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THE BIOLOGY, DAMAGE AND CONTROL OF THE POPLAR AND WILLOW BORER, *CRYPTORRHYNCHUS LAPATHI*[1]

De biologie, schade en bestrijding van de elzesnuitkever, Cryptorrhynchus lapathi

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Cryptorrhynchus lapathi has a two-year life cycle, during which it hibernates once as a first instar larva, and again as an adult. As a rule the adults emerge, feed and lay eggs in the even years, while the larvae have their main feeding period in the odd years. The species is harmful to poplar and willow, not only by its own feeding, but also indirectly by facilitating entrance of other insects and infection by micro-organisms. Control by insecticides should preferably not take place in the adult, but in the larval stage. In both cases very poisonous chemicals are required, but the amounts needed for controlling the larvae are smaller than those needed to control the adults and the techniques for applying them entail less risk of poisoning other organisms.

INTRODUCTION

Owing to the damage done by *Cryptorrhynchus lapathi* (L.) to willow and poplar, this insect has been studied by research workers in many countries. PRIMM (1918) and the Dutch authors LINDEYER (1932) and TER PELKWIJK (1946) noted that infestations of *C. lapathi* may give rise to infection by various other wood-infesting organisms.

In their study of the biology of *C. lapathi*, the above-mentioned authors obtained results which differed in certain respects from those found in countries with a similar climate. It therefore seemed advisable to investigate again the biology of this insect in the Netherlands. In the last section of this paper the problem of achieving effective control by the use of modern insecticides is discussed in relation to present knowledge of the bionomics of the beetle.

In Mediterranean and in subtropical areas the species has a one-year cycle, and in colder areas, including the Netherlands, a two-year cycle.

METHODS

From 1960 to 1964 a number of the insects were reared on poplar for regular observation in two rearing cages situated in the laboratory grounds. The data relating to the two complete generations obtained in this period were compared with data from specimens living on willow in an osier bed near Oud Zevenaar. The species was also occasionally studied in places in Zealand, North Holland, North Brabant, Utrecht, Guelderland and in the North-East Polder. In these areas we paid special attention to the stage in which the insect was found in a given year and to the preference, if any, shown for particular host plants.

The two rearing cages, each measuring 2 × 2 × 2 m, consisted of a wooden frame round which nylon gauze had been stretched. In these cages *Populus candicans* Ait. was mainly planted, as it had been found that this species is more frequently attacked by *C. lapathi* than others. For comparison some specimens of *P. nigra* L. cv. 'Italica', *P.* × *canadensis* Moench cv. 'Robusta' and *P. tremula* L. were interplanted.

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The beetles required for the rearing trials were collected in the osier bed near Oud Zevenaar. Twenty specimens were placed in each cage in an equal sex ratio. The females were previously marked with red lead on the elytra.

The life cycles of the insects living freely on willow showed no difference from those of the insects on the poplars in the rearing cages.

HOST PLANTS

In the Netherlands we found *Cryptorrhynchus lapathi* only on willow, poplar and alder. According to reports from other countries birch may also be attacked, but this is an exception and the attack is never severe (ESCHERICH, 1923; MATHESON, 1917; SCHOENE, 1907).

Of the three tree species attacked in the Netherlands, willow and poplar are far more susceptible than alder, as will appear from the following observations. Where poplar stands were interplanted with alder we invariably found the insects on the poplar, but few if any on the alder. When willow instead of alder was planted in poplar stands, it was slightly more affected than the poplar. In one case, at Steenbergen, both alder and willow were found between the poplars. The attack here (1957 and 1959) was most severe on the poplar, less so on the willow, while on the alder only a few affected spots were found after very careful examination.

Of the genus *Populus* we found that as a rule *P. candicans* was generally more heavily attacked than other species or cultivars, *P. tremula* not at all, and *P. nigra* cv. 'Italica' less than Canadian poplars.

We found in the spring of 1961 that mortality among the young larvae was far smaller in *P. candicans* than in 'Robusta'. This lesser mortality in *P. candicans* may have been due to the greater softness of the wood of this species, which enabled the larvae to penetrate more rapidly and deeply, thus protecting themselves from the night frosts which occurred in April.

DESCRIPTION AND LIFE CYCLE

Adult

The sexes are fairly easy to distinguish. The metasternum of the female is regularly convex and that of the male shows a sharp, longitudinal groove in the middle. Like other authors, we have never found the beetle in flight, though it has normally developed wings. It should be mentioned here that the closely related *Cryptorrhynchus gravis* (F.) does fly but over short distances (cf. VOÛTE, 1935).

In colder areas, including the Netherlands, the beetle hibernates in its birthplace, i.e. in the wood of its host plant. In southern parts of Europe (Mediterranean), however, it does not hibernate, but emerges in July and August and starts breeding before winter. In the Netherlands it appears after its hibernation, i.e. from mid-May onward, at about the time when the poplar shoots are 8–10 cm long. We observed that the males appear first. About fourteen days later the females also came out of their hibernacula.

Both the males and females become sexually mature after a period of feeding, which according to our observations lasts from ten to fourteen days. The beetles bore holes in the twigs in or near the young shoots, feeding on the contents (Fig. 1). As soon as both sexes are on the plant, we have almost invariably observed a phenomenon we will term "pairing". The mature male clings to the back of the female, by which it is carried along. CRAMER (1954) observed a similar behaviour with the large poplar longhorn, *Saperda carcharias* (L.). It may be assumed that there is no copulation before the females have also become sexually mature. This stage, which is reached about 10 June, generally coincides with the preparations of the female for depositing her eggs, viz. boring an egg-hole (see: *Oviposition*). Oviposition is repeatedly interrupted for feeding on shoots and twigs, and may continue until October. After this time the activity of the beetles decreases with falling temperatures. In November all beetles disappear from the crop and lie in the litter on the ground.

When we collected some beetles from the litter in the rearing cages in January and took them to a heated room, they soon regained their activity; when we repeated this experiment in March, it was found that most of the beetles were dead. Only a few survived hibernation in the litter. We observed this, for instance, after the severe winter of 1962/63, when in March five beetles (4 males and 1 female) were found in our rearing cages. They moved very slowly and died in April and May without reproducing.

Oviposition

After, or even during, copulation, the female seeks a suitable place for depositing her eggs. In osier beds the stumps are generally chosen for this purpose, but in poplar the raised edges of leaf scars on thin trunks or thicker branches, the surroundings of branch forks, callus growths (for instance of wounds) and, to a smaller extent, lenticels. In the selected place the beetle bores a hole with its proboscis until it has reached its full depth. It then hollows out the hole internally by constant changing its position, using the proboscis in the hole as an axis. As the proboscis is convex, a pear-shaped hollow is obtained which remains partly filled with frass. Finally, the beetle turns round and uses its ovipositor to deposit a single egg through the entrance hole.

This egg, which is about 1 mm long, is at first white and later cream-coloured. It has a thin, somewhat flexible shell, so that to some extent it adapts itself to the shape of the cavity. A fresh cavity is excavated for each egg, sometimes near to or even adjacent to the previous one. The latter is more usual in places where the wood has partly died, or in callus growths. After one or more eggs have been deposited, regenerative feeding occurs which bears a close resemblance to maturation feeding. In this period there may be renewed copulation.

We have not established how many eggs a female can deposit in the period from June to October. SCHOENE (1907) states an average of 16, but ZIVOJINOVIĆ (1962) found an average fertility of about 160 eggs per female in laboratory trials.

Larva

The embryonic development takes about 18–21 days. Even in places where the eggs had been deposited in October we found larvae in November. We also found that the larvae of the eggs deposited in July and in October were of the same size in December, both being in the first larval instar (head-capsule width 0.5 mm). This indicates that the larva in the first instar does not develop further in the year of its emergence, and passes into an obligatory diapause after a short active period. In this period the larva makes a slanting gallery from the egg-cavity towards the surface. At the end of this gallery, just beneath the bark, it makes an ovoid cavity, in which it remains until the following spring (March). The same phenomenon was found in areas in which the insect passes through a one-year cycle (MRKVA, 1963; SZALAY-MARSZÓ, 1962; ZIVOJINOVIĆ, 1962; and others). In view of the above findings we cannot endorse the opinion of LINDEYER and TER PELKWIJK that the insect hibernates in the egg stage and not in the larval stage.

As already mentioned, the larva resumes its activity in March. First it enlarges its hibernation cavity into a small flat space just underneath the bark. This attack becomes visible as soon as fine frass comes out of a hole gnawn from the inside. Galleries are then made in the cambial zone, generally in horizontal and vertical directions. The bark over these passages turns a reddishbrown and at intervals shows small, round holes from which frass is removed (Fig 2). Sometimes this type of attack is absent, as for instance, when a soft kind of wood is affected *(P. candicans)*. The larva then almost immediately penetrates more deeply into the wood, ejecting the frass from the original opening in the bark, which is regularly enlarged as the larva grows.

The larval development in which, according to ZIVOJINOVIĆ, four moults and consequently five instars are distinguished, lasts until about mid-July. After the third instar the larva generally penetrates more deeply into the wood and during the fourth instar it reaches the pith of young trunks or branches. It then moves upwards until it is fully grown. At the end of the tunnel, which is filled with frass, it makes a pupal cell, the wood fragments of which are so pressed into the tunnel end that a compact mass of them, mixed with excrement, shuts off the chamber. Before pupating in the latter half of July, the larva turns round so that its head points toward the exit of the cavity. If, through some cause or other, this is not done, the beetle will (as we have repeatedly observed) be unable to turn round afterwards and leave the pupal cell and will die.

Pupa

The pupal stage usually lasts from 10 to 18 days, so that the beetles emerge from the pupae by the end of July or the first half of August, after which, as already stated, they remain in the pupal cell until the following spring (May).

Some remarks on the two-year cycle

The total two-year life cycle is shown in Table 1. As already mentioned in the introduction, TER PELKWIJK noticed that the larvae occur in the odd years and the beetles in the even years. Our observations, made in various places from 1960 to 1964, generally confirm the existence of this rhythm. Only on a very limited scale and very locally did we find some larvae in "beetle years". This was the case, for instance, on *P. candicans* along the Sea Road near Zandvoort in 1962, and in an osier bed near Over Langbroek (U.) in 1964. Such cases have hitherto been so sporadic and insignificant that for the time being they may be considered to have no practical significance.

DAMAGE

The holes which the beetles bore in the young shoots and twigs during feeding make these shoots and twigs liable to break, especially when there are several holes together. In osier beds this form of damage is one of the most serious, because it makes the twigs unfit for basket plaiting. Moreover the twigs may die above

TABLE 1. Diagram showing the two-year life cycle of *C. lapathi* in the Netherlands.
i = adult (imago), (i) = adult in pupal cell, e = egg, l = larva, (l) = first instar larva in hibernation cell, p = pupa in pupal cell.

Schematische voorstelling van de tweejarige ontwikkelingscyclus van C. lapathi *in Nederland.*
i = *volwassen kever (imago)*, (i) = *jonge kever in popwieg*, e = *ei*, l = *larve*, (l) = *eilarve in overwinteringsholte*, p = *pop in popwieg.*

	March	April	May	June	July	August	September	October	November — February
Even year *Even jaar*	(i) (i)	(i) (i)	(i) i	i i e e	i i e e (l) (l)	i i e e (l) (l)	i i e e (l) (l)	i i e (l) (l)	 (l)–(l)
Odd year *Oneven jaar*	l l	l l	l l	l l	l l p p (i)	 p p (i) (i)	 (i) (i)	 (i) (i)	 (i)–(i)

the site of attack, beneath which new side-shoots are formed. It is clear that this material is also of little value for the basket industry.

In poplar, however, this kind of attack is of little account. It is true that some shoots may fall a victim to these attacks, but this hardly affects the growth of the trees.

The larvae, however, may cause far greater damage. Thus it is stated in foreign reports that they may considerably reduce the production of new shoots in osier plantations as a result of the havoc they play in the stumps and that they may even destroy the willows in nurseries (Fig. 3) (SCHVESTER & BIANCHI, 1961; SZALAY-MARSZÓ, 1961; KEMMER, 1957; etc.).

The larvae of *C. lapathi* may also severely damage young poplars. This occurred, for instance, near Steenbergen in 1957 and again in 1959, when a young plantation was so heavily infested that many trees would have died if the pest had not been controlled. As a result of the feeding of the larvae in the cambial zone the trees there were all but girdled (Fig. 4). They also became susceptible to wind damage because of the numerous tunnels in the wood and a good many broke off.

Besides the direct forms of damage just discussed, the insect is responsible also for indirect damage, caused by secondary parasites penetrating into the tree through the wounds made. These parasites are:

1. *Insects.* Besides the Goat Moth, *Cossus cossus* (L.), of which it is known that the young caterpillars are only able to penetrate into the tree through existing injuries (BLANKWAARDT *et al.*, 1954), we also frequently found caterpillars of the Clear Underwing, *Sciapteron tabaniformis* (Rott.), in the tunnels of *C. lapathi* in poplar.
2. *Bacteria.* LINDEYER (1932) and TER PELKWIJK (1946) held *C. lapathi* responsible as a vector of bacterial cankers *(Pseudomonas)* in willow and poplar.
3. *Moulds.* As early as 1918 PRIMM found a certain connection between *C. lapathi* infestations and the occurrence of *Dothichiza populea* Sacc. et Briard (= *Chondroplea populea* (Sacc.) Klebahn). We also found that in cages with *P. candi-*

cans infested by *C. lapathi* the trees ultimately died of *Dothichiza*, whereas they remained free from this fungus in the cages without *C. lapathi*. VAN VLOTEN (1960) states that only wounded trees can be infected with *D. populea*, sound bark being immune from infection.

CONTROL

Since, theoretically, both the larvae and the beetles can be controlled with modern insecticides, the question arises, in which of the two stages of development control will be most worthwhile. The bionomics of the adult leads to the conclusion that control in the imaginal stage is the least favourable. The beetles appear very irregularly in May and June (of the even years), so that one treatment will certainly not suffice. Therefore, to control the beetle, the Plant Protection Service (1953) advises repeating the treatment every 5–7 days; they recommend spraying with 240 ml dieldrin 25% per 100 l water or dusting with parathion-dust 2%. We need hardly say that these two chemicals are very toxic, even to man, so that strict precautions should be taken when using them. Further, they are generally applied by means of large spraying or dusting apparatus, part of the insecticide being carried off by the wind. This means waste of insecticides and hazard for persons, animals and crops (fruit and vegetables) in the neighbourhood.

Other chemicals must be used for controlling the larvae, preferably systemic insecticides, in which case a single treatment will generally suffice. Since in young crops the larvae are generally found in the lower parts of the plants, the above-mentioned hazards can be avoided by close-range application. In osier beds the chemical may be applied to the stumps with a simple knapsack sprayer when they are most accessible (April). When the trunks of young poplars are treated for larval infestation, the chemical may be painted on or worked in with a brush. This control method is also a quick and safe one. It may be possible for 800–1000 poplars in plantations to be treated in this way per man/day.

Larval control should be carried out before 15 May. An investigation into the larval development showed that on this date 70% of the larvae had reached or passed the second instar and that a month later they were already full-grown. Consequently the best time for control of *C. lapathi* is in April (of odd years) as soon as the growing season starts and the leaves begin to show. It is only when more or less volatile (for instance chlorine-containing) chemicals are used, that the temperature will also determine the time of treatment.

The following systemic insecticides which have so far been succesfully applied may be mentioned: 1% solution of meta-iso-systox (CAVALCASELLE & DE BELLIS, 1962) or 1–2% solution of fosfamidon (= Dimecron-20), recommended by the Plant Protection Service on the basis of experience abroad, 1–2% solution of thiometon (e.g. Ekatin), recommended and already applied by the Plant Protection Service (ONRUST & ROERSCH, 1960). With the latter chemical no harmful effect was found on the trees, even when the undiluted solution was applied to the trunks of young poplars by way of experiment.

In other countries non-systemic chemicals have also been succesfully used against the larvae of *C. lapathi*, e.g. 0.1 to 0.5% parathion (PIETRI-TONELLI & ROSI, 1957; FRANCKE-GROSMANN, 1958), 1.6% trichlorfon (= Dipterex)-emulsion (SCHNAIDER, 1962); 1–5% lindane-emulsion (SCHVESTER & BIANCHI, 1962), 5–10% BCH in mineral oil 20% (KUTEEV, 1964).

SAMENVATTING

Tijdens zijn tweejarige ontwikkelingsduur overwintert *Cryptorrhynchus lapathi* in Nederland als larve (1e stadium) en als imago. Als regel komt het insekt in de even jaren in het imaginale, in de oneven jaren in het larvale stadium tot activiteit (tabel 1).

Behalve van primaire aard (fig. 1, 2, 3, 4) is de schade aan wilg en populier ook door secundaire, parasitair optredende organismen (bacteriën, schimmels, insekten) van betekenis.

Bij de bestrijding is toepassing van chemische middelen in het jonge larvale stadium te prefereren boven die in het imaginale. In beide gevallen worden giftige insekticiden gebruikt. Tegen de larven in jonge populierenbeplantingen of in de griendcultuur kunnen de middelen echter op een gerichte wijze worden toegepast, waardoor men naast een minimale verspilling van het insekticide bovendien een hogere graad van veiligheid bereikt.

REFERENCES

BLANKWAARDT, H. F. H., E. T. G. ELTON, G. MINDERMAN & H. J. VAN DER SLOOTEN, – 1954. Ontstaan van wilgenhoutrups-aantastingen (Cossus cossus L.). Ned. BosbTijdschr. 26: 249–255.

BRUSA, L. & M. CORSI, – 1956. The control of Cryptorrhynchus lapathi L., a pest of poplar, with sprays containing BHC. Annali Sper. agric. (N.S.) 10, 1: 109–117. [Rev. appl. Ent. A 44: 203].

CAVALCASELLE, B. & E. DE BELLIS, – 1962. Nouvelles précisions sur les moyens de lutte contre le Cryptorrhynchus lapathi L. Org. des Nations Unies pour l'alimentation et l'agriculture, Rome: FAO/CIP/128.

CRAMER, H. H., – 1954. Untersuchungen über den grossen Pappelbock, Saperda carcharias L. Z. angew. Ent. 35: 425–458.

ESCHERICH, K., – 1923. Die Forstinsekten Mitteleuropas II. Paul Parey, Berlin: 406–411.

FRANCKE-GROSMANN, H., – 1958. Versuche zur chemischen Bekämpfung der Junglarven des Cryptorrhynchus lapathi L. in Weidenkulturen. Meded. LandbHogesch. OpzoekStns Gent 23: 678–684.

KEMMER, C., – 1957. Cryptorrhynchus lapathi L. Ein schädlicher Rüsselkäfer in Weidenkulturen. Forst Jagd 7: 303–304, 321–322.

KUTEEV, F. S. – 1963. Chemical control of the alder snout beetle, Cryptorrhynchus lapathi L. Les. Khoz. 16: 50–51. [Summary].

LINDEYER, E. J., – 1932. De bacteriënziekte van de wilg veroorzaakt door Pseudomonas saliciperda n. sp. Diss. Amsterdam.

MATHESON, R., – 1917. The poplar and willow borer. Bull. Cornell Univ. agric. Exp. Stn 388: 457–481.

MRKVA, R., – 1963. Beitrag zur Kenntnis der Bionomie und der Bekämpfung des Erlenrüsslers, Cryptorrhynchidius lapathi L. Lesn. Cas. 9: 551–568. [Zusammenfassung].

ONRUST, J. C. & J. C. ROERSCH, – 1960. Een methode ter bestrijding van de wilgensnuittor (Cryptorrhynchus lapathi L.). Ned. BosbTijdschr. 32: 204–207.

PELKWIJK, A. J. TER, – 1946. Onderzoek naar de biologie van de elzensnuitkever, Cryptorrhynchus lapathi L. Tijdschr. PlZiekt. 52: 22–25.

PIETRI-TONELLI, P. DE & O. ROSI, – 1956. Cryptorrhynchus lapathi L. A single timely application of parathion frees the trunks from larvae of the Curculionid. Italia agric. 93, 12: 957–963. [Rev. appl. Ent. A 45: 370].

PLANTENZIEKTENKUNDIGE DIENST, – 1953. De wilgensnuittor (Cryptorrhynchus lapathi L.). Vlugschr. plziektenk. Dienst Wageningen 33.

PRIMM, I. K., – 1918. The poplar canker in the vicinity of Philadelphia, Penn. J. econ. Ent. 11: 129–133.

SCHNAIDER, F. S., – 1962. Bekämpfung von Cryptorrhynchus lapathi L. in Korbweidenpflanzungen. Pr. badaw. Inst. badaw. Leśn. 246–249: 225–250. [Zusammenfassung].

SCHOENE, W. J., – 1907. The poplar and willow borer. Bull. N.Y. St. agric. Exp. Stn 286.

SCHVESTER, D. & H. BIANCHI, – 1961. On a method of controlling the patience weevil (Cryptorrhynchus lapathi L.) in osier beds. C.r. hebd. Séanc. Acad. Agric. Fr. 47: 494–497.
SZALAY-MARZSÓ, L., – 1961. Damages caused by the willowborer, Cryptorrhynchus lapathi L. in Hungary and its control possibilities. Acta agron. hung. 11: 217–236. [Summary].
SZALAY-MARZSÓ, L., – 1962. Zur Morphologie, Biologie und Bekämpfung des Erlenwürgers Cryptorrhynchus lapathi L. in Ungarn. Z. angew. Ent. 49: 163–194.
VLOTEN, H. VAN, – 1960. De aantasting van populieren door Cryptodiaporthe populea (Sacc.) Butin. In: H. A. VAN DER MEIDEN, Handboek voor de populierenteelt, Arnhem: 215–224.
VOÛTE, A. D., – 1935. Cryptorrhynchus gravis F. und die Ursachen seiner Massenvermehrung in Java. Archs néerl. Zool. 2: 112–142.
ZIVOJINOVIĆ, S., – 1962. Beitrag zur Kenntnis der Biologie des Erlenrüsslers, Cryptorrhynchus lapathi L. Topola 6: 81–87. [Zusammenfassung].

FIG. 1. Punctures on willow twig caused by feeding of the adult.
Gaatjes in wilgetwijg, veroorzaakt door vreterij van de kever.

FIG. 2. Tunnels of young larvae in alder.
Gangen van jonge larven in els.

FIG. 3. Damage to willow stubs caused by *C. lapathi* attack.
Schade aan wilgestronken door aantasting van C. lapathi.

FIG. 4. Infestation by larvae in balsam poplar.
Larvenaantasting in balsempopulier.