Orientation of *Tylenchorhynchus martini* Swarmers to Chemical Stimuli

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**ABSTRACT:** The use of swarming *Tylenchorhynchus martini* nematodes provided a rapid and efficient in vitro method for the study of nematode orientation mechanisms as affected by chemical stimuli. Orientation of the nematodes occurred in concentration gradients diffusing from agar discs containing 0.05, 0.1, 0.25 M of both AlCl3 and CdCl2, and 0.25 M of NH4Cl. Attraction of the nematodes did not occur at the other concentrations tested: 0, 0.5, or 1.0 M, or with the other chemicals: MgCl2, MgSO4, Na2S2O4·2H2O, or ascorbic acid. There was no repulsion in any of these tests to nematodes.

Swarming nematodes of *Tylenchorhynchus martini* (Fielding, 1956) have continual and rapid jerky movements which result apparently from attempts of individuals to break free from the sticky cuticle of swimmers (Hollis, 1958, 1960, 1962; McBride and Hollis, 1966). Hollis suggested that swarming may be conditioned by the state of polysaccharide, lipid, or protein substances of the cuticle and that it is characterized by innate morphological modifications of the cuticle. The use of the electron microscope revealed morphological modifications in the cuticle of swarming *T. martini* (Ibrahim, 1967). These modifications must be related to the sticky condition of the cuticle. Thus, the use of swarming *T. martini* provided a rapid and efficient in vitro method for the study of orientation mechanisms of nematodes.

Orientation is the process whereby nematode movement is influenced by external stimuli. Little information is available on the mechanisms of nematode orientation and almost nothing is known of stimuli reception by nematodes (Klinger, 1965; Van Gundy, 1965; Wallace, 1964; and others). Chemical stimuli are of importance because they play a role in nematode orientation to germinating seeds and host plant roots. In view of this, the present study was made to determine the effect of certain chemicals on the orientation of swarming *T. martini*. A preliminary report stressing the reliability of the method has been published (Ibrahim and Hollis, 1967).

**Materials and Methods**

The following chemicals were tested for their attractiveness to swarming *T. martini*: aluminum chloride (AlCl3), cadmium chloride (CdCl2), ammonium chloride (NH4Cl), magnesium chloride (MgCl2), magnesium sulfate (MgSO4), sodium thiosulfate (Na2S2O4·2H2O), and ascorbic acid. Agar discs containing these chemicals of molarities 0, 0.05, 0.1, 0.25, 0.5, and 1.0 were substituted for 5-mm-diameter agar discs taken from the edges of 50-mm petri plates containing 6 ml of 2% water agar. A swarming population of *T. martini* was reared on rice plants grown in a greenhouse. Nematodes were collected from the infested soil by the sifting and gravity method. Nematode swarmers in water suspension were dispersed by agitation, then 5 ml of this suspension containing about 200 nematodes were spread evenly over the agar surface of each petri plate containing the tested chemicals. The plates were covered and incubated at room temperature for 6 hr.

Duplicate tests containing four replicates and six treatments of each tested chemical were set up in randomized blocks. Average distance from the agar disc to the resultant one to three swarms forming in each plate was then determined and the data evaluated by the analysis of variance.

**Results and Discussion**

The data obtained from the duplicate tests of each of the tested chemicals were significantly similar and Table 1 shows the results of one of these tests. Significant orientation of *T. martini* swarmers occurred in concentration...
Table 1. Effect of seven chemicals on the orientation of Tylenchorhynchus martini swarms.

<table>
<thead>
<tr>
<th>Chemical concentration in moles</th>
<th>Average distance (mm) from discs to swarms*</th>
<th>Ascorbic acid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AlCl₃</td>
<td>CdCl₂</td>
</tr>
<tr>
<td>1.0</td>
<td>26.3</td>
<td>26.8</td>
</tr>
<tr>
<td>0.5</td>
<td>25.3</td>
<td>26.8 **</td>
</tr>
<tr>
<td>0.25</td>
<td>13.3**</td>
<td>21.0**</td>
</tr>
<tr>
<td>0.1</td>
<td>5.8**</td>
<td>22.5**</td>
</tr>
<tr>
<td>0.05</td>
<td>16.8**</td>
<td>23.8**</td>
</tr>
<tr>
<td>Control</td>
<td>28.5</td>
<td>29.8</td>
</tr>
<tr>
<td>LSD (99:1)</td>
<td>4.6</td>
<td>4.5</td>
</tr>
</tbody>
</table>

* Mean of four replicates. ** Highly significant.

gradients diffusing from agar discs containing: 0.05, 0.1, and 0.25 M AlCl₃ or CdCl₂, and 0.25 M NH₄Cl. Attraction did not occur at any of the tested concentrations of the other four chemicals, MgCl₂, MgSO₄, Na₂SO₄·2H₂O, and ascorbic acid. There was no repulsion effect of these chemicals on the nematode movements in any of the tested concentrations.

One-tenth molar AlCl₃, in particular, had a maximum attractive value whereas 0.25 M AlCl₃ attracted the nematodes more than 0.05 M. The three effective concentrations of CdCl₂ attracted the nematodes in the following descending order: 0.25 M > 0.1 M > 0.05 M and their attractive values were less than those of the similar concentrations of AlCl₃. The concentration 0.25 M of NH₄Cl was the only attractive one of this chemical, and it had the minimum attractive value.

The present results show that the nematodes responded to a diffusible factor operating at some distance from the agar disc containing the attractive concentration of the chemical. Orientation of nematodes resulted from direct or indirect migration of the swarvers toward the source of stimulation. It is probable that both the chemical properties and the concentration of tested chemicals were responsible for the orientation of the nematodes. In the cases of no attraction, the nematode migration and aggregation took place on a purely chance basis.

Similar work on the orientation of Meloidogyne javanica larvae by different amino acids was done by Oteifa and Elgindi (1961). They found that the amino acid tyrosine attracted this nematode more than 13 other amino acids tested, which were either neutral or repellent to the nematode larvae.

**Literature Cited**


