EFFECT OF *TRICHODERMA* ISOLATES ON YIELDING OF WILD STRAINS OF *COPRINUS COMATUS*

Dorota Frużyńska-Jóźwiak[1], Krzysztof Sobieralski[2], Marek Siwulski[2], Tomasz Spiżewski[2], Lidia Błaszczyk[3], Iwona Sas-Golak[2]*

Poznań University of Life Sciences
Dąbrowskiego 159, 60-594 Poznań, Poland
[1] Department of Phytopathology
[2] Department of Vegetable Crops
[3] Institute of Plant Genetics, Polish Academy of Science
Strzeszyńska 34, 60-479 Poznań, Poland

Received: March 3, 2011
Accepted: July 18, 2011

Abstract. The impact of infestation with *Trichoderma aggressivum* f. *europeanum* and *Trichoderma longibrachiatum* isolates on the yielding of three wild strains and one cultivated strain of *Coprinus comatus* was investigated. A significant yield reduction of *C. comatus* on substrates infested with the examined *Trichoderma* isolates was determined. The recorded percentage yield reduction was significantly higher in the case of the infestation with the *T. aggressivum* than with the *T. longibrachiatum* isolate.

Key words: *Trichoderma* spp., *Coprinus comatus*, wild strains, cultivated strain, yield

INTRODUCTION

The greatest losses in mushroom cultivation are brought about by fungi from the *Trichoderma* genus which cause green moulds (Mamoun *et al*. 2000). The most aggressive forms of the above-mentioned fungi were designated as *Trichoderma aggressivum* f. *europeanum* Th2 in Europe, and *T. aggressivum* f. *aggressivum* strain Th4 identified in North America (Williams *et al*., 2003). The above-mentioned strains constitute biotypes of a non-aggressive form of *T. harzianum* in relation to cultivated mushrooms. The aggressive strains differ from non-aggressive forms, primarily, by the speed of mycelium growth (Samuels *et al*. 2002; Sobieralski *et al*. 2009). The cultivation of *Agaricus bisporus* is technologically similar to the cultivation of *Coprinus comatus*. In the cultivation of *A. bisporus*, apart from the above-mentioned species of *Trichoderma,* the species *T. atroviride* and *T. longibrachiatum* also frequently occur (Szczech *et al*. 2008).

The objective of the performed investigations was to determine the influence of the substrate infestation with *T. aggressivum* f. *europeanum* and *T. longibrachiatum* isolates, on yielding of several wild strains and one cultivated strain of *C. comatus*.

MATERIALS AND METHODS

Both isolates of *Trichoderma* as well as *C. comatus* strains derived from the collection of cultivated mushrooms of the Department of Vegetable Crops, Poznań University of Life Sciences. Two *Trichoderma* isolates *i.e. T. aggessivum* f. *europaeum* T.a/c/KW/11/12 and *T. longibrachiatum* T.l/d/KW/3/27 obtained from mushroom farms, were used in the experiment. Identification of isolates was carried out at the Institute of Plant Genetics – the Poznań Branch of the Polish Academy of Sciences. The applied polimeraze chain reaction (PCR) techniques, PCR multiplex and radom amplification of polymorphic DNA (RAPD) revealed that the isolates used in the experiments belonged to the *T. aggressivum* f. *europeanum* and *T. longibrachiatum* biotypes. Three strains of *C. comatus*: Cop.KW/12/2, Cop. RM/9/6 and Cop.WS/12/8 obtained in 2009 from natural sites located in different regions of Poland as well as one cultivated strain Somycel 4030 were used in the experiments. Detailed methods and techniques of substrate and cover preparation along with conditions required during cultivation were given by Siwulski *et al*. (2001).

The results of the experiment were compared using the analysis of variance for factorial experiments at the level of significance $\alpha = 0.05$ (the Newman-Keuls test).

RESULTS

The performed experiments revealed that the infestation of the cultivation substrate with the *T. aggressivum* f. *europaeum* isolate resulted in a significant yield drop. The yields from the *C. comatus* strains obtained on the infested

*Corresponding address:
romstand@up.poznan.pl

substrate, fluctuated from 18 to 37 g/kg fresh matter of substrate (Fig. 1). Yield reduction varied widely from 26 to 59% (Table 1). Yields of the wild strains Cop.KW/12/2 and Cop.WS/12/8 as well as of the cultivated strain Somycel 4030 grown on the substrate infested with the above-mentioned isolate were reduced by similar values, namely: 56.1 and 59.0%. The response of the third wild strain – Cop.RM/9/6 was different and the yield drop amounted to only 26%.

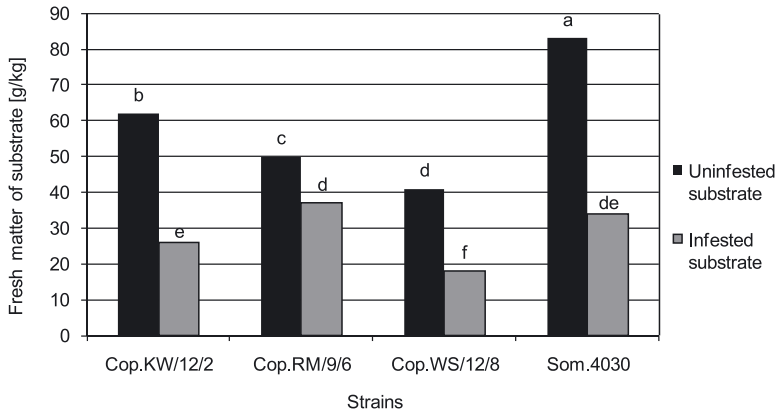
Table 1. Reduction of yield (in %) of wild and cultivated strains of *C. comatus* grown on substrates infested with the *T. aggressivum* f. *europaeum* T.a/c/KW/11/12 isolate

Strain + isolate	Yield reduction in %
Cop.KW/12/2 + *T. aggressivum* f. *europaeum* T.a/c/KW/11/12	58.1
Cop.RM/9/6 + *T. aggressivum* f. *europaeum* T.a/c/KW/11/12	26.0
Cop.WS/12/8 + *T. aggressivum* f. *europaeum* T.a/c/KW/11/12	56.1
Som.4030 + *T. aggressivum* f. *europaeum* T.a/c/KW/11/12	59.0

Analysing the yielding of *C. comatus* strains on substrates infested with the *T. longibrachiatum* isolate, showed a yield range of from 21 g/kg fresh matter of the substrate in the case of strain Cop.RM/9/6 to 65 g/kg fresh matter of the substrate in the case of the cultivated Somycel 4030 strain (Fig. 2). Both wild strains and the cultivated strain of *C. comatus* grown on substrates infested with *T. longibrachiatum* isolate responded with significant yield drops which, in the case of Cop.KW/12/2, Cop.WS/12/8 as well as Somycel 4030 strains, ranged from 21.9 to 30.7%. Yields of the Cop.RM/9/6 strain were considerably lower and the recorded percentage yield drop amounted to 63.8% (Table 2).

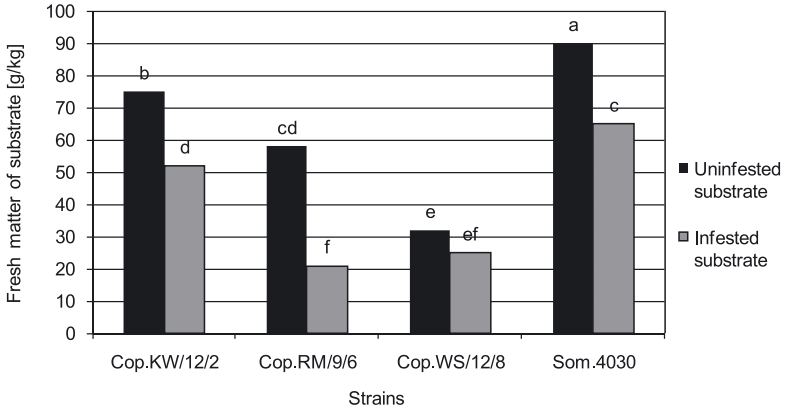
Table 2. Reduction of yield (in %) of wild and cultivated strains of *C. comatus* grown on substrates infested with the *T. longibrachiatum* T.l/d/KW/3/27 isolate

Strain + isolate	Yield reduction in %
Cop.KW/12/2 + *T. longibrachiatum* T.l/d/KW/3/27	30.7
Cop.RM/9/6 + *T. longibrachiatum* T.l/d/KW/3/27	63.8
Cop.WS/12/8 + *T. longibrachiatum* T.l/d/KW/3/27	21.9
Som.4030 + *T. longibrachiatum* T.l/d/KW/3/27	27.8



Means followed by the same letter do not differ significantly according to Newman-Keuls's test at p = 0.05

Fig. 1. Yielding of wild and cultivated strains of *C. comatus* grown on substrates infested with the *T. aggressivum* f. *europaeum* T.a/c/KW/11/12 isolate



Means followed by the same letter do not differ significantly according to Newman-Keuls's test at p = 0.05

Fig. 2. Yielding of wild and cultivated strains of *C. comatus* grown on substrates infested with the *T. longibrachiatum* T.l/d/KW/3/27 isolate

DISCUSSION

Cultivation facilities in which mushrooms are cultivated are characterised by relatively high temperatures and air humidity in addition to large quantities of organic matter favouring the development of various species and forms of *Trichoderma* (Grogan 2005). Results obtained in the discussed experiments corroborate information presented in a number of earlier investigations carried out both in Poland and abroad, regarding the impact of fungi of the *Trichoderma* spp. on yields of the common mushroom mycelium. Researchers demonstrated, a considerable decline of yields of *A. bitorquis* in the case of its infestation with the *T. aggressivum* f. *europaeum* isolate (Sobieralski *et al*. 2010a). Moreover, they also demonstrated that the response of the common mushroom strains, gathered from natural sites, to substrate infestation with the examined *T. aggressivum* f. *europaeum* isolates, varied significantly. The observed yield drops ranged from 23.1 to 84%. The researchers also further demonstrated considerable yield reductions in other mushroom species, among others: *A. bisporus* (Sobieralski *et al*. 2009), *P. ostreatus* (Siwulski *et al*. 2009) and *P. eryngii* (Sobieralski *et al*. 2010b). Recent investigations carried out by Frużyńska-Jóźwiak *et al*. (2010) revealed that *C. comatus* strains can exhibit certain defense mechanisms in relation to *T. aggressivum* and *T. longibrachiatum* isolates. It was found in the above experiments that growth inhibition of the *C. comatus* mycelium by the *T. longibrachiatum* and *T. atroviride* species was much smaller than by *T. aggressivum*.

In the performed experiments the recorded declined of the *C. comatus* yield was considerably higher in the case of the infestation with *T. aggressivum* than with the *T. longibrachiatum* isolate. Moreover, the obtained results showed that the response of the examined strains expressed by the percentage drop in yields could be specific for individual strains. An interesting observation was that the Cop.RM/9/6 strain growing on the substrate infested with the *T. aggressivum* f. *europaeum* isolate responded to it with relatively small reduction of yields in comparison with other examined wild strains as well as the cultivated strain. On the other hand, the above strain infested with the *T. longibrachiatum* isolate responded with a significantly higher decline of yields in comparison with the remaining *C. comatus* strains. Earlier investigations carried out by Siwulski *et al*. (2009) and Sobieralski *et al*. (2010b) demonstrated no defensive mechanisms in strains of common mushrooms and oyster mushrooms to *T. aggressivum*. Some *C. comatus* strains derived from natural sites exhibited small yield reductions in response to the infestation with fungi of the *Trichoderma* spp. and, therefore, can be potentially useful in creative breeding of *C. comatus*.

REFERENCES

Frużyńska-Jóźwiak D., Siwulski M., Sobieralski K., Sas-Golak I., Błaszczyk L. 2010. Impact of *Trichoderma* isolates on the mycelium development of wild strains of *Coprinus comatus* (Müll.) S.F. Gray. J. Plant Protection Res. 51 (2): 162–165.

Grogan H.M. 2005. Zielone pleśnie – wczoraj i dziś. Materiały Ogólnopolskiej Konferencji Naukowej „Ochrona i Uprawa Pieczarki oraz Innych Grzybów Uprawnych". Skierniewice, 21 kwietnia 2005: 19–25.

Mamoun L.M., Savoie J-M., Olivier J-M. 2000. Interactions between the pathogen *Trichoderma harzianum* and *Agaricus bisporus* in mushroom compost. Mycologia 92 (2): 233–240.

Samuels G.J., Dodd S.L., Gams W., Castlebury L.A., Petrini O. 2002. *Trichoderma* species associated with the green mould epidemic of commercially grown *Agaricus bisporus*. Mycologia 94 (1): 146–170.

Siwulski M., Sobieralski K., Pawlak R. 2001. Utilization of wild forms of mushroom *Coprinus comatus* (Mull.) S.F.Gray in breeding of commercial strains. J. Vegetable Crop Prod. 7 (1): 3–7.

Siwulski M., Sobieralski K., Buśko S., Górski R. 2009. Wpływ różnych szczepów grzybów z rodzaju *Trichoderma* na rozwój grzybni dwóch odmian boczniaka ostrygowatego – *Pleurotus ostreatus* (Jacq.) Queilet [Influence of different isolates of *Trichoderma* genus fungi on mycelium development of two strains of oyster mushroom *Pleurotus ostreatus* (Jacq.) Queilet]. Prog. Plant Protection/Post. Ochr. Roślin 49 (2): 714–718.

Sobieralski K., Siwulski M., Frużyńska-Jóźwiak D., Górski R. 2009. Impact of *Trichoderma aggressivum* f. *europaeum* Th2 on the yielding of *Agaricus bisporus*. Phytopathologia 53: 5–10.

Sobieralski K., Siwulski M., Jasińska A., Frużyńska-Jóźwiak D., Sas-Golak I., Szymański J. 2010a. Impact of infections with *Trichoderma agressivum* f. *europaeum* isolates on the yielding of some wild strains of *Agaricus bitorquis* (Quel.) Sacc. from different regions of Poland. Phytopatologia 58: 5–11.

Sobieralski K., Siwulski M., Górski R., Frużyńska-Jóźwiak D., Nowak-Sowińska M. 2010b. Impact of *Trichoderma aggressivum* f. *europaeum* isolates on yielding and morphological features of *Pleurotus eryngii*. Phytopatologia 56: 17–25.

Szczech M., Staniaszek M., Habdas H., Ulinski Z., Szymański J. 2008: *Trichoderma* spp. – the cause of green mold on Polish mushroom farms. Vegetable Crops Res. Bull. 69: 105–114.

Williams J., Clarkson J.M., Mils P.R., Cooper R.M. 2003. Saprotrophic and mycoparasitic components of aggressiveness of *Trichoderma harzianum* groups toward the commercial mushroom *Agaricus bisporus*. Appl. Environm. Microbiol. 69 (7): 4192-4199.