IMPACT OF TRICHODERMA PLEUROTUM AND T. PLEUROTICOLA ISOLATES ON YIELDING OF PLEUROTUS OSTREATUS (FR.) KUMM.

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Abstract: The influence of substrate infestation with Trichoderma pleurotum and T. pleuroticola isolates on yielding of two commercial strains of Pleurotus ostreatus was investigated. The examined P. ostreatus strains growing on substrates infested with Trichoderma isolates showed a considerable yield decline. T. pleuroticola isolates were found to exert a greater unfavorable impact on P. ostreatus yields than T. pleurotum isolates. The performed experiments demonstrated that the response of the examined P. ostreatus strains to infestations with T. pleurotum and T. pleuroticola isolates was similar.

Key words: Trichoderma spp., Pleurotus ostreatus, strain, infested substrate, yield

INTRODUCTION

According to recent investigations, oyster mushroom cultivations are infested with two genetically closely related, though phenotypically quite different, Trichoderma species: T. pleuroticola and T. pleurotum (Kommon-Żelazowska et al. 2007). The above-mentioned species were found in mushroom cultivations and substrates in Europe, Iran and South America. T. pleuroticola species was found to occur in soil and wood samples obtained from different regions of Canada, the USA, Europe, Iran and New Zealand (Park et al. 2004a–c; Szekeres et al. 2005; Kommon-Żelazowska et al. 2007). A wide range of different species of green fungi were isolated from oyster mushroom cultivations in many countries including South America (Sharma and Vijay 1996), South Korea (Park et al. 2004, 2006), Italy (Woo et al. 2004), Hungary (Hatvani et al. 2007), Romania (Kredics et al. 2006) as well as in Spain (Gea 2009). Kommon-Żelazowska et al. (2007) demonstrated that, in the environment in which oyster mushroom occurs, T. pleurotum and T. pleuroticola isolates probably occupy various ecological and trophic niches. In the environment in which Pleurotus ostreatus occurs, a number of species of the Trichoderma genus were also identified. The most frequent of them included: T. pleuroticola as well as T. harzianum, T. longibrachiatum and T. atroviride (Kredics et al. 2009). The PCR marker developed in recent years, allows for a rapid method of identifying the two aggressive Trichoderma species found in oyster mushroom cultivations: T. pleurotum and T. pleuroticola (Park et al. 2006; Kredics et al. 2009).

The aim of our investigations was to determine the impact of substrate infestation with different T. pleurotum and T. pleuroticola isolates on yields of two commercial strains of P. ostreatus.

MATERIALS AND METHODS

The following two strains of P. ostreatus were used in the experiment: P80 and PX. The P80 strain is widely cultivated in Poland at the present time, whereas the PX strain was popular in the 1970s and 1980s. The T. pleurotum and T. pleuroticola isolates used in the experiments are shown in table 1.

The substrate employed in the trial was straw cut into 2–5 cm in length chaff. The experimental substrate was subjected to pasteurization with water steam of 90–95°C for a period of 1 hour, moistened with tap water to achieve a moisture content of 67 to 70% and then placed in perforated plastic foil bags. The bags were filled with 12 kg of substrate each. A hydraulic press was used for filling the bags. Substrate blocks in plastic foil bags measured 25x30x35 cm. Incubation took place in darkness, at a temperature of 18–21°C and with a relative air humidity of 80–85%.
Table 1. List of *Trichoderma* isolates used in the studies

<table>
<thead>
<tr>
<th>Species</th>
<th>Isolate designation</th>
<th>Identification</th>
</tr>
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<tbody>
<tr>
<td><em>T. pleurotum</em></td>
<td>E136</td>
<td>Vienna University of Technology, Institute of Chemical Engineering, Division of Applied Biochemistry and Gene Technology</td>
</tr>
<tr>
<td><em>T. pleurotum</em></td>
<td>E139</td>
<td>Institute of Genetics Polish Academy of Science, Poznań</td>
</tr>
<tr>
<td><em>T. pleurotum</em></td>
<td>T12/B</td>
<td>Institute of Genetics Polish Academy of Science, Poznań</td>
</tr>
<tr>
<td><em>T. pleuroticola</em></td>
<td>M142</td>
<td>Vienna University of Technology, Institute of Chemical Engineering, Division of Applied Biochemistry and Gene Technology</td>
</tr>
<tr>
<td><em>T. pleuroticola</em></td>
<td>M143</td>
<td>Institute of Genetics, Polish Academy of Science, Poznań</td>
</tr>
<tr>
<td><em>T. pleuroticola</em></td>
<td>T4/15/A</td>
<td>Institute of Genetics, Polish Academy of Science, Poznań</td>
</tr>
</tbody>
</table>

Mycelium of the examined oyster mushroom strains was prepared in the biological laboratory of the Department of Vegetable Science, Poznań University of Life Sciences and in the Cultivated Mushroom Spawn Farm in Lobez near Jarocin. The cultivation substrate was inoculated using grain mycelium prepared according to the recipe developed by Lemke (1971). Mycelium of the tested *T. pleuroticola* and *T. pleurotum* isolates was also prepared on wheat grain in the same way as the oyster mushroom mycelium. Infestation of cultivation substrates using the grain mycelium of *Trichoderma* isolates was carried out on day 12 of the oyster mushroom incubation. The cultivation substrate in plastic bags, was inoculated with the mycelium of the examined *Trichoderma* isolates. A 3 cm diameter tube with a piston was used to do the inoculating. Approximately 5 g of mycelium were introduced into the cultivation block to a depth of 9–11 cm. The mycelium was introduced in such a way as to achieve possible uniform distribution of the inoculum, by injecting it into 5 precisely defined places (corners and the centre) of the substrate block on each block side. A total of 50 g of grain mycelium of the above-mentioned *Trichoderma* isolates was used to inoculate each substrate block. Then, the blocks were incubated in darkness at a temperature of 21°C and 85–90% humidity. Incubation was conducted until the 21st day counting from the day of substrate inoculation with the oyster mushroom mycelium. After incubation, the substrate was transferred to the cultivation chamber where the temperature was kept at 13–15°C and relative air humidity – at 80–85%. The cultivation chamber was lit with fluorescent bulbs (Day-Light) with a lighting intensity of 500 lx for 10 hour a day periods.

In the described trials, only yields of the first flush were harvested because due to the infestation with fungi of the *Trichoderma* genus, no yields were harvested from the second flush in any of the experimental combinations. The control combinations were PX and P80 strains grown on non-infested substrate. Two cultivation cycles were carried out.

**RESULTS**

Yields of the PX strain growing on the non-infested substrate amounted to 173 g/kg fresh matter of substrate. The highest oyster mushroom yields on the substrate infected with *T. pleurotum* were recorded in the case of the E139 isolate (102 g/kg). The remaining two strains, *i.e.* T12/B and E136 caused significantly smaller but similar oyster mushroom yield losses. In the case of infestation with the above-mentioned isolates, oyster mushroom yields amounted to, respectively, 81 and 73 g/kg fresh matter of substrate. Yields obtained from the PX strain infested with the *T. pleuroticola* strain were considerably smaller. The highest oyster mushroom yield was observed in the case of infestation with M142 isolate (55 g/kg). Oyster mushroom yields obtained on substrates infested with M143 (40 g/kg) and T4/15/A (36 g/kg) isolates were similar (Fig. 1).

![Fig. 1. Yield of *P. ostreatus* PX strain on substrate infested with *T. pleurotum* and *T. pleuroticola* isolates](image-url)
The performed analysis of the percentage of *P. ostreatus* yield losses of the P80 strain cultivated on substrates infested with *T. pleurotum* and *T. pleuroticola* isolates revealed that infestation with the above-mentioned isolates caused very significant yield drops. Substrate infestation with *T. pleuroticola* isolates led to high yield losses. The highest yield loss of the P80 strain was determined in the case of the infestation of the substrate with the M143 isolate (84.6%) and the smallest – when the substrate was treated with the M142 isolate (78.5%). Substrate infestation with the *T. pleurotum* isolate caused yield losses of the P80 strain ranging from 69.7% in the case of substrate infestation with the E139 isolate, to 54.9% in the case of the E136 isolate (Table 3).

Table 3. Yield reduction [%] of *P. ostreatus* P80 strain on substrate infested with *T. pleurotum* and *T. pleuroticola* isolates

<table>
<thead>
<tr>
<th>Strain + <em>Trichoderma</em> sp. isolate</th>
<th>Yield reduction [%]</th>
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<tbody>
<tr>
<td>P80 + <em>T. pleurotum</em> M143</td>
<td>84.6</td>
</tr>
<tr>
<td>P80 + <em>T. pleurotum</em> T4/15/A</td>
<td>80.5</td>
</tr>
<tr>
<td>P80 + <em>T. pleurotum</em> M142</td>
<td>78.5</td>
</tr>
<tr>
<td>P80 + <em>T. pleuroticola</em> E139</td>
<td>69.7</td>
</tr>
<tr>
<td>P80 + <em>T. pleurotum</em> T12/B</td>
<td>64.1</td>
</tr>
<tr>
<td>P80 + <em>T. pleuroticola</em> E136</td>
<td>54.9</td>
</tr>
</tbody>
</table>

DISCUSSION

The performed trials showed that fungi of the *Trichoderma* genus, i.e. *T. pleurotum* and *T. pleuroticola* species caused significant losses of *P. ostreatus* yields. It can be said that *T. pleuroticola* isolates resulted in greater yield losses.

There is no information in the available literature regarding the influence of substrate infestation with *Trichoderma* isolates on *P. ostreatus* yields. Earlier investigations conducted by the authors concerning the impact of *T. aggressivum* f. *europaeum* showed that *Agaricus bisporus* strains are characterised by different resistance to the infestation with the above-mentioned *Trichoderma* species. We found that brown strains responded to the infestation with lower yield losses than white strains (Sobiersalski et al. 2009). The performed experiments failed to demonstrate significant differences in the response to *T. pleurotum* and *T. pleuroticola* infestation between the two examined *P. ostreatus* strains. The P80 strain yield cultivated on the substrate not infested with *Trichoderma* isolates, was slightly higher than the yield of the PX strain. Nonethe-
less, yield losses in the case of both species infested with *T. pleurotum* and *T. pleuroticola* isolates were very similar.

The performed experiments confirmed the results of earlier studies regarding yield losses caused by aggressive forms of *Trichoderma* in mushroom cultivations. Investigations carried out in recent years revealed that fungi of the *Trichoderma* genus can significantly reduce yields of *Coprinus comatus* (Frużyńska-Jóźwiak et al. 2011). The performed experiments confirmed that like *P. eryngii*, *P. ostreatus* also show poor resistance to infestations of the *P. ostreatus* species associated with *Pleurotus ostreatus* and natural substrates of the oyster mushroom. Microbial. Lett. 300: 58–67.


CONCLUSIONS

1. Infestation of the cultivation substrate with *T. pleurotum* and *T. pleuroticola* isolates caused significant yield losses of the examined strains of *P. ostreatus*.

2. Substrate infestation with *T. pleuroticola* isolates exerted a stronger negative impact on *P. ostreatus* yields than with the *T. pleurotum* isolate.

3. The observed response of *P. ostreatus* strains to the infestation of growing substrates with *T. pleurotum* and *T. pleuroticola* isolates was similar.

REFERENCES


