

### Mini data sheet on *Heterobasidion irregulare*

*Heterobasidion irregulare* was added to the EPPO A2 List in 2015. A full datasheet will be prepared, in the meantime you can view here the data which was previously available from the EPPO Alert List (added to the EPPO Alert List in 2013-deleted in 2015).

#### *Heterobasidion irregulare*

**Why:** *Heterobasidion annosum* sensu lato, associated with root and butt rots, was long regarded as a single species until mating experiments, phylogenetic studies, and the existence of different host preferences led to the description of separate fungal species. Among these, *Heterobasidion irregulare* has recently been described as a new species belonging to the *H. annosum* complex and originating from North America. However, *H. irregulare* was introduced into Lazio region in Italy, most probably during World War II by US troops via infected wood material. Research studies have demonstrated that *H. irregulare* has spread from its initial introduction site (Castelporziano) and is currently causing extensive mortality in several *Pinus pinea* stands. Dr Gonthier (University of Torino) and Dr Garbelotto (University of California, Berkeley) who have studied *H. irregulare* extensively during the last decade, recently contacted the EPPO Secretariat and suggested that this pathogen should be added to the EPPO Alert List because of the risk it may present to pine trees in the EPPO region.

**Where:** *H. irregulare* originates from North America, where it is commonly found in the Eastern and Western parts, and less commonly found in the central part.

**North America:** Canada (Ontario, Québec), Cuba, Dominican Republic, Mexico, USA (Alabama, California, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Montana, Oregon, South Carolina, Vermont, Washington, Wisconsin).

**EPPO region:** Italy (Lazio region). Data from spore trapping studies performed in 30 sites have shown that *H. irregulare* is currently distributed in all coastal pine stands along 103 km of the Tyrrhenian coastline from Fregene in the north to San Felice Circeo in the south. Inland, it has been found as far as 9 km from the coast at Castel di Guido in the north and 18 km from the coast at Fossanova in the south. There is no continuity between infected areas (Fregene, Coccia di Morto, Castelfusano, Castelporziano, Anzio, Nettuno, Circeo), as each forest is surrounded by agricultural and urban areas. *H. irregulare* has also been detected in the gardens of several historical villas in the city of Rome (Villa Ada, Villa Borghese, Villa Doria-Pamphili), infecting *P. pinea* and *P. halepensis* trees. Genetic studies have suggested that the outbreak of *H. irregulare* in Italy results from a single introduction (most probably in Castelporziano) originating from a single (unknown) location in the Southeastern USA.

**On which plants:** *H. irregulare* mainly attacks *Pinus* spp. In its native range, it has been found in several *Pinus* species (e.g. *P. elliotii*, *P. jeffreyi*, *P. palustris*, *P. ponderosa*, *P. radiata*, *P. resinosa*, *P. taeda*), as well as on *Calocedrus decurrens* and *Juniperus virginiana*. In its invaded range, *H. irregulare* has mostly been found on *P. pinea*, and occasionally on *P. halepensis*. Inoculation experiments have confirmed that *H. irregulare* is pathogenic on both *P. pinea* and *P. halepensis*, and have showed that *P. sylvestris*, which is the most widely distributed pine species in Europe, is also susceptible. Since *H. irregulare* commonly attacks *Juniperus virginiana* in the USA, attention should be paid to the possible susceptibility of *Juniperus* species present in the EPPO region. Finally, during spore trapping studies, the presence of *H. irregulare* was observed in Italian oak woodlands, probably living as a saprophyte without causing any disease, but this suggest that oak stands can be a habitat for *H. irregulare*.

**Damage:** *H. irregulare* causes root and butt rots on its host plants. In both its native and invaded range, tree mortality is observed. *H. irregulare* colonizes the cambial layer and sapwood of its hosts, both in the root system and at or just above the root collar. The mycelium colonizes the wood, resulting in the early stages of infection in a darker, almost purple stain in the wood, and later producing a stringy white rot. The sexual reproductive structures of the fungus (basidiocarps) appear on decomposing stumps and at the base of dead trees. Disease incidence is reported to increase with stand age at rates that depend on host species and silvicultural management techniques. The disease affects species composition, stand density and structure of forests. When tree mortality occurs, gaps develop in the forest canopy, resulting in changes of light, moisture and temperature of the forest. In Italy, extensive tree mortality occurs in the dry coastal *P. pinea* stands around Rome. In the most affected sites, mortality centres including dozens of trees and with diameters larger than 50 m have been observed.

**Dissemination:** *H. irregulare* spreads from tree to tree by root contact or grafts, spreading outward in concentric rings emanating from the stump or tree that represented the original infection site. Primary infection is effected by airborne propagules (mainly basidiospores) on freshly exposed wood surfaces (e.g. in particular stump tops, or stem and root wounds). Once established through primary infections, the fungus may spread and infect uninjured trees by vegetative growth of the mycelium through root contacts or grafts (secondary infections). Although the fungus produces both sexual spores and conidia, only sexual spores seem to cause infections in nature. Colonization proceeds downward to the root system at a rate of up to 20 cm per month, depending on climate and host species. *H. irregulare*, as is the case for other species in the *H. annosum* s.l. complex, is not able to freely grow in the soil but may remain active in dead stumps and in the root system for decades. Although spores of *H. annosum* s.l. have been reported to travel hundreds of kilometres, there is an increasing body of evidence pointing to a geographically limited range of effective spore dispersal that results in fungal establishment. A model has proposed that only 0.1% spores travel 100 m. Other studies indicated that effective spore dispersal was between 98 and 1255 m. In Italy, the rate of spread of *H. irregulare* has been estimated at 1.3 km per year, but considering that available habitats are very fragmented in the outbreak area, a much faster rate of colonization may be expected in other parts of the EPPO region. Over long distances, the introduction into Italy clearly shows that wood packaging material and other wood products can be a pathway. The possible role of non-host plants carrying saprophytic populations of the fungus remains to be clarified.

**Pathway:** Plants for planting, wood and wood products (including wood packaging material) of *Pinus* spp and other host species.

**Possible risks:** *Pinus* spp. trees are widely planted across the EPPO region for forestry and amenity purposes. In both its native and invaded range, *H. irregulare* causes extensive tree mortality. The most affected pine species in Italy, *P. pinea*, has been used and cultivated for its edible pine nuts since prehistoric times around the Mediterranean Basin, and is a valuable tree in the Mediterranean landscape. The fact that *P. sylvestris*, *P. halepensis* and *Juniperus* spp. might also be susceptible to *H. irregulare* adds to the risk. In North America, control measures against *Heterobasidion* spp. are mainly preventive, and generally aim for containment rather than eradication. These control measures can include: careful stump and root removal combined with digging of trenches (150 cm deep) around infected sites, conducting thinning and logging operations during periods when spore release is absent or low, immediate treatment of stump surfaces with chemicals or a biocontrol agent (e.g. *Phlebiopsis gigantea*).

In the invaded area in Italy, studies have shown that both the exotic *H. irregulare* and the native *H. annosum* sensu stricto were occurring. Although *H. annosum* s.s. was relatively rare and causing very limited mortality, the native species is being gradually replaced by the exotic one. In some conditions, *H. irregulare* has been shown to be a faster colonizer than

the native species *H. annosum* s.s. In addition, studies have demonstrated that *H. irregulare* and *H. annosum* s.s. could hybridize which could potentially accelerate the evolution of both pathogenic species and facilitate the adaptation of the invasive species to new environments. Considering the invasive behaviour of *H. irregulare* in Italy, its interaction with native fungal populations, and the currently observed mortality on *P. pinea*, it is desirable to prevent any further spread of this pathogen in the EPPO region.

### Sources

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