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Insect pests and their control - The Mediterranean fruit fly

Erratum

ERRATA In the May-June issue, page 342, the illustration (Fig. 2) was incorrectly captioned. It should read as follows:— Fig. 2.—1 and 2, Side and end views of larva of tomato fly (*Lonchea splendida*); 3 and 4, Side and end views of larva of Mediterranean fruit fly (*Ceratitls capitata*); 5, Pupa of Mediterranean fruit fly; 6. Larva of ferment fly (*Drosophila* sp).

INSECT *Pests* AND THEIR CONTROL

By C. F. H. JENKINS, M.A., Government Entomologist, and
D. G. SHEDLEY, B.Sc. (Agric.)

THE MEDITERRANEAN FRUIT FLY

THE Mediterranean fruit fly (*Ceratitis capitata* Wied) is without doubt the most serious insect pest with which West Australian orchardists have to contend. The creature has been known to science for nearly 140 years, and in that time has spread to almost every important fruitgrowing country in the world.

Experiments have shown that there is no more effective insecticide for use in fruit fly bait than sodium fluosilicate and that this bait when used correctly in conjunction with strict orchard hygiene can do much to reduce the ravages of this pest.

Regulations gazetted under the Plant Diseases Act make it compulsory to take action against fruit fly.

DISTRIBUTION

In this State the insect is known as far north as Carnarvon, where it was first found in 1934. The permanent home of the pest, however, may be regarded as that area of the State westward of a line running from Gingin south-eastwards to include Northam and York, and thence southwards to Balingup and Busselton. Casual outbreaks have occurred at Bridgetown, Albany, Mt. Barker, Kalgoorlie, Sandstone, and other outlying localities where it has failed to become established.

In the case of the southern fruitgrowing areas, failure is probably due to the stringent control measures adopted and relatively unfavourable climatic conditions, whereas in other districts the scarcity and lack of continuity of suitable host fruits accounts for its spasmodic appearances.

DESCRIPTION AND LIFE HISTORY

The Adults.

The Mediterranean fruit fly is a two-winged insect a little smaller than the house fly. The general colour is yellowish or light brown. The wings bear brownish bands and spots, and the abdomen has two light coloured rings. The pattern on the thorax or back consists of irregular white markings on a black background,

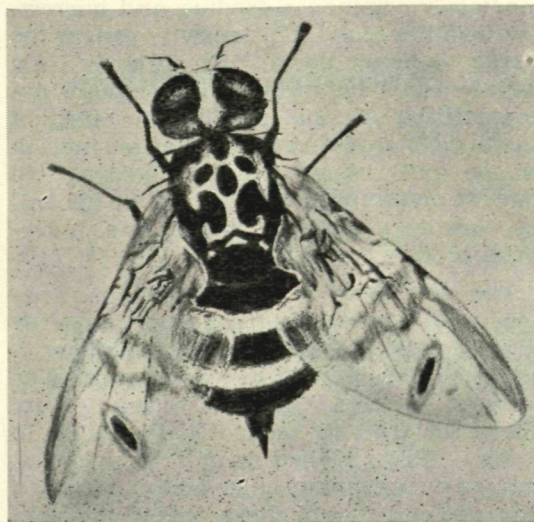


Fig. 1.—Adult female of Mediterranean fruit fly (greatly enlarged).

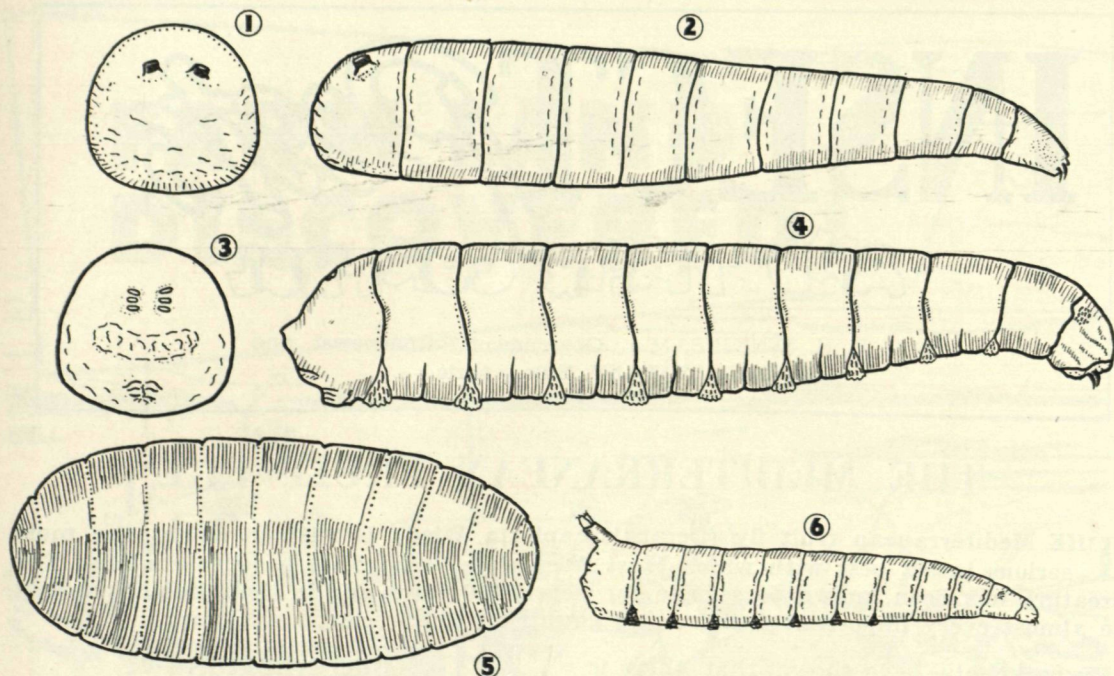


Fig. 2.—1 and 2, side and end views of larva of tomato fly (*Lonchea splendida*). 3 and 4 side and end views of larva of Mediterranean fruit fly (*Ceratitis capitata*); 5, Pupa of Mediterranean fruit fly (*Drosophila* sp.).

giving a mosaic appearance. In the sunlight this pattern often shows a metallic sheen. The wings are normally held in a drooping and what appears to be a semi-spread position, and are never folded flat on the back as in the case of the house fly.

Mating and egg-laying does not take place in the young flies until they are about a week old. During this period the flies can be most successfully attacked, for like house flies these insects are fond of sweet liquids. They are unable to live longer than about four days without food and consequently if baiting is regularly carried out by all growers it would be possible to poison off many flies before they reach the egg-laying stage.

The female fruit fly seldom strays far from the protecting foliage of fruit trees and when suitable hosts are available a puncture is made in the skin of the ripe or ripening fruit and six to eight eggs are deposited in the cavity made.

The Eggs.

The eggs, which measure approximately $\frac{1}{25}$ th inch in length and are a creamy

white colour, hatch in summer in from two to four days. In winter, however, the time required may be as long as 20 days.

The Larvae.

The tiny maggots, upon hatching, immediately commence feeding and burrowing into the fruit. This activity causes the tissue to break down, soft spots to form and in some instances the complete decomposition of the fruit. The maggot when fully grown is about $\frac{1}{3}$ of an inch in length and creamy white in colour. In fact, it resembles very much in general appearance a house fly maggot or a under-sized blowfly maggot.

The time spent in the fruit will vary according to the weather conditions and the type of fruit, but the period in summer is about 14 days and in winter sometimes as long as 45 days. One interesting feature about the fruit fly maggot is its ability to jump. When placed on a dry surface it can, by a sudden muscular action, skip to a distance of a foot or more, this is not however a characteristic of the fruit fly maggot alone for various fly larvae, including



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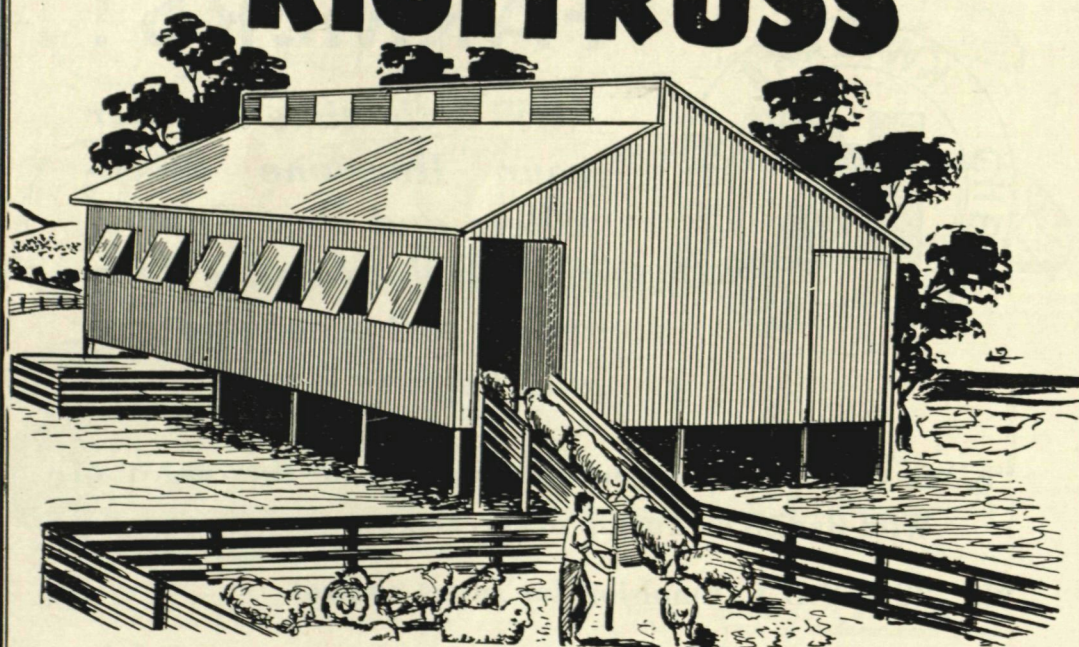
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"cheese jumpers" and the maggots of the tomato fly, possess this ability.

When fully developed, the maggot leaves the fruit, drops to the ground, if the fruit has not already fallen, and burrows into the soil.

The Pupae.

As soon as it burrows into the ground the maggot changes into a rounded barrel-shaped pupa looking not unlike a rather dark swollen grain of wheat. The pupal or resting stage varies from 12 to 50 days according to the time of year after which the fully developed fly emerges and forces its way up to the surface of the ground.

LIFE SPAN OF FRUIT FLY STAGES IN WESTERN AUSTRALIA

	Adult Fly	Egg	Larva	Pupa
Summer	28-112 days	2-4 days	14-16 days	12-14 days
Winter	17-112 days	10-20 days	25-45 days	25-50 days

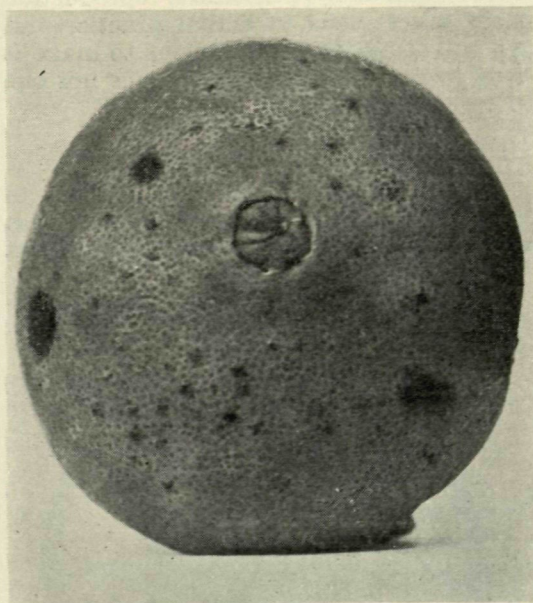


Fig. 3.—An orange showing numerous fruit fly punctures in the skin.

FRUITS ATTACKED

Well over 100 fruits, nuts and vegetables have been recorded as hosts for the fly in different parts of the world. Many of these records have, however, been secured under artificial conditions and certain hosts are definitely more susceptible to attack than others.

In Western Australia the fly has been found attacking peaches, figs, apricots, pears, all citrus fruits, nectarines, apples,

grapes, plums, persimmons, quinces, loquats, plantains, passion fruit, bananas, mulberries, olives, walnuts, tomatoes and the sapodilla. Such ornamentals as the guava, feijoa, pomegranate, clerodendron, lillypilly, chilli, rose, Irish strawberry, Barbados gooseberry, prickly pear, Osage orange and Natal plum, are also known hosts, and to complete the list must be added the following weeds: African box thorn, apple of Sodom, and black-berried nightshade.

An examination of this list will show that not a single native plant is included. The importance of this cannot be too fully emphasised, for it means that with the exception of relatively unimportant weeds, all the hosts of the fruit fly in Western Australia are cultivated plants. This simplifies, or should simplify, the problem of control very considerably. It means that if all growers were fully alive to their responsibilities the fruit fly menace could be, if not eradicated, so reduced as to be of little importance. In countries where native fruits harbour the pest the task is very different. There every care may be taken in the orchard only to be nullified by an invasion from bush or jungle, but in Western Australia a man can only blame either himself or his neighbour (of course it is usually the latter) for the presence of fruit fly in his orchard.

RELATIVE IMPORTANCE OF DIFFERENT HOST FRUITS

All host plants are, of course, not equally attractive to the fly or suitable for its development. In the passion fruit, for instance, fully-developed maggots have never been found in this State, although damage is caused by the disfiguring wart-like growths which arise on the skin following egg-laying. Maggots have been found working in pomegranates but no flies have been reared from such fruits. Although not normally regarded as a host when picked under commercial conditions, bananas have been found infested with fruit fly and adult flies have been bred from fruit infested in the field. Tomatoes, olives and walnuts were all found infested with fruit fly for the first time in Western Australia in 1955, and so far only a single record of each has been noted (Jenkins 1955). Development in lemons only occurs

in very ripe fruit and normally then only when the skin has been split or broken. Many plums and grapes are apparently too watery to form suitable homes for the maggots. Peaches, apricots, pears and figs, on the other hand, are notorious breeders of the fly.

Although citrus growers suffer comparatively little loss from fruit fly, citrus are amongst the most important hosts of the pest. The reason for this is that when the summer soft fruits are finished the fly is able to carry over the winter in the citrus orchards. Grape-fruits are amongst the most susceptible varieties to infestation, but it is an interesting fact that only a low percentage of the eggs laid in citrus develop successfully. It is believed that the oil in the rind seals the egg cavity, or in some way interferes with normal hatching.

The attractiveness of oranges to the fly is amply exemplified by the number of punctures which may be seen on fruits in any infested orchards. These punctures are readily observed, for a discolouration of the surrounding skin results, and such marks are popularly known as "stings."

Another host plant which must receive attention is the loquat. This fruit is very important because it serves as a link between the winter citrus and the early stone fruits, and the bigger build up of population there is in the loquats, the earlier will losses occur in apricots and other soft fruits.

POWERS OF REPRODUCTION

As an illustration of the great reproductive powers of this fruit pest, the following figure are illuminating. From one pair of flies laying on September 1, the possible progeny by the middle of January, a period of $4\frac{1}{2}$ months, would amount to 6,750,000 flies. Such a calculation is based upon each female laying 300 eggs, 150 of which would produce female flies, and so on. Of course, this hypothetical reproduction never takes place in actual practice, but the potentialities are sufficient to make it clear to everyone that the pest is not one to be trifled with.

ECONOMIC IMPORTANCE

The financial loss to fruit growers in this State generally caused by the fruit fly each year is difficult to calculate; that

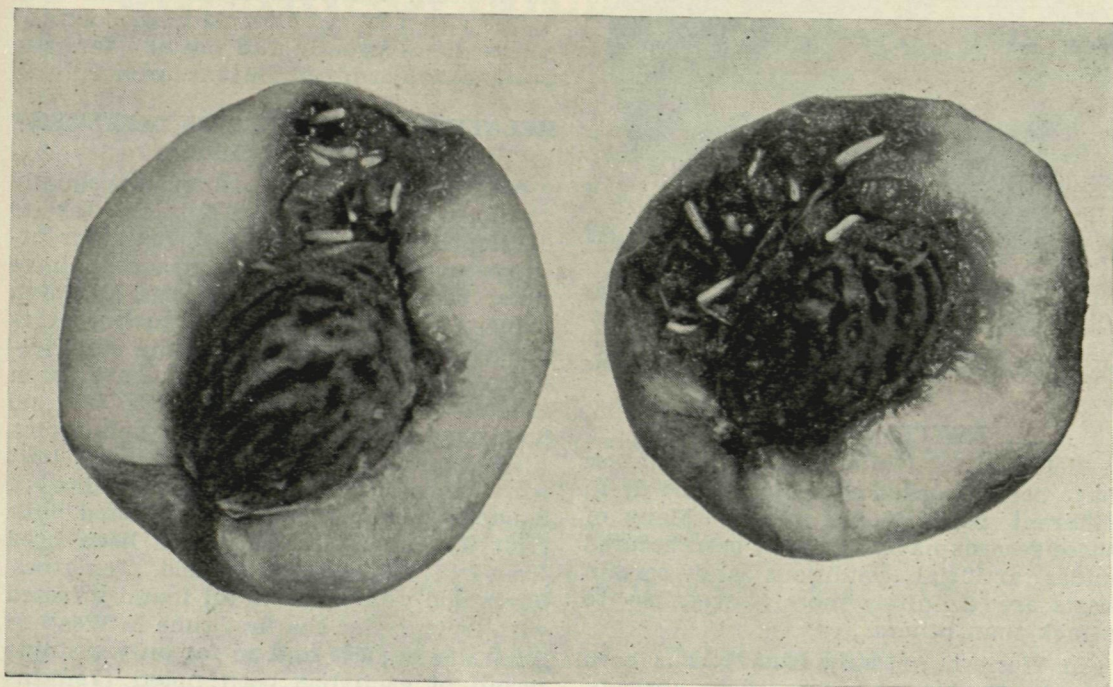


Fig. 4.—Peaches showing typical fruit fly damage.

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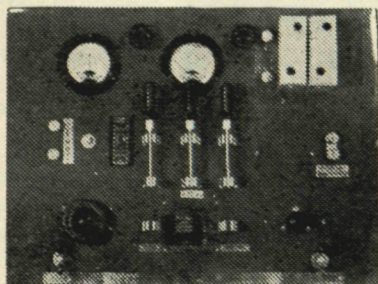
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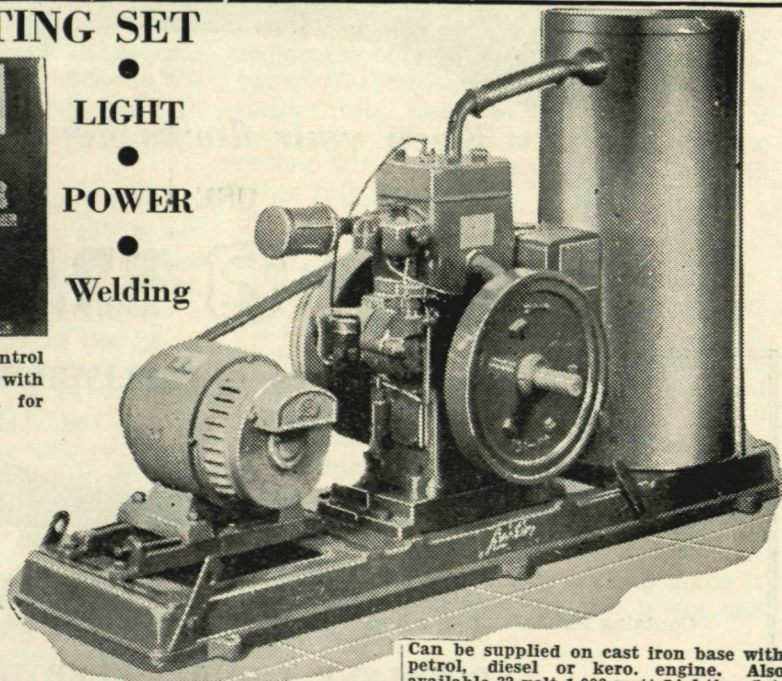
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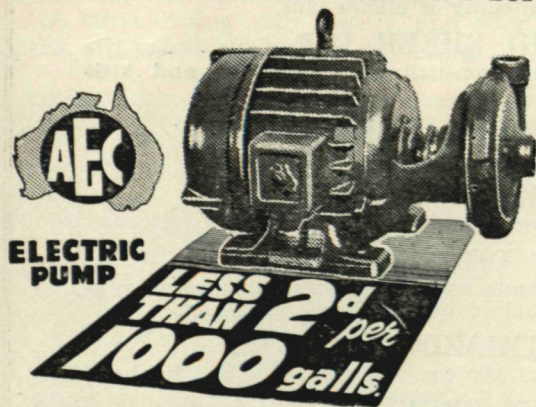
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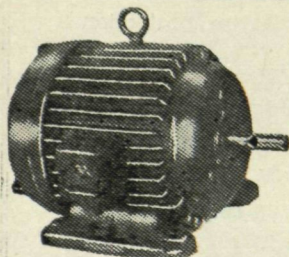
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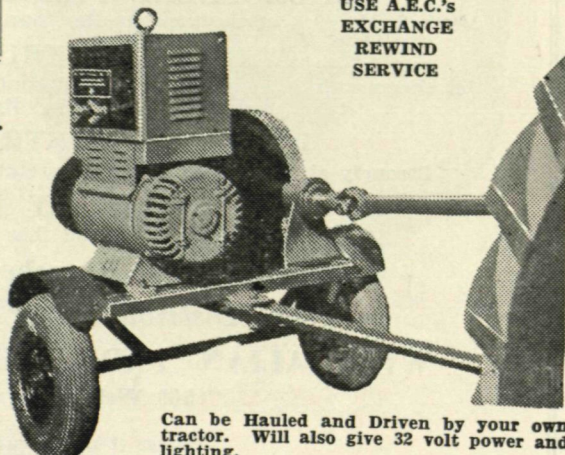
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it is considerable none will deny. In addition to the actual value of the fruit lost and the expense and labour of constantly fighting the pest, the indirect loss caused by the fact that the cultivation of certain profitable crops is prevented or limited must be borne in mind. When it is remembered that the average value of the fruit industry to Western Australia is several million pounds per annum, the necessity for doing everything possible to control the pest will be evident. Not only must it be checked in areas where it is now present, but its spread to clean districts must be prevented.

CONTROL MEASURES

The first thing to be realised is, that for really satisfactory results, concerted action is necessary, both in the application of bait sprays and in the regular and thorough removal and destruction of infested fruit. A few careless individuals in a district can do much to nullify the work of their neighbours and perhaps jeopardise their livelihood.

BAITING

For many years trapping by means of lures such as pollard and borax, "Clensel" and "Beeco" solutions in glass jars and tins was widely advocated, and when intensively carried out was quite effective. This method was later replaced by the use of foliage baits (Newman and Jenkins 1936) which, besides being efficient, have the advantage of being easily and rapidly applied, especially where large areas need treatment. Although various insecticides including DDT, BHC, Parathion, HETP ("Hexone"), dieldrin, aldrin and chlordane have been tested for fruit fly control, nothing has been found superior to sodium fluosilicate when mixed in a sugar solution and applied to the foliage. (Ryan 1950) (Shedley 1954).

Bait Formula Recommended.

Sodium fluosilicate—1 oz.
White sugar—2½ lb.
Water—4 gallons.

One gallon is sufficient for 40 normal sized trees or 100 vines.

For backyard gardens, a stock solution can be made using:—

Sodium fluosilicate—1 teaspoonful.
Water—1 pint.

For use, thoroughly shake the mixture and add six tablespoonfuls (3 ozs.) of the stock solution and 3 tablespoonfuls of sugar to one pint of water. This should be sufficient for five or six trees.

Proprietary Mixtures.

In addition to the home-made bait, there are certain proprietary mixtures available, viz. "Luratox," "Fluotox" and "Lurafly" which comply with Departmental recommendations.

How to Apply Bait.

In a large orchard or vineyard the use of some type of spray pump fitted with a coarse nozzle will usually be found the most convenient way of applying the spray. Where such expensive equipment is not warranted, however, the bait can be splashed on the foliage with a whitewash brush or applied through a container with a perforated lid such as a shaker topped bottle.

When to Apply Bait.

The maximum period between treatments should be six days, but, of course, if heavy rain washes the bait off before this time has elapsed, a second treatment should be given. As the fruit fly frequently attacks fruit before it is ripe baiting should be commenced at least six weeks before the crop is ready to pick and continued right through the season until a couple of weeks after the trees have been stripped, just to make sure that any straggling flies are not allowed to escape.

Warning.

In mixing and applying any of the formulae the quantities stated should be rigidly adhered to, thus reducing the chance of any possible injury to the foliage or harmful deposits of poison on the fruit. Some people apply a complete cover spray to their trees when baiting in the belief that they are fulfilling requirements. The object should be to have a quantity of sticky bait here and there on two or more sides of the tree, avoiding the fruit as much as possible. Wandering flies will then have a good opportunity of feeding.



Fig. 5.—Foliage bait spraying and picking up fallen fruit.

ORCHARD SANITATION AND DISPOSAL OF INFESTED FRUIT

Although foliage baiting is an important factor in fruit fly control, it can only hope to be really effective when carried out in conjunction with strict orchard sanitation. As the fruit becomes mature, it should be picked. Fruit left on the tree is a potential breeding ground for the pest which will develop rapidly in the ripe material. Infested fruit should never be allowed to lie on the ground, and should be disposed of by boiling, burning or soaking in water and kerosene. Burying is not recommended and when the life history of the pest is recalled the reason will be clear. The maggot naturally burrows into the soil to pupate, so that by burying maggoty fruit the flies' normal development is only being assisted. Certainly, if the fruit is buried deeply enough no insects can emerge, but when it is remembered that fruit flies have successfully pushed their way through four feet of dry sand the weakness of this method is obvious. It has been found that infested fruit placed in a pit and liberally treated with BHC dust before filling in will prevent fruit fly development (Ryan 1950). This technique may be of value where disposal

of large quantities of infested fruit is necessary and where other means of disposal would be too difficult.

In order to simplify the work of sanitation, growers, and this especially applies to backyard growers, are advised not to let their trees attain such proportions that the fruit cannot be easily reached. Special attention should be paid to fig trees and loquats, for often these are neglected and allowed to carry far more fruit than can possibly be used. Such trees should be cut back to a height of say 10 feet so that they can be baited easily and so that the fruit can be conveniently picked. When allowed to grow unchecked they become a menace to neighbours and perhaps to the owner when the Fruit Fly Inspector calls.

Where individual trees are found to be heavily infested, besides baiting the foliage and destroying the fruit, the surface of the ground under the tree may be dusted with BHC which should then be worked into the surface layer of the soil. For this purpose 100 lb. of 10 per cent. BHC per acre or 1 oz. per 3 square yards, ($1\frac{1}{4}$ lb. of lindane per acre), is recommended. This will help greatly in preventing flies from emerging from pupae already in the ground.



Fig. 6.—Infested fruit being tipped into a drum of water and kerosene.

Every grower should aim at getting good clean fruit from his trees, and if this cannot be realised he will be doing a public service by removing them.

LEGISLATION

To aid in the control of fruit fly, it has been found necessary to introduce certain regulations including the compulsory baiting in certain areas and the restriction of movement of fruit within the State.

Registration.

All fruit trees must be registered annually with the Department of Agriculture and a registration fee paid. The details supplied enable Inspectors to check on the most susceptible types of fruit at various seasons of the year and to advise on control measures where these are not being carried out efficiently.

Compulsory Baiting.

Where fruit fly occurs it is compulsory to carry out control measures including the application of the bait recommended in this article and the regular gathering of fallen fruit.

In districts where more than 60 per cent. of the growers voting in a poll agree, the baiting may be carried out on a community basis.

Movement of Fruit.

The main fruit growing districts of the State have been divided into three areas. District 1, which includes the Metropolitan Area, the coastal plain as far south as Cookernup and the associated hills districts, is considered to be regularly infested and fruit movement from this area is restricted. District No. 3 which embraces that part of the State south of Katanning and Kirup is considered normally to be free of fruit fly and movement of fruit into this area is restricted. Area No. 2, which is the zone between areas 1 and 3, has certain restrictions limiting both the inward and outward movement of fruit.

Further details concerning these Regulations can be obtained by referring to the relevant portions of the Plant Diseases Act, copies of which are available on application from the Department of Agriculture.

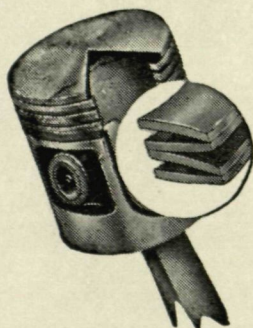
SUMMARY OF CONTROL MEASURES

- (1) Prune trees to a manageable size.
- (2) Bait regularly using a sodium fluosilicate foliage bait.
- (3) Pick fruit as it ripens.
- (4) Destroy properly all infested fruit.

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