soils in Imperial Valley, southern California. The fifth experiment (Suey) was on a clay loam soil near Santa Maria, Santa Barbara County, California. Details are given in Table 1.

Testing chemicals against *H. schachtii* in heavily infested fields is suitable for determining the most effective material. Extrapolation of results is hazardous, however, since results may differ in areas where infestation is lighter, making the sugarbeet nematode a less important factor limiting sugarbeet production.

Sugarbeet yields in three experiments in fields with less than 65 eggs/100 g of soil (Table 1) were not influenced appreciably by any nematicide treatment. In the Doel field, where preplanting samples taken on separate occasions contained 65 and 208 eggs/100 g of soil, yields were increased by 5.2 to 8.2 tonnes/ha in one experiment and by 7.5 to 10.4 tonnes/ha in another. Yield increases following nematicide treatments were much larger in experiments where there were 3,960 eggs/100 g of soil in 1974 and 383 eggs/100 g of soil in 1975 (3).

From those results, the economic threshold for *H. schachtii* on sugarbeets is about 150 eggs/100 g of soil (1).

Some fields infested with *H. schachtii* are being treated unnecessarily with nematicides. A rapid and effective soil sampling method, e.g., by an automatic surface sampler (2), would reduce costs of sampling, allowing more samples in fields or parts of fields.

**LITERATURE CITED**


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**Automated Dehydration of Small Specimens**

L. J. STOWELL and MICHAEL A. McCLURE

Ethanolic dehydration of biological specimens for electron microscopy is a standard technique. With specimens visible only under a dissection microscope, however, problems arise in handling. Transfer of tissues from one solvent to the next is required in conventional automated tissue preparation for microscopy. Confinement of the specimen becomes particularly difficult when it is smaller than 1 mm³. A device described by Viglierchio and Maggenti (1) substitutes solvent exchange for conventional tissue transfer in handling small specimens such as nematodes. Their solvent exchanger is suitable for preparation of large numbers of specimens. The specimen container is so large, however, that it is difficult to locate processed samples consisting of only one or a few nematodes. The S&M (Stowell & McClure) model 1000 programmable solvent exchanger, in contrast, has a low-volume glass specimen chamber in which the specimens can be inspected with a dissecting microscope (2). This chamber is coupled to the solvent exchanger, and ethanolic solutions of decreasing water concentration are pumped through the chamber (Fig. 1). Reproducibility of specimen dehydration is important for critical microscopy. In addition to reproducibility, low cost and a low-volume specimen chamber (2) make the S&M model 1000 programmable solvent exchanger superior to commercially available devices.
FIG. 1 (A-B). The S&M model 1000 programmable. A) Top view showing the pump (P), timer (T), solenoid (S), and relay (R); B) front view.
FIG. 2 (A-C). A) Mixing chamber with specimen chamber attached; B) exploded view of rotary valve; C) circuit diagram.
Solutions of ethanol are stored in ten separate reservoirs. A Teflon tube connects each reservoir to a solenoid-actuated rotary valve constructed of Teflon. Selection of the solvent reservoir is controlled automatically by a timer or manually by an override switch. Solvent is drawn from one reservoir at a time through the valve (Fig. 2B) by a peristaltic pump at a rate of 0.8 ml/min. The solvent is then pumped into a 2.0-ml mixing chamber (Fig. 2A). This device produces a series of gentle step gradients by mixing solvents in the 2.0 ml of dead volume of the mixing chamber. Ethanol has a density of about 0.8 g/ml. Therefore, mixing occurs as lower-density solutions are pumped into the bottom of the mixing chamber. About 4 min are required to change the solvents in the mixing chamber at a flow of 0.8 ml/min. The rate of specimen dehydration is determined by the length of time each solvent is pumped through the specimen chamber and the change in water content between successive reservoirs. This prototype was constructed in 1977 at a cost of under $300.00 (parts only).

The electrical relationships of the components are described in Fig. 2C. The component designations of the schematic (e.g., $S_z$) are in parentheses following the component name. The products listed were chosen by specification and availability. Any comparable substitute would be satisfactory.


**Solenoid** ($K_1$): Intermittent-duty Dormeyer solenoid. W. W. Granger, Inc., Tucson, Arizona 85719. One-inch stroke, 6.0 lb pull per inch, 23.0 watts at 115 VAC, 60 Hz. Stock no. 4X898. Manufacturer’s no. 7110-2A.


**Main switch** ($S_4$, $I_1$): Push-on, push-off, with neon light ($I_2$). Radio Shack, Fort Worth, Texas 76107. 6 amp at 250 VAC. Catalog no. 275-671.


**Toggle switch** ($S_9$, $S_{10}$): Single-pull, single-throw toggle switch. Radio Shack, Fort Worth, Texas 76107. 6 amp at 250 VAC. Catalog no. 275-654.

**Indicator lights** ($I_2$-$I_{11}$): Neon lamps.

### Table 1. Position of switches required for different operations by the dehydrator.

<table>
<thead>
<tr>
<th>System status</th>
<th>$S_2$</th>
<th>$S_3$</th>
<th>$S_4$</th>
<th>$S_5$</th>
<th>$S_6$</th>
<th>$S_7^*$</th>
<th>$S_8$</th>
<th>$S_9$</th>
<th>$S_{10}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine off</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal operation between timer trippers</td>
<td>$-$</td>
<td>$+$</td>
<td>$+$</td>
<td>$+$</td>
<td>$+$</td>
<td>$-$</td>
<td>$+$</td>
<td>$-$</td>
<td>$+$</td>
</tr>
<tr>
<td>Normal operation on timer tripper</td>
<td></td>
<td></td>
<td>$-$</td>
<td></td>
<td></td>
<td>$+$</td>
<td>$-$</td>
<td>$-$</td>
<td>$-$</td>
</tr>
<tr>
<td>Normal operation automatic stop</td>
<td></td>
<td></td>
<td>$-$</td>
<td></td>
<td></td>
<td>$-$</td>
<td>$+$</td>
<td>$+$</td>
<td>$-$</td>
</tr>
<tr>
<td>Manual selection of solvent channel using override</td>
<td></td>
<td></td>
<td></td>
<td>$-$</td>
<td>$-$</td>
<td>$+$</td>
<td>$-$</td>
<td>$-$</td>
<td>$+$</td>
</tr>
</tbody>
</table>

1. $+$ indicates the switch is in the position shown in Fig. 2C.
2. $-$ indicates the switch is in the alternative position to that shown in Fig. 2C.
3. $S_7^*$ only operates momentarily when $K_1$ reaches the top of its stroke.
Radio Shack, Fort Worth, Texas 76107. Built-in dropping resistor 120 VAC. Catalog no. 272-703.


Switch (S1): This switch was constructed at the University of Arizona. It is suggested that a 12-way rotary valve be used in constructing similar devices; 12-way rotary switches are commercially available; 10-way rotary switches are not.

Rotary valve: The 10-way rotary valve used in this prototype was constructed at the University of Arizona. Commercially available valves are suitable for this application. A 12-way ceramic-faced rotary valve is available from JZ Associates, Brookline, Massachusetts 02146, Model no. RV1.

LITERATURE CITED


Nonsolanaceous Hosts of Globodera in the Andes

PARVIZ JATALA, J. FRANCO, A. VILCA, and W. CORNEJO

The potato cyst nematodes Globodera pallida (Stone) and G. rostochiensis (Wollenweber) are important pests of potatoes in the Andes of South America. Concern was occasioned by the discovery of these nematodes in soil collected from potatoes in a Peruvian ship, "Amazonas," arriving at the port of Seattle, Washington, U.S.A., on April 3, 1951, and again in another Peruvian ship arriving in New York harbor in September 1951. Investigators traced potatoes on the "Amazonas" to the province of Ambo, Department of Huanuco (8). Later surveys revealed widespread distribution of potato cyst nematodes in the highlands of Peru (5, 8). The only round-cyst-forming nematode reported from the Andes (in addition to those attacking potatoes) is Globodera leptonepia (Cobb & Taylor), which was collected on April 26, 1952, from soil (in ship's storage) with potatoes taken aboard at Callao, Peru, and intercepted at the port of Oakland, California (1). This nematode has not been found again in Peru or elsewhere.

Before Stone's (7) description of H. Pallida, in 1973, the potato cyst nematodes were regarded as a single species, Heterodera rostochiensis. Mulvey and Stone (6) placed the potato cyst nematodes and other nematodes with special cysts in a separate genus, Globodera. Stone used the cream or white immature female color in G. pallida to differentiate it from the golden color of female in G. rostochiensis. Evans et al. (3) reported that in Southern Peru G. pallida and G. rostochiensis occur together, but only G. pallida occurs north of Lake Titicaca in Peru, Ecuador, and Colombia. The host range of the potato cyst nematode is reported to be limited to Solanaceous plants (4).

Diaz and co-workers (2) suspected that Oxalis tuberosa ([Gray] Heller), Ullucus tuberosus (Caldas.), and Chenopodium quinoa (Wild.) were hosts of the potato cyst nematodes. Martin et al. (5) observed white female nematodes, which they called "white cysts," on the roots of Oxalis tuberosa and Tropaeolum tuberosum (Ruiz and Pav.) (two tuber-bearing food crops in the Andes) and on Medicago species in the province of Canta, Department of Lima, and the Department of Cajamarca (central and northern highlands of Peru). Franco (unpublished) tested those species in a greenhouse with a population of G. pallida from Tarma in the central highland and found that no cyst nematodes developed on

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