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INSECT Pests AND THEIR CONTROL

By G. D. RIMES, B.Sc., Entomologist

WAX MOTH—An apiary problem

THE damage to honeycomb caused by wax moth is a world-wide problem, the extensive distribution of the pest being due to the transport of infected material which has accompanied the expansion of bee-keeping. Although wax moth can be reared on a variety of materials not obtainable in the beehive, their association with the honey-bee is of such antiquity, that honeycomb in one form or another now forms its only natural food supply.

Wax moth is a pest to most bee-keepers at various times of the year, whether in weak colonies or in stored honey combs. Although in the active hive very little damage, if any, can be caused by the wax moth, a weak colony can suffer a severe set-back by the damage to the brood. However, it is the stored comb that is the real habitat of the pest, and it is mainly with the storage problem that this article is concerned. Insecticidal treatment of an infested hive is not possible even with the selectivity of present day insecticides. There is a belief that wax moth can combat foul brood, but this is incorrect.

There are two species of moths that cause trouble in Western Australia—the Greater Wax Moth, *Galleria mellonella* (L) and the Lesser Wax Moth *Achroia grisella* (F). Both are fawn-coloured moths, the difference to casual observation being size, the Greater Wax Moth having a wing span of approximately $1\frac{1}{4}$ in., the Lesser Wax Moth being approximately $\frac{3}{4}$ in. The life history, habitat and significance of both, is similar.

The eggs are laid in cracks in the comb frame, irregularities in the super, or in litter on the hive floor. Vast numbers of eggs, barely visible to the eye, are laid, some reports placing the number as high as 1,500 per female. These hatch in one to five weeks, depending on the seasonal temperature. Warm summer temperatures can shorten the incubation period to five days. The larvae then make for the midrib of the honeycomb, damaging cells on each side as they travel. The tunnels thus formed are lined with silken thread and show up clearly in frames when held to the light. They may also connect frames together with their silken web. The temperature most favourable for their development is 90° F. and at this temperature, the larval life is about one month. This may extend up to five months if temperature and food supply are unfavourable.

The food material consists mainly of cocoon debris and other impurities in the wax. It is impossible to rear wax moth in pure foundation wax.

When fully developed the larva prepares a depression in the woodwork and then spins a whitish cocoon in which it undergoes metamorphosis. This depression can be anything up to $\frac{1}{8}$ in. deep, and repeated infestations can seriously

weaken a hive structure. The cocoon stage occupies from one to eight weeks, depending on temperature. With several life cycles completed in a short period, severe infestation can result in complete destruction of the honeycomb, all that remains being a tangled mass of web, with the frames securely stuck together and to the box. The severity of damage depends on the existing temperature and food supply. Techniques which are suitable for storage in a cold area are entirely unsatisfactory in warmer climates.

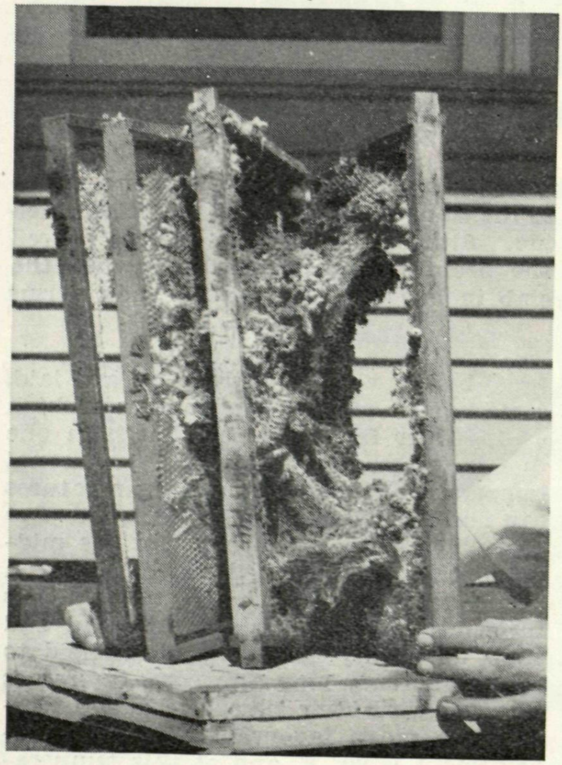

Fig. 1.—Frames of honeycomb showing wax moth damage

Control of wax moth is directed at satisfactory storage and fumigation techniques, the only control in the apiary being to preserve strong colonies and to use well-fitting lids and boxes.

STORAGE TECHNIQUES

Para-dichlor-benzene.

The most common way of storing honeycomb is with para-dichlor-benzene in the comb-cupboard. Para-dichlor-benzene is a white crystalline solid which slowly gives off a vapour toxic to wax moth. The comb-cupboard is generally at fault in this technique. Suitably airtight doors must be used and the whole structure must be proof against wax moth entry. Periodical inspection and renewal of fumigant is necessary if success is to be achieved. At least monthly investigation is necessary.

It is possible to dispense with the comb-cupboard and stack honeycombs in their boxes. The joints between boxes must be sealed. Approximately ½ oz. of fumigant should be placed on a piece of paper or card on the top of each box. Once more, periodical inspection must be carried out if any success is to be obtained.

One reason for the failure of these techniques is the fact that the temperature necessary for para-dichlor-benzene to vaporise must be 70° F., or more. At lower temperature the material is inoperative.

Sulphur Dioxide.

This is the pungent asphyxiating gas liberated when sulphur is burnt. This gas is very effective in killing the various stages of the life cycle of wax moth. It is produced by sprinkling sulphur over coals in a small brazier. The technique can be used in stacked boxes, suitably sealed, with the bottom box empty, a fireproof baseboard being necessary.

However, the most satisfactory way of using this material is with an airtight fumigation chamber or tank. In this way complete protection can be obtained with periodical fumigation. With experience, inspection can be eliminated, and comb stored throughout the danger period without risk.

Cyanide.

Cyanide fumigation is perhaps the most dangerous of all fumigation techniques. Commonly called prussic acid, the fumes are highly toxic to man, and to keep the solid cyanogas or calcium cyanide on hand is unwise as there is always the risk of accidental poisoning with children.

The cyanogas will slowly break down when exposed to the atmosphere and liberate the fumigant. Fumigation can be done either in a chamber, or with stacks of boxes, the fumigant being placed at

the bottom of the stack, at the rate of ½ oz. per box. Care must be taken to seal the joints of the boxes.

Carbon Bisulphide.

This liquid gives off a heavy toxic vapour which is very effective against various stages of wax moth. Honeycomb can be safely stored in a fumigation chamber with this compound, at the rate of 4 lb per 1,000 cu. ft. It is possible to fumigate stacked boxes in the open with the fumigant placed in a shallow tray in an empty box, on top of the stack, at the rate of ¼ oz. per box. The stack should be carefully sealed.

Carbon bisulphide is an extremely dangerous substance to handle. If forms explosive mixtures with air which can be set off by such temperatures as that of a steam pipe or an electric light bulb.

SOME NEW TECHNIQUES

In view of the undesirable characteristics of the above fumigants, work has been carried out by the Department of Agriculture in the past two years to enable improved storage of honeycomb. The important aspect of this work being the provision of an easily-handled fumigant, and one that does not possess a residual effect harmful to bees or honey.

Carbon Bisulphide and Carbon Tetrachloride.

Carbon bisulphide is an efficient fumigant, the only drawback being its inflammability and explosive properties. When mixed with carbon tetrachloride in the ratio of 1 to 4, it loses both these properties. Carbon tetrachloride also has some fumigatory action of its own.

The frames of honeycomb from 20 supers were weighed, and half of these were fumigated with the above mixture and half were stored without fumigation. The mixture was used at the rate of 20 lb. per 1,000 cu. ft. After 48 hours, the supers were removed and placed in a shed where the air was kept in circulation. After airing for 24 hours, four boxes of frames were made up, alternating four fumigated and four non-fumigated frames per box. These four boxes were placed out on four hives at the Departmental Apiary, Yanchep

A second batch of four boxes was placed out after one week's airing, being composed of half fumigated and half non-fumigated frames, alternating. This was repeated after 2, 3, and 4 week's airing, the aim being to determine the period necessary, if any, to remove odour repugnant to bees.

Each batch of frames was left on the hives for one month. At the end of this period, the frames were weighed and the honey yield from each determined. Comparisons were then made between fumigated and non-fumigated combs, and between the various periods of airing following fumigation. The statistical analysis showed no significant difference between treatments.

Another batch of frames was kept in the fumigation chamber, using the above fumigant, from August 15, 1957, until October 14, 1957. They were removed three hours prior to placing on hives, fumigated and non-fumigated frames being alternated in the boxes. Honey yield

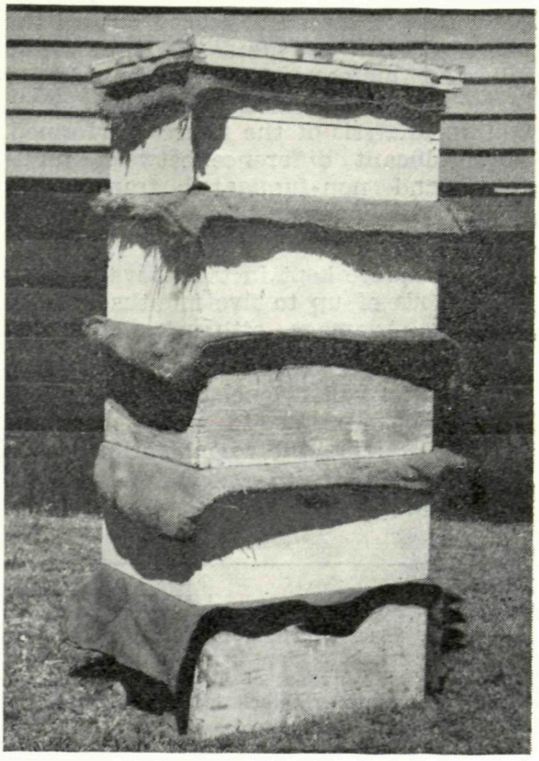

Fig. 2.—Supers of honeycomb undergoing fumigation with ethylene di bromide

was determined after one month and a statistical analysis of the results carried out. No significant difference between treated and untreated combs was found.

Conclusion.—The carbon bisulphide-carbon tetrachloride mixture has been demonstrated to be completely free from any repugnance to bees or tainting effect on the honey yield. Such a mixture can be used in fumigation chambers at the rate of 20 lb. per 1,000 cu. ft. or in small stacks of boxes, sealed together and the fumigant placed in a shallow tray, at the rate of one ounce per box, in the top box. The mixture consists of one volume of carbon bisulphide added to four volumes of carbon tetrachloride.

Ethylene di Bromide.

A further series of experiments was carried out to determine the suitability of the above fumigant for honeycomb fumigation. Boxes of frames were stacked with a piece of sacking between each, finely sprinkled with ½ oz. of ethylene di bromide. These were made up into boxes containing half fumigated, and half non-fumigated frames, and placed out on the hives. They were aired for three hours following fumigation. The honey yield per frame was determined after one month, and an analysis of the figures performed. No significant difference between fumigated and non-fumigated frames was found. There was no trace of taint in the honey yield.

Frames were kept in the above manner for periods of up to five months without wax moth damage, although activity of the moth was high.

Conclusion.—Ethylene di bromide has been demonstrated to give protection against wax moth, when sprinkled on sacking placed between boxes of frames. One ½ oz. per box, with monthly renewal of fumigant is necessary. Ethylene di bromide is a slowly evaporating liquid, and in colder areas bi-monthly renewal would be sufficient.

Acetic Acid.

Research work carried out at Rothamsted experimental station in 1954, on *Nosema* disease, led to the findings that control of wax moth could be obtained by the fumes of glacial acetic acid. Reporting this work C. G. Butler (1955) states, "It has been observed by L. Bailey that infestation by the Lesser Wax Moth (*Achroia grisella*) was eliminated in combs which were fumigated with acetic acid vapour for the control of *Nosema* and *Amoeba* diseases. Adult and larval wax moths were killed within 24 hours. Some fumigation experiments with the eggs of the Greater Wax Moth (*Galleria mellonella*) and of the Lesser Wax Moth showed that they were killed after exposure to acetic acid fumes for 12 to 24 hours at 59° F."

Trials carried out at the Department of Agriculture apiary, Yanchep, have shown that boxes of honeycomb can be fumigated and stored in stacks with a shallow tray of 80 per cent. acetic acid in the bottom box. One half pint was required for five boxes of frames. The boxes were sealed together at the joints with an adhesive tape. Periodic inspection and renewal of the acid is required. This technique has the added advantage of providing a degree of protection against *Nosema* (C. G. Butler, 1955.)

REFERENCE

Butler, C. G. (1955), Report Rothamstead Expt. Station.

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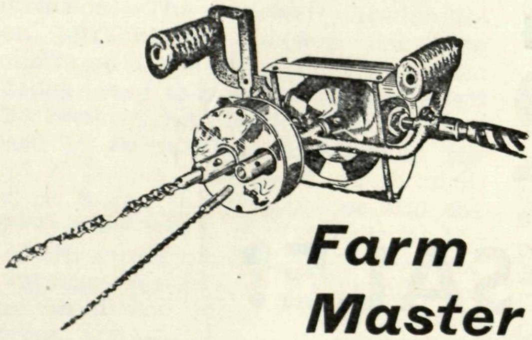

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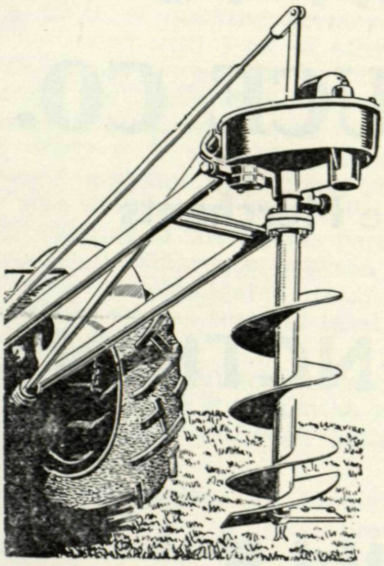

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