Infestation of Poppy Cultures with the Poppy Stem Gall Wasp (*Timaspis papaveris*) *Cynipidae: Hymenoptera*

Josef ŠEDIVÝ[1] and Pavel CIHLAŘ[2]

[1]Department of Entomology, Division of Phytomedicine, Research Institute of Crop Production, Prague-Ruzyně, Czech Republic; [2]Faculty of Agrobiology, Food and Natural Resources, Czech University of Agriculte in Prague, Prague, Czech Republic

Abstract

Šedivý J., Cihlař P. (2005): **Infestation of poppy cultures with the poppy stem gall wasp** (*Timaspis papaveris*) *Cynipidae: Hymenoptera*. Plant Protect. Sci., **41**: 73–79.

The mortality of pupae in stems lying on the ground during hibernation was 51.7% in 2003. The emergence of adults in 2003 and 2004 was monitored from late April to early July by photoeclectors placed on fields that grew poppy the previous year. Most adult gall wasps emerged in April to early May 2004. The occurrence of females ovipositing on poppy stems varied from April to July and the degree of damage to the plants increased. Most frequently the females oviposited in the first stem internodes. The infestation of poppy cultures with the gall wasps was almost uniform, the number of infested plants increasing still in June. In late June, only seven out of 600 plants were not infested. Green sticks covered with non-coagulating glue and placed in the poppy field, indicated the stem heights frequented by ovipositing females. The gall wasp larvae were parasitised by *Trichomalus bracteatus* Walker and *Pseudotorymus papaveris* Ruschka, with *T. bracteatus* predominating. Most frequently, gall wasp larvae inside the seventh internode were parasitised by this species.

Keywords: *Timaspis papaveris* Kiefer; poppy culture; damage; mortality; crop infestation; parasitisation

The poppy stem gall wasp (*Timaspis papaveris* Kieffer) is an oligophagous insect pest developing in the stems of several poppy species. Damage by this pest to poppy cultures in Europe is known from Hungary, Germany, Poland, Austria, Slovakia, Ukraine and the former Yugoslavia. In the Czech Republic it is known since 1953. Since the 1960s, at which time poppy was only sporadically grown in small fields, no noxious occurrence was observed in poppy cultures. However, its occurrence was repeatedly registered on wild poppy (*Papaver rhoeas* L.). Increased cultivation of poppy for culinary and pharmaceutical use at the beginning of this century created favourable conditions for the occurrence of the gall wasp, and its noxious occurrence was observed in southern Moravia and central Bohemia already in 2001. The surprising increase of gall wasp populations in poppy cultures is ascribed to populations having developed in the preceding years on wild poppies and migrated to poppy fields after hibernation.

Feeding of the yellow larvae of the gall wasp in the vascular tissues damages the poppy plants. The damaged parts of the tissues turn brown and die off, thus preventing the supply of water to those parts of the plants above the damaged parts. During the growing season, the vascular tissues are damaged all along the length of the stems, most frequently in the neighbourhood of the leaf origins. Equally often the basal parts of stems are damaged, the

Supported by the Ministry of Agriculture of the Czech Republic, Project No. QF 3173.

symptoms of which are long purplish blotches where the tissues are dying. In the ripening period of the poppy plants, these blotches turn brown and become prematurely dry in years of dry weather conditions. Miller (1956) states that a heavy infestation of poppy plants causes them to turn yellow or white and their capsules to dry prematurely. Mühle and Kuhfuss (1956) and Schmidt (1956) state that damage by larvae to the stems facilitates their infection with the fungus *Helmintosporium papaveris* Hennig, which indirectly contributes to the damage done by the gall wasp.

The aim of the present paper was to elaborate ways of targeted control measures based on monitoring the emergence and migration of the gall wasps to poppy fields. The study included examination of infestation of the poppy cultures with the gall wasp and the degree of infestation of individual poppy plants. Attention was also paid to the mortality of the gall wasp pupae after hibernation, and the parasitisation of larvae in the course of the growing season of poppy plants.

MATERIAL AND METHODS

The observations and experiments were done in fields of the variety Opál in 2003 and 2004 at Dřetovice (district of Kladno, central Bohemia). In 2003 the field was sown on 20 March, it germinated on 20 April; in 2004, on 19 March and 3 April, respectively.

The mortality among overwintered pupae was evaluated on 20 March 2003 on a poppy field grown and harvested in the previous year. One hundred poppy stems were collected on the soil or after having been partly or wholly covered with soil in a field of winter wheat that had received a reduced soil processing. Yellow pupae in their thin cocoons were considered to be alive, those brown and wrinkled to be dead.

In both years, the emergence of the gall wasps was studied in fields sown with winter wheat after last years crops of poppy. The number of emerged adult gall wasps was assessed using five bottomless photoeclectors placed 25 m apart from the edge in the direction towards the middle of the field. The area of each box was 0.24 m^2. The top of the photoeclector was covered with a transparent plastic foil the underside of which was coated with a layer of non-coagulating glue "Chemtop". In 2003, emergence was determined between 9 June and 9 July, in 2004 from 19 April to 3 July.

The degree of infestation of poppy stems with gall wasps was evaluated before the blossom period, on 11 and 22 June of 2003, in a poppy field of 35 ha. On each of the dates, spots of oviposition

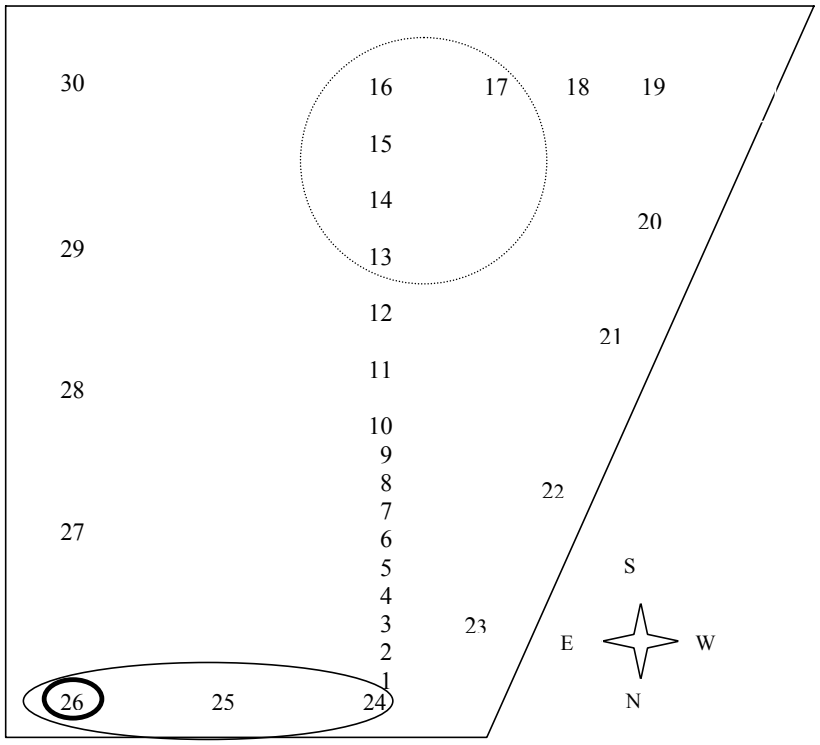

Figure 1. Distribution of observation points over the experimental field

were assessed on 300 poppy plants at observation points, of which points 1–10 were spaced 10 m apart, points 11–16 50 m apart, and the remaining ones 100 m apart (Figure 1). On each of the two dates, 10 plants were examined at each observation point. On the first date, the punctures made by ovipositing females were counted from the stem base up to the height of internode 3; on the second date up to internode 4.

The occurrence of gall wasps in the poppy stand was determined by sticks l m in length and 8 mm thick, painted green and smeared with non-coagulating glue. The sticks were supposed to simulate poppy stems and incidentally attract gall wasp females ready to oviposit. In both years, the sticks were irregularly distributed, 20–50 m apart and on that side of the field adjacent to last year's poppy crop. On the sticks the number of adult gall wasps captured on the glue up to the height of the fourth internode was counted.

At harvest time, the degree of parasitisation of gall wasp larvae was evaluated on 50 plants by the numbers of exit holes found all along the main stems.

Data on the different numbers of oviposition punctures and parasitoid exit holes in different internodes were subjected to analysis of variance (ANOVA). The statistical difference between different internodes was considered at $P = 0.05$.

RESULTS

In 2003, the mortality among overwintered pupae was high. Of the 228 pupae found in 100 poppy stems, 118 were dead, i.e. 51.7%. The largest numbers of live pupae were found in both the basal stem parts with firm non-decomposed tissues and in stems that had been partly or wholly covered with soil down to a depth of 50–80 mm.

In both years the photoeclectors used to study the emergence of adults were placed too late in the fields. In 2003, the study started in the first decade of June and ended in the first decade of July. The observations only covered the declining part of the period of emergence. The largest numbers of adults were found in the boxes at the beginning of the observations, with only 12 adults in five boxes. In the first decade of July, only two adults were caught in the boxes. Over the whole period, 29 adult gall wasps were trapped, for an average of 5.8 adults per box (Table 1). In 2004, emergence was observed from the second decade of April on. Again, the observation had started too late, with a more numerous emergence being recorded from its very beginning and lasting until the end of the first decade of May. Over that period, 53 adults were trapped in five boxes, averaging 10.6 adults per box. In June, the number of emerged adults dropped considerably and ended in early July. Over that period, only 13 adults were trapped, averaging 2.6 per trap; although no adults were found in some of them after the beginning of June. The total numbers of adults emerged over the emergence period was much the same, varying between 11 and 15 adults per box. In all, 66 adults were trapped, averaging 13.2 per box. The last emerged adults in the boxes were recorded on 10 July (Table 1). In 2004 numerous adults emerged already on 19 April and continued emerging until 12 May. The last adults were found in the boxes on 3 July (Table 2). The course of emergence was not uniform in the two years of observation. There was no difference in emergence of adult gall wasps between the edge of the stands and a distance of 130 m from the edge. Males emerged during May and the first decade of June.

In 2003, the degree of infestation of individual poppy plants by the gall wasps was evaluated on

Table 1. Numbers of emerged adult gall wasps caught in photoeclectors in 2003

Box No.	Checked on				Total
	9.6.	16.6.	29.6.	9.7.	
1	2	1			3
2	3		2		5
3	1	2			3
4	2	1	4	1	8
5	4	4	1	1	10
Total	12	8	7	2	29

Table 2. Numbers of emerged adult gall wasps caught in photoeclectors in 2004

Box No.	Checked on						Total
	19.4.	28.4.	12.5.	6.6.	24.6.	3.7.	
1	3	1	3		3	2	12
2	3	4	5		2		14
3	5	2	5	2	1		15
4	5	2	4	3			14
5	4	4	3				11
Total	20	13	20	5	6	2	66

the lower internodes of stalks. Of the 300 plants examined on the first date, nine plants were not infested, and only seven on the second date. A weak infestation was found on the southern edge of the field close to a windbreak, at observation points 13 to 17 where the mean numbers of punctures per 10 plants varied from 3.8 to 5.3 (Figure 2). The highest infestation was on the NW side of the stand, at observation points 23–26 where the average numbers of punctures on 10 plants varied between 55.8 and 199.2 per plant. In 20 out of 40 plants, the fourth and partly even the third internode were not damaged by oviposition. At point 26, the maximum numbers of punctures per plant were 61 on the first date and 66 on the second. The number of punctures caused by oviposition on individual internodes, increasing during June 2003, also signalises a slight increase in their number on internodes 1 and 2, and a two- to fourfold increase on internode 3 and higher (Figure 2). The number of punctures on internode 1 was significantly higher than that on internodes 2–4 and on internodes 2–3 (P = 0.05) (Figure 3, Table 5).

In 2003, the occurrence of gall wasps as determined by trapping on green sticks was studied only from 6 June to 29 June. The larger numbers were found in the first half of June and it dropped distinctly in late June. The numbers trapped on different sticks were considerably different, varying between six and nine on five sticks, and between 10 and 23 per stick on the remaining ones. In all, 107 gall wasps were captured on the green sticks in June. In 2004, their occurrence was studied from 13 June to 24 July. A heavier occurrence was ascertained in June, the total trapped being 44 gall wasps. In July, 23 wasps were caught. Their number varied from one to six on each of eight green sticks and 10 and 14 on the remaining two sticks (Tables 3 and 4). Twice the number of gall wasps (107 individuals) was caught during June

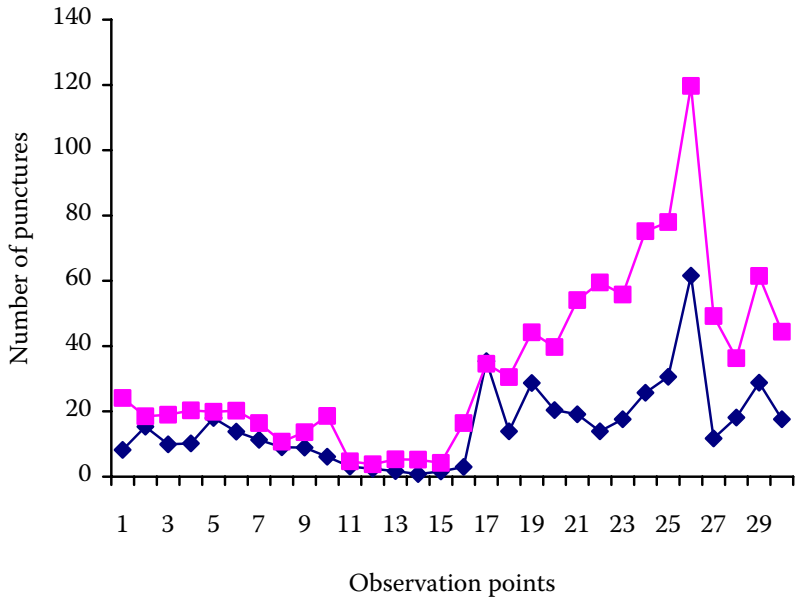

Figure 2. Number of oviposition punctures per poppy plant

2003 than between the beginning of June and the last decade of July in 2004 (56 individuals). In both years, male gall wasps were sporadically present on the green sticks until mid-June; seven males were captured in 2003, and four in 2004. The numbers of females captured on the sticks indiated their ovipositing on individual internodes. In both years, their numbers found on the sticks in June agreed with those ovipositing on internodes 1 and 2, while the captures in late June and in July signalised that more females were ovipositing on higher internodes of poppy stalks (Tables 3 and 4).

Two species of *Chalcidoidea* (*Hymenoptera*) were ascertained as parasitoids of the gall wasp. *Trichomalus bracteatus* Walker (*Pteromalidae*) was the dominant species, *Pseudotorymus papaveris* Ruschka (*Torymidae*) was subdominant. The adults of the dominant species emerge during June, but so far it is unknown how they hibernate. The exit holes found on poppy stalks indicate that the females more frequently parasitise gall wasp larvae in the upper internodes. The lowest numbers of exit holes of the parasitoid (at most two) were found on internode 1, the highest on internode 7 (at most 15). Their number found on internode 7

Table 3. Numbers of gall wasps caught on glued sticks in 2003

Stick No.	Checked on				Total
	6.6.	16.6.	23.6.	29.6.	
1	3	1		2	6
2	3	3	5		11
3	2	4	6		12
4	4	2	3		9
5	4	3	3		10
6	3	3	1	1	8
7	1	3	1	4	9
8	8	4	1		13
9	10	11		2	23
10	1	2	2	1	6
Total	39	36	22	10	107

Table 4. Numbers of gall wasps caught on glued stricks in 2004

Stick No.	Checked on				Total
	13.6.	21.6.	3.7.	24.7.	
1	1	9	2	2	14
2		2	2		4
3		1			1
4	1		2		3
5		1	1		2
6	1	2	2	1	6
7	2	4		4	10
8	1	2	1		4
9	2	1	2	2	7
10	3	1	1	1	5
Total	11	23	13	10	56

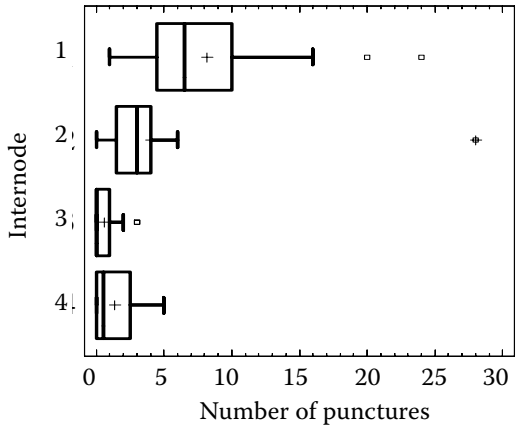

Figure 3. Number of oviposition punctures on different internodes

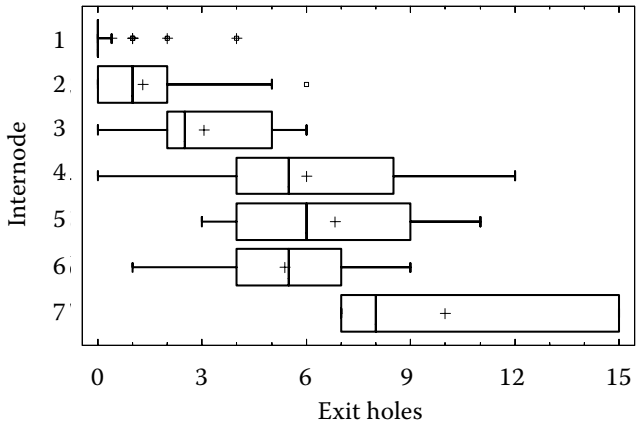

Figure 4. Distribution of exit holes of *Trichomalus bracteatus* over different internodes

Table 5. Statistical evaluation of the numbers of oviposition punctures on internodes
Method: 95.0 percent LSD

Internodium	Count	Mean	Homogenous groups	
3	16	0.625	X	
4	16	1.375	XX	
2	20	4.05	X	
1	20	8.15	X	
Contrast			Difference	+/– Limits

Table 6. Statistical evaluation of the distribution of parasitoid exit holes on internodes
Method: 95.0 percent LSD

Internodium	Count	Mean	Homogenous groups	
1	20	0.4	X	
2	20	1.3	X	
3	20	3.05	X	
6	8	5.375	X	
4	20	6.0	X	
5	17	6.823135	X	
7	3	10.0	X	
Contrast			Difference	+/– Limits

is significantly higher than those found on internodes 1 to 6 ($P = 0.05$). The number of exit holes found on internodes 4 to 6 was significantly higher than their numbers on internodes 1 to 3, and their numbers on internode 3 was significantly higher than on internodes 1, 2 and 6 ($P = 0.05$) (Figure 4, Table 6). The highest number of the parasitoid *T. bracteatus,* i.e. three to five adults per internode, was caught on the green sticks on 6 June.

DISCUSSION

Wild species of poppy, e.g. *Papaver rhoeas,* on which the gall wasps develop, are important sources of this pest on cultivated poppy. This is evident from the noxious occurrence of this gall wasp already during the first years after the area of poppy cultures was increased in the Czech Republic. In 2003, over 50% of gall wasp larvae died during

hibernation although they had pupated in the firm tissues of the basal part of poppy plants and may then have been covered with soil. Presumably, even the gall wasp populations developing on wild poppy species are reduced in the same way.

Observations on the periods of emergence and migration of adult gall wasps in 2003 and 2004 indicated that they last from April to July. In 2004, increased numbers of emerged adults were found from the last decade of April to the first decade of May. In that year, the beginning of the growing season was unfavourable for oviposition. Fields of poppy were sown as late as April so that the suitable phenophase of growth in length, required for oviposition, was not yet available when the female gall wasps migrated from either wild or cultivated poppies. The ovipositing females prefer the basal internodes of poppy stems. The infestation of poppy cultures on large areas was found to be almost uniform. Evaluations of the degrees of infestation, carried out on two dates of June 2003, showed that the level of infestation still increased in that month. A higher degree of infestation was observed on the sides of fields facing the prevailing wind direction. Focal weak infestations are irregularly distributed over the stands. Experimental results show that green sticks coated with non-coagulating glue can be used to determine at which heights the ovipositing gall wasp females stay in the stand. The captures of females on the sticks may make it possible to concentrate pesticide sprays on those parts of the stand where most of the females are found. The parasitoid *Trichomalus bracteatus* significantly reduces the occurrence of gall wasp larvae in the upper internodes. The period at which females of this parasitoid search for gall wasp larvae can also be determined by means of the green stick method described.

References

Miller F. (1956): Zemědělská entomologie. ČSAV Publishing House, Prague.

Mühle E., Kuhfuss K.-H. (1956): Neuartige und ernste Schäden durch Mohnstengelgallwespe. Nachrichtenblatt des Deutschen Pflanzenschutzdiensts, Berlin.

Schmidt M. (1956): Landwirtschaftlicher Pflanzenschutz. Halle.

Received for publication March 8, 2005
Accepted after corrections May 20, 2005

Abstrakt

Šedivý J., Cihlař P. (2005): **Osídlení porostu máku žlabatkou stonkovou** (*Timaspis papaveris*) *Cynipidae: Hymenoptera*. Plant Protect. Sci., **41**: 73–79.

Žlabatka stonková (*Timaspis papaveris*) je z území České republiky jako škůdce máku známá od roku 1953. Kromě máku setého se vyvíjí také na plevelných druzích máku. Po rozšíření plochy pěstování máku na počátku tohoto století byly zjištěny škodlivé výskyty žlabatky stonkové v suchých oblastech Čech a Moravy. V letech 2003 a 2004 bylo zjištěno, že během přezimování může uhynout více než 50 % larev a kukel. Líhnutí dospělců bylo pozorováno v období od poslední dekády dubna do poloviny července. Stupeň napadení porostů byl vysoký, z 300 rostlin nebylo napadeno pouze 7 až 9 rostlin. Nejvíce napadené rostliny byly zjištěny na návětrné straně porostů máku. Slabé výskyty žlabatky byly ohniskovité, nepravidelně rozmístěné v porostu. Při kladení vajíček dávají samice přednost bazálním internodiím stonků. Místa výskytu žlabatky v porostu je možné zjišťovat na zelených holích natřených netuhnoucím lepem. Dominantním parazitoidem larev byl druh *Trichomalus bracteatus*. Vysoká parazitace larev byla zjištěna v horních internodiích lodyh.

Klíčová slova: **ž**labatka stonková; mák setý; škodlivost; mortalita; osídelní porostu; parazitace

Corresponding author:

Doc. RNDr. Josef Šedivý, DrSc., Výzkumný ústav rostlinné výroby, odbor rostlinolékařství, oddělení entomologie, 161 06 Praha 6-Ruzyně, Česká republika
tel.: + 420 233 022 111, fax: + 420 233 115 592, e-mail: sedivy@vurv.cz