THE EFFECT OF THIRAM CONCENTRATION ON THE SPORE GERMINATION OF ISOLATES OF COCHLIOBOLUS CARBONUM

by


Abstract

Inhibition of spore germination of selected isolates of Cochliobolus carbonum was studied with increasing concentrations of thiram. Isolate differences were detected for the 'TMTD' polymodal curve. This difference was shown to be heritable and independent of tolerance to thiram as indicated by vegetative growth. The polymodal 'TMTD' curve of spore germination inhibition in C. carbonum may result from two (or more) thiram sensitive loci each genetically conditioned independently.

Introduction

The increasing use of new systemic fungicides with more specific target organisms activity spectra as well as modes of action has been associated with the appearance of highly tolerant fungal strains within normally sensitive genera. In addition, varying levels of tolerance have been observed to the older classic broad spectrum fungicides such as the dithiocarbamates. Future programs for control of plant pathogenic fungi by chemical fungicides will demand greater understanding of fungicide dose-response phenomena, especially genetic mechanisms, than is presently available.

The general relationship of pesticide dosage to target organism response is one of a curvilinear increase in effect with increasing dosage of toxic compound. One exception to this principle is the polymodal curve first described by Dimond et al. (2) for fungal spore germination response to tetramethyl thiram disulfide (thiram). This type of dosage-response was later named 'TMTD' for the prime letters of tetramethyl thiram disulfide (1). Montgomery and Shaw (5) reported that the polymodal curve occurs in five thiram sulfide derivatives and six dithiocarbamate derivatives. Turner (6) reported a 'TMTD' curve for the killing of aphids with derris dust extended with pyrophyllite. Turner's explanation was based on changes in electrical charge of the particles clinging to the insect. Barrett and Horsfall (1) reported in detail on the
‘TMTD’ curve and extended the explanation of Dimond et al. (2) and Turner (6) to four possible interactions: ‘(i) competition for the focus of toxicity, (ii) relative effects of permeation and inherent toxicity of a compound, (iii) relative significance of two modes of toxicity exhibited by a single compound, (iv) relative effects of clinging to an insect and poisoning it.’

MacKenzie et al. (4) reported on a complex, heritable system of tolerance in Cochliobolus carbonum Nelson [Helminthosporium carbonum Ullstrup]. Other studies with the same organism were reported (3) on the inheritance of tolerance to Cadmine and Acti-dione. In this system tolerance was expressed for both vegetative growth and spore germination.

The objective of the studies reported herein was to test the thiram tolerance previously reported (4) in C. carbonum as expressed by vegetative growth for its influence on the ‘TMTD’ curve. Such studies could help in further elaboration of the Barrett & Horsfall (1) explanations for the occurrence and causes of the ‘TMTD’ dosage response curve.

Materials and methods

Quantification of spore germination inhibition by thiram was undertaken for selected isolates of C. carbonum. Test isolates were selected to represent the parents and progeny of the earlier study (4) that gave quantitatively different levels of tolerance to thiram expressed as vegetative growth rate.

Thiram concentrations ranging from 1 ppm to 10 ppm (active) in potato-dextrose agar as 1 ppm increments were found to be most suitable for study of the ‘TMTD’ dosage-response curve. Media preparation methods, cultural methods, and statistical procedures were those previously described (3, 4). Solid agar plates were found in preliminary studies to be simple and reproducible for spore germination determinations.

Spore germination counts were based on microscopic examination of more than 100 spores for each of 3 replications and are expressed here as percent inhibition (see reference 1). It was not necessary to adjust for innate inability to germinate since conidia of most of the test isolates germinated in excess of 90 percent in the absence of thiram.

Results and discussion

The representative parent isolates gave the standard ‘TMTD’ curve of Barrett & Horsfall (1) with one exception. Fig. 1 gives the response curve for two of the typical isolates. These data are not presented on log scales as did Barrat & Horsfall. The use of log scales is justified for straightening some curvilinear relationships. However, it is not possible to straighten the ‘TMTD’ curve with log transformations. These data are, therefore, not transformed.

Statistical analyses of these isolate’s response indicated that they