

## Forest Pests

### Basic knowledge



**The Forest Pests Module is intended for forest managers and landowners concerned about the health of their forests or trees and interested in ways of managing pests. The module provides basic and more detailed information on good practices to minimize the incidence and spread of pests in forest areas and products.**

**The module also provides links to forest health tools and case studies of effective pest management.**

#### **What is a forest pest?**

A forest pest is any living organism that can cause harm to plants, trees or forests, or to forest products. Such organisms may be insects, spiders, mites, nematodes, fungi, bacteria, viruses, weeds (including woody weeds), mammals and other wildlife, and parasitic plants such as mistletoe.

Serious pest infestations can undermine years of management effort and greatly hamper the achievement of forest management objectives. Pests can adversely affect tree growth, vigour and survival and reduce the yield and quality of wood and non-wood products. Damage caused by pests can degrade wildlife habitat, thereby reducing local biodiversity, and can also have major negative impacts on recreational, aesthetic and sociocultural values. The presence of certain pests may result in the curtailment of reforestation programmes or require a change in the tree species used, and it may require the clearfelling of large areas of forest dominated by infested trees.

Measures to protect forests from pests are an integral part of sustainable forest management (SFM). Effective forest pest management (often called “integrated pest management” – see [In more depth](#)) involves:

1. maintaining the health of forests;
2. managing native pest disturbances that threaten forests; and
3. preventing the entry and spread of non-native species into new areas.

**Forest pests contributes to SDGs:**



#### Related modules

- [Forest inventory](#)
- [Forest management planning](#)
- [Management of non-wood forest products](#)
- [Management of planted forests](#)
- [Silviculture in natural forests](#)
- [Vegetation fire management](#)

## In more depth

Pests can be classified into two broad categories:

- Native – species occurring naturally at a site. Native pests are also referred to as “indigenous” pests.
- Non-native – species introduced to a particular place in recent history. Non-native pests are also referred to as “alien”, “exotic” and “foreign”

Native pests are generally of little concern to forest managers because they fulfil important ecological roles. However, when populations of native species reach damaging levels or behave invasively to the point where they threaten forest health and productivity, concerns arise and management strategies to reduce their impact may be needed.

Usually of more concern, however, is the introduction of non-native invasive species.

### ***Invasive species***

Invasive species are species that are non-native to a particular ecosystem and whose introduction causes, or is likely to cause, sociocultural, economic or environmental harm, or harm to human health. Invasive species are species that have spread beyond their known past or present range. In new environments, such species may not have natural enemies that normally keep populations in balance, and their new host trees may have insufficient or no resistance to them. Therefore, invasive species can have devastating consequences for forests and their products and services.

### ***Integrated pest management***

IPM can be defined as a combination of prevention, observation and suppression measures that are ecologically and economically efficient and socially acceptable, in order to maintain pest populations at suitable levels.

- **Prevention** may include selecting species and varieties that are well suited to a particular site, as well as natural regeneration, planting and thinning practices that reduce pest populations and favour sustainable control by natural enemies. Healthy trees and forests are less likely to be affected by pests, so maintaining the strength and vitality of trees is an important preventative measure. The selection and breeding of trees for pest resistance is another preventative tool that has grown in importance in recent decades.
- Careful **observation** and monitoring of pest populations, for example through visual inspection or trapping systems, can indicate when and where control measures are needed.
- For pest **suppression**, it is preferable to use mechanical control, biological control involving the use of natural enemies and biopesticides, and other sustainable methods rather than synthetic pesticides.

IPM requires an understanding of the ecology of the forest, as well as knowledge of the biology of the affected (tree) species and of the pest and its natural control agents. For IPM to be effective, field staff must be trained to recognize pests, monitor population levels and use biological control agents and other suitable control methods.

Biological control through the use of natural enemies is an essential component of IPM. Beneficial natural enemies may be promoted by suitable silvicultural practices (“biological control by conservation”) or by supplemental releases (“biological control by augmentation”); the latter may also involve the use of biological pesticides (“biopesticides”) based on the natural microbial diseases of pests. A third approach commonly used in forestry, “classical biological control”, involves the control of non-native pests by importing natural enemies (e.g. parasitoids, predators or fungal, bacterial or viral pathogens for pests, and arthropod herbivores and phytopathogens for weeds) from their regions of origin. This approach has been carried out successfully for well over a century. Nevertheless, introduced biological control agents can have undesirable side-effects and it is important, therefore, to gather all possible information on biological control before introducing a natural enemy of a pest to an area where it does not normally occur.

For further guidance on IPM, see [Tools](#).

### **Good practices to minimize pest presence and spread**

Many people associated with the forest sector can play a key role in preventing the spread of pests including those that grow, plant, manage and harvest trees and forests and those that manufacture, store, trade and transport forest products. The following sections share some good practices that you can adopt to protect your forests and forest products from pests.

### ***Wood-harvesting operations***

Forest pests can be spread in many ways, including in forest operations. Personnel involved in the harvest and transport of wood can minimize such spread with careful operational planning, harvesting, storage and transport. Personnel should be trained to recognize and report unusual pests and symptoms of diseased or infested trees and to carry out practices that reduce the risk that pest populations will move to other locations. The following practices can help minimize pest presence in forests.

- Identify pest outbreaks during the field planning phases and report these to pest professionals. In addition to recording all pest outbreaks, record where the pests occur. This will assist in determining pest-free areas in the future.
- Consider harvesting those stands with a high incidence of dead and dying trees to prevent more loss of stock by damage and to reduce the risk of pest spread. Extract and burn dead trees on site, or use them locally, to avoid the spread of pests to other areas.
- Consider the layout of harvest boundaries to reduce the chance that trees remaining after the harvest might blow down and provide food for pest build-up.
- Use harvesting practices appropriate to the landscape to help prevent erosion and the subsequent weakening of trees that can make them more susceptible to pests.
- Avoid causing damage to standing trees during forest operations because this can affect vigour, enable infection by wood-degrading fungi, and increase susceptibility to other pests.
- Remove felled trees from the forest quickly to avoid pest build-up or an outbreak.
- When felled trees have to be stored near or in a forest, consider removing their bark. This may help avoid the spread of certain woodborers and bark beetles.
- Transport logs during the dormancy period of known pests and apply appropriate control measures at the final destination before the pests emerge.
- When moving or storing wood originating from natural disturbances such as windstorms and fire, ensure that operations will not assist the spread of pests.
- Properly manage debris from harvesting, thinning and pruning to ensure that associated pests do not spread to other areas.
- Sanitize equipment and transport containers to avoid the transfer of pests.

### ***Sawmills and post-harvest treatments***

Roundwood should be processed promptly and carefully at the sawmill to reduce existing pest populations and minimize opportunities for pests to attack the wood. Debarking logs can be helpful if processing will not occur promptly. A wide range of post-harvest treatments can be implemented to minimize the spread of pests, including the following.

- Consider, where practical, the debarking of felled logs in the forest.
- Examine harvested logs before they enter the sawmill to determine if pests are present and whether they might spread to surrounding products or areas.
- Logs with advanced decay should be set aside so that decayed sections can be removed and used or disposed of in ways that safeguard the remainder. This will also reduce the amount of visual examination required in the production process.
- Where appropriate, store wood under cover or in water-sprinkler systems or ponds, and install pheromone or light traps to reduce the potential for further infestations and for outbreaks to spread to surrounding areas.
- Transport infested loads in covered, enclosed trucks.
- Immediately after unloading, clean the vehicles used to transport logs and remove bark and debris for safe disposal.
- Continually gather up bark and debris from storage yards for further use or disposal to prevent pest build-up and spread.
- Monitor all products during the manufacturing process for the presence of pests. Separate infested products for safe use or disposal to prevent the spread of the pests.
- Store infested products in a separate area to avoid contaminating pest-free products.

### ***Nurseries***

Because a forest nursery may supply plants for many different areas, their potential to aid the spread of forest pests is high. Buying healthy stock and carefully monitoring the condition of seedlings and cuttings are important practices. If possible, new plant materials should be kept separate from the main growing areas for a certain period of observation to ensure they do not harbour pests. Forest nurseries use intensive management practices which, if not carried out properly, may promote pest build-up. The artificial environment of a nursery, such as high planting densities and low genetic diversity, can be favourable for pest development.

The following practices can help minimize pest presence in nurseries.

- Provide the best possible growth conditions (e.g. nutrients, water, light, appropriate spacing and weed control) to raise healthy, vigorous, resistant plants.

- Collect or obtain seed from good-quality, genetically superior trees; use multiple sources of planting material to increase genetic diversity; use certified seed, if possible; and store seed in conditions that limit pest attack.
- Locate nurseries away from commercial stands to prevent contamination and the subsequent spread of pests around the region or country.
- Keep new plant material isolated from the main growing areas, where it can be monitored for pests without the risk that any pests it may harbour could spread to the whole nursery.
- Keep appropriate records that allow the identification and tracking of production material so that the source of any infestation or infection can be traced.
- Use soil or an inert growing medium that is free of insects, fungal, bacterial and viral pathogens, and weed seeds.
- Treat soil if necessary to kill pests before planting.
- Establish monitoring systems to allow the early detection of pests.
- Use adhesive traps to detect the presence of insect pests and spore traps to detect fungal spores.
- Use appropriate preventative silvicultural, chemical or biological control methods.
- Ensure that irrigation water is free of fungal, bacterial and viral pathogens and other contaminants such as pesticides, particularly if the water source is a pond where water accumulates from infected or treated fields or is suspected of being contaminated. Install filtration systems to sanitize infested water.
- Avoid leaving leaves wet, especially when watering at night, because this can encourage pathogens. Use trickle irrigation rather than sprinklers as a way of keeping leaves dry.
- Install screens or nets in plant production facilities to prevent insect entry or spread.
- Inspect materials prior to transport to ensure that plants are free of pests.
- Rotate crops to avoid recurrent pest problems; make sure the alternative crop is not susceptible to the pest.
- In infested areas, limit the entry of visitors to reduce the risk of transporting pests on clothing and footwear. Measures to limit the entry of animals and birds, which may spread pests, should also be considered.
- Clean (i.e. thoroughly remove all soil and plant materials from all surfaces and crevices) and, if necessary, disinfect all tools, footwear and equipment before entering and leaving nursery areas, especially if a fungal, bacterial or viral pathogen is suspected of being present. Clean and disinfect tools used for different operations within the nursery before and after use.
- Dispose of infested soil or growing media carefully so as not to contaminate new plants or soil.
- Frequently collect and remove dead plants and debris to decrease the probability of infestation. Destroy or sanitize infested plant waste by burning, composting or heat-treatment. If composting, make sure that the temperature attained is sufficient to kill the pest.

### ***Planted forests***

Some nursery pest management practices are also applicable in planted forests. For example, the use of appropriate genetic material that meets provenance (geographic origin) and species requirements, and planting the appropriate size and type of seedlings or cuttings, can reduce the likelihood of forest pest infestations. Choosing the most suitable species for a site's soil and climatic conditions reduces plant stress and thus susceptibility to pest infestations. Understanding local pest status can also reduce the risk of placing susceptible tree species in conditions that favour the pest.

Good planting practices that minimize pest presence include:

- Be aware that monocultures and clonal plantations can be more vulnerable to pests than mixed forests.
- Avoid reliance on a single tree species or clone.
- Choose provenances and tree species appropriate to the site and climate to ensure strong and healthy plants.
- Select appropriate growing sites to ensure healthy plants and avoid future pest problems.
- When selecting a non-native tree species for planting, consider its potential to become a pest.
- Be cautious when moving plants with soil; if possible, use bare-rooted plants (although see [planted forests](#) for the advantages of using containerized planting stock).
- Move bare-root plants when dormant and therefore less likely to spread forest pests (this also reduces plant stress). The potential of termite attack should be taken into consideration when planting bare-root crops.
- Provide healthy growing conditions, with sufficient water, sunlight and nutrients to avoid stress.
- Provide adequate spacing between field-planted seedlings to reduce susceptibility to pests.
- Consider appropriate cultural practices to allow good drainage and root expansion and breathing.
- Clean and disinfect footwear and equipment (e.g. tools and vehicles) before entering and leaving a planting site to reduce the risk of spreading diseases such as root rot fungus. Disinfect tools after each use.
- Survey often, particularly after planting, to ensure forest management goals are met and that pests are not prevalent.
- Control weeds to ensure that crop plants are able to grow well. Consider encouraging plants that promote the natural enemies of pests without harming trees.

- Where silvicultural wastes from pruning and thinning can be a breeding substrate for pests, dispose of them properly by burning, deep burial, composting or heat treatment sufficient to kill pests.

### ***Naturally regenerated forests***

Forests can be naturally regenerated by the sprouting of roots or stumps from the previous harvest, or by natural seeding. Small trees in the understory that are present prior to harvesting may help fill-in the natural seeding process. However foresters need to work for several years prior to harvest to ensure that these existing plants, called “advance regeneration”, are present and vigorous. In some cases natural regeneration is more resilient to environmental stresses because the species are well adapted for the site and they can be more vigorous. Using natural regeneration also reduces the likelihood of introducing new pests with plants for planting.

It is important that natural seeding be adequate to meet long-term management objectives, based on tree species and stocking requirements. To ensure that healthy trees are established, monitoring and pest surveys in the appropriate follow-up time frame are necessary.

Later, monitoring and pest surveys will be necessary to determine whether or not the natural regeneration is sufficiently free from weeds or competition from understory plants. Competition may also come from root-suckering of some deciduous species or overstocking by natural seeding of certain conifers. During silvicultural activities such as density control, pruning and fertilization it is imperative to ensure that these activities and the associated equipment and tools do not move pests or intensify their impacts. More good practices for minimizing pest presence in naturally regenerated forests include the following.

- Choose the most appropriate regeneration process, or combination of processes, to ensure healthy and vigorous forests.
- Conduct pest surveys to determine the probability of success of the natural regeneration process.
- Choose the most appropriate silvicultural, pest protection and harvesting practices to promote regeneration and reduce pest populations in the future forest.
- Conduct follow-up surveys to verify that regeneration is successful and to check for pests.
- Ensure appropriate spacing between naturally regenerated plants to reduce susceptibility to pests of concern and to promote tree growth.
- Control weeds when and where appropriate, giving due consideration to their potential as hosts of natural enemies of pests.
- Properly dispose of silvicultural wastes from pruning and thinning where they can be a breeding substrate for pests.
- Perform activities, such as pruning, thinning and harvesting of non-wood forest products (e.g. chestnuts, resin, sap and branches), during periods of low risk so that wounds do not allow the entry of pathogens.
- Clean and disinfect footwear and equipment (e.g. tools, trucks) before going off-site, particularly if site is infested, to help reduce the possibility of spreading diseases such as root rot. Disinfect operational tools after each use.
- Notify the appropriate officials if an unknown organism or an important or regulated pest is found.

### ***Forest pests and international trade***

Increased travel, faster transportation, and greater volumes of international trade are increasing the risk that pests will spread to new areas, and local climatic change may be accentuating the potential of some pests to establish in new areas. To address such a global issue requires coordinated international action. The International Plant Protection Convention (IPPC) is an international agreement between countries to control pests and prevent their spread. The governing body of the IPPC adopts international standards for phytosanitary measures (ISPMs), which provide guidelines for preventing the introduction and spread of pests while allowing safe trade.

In collaboration with the IPPC, FAO and partners have developed a tool to illuminate the application of ISPMs in the forest sector and to show that people associated with the forest sector can play a key role in preventing the spread of pests. [The Guide to implementation of phytosanitary standards in forestry](#) provides clear and concise guidance on forest health practices, including plain-language descriptions of the ISPMs and suggestions for their improved national implementation.

## Further learning

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## Credits

This module was developed with the kind collaboration of the following people and/or institutions:

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