T H E S I S

on

THE CODLING MOTH AND ITS CONTROL

for

THE DEGREE OF B. S. AGR.

in

IDAHO UNIVERSITY

by

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The purpose of this paper is to reduce to working form, information regarding the codling moth and its control.

IMPORTANCE OF THE PEST.

The control of the codling moth is of great importance in the apple growing industry. In any district where the pest has been introduced, the crop will become wormy and unprofitable in a few years time unless sprayed intelligently. A careful study of the moth and its life history has been made by entomologists in various parts of the country because of the cosmopolitan character of the pest.

LIFE HISTORY OF THE PEST.

The scientific name of the codling is Carpocapsa Pomomella. It is a true moth, and belongs to the order of Lepidoptera. The life history consists of four stages of development:

1 The Egg.

2 The Larva.

3 The Pupa.

4 The Adult.

THE EGG.

The egg is a whitish, disk-like object about one half the size of an ordinary steel pin head. Eggs are deposited singly, near or upon the blossoms or on the leaves of the apple or pear tree. They hatch in a period of five to twelve days with an average of seven days time. The time required for incubation depends a great deal upon the temperature.

THE LARVA.

Upon hatching, the larva at once seek food. As they are generally near or upon an apple blossom, or apple, they find little trouble in entering the fruit. Larvae can live upon a diet of leaves for a short time, but no one has ever brought them to maturity upon food of this kind. In rare instances worms may enter stone fruits. Records show that one was found in a peach and also one in a prune.

The larval stage lasts on an average of twenty days. The worm then cuts its way out of the fruit so that it may find a safe dry place to pupate. Larvae usually go to the core of the apple, but not always. They may or may not leave the apple by enlarging the burrow by which they first entered the fruit.

Worms nearly always descend to the lower trunk of the tree, or fall to the ground to pupate. They may lower themselves by a silken thread, drop in a windfall apple or pear, or fall to the ground; but a large per centage of them crawl down the trunk of the tree. Crevices under rough bark are often selected as places to pupate.

The last brood of worms carries the species over the winter. Or we might more properly say, that the individuals lie dormant over winter in the late larval, or early pupal stage. Some are killed by the effects of the climate during the winter. There are also two parasites that prey upon the moth during this stage.

THE PUPAL STAGE.

The pupal stage is a period of inactivity, during which time the worm slowly changes from the larva to the moth. This stage has been observed to last from eleven to forty-nine days, with an average of twenty days. The worm spins a cocoon around itself, and turns in color from a milky white to a brownish-yellow. The wings and other appendages gradually form under the outer skin or pupal case.

THE ADULT.

The adult has four wings irregularly streaked with gray and brown. These wings have horseshoe markings of copper color at the inner angle. The hind wings are of light yellowish brown. The moth spreads about three fourths of an inch. The life of an adult averages four days. They mate and a female lays about forty eggs in two days time.

Factors affecting the Broods:

1 Moisture.

2 Temperature.

3 Altitude.

M O I S T U R E .

Wet springs are detrimental to the development of the moth. It does not go through its various stages so rapidly, and therefore does not have an opportunity to produce so many broods in a season.

T E M P E R A T U R E .

Cool nights and cool weather during a season retard the various stages of moth development and have much the same effect as moisture.

A L T I T U D E .

High altitudes always shorten the season. This keeps the number of broods down, and is very detrimental to the increase of the moth. Altitude will not completely eradicate the moth, however, as it has been observed at an elevation of 6,000 feet in Bear Lake County, Idaho.

DAMAGE DONE BY THE CODLING MOTH.

FRUITS DAMAGED.

The moth attacks the apple family--apples, pears, quinces etc. It is regarded as an apple pest, however. Pears are only attacked by the moth when it is present in comparatively large numbers.

Early, fragrant and tender skinned varieties of apples are preferred by the codling moth. The Baldwin, Grimes Golden, Yellow Transparent and Winter Delicious are very susceptible varieties.

The extent of damage varies directly with the climatic conditions and the length of seasons, as the moth increases very rapidly as the broods increase in number. The following table shows the relative damage of the broods:

First brood female produces	40 eggs.
Second brood, twenty females produce	800 eggs.
Third brood, 400 females produce	16,000 eggs
Total.....	16,840 eggs.

Though no pair of moths will ever reproduce their kind to the limit of their possibilities, the table well shows the relative damage to be expected from each brood.

METHODS OF PREVENTING DAMAGE.

Much time and money were spent in experimenting, before satisfactory methods were obtained for controlling the moth. Spraying and banding were found to be about the only practical methods.

B A N D I N G .

The moth can be reduced to some extent by banding. A band of cloth is fastened around the trunk of the tree, and when the worms crawl up seeking a place to pupate, they can be taken and destroyed.

Banding will not eliminate worms in an orchard, nor is it a very efficient method. It can be applied, however, at any time of the year. Should the first spraying be missed because of rain, or for any other reason, banding is often necessary. When an orchard is more than two per cent wormy, banding is profitable.

SPRAYING.

Spraying is the best method for controlling the codling moth. Arsenate of lead is the best poison to use. There are several brands of lead arsenate and a standard strength would be of great use in determining the value of a brand upon the market. There is a bill before Congress at present, requiring that the article shall not carry more than fifty per cent water, and not less than twelve per cent arsenic pentoxide. This bill has not yet passed.

The following is the analysis by the Chemistry department of the Washington State College of the Manufacturers samples:

Year	Brand	Moisture	Arsenic pentoxide	Lead oxide	Kind of oxide
1907	Vreelands	.....	20.65	.....	.....
1908	California	39.99	13.76	43.82	basic
1908	Lavenburgs	57.53	9.62	29.58	neutral
1908	Eagle	46.36	16.77	34.41	acid
1908	Larget	40.48	15.52	40.71	mixed
1908	Disparene	50.59	14.90	29.37	acid
1908	Graselle	41.14	17.09	41.62	mixed

1908	Watsonville	47.65	10.64	40.90	Basic
1908	Sherwin & Williams	30.85	16.52	50.62	Neutral
1908	Rex	36.70	16.40	43.56	Mixed
1909	Hemingway	32.47	18.88	41.17	Acid
1909	"Ortho"	23.25	15.51	54.57	Basic
1910	Interstate	36.88	19.98	39.49	Acid
1910	Palmer	50.57	10.44	34.00	Basic
1910	Ortho	51.03	11.43	35.47	Basic

M I X I N G

Arsenate of lead is easily prepared for the spray machine. The quantity to be used is placed in a vessel with a few times as much water, and stirred and worked with a paddle until dissolved. The misture is then diluted as desired.

APPLICATION

The application of the spray material is very important as upon thisdepends the efficiency of the spraying.

The larvae have chewing mouth parts, so the poison must be placed in a location where the worms will be obliged to eat it.

About eighty-one per cent of the first brood upon hatching, enter the calyx-cup or blossom, of the fruit. This is due to the fact that there is so little of the apple developed at this time. Of the later broods, very few enter at the calyx, but attack the fruit at some point where it may rub a branch or touch another apple. This is thought to be due to the fact that the worm needs a support against which to brace itself when penetrating the skin of the fruit.

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FIRST SPRAY

The first spray should be applied at the time that about ninety percent of the blossoms have fallen. The cup will be wide open at this time and the object of spraying is to fill it with arsenate of lead so that when the sworm hatches the poison is present where the worm takes its first food. Some varieties like the Rome Beauty, require a second spraying in about ten days from the first as the blossoms do not all appear at once. The calyx-cup may be in condition to receive spray for as long as eight days, and it may close in three days. Rapid closing is induced by warm weather.

SECOND SPRAYING

The second spraying should come at the time when the greatest number of the first brood are hatching. It will be from ten to twenty days after the blooming season.

THIRD SPRAYING

The third spraying should come at the time when the second brood appears.

FOURTH SPRAYING

The fourth spraying should be done upon the first appearance of the third brood of worms.

TIME TO SPRAY

The first spraying may be regulated by the blossoms. Some method must be used to keep time on the following broods. A breeding cage is a very satisfactory method. It can be kept stocked with larvae from old neglected trees, wormy apples, or from bands.

A glass fruit jar makes a very good cage, and it should be placed under an apple tree, or in some place where the conditions will be the same as in the orchard.

MACHINERY.

Good machinery is essential to first class work. It is hard to get good results with a hand pump, as the pressure is neither strong nor regular. There is also a tendency to hurry over the work because of its tediousness. Power sprayers cost a great deal more but their superiority offsets the price.

A first class power sprayer consists of a gasoline engine capable of sustaining a pressure of 200 lbs. to the square inch; a 200 gallon spray tank; two leads of forty-foot hose; two ten-foot bamboo spray poles; and a raised platform upon which to stand while working.

The first spraying in the season is done with a Bordeaux nozzle with a half crook. The Bordeaux nozzle gives a coarse driving spray that penetrates the calyxcup, and the half crook makes it possible to spray directly into the cup. For the second and subsequent sprayings, the Vermorell type of spray nozzle should be used. The object in thus spraying is to coat the apple with a fine covering of poison.

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INSPECTION LAWS.

Inspection laws are important in the production of good fruit. Negligence and ignorance result in much wormy fruit. The laws should be strictly enforced, but an inspector should always woek upon practical lines. He should avoid legal action, if possible, for there is a tendency on the part of the fruit grower to become prejudiced against the enforcement of spraying laws.

Efficient laws can be made, and inspection service is cheap compared to the damage done by the moth.

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