INFLUENCE OF SOIL COMPACTION LAYERS ON DOWNWARD DIFFUSION OF FUMIGANTS IN SOIL

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The sting nematode, *Belonolaimus longicaudatus*, is the most economically important nematode pest of strawberry in Florida. In recent years, even methyl bromide has not always provided season-long protection from sting nematode in a number of fields. In these fields, additional preplant treatment with broadcast applications of 1,3-dichloropropene (1,3-D; Telone) has been effectively used to mitigate the sting nematode problem. New problems with sting nematode have continued to emerge however. In order to determine the cause for poor crop performance after soil fumigation with methyl bromide or 1,3- D, field surveys were conducted of sting nematode problem fields. In each of the bedded fields surveyed, a compacted zone (traffic layer) occurred between a soil depth of 1 to 3 inches below the soil level of the row middle and extended to a soil depth of 15 to 18 inches. In practical terms, the compaction zone appears to occur just below the depth of the deepest tillage operation / implement used within the field. For example, strawberry fields are typically disked to a maximum depth of 6 to 8 inches with a compacted zone immediately below the surface tilled layer. It was felt that the presence of the compacted zone may ultimately have influenced the overall success of fumigant treatment and dictated the time and degree to which various soilborne pests and pathogens recolonize the plant root system. Subsequently, field experiments were conducted during the summer and fall of 2003 to determine the potential impact of the soil compacted zone on fumigant movement of 1,3-dichloropropene in soil.

Procedure: Fumigant movement was evaluated in field experiments conducted during June through September 2003 in commercial strawberry fields near Plant City, Florida. Four treatments were evaluated in a complete randomized block design with 3 replications per treatment. The treatments included two methods of Telone II soil application (broadcast and in-row), each evaluated with and without deep chisel plowing as a tillage practice to destroy the compacted soil layer. Appropriate plots were chisel plowed to a soil depth of 15 inches and then rolled 10 days prior to soil fumigant application. Broadcast applications of Telone II (12 gal/a) were made with a Yetter® Avenger coulter application with knives spaced 12 inches apart delivering fumigant to a depth of 12 inches in non-bedded soil. In-row applications of Telone II (12 gal/a) were made with a Kennco® bedder fitted with 2 gas knives spaced 12 inches apart to a depth of 10 inches below the bedtop. The raised beds were then immediately covered with low density polyethylene mulch.

Gas concentrations of trichloroethylene were monitored immediately after soil injection by the following technique. Galvanized electrical conduit pipe (0.5 inch diam.) were cut into 36-inch lengths. One end of the pipe was pressed together and folded to seal one end of the pipe. The folded end was drilled with six small portholes to allow gas intrusion while the opposite and open end capped with a rubber stopper. The rubber capped conduit was then inserted into soil to depths of either 8 or18 inches for collection of soil volatiles in both the bedded and broadcast treated Telone II plots. A Gastek® Model GV-100 gas sampling vacuum pump together with Gastek detector tubes (No.132HA) specific to trichloroethylene (0-500 ppm) were then used to characterize fumigant concentrations at each of two soil depths at two time intervals after soil fumigation.

Results: Chisel plowing was qualitatively observed to significantly reduce soil penetration resistance using a simple probe tipped metal rod to characterize changes in soil bulk density. Based on analysis and comparison of gas concentrations at the two soil depths, it would appear that the downward diffusion of Telone II is significantly restricted by the presence of the soil compacted layer. In plots chisel plowed to a depth of 15 inches and the compacted layer destroyed prior to soil fumigation, fumigant concentrations were consistently higher at the 18-inch soil sampling depth compared to the shallower 8-inch soil sampling depth for both in-row and broadcast treatments. Higher soil concentrations of trichloroethylene were observed with in-row applications at both soil depths compared to broadcast treatments. For the broadcast treatment, the compacted zone appeared to completely restrict Telone II downward diffusion to the 18-inch soil sample depth at the BBI experimental site. In summary, these experimental results suggest that unless destroyed by deep chisel plowing prior to soil injection, the presence of a soil compaction layer restricts downward diffusion in soil of 1,3-D. It is assumed that these new tillage / application methods will not only reduce potential emissions of 1,3-D from treated fields but also significantly improve overall nematode control, particularly in the deeper, sandy soils of central Florida.

FIGURE 1. Influence of compacted zone on fumigant concentration.

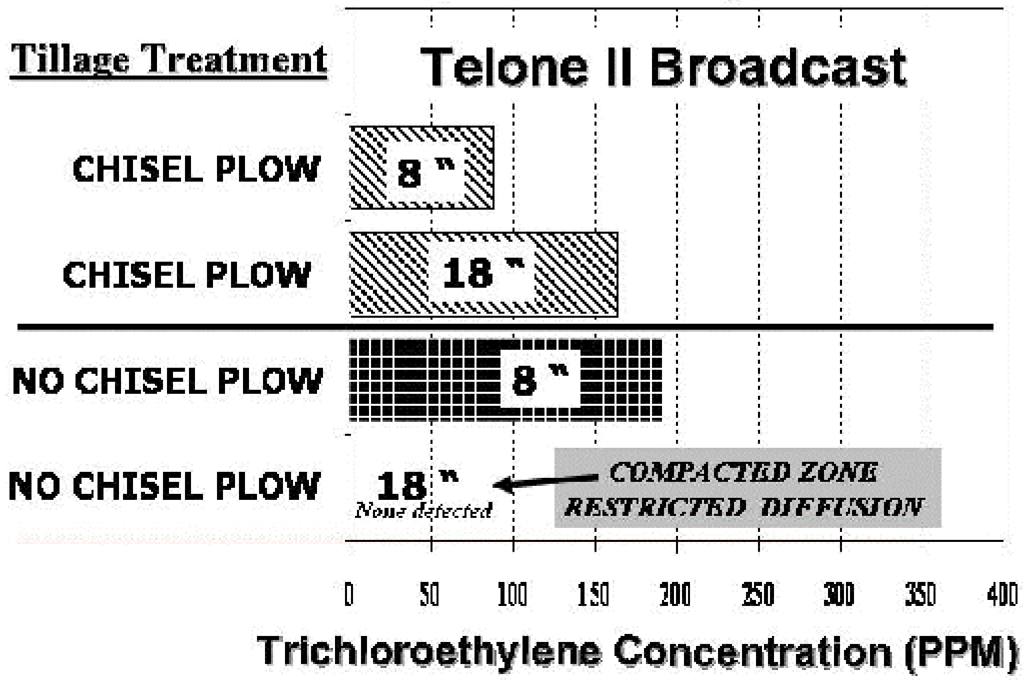

Figure 2. Influence of compacted zone on fumigant concentration.