lattice design with nine replicates. All accessions were of special interest in the breeding program. Included as a susceptible check was the commercial variety 'Valery.' One row of 'Valery' was planted as a border around the experimental area. Rhizomes were examined 12 and 19 months after planting, and average infestation per plot was rated on the same scale of 0 to 4.

Results are in Table 1, Experiment II. The following accessions, or cultivar groups, were either tolerant or resistant to *R. similis* (root lesion rating less than 1.00): *M. acuminata* subsp. *malaccensis*, the 'Pisang Bataua' cultivar group, the 'Pisang Jari Buaya' group except for 'Morong Datu' and 'Pisang Rotan'; and 'Pisang Edor Kuda' and 'Pisang Lidi' cultivar groups. The other 42 accessions were susceptible (root lesion rating more than 1.00).

The second examination of the plants in Experiment II showed that two accessions 'Pisang Ekor Kuda' and 'Pisang Kermian' of the 'Pisang Lidi' group had higher root-lesion ratings (both 1.78) than earlier. Ratings of other cultivars were unchanged.

The results confirm that resistance or tolerance to *R. similis* is available in *M. acuminata*, as observed by Leach (2).

The greater susceptibility of the 'Cavendish' group is important because the 'Pisang Ambon' group, which is susceptible to Fusarium wilt, has been replaced commercially with wilt-resistant 'Cavendish' cultivars. The 'Cavendish' cultivars are uneconomic in some areas infested with *R. similis* unless nematicides are used, whereas the 'Pisang Ambon' group can be grown in such areas without nematicide treatments and still yield enough to be economic despite nematode damage.

**LITERATURE CITED**


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**Restoration of Morphological Features of *Globodera pallida***

After Storage in Formalin

J. Franco and K. Evans

A main criterion in identifying different nematode species is their various morphological features. Used frequently in nematode taxonomy is stylet length. In preserved specimens, however, the tip and knobs of the stylet often become indistinct with time, preventing accurate measurement of stylet length. Toward solving that problem the effect of adding dyes to material stored in 4% formalin was investigated.

To see whether dyes would restore the clarity of the stylet tip and knobs of preserved specimens, we compared a number of dyes (New Blue R, Meldola Blue, Nile Blue A, Cotton Blue in lactophenol, potassium permanganate, and potassium dichromate) at different concentrations and
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FIG. 1 A-F. Effect of different processing techniques on second-stage juveniles of potato cyst nematode, *Globodera pallida*: A, B) Stylet protrusion and "shrinkage" of median bulb (MB), effects of ammonia treatment on live specimens. C) Poor stylet definition of juveniles stored in 4% formalin for one year. D) Clear definition of stylet tip (St) and knobs (Kn) as a result of potassium permanganate treatment on materials similarly preserved. E, F) Restoration of other morphological features by the same treatment.

temperatures. The dyes were tested on hatched second-stage juveniles of potato cyst nematode (*Globodera pallida*) killed with Stone’s techniques (2) to avoid changes in the measurement of morphological features, and stored in 4% formalin for 12–15 months.

The most effective dye, potassium permanganate, was compared with a method developed by Hooper (1) that makes 80% of the stylet tips visible by causing them to protrude. The dye treatment that improved stylet definition most was addition of a drop (ca.
TABLE 1. Dimensions in microns of second stage juveniles of *G. pallida* after potassium permanganate or ammonia treatments.

<table>
<thead>
<tr>
<th></th>
<th>Total length&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Stylet length&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Headtip to metacorpal valve</th>
<th>Metacorpal valve to excretory pore</th>
<th>Headtip to excretory pore&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Excretory pore to tail tip&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>KMnO&lt;sub&gt;4&lt;/sub&gt;</td>
<td>436.4</td>
<td>24.0</td>
<td>71.7</td>
<td>35.0</td>
<td>106.7</td>
<td>55.3</td>
</tr>
<tr>
<td>NH&lt;sub&gt;4&lt;/sub&gt;</td>
<td>444.0</td>
<td>23.8</td>
<td>64.5</td>
<td>42.5</td>
<td>107.0</td>
<td>54.3</td>
</tr>
<tr>
<td>SED</td>
<td>5.2</td>
<td>0.2</td>
<td>0.7</td>
<td>0.7</td>
<td>0.9</td>
<td>1.1</td>
</tr>
<tr>
<td>LSD 5%</td>
<td></td>
<td></td>
<td>1.4</td>
<td>1.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1%</td>
<td></td>
<td></td>
<td>1.9</td>
<td>1.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>*Averages for 30 nematodes.  
*bAverages for these dimensions do not differ significantly.  
</sup>

35 µl of 0.5% aqueous solution of KMnO<sub>4</sub> to 4 ml of nematode suspension and incubation overnight at room temperature (ca. 20°C). This treatment improved cuticular details (Fig. 1F) and definition of the glandular region of the esophagus (Fig. 1E). The visibility of the stylet tip and knobs was also improved (Fig. 1D) over that for untreated juveniles (Fig. 1C).

Hooper's ammonia treatment also increased visibility of the stylet tip (Fig. 1A), but it caused shrinkage of the median bulb (Fig. 1B). The distance between the metacorpal valve and the head tip or the excretory pore differed between specimens treated with KMnO<sub>4</sub> and those treated with ammonia (Table 1).

These differences seem to be caused by displacement of the median bulb as an ammonia effect in the latest techniques. Since the distance from headtip to excretory pore did not differ significantly, however, this feature would stand as a morphological character, together with stylet length, to identify populations of fresh-hatched second-stage juveniles of potato cyst nematodes.

The results suggest that both techniques will aid stylet measurement of potato cyst nematodes and that KMnO<sub>4</sub> is useful for restoring specimens that have been stored in formalin for long periods.

**LITERATURE CITED**


**Effects of Aldicarb on Fusarium Wilt-Root-Knot Nematode Disease of Cotton**

**E. C. JORGENSEN**

Aldicarb nematicide (2-methyl-2-(methylthio)-propionaldehyde-0-(methylcarbamoyl) oxime) may not be as effective for *Meloidogyne* spp. as for some other nematodes because its disorienting effect on males is of little use with parthenogenic species (2, 3). Even so, other sublethal effects of aldicarb on nematodes (including delayed hatching, impeded migration, and impaired feeding behavior) may be useful in root-knot nematode control on cotton (2, 3, 4).

The tests reported here were done to evaluate: 1) the effects of aldicarb on the fusarium wilt-root-knot nematode complex disease; and 2) the significance of systemic activity of aldicarb in cotton roots in relation to root-knot nematodes.