

The spray was applied in December and during February and March, up to the time that the buds were bursting. No difference was noticed in effectiveness between these two times of application. The end of March in an average year is practically the latest date when a dormant strength oil spray can be safely used.

Certain oil emulsions were used on the evergreen laurels without any injury resulting.

On the boulevard trees, an average of four to six gallons of spray was used per tree. The chief difficulty experienced with the solid stream nozzles, which were necessary to reach the taller trees, was in covering completely without undue waste or harmful amounts of oil running down the trunks.

Several acres of vine maples in Stanley Park which were sprayed both in 1924 and 1925 with oil show no damage from its use, and in fact have improved greatly in health since the scale was eliminated.

Experiments were conducted with a summer spray, using nicotine sulphate and whale oil soap at standard strength.

This was quite effective in killing the newly hatched scales, and should be applied during the first week in September. If applied earlier, some of the young scales will be missed, as all the eggs have not hatched before that date.

There is no doubt but that this pest is here to stay and will from time to time cause trouble.

It has not spread very rapidly, but at present is found in West Vancouver and North Vancouver, as well as in Vancouver itself, where Stanley Park and the west end of the city are generally infested. There are also isolated infestations in the suburbs at Kitsilano, Fairview and Grandview. These districts are within a two-mile radius of the original infestation.

Owing to the impossibility of private people possessing adequate spray machinery to cope with this pest, it will always be a municipal control project.

THE POPLAR SAWFLY (*Trichiocampus viminalis* (Fallén))

By W. DOWNES

During the month of August the Lombardy poplars in all parts of the city of Victoria, B. C., have in recent years been defoliated by numbers of small yellow and black caterpillars, which later on would descend the tree trunks and swarm over nearby fences and buildings. At first this insect was thought to be a new species, and was described as such by

the late Dr. MacGillivray under the name of **Platycampus victoria** (1). Lately this sawfly has been shown by H. L. Viereck, Dominion Entomological Branch, to be identical with **Trichiocampus viminalis** (Fallén) (2), a European species. It has previously been recorded under this name as occurring in destructive numbers in the city of Toronto in 1915 (3). In the United States the insect was first recorded at Albany, New York, by Lintner (4) and described by him under the name **Aulacomerus lutescens**. It has also been recorded from New Haven, Connecticut (5). In British Columbia enquiry has failed to elicit any information as to its occurrence prior to the year 1915, and the first published notice of it occurs in the Provincial Museum Report for 1917, p. 9, where an unusually heavy infestation of this sawfly is mentioned. In British Columbia the species is at present confined to the southern portion of Vancouver Island and has been recorded as far as Duncan, forty miles north of Victoria.

Host Plants

According to Rohwer (5), the recorded host plants in America are Carolina poplar (**Populus deltoides**) and **Populus monilifera**. In Europe, according to the same authority, it has been recorded from **Populus monilifera**, **Populus pyramidalis**, **Populus alba**, **Populus dilatata** and **Salix caprea**. In British Columbia the principal food plant of the species is the Lombardy poplar (**Populus nigra italica**), and it is occasionally taken on **Populus alba**, **Populus tremuloides**, and the native cottonwood (**Populus trichocarpa**), isolated trees of which have been badly stripped.

When the insect occurs in destructive numbers, the host trees may be completely defoliated, and, besides the injury done to the trees, annoyance is caused by the larvae when migrating in search of suitable places in which to pupate. Normally they enter holes and crevices in the tree trunks or beneath clods and loose bark, and there spin a brown waxy cocoon; but when in large numbers, they make for the nearest building or fence and sometimes enter houses. In 1920 a row of Lombardy poplars at the rear of the Empress Hotel in Victoria, B. C., was completely stripped by them, and later on thousands of larvae crossed the asphalt paving and climbed the walls of the building. Here they were swept down daily by the gardeners and gathered up by the shovelful. In 1918 a severe attack of the sawfly occurred, all poplar trees in the city being stripped. Since then the attacks have been less general, the species having been reduced to small numbers by a bacterial disease.

Life-history.

The winter is spent in the pre-pupal stage within the cocoon. The pupal stage lasts about fourteen days. The adults begin to emerge during the last week of May and continue to appear until the latter part of July. I have records of emergence as follows: May 20th, 29th, 30th,

June 6th, 10th, 26th, 27th, 28th, July 8th, 20th. I have found no evidence that there are two generations in British Columbia, although, in New York, two have been found by Lintner (4).

Oviposition: The first eggs were found on June 22, but there is evidence that some are laid as early as the first week in June. The latest date when females were seen ovipositing was July 23. On this date a pair were seen *in coitu*. About this time the males congregate together, and on warm days frequent shady places where they fly swiftly backwards and forwards. By August 1 the adults of both sexes had disappeared. The eggs are inserted in the leaf petioles, from ten to fourteen eggs being laid in each stem. The female takes up her position on the upper side at the lower end of the petiole and makes a longitudinal slit slightly to one side of the axis, inserting the egg at the same time. The process of laying an egg takes several minutes, and, when so engaged, the flies are very tame, and sometimes the leaf could be picked off without disturbing them or causing them to cease ovipositing. When disturbed, they drop from the leaf a short distance before taking to flight. Usually the eggs are laid alternately on the right and left of the petiole, but often stems were found with egg punctures on one side only. Mature leaves were always chosen, the young leaves at the tip of the shoots being avoided. The egg is pure white, frequently irregularly shaped, surface smooth and glossy, cylindrical, slightly tapering to one end and often slightly curved, giving it a bean-shaped appearance. As incubation progresses, the eggs increase slightly in size and sometimes become partly exposed and visible within the punctures. Occasionally the eggs are not inserted very deeply in the petioles and then become partly forced out of the slits by the pressure of the stem tissues. The period of incubation was found to be from 20 to 23 days.

The larva. Young larvae were first found on July 5, but there is no doubt whatever that many are hatched before this, as a full-fed larva was found on the 23rd, and as the period of growth is from 35 to 40 days, this one must have hatched about June 20. When newly hatched, the young larva is translucent, yellowish-white in colour, except the jaws, which are brown, and two black spots in the centre of the epieranial lobes. The body is slightly hairy, the hairs arising from tubercles on the back and sides. The head also has a few short hairs. Within a few hours the head becomes jet black. The legs are transparent, the claws are reddish brown, the skin is smooth and shiny and the internal organs show through. On hatching, the young caterpillars crawl to the under side of the leaf and there rest for a short time prior to feeding. They congregate together on the leaf and commence feeding by eating away the surface of the leaf near the tip. Gradually they extend this area until the edge of the leaf is reached, when they begin to feed backwards towards the petiole, keeping close together with their heads towards the tip of the leaf. This habit of feeding in company is maintained through

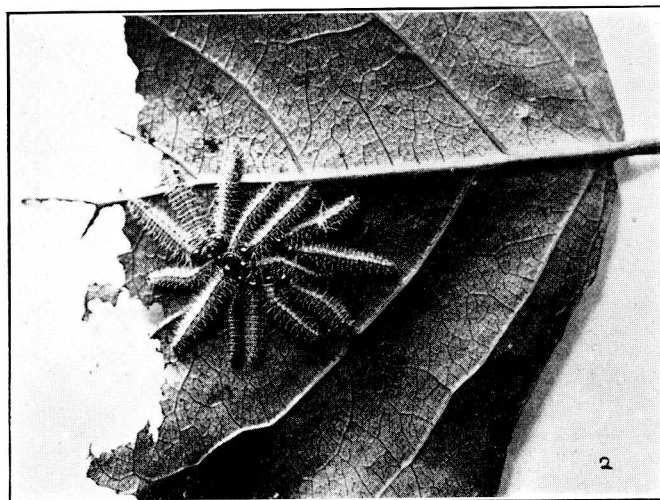


Fig. 1. Poplar Sawfly larvae feeding.
Fig. 2. Poplar Sawfly larvae at rest on leaf.
(Original)

every instar, and although they frequently wander away to find fresh leaves, they subsequently come together again, larvae of different ages being often found together. During the first and second instars only the parenchyma is eaten away, but as they grow older the entire leaf substance is eaten, with the exception of the midrib.

After the first instar the colour of the larva deepens; and during the second instar the first tint of yellow is seen on segments 2, 3 and 11, the rest of the body being very pale green. Practically no change in colour occurs in later instars until the larva is full-fed, except that the yellow colour of the segments mentioned becomes more intense and the black spots along the sides, which make their appearance in the second instar, become larger and more distinct. But when the larva is full grown, a curious change in colour occurs. The yellow colour gradually deepens and spreads over the entire body, and instead of the larva appearing somewhat translucent it becomes opaque, with the exception of a line down the centre of the dorsum, marking the division between the fatty tissue on each side of the body. This change of colour takes place towards the close of the fifth instar and may comprise about four days. When the colour has changed to a deep yellow, the larva ceases to feed and then begins to wander away in search of a place in which to pupate, spinning its cocoon very shortly afterward. Individuals commenced to turn yellow on Sept. 16, and on the 22nd two of these had commenced to spin up. There are five instars, and the average length of each instar was found to be seven days.

Method of study. It was found impossible to keep the larvae in confinement, partly owing to the fact that the poplar leaves could not be kept in a fresh condition even in water, but also because the young larvae cannot stand being moved to fresh food, especially in the earlier stages, and have difficulty in starting a fresh feeding place. When a colony has commenced feeding on a leaf they are accustomed to work backwards towards the petiole until the leaf is consumed, and, when young larvae are moved to fresh leaves, they appear confused and wander about looking for the familiar nibbled edge to which they are accustomed. Hunger forces them to nibble at the new leaves, and they attack the surface here and there in an aimless, irregular sort of way and before long apparently weaken and finally die, especially after they have been disturbed two or three times. Consequently it was found necessary to enclose colonies in cheesecloth bags on the trees, and the first lots of eggs were bagged on July 23 and at intervals thereafter. From time to time fresh colonies were enclosed since, owing to losses from disease, it was found necessary to secure more to keep up the necessary number for observation. The bags were examined daily and the moults were readily determined by the presence of cast skins in the bags. The appearance of a larva immediately after a moult is also distinctive, as the head does not harden for several hours, and, together with the rest of the body, is

translucent, pale yellowish-white, and the normal colour does not return until the larva recommences feeding.

Altogether, sixteen colonies were under observation from time to time. Of these, five were bagged in the egg stage, four from the commencement of the first instar, and the rest during later stages.

Average length of instars. 1st instar 7.5 days, 2nd instar 7 days, 3rd instar 6.8 days, 4th instar 7.7 days, 5th instar 11.2 days.

Pupation. The larvae do not necessarily enter the ground to pupate, but spaces and cracks under clods and stones may be utilized. They will enter crevices in the trunks of trees or under loose bark, working their way in as far as possible, or will crawl into the spaces between shingles on the sides of buildings. In captivity they will spin a cocoon in the corner of a tin, but always prefer to spin between two surfaces when possible. I have never known them to spin a cocoon in the leaves. The cocoon is brown, irregularly oval, thin, semi-transparent, about half an inch in length and composed of silk matted together with a gummy secretion which dries hard. The insect may remain in the pre-pupal condition for two years, as I bred three adults in 1919 from larvae that pupated in 1917. The larva normally remains in a pre-pupal condition within the cocoon all winter in a half-curved position and much diminished in size, and the pupal stage, which is quite short, does not occur until late spring or midsummer. Larvae collected in the fall and kept in outdoor cages commenced to pupate on June 19, and the first adult appeared on July 3. As the pupal stage approaches, the larva increases in size and swells. Two white lines make their appearance along each side of the body. In a week or ten days the skin splits on the dorsum and the pupa wriggles free and the larval skin is sloughed off. The pupal stage lasts a fortnight or longer, according to temperature, and the approach of the final stage is indicated by the darkening of the eyes and head, which gradually become entirely black. At the end of about a week the pupal membrane is cast off, and the perfect insect emerges after cutting a hole in the end of the cocoon.

Diseases and Natural Enemies

During the course of the investigation, it was found that the young larvae often died off very suddenly. This was particularly noticeable at the first when most of the larvae were small, and it was soon observed that they were being rapidly decimated by a bacterial disease. Many colonies died almost immediately after hatching; others contracted the disease at a later period, and up to the fourth instar there was much mortality. The diseased larvae were sometimes found shrunken and dry, adhering to the leaf surface by their prolegs with the thoracic segments bent backwards, but usually they fell to the ground, and as the season advanced great numbers of dead larvae could be seen beneath the trees. The disease seemed to be highly localized, as if it were dependent on some agent for its distribution. Its presence probably accounts for the fact of

the complete disappearance of the sawfly larvae from certain blocks of trees. It was noticed that in certain places in the city, where the trees have been completely defoliated, that the year following they would often be entirely free, and yet trees only two or three hundred yards away would be absolutely stripped. In certain seasons the larvae are well controlled by this disease, and in the year 1922 their numbers were kept down to a minimum in all parts of the city, being scarcely observable at all in some places where they were formerly abundant. According to Mr. G. F. White, of the United States Bureau of Entomology, who examined infected larvae forwarded by the Dominion Entomologist, this disease is allied to *Coccobacillus acridiorum* d'Herelle, and the symptoms of its attack are "not unlike those of similar diseases affecting other species. In these diseases a septicemia occurs which kills in a day or so. While this group of disorders is receiving considerable study, much is yet to be done in the solution of the problem, as it is quite complex."

Very few other natural enemies of the larvae have been observed. A single specimen of an ichneumon parasite was bred from a pupa, but none since, and this case is apparently exceptional. Syrphid larvae have been in several instances seen to attack them. Attempts to make coccinellid larvae eat them were a failure. Birds apparently will not touch the sawfly larvae owing to their acrid, unpleasant odour, which is quite perceptible at a distance of over one foot from colonies on the leaves. When offered to domestic poultry, the larvae were rejected. Not knowing what they were, the fowls seized them readily when first thrown on the ground, but dropped them at once with evident disgust, and could not be induced to pick them up a second time.

Control.

It was found that the larvae were readily controlled by spraying with arsenate of lead powder at the strength of one pound to 40 gallons of water. After three days it was found that all young larvae had been killed and most of the older larvae, a few of the latter only remaining on the leaves, and they were sickly and disappeared within the next few days. Stripping generally commences on the trees within twenty or twenty-five feet of the ground, and that leads me to infer that the flies do not rise very high to oviposit. It is quite noticeable in any season that the outbreak usually commences among the lower limbs, and the larvae gradually spread upwards as the food supply diminishes below. It would appear, therefore, that if taken in time, it would be only necessary to spray the lower parts of the trees to obtain satisfactory control.

- (1) Can. Ent. LII. p. 61, 1920.
- (2) Can. Ent. LVII. p. 43, 1925.
- (3) Cosens, Rept. Ent. Soc. Ont. 1915, p. 15.
Caesar, Ibid. p. 33.
- (4) Lintner, 4th Rep. Ins. N.Y. 1888, p. 44.
- (5) Rohwer, Proc. U.S.N.M. LX, p. 8., 1922.