

From wood protection to preservation of historic monuments: the commitment of Janssen PMP to cultural heritage conservation

Jan Bosselaers, Manager Scientific Support, Janssen Preservation and Material Protection, Turnhoutseweg 30, 2340 Beerse, Belgium. jbossela@its.jnj.com

Alex Valcke, Vice President, Janssen Preservation and Material Protection, Turnhoutseweg 30, 2340 Beerse, Belgium. avalcke@its.jnj.com

Abstract

Janssen Preservation and Material Protection, a division of Janssen Pharmaceutica NV, successfully developed a number of new, environmentally benign fungicides suited for a wide range of applications. The cornerstone of this innovative antifungal portfolio is constituted by a number of sterol biosynthesis inhibiting azole fungicides, the most important of these being imazalil and propiconazole.

Initial applications of these molecules in cultural heritage related projects include antifungal treatment and protection of a full size, seaworthy replica of the Batavia, the flagship of the Dutch Oost Indische Compagnie, as well as the medieval village in the Open-air Museum of Bokrijk, Belgium.

Other interventions where the Janssen PMP material protection expertise and portfolio actively assisted in cultural heritage projects concerned important museum collection pieces threatened by superficial mould growth. An imazalil smoke generator could be used with excellent results in each of these cases. Subsequent projects evolved into a collaboration with a broader perspective. The commitment of Janssen PMP in these projects was not limited to an *ad hoc* solution of the biodeterioration problem alone, but aimed for an integrated approach towards documentation, monitoring and conservation of selected sites.

Around the turn of the century, a cooperation agreement was signed between Janssen Pharmaceutica and the Museum of the Terracotta Warriors and Horses, encompassing the donation of specially formulated fungicide combinations to the Museum in order to treat the terracotta army, threatened by mould growth, the training of scientists from the Terracotta Museum at Janssen PMP in Beerse, as well as the equipment of a state of the art mycological laboratory in the Terracotta Museum itself.

A more recent collaboration between Janssen PMP and the Archeological Survey of India (ASI) on the preservation of monuments in Karnataka is based on the same broader, integrated approach towards cultural heritage preservation, in close collaboration with the UNESCO chair for Preventive Conservation, Monitoring and Maintenance of Monuments and Sites at K.U. Leuven, Belgium. Two sites were selected as pilot projects: the Tipu Sultan summer palace (Daria Daulat Bagh) in Srirangapatna, and the Hampi temple complex World Heritage Site.

Introduction

Janssen Preservation and Material Protection, a division of Janssen Pharmaceutica NV, successfully developed a number of new, environmentally benign fungicides suited for a wide range of applications from post-harvest protection of fresh produce to wood and material preservation (Anonymous 2009). The cornerstone of this innovative antifungal portfolio is constituted by a number of sterol biosynthesis inhibiting azole fungicides (Fig 1), the most important of these being imazalil (Godefroi & Heeres 1973) and propiconazole (Valcke 1989).

Initial applications of these molecules in cultural heritage related projects include antifungal treatment (Unger *et al.* 2001) and protection of a full size, seaworthy replica of the Batavia, the flagship of the Dutch Oost Indische Compagnie, as well as the medieval village in the Open-air Museum of Bokrijk, Belgium (Valcke & Bosselaers 2009).

Other interventions where the Janssen PMP material protection expertise and portfolio actively assisted in cultural heritage projects concerned important museum collection pieces threatened by fungi, such as a 1600 year old Egyptian mummy from the Royal Museum of Art and History in Brussels, many valuable manuscripts (Archief en Museum voor het Vlaamse Cultuurleven; Prentenkabinet Linnig, Museum Vleeshuis; Plantin-Moretus Museum, Atwerp) as well as a collection of mummies from the Museo El Carmen, San Angel, Mexico. As superficial mould growth (Florian 1997) on the pieces was the main problem, treatment with an imazalil smoke generator (Van Cutsem *et al.* 1988, Dale & Fryatt 2001) was advised and applied successfully in each of these cases.

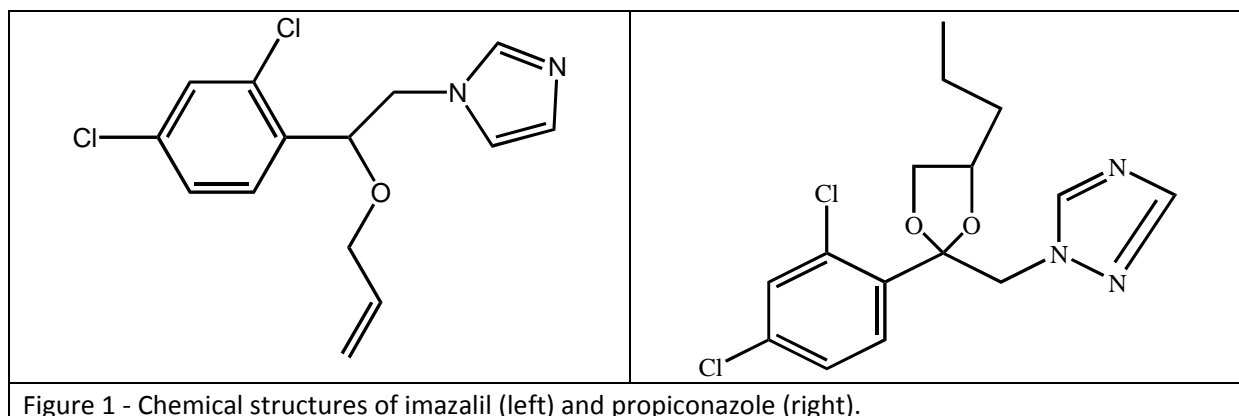


Figure 1 - Chemical structures of imazalil (left) and propiconazole (right).

Ongoing projects

In the mid-1990's, a potentially deleterious fungal growth was observed on the clay substrate of the excavation pits in the world-famous Museum in Xi'an, China (Sumei & Tie 2001). Fungal samples from the excavation area were cultured and identified, and fungicidal compounds were tested against them in a poison plate assay (Table 1).

Given the importance of the relics, it was decided not to limit commitment of Janssen PMP to an *ad hoc* solution of the problem at hand, but to engage in a collaboration with a broader perspective. A cooperation agreement was signed between Janssen Pharmaceutica and the Museum of the Terracotta Warriors and Horses, encompassing the donation of specially formulated fungicide combinations to the Museum in order to treat the terracotta army, training of scientists from the Terracotta Museum at Janssen PMP in Beerse, as well as the equipment of a state of the art mycological laboratory in the Terracotta Museum itself. The Dr. Paul Janssen Laboratory for Advanced Material Protection in the Xi'an

Museum is now a centre of excellence for research on biodeterioration of cultural heritage for the entire Peoples Republic of China.

Table 1. MIC values (in mg/l) of four fungicides against fungi isolated from the Terracotta army

	1	2	3	4
<i>Acremonium strictum</i>	20	20	>20	5
<i>Aspergillus flavipes</i>	0.62	0.31	2.5	0.31
<i>Aspergillus flavus</i>	5	2.5	1.25	2.5
<i>Aspergillus sp.</i>	>20	>20	5	2.5
<i>Aspergillus sulfureus</i>	20	10	>20	1.25
<i>Aspergillus versicolor</i>	10	1.25	2.5	0.31
<i>Cladodsporium cladosporioides</i>	0.31	1.25	0.62	0.31
<i>Fusarium subglutinans</i>	10	10	5	20
<i>Mucor plumbeus</i>	2.5	>20	>20	2.5
<i>Paecilomyces lilacinus</i>	10	5	20	5
<i>Penicillium chrysogenum</i>	20	1.25	1.25	2.5
<i>Penicillium citrinum</i>	0.62	0.62	0.31	1.25
<i>Penicillium janthinellum</i>	5	0.62	0.31	1.25
<i>Penicillium sp.</i>	20	1.25	20	2.5
<i>Rhizopus oryzae</i>	80	>80	>80	10
<i>Schizophyllum commune</i>	5	10	80	1.25
<i>Scopulariopsis chartarum</i>	10	>20	>20	0.31

Growth medium: potato dextrose agar. Fungicides: 1 propiconazole, 2 imazalil, 3 thiabendazole, 4 iodopropynylbutylcarbamate (IPBC).

A more recent collaboration between Janssen PMP and the Archeological Survey of India (ASI) on the preservation of monuments in Karnataka is based on the same broader, integrated approach towards cultural heritage preservation. A memorandum of understanding was signed between Janssen PMP and ASI, agreeing on an integrated approach towards documentation, monitoring and conservation of selected Karnataka cultural heritage sites, in close collaboration with the UNESCO chair for Preventive Conservation, Monitoring and Maintenance of Monuments and Sites at KU Leuven, Belgium. Two sites were selected as pilot projects:

1. The Tipu Sultan summer palace (Daria Daulat Bagh) in Srirangapatna, as one of the few remaining well preserved examples of this type of wooden Muslim architecture. The building is currently threatened by insect damage, and we isolated several species of surface moulds from the wooden ceiling and from wall paintings: *Aspergillus candidus*, *A. nidulans*, *A. niger*, *A. tamarii*, *A. versicolor*, *Curvularia affinis*, *Penicillium citrinum* and *Syncephalastrum racemosum* (Figure 2).

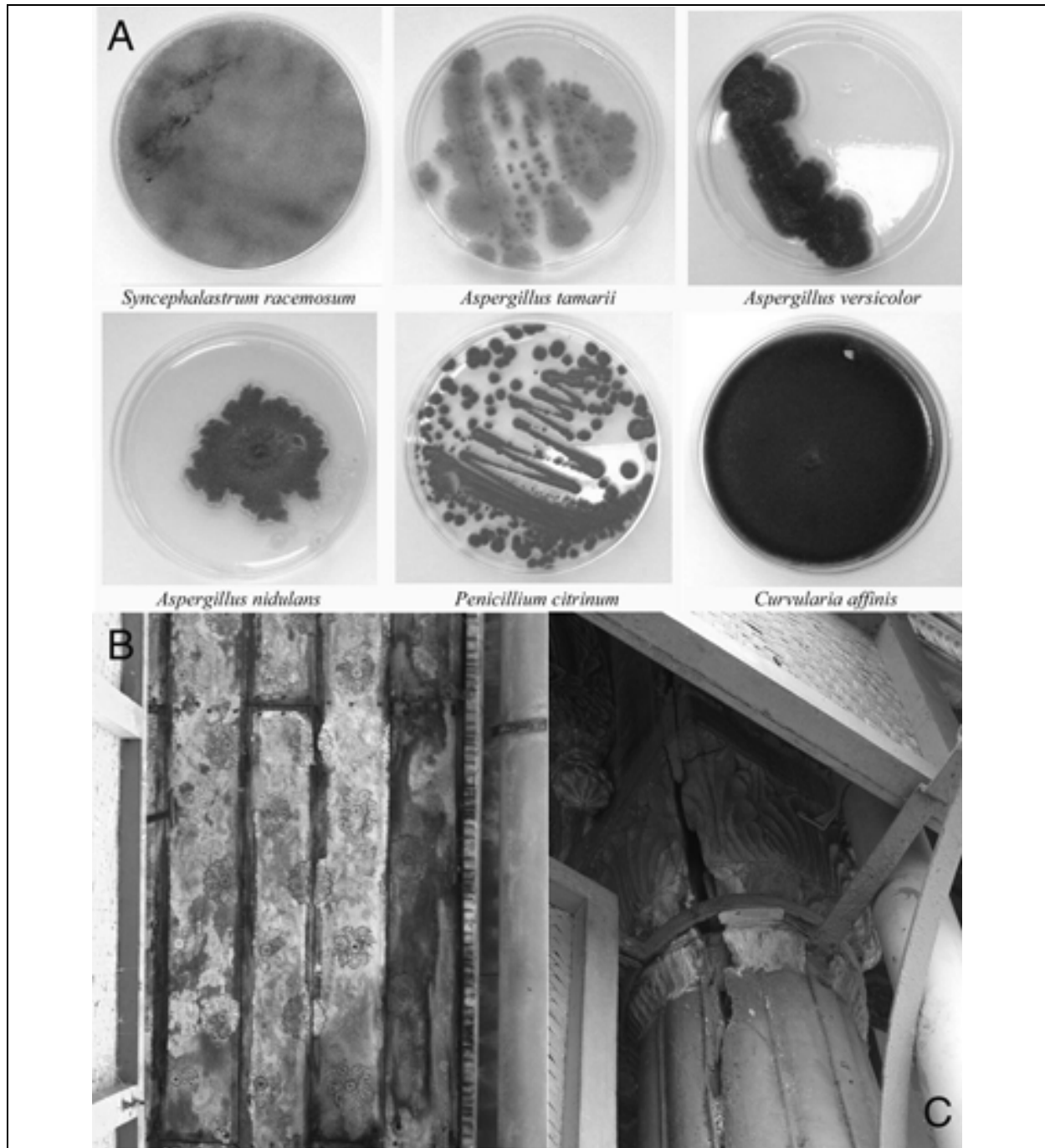


Figure 2 - Wood problems at Daria Daulat Bagh. A. Various surface moulds isolated from the palace. B. Moisture and mould damage to painted wooden cornice. C. Structural damage to wooden pillar.

2. The Hampi temple complex World Heritage Site (Filliozat 2004, Fritz & Michell 2001) is an example of an extensive site, where a variety of problems and challenges necessitate the integrated approach described above.

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