NEMATICIDAL ACTIVITY OF TECNAZENE: A TETRACHLORONITROBENZENE FUNGICIDE [ACTIVIDAD NEMATICIDA DE TECNAZENE: UN FUNGICIDA TETRACLORONITROBENCENICO].

R. Rodríguez-Kábana, Peggy S. King, J. R. Adams, Department of Botany and Microbiology, Auburn University, Agricultural Experiment Station, Auburn, Alabama, U.S.A. 36830.

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ABSTRACT

The fungicide tecnazene (1,2,4,5-tetrachloro-3-nitrobenzene) was added to a nematode infested Norfolk sandy loam at rates of 0, 0.025, 0.05, 0.1, 0.2, 0.4, and 0.5 g/kg of soil, and the soil was immediately planted to cotton. Thirty days later a significant decrease in numbers was recorded for *Meloidogyne incognita* larvae, *Pratylenchus brachyurus, Tylenchorhynchus claytoni,* and tylenchoid and dorylaimoid nematodes in soil which had received 0.025 g/kg or higher of the fungicide. Numbers of *Helicotylenchus dihystera* and *Hoplolaimus galeatus* were decreased significantly at rates as low as 0.05 g/kg. The number of root knot nematode galls per gram of root was significantly lower in all tecnazene-treated soils. No significant differences in the top weights of the cotton plants were recorded for any of the treatments; however, tecnazene at rates of 0.1 g/kg and above increased root weights significantly.

Key Words: Chloronitrobenzenes, nontarget effects, soil fungicide.

INTRODUCTION

Chlorinated nitrobenzenes are among the oldest fungicides used for treating seed and soil (5). These compounds are unusual in that fungicidal selectivity does not follow predictable chemical or taxonomic patterns (3,5). The effect of these compounds on nematodes has received little attention. Results of earlier work with pentachloronitrobenzene (PCNB) indicated that the fungicide either inhibited or stimulated populations of plant parasitic nematodes depending on the rate of application and nematode species (1,2,6). Recently, a tetrachloronitrobenzene isomer, 2,3,4,5-TCNB, has been reported to possess nematicidal activities (9). Another tetrachloronitrobenzene isomer, tecnazene (2,3,5,6-tetrachloro-4-nitrobenzene) has been used as a soil fungicide. Its properties are similar to those of PCNB but it also is active against *Fusarium* spp, a property lacking in PCNB (5). Because of the possibility that tecnazene may possess nematicidal activities, we initiated a study to determine its effects on nematodes. This paper presents the results of the study.

MATERIALS AND METHODS

Pure tecnazene (Pfaltz and Bauer) was dissolved in xylene and the solution added to attapulgite clay granules to obtain a 10% (w/w) formulation of the fungicide. The solvent was allowed to evaporate and the dried formulation was stored in a closed bottle.

Norfolk sandy-loam from a field under cotton monoculture was used for the experiment. The soil contained stunt (*Tylenchorhynchus claytoni),* spiral *(Helicotylenchus dihystera),* lesion *(Pratylenchus brachyurus),* lance *(Hoplolaimus galeatus),* and root

knot *(Meloidogyne incognita)* nematodes and non-parasitic tylenchoid (mostly *Ditylenchus* spp, and *Tylenchus* spp), dorylaimoid and saprophagous species. Moist soil was sieved, and 500 g amounts were weighed into polyethylene bags. Each bag received an amount of the granular formulation to provide tecnazene concentrations of: 0, 0.025, 0.05, 0.1, 0.2, 0.4, or 0.5 g/kg soil. After thorough mixing, the soil in each bag was transferred to an 11-cm-diam plastic pot and was planted with 2 cotton (M-8) seeds. Each concentration of the fungicide was represented by 8 pot replications arranged in a randomized complete block design in the greenhouse. Four weeks after planting, 50 cc of soil was removed from each pot for determination of nematode numbers by the molasses flotation-sieving technique (8). Cotton plants were removed from each pot and their roots were carefully washed free of soil. The number of root knot nematode galls and the weights of fresh root and shoot systems were determined. A subjective evaluation of the condition of the root system was made using a scale that ranged from 0 for very poor growth, to 5 for excellent root system.

LD 50 values were calculated following standard procedures (4). All data were analyzed following standard procedures for analyses of variance and differences between means evaluated for significance with the modified Duncan's multiple range test (10). Values for the least significant differences were calculated and are included in the graphs to aid interpretation. Except where otherwise stated, differences between means referred to in the text were significant at the 5% level of probability.

RESULTS AND DISCUSSION

The numbers of nematodes in soil declined sharply (Fig. 1A, 1B) in the presence of tecnazene. The decline was *quasi*-hyperbolic, the sharpest decrease occurring at concentration between 0 and 0.1 g/kg; higher concentrations produced little additional

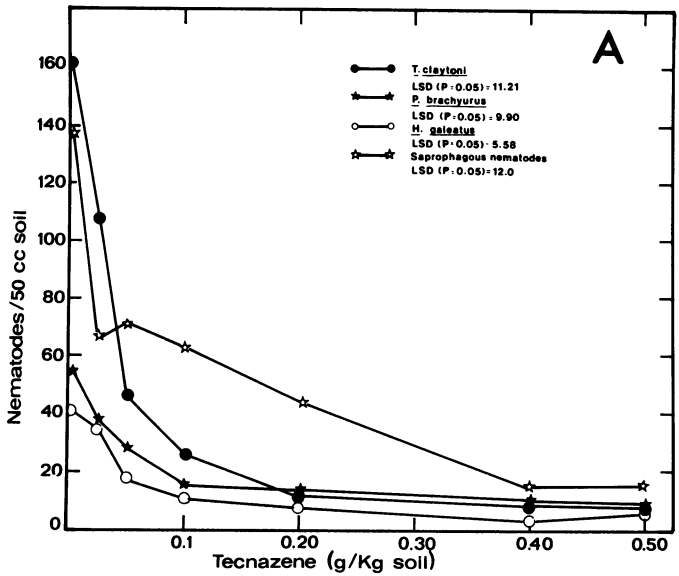
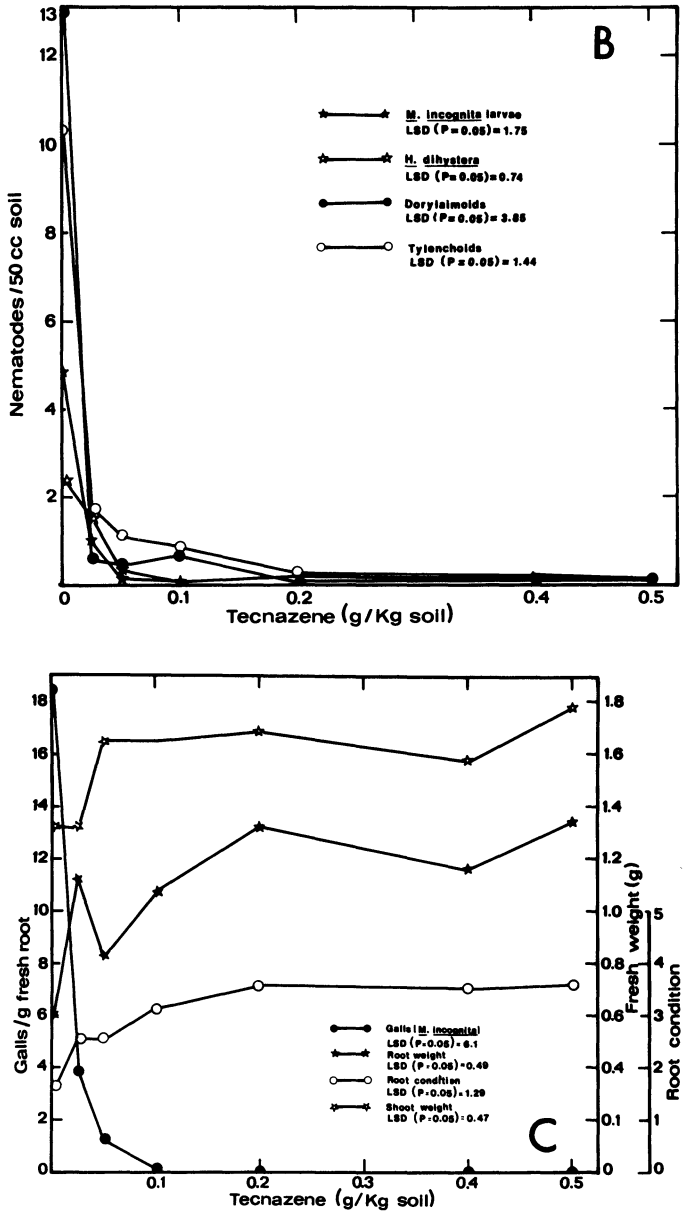


Fig. 1: Effect of the fungicide tecnazene on the number of nematodes in soil (A,B), and condition of cotton roots and shoots from the treated soil (C).



effect. LD 50 values expressed as mg tecnazene/kg soil varied slightly with species and were: 31.8, 34.3, 44.4, and 50.0 for spiral, stunt, lance and lesion nematodes, respectively. Larvae of root knot nematodes, and tylenchoid and dorylaimoid nematodes were more sensitive to the fungicide; the lowest concentration resulted in 89-95% reduction

in numbers of these nematodes. Reduction in the number of root-knot nematode galls (Fig. 1C) paralleled those for the larvae of this nematode in the soil; the greatest reduction in numbers occurred at concentrations $\leq$ 0.05 g/kg and was 79% for the 0.025 g/kg rate.

Differences in the fresh weights of shoot systems (Fig. 1C) were not significant. However, tecnazene produced significant increases in fresh weight of root at all concentrations except 0.05 g/kg. Values for the root condition index (Fig. 1C) increased in an almost exponential manner in response to tecnazene concentration so that the greatest rate of improvement occurred at concentrations $<$ 0.2 g/kg soil; little or no additional improvement was observed with the two highest concentrations.

Our results indicate that tecnazene possesses considerable nematicidal activity even at field concentrations of 15-30 kg/ha ($<$ 0.05-0.1 g/kg soil). The nematicidal activity of this compound is considerably greater than that previously recorded for PCNB (1). One possible explanation for the higher activity of tecnazene may be that the vapor pressure of PCNB is 20 times less than that of tecnazene (7). Assuming equivalent intrinsic nematicidal activity, this difference could result in a better distribution of tecnazene throughout the soil than of PCNB. More efficient kill through the higher fumigant activity of tecnazene would be expected since both compounds are only very slightly soluble in water. These results are similar to those obtained by Richardson (7) on the fungicidal activity of chloronitrobenzenes. Generally, fungicidal activity decreased with progressive chlorination of nitrobenzene while selectivity against fungal species increased.

The coincident fungicidal and nematicidal properties of tecnazene suggest that this compound or its isomers may be of value in the treatment of soil for control of disease complexes involving nematodes and fungi. We are currently testing this possibility in field experiments with cotton.

RESUMEN

El fungicida tecnazene (1,2,4,5-tetrachloro-3-nitrobenceno) se añadió a un limo arenoso tipo Norfolk a razón de: 0, 0.025, 0.05, 0.1, 0.2, 0.4, y 0.5 g/kg de suelo, seguido lo cual las mezclas se sembraron con algodón. Treinta días después de la siembra se observaron bajas significativas en el número de larvas de *Meloidogyne incognita* y en el número de *Pratylenchus brachyurus, Tylenchorhynchus claytoni* y en nematodos tilencoi- y dorilaimoidiformes en todos los suelos con concentraciones de tecnazene iguales o superiores a 0.025 g/kg. El número de *Helicotylenchus dihystera* y de *Hoplolaimus galeatus* disminuyó significativamente en suelos con concentraciones de 0.05 g/kg o más altas. También, los números de nódulos *(M. incognita)* por gramo de raíz resultaron ser significativamente inferiores al del testigo en todos los suelos con tecnazene. No se observaron diferencias significativas entre los pesos de tallos y follage, pero sí entre los correspondientes a las raíces, los que aumentaron sobre el del testigo en respuesta a concentraciones del fungicida iguales o superiores a 0.1 g/kg de suelo.

Claves: cloronitrobencenos, efectos aleatorios, fungicidas de suelo.

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