The Commercial Use of Dichloroethyl-Ether for the Control of Cheese Mites

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SUMMARY

Trials of various methods of application of dichloroethyl-ether for control of mites in cheese factory holding rooms and cool stores are described.

Mites directly exposed to " atomised " dichloroethyl-ether sprayed into the holding room were killed by a dosage rate of 1 lb. per 1,000 cu. ft. capacity. A second treatment was necessary after turning the cheeses. The rind of both waxed and unwaxed cheese was tainted for about three weeks.

Attempts at control of mites in cool stores by means of vaporization of the fumigant or spraying from a fixed spray line were unsuccessful.

Application by means of a hand " atomiser " proved effective in cool stores, giving a complete kill of mites and producing no lasting effect on flavour or rind.

INTRODUCTION

In recent years mite infestation has assumed importance in the holding rooms of cheese factories, in cool stores and in ships' holds. This is attributed to the longer period in which cheese was stored in Queensland factories and cool stores during the war years, due to irregularity in shipping time-tables, and to an increasing tendency to market locally a more matured cheese.

The species concerned are *Tyrophagus longior* Gerv. and *Tyrolichus casei* Ouds, dominant in factory holding rooms, and *Tyroglyphus farinae* De Geer, commonest in cool stores. The difference in species dominance appears to be related to temperature differences, holding rooms being maintained at generally higher temperatures than cool stores.

In efforts to control the mites without tainting the cheese, manufacturers have in the past tried various materials, including ammonia, sulphur dioxide and formalin ; only limited success has been attained with these chemicals. Following the reported successful experimental use of dichloroethyl-ether against cheese mites in New Zealand, the Department of Agriculture and Stock co-operated with a cheese manufacturing association and cool store owners in testing this material under commercial conditions in Queensland.

FACTORY HOLDING ROOM EXPERIMENTS

Two holding rooms containing cheeses (waxed and unwaxed) were treated with dichloroethyl-ether. The cheeses were standing flat on wooden shelves and neither room was filled to its capacity.

Equipment and Technique

An atomising spray trigger gun with adjustable fine spray nozzle, known as an Engine Cleaning Gun (Figure 1), was fitted to the factory's compressed air system by means of 90 ft. of $\frac{3}{8}$ in. diameter pressure tubing. A regulating valve and pressure gauge were attached at the end of the compressed air line. The fumigant was carried in a pint-calibrated half-gallon clear glass bottle. Army gas masks No. 4 III 1940 and 1941 models fitted with $\frac{3}{4}$ in. diameter 5-ply steam rubber hose, which was later replaced by the standard cannisters, were worn by the operatives.

Figure 1.
Atomising Spray Trigger Gun Fitted to Factory Compressed Air Line.

The dosages were calculated on the basis of 1 lb. of dichloroethyl-ether per 1,000 cu. ft. of room space and the discharge rate was 1 pint ($1\frac{1}{2}$ lb.) per 5 minutes.

The atomised spray was so directed that all cheeses, as well as empty shelves, were enveloped in the spray mist (Figure 2). As far as possible, marked wetting of cheese surfaces with the fumigant was avoided.

Room A

This room had a capacity of 5,500 cu. ft. and held approximately 15,000 lb. of cheese, consisting of 200 mediums, 600 loaf, 100 picnics, and 100 midgets. Most were waxed, with some unwaxed freshly removed from the press. Heavy mite infestations occurred on the floors, the shelving and the cheese.

A total of 4 pints of the fumigant was atomised at a pressure of 44 lb. per sq. in., which was considerably below the intended and optimum pressure of 70 to 75 lb. per sq. in. The room temperature at spraying was 79° F. and the relative humidity 73 per cent. The room was closed immediately after treatment and was kept sealed for 24 hours before being opened and aired. There was appreciable leakage of fumigant from the closed room.

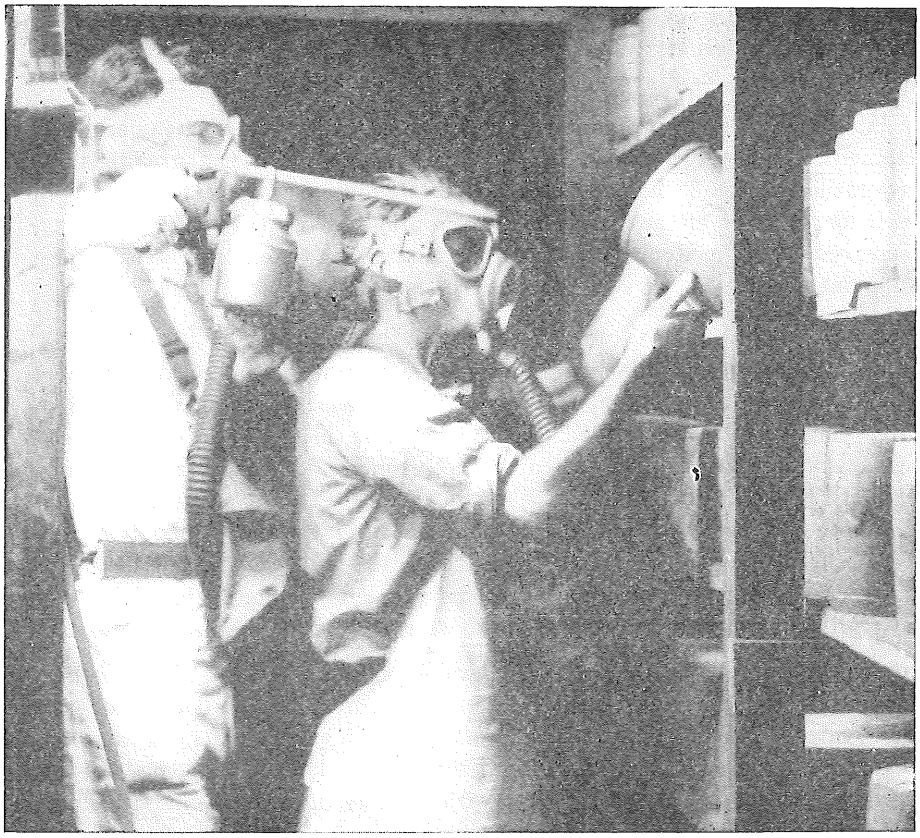

Figure 2.
Treating Cheese on Shelves in Factory Holding Room.

After airing, the cheese was turned and transferred to treated shelves so that the previously untreated surfaces were now exposed, and a second dosage of 4 pints was applied at a pressure of 70-75 lb. per sq. in. with the temperature at 73° F. and relative humidity at 69 per cent. The room was fairly tightly sealed for the ensuing 48 hours. Twenty of the treated cheeses (10 waxed loaf and 10 unwaxed loaf) were held in this room for two months for observation.

Room B

The second treated room had a capacity of 7,500 cu. ft. and held approximately 7,000 lb. of cheese. Altogether there were 200 separate cheeses in the room, consisting of loaf and medium size, with equal proportions of waxed and unwaxed. Heavy mite infestations, showing all stages of the life cycle, occurred throughout the room and on the stored cheese.

A total of 5 pints of fumigant was applied at a pressure of 70 lb. per sq. in. The temperature of the room when treated was 69° F., and the relative humidity 76 per cent. The room was closed immediately after the treatment was completed, and the air circulation system operated for 46 hours, after which the room was opened and aired for a few minutes before observations were made.

All cheeses were then inverted and transferred to treated shelving and a second treatment of 3½ pints applied at a pressure of 70-75 lb. per sq. in., the room temperature being 73° F. and the relative humidity 69 per cent. The room was closed for 48 hours after treatment. Observations were made on 28 of the treated cheeses (8 waxed medium, 10 waxed loaf and 10 unwaxed loaf) over a period of two months.

Subsidiary Trials

In view of the possible significance of the treatment in the trade, treated and untreated cheeses were crated and stored in a holding room heavily infested with mites. The treatments included (a) treated cheese, in untreated crate ; (b) treated cheese, in treated crate ; (c) untreated cheese, in treated crate ; and (d) untreated cheese. Each crate contained four 40 lb. cheeses, two waxed and two unwaxed. The treated cheeses were taken from Room B after the first fumigation and each therefore had one untreated surface. The treated crates had been sprayed thoroughly during treatment of the rooms and left for the 46 hours between the first and second treatments. Subsequent storage was for a period of two months.

In addition, one waxed and one unwaxed loaf cheese were each swabbed with dichloroethyl-ether, labelled, placed in the untreated cheese room, and examined periodically for odour retention. One waxed and one unwaxed cheese were retained in a saturated atmosphere of dichloroethyl-ether, the cheese being stored for a period of six weeks in a desiccator, with a petri dish containing the fumigant. Examinations were made as to any possible effect on the flavour of the cheese.

To check on the lethal effect on the total mite population, collections of dust scrapings, including eggs, nymphs and adults from shelves, floors and exposed cheese surfaces, were returned to the laboratory for examination. Small pieces of mite-free cheese were placed with each sample in sterile petri dishes and held up to a period of one month.

Results

Effect on Mite Infestation.

Immediately after the first treatment, samples taken from the floors, shelves and cheese surfaces were examined for living mites. The " kill " appeared to be complete at all stages of the life cycle where direct exposure to the effects of the

fumigant occurred. The treatment, however, had no effect on the mite population under the cheese, whether resting on the shelves or on other cheeses, or in cracked cheese where penetration of mites had occurred to a depth of up to 2 in. The surviving mite population, except in the cracked cheese, was, however, destroyed by the second application. Even in the cracked cheese there was a surprisingly high mortality of mites, though the percentage survival of mite population here was greater than was desirable.

The collections of dust scrapings when incubated with mite-free cheese in sterile petri dishes for one month gave no sign of further mite development.

Period of Immunity by Treatment.

Examination of the experimental cheese two months after treatment failed to reveal any mites apart from a few in Room B. There was furthermore no indication of rind taint or smell, or of taint of dichloroethyl-ether in the interior of the cheese.

However, two pockets of infestation were observed in Room A, suggesting that the lower pressure employed was less effective than the higher one used in Room B.

Continued observation of the treated rooms indicated that a second complete treatment was needed three months after the first treatment. With improved factory hygiene a considerably longer period of immunity could have been expected.

The two cheeses, one waxed and one unwaxed, swabbed with dichloroethyl-ether at the time of room treatment and stored for two months in the heavily infested third holding room, both became mite infested, but they were in much better condition than comparable untreated cheese. This suggests that the treatments had a residual effect. Neither the rind nor the interior of the cheese showed any effect of the treatment.

All of the crated cheese held in an infested room for two months carried a population of mites, but the treatments a, b and c showed a lower infestation than the check d; in fact, only mild and localized infestation occurred in the three treatments mentioned. The low infestation of untreated cheese in a treated crate suggested that this might represent a practicable method of handling export cheese.

Effect on Flavour of Cheese.

Immediately following the first treatment, plugs from waxed and unwaxed cheese were examined, and were found to be free from taint. However, the rind of both waxed and unwaxed cheese had a distinct smell of dichloroethyl-ether. The odour in the rind, and in the rooms generally, persisted for about a week, but it gradually diminished in intensity. After three weeks, neither the odour in the rooms nor the rind taint could be detected with any degree of certainty. There appeared to be no physical effect of the fumigant on the rind of either waxed or unwaxed cheese.

Both the waxed and unwaxed cheese initially swabbed with dichloroethyl-ether retained a strong rind smell and taint, but there was no evident penetration into the interior of either. After a period of two months no treated cheese showed

any indication of dichloroethyl-ether taint in the rind. The rinds of two cheeses, one waxed and one unwaxed, examined after six weeks' storage in a saturated atmosphere of dichloroethyl-ether had a strong odour of the fumigant, but the interior was free from taint.

COOL STORE EXPERIMENTS

The experimental work at the cool store was concerned mainly with attempting to devise a more convenient method of applying dichloroethyl-ether than was adopted at the cheese factory, as well as to ascertain the effect of the treatments on large consignments of export cheese both in cool store and during transit overseas. The cool store room had a capacity of approximately 50,000 cu. ft.

The methods tried were (a) vaporization of the fumigant, buffered against explosion with carbon dioxide ; (b) spraying from a fixed spray line ; and (c) spraying from a hand " atomiser."

Dichloroethyl-ether as a Vapour

The apparatus used for the vapour treatment consisted of a drum container for the fumigant, a hot water tank fitted with a double-header constructed from 3 in. and $\frac{1}{2}$ in. piping, and a bank of six 50 lb. CO_2 cylinders linked together with a header. Compressed air at 200 lb. per sq. in. was also available. These were joined together into a system with $\frac{1}{2}$ in. piping, pressure taps and gauges, the outlets being distributed along a pipeline within the building. The drum to hold the fumigant and the hot water tank were each placed on a large electric hot plate. However, in spite of the amount of heating provided, this method of vaporizing the fumigant in sufficient quantity was unsuccessful and, even so, pipeline condensation took place.

Dichloroethyl-ether from a Fixed Spray Line

For this purpose the apparatus used in the vaporization trial was modified by the omission of the heating equipment and the CO_2 cylinders. The plain pipeline outlets were replaced by downwardly directed fine mist nozzles uniformly spaced, the line being suspended at a suitable height entering from the west end of the chamber. The fumigant was sprayed by means of the compressed air.

Eighteen paper trays, each approximately 18 in. square and 1 in. deep, were placed in various parts of the chamber and at different levels. Each tray contained approximately a level teaspoonful of living cheese mites and mite debris. Of each pair of trays, one was open and exposed, the other was covered to the extent that a piece of flat cardboard of equal size was supported above it on legs 6 in. high to intercept any downward falling spray.

The full dose of 1 lb. of fumigant per 1,000 cu. ft. of chamber space was given, but maximum pressure obtained in the airline was only 130 lb. per sq. in. This relatively low pressure, combined with some unsuitability of the nozzles for " atomisation " and the pressure gradient in the pipeline, resulted in poor distribution of the fumigant in the chamber.

Table 1, showing the results of examinations of the mite samples on the paper trays removed from the chamber after an exposure of 24 hours, indicates that, except in the case of three trays placed at the 4-crate level, what may be termed the mite-survival figure was satisfactorily low, compared with a control figure of 50.

Table 1

NUMBERS OF LIVING MITES FOUND IN SAMPLES OF MITES AND MITE DEBRIS DURING 8-MINUTE SEARCH PERIODS.

Part of Building	Level of Tray	Tray	
		Covered	Exposed
East end	On floor	0	0
	2-crate	6	5
	4-crate	20	17
Centre	On floor	0	0
	2-crate	1	6
	4-crate	0	18
West end	On floor	0	0
	2-crate	0	0
	4-crate	0	1
	TOTALS	27	47

Number of living mites found in one untreated sample during 8-minute search period : 50.

The mite survival figure at the east end was low because of the poor operation there of the nozzles, but it indicated that some general diffusion of the mist and vapour did take place, aided by the air-circulatory system of the chamber.

Dichloroethyl-ether from an "Atomiser"

An engine spray gun with an adjustable spray nozzle and a one-quart capacity cannister was attached by means of 60 ft. of $\frac{3}{8}$ in. diameter pressure tubing to a mobile compressed air tank with an air compressor operated by an electric motor. A pressure gauge and a regulating valve operating at 80 lb. per square inch were fitted. The general arrangement of this equipment is illustrated in Figure 3.

All outlets were carefully checked and sealed against possible gas leakage where deemed necessary.

As in the fixed line spraying experiment, trays containing samples of living mites were exposed in various parts of the room and at varying heights, some being protected and others unprotected from possible direct spray. As a simpler technique in checking mite survival, the outlines of mite accumulations were traced on the paper trays prior to the treatment.

The fumigant was applied as an atomised spray at the rate of 1 lb. per 1,000 cu. ft. and as uniformly as possible over crates, walls and towards the ceiling. Open floor spaces were also treated. The room was securely sealed for a period of 48 hours.

All of the sample trays examined after the room was opened showed a complete kill of mites. The cheese was examined by both Commonwealth and State graders,

who found neither the cheese flavour nor the rind to have been affected by the treatment.

Treated Cheese Consigned to U.K.

The contents of the rooms that had been treated by the fixed spray line and by the atomiser method were consigned in the one shipment to the United Kingdom, and examination in London by a qualified Commonwealth officer revealed the absence of mite infestation and of taint.

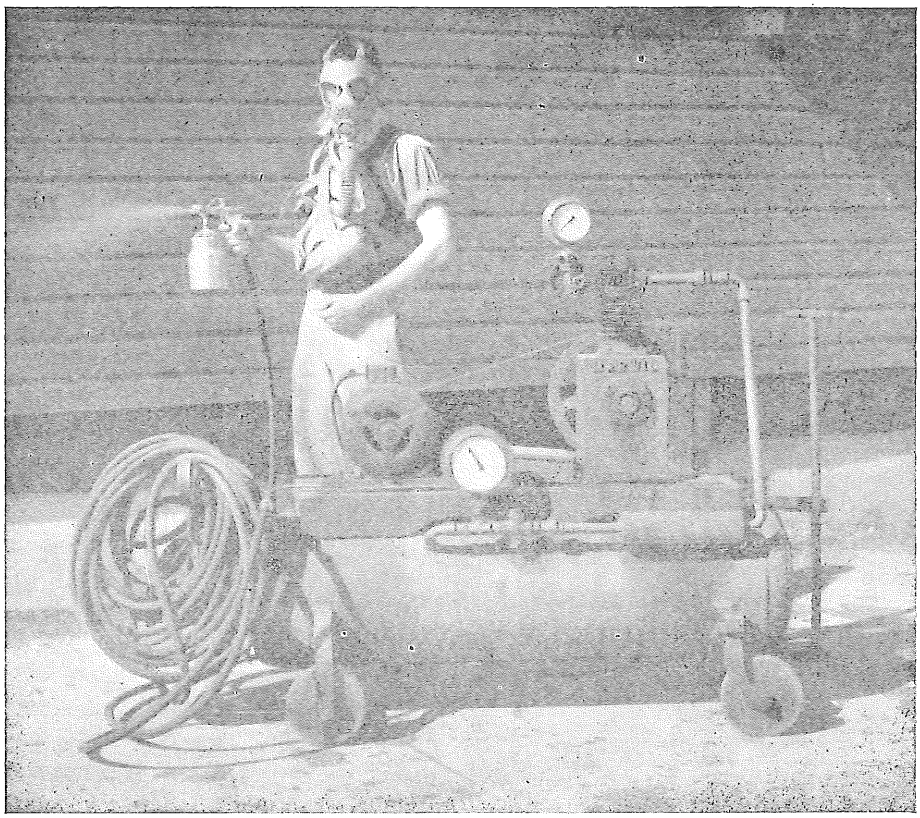

Figure 3.
Equipment used for Applying Fumigant to Cheese in Cool Store.

COSTS OF DICHLOROETHYL-ETHER TREATMENT

The costs of treatment at the cheese factory amounted to only a small fraction of a penny per lb., while at the cool stores the large quantity treated further reduced the costs. Dichloroethyl-ether is readily available and where improvised equipment cannot be used a complete portable outfit as illustrated in Figure 4 can be obtained at a reasonable price. Further large scale treatments carried out by the employees at six cheese factories and four cool stores have proved the " atomisation " method to be cheap, practicable and effective in controlling cheese mites.

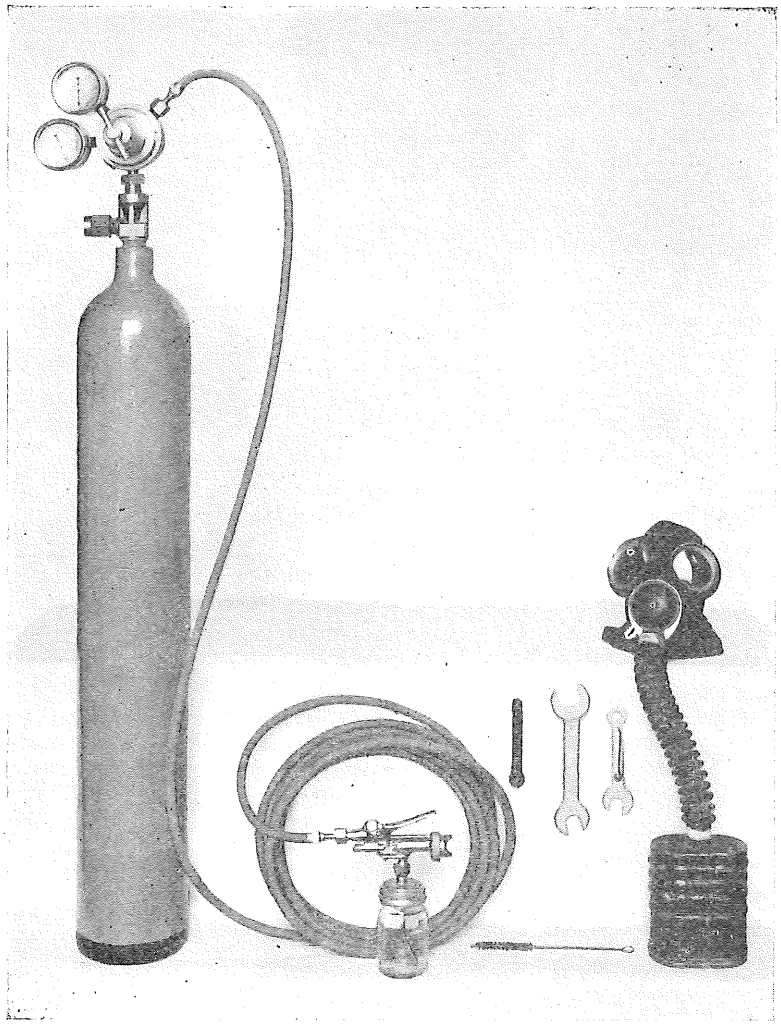

Figure 4.
Equipment Devised for Fumigating Cheese in Factory Holding Rooms.

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