This can be realized at local as well as international level through various training programmes.

The unavailability of equipment and consumables is a problem for 15 percent of respondent CPs. To address this, efforts are needed first of all at the national level. Various international programmes could be useful to help strengthen CPs' diagnostic capacities.

Figure 9. Limiting factors regarding the use of DPs



9. Feasibility of language translations

Analysing the data on the use of different language versions of DPs it was found that 84 percent of respondents use DPs in English. Only 16 percent answered that they use other languages and do not use English at all. Moreover, the survey showed that countries use DPs in their native languages. It can be assumed that they translate the necessary documents for their own needs. Most diagnosticians and researchers around the world use English as their working language. It can be concluded that a translation of all DPs developed by the IPPC into all official UN languages is not feasible as it may entail unreasonable and unnecessary costs.

However, in response to a question about the factors limiting the use of DPs, four countries (two Spanish speaking, one French speaking and one Russian speaking) pointed to the item "Translation not available", which indicates that they are in need of translations.

Certainly, there are countries that do not use English and will need help in implementing DPs as well as other phytosanitary procedures. In this case, international projects to strengthen phytosanitary services can be useful, in which the DPs will be translated directly into the native languages. This support should be provided on a case-by-case basis and consider the DPs which are relevant for them.

Other options are possible, such as translating certain documents into the required official language upon the request of interested CPs. This will help to save the resources used for translations. It may be possible to monitor the need for different languages within the work of the TPDP.

Table 2 shows the possible solutions based on the data received from the survey participants. These conclusions can be used in a further comprehensive cost–benefit analysis.

Table 2. Recommendations for further development of the DPs

Activity	Findings from the survey	Recommendations
Development of new DPs	• The percentage of adopted DPs that are relevant to CPs is 88.5 (46.5 percent are relevant and used and 42 percent are relevant and not used but could potentially be used). • NPPOs are interested in developing new DPs. • NPPOs have proposed more than 50 pests for the development of new DPs. • There are proposals from NPPOs to elaborate other procedures relating to diagnostics. • NPPOs lack capacity to develop DPs on their own. • Existing DPs in the regions can be used to develop DPs at the global level.	Continue to develop the DPs in accordance with priorities.
Translation of DPs into official UN languages	• Eighty-four percent of NPPOs use English versions of DPs, 64 percent use them only in English. • English is a working language in the laboratories of many countries. • NPPOs translate DPs into their own language, when necessary. • The percentage of NPPOs not currently using DPs is 53.5. • Fifteen percent of participants consider the lack of translation of DPs as a limiting factor for their application.	The translation of all DPs into all UN languages is not feasible. But in case of discontinuation of DP translations, possibilities should be envisaged to provide NPPOs with translations individually, if necessary, upon request.
Revision of the adopted DPs	• Twenty-two percent of NPPOs indicated outdated DPs as a limiting factor for DP usage. • Responses noted the necessity to revise the DPs, as they need to be kept up to date.	Revise and update the adopted DPs if necessary.

10. Diagnostic laboratories

In accordance with ISPM27: Diagnostic protocols for regulated pests, proper detection and identification of pests are crucial for the appropriate application of phytosanitary measures. The most important condition for IPPC CPs to fulfil their responsibilities is a good level of diagnosis, which is impossible without modern, well-equipped laboratories. Therefore, several questions were devoted to the availability of laboratories, their type and status.

Eighty-one percent of respondents (22) indicated that the NPPO has diagnostic laboratories.

Most laboratories that are part of an NPPO or associated with its work are national public laboratories (17 responses). Only one respondent mentioned a national private laboratory being associated with an NPPO.

Four respondents simultaneously identified laboratories as official and recognized. Seven participants did not indicate the official status of the laboratory. One CP noted that the laboratory operates as an official laboratory, but it is not recognized on a legal basis. Apparently, the various NPPOs have different systems for recognition or authorization of laboratories to engage on their behalf.

Twenty-two survey participants responded to the question about the status of the laboratory, and 12 of them answered that the NPPO has accredited laboratories.

In the section "Other" it was noted by one participant that research institutes are subcontracted by NPPOs for some screening tests.

A similar situation was revealed about the laboratories which are engaged by the NPPO to perform phytosanitary diagnosis. Twenty CPs out of 27 were noted as national public laboratories, and three as national private laboratories. Seven NPPOs were engaged with regional laboratories and five laboratories were in other regions.

Several respondents also noted laboratories of scientific institutes, both within and outside the region.

Figure 10. Types of laboratories that the NPPO has or associates with, in its work

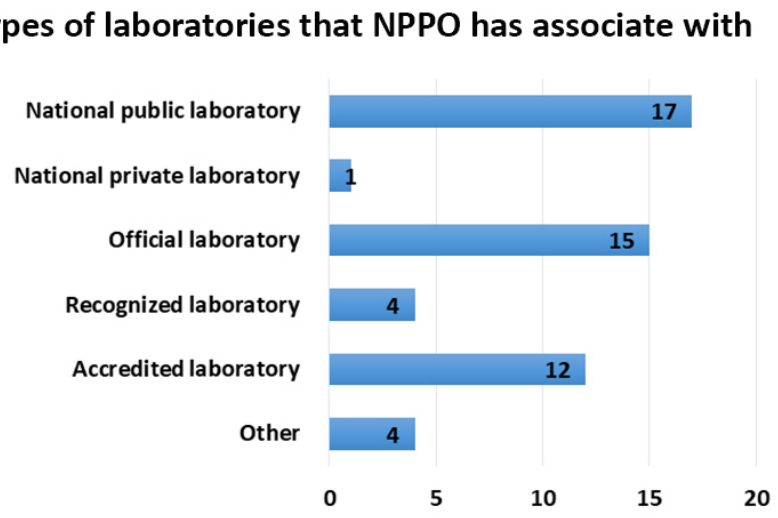
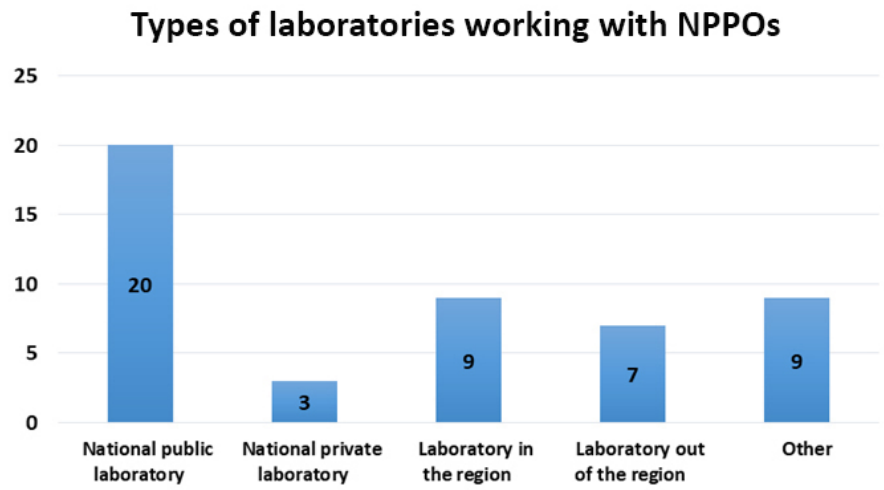


Figure 11. Types of laboratories working with NPPOs to perform phytosanitary diagnosis



In summary, the following points should be noted. NPPOs either have or involve a variety of laboratories to perform phytosanitary diagnostics. Among them are national public and private laboratories, and official, recognized, and accredited laboratories operating both inside and outside the regions.

According to the results of the survey, it was found that, along with complex laboratories that perform diagnostics of various taxonomic groups of pests, there are specialized laboratories working in the field of forestry, entomology, bacteriology, mycology, virology, nematology and plants.

Two respondents noted that NPPOs involve laboratories of scientific institutes and universities in their work to conduct phytosanitary diagnostics.

A number of NPPOs, in addition to central laboratories, have a network of regional laboratories, as well as laboratories in airports, seaports, etc., which are coordinated by the NPPO and provide diagnostic capabilities for the country.

Annex 5 provides a list of the laboratories performing phytosanitary diagnostics in the countries that participated in the survey.

However, there are countries with limited capacity in phytosanitary diagnostics that need support to be able to implement and use IPPC DPs. This conclusion is based on the fact that two respondents answered that they do not use DPs, two more indicated "none" in the list of laboratories that can perform phytosanitary diagnostics and five out of 27 respondents answered that their NPPOs do not have diagnostic laboratories. Nine CPs indicated as limiting factors for the use of IPPC DPs the lack of technical expertise, and unavailability of equipment and consumables, and one CP noted a lack of financial resources.

11. Conclusion

1. Countries vary in their capacities, including the use of modern technology to develop diagnostics, so it is impossible to apply a uniform approach in providing different kinds of assistance. The global tendency towards accreditation is very important for many countries because it ultimately contributes to trade development. In the context of globalization, where trade has significantly increased in recent years, many countries, even those with access to advanced technology, are unable to respond quickly to new pest threats. Furthermore, not all countries have the capacity to conduct scientific research on plant quarantine. Therefore, the availability of globally developed and published DPs taking into account the different capabilities of CPs from different FAO regions enables a rapid response to the need to provide diagnosis of unknown or rarely found pests, including microorganisms (viruses, viroids, phytoplasmas, bacteria), allows to validate new methods developed in laboratories around the world, and is a reliable source of information about reference materials, sequences, alternative diagnostic methods, etc. The laboratories can confidently use such DPs for their objectives and harmonize their activities with other countries in order to obtain comparable results. Adopted IPPC DPs are a kind of reference point in the world of phytosanitary diagnostics and are very important for CPs, which is confirmed by the results of the survey.
2. Only 27 out of 184 CPs participated in the IRSS survey on the use of IPPC DPs. This was due to several reasons such as the survey only being released in English which limited the opportunity for non-English speaking participants to respond or share their story. Also, the survey was conducted at the end of the year, and this had a significant impact on participation. It also must be taken into account that the questionnaire was sent only to CPs and didn't include RPPOs. Nevertheless, the provided information reflects the diverse positions of the CPs that utilize diagnostics, which makes it possible to assess the overall situation and draw some conclusions regarding the further development of DPs. All countries, even those that do not use DPs today, have expressed their interest in the using IPPC DPs in the future.
3. Most CP participants of the survey use the IPPC DPs in their daily work. The IPPC DPs are used in all circumstances: first time detection of a pest, routine diagnosis, surveillance purposes, export certification, pest declarations, import interceptions, etc. DPs are used by diagnosticians, researchers, and other NPPO staff.
4. Almost all of the laboratories associated or engaged in plant quarantine diagnostics operated by the NPPO are national public laboratories. Many of them are official and accredited. Three CPs have designated national private laboratories. Two CPs invite laboratories from research institutes as subcontractors. The survey showed that a wide range of various laboratories are used to carry out phytosanitary diagnoses in different countries. It is therefore important to harmonize their performance in the detection and identification of pests.
5. The survey demonstrated that CPs use IPPC DPs in their work. While 46.5 percent of the DPs are relevant and in use by CPs, 42 percent are relevant but not used and only 11.5 percent are not relevant. A total of two categories of DPs (relevant but not used, and relevant and used) account for 88.5 percent of the total number of responses. Those DPs that are relevant but not currently in use have the potential to be used by those countries in the future.
6. All 27 respondents indicated limiting factors in the implementation of the DPs. Among them, the most important are the lack of technical expertise and unavailability of equipment and consumables, the unavailability of the relevant language version and outdated DPs.
7. Regarding the different language versions of the IPPC DPs, 16 out of 25 CPs (two CPs do not use IPPC DPs) responded that they only use the English version, which accounts for 84 percent of the total number of responses, among them 64 percent use English only and 20 percent use English along with Spanish, French and Russian. Two CPs

use only Spanish, one only French and one only Russian translations of DPs, which accounts for 16 percent of the total number of responses. There is no information on the use of Chinese and Arabic language versions, because participants from countries where these languages are spoken did not participate in the survey.

8. Analysis of the survey data leads to the conclusion that the development of new DPs needs to continue, and that a revision of the DPs should also be undertaken.
9. Regarding the translation of DPs into official UN languages, the decision can be deemed complicated. Based on the survey results it is clear that a translation of all IPPC DPs into all official UN languages is not feasible as it entails unreasonable costs because 88.5 percent of NPPOs responded that their diagnostic services staff use English in their work. However, 7 percent of respondents indicated that the lack of DP translations is a limiting factor for their use. To summarize, it can be concluded that the translation of all DPs into all UN languages is not feasible. Nevertheless, possibilities should be envisaged to provide NPPOs with translations individually, if necessary, on request.
10. Thirty percent of responding CPs were unaware that the IPPC has a call for topics to develop new DPs.
11. The responses generally show a great deal of interest in the further development of DPs. CPs have proposed about 50 harmful organisms for the development of new DPs.
12. The modern development of laboratory techniques and methodologies determines the trend towards progress in the microbiological disciplines (virology, bacteriology, mycology) and raises a wide range of issues related to diagnosis, such as evaluation of method criteria, validation and verification of methods, use of sequencing for routine analyses, multilaboratory testing, etc. Therefore, many laboratories are interested in developing appropriate procedures, as demonstrated by the answers received.
13. The survey showed differences in terminology across countries, e.g. when describing the status of laboratories, in the names of methods and pests.
14. Diagnostic protocols are popular in use within different varieties of expertise. This mainly includes technicians and professional researchers working in the field of plant health.

12. Recommendations on diagnostic protocols

In line with the IPPC provisions and understanding the current trends in diagnostic development, the diagnostic capacity of NPPOs should be further strengthened. The improvement of IPPC use of DPs is one of the most important parts of this strengthening.

General recommendations on the results of the survey are:

1. The development of new DPs is highly recommended in accordance with the priorities identified with the involvement of the CPs. This is in addition to mutually agreed revisions on a regular basis.
2. Undertake an assessment of the relevance of the adopted DPs and review them on an ongoing basis to enhance and maximize the utilization of DPs since this procedure can secure the regular updates and enhance the quality of the produced IPPC DPs.
3. According to the needs of the laboratories consider the extension of the scope of the development of documented procedures related to laboratory activities.
4. The relevance of DPs for NPPOs is highly influenced by the level of phytosanitary diagnostics and protocol utilization. For instance, 50 percent of CPs frequently utilize DPs related to Bursaphelenchus xylophilus and *Xylella fastidiosa*, *Thrips palmi*, and *Trogoderma granarium*. Because of the economic importance of these pests, frequent revision and technique updates should be considered on a regular basis.
5. The use of regional DPs is inversely proportional to the use of published IPPC DPs. The majority of European Union countries which participated in this survey, prioritize the utilization of the published EPPO protocols. As a result, harmonization in diagnostic methodologies between both protocol types is recommended when developing new DPs or improving existing ones. This could contribute to the increase of NPPO compliance and enhance the proper implementation of the convention, its standards and CPM recommendations.
6. The determination of specific procedures for NPPOs, to share their developed national DPs and other documented procedures is crucial for harmonizing the utilization of DPs within countries. This can reflect the transparency between NPPOs.
7. Based on the survey data, the difference in terminology in phytosanitary diagnostics and related disciplines should be considered when describing the status of laboratories, and in the naming of methods and pests. The secretariat should raise awareness of these issues while encouraging CPs to submit DPs during the call for topics.
8. Considering the greater part of NPPOs using the published English versions of IPPC DPs, a review programme for translating DPs into official UN languages should be considered, since other translations are not in high demand by countries. DP translations are much more feasible when requested by individual CPs. But this conclusion does not take into account the requirements of Chinese and Arabic speaking countries which were not represented in this study.
9. It's necessary to take into account the need to further strengthen training in diagnostics, exchange reference materials, extend proficiency-testing programmes, and make them more accessible. This can enhance the capacity building of supporting diagnostic laboratories in countries where their infrastructure needs improvement for diagnosis.
10. Assisting CPs through international projects, is needed for strengthening diagnostic services.
11. It's important to seize the opportunity that NPPOs are considering the diagnostics as a priority to enhance the diagnostic capacity of their laboratories, their equipment, provision of consumables, and training for laboratory staff, including language training.
12. An exclusive list of pests (see Table 1) can offer the baseline for pest priorities when developing a new list of topics for regulated pests.
13. Producing topics related to phytosanitary diagnostics, such as validation and verification of methods, implementation of new molecular techniques, management of reference collections, and waste management, would be helpful and is recommended to be taken into consideration by TPDPs. This would broaden the scope of their activities.

13. General recommendations on International Plant Protection Convention surveys

One positive outcome from this study is the ability to share some key lessons to support the improvement of the overall communications:

1. Maximizing the range of invitations to include RPPOs along with CPs and stakeholders will give the opportunity to identify more gaps and share more experiences to guide the improvement of the list of DP topics.
2. Reviewing the length of time allocated for survey responses and timing of reminder notices is recommended when initiating studies. This is to maximize the number of respondents and to achieve a higher representation of countries.
3. Adding a variety of questionnaire platforms, besides Microsoft® platform is recommended to be considered. This is because some countries may not be familiar with it, or it may not be the standard utilized tool for some countries.
4. Diversifying questionnaire means and considering mail delivery distribution to IPPC points of contact alongside electronic means, can support the situation in many countries, as a range of countries may encounter problems with internet connections, or their infrastructure might not be well developed.
5. No Arabic or Chinese language speaking countries responded to the survey. The availability of IPPC surveys in the six UN languages is highly recommended to increase the number of respondents.

14. References

FAO. 2016. Recommendation on: The importance on pest diagnosis. In *IPPC*. Rome, Italy. Cited 6 July 2022. www.ippc.int/static/media/files/publication/en/2017/04/R_07_En_2017-04-26_Combined_UdBd23X.pdf

IPPC. 2022. Adopted Standards (ISPMs). In *IPPC*. Rome, Italy. Cited 8 July 2022. www.ippc.int/en/core-activities/standards-setting/ispms

IPPC. 2022. List of Countries. In *IPPC*. Rome, Italy. Cited 8 July 2022. www.ippc.int/en/countries/all/list-countries

IPPC. 2022. Technical Panel on Diagnostic Protocols (TPDP). In *IPPC*. Rome, Italy. Cited 8 July 2022. www.ippc.int/en/core-activities/standards-setting/expert-drafting-groups/technical-panels/technical-panel-diagnostic-protocols

ISPM 27. 2006. *Diagnostic protocols for regulated pests*. Rome, IPPC Secretariat, FAO.

Annex 1

Questionnaire

IRSS survey on the use of IPPC Diagnostic Protocols

No.	Question	Answer
1	Are the IPPC Diagnostic Protocols (DPs) of ISPM 27 used in the work of your NPPO?	Yes No
2	For which purposes are the IPPC Diagnostic Protocols used in your NPPO?	(select all that applies) • First time detection of a pest • Routine diagnosis • Surveillance purposes • Export certification • Pest declarations (e.g. pest status) • Others – please specify
3	Which factors limit the use of the IPPC Diagnostic Protocols in your NPPOs work?	• No relevant adopted DP • Lack of technical expertise • Unavailability of equipment and consumables • Outdated DP • Existing national/regional DP • Translation not available • Other - please specify
4	Do you use IPPC Diagnostic Protocols in languages other than English?	• No, in English only
5	If yes, in which language are IPPC Diagnostic Protocols used in your NPPO?	• Arabic • Chinese • English • French • Spanish • Russian • Other - please specify
6	Who uses the IPPC Diagnostic Protocols?	• Diagnosticians, • Researchers, • Others - please specify
7	Do you know that the IPPC has a Call for topics in which proposals to develop DPs can be put forward?	Yes No
8	Please list a maximum of 5 pests for which the development of IPPC Diagnostic Protocols would be useful for your NPPO.	1. 2. 3. 4. 5.
9	Is there any other topic related to diagnosis in which an ISPM could be useful to help with the implementation of IPPC DPs?	Yes No
10	Please provide the topic and the reason.	1. 2. ...
11	Is the Diagnostic Protocol relevant for your country?	Complete list including the 30 adopted DPs by November 2021 (Annex 2).
12	If yes, is the Diagnostic Protocol used?	

(Cont.)

No.	Question	Answer
13	When it is relevant, how often do you use the Diagnostic protocol on average?	• Once a year • Twice a year • Three times a year • More than three times a year
14	Does your NPPO has have a laboratory for pest diagnosis?	Yes No
15	If any, what type of laboratory does your NPPO has or associate within your work?	(select all that apply) • National public laboratory • National Private laboratory • Official Laboratory • Recognized Laboratory • Accredited Laboratory • Other – please specify
16	What type of laboratory do you call upon to carry out the phytosanitary diagnostics?	(select all that apply) • National public laboratory • National Private laboratory • Laboratory in the region • Laboratory out of the region • Other – please specify
17	Please list the main laboratories at the national level that can conduct phytosanitary diagnostics.	
18	Please insert your name, surname, country and position in your NPPO.	

Annex 2

Relevance of the adopted diagnostic protocols for contracting parties

DP number (related to ISPM 27 Annexes)	DP name	Relevant but is not used	Relevant and used	Not relevant
DP 01 (2010)	*Thrips palmi* Karny	9	15	3
DP 02 (2018)	Plum pox virus	8	14	5
DP 03 (2012)	*Trogoderma granarium* Everts	8	15	4
DP 04 (2014)	*Tilletia Indica* Mitra	8	13	6
DP 05 (2014)	*Phyllosticta citricarpa* (McAlpine) Aa on fruit	9	11	7
DP 06 (2014)	*Xanthomonas citri* subsp. *citri*	13	8	6
DP 07 (2016)	*Potato spindle tuber viroid*	10	13	4
DP 08 (2015)	*Ditylenchus dipsaci and Ditylenchus destructor*	9	14	4
DP 09 (2015)	Genus *Anastrepha Schiner*	12	8	7
DP 10 (2016)	*Bursaphelenchus xylophilus*	7	16	4
DP 11 (2016)	*Xiphinema americanum sensu lato*	10	9	8
DP 12 (2016)	Phytoplasmas	11	15	1
DP 13 (2016)	*Erwinia amylovora*	10	12	5
DP 14 (2016)	*Xanthomonas fragariae*	10	11	6
DP 15 (2016)	*Citrus tristeza virus*	12	10	5
DP 16 (2016)	Genus *Liriomyza*	9	14	4
DP 17 (2016)	*Aphelenchoides besseyi*, *A. fragariae* and *A. ritzemabosi*	9	11	7
DP 18 (2017)	*Anguina* spp.	10	9	8
DP 19 (2017)	*Sorghum halepense*	12	4	11
DP 20 (2017)	*Dendroctonus ponderosae*	11	5	11
DP 21 (2017)	'*Candidatus* Liberibacter *solanacearum*'	13	13	1
DP 22 (2017)	*Fusarium circinatum*	10	11	6
DP 23 (2017)	*Phytophthora ramorum*	11	12	4
DP 24 (2017)	Tomato *spotted wilt virus*, Impatiens *necrotic spot virus* and Watermelon *silver mottle virus*	12	11	4
DP 25 (2018)	*Xylella fastidiosa*	10	16	1
DP 26 (2018)	*Austropuccinia psidii*	10	5	12
DP 27 (2018)	*Ips* spp.	11	8	8
DP 28 (2018)	*Conotrachelus nenuphar*			
DP 29 (2019)	*Bactrocera dorsalis*	11	14	2
DP 30 (2021)	*Striga* spp.	11	8	8
	Total	**42.0%**	**46.5%**	**11.5%**

Note: The figures in the table show the number of survey participants' responses for each of the three categories of DPs. The final line indicates the total percentage of relevance (irrelevance) of DPs.

Annex 3

Proposals of CPs for the development new DPs for regulated pests

No.	Proposals for new DPs	Comments from CPs where exist
1	Lethal yellowing phytoplasma; *Fusarium oxysporum/commune*	Many strains within the *F. oxysporum* complex are pathogenic to plants, especially in agriculture.
2	*Fusarium oxysporum f. sp. cubense* R4T Candidatus Liberibacter asiaticus Banana bunchy top virus Frog skin disease in cassava *Ralstonia solanacearum*	No comment(s) were received
4	*Xanthomonas citri susp.citri* Plum pox virus *Thrips palmi* Potato spindle tuber viroid *Xylella fastidiosa*	No comment(s) were received
5	Autumn legionnaires' caterpillar Fruit fly *Palmi thrips*	No comment(s) were received
6	*Spodoptera frugiperda* *Tuta absoluta* Pest responsible for cassava root rot Fusarium R4 *Phytophtora sp.*	No comment(s) were received
7	*Atropellis* *Mycodiella laricis-leptolepidis* *Anisogramma anomala*	No comment(s) were received
8	*Tuta absoluta* *Fusarium* wilt TR4 *Raoiella indica* (red palm mite) *Xanthomonas citri* Lethal yellowing of coconuts/palms	No comment(s) were received
9	*Xylella fastidiosa* *Phyllosticta citricarpa* Tomato Brown Rugose fruit virus Citrus Tristeza Virus	Real-time PCR test needs to be developed, including identification Citrus Tristeza Virus strains.
10	*Bactrocera invadens* *Spodoptera frugiperda* African Cassava Mosaic Virus *Phytophtora palmivora* *Fusarium oxysporium* cubense du bananier	No comment(s) were received
11	Autumn legionnaires' caterpillar Cassava brown streak virus Mealy mealybug from the papaya tree Banana Bunchy top virus	No comment(s) were received
12	*Ralstonia syzygii*	No comment(s) were received
13	*Radopholus similis* *Rhodococcus fascians* *Scolytidae* spp. (non-European) *Phytophthora pluvialis* Tomato mottle mosaic virus	No comment(s) were received

(Cont.)

No.	Proposals for new DPs	Comments from CPs where exist
14	*Fusarium oxysporum f. sp. cubense* (Foc R4T) *Acathina fulica* *Colletotrichum kahawe* *Candidatus* Liberibacter Asiaticus Tomato Brown Rugose Fruit Virus (ToBRFV)	No comment(s) were received
15	*Pectinophora gossypiella* *Cercospora kikuchii* Arabis mosaic virus *Rathayibacter tritici* *Bursaphelenchus xylophilus*	No comment(s) were received
16	Tomato Brown Rugose Virus *Synchytrium endobioticum* Rose rosette virus	No comment(s) were received
17	Tomato brown rugose fruit virus (ToBRFV) Rose rosette virus	No comment(s) were received
18	*Dickeya solani* *Drosophilia suzukii* Fall Armyworm (*Spodoptera frugiperda*) *Heterobasidion annosum*	No comment(s) were received
19	*Synchitrium endobioticum* Tomato leaf curl New Delhi virus Tomato Brown Rugose virus *Dendrolimus sibiricus/pini* *Agrilus planipennis*	No comment(s) were received
20	Fruit flies *Fusarium oxyporum fsp cubence* Foc TR4 Maize chlorotic mottle virus Tomato brown rugose fruit virus (ToBRFV) *Aphids*	No comment(s) were received
21	Tomato brown rugose fruit virus *Monilinia fructicola* *Colletotrichum acutatum* *Tetranychus evansi* *Grapholita molesta* *Carposina niponensis*	No comment(s) were received
22	*Candidatus* Liberibacter asiaticus (Huanglongbing) Identification of Bunt spores *Phytophthora fragariae* European canker (*Neonectria ditissima*)	NPPO is looking into its priority pests and will be able to provide further input into what DP's would be useful in the future.
23	*Fusarium oxysporum f. sp. cubense* raza 4 Tropical Banana bunchy top virus *Ralstonia solanacearum raca 2* (pathogenic in bananas)	No comment(s) were received
24	Tomato brown rugose virus Potato yellow vine virus *Candidatus* Phytoplasma mali (pyri) *Acidovorax citrulli* Tomato ringspot nepovirus Tobaco ringspot nepovirus Cherry rasp leaf virus	No comment(s) were received
25	Tomato brown rugose fruit virus Pepino mosaic virus *Diaporthe vaccinia* *Megaselia scalaris*	No comment(s) were received

Note: Proposals from CPs are included in the list without changes.

Annex 4

Proposals of CPs for additional topics related to diagnostics

No.	Topics related to diagnostics proposed by CPs	Reasons highlights
1.	Method validation and verification.	Guidance on the criteria. Adoption of any diagnostic protocol may require validation and verification for any change implemented i.e. reagents etc. and this is required for accredited laboratories. Currently, there is only the EPPO PM7/98 standard that focus on method validation and verification. An ISPM on this that can be applied to validation and verification would be extremely helpful.
2.	Protocols for biosecurity waste management of plant tissue samples and potentially contaminating laboratory materials.	No highlights
3.	Pest specific guidelines for visual inspection of consignments with its diagnostic protocol.	No highlights
4.	Capacity building in the field of diagnostics and implementation of standards.	Our NPPO does not have in number and qualification of personnel.
5.	Sampling for specific pests.	It is not always easy to find information.
	Diagnostic standard for groups of pests, e.g. high throughput gene sequencing.	We need techniques with multiple targets.
6.	Guidelines for the management of plant health collections.	Work has been carried out for this at EPPO level.
	The development and use of molecular diagnostic tools.	No highlights
7.	Protocols for the detection of phytopathogenic fungi in seeds.	Important for international trade.
	Specific procedures for the collection and preservation of samples during shipment.	Diagnoses depend on the quality of the sample.
8.	Protocol verification.	No highlights
9.	Determination of detection thresholds in molecular testing.	No highlights
	Quality assurance for next-generation sequencing.	No highlights
	Calculating Measurement Uncertainty in semi-qualitative test, e.g. ELISA.	No highlights
	General detection and morphologic identification of weed seeds.	No highlights
10.	Requirements for the use of testing laboratories.	To harmonies the use of testing laboratories by contracting parties, Japan submitted the topic during call for topics this year.
11.	Pest risk analysis	Because diagnostics can provide essential information to clarify, which specific pest risks need to be analysed.
	Surveillance	Because diagnostics provide essential information on organisms collected through specific surveys, in order to provide accurate information on pest status etc.
12.	Soil testing for fungi such as Verticillium;	No highlights
	Seed testing for different fungi and bacteria.	With a focus on export and import functions.
13.	High-throughput sequencing (HTS) technologies and bioinformatic analyses.	As a routine diagnostic tool in the field of plant viruses.
	Next-generation sequencing (NGS) or deep sequencing.	No highlights
14.	Method validation and verification protocol.	No highlights
	General requirements for phytosanitary diagnostic laboratories.	No highlights
	Procedure for waste management in phytosanitary laboratories.	No highlights
	List of equipment for conducting all types of phytosanitary analysis.	No highlights

Note: Proposals from CPs are included in the list without changes.

Annex 5

List of the main laboratories at the national level that can conduct phytosanitary diagnostics[1]

No.	Name of Laboratories
1.	Plant Science and Health Laboratory, National Parks Board, Singapore (NPPO), Singapore
2.	NSAI Regional Laboratories, Venezuela (Bolivarian Republic of) Phytosanitary Laboratories of the country's universities (USB, UCV, LUZ, UCLA, UNELLEZ, UNERG and others), Venezuela (Bolivarian Republic of) Laboratories of Research Centers (INIA, IDEA, IVIC, DANAC), Venezuela (Bolivarian Republic of) Accredited Private Laboratories (SEDICOMVET, BROLAB, LOS LAURELES, and others), Colombia
3.	Benaki Phytopathological Institute, Greece
4.	Laboratory of analysis of Farcha, center of control of foodstuff, Chad
5.	Laboratory of the faculties of agronomic sciences of Yangambi and of the university of Kinshasa, Democratic Republic of Congo Laboratories of the IITA of the country and Benin, Benin Laboratory of Gainesville in Florida, United States of America
6.	The Food and Environment Research Agency (FERA) Fera Science Ltd, United Kingdom of Great Britain and Northern Ireland SASA, Scotland, United Kingdom of Great Britain and Northern Ireland
7.	Paso Canoas Entomological Module (MEPC), Panama
8.	CFIA Charlottetown Lab, Canada CFIA Saskatoon Laboratory, Seed Science & Technology Section, Canada CFIA Sidney Laboratory, Plant Viruses and Virus-like Diseases, Canada CFIA Sidney Laboratory, Molecular Plant Pathogen Research, Canada CFIA Ottawa Plant Laboratory (Fallowfield), Plant Pathology, Canada
9.	Plant Protection Stations, MAFF, Japan
10.	Plant Health and Environment Laboratory, Ministry for Primary Industries, New Zealand
11.	Because diagnostics can provide essential information to clarify, which specific pest risks need to be analysed. Because diagnostics provide essential information on organisms collected through specific surveys, in order to provide accurate information on pest status etc.
12.	NPPO-labs, trb, saz, Government Analysit, University labs., United States of America
13.	The National Reference Centre of the NVWA (The NVWA is the NPPO of the Netherlands), Netherlands Official laboratories of the inspection services Nak, Naktuinbouw and BKD, Netherlands
14.	Azerbaijan Central Phytosanitary Laboratory of the Azerbaijan Food Safety Institute; Khachmaz Regional Testing Laboratory of the Azerbaijan Food Safety Institute;Lenkoran Regional Testing Laboratory of the Azerbaijan Food Safety Institute. Plant clinic of the Azerbaijan State Agrarian University
15.	Australia DAWE Regional Laboratories: Mascot, Sydney Tullamarine, Melbourne Eagle Farm, Brisbane Cairns Airport, Cairns Eaton, Darwin Perth Airport, Perth Adelaide International Airport, Adelaide Post Entry Quarantine, Mickleham.

(Cont.)

[1] Based on information provided by survey respondents.

No.	Name of Laboratories
16.	Laboratories subordinated to NPPO: FGBU All-Russian Plant Quarantine Center, 22 diagnostic laboratories, including branches in the country; Russia Federal Center of grain quality and safety testing laboratories, Russia Reference Centers in the regions, Russia
17.	Belarus Laboratory of Main State Inspectorate for Seed Breeding, Quarantine and Plant Protection, Laboratory of Brest Regional Inspectorate for Seed Breeding, Quarantine and Plant Protection, Laboratory of Vitebsk Regional Inspectorate for Seed Breeding, Quarantine and Plant Protection, Laboratory of Gomel Regional Inspectorate for Seed Breeding, Quarantine and Plant Protection, Laboratory of Grodno Regional Inspectorate for Seed Breeding, Quarantine and Plant Protection, Laboratory of Minsk Regional Inspectorate for Seed Breeding, Quarantine and Plant Protection, Laboratory of Mogilev Regional Inspectorate for Seed Breeding, Quarantine and Plant Protection

IPPC

The International Plant Protection Convention (IPPC) is an international plant health agreement that aims to protect global plant resources and facilitate safe trade. The IPPC vision is that all countries have the capacity to implement harmonized measures to prevent pest introductions and spread, and minimize the impacts of pests on food security, trade, economic growth, and the environment.

Organization

- There are over 180 IPPC contracting parties.
- Each contracting party has a national plant protection organization (NPPO) and an Official IPPC contact point.
- Ten regional plant protection organizations have been established to coordinate NPPOs in various regions of the world.
- IPPC liaises with relevant international organizations to help build regional and national capacities.
- The Secretariat is provided by the Food and Agriculture Organization of the United Nations (FAO)

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