

Control by spraying: Fortunately, one spray applied at the proper time will usually give good control of this species. In England a spray of free nicotine (98%) at the strength of 8 oz. to 100 gallons, with or without lime-sulphur, applied within a week after petal-fall, is recommended (2, 3, 4). As the object is to destroy the eggs, a coarse driving spray directed at the calyces should be used. The addition of a spreader is desirable, but not essential. Lead arsenate will not control the sawfly but may be added to sprays for the purpose of controlling other pests. Velbinger (6) states that the best control of *H. testudinea* in Germany was obtained by spraying with a strong solution of quassia; or with quassia in combination with arsenic, copper, and lime, at petal-fall. Contrary to English data, he states that nicotine with lime sulphur and lead arsenate was ineffective.

At Victoria in 1941 experiments with nicotine sulphate in a 1½ per cent summer oil spray gave control equal to that obtained in England with free (98%) nicotine. The nicotine sulphate was used at a strength of 1 to 600, and lead arsenate was added at the rate of 2 lbs. to 40 gallons. As this trial was conducted in city gardens where no satisfactory check trees could be used owing to the number of different varieties of apple in the gardens, the result must be taken only as an indication. Infestation was kept down to 3.9 per cent in the case of one series of trees and to 5.2 per cent in another, while unsprayed trees in a nearby garden showed as high as 80 per cent attack. The addition of lead arsenate had a good effect in clearing the foliage of sundry other pests such as apple and thorn skeletonizer and other caterpillars.

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THE ADVANCE OF THE CODLING MOTH IN BRITISH COLUMBIA

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The codling moth, *Carpocapsa pomonella* (L.), has increased to such an extent during the last fifteen years that it has now become the chief limiting factor in apple production throughout the apple producing areas of the southern Interior of British Columbia. Until about 1915 the codling moth was practically unknown in the Interior. Although infestations were reported at Victoria in 1900 and at Kamloops and Kaslo in 1905, these infestations evidently covered

only small areas. They were believed to have resulted from the importation of wormy pears from California and wormy apples from Ontario.

In 1912 codling moth was reported from Armstrong and Rutland. At Armstrong worms had evidently been imported in nursery cases from Oregon, and at Rutland in settlers' effects. Prompt eradication measures were carried out. Weather conditions were helpful for in the spring of 1913 a heavy frost prac-

tically eliminated the apple crop in these districts. No codling moths were found in a careful inspection the the following year.

An outbreak of *C. pomonella* was discovered in the north end of the town of Kelowna in 1913. It was believed to have started from infested railway cars. Orchards were banded and sprayed and all wormy fruit destroyed during the summers of 1914 and 1915 and as far as could be determined this infestation was eliminated. Within Kelowna city limits in 1915 four government power-sprayers commenced operation directly the blossoms fell. Three thorough sprayings with arsenate of lead were administered and the trees banded and patrolled. Only seventeen larvae were found during the season in the Kelowna city limits.

Just about the time it was believed no worms existed in the Okanagan, more infestations were discovered at several points in the Valley. In August 1915 codling moth was found at Westbank. Twenty-four orchards were involved, forming an area of about 200 acres. The trees were immediately sprayed and the fruit ordered packed at the packing house instead of in home orchards. Any fruits showing signs of worms were destroyed in a boiler rigged up on the beach. Trees were banded and patrolled. No apples, pears, or quinces were allowed to leave the district without first being inspected. The infestation varied in these orchards from 1 to 5 per cent.

Until 1913 codling moth control work had been in charge of the late Thomas Cunningham, chief orchard inspector for the Province, a man who took most vigorous action whenever he believed the circumstances warranted—and that was invariably so where *C. pomonella* outbreaks were concerned. In 1914 and 1915 the work was directed by W. H. Lyne. In 1916 the Horticultural Branch took over the codling moth control work in the Province. P. E. French was in charge of the North Okanagan and C. P. R. Mainline districts, the writer

from Kelowna to the International Boundary. The spraying of orchards and the destruction of infested fruit in quarantined districts was continued. An area of 65 acres was found to be infested at Walhachin in the fall of that year.

Spraying, band inspection and destruction of wormy fruit was continued throughout 1917. As no worms were found in the Kelowna city area during 1917 this area was assumed to be free of codling moth. Of the work at Walhachin, P. E. French reported as follows: "Methods of eradication employed here were similar to those practised at Okanagan Landing. Very thorough work was done by Mr. Buckell, who was in charge of this work at Walhachin for the season."

In 1918, all codling moth control work in the Interior came under the supervision of the writer. H. H. Evans was in charge at Vernon, Mr. Chesbro at Westbank, and C. Barlow in the Salmon Arm area. At this time there were about five hundred acres under quarantine in the Interior of the Province. Walhachin, Vernon, and Westbank districts were involved. Two sprays of arsenate of lead were applied, the calyx spray commencing May 20, and the second spray on June 20. Twelve thousand trees were banded and the bands inspected five times during the season. On the third inspection, three worms were found. Two more inspections followed this, but with no sign of the pest.

The results of the work at Westbank are shown in the following figures: In 1916, 340 worms were found; in 1917, 58, and in 1918, 3.

On the recommendation of P. E. French and R. C. Treherne, Dominion Entomologist for British Columbia, the policy at Vernon was changed in 1918. Instead of spraying and banding the trees in the area under quarantine, the apples on about 50 acres were purchased by the government, picked before maturity and destroyed. In band inspections no worms

were found. Although the worms had apparently been eradicated in this area, two new infestations were found in the Vernon area in 1918. Four properties aggregating 15 acres were infested about one mile north of the quarantined area, and a new outbreak was discovered in the town of Vernon. In all, seven additional properties were quarantined.

At Westbank the work continued during 1919. No worms were found in the district. At Vernon in 1918, 394 specimens were captured. From the same area in 1919, 195 were taken. However, in 1919 a new infested area was discovered, and from this area 178 specimens were taken, bringing the total captured in 1919 to 372. All orchards adjacent to those infested were held under quarantine.

Three hundred and seventy-eight foreign refrigerator cars were inspected for codling moth at Okanagan Landing and 88 at Similkameen during this period. At Okanagan Landing 203 specimens were taken. Twenty larvae were found in a single car.

In 1921 an outbreak of codling moth was located on the K.L.O. Benches at Kelowna and in 1922 outbreaks occurred at Kaleden and Summerland. Rewards were offered for the detection of codling moth in new areas; \$20.00 for the detection of worms in an orchard located in a district where worms had already been found, but outside an actual quarantine area; \$100.00 for the detection of codling moth in a section or district in the Okanagan where no quarantine existed. Two rewards were paid in 1922, \$20.00 in the Kelowna district and \$100.00 in the Kaleden district.

In 1922 according to the report of H. H. Evans, 990 refrigerator cars were inspected at Revelstoke, Kamloops, Penticton, Keremeos, West Summerland and Okanagan Landing. Of this total 249 were super-heated. For superheating work at Revelstoke, steam was supplied by the round-house boilers, carrying a pressure of from 80 to 100 pounds. Since the

distance from boilers to cars was 300 to 600 feet, the low and variable pressure gave unsatisfactory results. Car temperature above 170° after 10 minutes heating were attained at Okanagan Landing and results in such cases were satisfactory. Moisture condensation is much more pronounced in cars treated under low temperatures and pressures than with higher pressures and temperatures. Excess moisture was found to be undesirable.

Through 1923, 1924 and 1925 the codling moth continued to survive in the Okanagan Valley and though there was considerable success in cleaning up certain areas, most of the officials in the Department came to feel that quarantine measures were becoming of less value each year. The following table shows the areas infested in 1924 and larvae and pupae captured in 1923 and 1924 in the Okanagan district:

Table 1. Status of Codling Moth in Okanagan District, 1923-1925

	Acres Sprayed 1924	Acres To be Sprayed 1925	Larvae and Pupae Found	
			1923	1924
Vernon:				
Swan Lake	55	0	0	0
Ok. Landing	55	35	541	14
Winfield	110	210	0	99
Kelowna:				
K. L. O.	324	324	196	88
Benveulin	0	50	0	9
City Area	205	205	1278	2319
Glenmore	0	200	0	160
Rutland	0	60	0	8
Penticton:				
Deg Lake	291	316	283	29
Kaleden	20	0	3	0
Green Lake	7	7	0	192
Totals:	1067	1407	2301	2918

The year 1925 was the last of general quarantine areas. W. H. Robertson, Provincial Horticulturist, reported as follows in 1926: "It was decided by the government that the old system of quarantine areas and the spraying of

same for the control of codling moth would be discontinued at the end of 1925. Districts were, however, given the opportunity of forming compulsory spraying zones. An Order in Council was passed which made this possible upon receipt of a petition from any district signed by 60 per cent of the growers. Your Branch also thought it advisable that there should be certain regulations as to the number of spray machines. This requirement was finally placed at one 4-horsepower machine for every 50 acres. Regulations were also drafted based upon the 'Agricultural Act,' Part II, R.S.B.C. 1924, which outlined the actual spraying requirements and penalties for non-compliance. Because of certain deficiencies in the Act under which this work would have to be carried out no spraying zones were formed. It is expected, however, that with the amendment to the Act which it is proposed to make at the next meeting of the Legislature there will be a number of zones established during the coming year."

A certain amount of work, however, was still carried on. At Okanagan Landing and Kamloops, spraying and banding

were done by the provincial government in 1926 and paid for by the growers. This work was continued in 1927 at the above points and in the city of Kelowna. At Salmon Arm, growers sprayed an area in quarantine in 1925, 1926 and 1927 under supervision of the Horticultural Branch and the cost of band inspection was borne by the government. The Salmon Arm quarantine was lifted in 1927 when no further infestation was found.

In 1929, trees were sprayed throughout the Vernon City area and the cost assessed to the lot owners. This work was continued in this area until 1941, when it was done by contract under the supervision of the city.

Aside from spraying work in and around the Vernon district by the Department of Agriculture, all quarantine work was dropped in 1926 and the Okanagan Valley south of Vernon was assumed to be generally infested with codling moth. Though many sections then were commercially free of the insect, infestations were so numerous and widespread that it was conceded by officials and most growers that the codling moth had become a pest with which the apple industry had to learn to live.

EFFECT OF LIME AND LIME-SULPHUR ON THE LARVICIDAL VALUE OF CRYOLITE*¹

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Apparently it is generally believed that because of chemical incompatibility, sodium aluminum fluoride (cryolite) should not be used in a spray mixture containing lime or lime-sulphur. So far as can be determined, however, there has been presented no evidence of incompatibility in terms of insecticidal effectiveness.

Carter (1931) mentions that sodium silicofluoride (sodium fluosilicate) and lime react to precipitate the insoluble

fluoride of calcium which evidently is considerably less toxic than the more soluble salts such as sodium fluoride. Barium silicofluoride, according to Carter (1932), is likewise incompatible with lime as well as with lime-sulphur solution. Popov and Rasina (1939) report that the addition of lime to sodium fluoride and sodium silicofluoride lowers both the phytocidal properties and the insecticidal value of these compounds. On the other hand Hockenyos (1939) states that as a contact insecticide, sodium fluoride was more quickly lethal to the

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