ORIGINAL ARTICLE Open Ac-

ISSN 2278-1404

International Journal of Fundamental & Applied Sciences

An antimycotic study of Propiconazole for mould inhibition on rubber wood

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Abstract

Background & Aim: The present study was carried out to evaluate the efficacy of Propiconazole on Rubber wood veneers against mould fungi. **Methods:** It was achieved by testing three different concentrations of Propiconazole viz., 0.5, 1 and 2% against mould fungi. **Results**: Propiconazole (25% EC) acts as an effective mouldicide against mould fungi. **Conclusion:** The lethal dose of Propiconazole to control mould fungi was found to be 2%.

Keywords: Propiconazole; Mouldicide; Mould fungi; Rubber wood

1. Introduction

Wood is an aesthetic and versatile structural material and it represents one of the most valuable renewable resources. However, vulnerability to moisture and bio-deterioration are important limitations to the expected long service life of wood and can result in significant economic loss. One of the surest ways to extend the available timber supply and increase the resources to meet present and future demands is by improving the durability of wood in use.

Moulds are fungi which often grow superficially on lignocellulosic materials, but generally do not decay or weaken the strength of such materials[1]. Carbon sources utilized by moulds are simply residual sugars and stored carbohydrates of said materials. Although mould fungi do not cause decay, the disfigurement and discoloration of materials can be of aesthetic and economic importance. Mould fungi thrive in high humidity and warm temperatures. These fungi have evolved to rapidly colonize a substrate and utilize the stored sugars as quickly as possible.

Mould fungi adversely affect the appearance of the wood at the time of consumer purchase and use, and create concerns over the quality of the product. It increases the permeability and reduces toughness of wood. It is therefore desirable to suppress mould growth under normal conditions. In the event of poor design or maintenance, mould growth can be found on many domestic and commercial construction materials in service. The majority of the moulds found in homes are *Cladosporium, Penicillium,* and *Alternaria*, which are now known to cause chronic sinus infections, respiratory infections, and asthma[2]. A potentially lethal mould, *Stachybotrys atra* produces airborne toxins that can cause inflammation and injury in the gastrointestinal and pulmonary tissues in children and adults. Hence, to avoid all the above said problems, it is usually recommended to treat the panel products with suitable preservative chemical. In the present study Propiconazole was explored to study its efficacy against mould fungi.

Propiconazole (figure I) is an organic triazole biocide that is effective against wood decay fungi[3]. It is soluble in some organic solvents, but it has low solubility in water. It is stable and leach resistant in wood[3]. Propiconazole is a systemic foliar fungicide with a broad range of activity. It's mode of action is demethylation of C-14 during ergosterol biosynthesis, leading to the accumulation of C-14 methyl sterols[4]. The biosynthesis of these ergosterols is critical to the formation of cell walls of fungi. This lack of normal sterol production slows or stops the growth of the fungus, effectively preventing further infection or invasion of host tissues[4]. Therefore, propiconazole is considered to be fungistatic or growth inhibiting rather than fungicidal or killing [4]. Propiconazole has been approved by Environmental Protection Agency (EPA) for surface application or pressure treatment of plywood, and above-ground structural timbers[5].

On the perusal of literature, it has been found that the work on efficacy of Propiconazole has not been done in India and hence, the present study deals with the efficacy of Propiconazole against mould fungi on Rubber wood veneer.

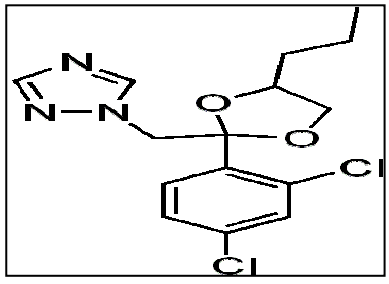

Figure I: Structural formula of Propiconazole

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2. Material and Methods

2.1 Test Fungi:

The spore suspension of Black mould (*Aspergillus* spp.), Green mould (*Penicillium* spp.) and Brown mould (*Verticillium* spp.) was utilized to find out the efficacy of propiconazole against mould.

2.2 Test Pesticide/Preservative Chemical:

IUPAC Name :1-[[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl] methyl]-1,2,4-triazole

Molecular formula :$C_{15}H_{17}C_{l2}N_3O_2$

Trade Name : Tilt, Alamo®, Banner®, Orbit®, and Quilt™

Chemical Family : Triazole, Conazole

CAS Number : 60207-90-1

Boiling point : 180^{0}C

2.2.1 Toxicological information:

LD_{50} for rats (Oral) : 1517 mg kg^{-1} [6]

LD_{50} for rats (Dermal) : >4000 mg kg^{-1} [6]

2.3 Testing against moulds:

The toxicity test was carried out according to Padmanabhan[7]. Rubber wood (*Hevea brasiliensis*), a non–durable class timber was selected and specimen of size (12.5 x 12.5 x 0.14 cm^3) were prepared from defect free veneers. All these samples in the lot of six replicates were treated with Propiconazole (25% EC). The moisture content of the sample was 30%. The chemical solution of different concentrations (0.5, 1 and 2%) was prepared and the veneers were dipped for overnight. The veneers were then removed and stacked for some period so as to drain out the excess preservative solution and to attain the moisture content of 8 – 10%. The amounts of preservative solution absorbed by the samples were recorded and results are presented in Table I. Later the treated veneers and the veneers without preservative treatment (control) were sprayed with a suspension of different moulds viz. *Aspergillus* spp. *Penicillium* spp. and *Verticillium* spp. then kept in incubation chamber (to maintain relative humidity of 70± 5% and temperature of 25± 5°C). After three months of incubation, test samples were removed and the percentage of infection was calculated by visual observation.

3. Results and Discussion

Table I: Retention of propiconazole on rubber wood ve-

Sl. No	Chemical	Concentration of chemical	Retention (kg/m^3) (average of 6 samples)
1.	Propiconazole (25% EC)	0.5	0.064
		1	0.120
		2	0.190
2.	Control	-	-

The present research work was planned with a view to examine the efficacy of a Propiconazole against mould fungi. The degree of protection achieved depends on the preservative used and the proper penetration and retention of the chemicals. Penetration or absorption of preservative chemical plays an important role in protection of wood from mould attack in use. The average retention obtained after dipping the veneers for overnight in the solution of Propiconazole (25% EC) is shown in table I (Fig.II). Propiconazole (25% EC) at 2% had the highest average retention of 0.190 kg m^{-3} followed by Propiconazole at 1 % (0.120 kg m^{-3}). As expected the lowest retention of 0.064 kg m^{-3} was recorded in Propiconazole at 0.5%.

Results of toxicity test for exposure periods of three months are presented in the Table II. All the tested concentrations of Propiconazole resisted the attack of mould fungi as compare to untreated control. But, Propiconazole (25% EC) at 2% was found to be the most effective treatment in

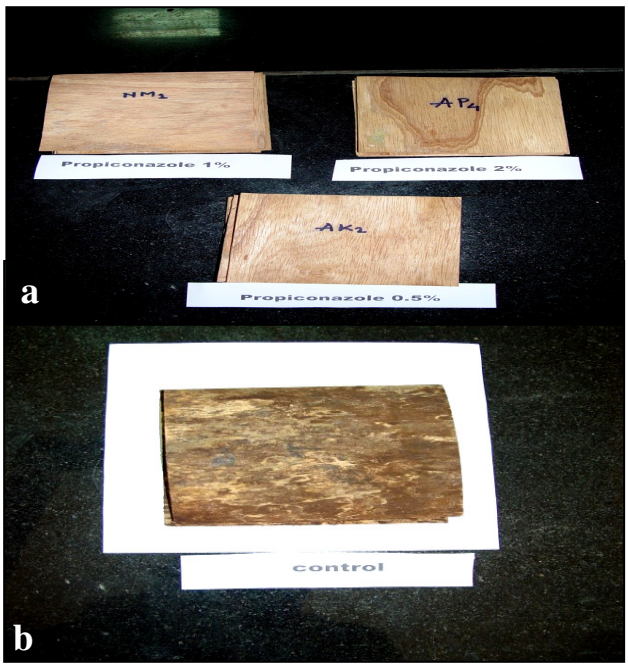

Figure II: Samples after exposure showing mould attack (a. samples treated with Propiconazole 1, 2, &0. 5% respectively b. Control

controlling the mould growth on rubber wood veneer. The average percent surface attack of 4.83 was found in

Table II: Toxicity of propiconazole treated veneer against moulds

Sl. No	Chemical	Concentration of chemical	Average Percentage surface
1.	propiconazole (25% EC)	0.5	5.83 (0.75)
2.	propiconazole (25% EC)	1	4.83 (0.75)
3	Propiconazole (25% EC)	2	2.67 (0.51)
4.	Control	-	15 (3.16)

Parenthesis values are standard deviation.
* Average of six replicates.

Propiconazole (25% EC) at 1% treated samples against untreated control samples (15%). Propiconazole (25% EC) at 0.5% treated samples had recorded 5.83 of average percent surface attack which is less among the three tested concentration levels. Untreated samples failed to resist the attack of mould after three months of test.

Propiconazole has been emerged as the effective Antimycotic wood preservative chemical to arrest the mould growth. Similar results were recorded by Roy[8] wherein he found the antifungal activity of triazole fungicides against powdery mildew, rust, scab and leaf spot diseases on different crops. Triazoles are highly active against wood decay fungi,

readily soluble in hydrocarbon solvents and exhibits good stability and leach resistance in wood[9].

Conclusion

On the basis of results and discussion of present investigation it can be concluded that the lethal dose of Propiconazole to control mould fungi is 2%. In the present study, Propiconazole has emerged as the best Antimycotic wood preservative chemical. As stated earlier, work on the efficacy of Propiconazole against mould fungi has not been documented so far in India and hence, the present report can be claimed as the first report wherein Propiconazole has been used against mould fungi.

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