DITERA NEMATICIDE

Joe Maliekal*, Mark Beach, Prem Warrior

Nematodes are microscopic roundworms that are commonly in all soils. Plant parasitic nematodes infect many major food and fiber crops, as well as turf and ornamentals, and cause significant reduction in crop yield and quality. Nematodes have been estimated to cause annual crop losses of about $78 billion worldwide (from the report "Plant & Soil Nematodes: Societal Impact and Focus for the Future", sponsored by USDA-CSRS and The Society of Nematologists).

Most plant parasitic nematodes feed on the roots, but a few species attack above-ground plant parts. Damage from nematodes is primarily due to feeding and wounding, which in turn affects water and nutrient absorption, and can lead to secondary infections by bacterial and fungal pathogens. In addition, root-feeding nematodes have been implicated in transmission of viral diseases.

Plant-parasitic nematodes seldom kill plants outright. A loss of yield or quality can occur without specific above-ground symptoms. Sometimes these losses are attributed to other pests, fertility problems, or improper water management. The symptoms of nematode damage may vary among crops and are generally manifested as root galling, lesions, premature wilting, chlorosis and overall reduction in plant vigor.

The most popular means of controlling nematodes include the use of soil fumigants such as Methyl Bromide, or non-fumigant nematicides such as organophosphates and carbamates. These and most other currently used nematicides are toxic to mammals and other non-target organisms, pose a potential threat to the environment and ground water, and may leave chemical residues in food products. Resistant varieties, cultural practices such as rotation, organic amendments, and even biological control have been used with varying degrees of success to control nematodes.

DiTera is a nematicide of microbial origin discovered at Abbott Laboratories in 1987. The product is produced by submerged fermentation of the hyphomycete fungus, *Myrothecium* spp. The strain was originally isolated from a soybean cyst nematode, *Heterodera glycines* and has been further selected in the laboratory for increased activity against plant parasitic nematodes, especially the root-knot nematode, *Meloidogyne incognita*. The fungus is a common saprophyte with a cosmopolitan distribution. Abbott Laboratories holds a U.S. patent (No. 5,051,255) on this product; foreign filings have been completed and patents have been issued in several parts of the world. The active ingredient is a microbial composition containing all fermentation solids and solubles of the fungus. There are no viable propagules in this product, as determined by microbial testing of the final product. Thus, DiTera is a "killed microbial" product.

DiTera provides protection to vegetable and fruit crops specifically against plant parasitic nematodes. This microbial product exhibits environmentally safe and effective control of several economically important nematode species, including root knot (*Meloidogyne* spp.), cyst (*Heterodera* spp.), and burrowing (*Radopholus similis*) nematodes. Interestingly, DiTera has not shown any direct toxicity or adverse effect against free-living, saphrophytic, or insect-pathogenic nematodes.

The Technical Grade Active Ingredient (TGAI) of DiTera is a spray-dried powder (average particle size 40 microns) produced by fermentation, and is also known as DiTera WP. Commercial formulations include DiTera ES, an emulsifiable liquid suspension, and the granular formulations, DiTera G and WDG. Additional formulations are also under development.

DiTera is composed primarily of proteins and sugars and thus is a natural product. It is quite stable to heat and environmental rigors. The nematicidal components of DiTera are mostly soluble in water; the TGAI suspends well in water on agitation. In a stability study, carried out in support of U.S. EPA requirements for product registration, DiTera did not lose its nematicidal activity even after 24 months of storage at room temperature (25°Celsius). Moisture-controlled greenhouse experiments to determine soil persistence demonstrated that the activity is maintained to its original level up to six weeks in artificial sandy loam soil. In soil-column studies, the nematicidal activity was observed to move readily along with the water front.

The active ingredient constituents of DiTera kill nematodes in the soil on contact. The product has also shown ovicidal activity when incubated with eggs of the root-knot nematode, *Meloidogyne incognita*. No fungicidal or anti-bacterial activity has been identified for this product. It is also believed that application of DiTera, in addition to its direct effects on nematode development, changes the rhizosphere microbiology leading to increase of natural predators and organisms antagonistic to nematodes resulting in the overall suppression of nematodes and improvement of plant performance.

Based on the data provided, the U.S. EPA has determined that DiTera is “exempt from the requirement of a tolerance on all agricultural commodities,” indicating that DiTera or its residues do not pose hazard or risk to humans. DiTera technical (WP), ES, and G/WDG formulations have now been granted unconditional registration for use on a variety of crops in the U.S. DiTera has also been approved for use in several states including California, Florida, New York, and Texas. Due to its unique profile, DiTera may be applied at any stage in the crop cycle, thus providing the versatility needed for nematode management in annual and perennial crops. The product has already been registered in Costa Rica, Guatemala, Chile, Mexico, and Panama; additional foreign registrations are anticipated.

DiTera was discovered due to its high and consistent biological activity in a target-directed laboratory assay designed to detect nematicidal activity specifically against the root-knot nematode, *Meloidogyne incognita*. Evaluations through various levels of

laboratory, growth chamber, greenhouse, micro-plot, and field studies were carried out during the past ten years. While the laboratory and greenhouse studies were primarily directed at strain selection, fermentation improvements, etc., the field studies focused on confirming biological activity in suppressing field populations of nematodes on various crops in different soil types in multiple locations.

On the basis of field trials carried out to date, it was determined that DiTera exhibits good activity in reducing nematode populations in the soil and roots. Most of the studies to date have been carried out on fruit and vegetable crops (carrot, melon, cole crops, banana, and grape) as well as turf. Additional work has also been initiated on crops such as citrus and tobacco. Reductions in nematode populations were noted at use rates in the range of 25 to 50 lbs./acre (28-56 Kg/H) applied on a broadcast basis. The product can be applied as a suspension in water either as a preplant treatment, or preferably at planting, emergence, or immediately after transplanting. Alternatively, formulations of DiTera can be sprinkled around the root-zone and incorporated into the soil either mechanically or with water, prior to planting. Applications of DiTera can also be made through irrigation systems. Typically, a single application at the recommended rate is sufficient to reduce nematode populations and protect the young seedlings in the soil; but in instances of high nematode population pressures, and in perennial crops, multiple applications of DiTera are recommended. As is widely recognized, applications during early stages of plant growth protect the plant during critical stages of development, translating into better performance and yield. At this point, little information on the compatibility of DiTera with other soil pesticides is available.

Because the EPA has exempted DiTera from residue tolerances, there are no pre-plant, pre-harvest, or post-harvest restrictions. Therefore, there are no regulatory restrictions regarding the amount of DiTera that can be applied during a crop cycle or calendar year. The re-entry interval following a DiTera application for agricultural uses as determined by the U.S. Environmental Protection Agency is 4 hours (the shortest period allowable under current regulations).