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Laboratory evaluation of chlorothalonil formulation for stain and mold control on rubberwood and maple

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LABORATORY EVALUATION OF CHROLOTHALONIL FORMULATION FOR STAIN AND MOLD CONTROL ON RUBBERWOOD AND MAPLE[1]

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Abstract: We evaluated the efficacy of several chlorothalonil and carbendazim fungicides (F1 and F2), etc. in the control of mold and stain fungi on rubberwood and maple. The results showed that these formulations effectively inhibited the selected fungal species such as Aspergillus niger, Penicillium sp., Trichoderma sp. (P71H), Aureobasidium pullulans, Ceratocystis minor(C-188), Ceratocystis pilifera (RWD 9472) in laboratory tests.

1. INTRODUCTION

Chlorothalonil is a common fungicide which are used in many agricultural crops for preventing diseases and it also has been used for controlling certain spectra of wood stain fungi (1-14). The most important advantage of chlorothalonil is that it is highly effectively and environmentally friendly if it is properly combined with other fungicides. Some potential commercial formulations containing chlorothalonil for controlling wood stain and mold fungi have been developed in recent years, such as Tuffbrite C (a.i. chlorothalonil and carbendazim), Tuffbrite 404 (a.i. chlorothalonil and copper oxine), NeXgen (a.i. 14.5% chlorothalonil and 14.7% MBT) (11). Recently Tuffbrite C has been registered in New Zealand.

Chlorothalonil is commercially available in China and it is a potential alternative preservative to sodium pentachlorophenol, which is strictly restricted or prohibited in some countries but is currently used widely in China, for controlling wood stain and mold. The purpose of this paper is to determine the effect of chlorothalonil formulations for controlling stain and mold on rubberwood and maple, which are common tree species in southern China and North America, respectively.

2. MATERIAL AND METHOD

2.1 Wood Sample and Fungi

Wood sample size: Rubberwood 50 × 2 × 0 × 1 mm, maple 40 × 20 × 3 mm.

Fungal species: *Aspergillus niger, Penicillium sp., Trichoderma sp.(P71H), Aureobasidium pullulans, Ceratocystis minor(C-188), Ceratocystis pilifera (RWD 9472):*

2.2 Exposure to fungi

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Samples were incubated with the above fungal species tier dipping the samples in the solutions for 15 seconds according to ASTM D-4445-91. Four replications of wood species were used.

2.3 Chemicals

F1: chlorothalonil wettable powder, F2: carbendazim wettable powder,

Tuffbrite C, Tuffbrite 404 and NeXgen were provided by ISK Biosciences Co.;

Tuffbrite C: 1liter liquid containing 450g chlorothalonil and 100 g carbendazim;

Tuffbite 404: chlorothalonil and copper oxine;

NeXgen: liquid containing 14.5% chlorothalonil and 14.7% MDT.

2.4 Ranking Standard

1 - Clean: stain or mold covering less than 5% upper surface;

2 - Light stain: stain or mold covering 5 -20% upper surface;

3 - Moderate stain: stain or mold covering 20-40 % upper surface;

4 - Heavy stain: stain or mold covering more than 40% upper surface.

3. RESULTS AND DISCUSSION

3.1 Laboratory evaluation of chrolothalonil formulation for stain and mold control on rubberwood

Table 1. Comparison of the effectiveness of anti-mold treatments against Aspergillus niger on rubberwood

Anti-sapstain Treatment	Average
Untreated Control	4.0±0.0
0.5% NaPCP	1.0±0.0
1.0% NaPCP	1.0±0.0
0.05%F1 + 0.1%F2	1.50±0.50
0.05%F1 + 0.2%F2	1.0±0.0
0.1%F1 + 0.05%F2	1.0±0.0
0.1%F1 + 0.1%F2	1.0±0.0
0.1%F1 + 0.2%F2	1.0±0.0
0.2%F1 + 0.1%F2	1.0±0.0
0.5%Tuffbrite C	1.0±0.0
1%Tuffbrite C	1.0±0.0
2%Tuffbrite C	1.0±0.0
1%Tuffbrite 404	1.0±0.0
2%Tuffbrite 404	1.0±0.0
1%NeXgen	1.0±0.0
2%NeXgen	1.0±0.0

Table 2. Comparison of the effectiveness of anti-mold treatments against Penicillium sp. on rubberwood

Anti-sapstain Treatment	Average
Untreated Control	4.0±0.0
0.5%NaPCP	1.75±0.43
1.0%NaPCP	1.0±0.0
0.05%F1 + 0.l%F2	1.0±0.0
0.05%F1 + 0.2% F2	1.0±0.0
0.1%F1 + 0.05% F2	1.0±0.0
0.1%F1 + 0.1%F2	1.0±0.0
0.1%F1 + 0.2% F2	1.0±0.0
0.2%F1 + 0.1% F2	1.0±0.0
0.5%Tuffbrite C	1.0±0.0
l%Tuffbrite C	1.0±0.0
2%Tuffbrite C	1.0±0.0
1%Tuffbrite 404	1.0±0.0
2%Tuffbrite 404	1.0±0.0
l%NeXgen	1.25±0.43
2%NeXgen	1.0±0.0

Table 3. Comparison of the effectiveness of anti-mold treatments against Trichoderma sp.(P71H) on rubberwood

Anti-sapstain Treatment	Average
Untreated Control	4.0±0.0
0.5%NaPCP	1.0±0.0
1.0%NaPCP	1.0±0.0
0.05%F1 + 0.1%F2	1.0±0.0
0.05%F1 + 0.2%F2	1.0±0.0
0.1%F1 + 0.5%F2	1.0±0.0
0.1%F1 + 0.1%F2	1.0±0.0
0.1%F1 + 0.2%F2	1.0±0.0
0.2%F1 + 0.1%F2	1.0±0.0
0.5%Tuffbrite C	1.0±0.0
1%Tuffbrite C	1.0±0.0
2%Tuffbrite C	1.0±0.0
1%Tuffbrite 404	1.0±0.0
2%Tuffbrite 404	1.0±0.0
1%NeXgen	1.0±0.0
2%NeXgen	1.0±0.0

Table 4. Comparison of the effectiveness of anti-sapstain treatments against Aureobasidium pullulans (MDX-18) on rubberwood

Anti-sapstain Treatment	Average
Untreated Control	4.0±0.0
0.5% NaPCP	1.0±0.0
1.0% NaPCP	1.0±0.0
0.05%F1 + 0.1%F2	1.0±0.0
0.05%F1 + 0.2%F2	1.0±0.0
0.1%F1 + 0.05%F2	1.0±0.0
0.1%F1 + 0.1%F2	1.25±0.43
0.1%F1 + 0.2%F2	1.0±0.0
0.2%F1 + 0.1%F2	1.0±0.0
0.5%Tuffbrite C	1.0±0.0
1%Tuffbrite C	1.0±0.0
2%Tuffbrite C	1.0±0.0
1%Tuffbrite 404	1.0±0.0
2%Tuffbrite 404	1.0±0.0
1%NeXgen	1.0±0.0
2%NeXgen	1.0±0.0

Table 5. Comparison of the effectiveness of anti-sapstain treatments against Ceratocystis minor(C-188) on rubberwood

Anti-sapstain Treatment	Average
Untreated Control	2.50±0.50
0.5% NaPCP	1.0±0.0
1.0% NaPCP	1.0±0.0
0.05%F1 + 0.1%F2	1.50±0.50
0.05%F1 + 0.2%F2	1.75±0.43
0.1%F1 + 0.05%F2	1.0±0.0
0.1%F1 + 0.1%F2	1.75±0.43
0.1%F1 + 0.2%F2	1.0±0.0
0.2%F1 + 0.1%F2	1.0±0.0
0.5%Tuffbrite C	1.0±0.0
1%Tuffbrite C	1.0±0.0
2%Tuffbrite C	1.0±0.0
1%Tuffbrite 404	1.0±0.0
2%Tuffbrite 404	1.0±0.0
1%NeXgen	1.0±0.0
2%NeXgen	1.0±0.0

3.2 Laboratory evaluation of Tuffbrite C. Tuffbrite 404 and NeXgen for stain and mold control on maple

Table 6. Comparison of the effectiveness of anti-mold treatments against Aspergillus niger on maple

Anti-sapstain Treatment	Average
Untreated Control	4.0±0.0
0.5%Tuffbrite C	3.0±0.0
1%Tuffbrite C	1.0±0.0
1%Tuffbrite 404	1.0±0.0
2%Tuffbrite 404	1.0±0.0
1%NeXgen	1.0±0.0
2%NeXgen	1.0±0.0

Table 7. Comparison of the effectiveness of anti-mold treatments against Penicillium sp. on maple

Anti-sapstain Treatment	Average
Untreated Control	4.0±0.0
0.5%Tuffbrite C	1.0±0.0
l%Tuffbrite C	1.0±0.0
l%Tuffbrite 404	1.0±0.0
2%Tuffbrite 404	1.0±0.0
l%NeXgen	1.0±0.0
2%NeXgen	1.0±0.0

Table 8. Comparison of the effectiveness of anti-mold treatments against Trichoderma sp.(p71H) on maple

Anti-sapstain Treatment	Average
Untreated Control	4.0±0.0
0.5%Tuffbrite C	1.0±0.0
1%Tuffbrite C	1.0±0.0
1%Tuffbrite 404	1.0±0.0
2%Tuffbrite 404	1.0±0.0
1%NeXgen	1.0±0.0
2%NeXgen	1.0±0.0

Table 9. Comparison of the effectiveness of anti-sapstain treatments against Aureobasidium pullulans (MDX- 18) on maple

Anti-sapstain Treatment	Average
Untreated Control	4.0±0.0
0.5%Tuffbrite C	1.0±0.0
1%Tuffbrite C	1.0±0.0
1%Tuffbrite 404	1.0±0.0
2%Tuffbrite 404	1.0±0.0
1%NeXgen	1.0±0.0
2%NeXgen	1.0±0.0

Table 10. Comparison of the effectiveness of anti-sapstain treatments against Ceratocystis pilifera (RWD 9472) on maple

Anti-sapstain Treatment	Average
Untreated Control	4.0±0.0
0.5%Tuffbrite C	1.0±0.0
1%Tuffbrite C	1.0±0.0
1%Tuffbrite 404	3.25±0.43
2%Tuffbrite 404	3.0±0.0
1%NeXgen	1.0±0.0
2%NeXgen	1.0±0.0

From Tables 1-10, F1 and F2 mixture, Tuffbrite C, Tuffbrite 404, NeXgen inhibited mold and stain fungi very effectively although Tuffbrite 404 did not inhibit Ceratocystis pilifera on maple (Table 10) and some formulations at lower concentrations on rubberwood and maple (Tables 5 and 6). The higher concentrations might work very well. The F1 and F2 mixture might be suggested for commercial use according to the following pilot test of stain and mold control from this of Botryodiplodia theobromae on rubberwood.

REFERENCE

1. Woods T L, Bell J P. Development of Chlorothalonil As a Wood Preservative. Proc. Am. Wood Preservers' Assoc. 1990, 86:190~196

2. Woods T L. Chlorothalonil as a New Wood Preservative. Wood Preservation Beyond '90

3. Laks P E, Pickens T L et al. Performance of Chlorothalonil and Chlorothalonil /Biocide Combinations in Anti-sapstain Tests. Forest Prod. J., 1991, 41(5):23~30

4. Woods T L, Laks P E, Fears R D. Wood Preservative Effectiveness of Combinations of Chlorothalonil and Chlorpyrifos. Proc. Am. Wood Preservers' Assoc. 1994, 90:22~24

5. Laks P E et al. Efficacy of Chlorothalonil against 15 Wood Decay Fungi. Forest Prod. J., 1992, 42(9):33~38

6. Micales J A, Highley T L, Richter A L. The Use of Chrolothalonil for Protection against Mold and Sapstain Fungi. IRG/WP 89-3515

7. Laks P E et al. Evaluation of Chrolothalonil for Stain and Mold Control on Lumber. IRG/WP 92-3713

8. Woods T L et al. Evaluation of the Effectiveness of In the Control of Sapstain In The Laboratory And Field Tests. IRG/WP 92-3718

9. Laks P E, Woods T L. Chrolothalonil: A New Ground Contact Wood Preservatives. IRG/WP 92-3712

10. Kennedy M J, Woods T L. Selective Adsorption of Antisapstain Actives from 2 Aqueous Suspensions, and Movement of Actives into Wood. IRG/WP 96-30103

11. Wakeling R, Woods T L. Antisapstain Field Trials of Nexgen in New Zealand. IRG/WP 97-30145

12. Eden D et al. Field Performance of Novel Antisapstain Formulations. IRG/WP 97-30125

13. Wakeling R, Maynard P. Laboratory & Field Trials of Novel Antisapstain Formulations. IRG/WP 97-30146

14. Wong A H H, Woods T L, Hong L T, Leech T J. A Malaysian Performance Evaluation of Selected Environmentally Acceptable Preservatives against Sapstain in Green Rubberwood. IUFRO, 1997