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International
Plant Protection
Convention

Summary for policymakers of the

Scientific review of the impact of climate change on plant pests

**A global challenge to prevent
and mitigate plant pest risks in
agriculture, forestry and ecosystems**





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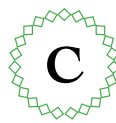
The scientific review was prepared with contributions from selected experts in the FAO Plant Production and Protection Division, the Forestry Division, the Land and Water Division, and the Office of Climate Change, Biodiversity and Environment.

Acronyms and abbreviations

- ◆ **FAO**
Food and Agriculture Organization of the United Nations
- ◆ **IPPC**
International Plant Protection Convention
- ◆ **ISPM**
International Standard for Phytosanitary Measures
- ◆ **IYPH**
International Year of Plant Health
- ◆ **NPPO**
National plant protection organization
- ◆ **PRA**
Pest risk analysis
- ◆ **TR4**
Tropical race 4 of *Fusarium oxysporum*



Foreword

Climate change represents an unprecedented challenge to the world's biosphere and to the global community. It is a threat beyond compare to the planet's biodiversity, to human health and to the world's economy. It also represents a unique challenge for plant health. Climate change will affect ecosystems and agricultural production systems throughout the world. It will influence international trade flows of agricultural products and it will change the infectivity, severity and distribution of pests throughout the world. Climate change will, in particular, present an extraordinary trial to the international plant health community and its ability to react in a scientific, decisive and unified manner to these challenges.

The International Year of Plant Health (IYPH) 2020 has been an effort to raise public and political awareness of plant health, and to help governments and the international community address plant health challenges. One important challenge to plant health that must be addressed is the impact of climate change. To this end, the IYPH International Steering Committee commissioned a scientific review of the topic. To strengthen the review's scientific foundation, the Steering Committee convened a panel of reputable scientists from around the world to write the review, and established a rigorous peer review system to validate its findings. The Scientific review of the impact of climate change on plant pests: A global challenge to prevent and mitigate plant pest risks in agriculture, Forestry and Ecosystems was prepared by lead author Professor Maria Lodovica Gullino (University of Turin, Italy) and a group of ten co-authors representing all FAO regions and with expertise in plant pathology, entomology, herbology, climatology and data analytics. The scientific review was prepared under the auspices of the Secretariat of the International Plant Protection Convention (IPPC).

With this scientific review of the impact of climate change on pests and consequently plant health, the IYPH International Steering Committee hopes to provide the scientific background necessary to inform successful discussions on the assessment and management of climate change impacts in international phytosanitary fora. It is the hope of the IYPH International Steering Committee that the review will be an impetus for the Commission on Phytosanitary Measures of the IPPC to discuss and develop international policies to mitigate climate change impacts on plant health. This scientific review is considered a first step in implementing the IPPC Strategic Framework 2020–2030 Development Agenda item “Assessment and management of climate change impacts on plant health”. It is our sincere hope and expectation that the review will elicit a decisive and unified response by the international community to challenges posed to plant health by climate change.

Yours sincerely,

Ralf Lopian

Chairperson of the International Steering Committee for the IYPH 2020

Introduction

Key messages





The Summary for Policymakers presents key findings of the scientific review, based on an assessment of available scientific literature¹ relevant to evaluating the impact of climate change on plant pests and thus on plant health. It includes key messages of the main results and recommendations.

The Summary for Policymakers highlights selected pests that have already expanded or are projected to expand their host range or distribution at least partly due to climate change. The Summary also highlights the main natural and human-assisted pathways for pest distribution, and proposes prevention, mitigation and adaptation methods to address the effects of climate change on plant pests.

The Summary for Policymakers also provides recommendations on how to address the impact of climate change on plant health.

A plant pest, referred to in this document as a “pest”, is any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products, as per the definition in the International Standard for Phytosanitary Measures (ISPM) 5, as adopted by the Commission on Phytosanitary Measures of the International Plant Protection Convention.



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1. List of references can be found in the full scientific review.

1 Climate change increases pest risks in agricultural ecosystems, especially in cooler Arctic, boreal, temperate and subtropical regions. Some pests have already expanded their host range or distribution due to changes in climate.

2 Increased pest risks may pose a threat to the environment because invasive pests are one of the main drivers of biodiversity loss.

3 Weather is the second most important factor for pest dispersal after international travel and trade. Temperature, humidity, light, wind or any combination of these factors can influence the life cycle (survival, reproduction and dispersal) of pests.

4 Climate change effects on pest species are complex; they may be direct or indirect, and also interact with each other. Possible effects of climate change on pests include the increased risk of pest introduction and changes to their geographical distribution, seasonal phenology and population dynamics. The effects are easier to predict for pest species that are mainly affected by temperature. Prediction is more difficult for pests whose reproduction and dispersal are strongly related to water availability, wind and crop management.

5 Prevention is the most efficient and effective strategy to minimize the impact of a new pest. Climate change considerations should be included in the management of phytosanitary regulatory systems in a country or region.

6 It is already necessary to adjust **plant protection methods** to respond to the impact of climate change. Maintaining ecosystem services under climate change conditions is key to protecting plant health, sustaining the environment and ensuring food security.

7 **Pests do not respect borders.** International cooperation is critical to ensure that all countries can successfully adapt their pest risk management measures to climate change. Increased international cooperation should be encouraged. It is important to examine how increased cooperation can enhance effective pest management and allow for the development of harmonized pest management strategies to mitigate the impact of climate change on plant health.

8 It is important to intensify national, regional and international **surveillance and monitoring activities** for plant health threats. Multilateral surveillance programmes should be enhanced in order to offset phytosanitary threats.

9 **Pest risk analysis activities** need to be intensified at national, regional and international levels, and climate change considerations need to be included in the assessment of pest risks.

10 Policymakers should encourage countries to conduct phytosanitary capacity evaluations with the support of the IPPC Secretariat. This will result in greater national phytosanitary capacity and cost-benefit improvements.

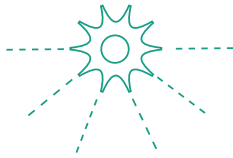
11 To protect plant health worldwide, policymakers should encourage the use of environmentally friendly methods such as integrated pest management, strengthen the phytosanitary capacity of national and regional plant protection organizations to monitor and contain pest outbreaks, and enhance information exchange and coordinated responses among countries. An active, official international information exchange mechanism dedicated to providing data about the occurrence and risk of pests and the development of potential pathways should be established.

12 Multidisciplinary approaches and collaboration are beneficial when assessing and managing the impact of climate change on pests, and consequently on plant health. It is important to enhance knowledge-sharing among, inter alia, plant pathologists, entomologists, meteorologists, weed scientists, agronomists and microbiologists. It would also be beneficial to strengthen overall cooperation among experts working on human, animal and environmental health in different ecosystems and sectors, such as agriculture, forestry and unmanaged ecosystems (e.g. the “Circular Health” or “One Health” approaches).

13 To better inform policymaking with up-to-date scientific data, policymakers should support empirical research on the impact of climate change on pests and, by extension, on plant health. Establishing a global mechanism for research coordination would enhance international efforts to protect agriculture, the environment and trade activities from pests.

Climate change increases pest risks globally





Climate change presents growing challenges to lives and livelihoods globally, and amplifies problems already facing humankind. It can have devastating effects on ecosystems and human society, and also has the potential to exacerbate global risks associated with pests and diseases.

Climate change and human activities have altered ecosystems and created new niches where pests and diseases can thrive. This poses a threat to the environment because pests, which are invasive alien species, are among the main drivers of biodiversity loss.

The severity of climate-related impacts depends on the degree and the pace of climate change, on geographical location, on levels of regional and local development and vulnerability, on adaptive capacities and on mitigation measures. The majority of studies indicate that, in general, pest risk will increase in agricultural ecosystems under climate change scenarios, particularly in today's cooler Arctic, boreal, temperate and subtropical regions. This is largely true for forestry pest risks as well.

There is evidence that climate change is affecting biological systems at multiple scales, from genetic diversity to ecosystems. Anthropogenic climate change has affected 82 percent of 94 core ecological processes recognized by biologists. Global food and fibre production and plant biosecurity, which include all strategies to assess and manage the risks posed by infectious diseases, quarantine pests, invasive alien species, living modified organisms, and biological weapons in natural and managed ecosystems, will also be adversely affected.

The effects of climate change are easier to predict for pest species that are mainly affected by temperature, and more difficult to predict for pests whose reproduction and dispersal are strongly related to water availability, wind and crop management. This is also true for pests that are strongly affected by interactions with other organisms such as vectors.

At a given location, a shift in warming and other climate and atmospheric conditions may result in direct or indirect effects on pests and may include:

- ◆ changes in their geographical distribution, such as range expansion or retreat, or increased risk of pest introduction;
- ◆ changes in seasonal phenology, such as the timing of spring activity or the synchronization of pest life cycle events with their host plants and natural enemies; and
- ◆ changes in aspects of population dynamics, such as overwintering and survival, population growth rates, or the number of generations of polycyclic species.

An outlook on the impact of climate change on selected insect pests

In general, all important life cycle stages of pests – survival, reproduction and dispersal – are more or less directly influenced by temperature, humidity, light quality or quantity, wind or any combination of these factors. Indirect effects are mediated through the host plants or through climate change–driven adaptations to crop management.

Half of all emerging pests are spread by global travel and trade. Weather is the second most important factor. The interaction between travel, trade and weather also has an impact on the spread of diseases. One unusually warm winter may be sufficient for an invasive pest to establish itself in a new area. In fact, increased globalization in recent years, coupled with the increase in global mean temperatures, has created a situation that is extremely favourable to pathogen and pest movement and establishment, with concomitant increases in the risk of severe crop yield losses.

Some pests have already expanded their host range or distribution, at least in part due to changes in climate. Examples of such pests are summarized below.



Emerald ash borer

Emerald ash borer

Agrilus planipennis

What it is: a phloem-feeding beetle that infests ash trees. It is a serious threat to biodiversity because ash trees provide food, shelter and habitat for many species. Considered to be the most destructive and costly invasive forest insect pest.

Invasive range: Asia, Europe, North America

Impact of climate change: modelling demonstrates that climate change may result in a more northerly distribution of the beetle in North America.



Tephritid fruit flies

Tephritid fruit flies

e.g. *Ceratitis capitata* or *Bactrocera* spp. (including *B. dorsalis*)

What it is: a diverse family of insects, with more than 4 000 described species. Most of the species feed on plants, and several species can cause substantial economic damage, especially when their larvae develop in fruits with high market value.

Invasive range: global

Impact of climate change: Tephritids have been able to expand geographically partly because climate change has allowed for their winter survival and reproduction in previously unsuitable habitats. Tephritid species may establish themselves not only in temperate, Mediterranean-climate regions but also in the colder climates of northern Europe.

Red palm weevil

Rhynchophorus ferrugineus

What it is: a beetle, considered to be one of the most economically damaging insect pests of palm trees. Larvae feed within the apical growing point of the tree, causing extensive damage to the plant tissue, weakening the plant's structure and, in many cases, resulting in tree death.

Invasive range: Near East, Africa, Europe

Impact of climate change: the distribution of the red palm weevil may expand as a result of climate change. It is predicted that the number of areas in China highly favourable to this pest will increase with climate change, resulting in a more northerly expansion of the insect's range in China.



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Red palm weevil



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Fall armyworm

Fall armyworm

Spodoptera frugiperda

What it is: a moth with hundreds of host plant species, causing severe damage in grasses – particularly maize and sorghum, which are the main preferred hosts – along with other crops, such as rice, cotton and soybean.

Invasive range: Americas, Africa, Asia

Impact of climate change: fall armyworm is adapted to warm climates, and its geographical distribution is closely dependent on climatic conditions. Fall armyworm has already expanded its range in warmer climates. However, a reduction or even partial disappearance of the species is predicted in South America due to the warmer and drier conditions expected there by the middle or end of this century. Nevertheless, some warm areas in Europe, such as Spain, Italy and Greece, may provide suitable climatic conditions for establishment of the species.

Desert locust

Schistocerca gregaria

What it is: a grasshopper that swarms and feeds voraciously on key crops such as maize and sorghum, on pasturelands and on any green vegetation it may come by, creating significant hardship for smallholder farmers and pastoralists.

Invasive range: Africa, western and southern Asia

Impact of climate change: the behaviour, ecology and physiology of the desert locust changes in response to certain climatic conditions. It can change, over generations – in response to environmental conditions – from a solitary, highly fecund, non-migratory form to a gregarious, migratory phase in which it may travel long distances, finally spreading to new areas. Increases in temperature, rainfall in desert areas and the strong winds associated with tropical cyclones create favourable conditions required for the development, outbreak and survival of the locust. Climate change (changing wind directions and other weather conditions) may have an impact on future migration routes of the desert locust.



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Hopper bands of desert locust infesting a farm in Nakukulas, Turkana County, Kenya

Desert Locust control operations in the Horn of Africa



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An outlook on the impact of climate change on selected plant diseases



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Trained field workers from the Ministry of Agriculture check for further signs of coffee leaf rust in the affected area of Jinotepe, Nicaragua

Coffee leaf rust

Hemileia vastatrix

What it is: a fungus, one of the main factors limiting arabica coffee yields worldwide.

Invasive range: Africa, Asia, Latin America

Impact of climate change: climate appears to play a role in the prevalence of this disease. One of the factors promoting the occurrence of the rust epidemics in Central America was a reduction in the diurnal temperature amplitude, decreasing the disease's latency period. Similarly, the pathogen's incubation period may be shortened by global warming, meaning more generations of the pathogen can develop over a growing season. Consequently, the risk of coffee leaf rust epidemics may increase in the future. Warmer winters can also increase the amount of inoculum, facilitating pathogen infection.



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Banana Fusarium wilt

Fusarium oxysporum TR4

What it is: a soil-borne fungus, causing Fusarium wilt in bananas.

Invasive range: Australia, Mozambique, Colombia, Asia, Near East

Impact of climate change: high temperatures (over 34 °C), and extreme environmental events such as cyclones and tropical storms may increase the risk of banana Fusarium wilt, particularly when 'Cavendish' varieties grown in tropical climates are exposed to waterlogged soil.

Scanning electron micrograph of *Fusarium oxysporum* fungus infecting a banana pseudostem



Olive quick decline syndrome

Bacterial diseases caused by *Xylella fastidiosa*

What it is: a xylem-limited, Gram-negative bacterium that causes diseases in several economically important crops, such as grapevine, citrus, olive, almond, peach and coffee, and in ornamental and forestry plants.

Invasive range: Americas, southern Europe, Near East

Impact of climate change: bioclimatic distribution models have shown that *X. fastidiosa* has the potential to expand beyond its current distribution and may reach more areas in Italy and elsewhere in Europe and the Mediterranean Basin. Although climate change is not predicted to further increase the risk of *X. fastidiosa* across most of the Mediterranean region in the future, the complete “host plant–vector–bacterium” relationship must be taken into consideration when predicting future risk.



Late Blight of Potato caused by *Phytophthora infestans*

Potato late blight

Phytophthora infestans

What it is: an oomycete fungus that causes late blight in potato and tomato.

Invasive range: global

Impact of climate change: the potential displacement of oomycetes polewards as a result of climate change will present a challenge for plant protection, in the northern hemisphere in particular. *P. infestans* has a great capacity to adapt to changing conditions, an important factor in determining the risk of severe epidemics in the future. Wet and warm winter seasons can promote potato late blight epidemics. Favourable conditions in the winter allow a build-up of pathogen inoculum on early cultivars at the start of the growing season, creating a tendency for the blight to appear in later-planted potato crops. As a result, climate change is likely to lead to late blight epidemics in the future.



Plasmopara viticola symptom on grapevine leaf in Bourgogne Franche Comté region (France)

Grape downy mildew

Plasmopara viticola

What it is: an oomycete fungus causing substantial production losses in most grape-growing regions.

Invasive range: all grapevine producing areas

Impact of climate change: increases in air temperature will favour occurrence of the disease. Earlier disease outbreaks requiring more intensive control measure are also projected. Under simulated climate change conditions, the severity of grape downy mildew outbreaks increased.

Climate change facilitates pest dispersal through natural and human mediated pathways

Pest dispersal occurs through both natural and anthropogenic processes. This has been strongly facilitated in recent decades by the globalization of markets for plants and plant products, including food, planting material and wood. International tourism and passenger transport, the internationalization of seed and planting-material markets, and the trade of agricultural products have moved crops, weeds, pathogens and insect pests away from their original native environments to new areas. With climate change, pests may find favourable climate conditions in areas where they could not previously survive, and consequently spread to those areas. Historically, wood, including wood packaging material, has been important in the spread of pests. Conveyances and cargo such as tractors, cars, trucks, railways, ships, aeroplanes, containers, re-sold used agricultural equipment and other vehicles are common instruments for passive pest movement.

There are examples where native and non-native pests have significantly expanded their geographical ranges naturally (i.e. without human intervention). This usually happens in response to major changes in host distribution or climate. Increasing temperatures in particular have facilitated pest range expansion, especially at higher latitudes and altitudes. Additionally, wind and storms can transport pathogen spores over long distances, even across continents.





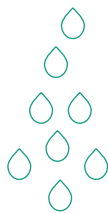
Wood logs extracted from the pine forest



Aerial view of container cargo ship in sea

Prevention, mitigation and adaptation





The most effective way to prevent and limit the international spread of pests from trade and passenger movement is through regulatory means by establishing phytosanitary measures. It is also important to ensure that agricultural best practices are followed to reduce the incidence of pests at the place of origin.

Phytosanitary import legislation is the first line of defence in preventing the international spread of any pest.

The cornerstone of any efficient phytosanitary import regulatory system is the availability of a pest risk analysis (PRA) in a national plant protection organization (NPPO). A PRA provides an NPPO with the rationale for phytosanitary measures to prevent the introduction of a pest, drawing on scientific evidence to determine whether an organism is a pest. It is crucial to have good PRA capabilities and to employ them to assess potential risk scenarios that take climate change into account.

Well-functioning and well-organized surveillance and monitoring activities are important. In the light of a changing climate, official surveying and monitoring services are also needed for early detection of and rapid response to new pest introductions (which themselves can also be caused by changes in climate).

Establishing a reliable, international information exchange network that provides information about pest occurrence and potential pathways to official agencies would permit regulators to base their assessments and mitigation measures on scientifically verifiable data.

Best-available pest management practices include the production of clean seed and planting materials, early warning systems, good diagnostic tools and effective treatments, such as seed dressings, in association with sampling and monitoring. In addition to these practices, also important are the use of resistant cultivars when available, the adoption of cultural practices promoting plant health, integrated pest management systems, the application of rigorous hygiene measures and the use of biological crop protection products. In other words, establishing an integrated pest management system that builds on avoidance, preventive and direct control measures is necessary in agriculture and any other managed ecosystem. These and other preventive and curative plant protection measures will be needed for countries to adapt to new climate scenarios. Innovative plant protection measures, such as nanotechnology, should also be used in the future, when sufficiently effective, environmentally friendly and officially registered for practical use.



© FAO/Giulio Napolitano

Farmers learning Integrated Pest Management (IPM) techniques at a Farmers Field School (Bangladesh)

With very few exceptions, pest risk simulations have not included options that farmers and growers might take to mitigate, or adapt to, increased future pest risks. This is true for agriculture and forestry. In agriculture, there is a range of potential short-term mitigation and adaptation options, and these should be taken into consideration not only by farmers and growers but also when preparing simulation models to inform future decision making.

Improved host plant resistance (competitiveness of crop plants to weeds) and adjustments to pesticide application are considered to be the two most effective ways of adapting crop protection to future climatic conditions.

In forestry and agriculture, climate-smart strategies for pest management may also need to be adopted. In general, integrated pest management includes a wide range of direct and indirect plant health management measures.

In the context of adapting cropping systems to climate change, breeding for disease resistance is one of the most attractive options. Although crop breeding, and especially tree breeding, has a long lag time in response to new challenges, models of climate change effects on pest risk can help to inform strategies in advance of new problems.

In forestry, adaptive responses to potential climate change effects are most likely to involve preventative measures, such as removing infested trees to avoid the further spread of pests, given the difficulties in effectively managing tall, adult trees. Other major preventative adaptation strategies include the use of tree genetic diversity and selecting suitable tree species.

The choice of adaptation strategies will depend on many factors, one of which is cost. To reduce the vulnerability of crop production to climate change, more low-cost adaptation strategies should be explored, such as changing the sowing date or choice of cultivar. The effectiveness of changing planting or harvesting dates, however, is dependent on the potential yield penalty and on the location where the crop is grown, cultivar preferences of farmers and consumers, and the market situation.

More expensive adaptation options may also be needed. If combined with already well established methods such as crop rotation, developing more powerful methods to manage pathogens in crop residues could, for example, reduce saprophytic colonization of crop residues by pathogens and decrease the carry-over of inoculum between cropping seasons.

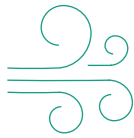
Strategic planning is also important when deciding where to grow perennial agricultural crops such as date palms. Knowing where economically important diseases for perennial crops are likely to occur in the future, low-risk locations could be identified to avoid or minimize the future impact of these diseases. This also applies to forestry, where planning is particularly important to avoid or minimize exposure to increased pest risks in the future.



Nepal is one of the countries hardest hit by the impacts of climate change. Farmers are the worst affected.

Results and recommendations





To conclude, the evidence collected in the preparation of this scientific review points strongly to the fact that, in many cases, climate change will result in increasing plant health problems in managed (e.g. agriculture, horticulture, forestry) and semi-managed (e.g. national parks) ecosystems, and presumably in unmanaged ecosystems as well.

Adjustments in phytosanitary policies and plant protection strategies are already necessary today because of recent climate change effects, and will be even more crucial in the future, should projected climate change scenarios be borne out.

Maintaining managed and unmanaged ecosystem services and produce, including food, under climate change conditions is of paramount importance, and preventive and curative plant protection is one of the key components to maintaining current and future food security.

Recommendations:

- ◆ International cooperation is critical to ensure that all countries can successfully adapt their pest risk management measures to climate change. Increased international cooperation should be encouraged. It is important to examine how increased cooperation can enhance effective pest management and allow for the development of harmonized pest management strategies to mitigate the impact of climate change on plant health.
- ◆ International information exchange on trade flows, pest occurrences and pest interceptions is extremely important to offset the paucity of scientific research on the impact of climate change on plant health. In addition, it is critical to share research findings on changes to the distribution, adaptability and host range of pests. It is necessary to enhance the IPPC reporting system, which combines official reporting by contracting parties with other available and published information.
- ◆ Establishment of a global mechanism for research coordination would enhance international efforts to protect agriculture, the environment and trade activities from pests. There is a need for multidisciplinary collaboration, coordination and knowledge exchange in climate-change biology research to bring together scientists working on different biota within the same ecosystem, for instance plant pathologists and entomologists, and those working on different ecosystems and sectors, such as agriculture, forestry and unmanaged ecosystems (e.g. the “Circular Health” and “One Health” approaches). Comprehensive and multidisciplinary research programmes that cover the needs of industrialized as well as developing countries are required.
- ◆ Research gaps:
 - Much more extensive investigation is required on the direct impact of climate change on the effectiveness of management strategies, particularly for chemical and biological control measures.
 - Most research related to potential climate change effects on pests has disproportionately focused on above-ground pests, despite the importance of below-ground pests on below ground processes and their influence on soil health.
 - Plant diseases have been investigated much more in agriculture systems compared to forestry, and research on pests in unmanaged ecosystems is rare.

- ◆ Regional cooperation needs to be intensified to allow for better regional information exchange and the development of common regional strategies to address climate change impacts to plant health. Support for the capacity enhancement of regional plant protection organizations should, therefore, be considered
- ◆ Investments by national governments, and international assistance, should be directed to strengthening national phytosanitary systems and structures – such as surveillance, pest risk analysis and diagnostic laboratories – to be able to rapidly respond to potentially invasive alien species.
- ◆ Pest risk analysis activities need to be intensified on national, regional and international levels, and climate change considerations need to be included into the assessment of pest risks.
- ◆ National, regional and international surveillance and monitoring activities for plant health threats should be intensified. Multilateral surveillance programmes should be developed to offset phytosanitary threats.
- ◆ National phytosanitary authorities are encouraged to carry out an IPPC-recommended phytosanitary capacity evaluation to determine if their phytosanitary capacities are sufficient to address plant health risks, including those presented by climate change.



Farmers at work during a FAO team visit to Fall Army Worm (FAW) infested maize cultivation in the North Central province of Sri Lanka.



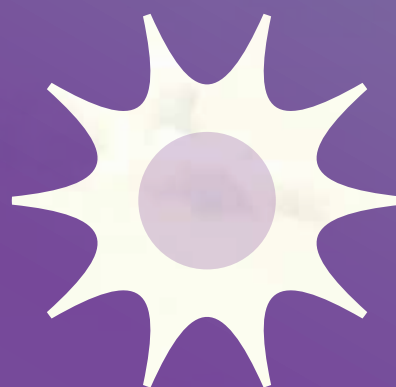
IPPC

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.
- ◆ 10 regional plant protection organizations (RPPOs) have been established to coordinate NPPOs in various regions of the world.
- ◆ The IPPC Secretariat 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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