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C W. Robartson

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PRESSURISED SOIL FUMIGATION EQUIPMENT
FOR CONTROL OF EELWORM

This article gives details for the construction of a simple pressurised fumigator which could be easily made by most orchardists, vignerons and market gardeners.

By C. W. ROBARTSON, Laboratory Technician, Plant Pathology Branch.

The treatment of soil infested with eelworms involves the use of chemical fumigants usually in the form of volatile liquids.

These fumigants upon introduction into the soil vapourise and diffuse throughout the soil killing the eelworms present.

For large-scale application the liquid fumigant is best applied by running it into furrows made by suitable tractor drawn equipment.

One of the most accurate means of maintaining constant delivery of fumigants to the soil for eelworm control is by pressurised equipment.

Outline of function

The fumigant is pumped from a drum or suitable container mounted on the cultivator, through a pressure control head where the pressure throughout the system is adjusted to approximately 8 pounds per square inch. The chemical then passes into a pressure equalisation chamber and through a number of flow-control taps to the injectors.

The injectors deliver the liquid fumigant into the bottom of the furrows immediately behind the disc or tyne where it is subsequently covered with soil. (Figs. 1 and 3.)

With suitable alterations the equipment could be easily converted to fit a tyned implement.

Major components

Drum and hoses

A suitable container is required to hold the fumigant. A 30-gallon drum, mounted and secured to the frame of the cultivator can be used. This drum may be easily replaced if it becomes corroded by the fumigant.

Because of the harsh nature of most fumigants, ½ in. petrol resistant rubber hose should be used. Although ½ in. petrol resistant P.V.C. hose has been shown to be resistant to fumigant, it does tend to become soft during fumigation. From the drum the fumigant passes through a bronze gauze strainer to the pump.

Gear pump

A ¾ in. self-priming rotary gear pump is used; this type of pump can be fitted to the P.T.O. of any tractor but other similar pumps could be used. It is important that the pump be of bronze with stainless steel shafts to prevent corrosion. From the gear pump the liquid is carried through the control head.
Control head and gauge (Fig. 2-A)

Although many types of control heads or blocks are available, it is necessary to have an all bronze type to minimise corrosion.

The control head has an adjustable pressure valve and by-pass outlet, also there is an on-off control valve incorporated in the head.

Other units are available with the on-off stop-cock as a separate attachment.

Most types of control heads may be screwed into the pump or connected by a hose to the pump for use as a remote control handy to operator. With this equipment the control is mounted on the tractor mudguard.

A suitable pressure gauge is fitted to the control head. As the equipment is operated at a low pressure, approximately 8 pounds per square inch, a gauge with a small pressure range is required for accurate readings. From the outlet of the control head a hose is attached to convey the fumigant to the pressure equalisation chamber.

Pressure equalisation chamber (Fig. 2-B)

The pressure chamber is required for equalising the pressure throughout the system and it is from here that the liquid fumigant is evenly delivered to the injectors.

Construction

The pressure equalisation chamber is constructed from a piece of 2½ in. galvanized water pipe 3 ft. long.

Both ends of the pipe are welded up with metal plate. A number of evenly spaced ½ inch diameter holes are drilled in a line along this pipe (the number of holes is determined by the number of injectors required).

Each of these holes serves as an outlet from which the fumigant flows to the injectors.

A single hole of the same diameter is drilled midway along the pipe on the opposite side to serve as an inlet. All of the holes are tapped with ½ inch B.S.P. thread (1/2 inch water pipe thread) and
into each is screwed $\frac{1}{4}$ inch to $\frac{3}{4}$ inch B.S.P. brass reducing bushes. For added strength these are brazed or silver soldered into position.

Into these outlet bushes are fitted Rega No-drip hose cocks to take the outlet hoses. Into the inlet bush a hose adaptor is screwed to take the $\frac{1}{4}$ inch hose from the control head.

Suitable brackets are required for mounting the pressure chamber on to the cultivator.

From the outlet cocks, hoses are connected to run to each injector.

**Injectors (Fig. 2-C)**

The purpose of the injectors, as the name implies, is to inject or squirt the liquid fumigant into the soil.

They are constructed from bronze tubing of $\frac{1}{2}$ inch outside diameter and approximately 2 ft. long. Each tube is threaded at one end with $\frac{1}{4}$ inch B.S.P. (gas) thread to take the injector nozzles. The nozzles are made from 45° cyclone spray nozzles (Rega) by unscrewing the cap and removing the whirl disc and stainless steel flat disc and replacing them with a number 4 nozzle from a “Terra jog gun.” Alternatively 45° cyclone spray nozzles with the whirl disc removed could be used.

A suitable frame is required to hold the injectors into position behind the discs and is constructed from a 5 ft. length of 2 inch water pipe.

Holes are drilled in line along the pipe at 9 inch intervals through which the bronze injector tubes can slide. (Spacing will depend on distance between discs or tynes.) The injector tubes are held in place by studs screwed into the pipe at right angles to them. By loosening these studs the injectors can be moved up and down as required.

This frame is fixed to the frame of the cultivator with bolts.

**Cultivation implement**

The fumigation equipment is mounted on to a small disc plough. Although a tyned implement could be used, a disc cultivator is less likely to damage surface roots than a tyned implement.

The discs should be set at a narrow angle so that the soil falls in over the fumigant.

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Fig. 2.—Diagrammatic plan of fumigation equipment.
The furrows should not be more than one foot apart and should be 6 to 8 inches deep.

Rate of application
As the dosage rate will vary with individual fumigants, the makers recommendations should be checked before use.

The rate of flow from the outlets is set according to the tractor speed to ensure the fumigant will flow from each injector at the required rate to provide the desired dosage. (See table below.)

The pressure of the system must be set before application. This is done by adjusting the pressure valve on the control head to obtain a pressure of approximately 8 pounds per square inch. It is important that the pressure once adjusted, be kept as near as possible to constant during the operation. Before adjusting the rate of flow the speed of the tractor with the discs or tynes in the soil at the required depth must be calculated. The speed is determined by measuring the time taken for the tractor to move a measured distance. (See table below.) Select a speed between 1 1/2 m.p.h. and 4 m.p.h. at which the equipment can be comfortably operated.

Note.—The speed as indicated by the “rev.” counter of the tractor is not always correct when cultivation equipment is attached.

For this reason the speed should be calculated as mentioned above, and a comparison made with the “rev.” counter of the tractor.

### RATE OF FLOW OF FUMIGANT FROM OUTLETS AT SELECTED TRACTOR SPEEDS

<table>
<thead>
<tr>
<th>TRACTOR SPEED</th>
<th>NUMBER OF FLUID OUNCES PER OUTLET PER MINUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 gal./acre at 9 in. between furrows</td>
<td>25 gal./acre at 9 in. between furrows</td>
</tr>
<tr>
<td>1 1/2 m.p.h. = 44 yds/min.</td>
<td>8</td>
</tr>
<tr>
<td>2 m.p.h. = 59 yds/min.</td>
<td>10</td>
</tr>
<tr>
<td>2 1/2 m.p.h. = 74 yds/min.</td>
<td>12</td>
</tr>
<tr>
<td>3 m.p.h. = 88 yds/min.</td>
<td>15</td>
</tr>
<tr>
<td>3 1/2 m.p.h. = 102 yds/min.</td>
<td>17</td>
</tr>
<tr>
<td>4 m.p.h. = 117 yds/min.</td>
<td>20</td>
</tr>
</tbody>
</table>

If for unavoidable reasons furrows greater or less than 9 inches are cut, it is necessary to adjust the rate of flow accordingly. For example, the table shows that for a dosage rate of 25 gallons per acre and a speed of 2 m.p.h. on a 9 inch furrow, the flow from each outlet is at the rate of 12 fluid ounces per minute. If a 7 inch furrow is being cut, the rate of flow would be 12 x \(\frac{7}{9} = 9\frac{1}{3}\) fluid ounces per minute from each outlet. If a 12 inch furrow is cut, it would be 12 x \(\frac{12}{9} = 16\) fluid ounces per minute from each outlet.
Once the speed has been determined the tractor must be driven as close as possible to that speed throughout the fumigation.

The rate of flow of fumigant from the injectors is controlled by the stop-cocks on the pressure chamber. These must be individually adjusted to give the correct flow per outlet per minute according to the dosage rate and tractor speed as given in the table.

For example, the table shows that for a dosage rate of 20 gallons per acre and a speed of 2 m.p.h. on a 9 inch furrow width, a flow of 10 fluid ounces per outlet per minute is required. To adjust the flow to this rate the tractor engine is set running at the required "revs." (equivalent to the speed of 2 m.p.h.). Each stop-cock on the pressure chamber is then adjusted until a flow of 10 fluid ounces per minute is running out of each injector. These adjustments may take a little time, however, once the stop-cocks are set there need be no other changes during the operation unless of course a change is required in the dosage rate or tractor speed.

Once the correct rate of flow is obtained the equipment is ready for use.

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