

BIOLOGICAL CONTROL OF THE ROOT-KNOT NEMATODE, *Meloidogyne javanica* BY FOUR ISOLATES OF *Paecilomyces lilacinus* AND AN ISOLATE OF *Isaria farinosa* ON TOMATO PLANTS *

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Abstract

Antagonistic effects of four isolates of *Paecilomyces lilacinus* and an isolate of *Isaria farinosa* on root-knot nematode *Meloidogyne javanica* were examined under *in vitro* and greenhouse conditions. Root-knot nematode as well as fungal isolates were identified using morphological and species specific primers. Infection ability of different fungal isolates on the eggs of *M. javanica* and effects of fungal culture filtrates on egg hatching and mortality of *M. javanica* juveniles (J₂) were tested *in vitro*. Results indicated that nematode eggs parasitization percent by various fungal isolates and J₂ mortality as well as egg hatching inhibition of the culture filtrate of these fungi have variable effects on target nematode. *P. lilacinus* (isolate P3) showed more efficiency than the other isolates. In greenhouse experiment, effects of *P. lilacinus* and *I. farinosa* on tomato plant growth factors and nematode population were tested. Fungal isolates were propagated on sterilized wheat seed and mixed (0.5% w/w) with autoclaved soil. Four leaf seedlings of tomatoes were transplanted into each pot and inoculated by 4000 eggs and juveniles (J₂) after ten days. Pots were kept in greenhouse for two months. Results showed that *P. lilacinus* isolate P3, P1, P4, and P2 and *I. farinosa* had 65%, 44%, 42%, 29% and 23% nematode control, respectively, indicating a good potential of some isolates in reducing nematode population.

Keywords: Fungus culture filtrate, Plant parasitic nematode, Antagonistic fungi, *Paecilomyces*, *Isaria*.

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References

- AHMADI, A. R., KHEIRI, A., SHARIFI-TEHRANI, G. H. and HEDJAROUDE, A. 2000. Efficacy of *Paecilomyces* spp. And *Fusarium solani* on biocontrol of *Heterodera schachtii* on sugarbeet in growth chamber. **Iran. J. Plant Pathol.** 36: 113-119. (In Farsi With English Summary).
- ATKINS, S. D., CLARK, I. M., PANDE, S., HIRSH, P. R. and KERRY, B. R. 2005. The use of real-time PCR and species-specific primers for the identification and monitoring of *Paecilomyces lilacinus*. **FEMS Microbiol. Ecol.** 51: 257-269.
- BHAT, M., MUDDIN, H. and BHAT, N. A. 2009. Histological interaction of *Paecilomyces lilacinus* and *Meloidogyne incognita* on bitter group. **J. Amer. Sci.** 5: 8-12.
- CABANIILAS, E. and BARKER, K. R. 1989. Impact of *Paecilomyces lilacinus* inoculums level and application time on control *Meloidogyne incognita* on tomato. **J. Nematol.** 21: 115-120.
- CABANIILAS, E., BARKER, K. R. and DAKIN, M. E. 1988. Histology of the interaction of *P. lilacinus* with *Meloidogyne incognita* on tomato. **J. Nematol.** 20: 362-365.
- CAYROL, J., DIHIAN, C. and PIJAROWSKI, L. 1989. Study of the nematocide properties of culture filtrate of the nematophagous fungus *Paecilomyces lilacinus*. **Revue. Nematol.** 12(4): 331-336.
- DJIAN, C., PIJAROWSKI, L., PONCHET, M., APRIN, W. and FAVRE-BONVIN, J. 1999. Acetic acid: a selective nematocidal metabolite from culture filtrate of *Paecilomyces lilacinus* and *Trichoderma logibrachiatum*. **Nematologica** 37: 101-112.
- DUNN, M. T. 1983. *Paecilomyces nostocoides* a new hyphomycete isolated from cyst of *Heterodera zaeae*. **Mycologia** 75: 179-182.
- EISENBACK, J. D. and TRIANTAPHYLLOU, H. H. 1991. **Root-knot nematode: *Meloidogyne* spp. and races.** Manual of Agricultural Nematology. Marcel Dekker, New York, 374 p.
- FATEMI, S. 1998. Antagonistic activity of *Paecilomyces fumosorosceus* against *Meloidogyne javanica* and *Heterodera schachtii*. **Iran. J. Plant Pathol.** 34: 67-75 (In Farsi With English Summary).
- GANAIE, M. A. and AHMADKHAN, T. 2010. Biological potential of *Paecilomyces lilacinus* on pathogenesis of *Meloidogyne javanica* infecting tomato plant. **Eur. J. Appl. Sci.** 2: 80-84.
- GORATARI, M. C., GALARZA, B. C., CAZAU, M. C. and HOURS, R. A. 2008. Comparison of the biological properties of two strains of *Paecilomyces lilacinus* associated to their antagonistic effect on to *Toxocara canis* eggs. **Mal. J. Microbiol.** 4: 35- 41.
- GOSWAMI, B. K. and UMA R. 1997. Studies on different isolate of *Paecilomyces lilacinus* collected from different agroclimatic regions of india. **Ind. J. Nematol.** 27: 238-240.
- HOLLAND, R. J., WILLIAMS, K. L. and NEVALAINEN, K. M. H. 2001. *Paecilomyces lilacinus* strain 251 is not plant endophyte. Australas. **Plant Pathol.** 37: 473-478.
- HUSSEY, R. S. and BARKER, K. R. 1973. A comparison of method of collecting inoculation for *Meloidogyne* spp. Including a new technique. **Plant Dis. Rep.** 57: 1025-1028.
- JATALA, P. 1986. Biological control of plant parasite nematodes. **Annu. Rev. Phytopatol.** 24: 453-489.
- JATALA, P., KALTENBACH, R. and BOCANGEL, M. 1979. Biological control of *Meloidogyne incognita* and *Globodera pallid* on potatoes. **J. Nematol.** 11: 303-316.
- JENKINS, W. R. 1964. A rapid centrifugal-floatation technique for separating nematode from soil. **Plant Dis. Rep.** 48: 692-700.
- JONATHAN, E. I., ARULMOZHIAN, R., MUTHSAMAY, S. and MANUEL, W. 2000. Field application of *Paecilomyces lilacinus* for the control of *Meloidogyne incognita* on betelvine, piper betle. **Nematol. Medit.** 28: 131-133.
- KHAN, M. R. and GOSAWAMI, B. K. 1999. Nematocide effect of culture filtrate *Paecilomyces lilacinus* isolates on *Meloidogyne incognita*. **Ind. J. Nematol.** 29: 2-8.
- KHAN, M. K. and GOSWAMI, B. K. 2000. Effect of culture filtrate of *Paecilomyces lilacinus* on hatching of *Meloidogyne incognita* eggs. **Ann. Plant Protec. Sci.** 8: 62- 65.
- KHAN, A., WILLIAMS, K. L. and NEVALAINEN, H. K. M. 2004. Effects of *Paecilomyces lilacinus* protease and chitinase on the eggshell structures and hatching of *Meloidogyne javanica* juveniles. **Biological Control** 31: 346-352.

- KHAN, A., WILLIAMS, K. L. and NEVALAINEN, H. K. M. 2003. Testing the nematophagous biological control strain *Paecilomyces lilacinus* 251 for paecilotoxin production. **FEMS Microbiol. Ecol.** 227: 107-111.
- LUANGSA-ARD, J. J., HYWEL-JONES, N. L. and SAMSON, R. A. 2005. The polyphyletic nature of *Paecilomyces* sensu lato based on 18S-generated rDNA phylogeny. **Mycologia** 96: 773-780.
- MIKAMI, Y., YAZAWAK, K., FUKUSHIMA, K., ARAI, T., UDAQAVAS, S. and SAMSON, R. A. 1989. Pecilotoxin production in clinical or terrestrial isolates of *Paecilomyces lilacinus* strains. **Mycopathologia** 108: 195-199.
- MUKHTAR, T. and PERRVAZ, L. 2003. Evaluation of ovicidal and larvicidal effect of culture filtrate *Verticillium chlamydosporium* against *Meloidogyne javanica*. **Intl. J. Agric. Biol.** 4: 576- 579.
- MURRAY, H. G. and THOMPSON, W. F. 1980. Rapid isolation of high molecular weight DNA. **Nucleic Acids Res.** 8: 4321-4325.
- OCLARIT, E. and CUMAGUN, C. J. R. 2009. Evaluation of efficacy of *Paecilomyces lilacinus* as biological control agent of *Meloidogyne incognita* attacking tomato. **J. Plant Protec. Res.** 49: 337-340.
- OOSTENBRINK, M. 1966. Major characteristics of the relation between nematodes and plants. **Meded. Landbouwhogech. Wageningen.** 66: 1-46.
- PERRY, R. N., MOENS, M. and STARR, J. L. 2010. **Root-Knot Nematode**. CABI. Pub., UK. 531p.
- REDDI, K. M., SAILAJA, R. J. and JOHN, S. M. 2008. Effect of culture filtrate of *Paecilomyces lilacinus* on mortality and hatching of root-knot nematode *Meloidogyne incognita*. **Ind. J. Nematol.** 38: 1-8.
- SAMSON, R. A. 1974. *Paecilomyces* and some allied Hyphomycetes. **Studies in Mycol.** 6: 1-19.
- SASSER, J. N. 1990. **Plant Parasitic Nematodes**. North Carolina University Graphics. 115 p.
- SASSER, J. N. and CARTER, C. C. 1985. An advance treatise on *Meloidogyne*. Biology and control. North Carolina university graphics. 422 p.
- SCHENCK, S. 2004. Control of nematodes in tomato with *Paecilomyces lilacinus* strain 251. **Veg. rep.** 5: 1-5.
- STIRLING, G. R. and WEST, L. M. 1991. Fungal parasites of root knot nematode eggs from tropical and subtropical regions of Australia. **Austr. Plant Pathol.** 18: 39-44.
- TAYLOR, D. P. and NETSCHER, C. 1974. An improved technique for preparing perineal patterns of *Meloidogyne* spp. **Nematologica** 20: 268- 269.
- VERDEJO-LUCAS, S., VIERA, A., STEHIGEL, A. M. and SORRIBAS, F. J. 2009. Screening culture filtrate of fungi for activity against *Tylenchulus semipenetrans*. **Span. J. Agric. Res.** 7: 896-904.
- ZIJLSTRA, C. 1997. A fast PCR assay to identify *Meloidogyne hapla*, *M. chitwoodi* and *M. fallax* and to sensitively differentiate them each from each other and from *M. incognita* in mixtures. **Fundam. Appl. Nematol.** 20: 505-511.
- ZIJLSTRA, C., DONKERS-VENNE, D. T. H. M. and FARGETTE, M. 2000. Identification of *Meloidogyne incognita*, *M. javanica* and *M. arenaria* using sequence characterised amplified region (SCAR) based PCR assays. **Apple. Nematol.** 2: 847-853.
- ZIMMERMANN, G. 2008. The entomopathogenic fungi *Isaria farinosa* (formerly *Paecilomyces farinosus*) and the *Isaria fumosorosea* species complex (formerly *Paecilomyces fumosoroseus*): biology, ecology and use in biological control. **Biol. Sci. Technol.** 18: 865- 901.