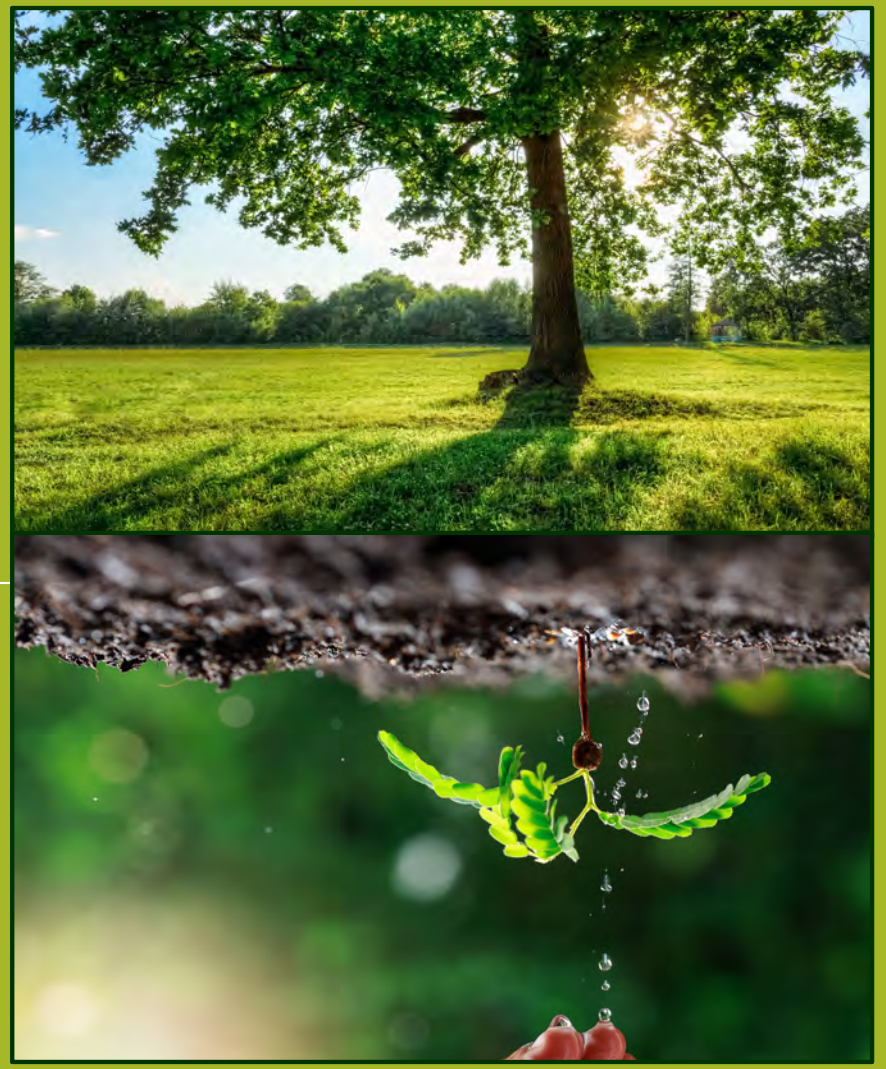
IMPACT OF CLIMATE CHANGE ON PLANT PESTS

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

Maria Lodovica Gullino, Agroinnova - University of Torino

High-Level Launch Event - 2021, June 1st



Authors

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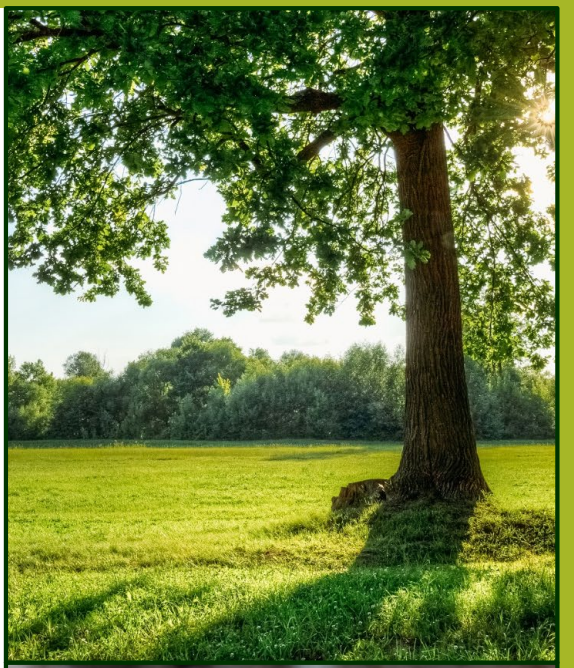
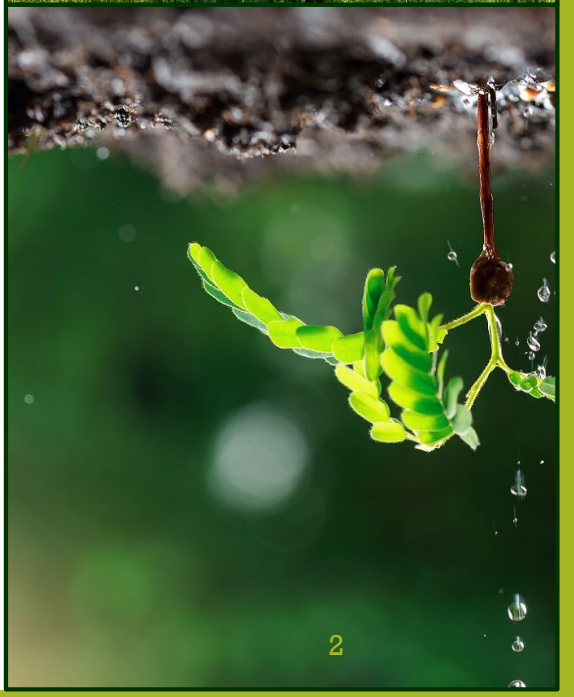
Methodology adopted

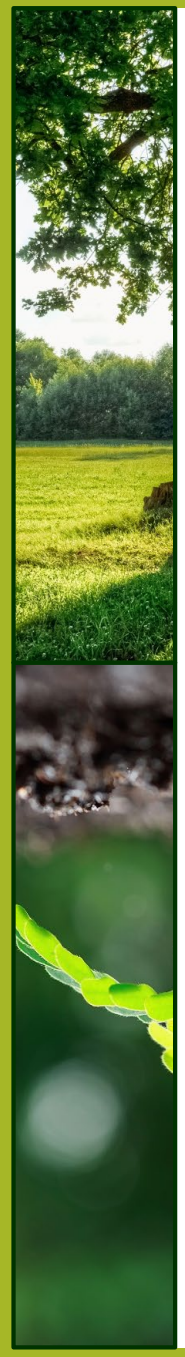
Review of the best available literature.

Broad expertise, covering topics from plant pathology to entomology and climatology.

Participatory process, including a peer-review process.







AIM

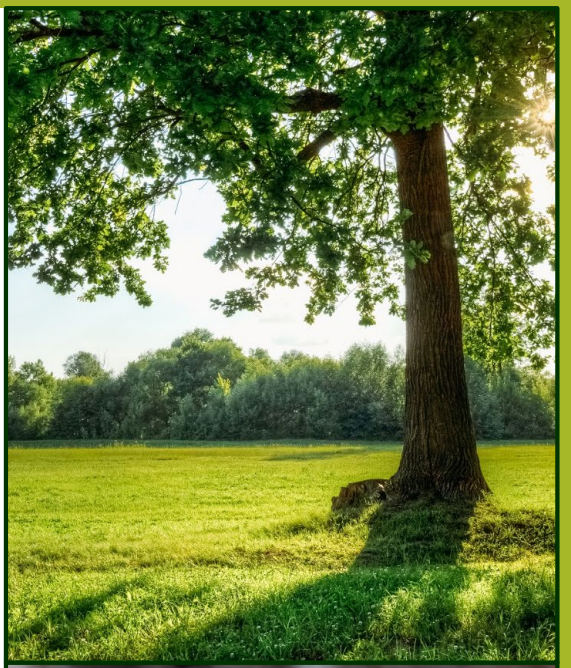
To asses the potential effects of climate change on plant pests and consequently to plant health.

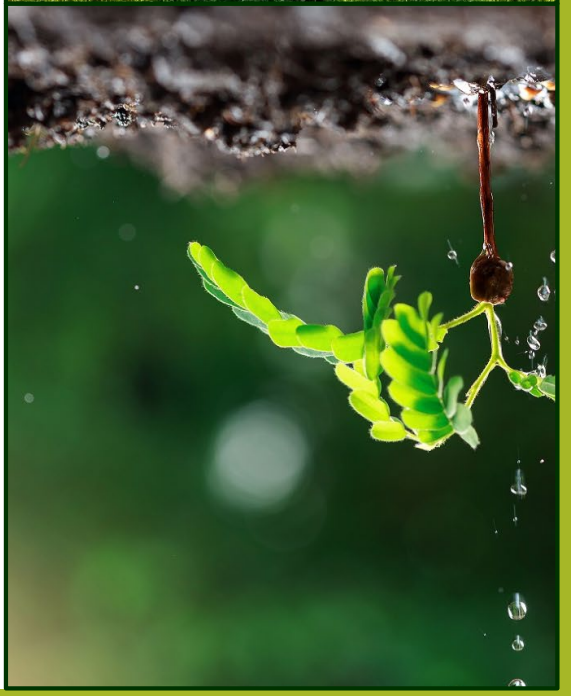
To provide information on:

- what has happened in the last decades;
- what is expected to happen in the next decade;
- what we can do in order to mitigate its impacts, to adapt to changing climates locally, regionally and globally.

Content of the scientific review

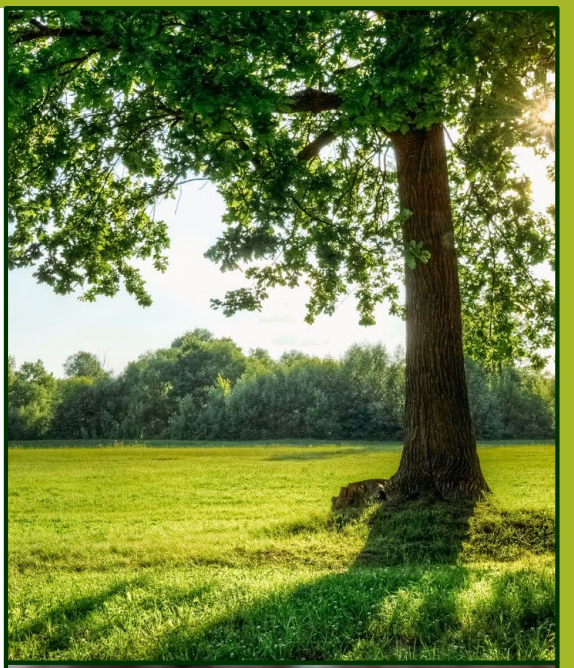
- **Introduction**
  - Effects of climate change on agriculture, forestry and ecosystems
  - Global pests affecting crops, forestry and ecosystems
  - Pathways used by pests
  - Approaches used to investigate the effects of climate change on plant pests
- **Effects of climate change on plant pests**
  - Simulation of future pest risks
  - Effects on individual pest species
- **Prevention, mitigation and adaptation**
  - Preventive measures
  - Recent technological developments
  - Mitigation and adaptation
- **Conclusions and recommendations**
  - Policy making and regulatory issues
  - Research required
  - International cooperation
  - Capacity building

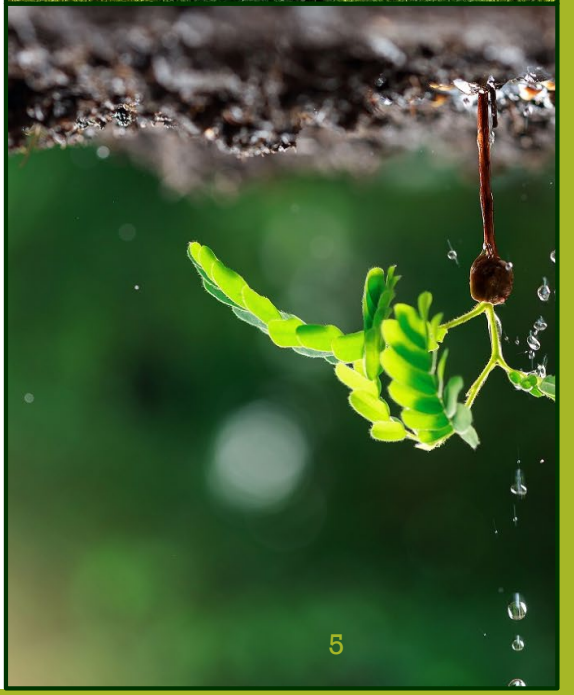




THE PRESENTATION TODAY:

- Definitions
- Case studies
- Results
- Key messages
- Recommendations

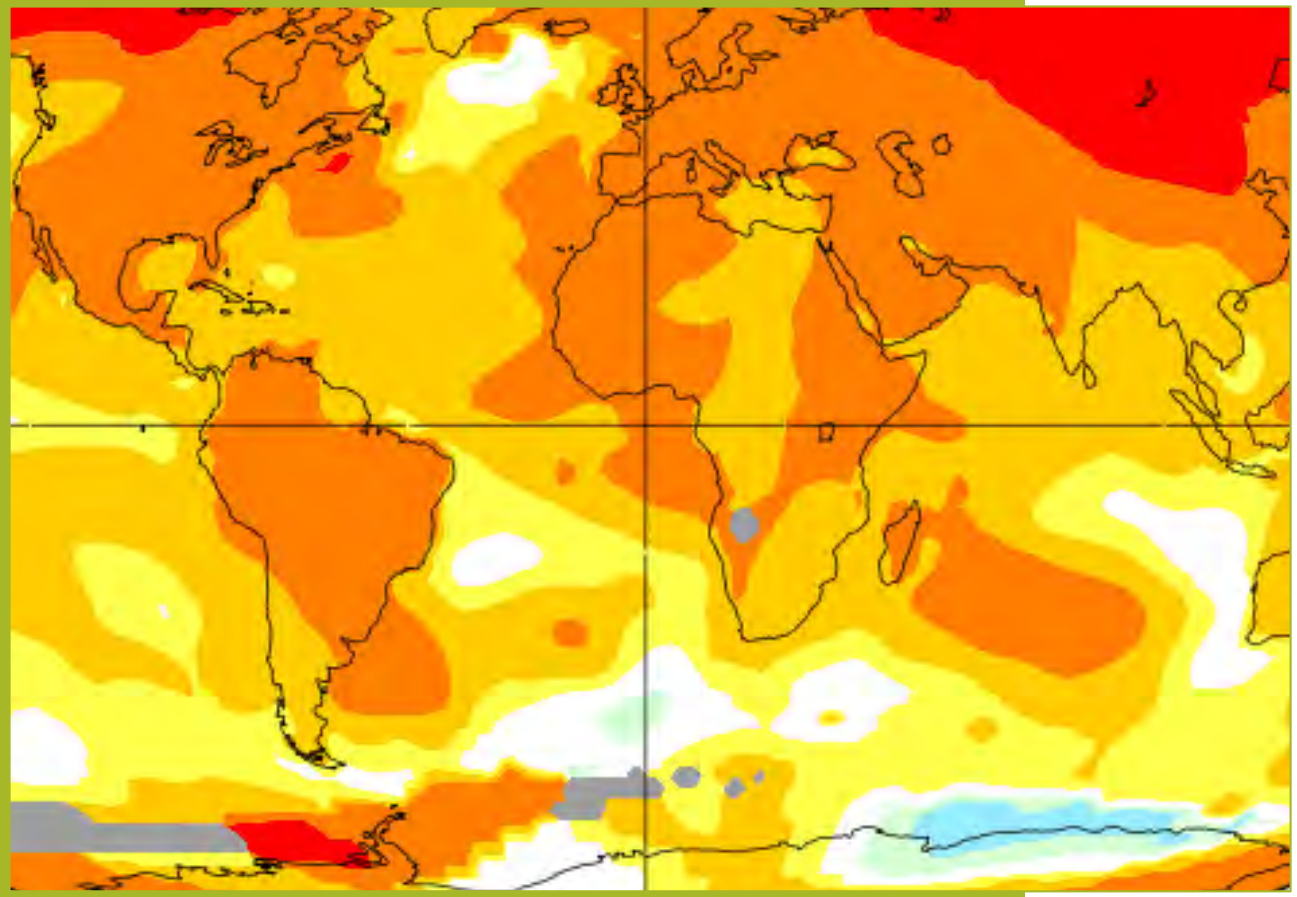




A few definitions:

- climate change
- pest: any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products

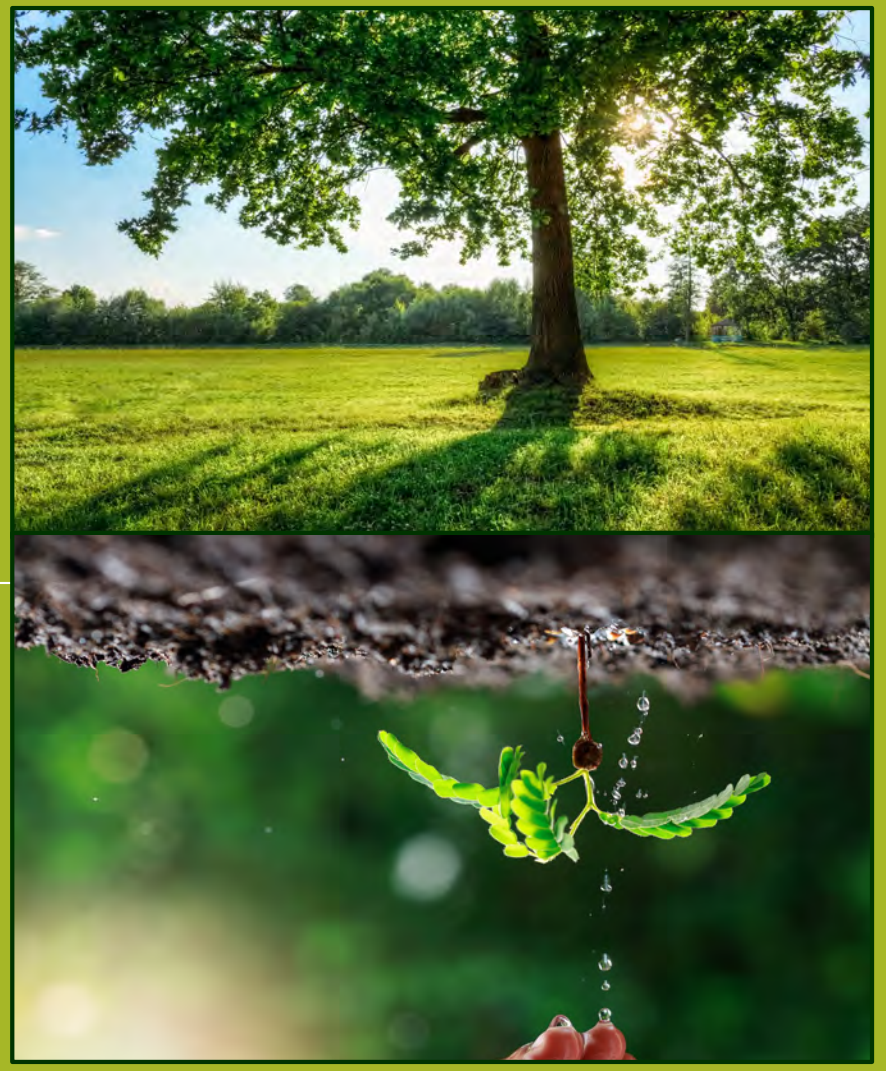
CLIMATE CHANGE INCREASES PEST RISKS GLOBALLY

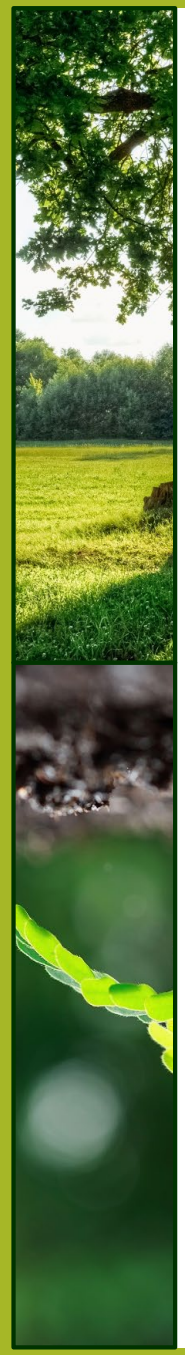


A shift in warming and other climate and atmospheric conditions may result in direct or indirect effects on pests, including:

- changes in their geographical distribution;
- changes in seasonal phenology;
- changes in pest population dynamics.

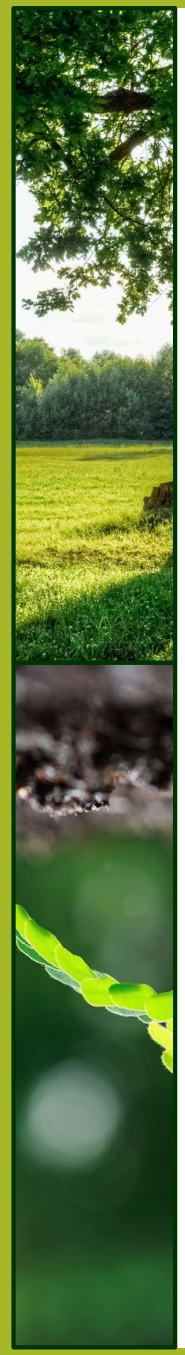
EFFECTS OF CLIMATE CHANGE ON PLANT PESTS





EFFECTS ON INDIVIDUAL PEST SPECIES

In general, all important life-cycle stages of insect pests, pathogens, and weeds (survival, reproduction and dispersal) are more or less **directly** influenced by temperature, relative humidity, light quality or quantity, wind or any combination of these factors. The physiological processes of most pest species are particularly sensitive to temperature.



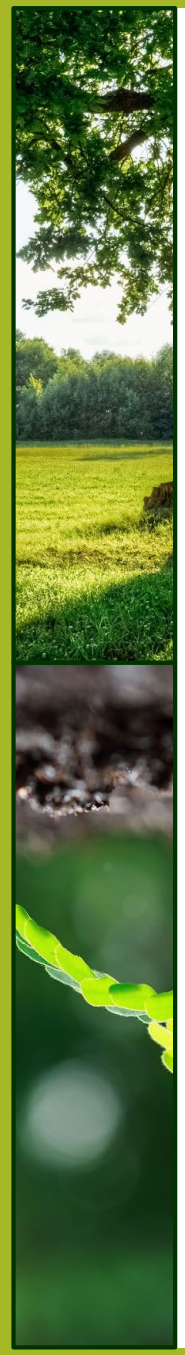
EFFECTS ON INDIVIDUAL PEST SPECIES

Indirect effects are mediated through the host plant or through climate-change driven adaptations to crop management. Under warmer mean air temperatures, especially in early spring under temperate climatic conditions, life-cycle stages in the host plant may occur earlier.

This can affect pathogens that infect the host during a particular life-cycle stage.

Insect pests considered

- Emerald ash borer (*Agrilus planipennis)*
- Tephritid fruit flies (Global)
- Red palm weevil (*Rhynchophorus ferrugineus)*
- Fall armyworm (*Spodoptera frugiperda*)
- Desert locust (*Schistocerca gregaria*)



IMPACT OF CLIMATE CHANGE ON SELECTED INSECT PESTS

Emerald ash borer (*Agrilus planipennis)*

A phloem-feeding beetle that infests ash trees.

A serious threat to biodiversity.

Invasive range: Asia, Europe, North America

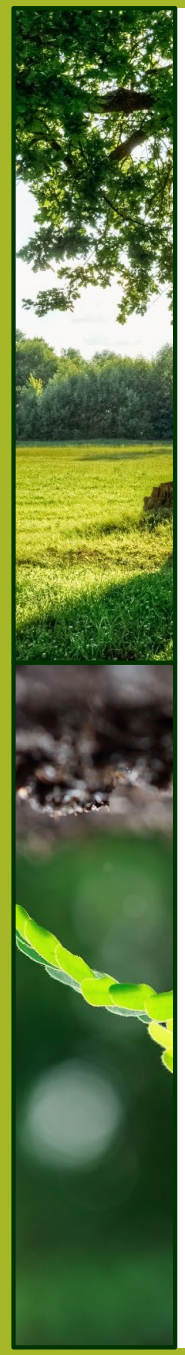
Climate change may result in a more northerly distribution of the beetle in North America.

Tephritid fruit flies (e.g. *Ceratitis capitata* or *Bactrocera* spp.,including *B. dorsalis*)

A diverse family of insects.

Invasive range: global

Climate change has allowed winter survival and reproduction in previously unsuitable habitats.



IMPACT OF CLIMATE CHANGE ON SELECTED INSECT PESTS

Red palm weevil (*Rhynchophorus ferrugineus)*

One of the most economically damaging insect pests of palm trees.

Invasive range: Near East, Africa, Europe

The red palm weevil may expand as a result of climate change.

Fall armyworm (*Spodoptera frugiperda)*

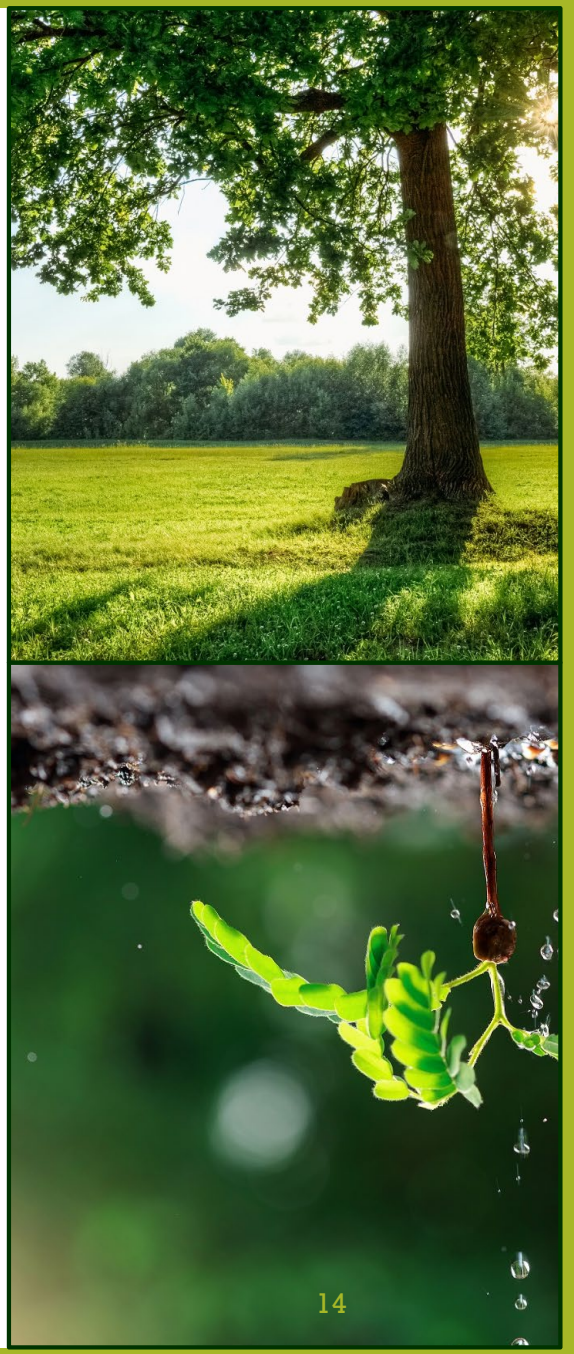
A moth with hundreds of hosts, such as maize, sorghum, rice, cotton and soybean.

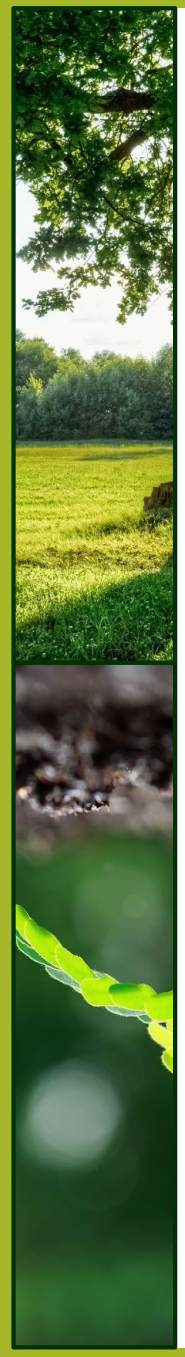
Invasive range: Americas, Africa, Asia

Already expanded its range in warmer climates.

PLANT DISEASES CONSIDERED

- Coffee leaf rust (*Hemileia vastatrix)*
- Banana Fusarium wilt (*Fusarium oxysporum* f.sp. *cubense)*
- *Xylella fastidiosa*
- Oomycetes, including *Phytophthora infestans* and *Plasmopara viticola*
- Fungi producing mycotoxins





IMPACT OF CLIMATE CHANGE ON SELECTED PLANT DISEASES

Coffee rust *(Hemileia vastatrix)*
A fungus, one of the main factors limiting arabica coffee yields worldwide.

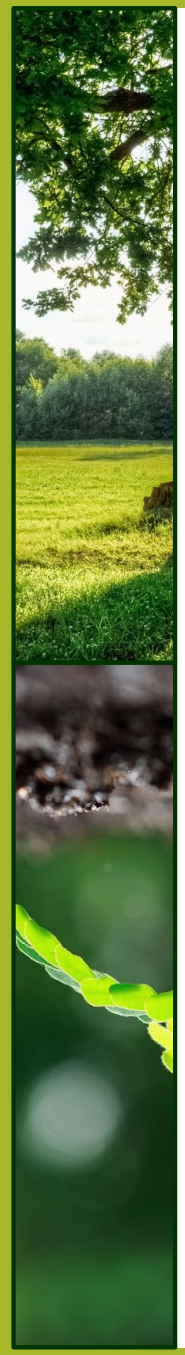
Invasive range: Africa, Asia, Latin America

Its incubation period may be shortened by global warming, meaning more generations of the pathogen can develop over a growing season.

Banana Fusarium wilt (Fusarium oxysporum TR4)
A soil-borne fungus.

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

Temperatures over 34 °C and extreme events may increase the risk of banana Fusarium wilt, particularly when 'Cavendish' varieties grown in tropical climates are exposed to waterlogged soil.



IMPACT OF CLIMATE CHANGE ON SELECTED PLANT DISEASES

Potato late blight (*Phytophthora infestans*)
An oomycete that causes late blight in potato and tomato.

Invasive range: global

Great capacity to adapt to changing conditions. Wet and warm winter seasons can promote potato late blight epidemics.

Bacterial diseases caused by *Xylella fastidiosa*
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

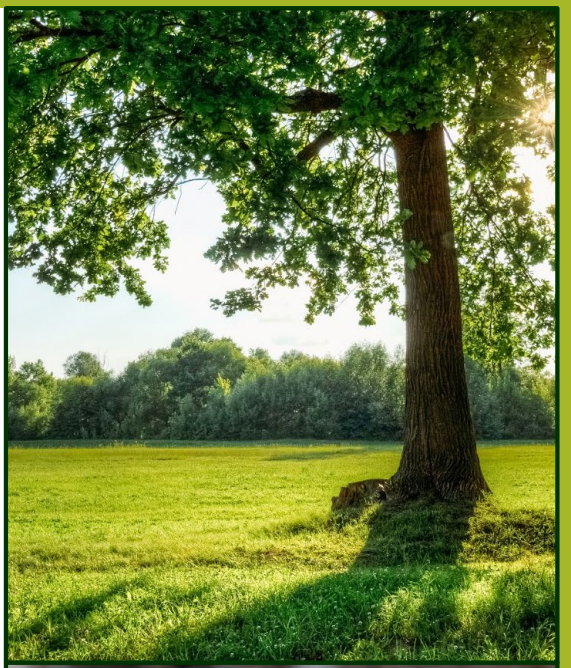
Potential to expand beyond its current distribution.

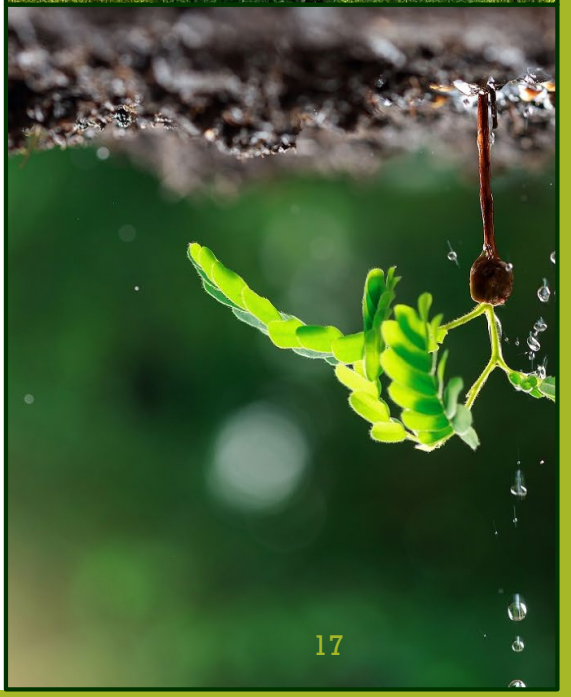
Nematodes

- Citrus lesion nematode (*Pratylenchus coffeae*)
- Soybean cyst nematode (*Heterodera glycines*)
- Pine wilt nematode (*Bursaphelenchus xylophilus*)

Weeds

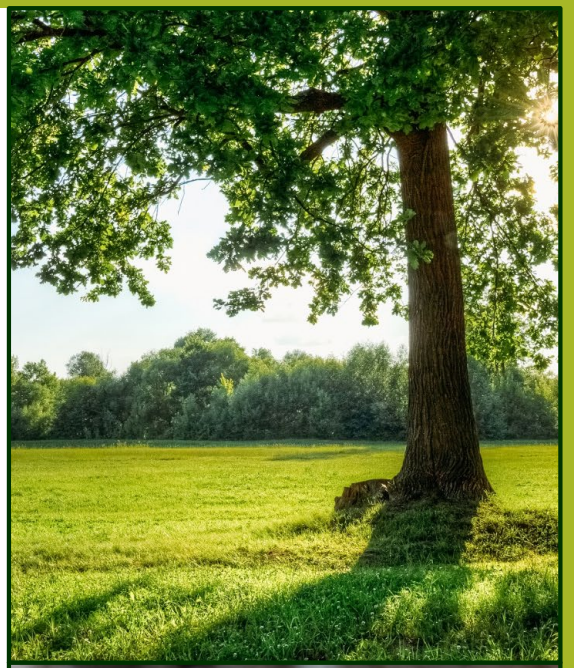
- Butterfly bush (*Buddleja davidii*)
- Serrated tussock grass (*Nassella trichotoma*)

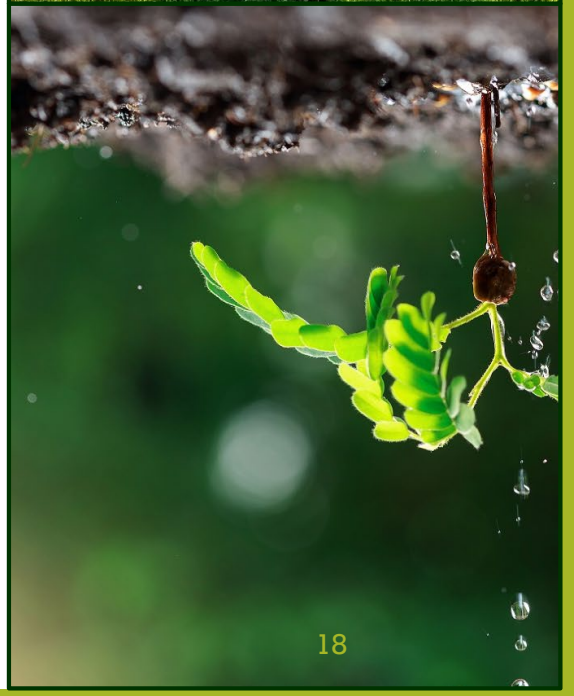




EFFECT OF CLIMATE CHANGE ON FOOD SECURITY

Climate change may also threaten food security with impacts on food crops and plant-based animal feed. For wheat, rice and maize worst impacts are expected in the tropics and subtropics.





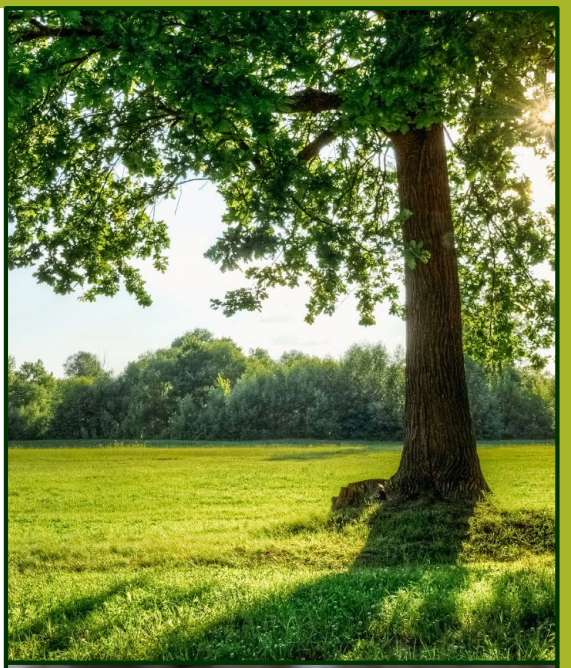
CLIMATE CHANGE FACILITATES PEST DISPERSAL THROUGH NATURAL AND HUMAN MEDIATED PATHWAYS

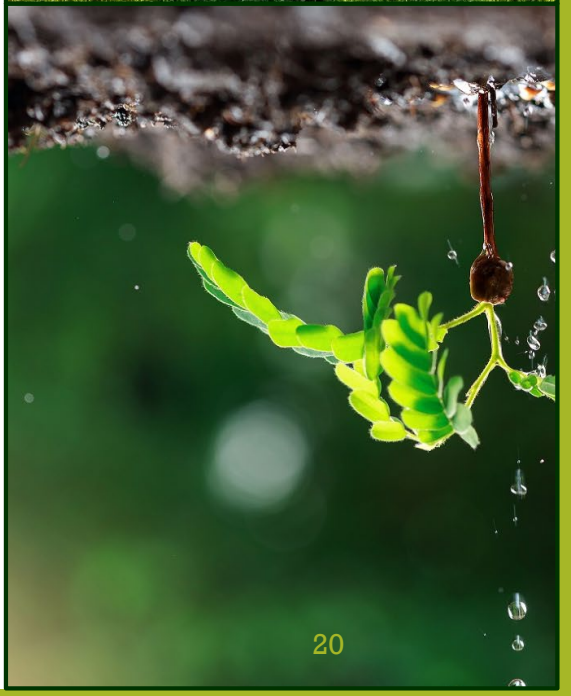
- Pest dispersal occurs through natural and anthropogenic processes.
- The four T (trade, tourism, traffic, transportation).
- Wood, including wood packaging, as well as conveyances, cargo, agricultural equipment are instruments for passive pest movement.

PREVENTION AND MITIGATION

The most effective way to prevent and limit the international spread of pests from trade and passenger movement is through:

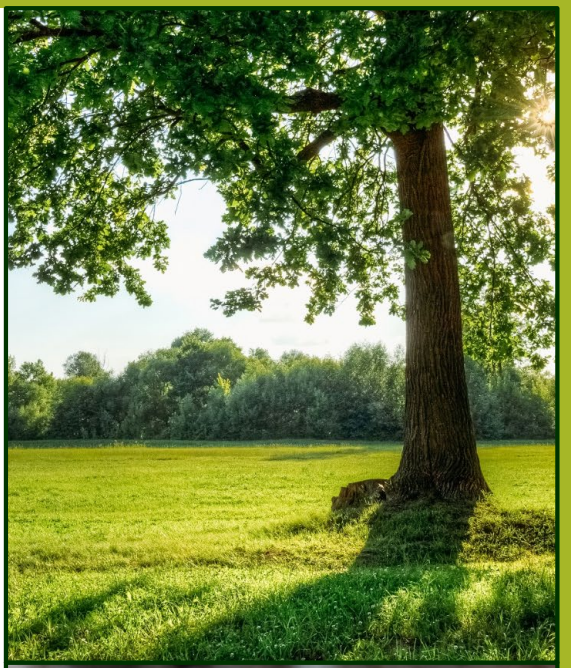
- regulatory means;
- phytosanitary import legislation;
- pest and risk analysis;
- surveillance and monitoring;
- best management practices;
- information exchange.

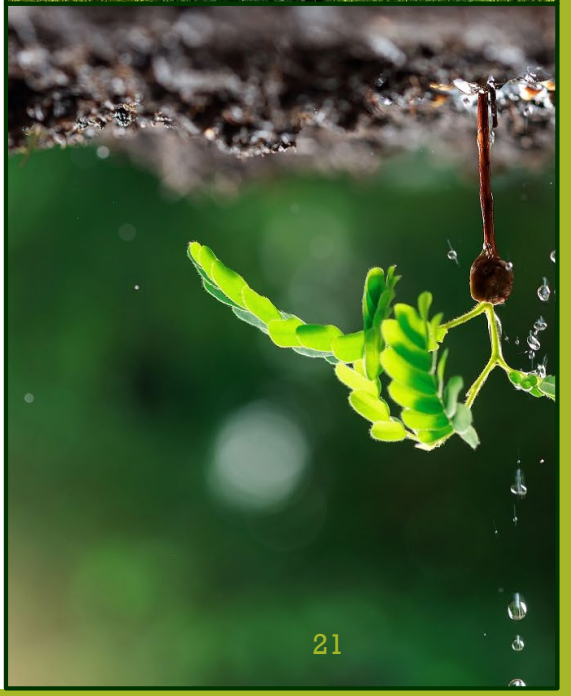




RESULTS

- 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 already necessary today, and even more crucial in the future.



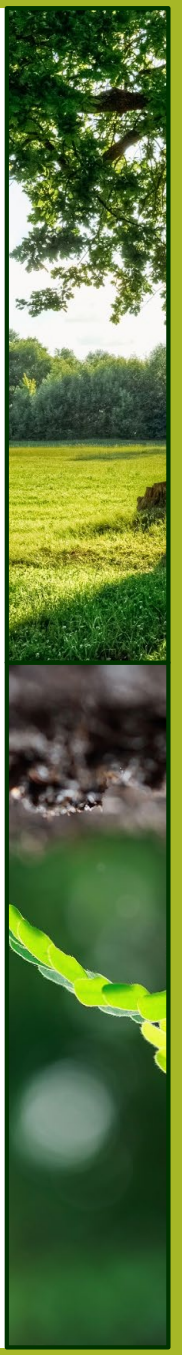


Key messages (1/4)

- Climate change increases pest risks in agricultural ecosystems. Some pests have already expanded their host range or distribution.
- Invasive pests are one of the main drivers of biodiversity loss.
- Weather is the second most important factor for pest dispersal after international travel and trade.
- Climate change effects on pest species are complex; direct or indirect, often interacting.

Key messages (2/4)

- 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.
- It is already necessary to adjust plant protection methods to respond to the impact of climate change.
- Pests do not respect borders.
- International cooperation is critical, as well as national, regional and international surveillance and monitoring activities.



Key messages (3/4)

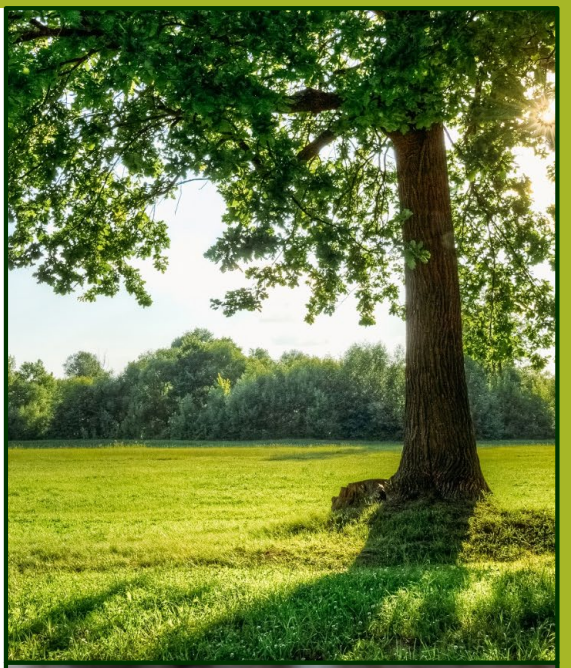
- Pest risk analysis activities need to be intensified at national, regional and international levels, and climate change considerations need to be included in the assessment of pest risks.
- Policymakers should encourage the use of IPM, strengthen the phytosanitary capacity of national and regional plant protection organizations.

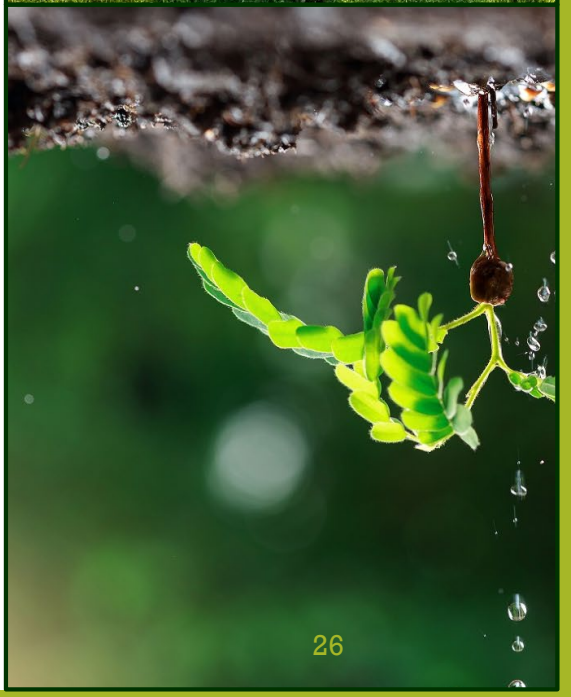
Key messages (4/4)

- Knowledge-sharing is needed not only among agricultural scientists, but also among experts working on human, animal and environmental health (the "Circular Health" or "One Health" approaches).
- Policymakers should support empirical research on the impact of climate change on plant health.
- A global mechanism for research coordination would enhance international efforts to protect agriculture, the environment and trade activities from pests.

RECOMMENDATIONS 1/4

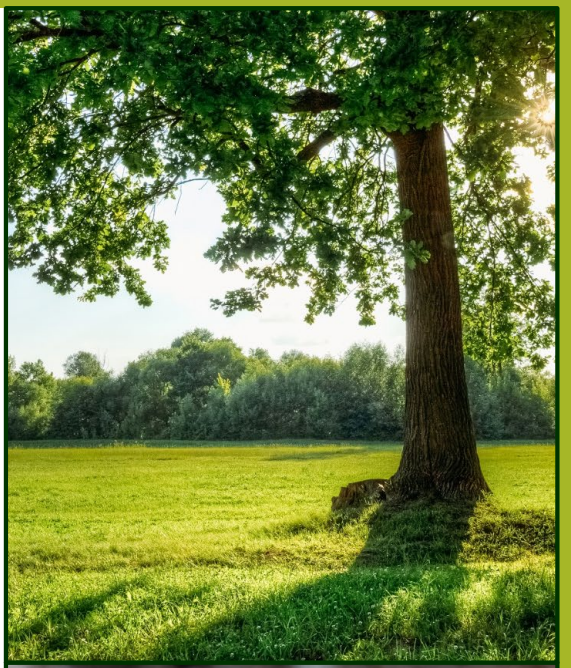
- **International cooperation**
- **International information exchange** on trade flows, pest occurrences and pest interceptions.
- **Establishment of a global mechanism for research coordination**
- **Multidisciplinary collaboration**, coordination and knowledge exchange in climate-change biology research

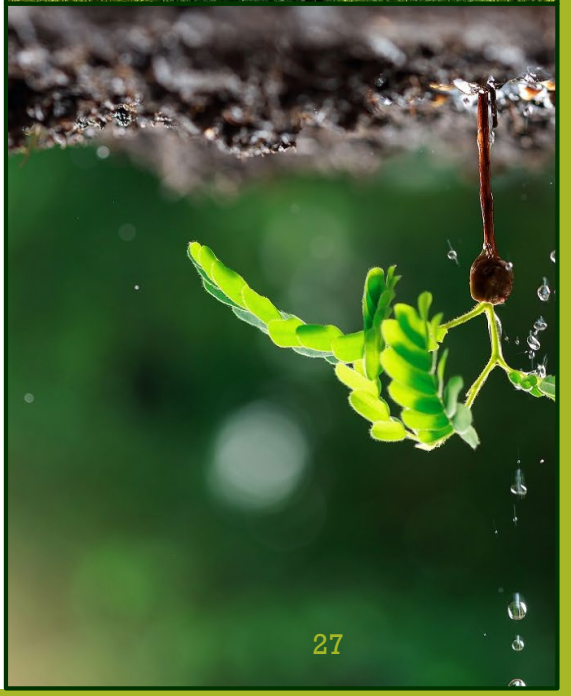




Recommendations 2/4
Research gaps

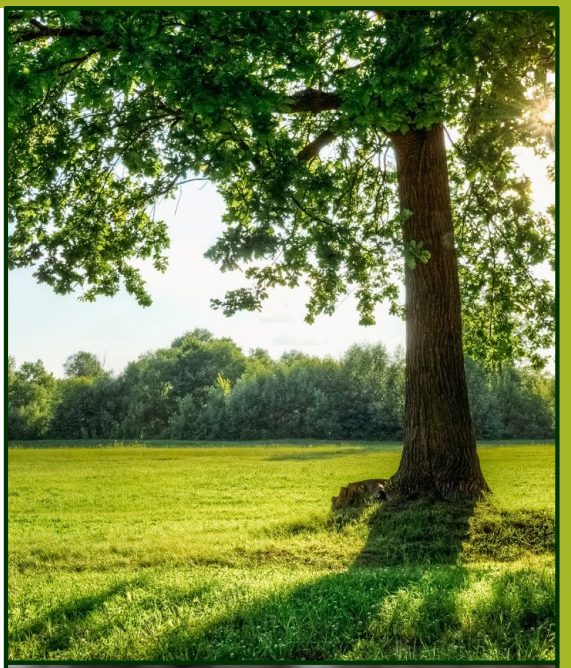
- The direct impact of climate change on the effectiveness of management strategies, particularly for chemical and biological control measures, should be evaluated.
- Few studies on below-ground pests on below-ground processes and their influence on soil health.
- Need of more research in forestry and unmanaged ecosystems.

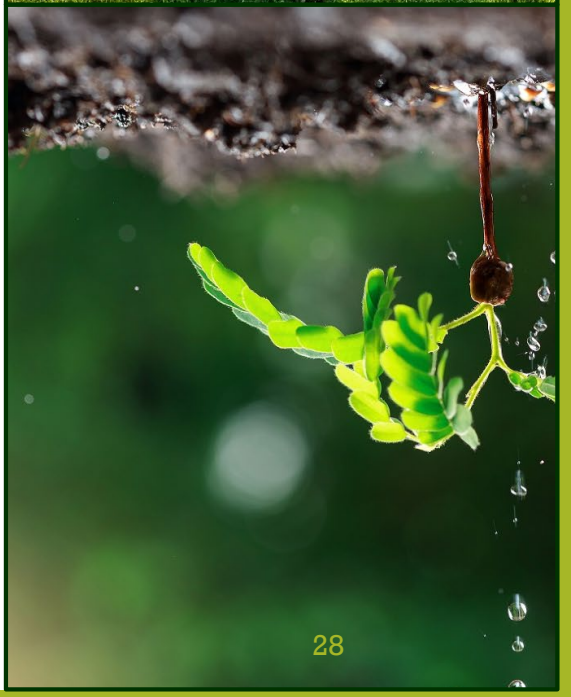




Recommendations 3/4

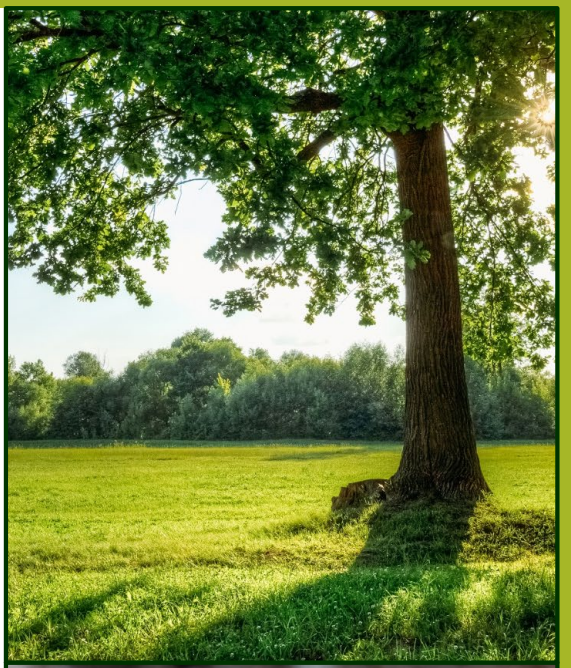
- **Regional cooperation** needs to be intensified
  - → Better regional information exchange and the development of common regional strategies to address climate change impacts to plant health.
  - → Support for the capacity enhancement of regional plant protection organizations
- **Investments** directed to strengthening national phytosanitary systems and structures – such as surveillance, pest risk analysis and diagnostic laboratories –to rapidly respond to potentially invasive alien species.

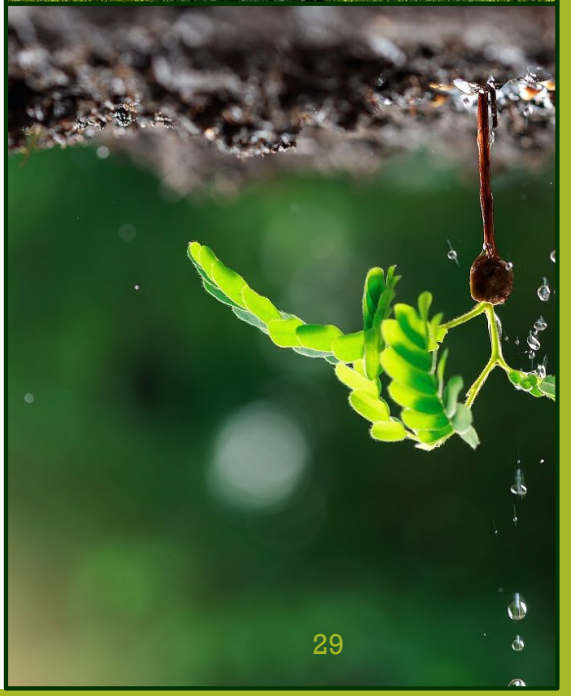




Recommendations 4/4

- **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.





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