

## A Simple, Inexpensive, Portable Apparatus for Injecting Experimental Chemicals in Drip Irrigation Systems

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The loss of 1,2-dibromo-3-chloropropane (DBCP) as a postplant nematicide created a serious void in nematode protection for crops nationwide. An acceptable replacement for DBCP is needed, especially on susceptible perennials such as grapes, *Vitis vinifera* L. Phases of our postplant nematicide research were conducted in commercial vineyards where nematode disease existed on established vines watered by drip irrigation. Drip irrigation was chosen as a delivery system for nematicides because it is becoming a popular form of irrigation.

Most vineyards are irrigated by a single 13-mm line placed on the soil surface under the vine row. One or two emitters deliver the water supply to each vine in the row. Sixty vines are often irrigated with a single line, and 16.2 hectares are often watered simultaneously with a single pump.

A small mechanical injection machine was devised to test nonregistered chemicals in small plots in commercial vineyards. This apparatus allowed injection of chemicals into a dripline at any location to treat 5-10 vine plots with candidate nematicides. With many injectors, various replicated treatments may be applied simultaneously. Thus watering differences and other sources of experimental variation among treatments can be avoided. Data from such small plots are as reliable as data from larger plots. Furthermore the chemical injector developed is inexpensive enough to be used for research purposes.

The injector is simple, accurate, and easily deployed, enabling a researcher to in-

ject any water-soluble chemical into a pressurized or nonpressurized irrigation system.

The unit consists of four primary components: 1) a small high-torque rotisserie motor (Fig. 1D), 2) drive shaft (Fig. 1E), 3) syringe (Fig. 1J), and 4) support container (Fig. 1A). The complete injector (Fig. 2) can weigh less than 2 kg. The motor is powered by a single D flashlight battery which usually lasts for 6 hours of use (Fig. 1C). Cost of materials for one unit is ca. \$40. Construction time averages 3 hours per unit.

The unit's slow rotation, high-torque rotisserie motor is ca. 10 cm long × 5 cm wide × 3.75 cm deep and weighs ca. 250 g.

The drive shaft from the motor to the syringe plunger is 9.5-mm continuous SAE standard thread stock (21 threads per 2.54 cm) ca. 30 cm long. One end of the thread stock is ground square to fit the 9.5-mm female drive opening of the motor. The other end is ground to ca. a 50-degree taper which seats on the syringe plunger when in operation (Fig. 2). The pillow bearings (Fig. 1F) are placed in precut slots in the side panels of the three-sided box (Fig. 1B). The pesticide storage and delivery supply source is a 60-ml disposable syringe. The syringe shaft (30.2 mm o.d.) has a thin lip (39.8 mm o.d.) on top. The empty syringe with plunger down and needle in position is 19 cm long. The syringe fits snugly inside a 24-cm length of schedule 80 PVC pipe (31 mm i.d.) (Fig. 1G).

The lip of the syringe holds it in position within the PVC pipe when the syringe plunger is being depressed by the rotating drive shaft from the motor. The drive shaft presses on the capped end of the PVC pipe, forcing the liquid out the delivery tube (Fig. 1K) at a constant rate. The seating mechanism for the tapered end of the drive shaft is a 6.1-mm PVC plug which has a 0.6-mm hole (Fig. 1H). The plug is inverted and glued with PVC cement to the cap on the

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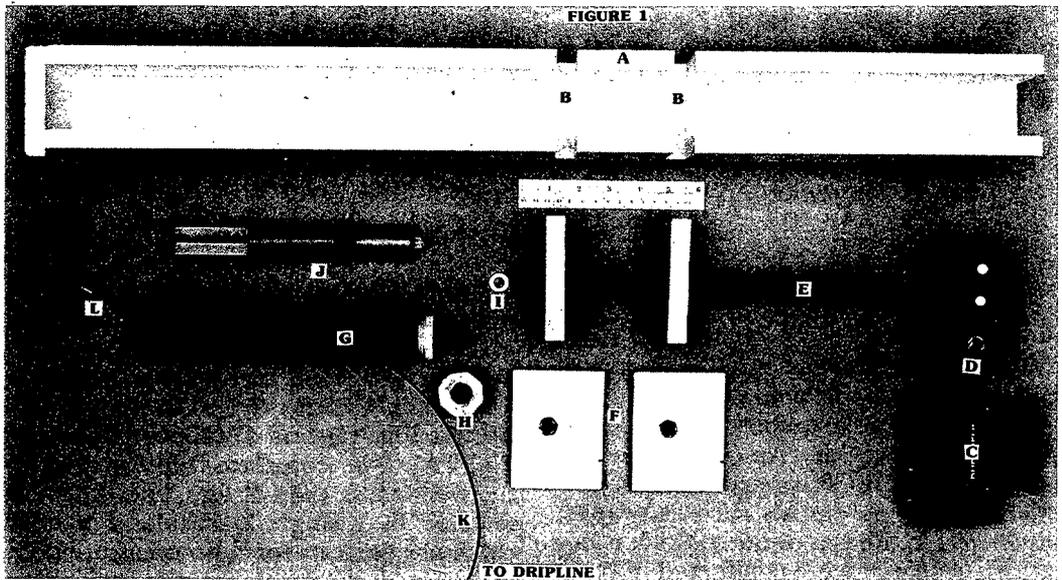


FIG. 1. Mechanical liquid injector parts. See text for names of A-L.

end of the PVC support tube for the syringe. A 10-mm steel flatwasher (Figs. 1I, 2) is inserted between the PVC plug and the driveshaft tip.

The support box, constructed of 16-mm thick pressboard, is ca. 75 cm long. Pillow bearings (Figs. 1F, 2) are placed in precut slots in the side panels and a notch in the bottom of the support box (Figs. 1B, 2). These pillow bearings are snug within the slot but loose enough to slide easily to maintain proper alignment under torque. A 3.2-mm hole is drilled in the side of the PVC tube ca. 2.5 cm from the end nearest the seat of the drive shaft (Fig. 1G). This

hole is for the feedline from the hypodermic needle within the cylinder to the drip irrigation line (Fig. 1K). The syringe needles (20 gauge) are fastened to the feedline by puncturing the line ca. 1.25 cm from the end with a hypodermic needle. The line is then bent at a 180-degree angle above the puncture hole and fastened to the needle shaft with plastic electrical tape to prevent leakage (Fig. 1L). An ample length of tubing (1.8-mm spaghetti type drip irrigation tubing) is used to connect the syringe and the drip line (Fig. 1K, 2).

The syringe is filled with liquid, attached to the syringe needle, and placed in the support cylinder. The unit is then inserted into the support box where the drive shaft is snugged by hand to the end of the syringe support housing. The feed tubing is then inserted into the drip irrigation line and delivery is started.

The motor turns at a constant 3 RPM requiring 25 minutes to deliver 50 ml of liquid from the syringe. Quantities of active ingredient delivered can be changed by diluting or concentrating the chemical, changing the thread size (and pillow bearing nuts) of the drive shaft or changing delivery time.

Injectors have been operated against water pressures up to 8,172 g/6.45 cm<sup>2</sup>

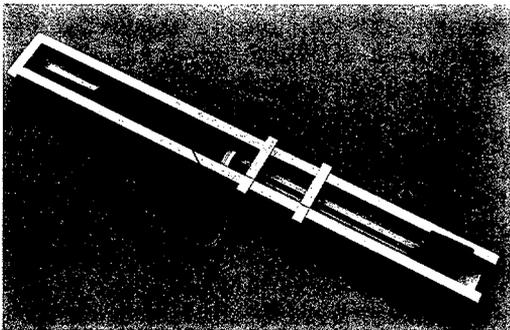


FIG. 2. Mechanical liquid injector assembled and ready for use.

with little variability in delivery time compared to a nonpressurized system. We currently operate 50 units which two workers can set up, inject liquids, and remove the

injectors in 2 hours. Nematicides can be premixed in the laboratory, saving field time and reducing the possible dangers of handling toxic chemicals.