

## THE ENTOMOLOGICAL BRANCH

### THE HISTORY OF THE CODLING MOTH IN BRITISH COLUMBIA

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**I**N presenting the history of the Codling Moth in the Province of British Columbia, I do so with a feeling of obligation to Thomas Cunningham, former Provincial Inspector of Fruit Pests, and his assistant, W. H. Lyne; to R. M. Winslow, former Provincial Horticulturist and his successor M. S. Middleton and to their field staffs of district horticulturists, who have allowed me access to unpublished records and who have given me verbal information respecting the various outbreaks in the years gone by.

The Dominion Entomological Branch has only been actively associated with the Codling Moth situation in the Province of British Columbia since 1916. During 1916, 1917 and 1918, life-history investigations have been conducted by the Dominion officer and advice has been given to the Provincial horticultural field officers, during these years, in order to enable the eradication and control measures that were instituted to be carried on to the best advantage. I take credit only in having conducted the life-history investigations and in compiling the record submitted herewith. The field work against this destructive insect, at all times, has been strictly in the hands of the Provincial officers to whom all credit is due for the position British Columbia is in to-day in regard to relative freedom from Codling Moth infestation.

The history of the Codling Moth in British Columbia may be viewed from two separate standpoints: To students of entomology the record will disclose interesting results of eradication methods against incipient and prolonged outbreaks; to the fruitgrowers of the province the record will show what work has been accomplished on their behalf and

the danger that lies ahead from present infestations.

By way of introduction it will only be necessary to review the status of the fruitgrowing industry of British Columbia. In 1890, the census showed 6,000 acres of fruit; in 1900, 8,000 acres; in 1910 the census showed 33,606 acres; in 1913, 38,196 acres; to-day there are approximately 40,000 acres of fruit which are largely composed of apples. The apple crop of 1917 was 2,959 carloads with approximately the same for 1918.

#### THE VARIOUS OUTBREAKS

1. *The Victoria Outbreak*—The Codling Moth was first recorded in British Columbia in the vicinity of Victoria. The actual year in which larvæ were first discovered is in doubt, but it occurred at some time between 1900 and 1905. The close resemblance of the larva of the Codling Moth to the larva of the Lesser Apple Worm (*Laspeyresia prunivora*) and the similarity of attack, clouded the issue at this time, coupled with a certain hesitancy on the part of Government officials to acknowledge its presence. The introduction of the moth on this occasion was believed to have been caused by the introduction of infested pears from California. This belief is supported by the fact that the first determined larvæ were found in orchards adjoining a picnic ground and by the fact that infested Californian pears were being received at that time on the market of Victoria. In 1906 and 1907 no remedial measures were undertaken but in the latter year the moth had increased to such an extent that remedial measures had to be undertaken. In 1908, 164 orchards were found to be infested and 3,140 sacks of infested fruit were

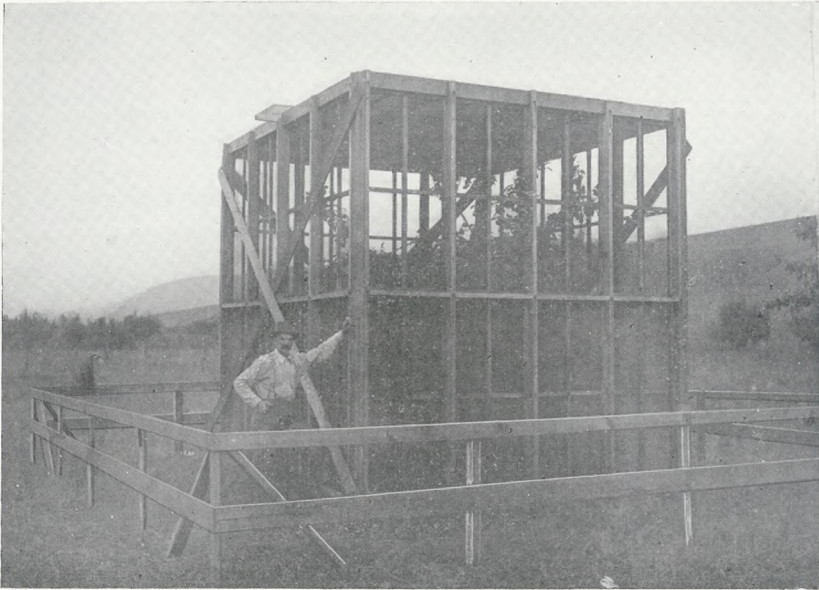
destroyed. Compensation was allowed certain growers in the locality inasmuch as some fruit was destroyed which apparently was not infested. In certain orchards the infestation was as high as 40 per cent. It may be remarked that the seasons of 1907 and 1908 were usually warm both in spring and summer.

In 1909, following a careful inspection of the trees in the infested area, 7,610 larvæ were captured. In 1910, the first gasoline power spraying machines used in the pro-

in 1915. In 1916, 1917 and 1918 no work under Government control took place.

It is believed that the Codling Moth still exists in the Victoria district, but the possibility of it becoming a serious orchard pest is not considered very great unless the district is again visited by a series of abnormally warm seasons.

2. *The Kamloops Outbreak*—Larvæ were discovered in the summer of 1905 within the city limits of Kamloops, but there is little doubt that



CAGE USED NEAR VERNON, B. C., FOR STUDYING LIFE-HISTORY OF THE CODLING MOTH  
(ORIGINAL)

vince, were operated in the Victoria Codling Moth area, a total of 12,931 trees being treated this year. In addition, 4,162 trees were sprayed by hand machines.

In 1911, inspection work during the year, revealed the presence of 7,000 larvæ, 77 orchards being involved. In 1912, 1,350 larvæ were taken in 50 orchards. In 1913, 432 larvæ were taken, and in 1914, 239 larvæ from 9 different properties. In 1914, an increase in the area of infestation took place, resulting in 291 larvæ being taken in 21 orchards

the infestation was present for some years previous. As in the case of the Victoria report the identity of the Codling Moth was confused with the Lesser Apple Worm. The introduction was believed to have been made through the medium of apples imported from Ontario. This outbreak proved an exceedingly difficult one to handle owing to its being located in city lots involving many separate owners, and on rented land. The summer of 1906 was, therefore, practically spent in demonstrating, pruning and spraying, and deter-

mining the limits of the outbreak. In 1907, the same work continued, 2,296 trees being sprayed. In 1908, the infestation was reported as 1 per cent and confined strictly within the city limits. In 1909, spraying and inspection continued. In 1910, evidently owing to the difficulty of dealing with the outbreak which apparently had been reduced to very small limits, the entire crop of apples was picked green upon the trees in July and August and destroyed. Remuneration was allowed to cover individual losses in apples. In 1911 and 1912 no larvæ were found. In 1913, however, an examination in late summer revealed the presence of a few larvæ and some empty cocoons. In 1914, therefore, the campaign again continued with a single power outfit at work, and a later inspection resulted in 12 larvæ being found. In 1915, in order to deal with a very tantalizing situation pressure was brought to bear which resulted in many worthless trees being cut down and the remainder severely pruned. Two sprayings, with hand and fruit inspections followed in an effort to cause complete eradication. The Government efforts were evidently successful because no larvæ have been taken in 1916, 1917 or 1918.

3. *The Kaslo Outbreak*—The moth was bred from apples grown at Kaslo in 1905. According to the reports of Dr. J. Fletcher, former Dominion Entomologist, this record was the first of its kind for the province, but in the light of later information there is no doubt that the outbreaks at Victoria and Kamloops preceded it. In 1906, moths were again bred from local grown apples and remedial measures instituted. These measures were either so successful, or the moth found conditions unsuitable to its growth and development, that no further reports of infestation have been received.

4. *The Armstrong Outbreak*—Early in the summer of 1912, twenty larvæ were taken in apples at Armstrong. Immediate inspection was under-

taken, resulting in 20 trees being found infested. The introduction occurred presumably through the medium of packing cases from some Oregon nursery. The entire crop on these 20 trees was bought in bulk, green upon the trees, placed in sacks and boiled.

This method should have been sufficient but in order to obviate any possibility of further outbreak the area was thoroughly sprayed in 1913 and an inspection of fruit followed. No larvæ were taken in 1913 or in any succeeding year.

5. *The Rutland Outbreak*—About 100 larvæ were taken in fruit at Rutland in 1912. Immediate inspection resulted in an area one mile square being found infested. Strict quarantine methods were instituted and all fruit handled under Government guidance. In 1913, two power spray outfits were placed at work, and inspection of band and fruit followed, resulting in no larvæ being taken this year or in any year succeeding. There was apparently no doubt but that this outbreak originated from infested fruit in settlers' effects from Ontario, the empty cocoons being found.

6. *The First Kelowna Outbreak*—On August 19, 1913, an infestation covering 5,000 trees was discovered within the city limits of Kelowna. The campaign in this year resulted in from 75-100 larvæ being taken. The moth was probably introduced through the medium of infested railway cars. In 1914, three thorough sprayings were given the infested area with four power machines in operation. At the close of the year, 12 larvæ had been captured. In 1915, under similar quarantine measures, 3 larvæ were taken. In 1916, following the same procedure as in the two previous years, only one suspicious example of infested fruit was reported, the cause of the injury not being discovered. In 1917 and 1918 no further sign of the moth was revealed.

7. *The Second Kelowna Outbreak*—A second outbreak, of a separate origin to the first, but probably from a similar source, occurred in Kelowna in 1915. The trees involved were sprayed, banded and inspected and only 14 larvæ were taken this year. No further report of the presence of larvæ was received in 1916, 1917, or 1918.

8. *The Okanagan Landing Outbreak*—In September, 1915, larvæ were noticed in some fruit in orchards at Okanagan Landing. Close inspection revealed the fact that five properties were involved, covering approximately 80 acres, and 5,000 larvæ were collected. No actual accurate larval counts were made, hence this figure is approximate. There was little doubt that the infestation had become established a few years previous, and had started from larvæ swept from railway cars at the Landing.

In 1916, quarantine measures were adopted. No actual larval record was kept in this year, but the belief of the inspectors was that fully 3,000 apples were condemned as "wormy." In 1917, the regular quarantine and eradication methods with eight band inspections were again adopted resulting in 550 worms being taken by the end of the year. In 1918, owing to the difficulties of properly handling the outbreak, the entire crop of 35 acres was bought and pulled off the trees during June, July and August. Band and fruit inspections followed resulting in 112 larvæ being taken. The last larva was found in the middle of August, no more being taken in two later tree-to-tree band inspections. Unfortunately, however, the flight of second generation moths in August caused a re-infestation in orchards in the vicinity which, either had never before been infested, or which had been declared free from infestation for two years. These orchards, now infested, are located at least half a mile from any orchard attacked in the spring. At the close of the 1918 season in the entire

Okanagan Landing district 369 larvæ have been taken over an area of about 109 acres.

9. *The Westbank Outbreak*—In August, 1915, a severe infestation was discovered at Westbank involving 24 different properties. Autumn inspection of fruit resulted in approximately 5,000 apples, doubtless attacked by the larvæ, being destroyed. There is little question that a fair proportion of these apples were, in reality, attacked by the Lesser Apple Worm. As in the case of the Okanagan Landing outbreak of this year, the lateness of the season and the need for rapid work precluded any opportunity of making exact larval counts. In 1916, the usual spray applications followed by band and fruit inspections, yielded in the neighbourhood of 500 worms. In 1917, following the same procedure, about 50 larvæ were collected and in this year, 1918, until the close of the year, after similar operations to 1916 and 1917, only 6 larvæ and 2 empty cocoons were taken. The last larvæ were taken on September 6th, and nothing in two later band inspections. The remarkable feature of this outbreak lies in the fact that the few larvæ taken in 1917 and 1918 were captured in fairly widely separated areas, covering an area nearly equal to the original sphere of infestation. In this outbreak approximately 200 acres were involved. In 1906, 7,788 trees were banded, and 8,000 in 1917. These bands were inspected 5 times between July and October.

It may be remarked that some larvæ, approximately 100, were discovered at Gellatly's in 1916, fully one mile from the nearest infested orchards at Westbank. Whether this infestation was due to the flight of moths, or to careless handling of fruit boxes, it is impossible to say, the former method of dispersal being considered feasible under the conditions attending the outbreak.

10. *The Eburne Outbreak*—Two larvæ and twenty attacked but abandoned apples were found at Eburne in

1915. Examination of the area, in 1916, revealed no further sign of infestation, though no remedial measures were definitely undertaken in this year. The prevailing temperatures and high humidity of the locality doubtless reacted against the successful propagation of the moth.

11. Two or three larvæ were reported from Kaleden in 1916. It is possible that confusion has arisen in this case with the larvæ of the Lesser Apple Worm, for no further sign of the Codling Moth has since occurred.

12. *The Vernon Outbreak*—During the winter of 1917-1918 a rumour was received that Codling Moth larvæ had been received in the packing houses from Vernon orchards during the 1917 apple packing season. Careful inspection during March, 1918, revealed the presence of 4 larvæ in the bark of some old apple trees in the City of Vernon. In June, all the developing fruit on 41 old trees in the vicinity was removed, and on 9 small trees, left to act as traps, the fruit was picked during the first week of September. Altogether during the year, (1918) 17 forms of Codling Moth were taken in Vernon.

13. *The Walhachin Outbreak*—During the autumn of 1916, larvæ were found in orchards at Walhachin. An area covering 60 acres was found liable to be infested. Spraying, band and fruit inspection work was undertaken during 1917 and 1918. In 1917, about 100 larvæ were taken; in 1918 no sign of larvæ was indicated, following four band inspections and the examination of the fruit output.

#### THE PRESENT SITUATION

At the close of the year 1918, Codling Moth larvæ in limited but unknown quantities are believed to exist in the city of Vernon, and in the orchards in the vicinity of Okanagan Landing, covering an area of 109 acres and involving 200 additional acres in the vicinity. The Walhachin and Westbank outbreaks

are apparently in a most healthy condition. To be optimistic it might be said that the orchards at the last two points may be considered free from infestation. For safety's sake, however, it is well to be guarded for the reason that precautionary measures are doubtless still needed. At Victoria, the moth is still believed to exist, but unless an unusual series of seasons approach, this outbreak is not viewed with great alarm. Kamloops, Kaslo, Armstrong, Rutland, Kelowna, Eburne and Kaleden are all supposed to be free from infestation, having been clear for from 2 to 12 years.

In order to express the history of the Codling Moth in another way, it may be said that since 1905, at least 12 and probably 13 distinct outbreaks have occurred in the province, at widely separated points. A marked increase in the numbers of outbreaks occurred after the year 1912, coincident with a noted rise in the fruit yielding capacity of British Columbia orchards. Altogether, since 1908 at least 40,000 Codling Moth larvæ have been collected and destroyed by hand labour, and at least 50,000 apple trees have, in this time, been under careful surveillance and inspection. In the year 1912, approximately 470 larvæ were taken in the province; in 1913, 542 larvæ; in 1914, 263 larvæ; in 1915, 10,330 larvæ; in 1916, 3,553 larvæ; in 1917, 625 larvæ, and in 1918, 394 larvæ.

In the year 1912, operations, tending towards the eradication of the Codling Moth were being carried on at 4 localities; in 1913, at 5 localities; in 1914 at 3 localities; in 1915 at 7 localities; in 1916 at 7 localities; in 1917 at 3 localities; in 1918 at 3 localities.

#### GENERAL ORCHARD OPERATIONS IN INFESTED AREAS

The following operations are undertaken wherever an outbreak is reported:

- (1) All trees are banded.
- (2) Periodical inspections are given the bands and main tree trunks:
  - (a) In May, for overwintering larvæ.
  - (b) In early July, for first generation of full grown larvæ.
  - (c) In late July.
  - (d) In mid-August (optional, according to seasonal development).
  - (e) In September for second generation larvæ.
  - (f) In October.
- (3) Windfalls from July onwards are disposed of by boiling and burying.
- (4) Two or three spray applications commencing with the calyx spray are given.
- (5) All root sucker growth is removed from the trees.
- (6) All loose bark and dead wood is removed.

In certain circumstances with closely confined infested areas, where labour difficulties arise, or spraying operations are not feasible, resource is had to the direct removal of the fruit by hand immediately after blossoming. This usually agrees with the period of year in a fruit grown district when labour is more available.

#### FRUIT DISPOSAL IN INFESTED AREA

The following procedure is adopted:

- (1) An order for the formation of a Codling Moth quarantine area is passed under the authority

of the Agricultural Associations Act.

- (2) All tree fruit is inspected before shipment.
- (3) Inspectors are notified when shipments are intended.
- (4) All fruit is packed in a packing house in the infested area, no fruit being allowed to be handled in a house through which fruit from a non-infested area is passed.
- (5) All orchard boxes used in quarantined areas must remain in such areas unless passed by an inspector.
- (6) All fruit in infested areas is loaded into railway cars by the most direct route and no such fruit is allowed to be sold in the province or for export from Canada.
- (7) Loose or unpacked fruit must not be moved from a quarantined area without permission from an inspector, and no fruit must be stored in cellars or houses without proper inspection.
- (8) Cull fruits must be at once made into cider, apple sauce, or be destroyed.
- (9) Railway companies are requested to dispose of the sweepings from fruit cars before loading by burning.
- (10) Refrigerator cars are inspected at as few points as possible, and infested cars are kept closed, iced as soon as possible, loaded locally, or are rejected.





