A Fumigant Vaporizer Unit for Use in Laboratory Experiments[1]

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ABSTRACT

The vaporizer unit described and illustrated in this paper proved to be satisfactory for use in applying microquantities of vaporized fumigant mixtures in known proportions, a difficult problem in laboratory testing. A wide range of fumigants can be vaporized with this unit, but the principal use made by the authors was to vaporize fumigants with high boiling points so that the fumigant was introduced into the fumigation chamber in the gaseous form.

Many of the candidate compounds evaluated for their usefulness as grain fumigants vary widely in their physical and chemical properties and require different methods of application.

In tests conducted by the authors, a liquid fumigant was introduced into the test chamber in one of two ways: applied to an absorbent material and allowed to vaporize by its own vapor pressure, or in a gaseous form.

The application of microquantities of vaporized fumigant mixtures in known proportions is a difficult problem

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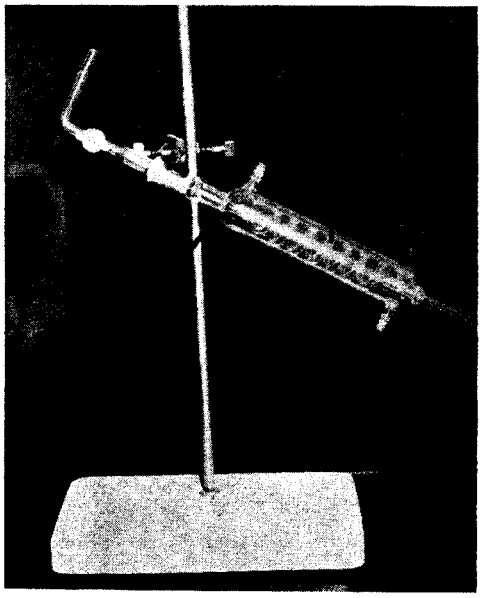


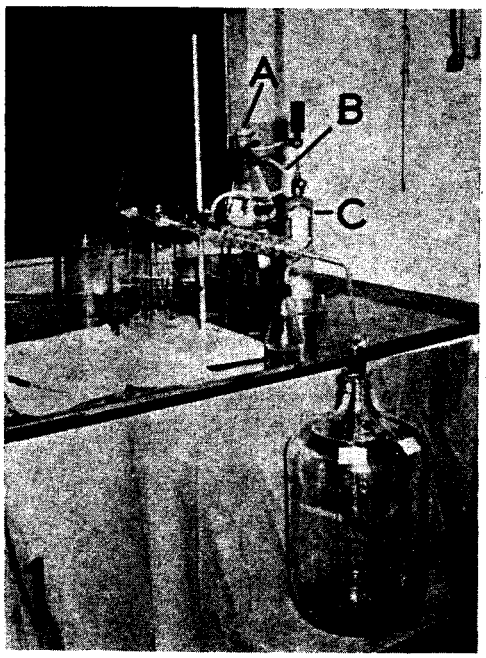
FIG. 1.—Vaporizer with stopcock in place. (See text for explanation of lettered parts.)

in laboratory testing. One of the more satisfactory ways of handling the fumigant is to measure the dosage as a cold liquid, confine it in a nonabsorptive container, and vaporize it into the fumigation chamber by the use of heat. However, care must be taken not to affect the temperature in the fumigation chamber. The vaporizer unit described and illustrated in this paper proved to be satisfactory for this purpose.

The unit (hereafter called a vaporizer) consisted of a Graham condenser of pyrex glass having a jacket approximately 200 mm. long and 40 mm. in diameter (fig. 1, *B*), and open at both ends (fig. 1, *E* and *F*), for the circulation of steam; a coiled conductor tube 8 mm. in diameter sealed within the condenser (fig. 1, *A*), with an outer T-joint (No. 19/38) (fig. 1, *G*) at the upper end (fig. 1, *H*); and a 90° connecting tube (fig. 1, *C*) with a stopcock (fig. 1, *J*) attached to an inner No. 19/38 T-joint (fig. 1, *I*), for the introduction of the liquid fumigant. Short lengths of polyethylene and Tygon plastic tubing were used to connect the vaporizer vent (fig. 1, *D*) to the fumigant chamber.

The unit was mounted on a burette stand at an angle of about 60° (fig. 1) to prevent the liquid fumigant from dropping directly through the coil into the fumigation chamber before being vaporized. Steam was generated by boiling distilled water in a 500-ml. glass distillation flask (fig. 2, 1*A*) on a Bunsen burner. The vent of the flask was attached to the upper opening in the steam jacket of the vaporizer by a Tygon tube (fig. 2, 1*B*). The steam which bathed the condenser coil caused the liquid fumigant to vaporize quickly and its own pressure forced it into the fumigation chamber. By observing the progress of the liquid fumigant through the glass the operator could determine when the fumigant dosage was completely vaporized. Immediately after each use the vaporizer was tested with a halide-leak detector (fig. 2, 1*C*) to determine if all of the gaseous fumigant had been forced from it into the fumigation chamber.

A wide range of fumigants can be vaporized with this unit, but the principal use made by the authors was to vaporize fumigants with high boiling points such as ethylene dibromide (boiling point 131.6° C.), so that the fumigant was introduced into the fumigation chamber in the gaseous form.



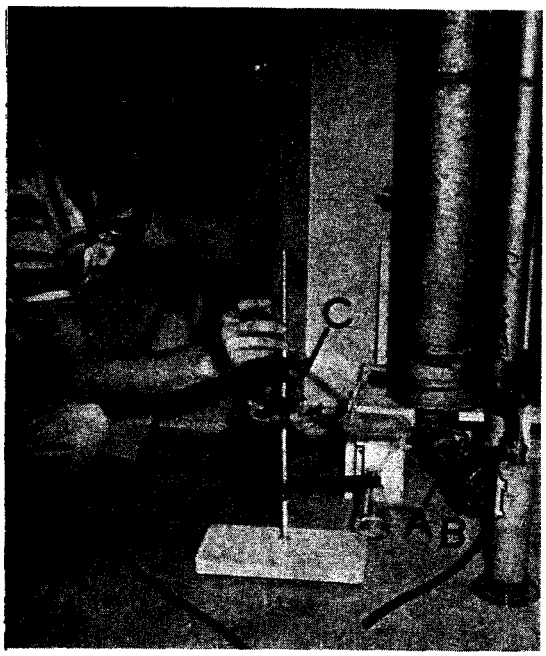


FIG. 2.—*1*, Vaporizer connected to bottle; *2*, vaporizer connected to recirculator. (See text for explanation of lettered parts.)

The vaporizer was used under two sets of conditions. First, it was attached to a partially evacuated (15 inches of mercury) 5-gallon glass bottle (fig. 2, 1*D*) and the vaporized fumigant was pulled through the vaporizer by releasing the vacuum in the bottle. The unit was removed as soon as the vacuum was satisfied. Second, the vaporizer was used to apply the fumigant in laboratory recirculators filled with wheat. The exhaust side of the unit was attached to an opening in the return duct of the recirculator on the intake side of the fan (fig. 2, 2*A*). Negative pressure, causing a slight vacuum in the vaporizer coil, aided in pulling the fumigant vapors into the fumigation chamber. Immediately after the liquid fumigant was introduced, a short polyethylene plastic tube was attached to an opening in the exhaust side of the recirculator fan (fig. 2, 2*B*) and attached to the glass tube (fig. 2, 2*C*) above the stopcock. This arrangement set up a recirculation through the vaporizer unit and aided in washing the gas into the fumigation system. The vaporizer was left attached to the recirculator for 5 minutes to give ample time to vaporize all of the liquid.

Under the conditions tested, the average temperature rise in the empty 5-gallon bottles was about 3° F. No rise in temperature was detected in the wheat-filled recirculators. Two formulations of ethylene dibromide and methyl bromide were tested with no detectable loss of methyl bromide and with complete volatilization of the fumigant in about 30 seconds.

Some precautions to be taken in the use of the vaporizer are:

1. Cool the stopcock and glass tube at the top of the vaporizer before the fumigant is applied in order to prevent premature volatilization.
2. Set the condenser at an angle to prevent the liquid from passing through without being completely vaporized.
3. Keep flammable fumigants away from the open flame of the Bunsen burner, and the electric motors of the fumigation apparatus.
4. Use some method, such as the use of the evacuated bottle, to clean the vaporizer coil of all of the fumigant vapor.

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