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Paecilomyces lilacinus on Nematode Management

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Paecilomyces is one of the principal genera of importance in bio-control studies in recent years and *Paecilomyces lilacinus* is a species which is a bio-control fungus which protects the root system against diseases caused by plant parasitic nematodes, specifically root-knot nematodes (*Meloidogyne* spp.), reniform nematode (*Rotylenchulus reniformis*), banana nematodes (*Radopholus similis*) and citrus nematodes (*Tylenchulus semipenetrans*). This bio-agent colonizes the root surface and is an antagonistic fungus, strongly parasitic to eggs and egg-masses and various females of plant parasitic nematodes. Fungal parasitization can destroy upto 90% of eggs and 75-80% of egg-masses or cysts.

Introduction

Paecilomyces lilacinus is a naturally occurring fungus found in many kinds of soils throughout the world. As a pesticide active ingredient, *P. lilacinus* is applied to soil to control nematodes that attack plant roots. It is an important bio-control fungus which protects the root system against diseases caused by plant parasitic nematodes. This bio-agent colonizes the root surface and is an antagonistic fungus, strongly parasitic to eggs, egg-masses, juveniles and various females of plant parasitic nematodes. It also has a wide pH tolerance and can grow on a variety of substrates.

Distribution

P. lilacinus is a cosmopolitan in distribution, it occurs with greatest frequency in areas with a warm climate, particularly in the tropics and subtropics.

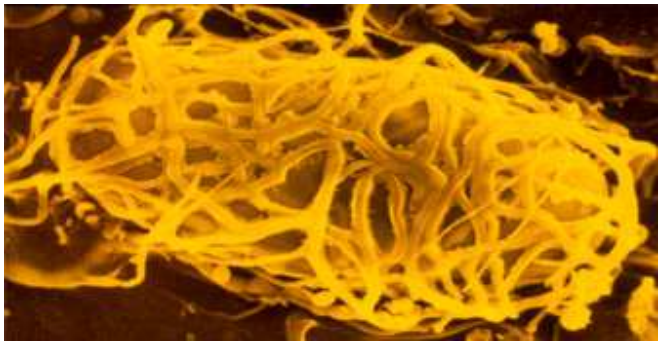
Biological mode of action

P. lilacinus has been reported to parasitize eggs of many sedentary endoparasitic nematodes. The infection process begins with growth of fungal hyphae in the gelatinous matrix; eventually the eggs of *Meloidogyne, Tylenchulus* or *Nacobbus* species are engulfed by the mycelia network, which becomes prostrate and spirals over the smooth egg surface. The proliferated hyphal branches penetrate the eggs. In cysts of *Globodera* species, the fungus penetrates the vulva or the broken and exposed neck region. After entering the cysts, the fungus grows saprophytically on the mucilaginous body content surrounding the eggs during or before its parasitism of the eggs. In all cases, eggs in the early embryonic developmental stages prior to the gastrulation process

are more vulnerable to infection. Once the hyphae is in contact with the egg, a series of ultrastructural changes occurs in the egg, shell due to the effect of exogenous metaboloites and to the chitinolytic activities of the fungus.

Colonization of eggs appears to occur by simple penetration of the egg cuticle by individual hyphae aided by mechanical or enzymatic/mechanical activities. In each case the infection peg is formed by swelling of hyphae at the penetration site. The pressure exerted on the egg cuticle, aided by the enzymatic activity of the fungus (such as chitinase production) causes rupture of the cuticle and subsequent penetration by the fungus. The pressure exerted by the hyphae can be readily distinguished by the presence of cuticular indentation at the infection site.

P. lilacinus on agar plate



P. lilacinus colonized root knot nematode egg

The exertion of pressure on the cuticle, couple with the chitinolytic activity of the hyphae can be appreciated by the observation of the extended invagination of the cuticle inside the egg around the penetrating hyphae. Once inside, the fungal mycelium radiates profusely in the eggs of early embryonic development until the entire embryo is replaced by a mycelial biomass. The mycelium may also penetrate and rupture the cuticle of the infected egg from within and then emerge to infect other eggs in the vicinity. The infection of the encased juvenile may also take place but in lower frequencies. Occasionally, *P. lilacinus* may penetrate the egg laying females through the anal and vulval openings after completely destroying the eggs in the egg mass or before the egg laying process has begun. In such case the infected female body cavity becomes filled with the fungal biomass as the nematode dies.

Target plant parasitic nematodes in soil

- *Tylenchulus semipenetrans* (Citrus nematode)
- *Radopholus similis* (Burrowing nematode)
- *Heterodera* spp. and *Globodera* spp. (Cyst nematodes)
- *Pratylenchus* spp. (Root lesion nematodes)
- *Rotylenchulus reniformis* (Reniform nematode)
- *Nacobbus* spp. (False root knot nematodes).

Commercial formulations of *P. lilacinus*

- Bio-nematon
- *Gmax bioguard*
- Bioprotectant
- Nemastin bionematicide

- Niyanthran
- Shakti Paecil
- Paceilo ®
- Nemasweep
- Sun nema
- Biocon
- Bioact/PL Plus and etc.

Methods of application

- Seed treatment
- Soil and foliar application
- Seedling root dip
- Drip irrigation

Carriers of *P. lilacinus*

- Grain substrates: Wheat, rice, sorghum, bajra, rye & gram
- Oil cakes: Neem, castor, mahua & mustard
- Plant parts: Neem leaves, Leaf extracts & residues of *Dalbergia sisoo*, Dried water lillies, *Prosopis* spp., *Hyptis suaveolus*, Banana petiole & pseudostem, castor leaves.
- Plant by-products: Sugarcane bagasse, cane trash, pressmud, sugarcane molasses, coffee husk (20g/l), soybean flour (5g/l) & distillary must (40%).

Diseases caused by *P. lilacinus*

Cats and dogs

- Paecilomycosis – infection of lungs
- Nosocomial infections
- Cutaneous infection

Human beings

- Invasive mycosis
- Keratitis
- Endophthalmitis
- Corneal ulcer
- Orbital granulomas
- Soft tissue infection
- Sinusitis
- Cutaneous ulcer
- vaginitis

Strength of *P. lilacinus*

- Good competitor in most soils
- Readily produces abundant inoculum
- Degrades chitin & strongly proteolytic
- Easily produced *in vitro*
- Antagonistic activity against bacteria and fungi
- Essential input for enriching the rhizosphere with organic matter and nematode preying fungi
- Effectively controls nematodes than the conventional chemical pesticides.

- Protects crops from nematodes throughout the crop period and hence avoid usage of chemical pesticides.
- It is target specific and do not destroy beneficial organisms.
- Promotes the growth of natural enemies of pests.

Cautions for handling and use of product

- Avoid inhalation and skin contact while diluting as there could be spillage/splashes of the product.
- Mixing and spraying equipment is to be thoroughly rinsed with water and detergent before using the same equipment for use of other agricultural chemicals.
- Surplus product should not be disposed in crop lands/stagnant water/flowing water where there is a possibility of causing pollution to natural resources
- Do not eat / drink / smoke during application.
- Direct incidence may cause irritation and therefore it is recommended that the operator should use protective gear *viz*., gloves, apron, mask, eye gear and hood.

Conclusion

P. lilacinus is a potential biocontrol agent causing reduction in the number of plant parasitic nematodes and thereby improving various plant growth parameters.

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