Effectiveness of Neem (*Azadirachta indica* A. Juss) Oil against Decay Fungi

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**Abstract**—The enormous use of metallic wood preservatives has caused destructive impact on environment as well as human health. Therefore realizing the urgency of switching to Environment friendly options such as natural oils are being tested for their antimicrobial properties. The present study aimed at investigating potential of Neem oil against the growth of decaying fungi. The ability of Neem oil to inhibit mycelia growth of *Schizophyllum commune*, *Fusarium oxysporum*, *Fusarium proliferatum*, *Coniophora puteana* and *Alternaria alternata* was tested at different concentrations of 0.25, 0.50, 0.75, 1.0, 2.0, 4.0, 6.0, 8.0 and 10%. Results of the study revealed Neem oil concentrations above 2% were significantly inhibitory to all the tested fungi.

**Keywords:** Antimicrobial, Neem Oil, Decaying Fungi, Mycelia, Wood Preservatives

**INTRODUCTION**

Bamboo is the best renewable natural resource with more than 1500 uses. Its strength comparable to timber, diversity and abundance in tropical and subtropical parts of world has made it a potential replacement for steel and timber (Scurlock et al. 2000). But the major drawback in using bamboo is its low natural durability. Bamboo has high amount of starch and negligible amount of extractives unlike timber, therefore, it becomes an easy prey to fungi (Kumar et al. 1994; Wei et al. 2013). With preservative treatment the service life of bamboo can be effectively enhanced but unbridled use of chemicals in wood preservation industry has brought human as well animal population at the verge of health threat. In many countries some of carcinogenic preservatives have been already banned (Edlich et al. 2005). Therefore, to explore antimicrobial potential of natural plants scientists have carried out extensive research on extracts and oils of various plant products. In present study Neem oil has been tested against various fungi including white rot, brown rot, soft rot and sap stain (Sharia et al. 2012; Kumar et al. 2013; Hyde et al. 2001; Schmidt et al. 2011). Neem oil is known to possess antimicrobial propertied and has been widely studied for its potential against fungi (Khetarpal 2010).

**MATERIALS AND METHOD**

Neem seed oil/ Neem oil was procured from the market with brand name VyaaNeem tail. Fungal strains of brown rot *Coniophora puteana* (Acc. No. MTCC 1068), white rot *Schizophyllum commune* (Acc. No. MTCC 1096), sap stain *Alternaria alternata* (Acc. No. 2060) were obtained from The Microbial Type Culture Collection and Gene Bank (MTCC), IMTECH Chandigarh and was maintained on Potato Dextrose Agar (PDA) medium at 25 ± 2°C. The soft rots *Fusarium proliferatum* and *Fusarium oxysporum* were provided by The Department of Horticulture, Aromatic and Medicinal Plants. These strains were also maintained on Potato Dextrose Agar medium at 25 ± 2°C.

**POISONED FOOD TECHNIQUE (PF)**

The antifungal property of Neem oil against the test fungi was assessed using the Poisoned Food (PF) technique. Different concentrations of Neem oil (0.25, 0.50, 0.75, 1.0, 2.0, 4.0, 6.0, 8.0, 10.0%) were added into the potato dextrose agar medium and 30 ml of medium was poured into each sterilized Petri dish (9 mm diameter). A final concentration of 0.5% (v/v) DMSO was used to dissolve Neem oil in PDA. DMSO was used as positive control. After inoculation with 5mm diameter mycelia discs were cut from the periphery of a freshly growing PDA culture, plates were incubated for 15...
days at 25 ± 1°C and 70 ± 2% relative humidity. Five replicates were taken for each concentration. The lowest concentration which inhibited the visible growth of the fungus was considered as minimum inhibitory concentration (MIC). Percentage of mycelia growth inhibition was calculated by the following formula:

\[
\text{Growth inhibition(%) = \frac{(dc - dt)}{dc} \times 100}
\]

Where,
'\(dc\) is the average diameter of fungal colony at 0.0% concentration of Neem oil,
'\(dt\)' denotes the average diameter of fungal colony in the treatment.

RESULTS AND DISCUSSION

Neem oil has proven efficacious as an insecticide. The present study is an attempt to evaluate its efficacy as a potential bio fungicide. The results of fungal growth inhibition at different concentrations of Neem oil (0–10.0%) are shown in Fig. 1.

In present investigation, the inhibitory effect of Neem oil was determined against the wood and bamboo decaying white rot, brown rot, soft rot and sap stain fungi at various concentrations using the food poison technique (Table 1). Neem oil was found to be effective against all the tested fungi in the present investigation. At the lowest tested concentration of Neem oil i.e., 0.25% there was no inhibition in the growth of \(S.\ commune\) whereas little inhibition as 5.0% and 2.5% was recorded in \(C.\ puteana\) and \(F.\ proliferatum\) respectively. At same concentration \(F.\ oxysporum\) and \(A.\ alternata\) were inhibited to fairly good extent as 16% and 12% respectively. At 0.0% concentration there was 100% growth of all the tested fungi. While in positive control (DMSO) there was 2.20, 5.00, 2.50, 15.54 and 12.00% growth inhibition in \(S.\ commune\), \(C.\ puteana\), \(F.\ proliferatum\), \(F.\ oxysporum\) and \(A.\ alternata\) respectively. With subsequent increments in concentration of Neem oil the growth inhibition rate of each fungus also increased. The 50% of growth inhibition was achieved in \(F.\ proliferatum\) at very low concentration of 0.25% only. While same extent of inhibition was recorded for \(S.\ commune\) at 2.0% concentration and for \(C.\ puteana\) and \(F.\ proliferatum\) at 4.0%. Complete inhibition for \(A.\ alternata\) and \(C.\ puteana\) occurred at the highest concentration taken in the experiment i.e., 10.0% while for \(S.\ commune\) it was achieved at 8.0%. Complete inhibition was achieved for both the soft rot fungi at lower concentration than the other test fungi i.e., 6.0% (Fig. 2 and 3).

![Efficiency of Neem Oil Against Fungi](image)

**Fig. 1: Growth Percent Inhibition of Bamboo Decaying Fungi by Neem Oil**

**Table 1: CRD Factorial Analysis of Percent Growth Inhibition of Fungi at Different Concentrations of Neem Oil**

<table>
<thead>
<tr>
<th>Neem Oil Concentrations (%) (B)</th>
<th>Fungal Strains (A)</th>
<th>Mean B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Control (DMSO)</td>
<td>(S.\ commune)</td>
<td>7.45</td>
</tr>
<tr>
<td>0.25</td>
<td>2.20, 5.00</td>
<td>14.07</td>
</tr>
<tr>
<td>0.50</td>
<td>3.14, 15.87</td>
<td>15.56</td>
</tr>
<tr>
<td>0.75</td>
<td>4.24, 22.54</td>
<td>15.56</td>
</tr>
<tr>
<td>1.00</td>
<td>4.33, 28.00</td>
<td>15.56</td>
</tr>
<tr>
<td>2.00</td>
<td>5.00, 36.00</td>
<td>15.56</td>
</tr>
<tr>
<td>4.00</td>
<td>6.10, 58.99</td>
<td>15.56</td>
</tr>
<tr>
<td>6.00</td>
<td>6.50, 60.55</td>
<td>15.56</td>
</tr>
<tr>
<td>8.00</td>
<td>100, 77.78</td>
<td>15.56</td>
</tr>
<tr>
<td>10.00</td>
<td>100, 100</td>
<td>15.56</td>
</tr>
<tr>
<td>Mean A</td>
<td>51.003</td>
<td>41.519</td>
</tr>
<tr>
<td>Factors</td>
<td>C.D @ 0.05</td>
<td>SE(d)</td>
</tr>
<tr>
<td>Factor(A)</td>
<td>0.599</td>
<td>0.303</td>
</tr>
<tr>
<td>Factor(B)</td>
<td>0.847</td>
<td>0.429</td>
</tr>
<tr>
<td>Factor(A × B)</td>
<td>1.893</td>
<td>0.959</td>
</tr>
</tbody>
</table>
CRD two factorial analyses of the results of percent fungal growth inhibition shows that increase in Neem oil concentrations significantly reduced the growth in all five fungal strains. Minimum inhibitory concentrations for both the *Fusarium* strains was 6.0%, 8.0% for *S. commune*. Likewise for *A. alternata* and *C. puteana* was found to be 10%. However, the results also revealed that Neem oil was effective even at lower concentrations (4.0%) for the inhibition of growth of *Fusarium* compared to other fungal strains. Overall, Neem oil concentrations above 1.0% showed a steep reduction of fungal growth. Neem oil-induced growth inhibition was highest in *Fusarium* strains followed by *S. commune* even at lower concentrations whereas *A. alternata* and *C. puteana* needed slightly higher concentrations to be effective.

**DISCUSSION**

The Neem oil was found to be significantly effective in inhibiting the growth of bamboo decaying fungi. The results obtained were in conformity with the findings reported by in other studies (Al-Abed et al. 1993; Quasem et al. 1996; Amadioha 1998; Amadioha 1999; Amadioha 2003; Steinhauer 1996; Al-Hazmi 2013; Kazmi et al. 1995; Ilyas et al. 1997; Shivpuri 1997; Mondali et al. 2009; Dubey et al. 2009). The Neemseed oil completely inhibited the growth of fungi viz., *F. moniliforme*, *Aspergillus niger*, *Drechslera rostrata* and *M. phaseolina* at 10.00% (Niaz et al. 2008). Niaz and Kazmi (2005) had found that Neem oil was effective against *Aspergillus* species. Singh et al. (1980) reported fungicidal impact of Neem oil against four pathogenic fungi while Singh et al. (1993) found the radial growth inhibition of *S. rolfsii* by Neem oil.

The active ingredients of Neemare mostly of triterpinoides, e.g., nimbin, nimbidine, azadirachtin etc. Neem contains varied chemical constituents such as nimolicinol, isoslimolicinolide, azadirachtol, nimmiline, nimbocinol, nimocin etc (Brahmachari 2004; Tewari 1992). The azadirachtin component of Neem has been reported to be as effective fungicidal as bavistin and mancozeb (Dubey et al. 2003).

Mizoram is well known for utility of Bamboo for both short term and long term uses. At the same time climatic conditions are highly suitable for fungal degradation. Therefore, it becomes invariably important to protect the raw material and products to enhance the service life. Neem oil being an effective and eco-friendly preservative as supported by the findings of present study and several other studies, there is scope for further testing with various combinations and against broad groups of wood decaying fungi.

**ACKNOWLEDGEMENT**

Authors are thankful to the HOD, Department of Forestry, Mizoram University, Aizawl for providing the laboratory facilities to conduct the experiments.

**REFERENCES**


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