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# THE BIOLOGY OF *Anacampsis populella* (CLERCK) (LEPIDOPTERA, GELECHIIDAE)

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## Abstract

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The paper deals with the occurrence, development and harmfulness of *Anacampsis populella* (Clerck) (Gelechiidae) on *Populus tremula* L. The pest was monitored on 5 to 15-year old trees of the species at Forest District Bílovice nad Svitavou (near the city of Brno) in 2008 and 2009. Caterpillars made leaf rolls of a mean length of 37.3 mm and width 5.5 mm there. In 80% leafrolls, one leaf was rolled up and in 20% two to five leaves. Towards the abaxial face of leaves, all leaves with caterpillars were rolled up but only part of peripheral leaves. Caterpillars occurred from 20 April to 25 June. They developed only through three instars and damaged leaves on an area of about 12.2 $cm^2$. Grown up caterpillars pupated mostly in leaf- rolls. Pupae occurred from 10 May to 25 July and imagoes from 20 May to the beginning of August. Some 63 to 88% population of caterpillars and pupae were killed by natural enemies (particularly insect parasitoids, insect predators and birds). Eggs overwinter. The pest development is univoltine.[1]

*Anacampsis* (= *Tachyptilia*) *populella* (Clerck), Gelechiidae, occurrence, development, harmfulness

*Anacampsis* (=*Tachyptilia*) *populella* (Clerck) is the representative of an extensive and taxonomically difficult family Gelechiidae. On the area of the CR, 233 species were determined (ELSNER, 1998). Their biology is various and mostly little known. Nevertheless, a number of them ranks among abundant to very abundant species and some can even occasionally do damage to agriculture, horticulture and forestry. As for species living on forest trees *A. populella* belongs to most abundant. Similarly as five other domestic species of the same genus also *A. populella* develops in leafrolls.

*A. populella* occurs mainly in the Euro-Siberian subregion, ie in the most extensive part of a Palaearctic region. SPULER (1913) mentions the species from Europe (except Greece) and from eastern Asia. According to MEYRICK (1927), it is known from England, southern Scotland and a broad zone from continental Europe to eastern Siberia. In western Siberia, it is regarded as a pest (TIBATINA and ZOLOTARENKO, 1976). It ranks among abundant species also in eastern Siberia, eg in the Bratsk region (SELIKHOVKIN, 1992). The species does considerable damage in a Chinese province Heilongkiang (LIU & PAI, 1979). PARK et al. (2000) mention the species in the Chang-san Mountains in China. MORRIS (1966) mentions the European origin of *A. populella*. The author found the species in a Canadian province Newfoundland. Nevertheless, CLARKE (1942) brings probably the first reports on its occurrence in a Nearctic region (from the state of Washington in the USA). In the area of former Czechoslovakia, *A. populella* ranks among very abundant species (PATOČKA, 1951, 1959). According to HRUBÝ (1964) it refers to a Euro-Siberian taxon, which occurs mainly in the zone of broadleaved forests and steppes, less frequently in the zone of high-elevation forests.

*Populus tremula* L. (SCHMITT, 1920; BURMANN, 1956; GEORGIEVIC and VACLAV, 1960; REIPRICH, 1960; YOUNG, 2002) or generally *Populus*

1 The paper was prepared at the Faculty of Forestry and Wood Technology, Mendel University in Brno within MSM 6215648902 research plan.

spp. (PATOČKA, 1951, 1959; GEORGIEV, 2000 etc.) are the main host species of *A. populella*. However, the species is not trophically exclusively related to *Populus*. For example, SPULER (1913) considers also *Betula* spp. and *Salix* spp. to be host species. In the Canadian province Newfoundland, it is mentioned from *Populus* sp. and in the Nova Scotia province from *Populus* sp. and *Salix* sp. (MORRIS, 1966). HRUBÝ (1964) mentions the species occurrence on *P. tremula*, *P. nigra* L. and *Salix caprea* L. GEORGIEV and BESHKOV (2000) found the species in Bulgaria, namely most abundantly on *P. deltoides* Marsh. and *P. × euroamericana*, less frequently on *P. tremula* and *P. alba* L. *Betula* spp. is also an important host plant. HASSANEIN (1978) found the species ordinarily on *B. pendula* Roth. and *B. pubescens* Ehrh. on peat bogs nearby Munich (Bavaria). However, the author did not find it on *P. tremula* and *Salix* spp. According to LIU and PAI (1979), it refers to a polyphage on *Populus* spp. (including *P. davidiana* Dode), *Salix* spp., *Acer* spp. and *Betula* spp.

Numerous literature sources briefly mention the occurrence, host plants and biology of *A. populella*. Nevertheless, special papers aimed at its bionomics and harmfulness are not nearly available. HASSANEIN (1978) brings fundamental findings on the species biology and ecology. The author (1979a, b) deals also with the bionomics, parasitization and population ecology of *A. populella* and other species of Lepidoptera developing in leafrolls on birch. The development and harmfulness of *A. populella* on poplars have not been studied in detail yet. The following paper is, therefore, primarily aimed at these problems.

## MATERIAL AND METHODS

In the Training Forest Enterprise "Masaryk Forest" in Křtiny (former district of Brno- country), the abundant occurrence was noted of *A. populella* on *P. tremula* in recent years. The increase of the pest population density was used for laboratory and field studies in 2008 and 2009. The survey was carried out in 5 to 15-year shrub formations of *P. tremula*, namely at a forest range Resslovka (Forest District Bílovice nad Svitavou). Examined stands occurred 2 to 3 km north of Brno, the Hády mound (altitude about 420 m). Mean annual temperature 7.7 °C, mean annual precipitation 620 mm and growing season 160 days.

Leaf rolls were sampled in one-week intervals for subsequent laboratory examinations from stands of the Resslovka forest range during the growing season. In 2008, ten samplings were carried out at 50 (and three samplings at 25) leafrolls (ie, 575 leafrolls). In 2009, 17 samplings were carried out at 130 (and three at 100) leafrolls (ie, 2 510 leafrolls). As necessary, other 750 leafrolls were sampled and examined in a laboratory in 2009.

Through regular analyses and parallel rearing, an overview was obtained on the development and health condition of *A. populella* in leafrolls. Dimensions of leafrolls and the number of leaves in rolls were recorded (including the direction of rolling the leaves towards the abaxial or adaxial face). In leafrolls, the number and length of web linkages and the number of fibres in linkages was evaluated. Instars of caterpillars were determined using micrometry according to the head width. The leaf area damaged by caterpillars of particular instars including defecation was examined. The period of development in leafrolls, the lifetime and the sex ratio of imagoes were also assessed.

## RESULTS AND DISCUSSION

### Host plants

In addition to *P. tremula*, also *B. pendula* and *S. caprea* occurred at examined localities. However, leafrolls of *A. populella* were found only on *P. tremula*. This finding is interesting because birch was attacked instead of aspen in Bavaria (HASSANEIN, 1978). Also in the area of western Siberia, *A. populella* was found mainly on birch (TIBATINA and ZOLOTARENKO, 1976). Causes why the same tree species is somewhere attacked by this species and elsewhere is ignored have not bean found. Generally, the trophic affinity of caterpillars of *A. populella* to *P. tremula* and *Betula* spp. is much higher than to *Salix* spp. Therefore, caterpillars of the 2nd and 3rd instars obtained from *B. pendula* consumed *B. pendula* and less *P. tremula* in rearing. However, they refused to consume other three species of poplars and three species of willows (HASSANEIN, 1978).

### Life cycle

Females of *A. populella* lay eggs about two weeks after hatching. They place these eggs individually or group-wise at the base of buds or at the end part of branches. According to HASSANEIN (1978), on average 56 eggs mature in ovaries, however, only 46.5 eggs are laid. The eggs overwinter. In the region of Brno, caterpillars hatch from eggs in the last decade of April. By means of fibres they roll newly unfolded leaves and develop in leafrolls. In the 2nd half of May and in the 1st half of June, they grow up and pupate usually in leafrolls. Imagoes occur from 20 May (or from the end of May). In short, it is possible to note that caterpillars occur from 20 April to 25 June, pupae from 10 May to 25 July and imagoes from 20 May to the beginning of August. Fertilized females lay eggs in June and July (Tabs. I and II). Thus, *A. populella* shows only one generation per year.

According to HASSANEIN (1978), caterpillars develop on birch from the end of April and the beginning of May to the end of June. Pupae occur from the end of June to 25 July. Imagoes fly in July, August and September (ie minimally 1 to 1.5 months later than in the region of Brno). In the Canadian province Nova Scotia, imagoes fly from 5 to 27 July and in the Newfoundland province during the 2nd half of July (MORRIS, 1966). According to SPULER (1913), PATOČKA (1959), REIPRICH (1960) and HRUBÝ

I: *Results of the analysis of development and health condition of Anacampsis populella (Cl.) in leaf rolls of Populus tremula. Bílovice n. Svitavou, 2008.*

| Date of checking | Undisturbed development | | | Disturbed development | | | Total |
|---|---|---|---|---|---|---|---|
| | vital caterpillars | vital pupae | hatched moths | insect parasitoids | predators | natural mortality | |
| **9. 5.** | 42/84 | - | - | 6/12 | 2/4 | - | 50/100 |
| **16. 5.** | 35/70 | 1/2 | - | 7/14 | 6/12 | 1/2 | 50/100 |
| **25. 5.** | 32/64 | 1/2 | - | 5/10 | 10/20 | 2/4 | 50/100 |
| **31. 5.** | 15/30 | 2/4 | 15/30 | 5/10 | 12/24 | 1/2 | 50/100 |
| **6. 6.** | 6/12 | 2/4 | 19/38 | 5/10 | 17/34 | 1/2 | 50/100 |
| **12. 6.** | 2/4 | 1/2 | 16/32 | 5/10 | 24/48 | 2/4 | 50/100 |
| **19. 6.** | 1/2 | 1/2 | 17/34 | 7/14 | 22/44 | 2/4 | 50/100 |
| **26. 6.** | - | 1/2 | 19/38 | 3/6 | 27/54 | - | 50/100 |
| **3. 7.** | - | - | 18/36 | 4/8 | 26/52 | 2/4 | 50/100 |
| **10. 7.** | - | - | 18/36 | 6/12 | 25/50 | 1/2 | 50/100 |
| **17. 7.** | - | - | 9/36 | 3/12 | 12/48 | 1/4 | 25/100 |
| **24. 7.** | - | - | 10/40 | 3/12 | 12/48 | - | 25/100 |
| **31. 7.** | - | - | 9/36 | 2/8 | 13/52 | 1/4 | 25/100 |
| **Total** | 133/23 | 9/2 | 150/26 | 61/11 | 208/36 | 14/2 | 575/100 |
| **Mean (July)** | - | - | 64/37 | 18/10 | 88/50 | 5/3 | 175/100 |

II: *Results of the analysis of development and health condition of Anacampsis populella (Cl.) in leaf rolls of Populus tremula. Bílovice n. Svitavou, 2009.*

| Date of checking | Undisturbed development | | | Disturbed development | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | vital caterpillars | vital pupae | hatched moths | insect parasitoids | insect predators | birds | natural mortality | |
| **24. 4.** | 127/98 | - | - | - | - | - | 3/2 | 130/100 |
| **30. 4.** | 111/85 | - | - | 12/9 | 2/2 | - | 5/4 | 130/100 |
| **7. 5.** | 99/76 | - | - | 11/9 | 7/5 | 5/4 | 8/6 | 130/100 |
| **14. 5.** | 75/58 | 2/2 | - | 14/10 | 18/14 | 9/7 | 12/9 | 130/100 |
| **21. 5.** | 33/25 | 4/3 | 11/9 | 14/11 | 29/22 | 17/13 | 22/17 | 130/100 |
| **28. 5.** | 10/8 | 4/3 | 24/18 | 12/9 | 36/28 | 26/20 | 18/14 | 130/100 |
| **4. 6.** | 4/3 | 5/4 | 17/13 | 14/11 | 46/35 | 27/21 | 17/13 | 130/100 |
| **11. 6.** | 2/2 | 5/4 | 21/16 | 14/10 | 47/36 | 27/21 | 14/11 | 130/100 |
| **18. 6.** | 1/1 | 10/8 | 17/13 | 8/6 | 52/40 | 30/23 | 12/9 | 130/100 |
| **25. 6.** | 1/1 | 7/5 | 15/12 | 14/11 | 60/46 | 24/18 | 9/7 | 130/100 |
| **2. 7.** | - | 3/2 | 18/14 | 8/6 | 62/48 | 26/20 | 13/10 | 130/100 |
| **9. 7.** | - | 1/1 | 15/12 | 12/9 | 58/45 | 33/25 | 11/8 | 130/100 |
| **16. 7.** | - | - | 17/13 | 9/7 | 65/50 | 29/22 | 10/8 | 130/100 |
| **23. 7.** | - | - | 14/11 | 6/5 | 68/52 | 37/28 | 5/4 | 130/100 |
| **30. 7.** | - | - | 14/11 | 10/7 | 66/51 | 32/25 | 8/6 | 130/100 |
| **6. 8.** | - | - | 18/14 | 7/5 | 60/46 | 38/29 | 7/6 | 130/100 |
| **13. 8.** | - | - | 13/10 | 11/8 | 62/48 | 32/25 | 12/9 | 130/100 |
| **20. 8.** | - | - | 13/13 | 8/8 | 45/45 | 24/24 | 10/10 | 100/100 |
| **27. 8.** | - | - | 9/9 | 9/9 | 46/46 | 30/30 | 6/6 | 100/100 |
| **3. 9.** | - | - | 9/9 | 8/8 | 49/49 | 28/28 | 6/6 | 100/100 |
| **Total** | 463/18 | 41/2 | 245/10 | 201/8 | 878/35 | 474/19 | 208/8 | 2 510/100 |
| **Mean (July)** | - | 4/1 | 78/12 | 45/7 | 319/49 | 157/24 | 47/7 | 650/100 |

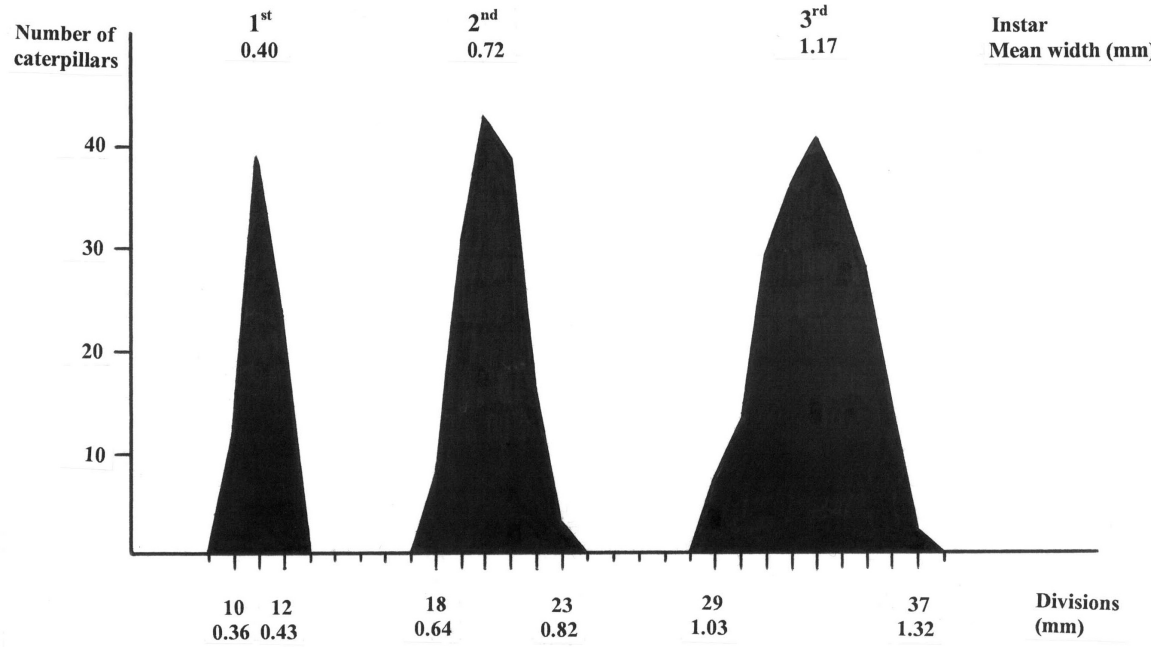
(1964) imagoes fly from June to September, according to GEORGIEV and BESHKOV (2000) from 12 May to 24 June.

## Dimensions of caterpillars, pupae and imagoes

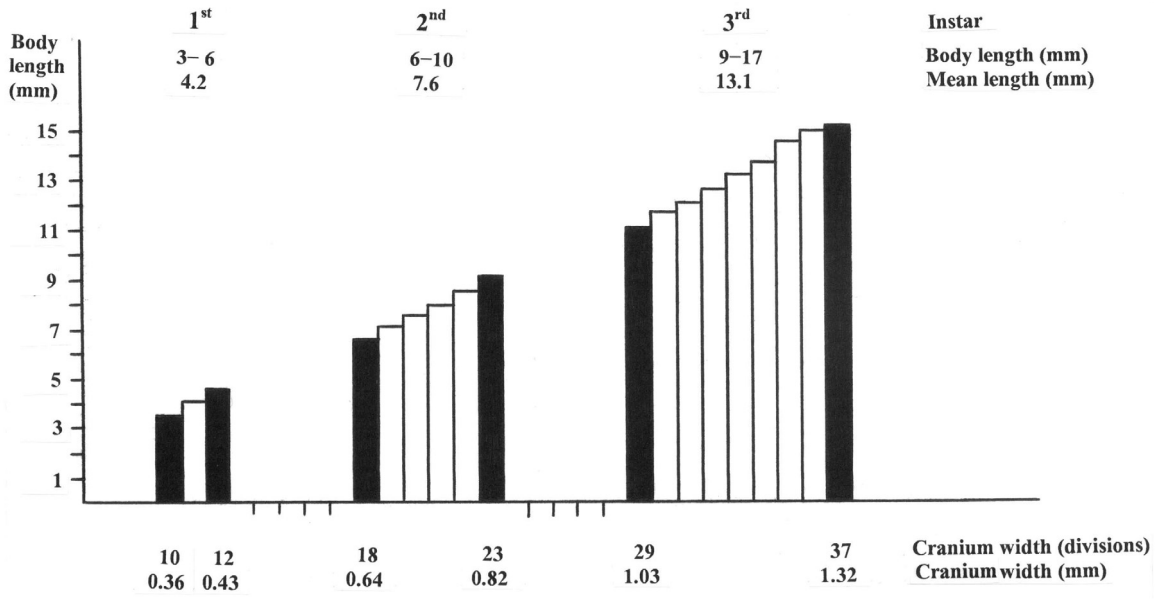
Caterpillars of *A. populella* moult twice during their development. Thus, they have only three instars (according to HASSANEIN, 1978 five instars). Caterpillars of the last instar have a cranium 1 to 1.3 mm wide (according to HASSANEIN 1978 only 0.98 to 1.13 mm). Their body is 9 to 17 mm long (Figs. 1 and 2).

Pupae are 6.5 to 9.5 (on average 8.1) mm long and 2.1 to 2.8 (on average 2.5) mm wide. Pupae developed from caterpillars on birch are on average 7.2 mm long and 2.1 mm wide (HASSANEIN, 1978). The sex of male pupae is distinguished on the 9th sternite and that of the female pupae on the 8th sternite.

The wing span of males and females is 14 to 20.5 (on average 17.6) and 13 to 21 (on average 18.4) mm, respectively. MORRIS (1966) mentions the same average span of wings (18 mm). The length of the species body without antennae is 6.5 to 9.5 (on average 7.6) and 6.5 to 9 (on average 7.6) mm in males and females, respectively. The length of antennae of




1: *Width of the cranium of particular instars of caterpillars of A. populella (1 division= 0.0357 mm)*




2: *Length of the body of particular instars of caterpillars of A. populella depending on the head width*

males is 4.1 to 6.2 (on average 5.3) mm and that of females 4.2 to 6.5 (on average 5.6) mm. Results of measurements of 116 males and 149 females show that the average size of male and female moths is virtually the same.

## Leafrolls

On average, 80% leafrolls of *A. populella* are made of one leaf of *P. tremula* and 20% leafrolls of two to five neighbouring leaves (Tabs. III and IV). According to SPULER (1913), leafrolls consist of two leaves, according to HASSANEIN (1978) of one to four leaves and according to GEORGIEV and BESHKOV (2000) of one to five leaves (but usually of two to three leaves). Leafrolls are on average 37.3 mm long and 5.5 mm wide. The size of leafrolls increases with the number of rolled up leaves (Tab. III). At an average 88.5% leafrolls, blades of leaves are rolled lengthwise (ie, in parallel with main leaf veins). At 9.2% leafrolls, leaf blades are rolled crossways to main veins and rarely (in 2.3%) across the main vein (Fig. 3). Particular leaf blade layers are rolled at each other loosely and, therefore, the leafrolls are rather wide and loose. They are easily distinguishable from closely cylindrical and tough leafrolls of *Byctiscus populi* (L.), which are on average 30 mm long and 3 mm wide (Fig. 4).

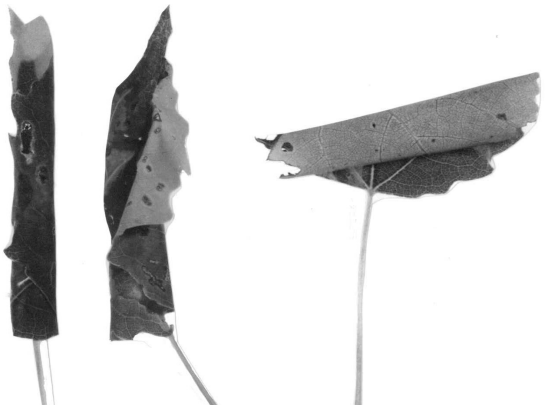
Generally (in 78%), the whole leaf blade is rolled up to a leafroll. In 13% leafrolls, ¾ blade areas are rolled up, in 7% leafrolls ½ leaf blades and in 2% leafrolls ¼ blade areas (Fig. 5). Leaves with caterpillars

III: *Number/% leaves in rolls and dimensions of leafrolls of A. populella (mm). Bílovice n. Svitavou, May 2008*

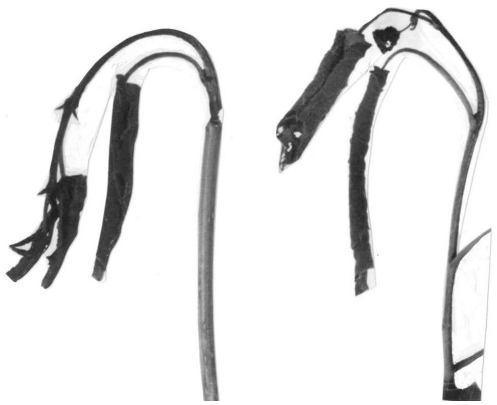
| Number of leaves in rolls | Number/% leafrolls | Mean dimensions of leafrolls | |
|---|---|---|---|
| | | length | width |
| **1** | 233/83.8 | 36.3 | 5.1 |
| **2** | 38/13.7 | 42.0 | 7.1 |
| **3–5** | 7/2.5 | 46.6 | 8.5 |
| **Total/mean** | 278/100.0 | 37.3 | 5.5 |

IV: *Direction of rolling up leaves in rolls of A. populella (according to the number of leaves in rolls). Bílovice n. Svitavou, May 2009*

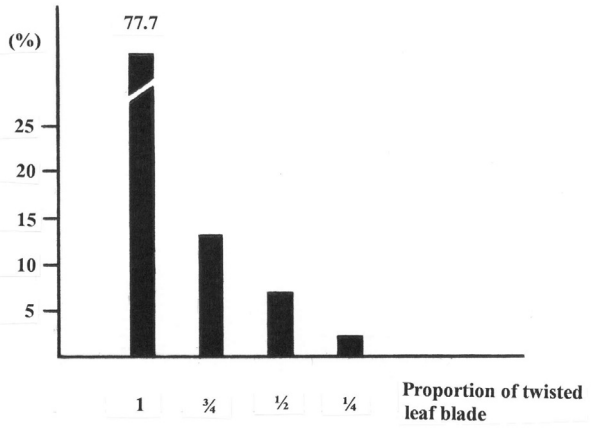
| Number of leaves in rolls | Number/% leafrolls | Number/% of rolled up leaves | Number/ % leaves rolled up towards the abaxial face | | | | |
|---|---|---|---|---|---|---|---|
| | | | leaf with a caterpillar | the second leaf | the third leaf | the fourth leaf | total |
| **1** | 178/78.4 | 178/59.1 | 176/98.9 | - | - | - | 176/98.9 |
| **2** | 30/13.2 | 60/19.9 | 30/100.0 | 25/83.3 | - | - | 55/91.7 |
| **3** | 13/5.7 | 39/13.0 | 13/100.0 | 9/69.2 | 4/30.8 | - | 26/66.7 |
| **4** | 6/2.7 | 24/8.0 | 6/100.0 | 4/66.7 | 3/50.0 | 2/33.0 | 15/62.5 |
| **Total** | 227/100.0 | 301/100.0 | 225/99.1 | 38/77.6 | 7/36.8 | 2/33.3 | 272/90.4 |



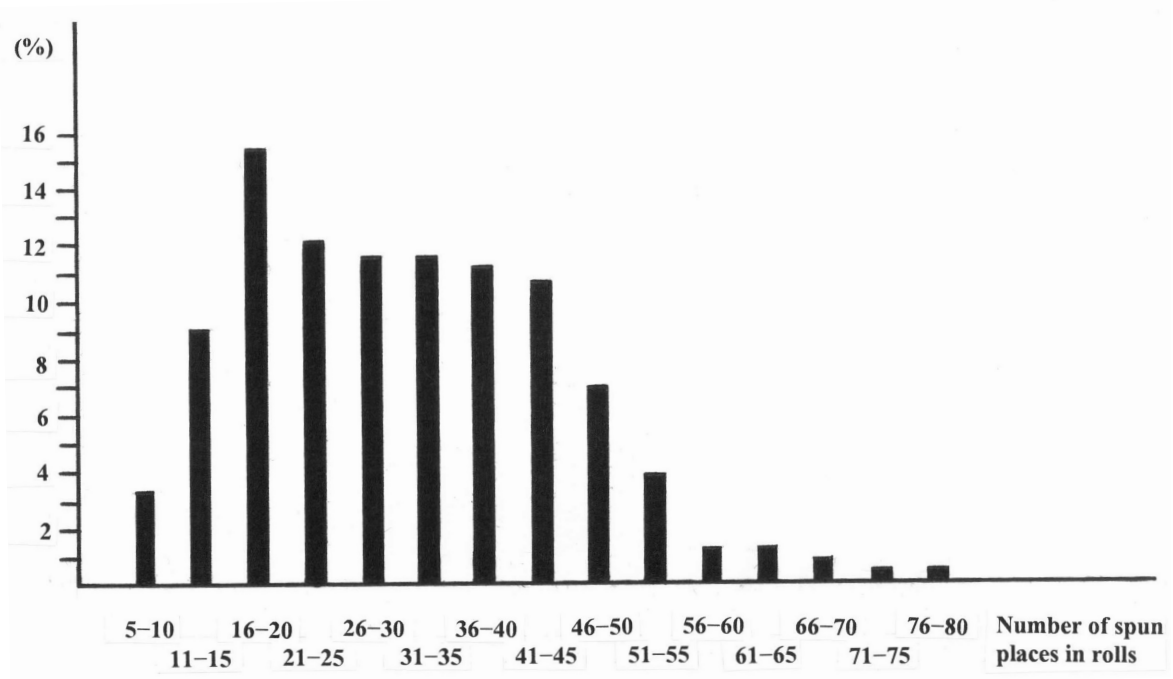
3: *Leafrolls of A. populella*



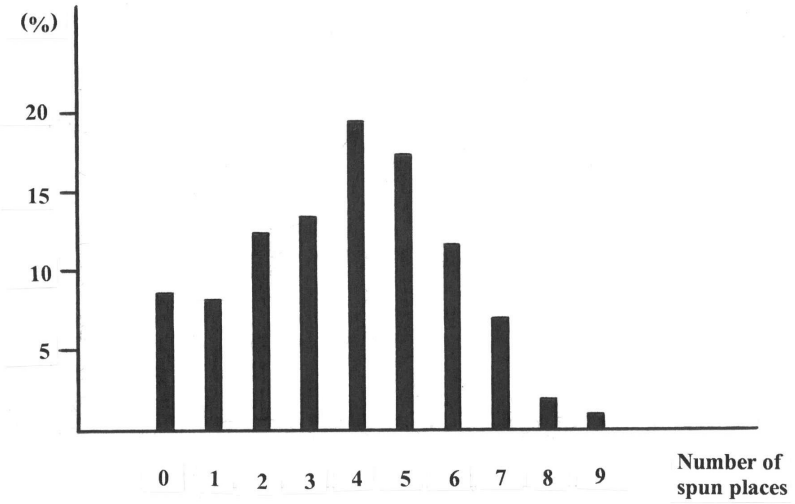
4: *Leafrolls of Byctiscus populi*




5: *The percentage proportion of leafrolls of A. populella according to the proportion of the rolled up leaf blade area. On average 91.5% blade were included into leafrolls (30 April 2009)*




6: *The percentage proportion of leafrolls of A. populella according to the total number of web linkages (7 May 2009)*




7: *The percentage proportion of leafrolls of A. populella according to the number of outer web linkages (7 May 2009)*

(ie, leaves in one-leaf rolls and inner leaves in multi-leaf rolls) are almost always (on average in 99.1%) rolled towards the abaxial face (ie, by the adaxial face outwards). Other (ie, the second in sequence) leaves are rolled up towards the abaxial face in 77.6%, the third leaves in 36.8% and the fourth leaves in 33.3%. The proportion of leaves rolled up towards the abaxial face is largest (98.9%) at single-leaf rolls. This proportion gradually decreases with the increasing number of leaves in rolls and in four-leaf rolls, it reaches 62.5%. On average, 90% leaves are rolled up towards the abaxial face (Tab. IV). Thus, the statement of HASSANEIN (1978), MORRIS (1966) and others that leaves are always rolled up by their abaxial face inwards the roll is not exact.

The shape of leafrolls is maintained by numerous web linkages. Inner linkages reinforce the leafrolls from the inside, outer linkages from the outside (at the outer edge of the leaf blade). The average number of linkages increases with the leaf blade area and the number of leaves in a roll. At examined localities, leafrolls were reinforced by 5 to 77 (on average 31) linkages, out of a total number by 0 to 9 (on average 3.8) outer linkages (Figs. 6 and 7). Linkages were 2 to 4 (on average 3) mm long being created by 28 to 55 (on average 42) fibres.

Leaves damaged by caterpillars begin to die from the end of June and one-leaf rolls fall off prematurely. In multi-leaf rolls, usually only inner (ie, mostly damaged by caterpillars) leaves die. Outer leaves remain usually green until the end of the growing season. The leaves fall on the soil surface usually during the current leaf fall in autumn.

## Characteristics of the species development in leafrolls

Caterpillars develop through three instars. Caterpillars of the 1st instar skeletonize leaves of *P. tremula* from the abaxial face. Caterpillars of the 2nd instar also skeletonize the leaves and rarely punch them. Younger caterpillars of the 3rd instar usually skeletonize the leaves, older caterpillars usually punch them. The caterpillars never damage main and secondary veins.

Under common laboratory conditions, caterpillars grew up on average after 14.4 days. Caterpillars of the 1st instar developed on average 4 days, caterpillars of the 2nd instar 3.6 days and caterpillars of the 3rd instar 6.8 days. Prepupae took on average 3.7 days and pupae 12 days. Imagoes hatched on average after 30 days from the emergence from eggs and lived on average 12.6 days. The whole development (from hatching the caterpillars from eggs until the death of imagoes) took on average 42.7 days. Male and female individuals developed during the same time period (Tab. V). Males hatched mainly from leafrolls sampled in the 1st half of May. From leafrolls sampled in the 2nd half of May and in June, mainly females hatched. From leafrolls sampled in the 1st half of July, exclusively females hatched (Tab. VI).

In nature, caterpillars (including prepupae) develop 3 to 4 weeks. Grown up caterpillars pupate in leafrolls, less frequently also at other hidden places. The stage of pupae takes 2 to 3 weeks. Imagoes live 1 to 4 weeks, according to HASSANEIN (1978) 1 to 10 weeks. Soon after the end of reproduction,

V: *The mean time of development of A. populella in leafrolls and the mean time of the imago lifetime. Laboratory examination, 24 April to 10 June 2009.*

| Characteristics (days) | Sex | | Mean |
|---|---|---|---|
| | male | female | |
| **Time of the development of caterpillars** | 14.5 | 14.2 | 14.4 |
| **Time of the duration of prepupae** | 3.8 | 3.6 | 3.7 |
| **Time of the duration of pupae** | 12.2 | 11.8 | 12.0 |
| **The lifetime of imagoes** | 12.8 | 12.4 | 12.6 |
| **Total** | 43.3 | 42.0 | 42.7 |

VI: *The mean time of development in the laboratory and the sex ratio of moths of A. populella. Laboratory examination, 2009.*

| The period of sampling leafrolls from nature | The mean time of development (days) | Sex ratio (♂♂:♀♀) |
|---|---|---|
| **1st half of May (7. 5. and 14. 5.)** | 19 | 1.3:1 |
| **2nd half of May (21. 5. and 28. 5.)** | 16 | 1:1.4 |
| **1st half of June (4. 6. and 11. 6.)** | 12 | 1:1.8 |
| **2nd half of June (18. 6. and 25. 6.)** | 8 | 1:3 |
| **1st half of July (2. 7. and 9. 7.)** | 2 | 0:4 |
| **Total** | - | 1:1.3 |

VII: *Leaf area damaged by caterpillars of the 1st to the 3rd instar and defecation of caterpillars of A. populella. Laboratory examination, 24 April to 10 May 2009.*

| Indicator | 1st instar | 2nd instar | 3rd instar | Total |
|---|---|---|---|---|
| **Damaged area (from–to) (cm²)** | 0.2–0.28 | 0.8–1.2 | 8.1–13.9 | 9.1–15.3 |
| **Mean damaged area (cm²)** | 0.24 | 1.0 | 11.0 | 12.2 |
| **Number of frass pellets (from–to)** | 44–60 | 140–200 | 350–465 | 534–725 |
| **Mean number of frass pellets** | 52 | 170 | 413 | 635 |
| **Dimensions of frass pellets (mm)** | 0.23×0.13 | 0.40×0.23 | 0.72×0.41 | - |
| **Volume of one frass pellet (mm³)** | 0.00305 | 0.01661 | 0.09501 | - |
| **Volume of frass pellets (from–to) (mm³)** | 0.1342–0.1830 | 2.3254–3.3220 | 33.2535–44.1796 | 35.7131–44.1796 |
| **Mean volume of frass pellets (mm³)** | 0.1586 | 2.8237 | 39.2391 | 42.2214 |
| **Volume of frass pellets /cm² (mm³)** | 0.7 | 2.8 | 3.6 | 3.4 |

the moths die. In nature, the development is, thus, slower than in the laboratory.

Caterpillars damage on average 12.2 $cm^2$ leaves of *P. tremula*. Thus, caterpillars of the 1st instar damage on average 0.24 $cm^2$ (2.0%), caterpillars of the 2nd instar 1.0 $cm^2$ (8.2%) and caterpillars of the 3rd instar 11.0 $cm^2$ (90.2%) (Tab. VII). In the course of feeding, caterpillars produce numerous frass pellets, which soon grow black. The frass pellets are rounded-cylindrical, in the 1/4 to 1/5 of their length slightly transversally necked. Mean number, dimensions and volumes of frass pellets defecated by caterpillars of particular instars are given in Tab. VII.

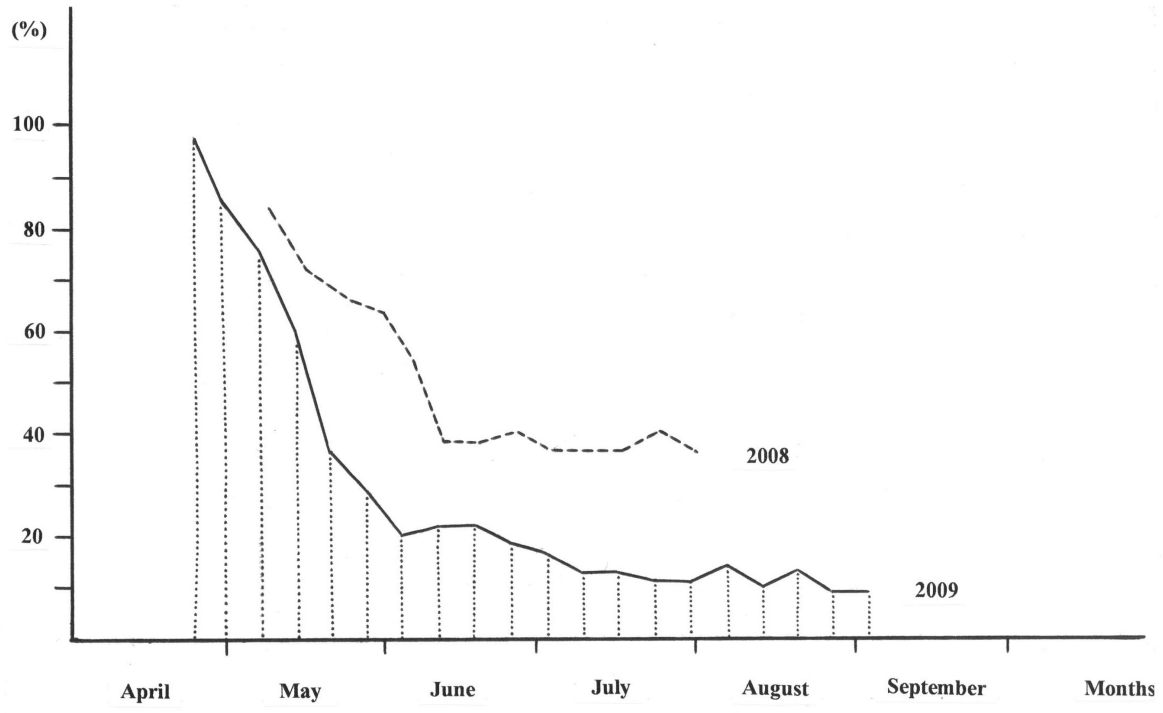
In the area of our study, caterpillars rolled up leaves of an area of 7 to 25 (on average 15.5) $cm^2$. Leaves of average size provided sufficient food to the caterpillars. In the only leaf, about 70% caterpillars developed there. About 30% caterpillars completed their feeding on other leaves in a roll or in newly produced leafrolls. No information is noted in literature on the creation of leafrolls (or folded leaves) by caterpillars of the 3rd instar.

## Regulation factors

Through the effect of mortality factors the population density of *A. populella* considerably fluctuates. Wintering eggs are subject to unfavourable weather for a long time (from the beginning of June until 20 April). The majority of caterpillars (less frequently pupae) is subject to insect parasitoids and predators, birds etc. In 2008 and 2009, some 37 and 12% caterpillars, respectively reached the stage of imagoes (Fig. 8). In 2008, insect parasitoids accounted for 10% of this mortality, predators 50% and constitution (natural mortality) 3%. In 2009, insect parasitoids accounted for 7% fall of the population density, insect predators 49%, birds 24% and constitution 7%. A fact that eggs are produced and grown up in ovaries of females only during the first two weeks the moth life can play a certain regulation role. Therefore, some imagoes are subject to predators (mainly birds) before reaching their sex maturity.

From leafrolls of *A. populella*, 119 imagoes of insect parasitoids were reared. Out of this number, 54 individuals (45.4%) ranked among Braconidae, 32 individuals (26.9%) among Ichneumonidae, 25 individuals (21.0%) among Tachinidae and 8 individuals (6.7%) among Chalcidoidea. During the development of the *A. populella* caterpillars, species of Heteroptera, Neuroptera, Coccinellidae and Syrphidae occurred often in the leafrolls. Aranae, *Lasius niger* (L.) (Formicidae), *Dorytomus longimanus* (F.), sporadically *D. tortrix* (L.) (Curculionidae), *Crepidodera aurea* (Geoffr.) (Alticidae), *Ectobius sylvestris* (Poda) (Blattidae), Dermaptera, Chilopoda etc. hid very often in leafrolls.

HASSANEIN (1978, 1979a, b) studied in detail parasitization of *A. populella* in Bavaria. From the beginning of June to the end of July, parasitization increased there from 8.8 to 59.0%. In the spectrum of parasitoids from the order of Hymenoptera, 14 species were primary parasitoids (10 species out of caterpillars and 4 species out of pupae) and 6 species of secondary parasitoids. *Dolichogenidea laevigata* (Ratz.), *Apanteles xanthostigma* (Hal.), *Lissogaster hospes* (Marsh.) (Braconidae) and *Copidosoma* sp. (Encyrtidae) were dominant species (total dominance 90.7%). All three species of Braconidae are solitary endopa-




8: *The percentage proportion of leafrolls with the undisturbed development of A. populella in 2008 and 2009*

rasitoids of larvae and *Copidosoma* sp. is a gregarious endoparasitoid of larvae. A family Tachinidae did not occur among parasitoids.

### Harmfulness

In the CR, *A. populella* developed most frequently on *P. tremula*, namely in open forests, at forest edges, cleared boundary lines, along roads and on old clear-felled areas. It attacks mainly tree species of lower age classes. *A. populella* creates leafrolls at the very beginning of the growing season. Its caterpillars feed in spring. Damaged leaves begin to die at the beginning of summer. Under conditions of gradation, the assimilatory area of leaves and thus also the increment of trees is considerably reduced by the creation of leafrolls and feeding. Consequently, the species is rightly considered to be a forest pest.

In the monitored region, the mean area of leaves in rolls was a little larger (about 15.5 $cm^2$) than the mean damaged area (about 12.2 $cm^2$). About ¾ caterpillars damaged only one leaf there. About ¼ caterpillars developed in two- to five-leaf rolls created usually by smaller leaves. Most of these caterpillars (including un-grown caterpillars, which leaved eaten out single-leaf rolls) damaged more than one leaf. Only small part of leaves was damaged and, thus, trees tolerated damage without larger impacts.


## SUMMARY

The paper deals with the occurrence, development and harmfulness of *Anacampsis populella* (Clerck) (Gelechiidae) on *Populus tremula* L. The pest was studied in 5 to 15-year tree species at Forest District Bílovice nad Svitavou (near Brno) in 2008 and 2009. Caterpillars created there leafrolls of a mean length of 37.3 mm and width 5.5 mm. In 80% rolls, only one leaf was rolled up, in 20% two to five leaves. All leaves with caterpillars were rolled up towards the abaxial face except for part of peripheral leaves. Caterpillars occurred from 20 April to 25 June. They developed through three instars only and damaged leaves on an area of about 12.2 $cm^2$. Grown up caterpillars pupated mostly in leafrolls. Pupae occurred from 10 May to 25 July and imagoes from 20 May to the beginning of August. Some 63 to 88% population of caterpillars and pupae succumbed to natural enemies (particularly insect parasitoids, insect predators and birds). Eggs overwinter. The pest development is univoltine.



## SOUHRN

Biologie *Anacampsis populella* (Clerck) (Lepidoptera, Gelechiidae)

Práce pojednává o výskytu, vývoji a škodlivosti *Anacampsis populella* (Clerck) (Gelechiidae) na *Populus tremula* L. Škůdce byl studován v letech 2008 a 2009 na 5 až patnáctiletých dřevinách na polesí Bílovice n. Svitavou (poblíž města Brna). Housenky tam zhotovovaly listové smotky o průměrné délce 37,3 mm a šířce 5,5 mm. V 80 % smotků byl stočen jeden list, ve 20 % dva až pět listů. Na abaxiální (rubovou) stranu byly stočeny všechny listy s housenkami, ale jen část obvodových listů. Housenky se vyskytovaly od 20. dubna do 25. června. Vyvíjely se pouze přes tři instary a poškodily listy na ploše kolem 12,2 $cm^2$. Dorostlé housenky se kuklily většinou v listových smotcích. Kukly se vyskytovaly od 10. května do 25. července a dospělci od 20. května do začátku srpna. Přirozeným nepřátelům (zejména hmyzím parazitoidům, hmyzím predátorům a ptákům) podlehlo 63 až 88 % populace housenek a kukel. Přezimují vajíčka. Vývoj je univoltinní.


*Anacampsis* (= *Tachyptilia*) *populella* (Clerck), Gelechiidae, výskyt, vývoj, škodlivost

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