RESEARCHES ON BIOLOGY, ECOLOGY AND CONTROL OF SADDLE GALL MIDGE (*HAPLODIPLOSIS MARGINATA* VON ROSER) IN ROMANIA

Constantin Popov[1], Lucica Petcu[2] and Alexandru Bărbulescu[1]

ABSTRACT

***Haplodiplosis marginata* von Roser is a recently recorded wheat pest in Romania (1970) and occurs on a relatively restricted area (about 250,000 ha) in the centre of the Romanian Plain. Infestation by more than 25-30 larvae per plant determines plant height reduction by 34%, the number of kernels per ear by 63%, as well as their weight by 64%. Climatic conditions favourizing numerical explosions are firstly determined by rainfall during April 15 – June 15 (over 200 l/sq.m evenly distributed). Years with reduced rainfall during this time (sometimes below 20 l/sq.m) induced extension of soil larval stage by 1 – 2 years. The soil larval biological supply in plots heavily infested recorded 2.000 – 6.000 larvae/sq.m in favourable years and only 100 – 350 in unfavourable ones. Among the control measures crop rotation is an efficient method when heavily infested plots are avoided by wheat sowing. The economic damage threshold is considered as being 30 larvae/sq.m. One to three treatments are recommended, depending upon dynamics of adult emergence. Synthetic pyrethroids showed the best efficacy (Fastac 10 EC, Decis 2.5 EC, Karate 2.5 EC and Sumi Alpha 2.5 EC).**

Key words: control, ecological factors, *Haplodiplosis marginata*, life-cycle, sadlle gall midge, wheat

INTRODUCTION

The saddle gall midge (*Haplodiplosis marginata*) is a major pest due to high damages caused to straw cereals and particularly wheat, in nearly all European countries (Baier, 1964; Popov, 1991; Petcu et al., 1991; Popov et al., 1994).

References on this species have appeared still in first half on this century, however without revealing the harmful features acquired by its massive reproduction. Since 1950 literature on this pest has rapidly enriched due to the apearance of new focuses and particularly to the high damage level of the species (Bjegović, 1967; Faber, 1959; Csörgö et al., 1967; Hulshoff, 1968; Thygensen, 1970; De Clercq and D'Herde, 1966; Baniță et al., 1973).

Till now investigation have been focused to the morphology of this insect and its mode of causing damages, outlining its pecualiarities as a gall midge and the ecological factors favourizing outbreaks of dense populations, able to severely diminish harvests (Baier, 1964; Faber, 1959; Heddergott, 1970; De Clercq and D'Herde, 1972; Popov, 1974; Petcu and Popov, 1978; Petcu et al., 1986, 1991; Genov, 1977; Skuhravy, 1982). Yet, evolution of this pest has many unknown sides, threfore losses maintain at high levels, and the control opportunities are still reduced. We present in this paper our results obtained in the main pest damaging area in Romania, where the elements of its life-cycle and factors influencing it have been investigated, as well as the culture possibilities to confine the pest populations by crop and soil management and chemical control.

MATERIALS AND METHODS

Spreading of *Haplodiplosis marginata* has been searched by collecting samples allover the country and plants/plot have been examined. The number of plants bearing galls (attack frequency) and the number of galls per plant (attack intensity) have been recorded. In the damaging area at Bârla and Mozăceni, under heavy infestation, all stages of this species have been studied: pupa, adult, egg-batches and larva, in all growth and diapause phases, as well as the factors conditioning their evolution. Techniques differed in dependence on the searched elements. Diapause and pupation have been noted by periodical soil sampling within the 0-30 soil layer; the adults have been captured by entomological glued traps (yellow 25 x 25 cm plates set 80 cm above the soil), liquid traps (plastic vessels 25 x 25 cm with detergent-water solution) and net sweepings (nets of 40 cm in diameter) with 30 traps or net sweepings evenly distributed in a plot. Pest-host relationships have been examined by measuring plant biological parameters in de-

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pendence on the attack intensity as expressed by the number of larvae/plant.

Influence of crop rotation was studied in production plots by the attack level in wheat, as depending on the preceding crop. Influence of species and cultivars of straw cereals was searched in an assortment sown on surfaces of 1 ha each, in plots with high larval soil infestation.

Chemical control was applied to plots of 100 sq.m as season sprayings and 500 sq.m for insecticides applied to soil. The amount of solution was 250 l/ha. Six replications randomized in Latin rectangle were used. Efficacy of sprayings was rated by records on the attack frequency of variants and its reference to the frequency reported in the untreated check. For soil applications the number of dead larvae was referred to the number of the analysed larvae. The results have been statistically treated.

RESULTS AND DISCUSSIONS

The species *Haplodiplosis marginata* was first recorded in Romania in 1969 at Corbu (District of Argeş). As shown in figure 1, at present this species is widely distributed in a number of districts in Muntenia, Western Plain and the Plain and Plateau of Transylvania. Its damaging area is more restricted, enclosing only the hilly zone of Muntenia, in the districts Argeş, Dâmboviţa, Teleorman, Olt and Giurgiu, affecting some 250,000 ha cropped with straw cereals. In this area the larval biological supply, as estimated in spring in wheat monoculture plots is sometimes extremely high, reaching even 6,400 larvae/sq.m (Table 1).

Table 1. Estimation of larval biological supply in the damaging area in periods of peak infestation (1982 – 1985) compared to periods with moderate attack (1990 – 1993)

Zone	Localities	Density, larvae/sq.m	
		1982 – 1985	1990 – 1993
Slobozia	Ştefan cel Mare	6400	346
	Mozăceni	6050	210
Teiu	Negraşi	3250	250
	Teiu	2820	188
Miroşi	Strâmbeni	2070	300
	Miroşi	1850	175
	Ungheni	1500	220
Izvoru	Recea	2010	150
	Popeşti	1680	230

Comparing these levels with the economic damage threshold of 30 larvae/sq.m, above which chemical control should be applied, the impact of this pest on wheat crop

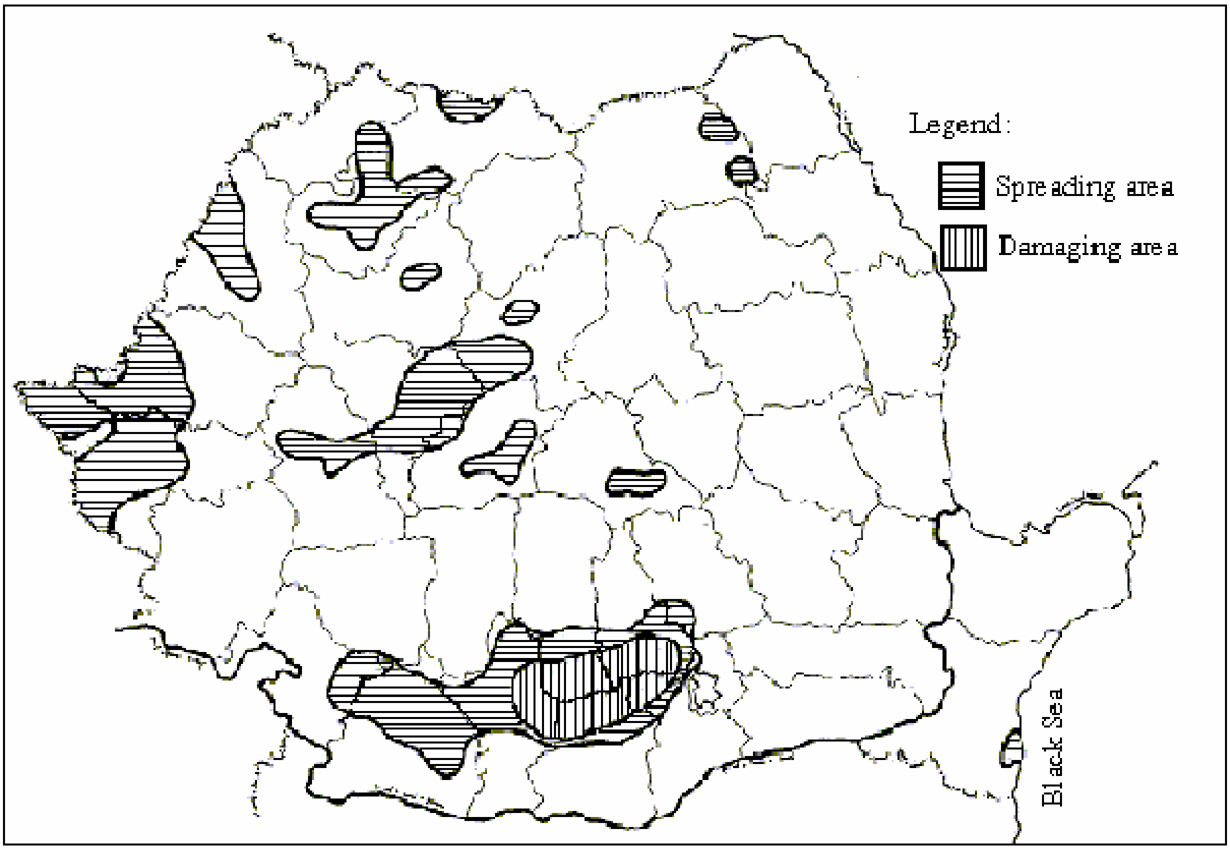

Figure 1. Distribution of *Haplodiplosis marginata* in Romania

sown in plots housing such larval biological supplies can be more accuratelly estimated. Likewise, generalization at high level can be assumed for diapausing larvae of this pest, nearly in all plots in the damaging area. This phenomen is mainly due to two factors: planting wheat after wheat and peculiarity of this pest to prolong diapause by one or more years, under unfavourable climate conditions.

Analysis of data from table 2 points out that the pest attack is greatly influenced by the preceding crop.

Table 2. Influence of preceding crop on the attack by the saddle gall midge in periods with various infestation levels

Crop	Heavy infestation	Moderate infestation
Wheat	65.8	38.4
Barley	43.5	12.4
Maize	11.1	1.3
Sunflower	10.5	1.1
Flax	8.3	0.8
Clower	7.6	0.1
Beans	6.5	0.2
Pea	3.4	0.3

When wheat follows wheat for one or several years, the larval supply accumulates unceasingly in soil and favours the development of ever more numerous populations, the attack increasing year after year. All the other crops, except straw cereals, are not hosts of this pest, and the attack recorded in wheat sown after other crops is principally a consequence of migration from the neighbouring plots. As also results from table 3, even among straw cereal species there are important differences, in the sense that wheat is by far more severely attacked than other species. It can be noted that, though in barley, two-rowed barley, rye or triticale the attack frequency does not largely differ from that occuring in wheat, however their attack intensity considerably diminishes.

Compared to an intensity of 18-22 larvae/plant in wheat, the other species recorded 3-fold more reduced levels. Analysis of an assortment of wheat cultivars did not reveal significant differences concerning their tolerance or resistance to the attack of this pest.

Table 3. Influence of straw cereal species and cultivars on the attack induced by the saddle gall midge (*Haplodiplosis marginata*) (multiannual average)

Crops		Attack level	
Species	Cultivar	I	II
Wheat	Fundulea 29	75.4	22.5
	Iulia	72.8	20.4
	Albota 69	66.4	18.7
	Lovrin 32	69.8	19.2
	Fundulea 133	73.5	22.0
	Dacia	69.2	20.4
Barley	Miraj	53.4	6.2
Two-rowed barley	Victoria	50.8	6.7
Rye	Petkus	39.5	4.2
Triticale	TF 2	30.2	5.1

I) Attack frequency (%)
II) Attack intensity (larvae/plant)

Likewise, the biological peculiarity of the pest to prolong its diapause under unfavourable climate conditions (excessive drought at adult emergence) makes its control even difficult. Table 4 shows that some 20% of larvae normally remain in soil, to prolong diapause; nevertheless, under unfavourable conditions this proportion can surpass 75%. This peculiarity should be considered when setting up crops, so that wheat lay out should not be made automatically, taking into account only the preceding crop, but also the level of soil larval biological supply.

*Table 4.*Annual dynamics of *H. marginata* adult formation as depending on the impact of climate conditions

Years	Characterization of methodological conditions from the pest standpoint	Larval population (%) with prolonged diapause	
		Limits	Mean
1982	very favourable	5.0 – 28.5	17.2
1984	very favourable	8.1 – 31.1	19.8
1985	relatively favourable	35.4 – 60.0	42.8
1990	moderately unfavourable	64.0 – 81.3	73.0
1991	unfavourable	79.3 – 94.0	89.1
1993	moderately favourable	28.4 – 40.0	33.5

Figures 2 and 3 show that pest evolution is greatly influenced by climate conditions. Thus, in 1984, particularly favourable to this pest by humidity induced by rainfall before May 1-st, pupation and adult emergence having rather and uniform rhythms, both processes concluded in about 35 days. One can estimate that abundant rainfall during April 15 – June 15 (some 200 1/sq.m) evenly distributed within this interval, was a very favourable factor, able to induce numerical explosion of the pest. These processes evolued in quite another way in 1991, a year with very unfavourable climate conditions extended over 55 days (Figure 3).

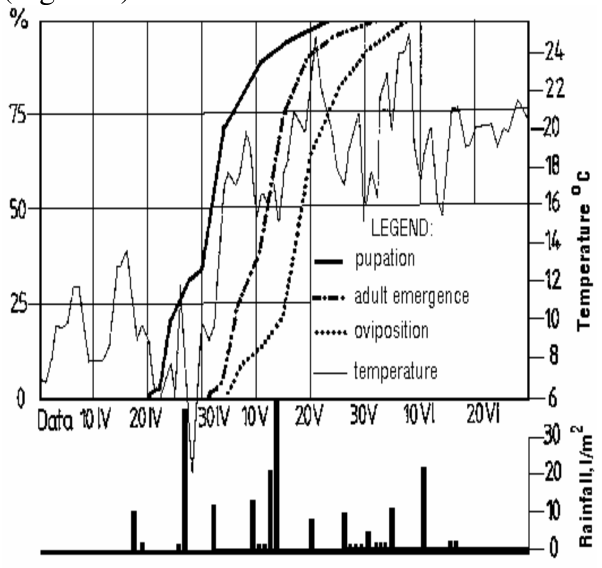

Figure 2. Life cycle of *Haplodiplosis marginata* under favourable climate conditions (1984)

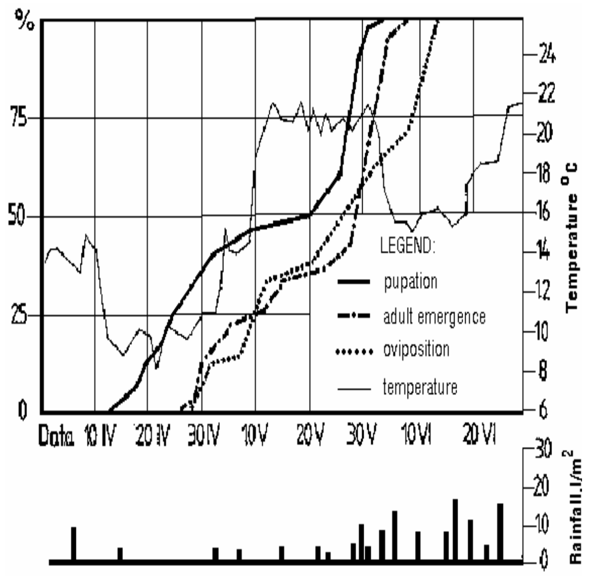

Figure 3. Life cycle of *Haplodiplosis marginata* under unfavourable climate conditions (1991)

These developments were slow, particularly in the early part of this interval, being determined by the excessive drought (reduced rainfall till May 25 failed to soften the crust of top soil layer). The two figures examined reveal that temperatures play no particular role in evolution of pupal and adult stages.

Figure 4 outlines that pupation dynamics is substantially influenced by spring soil tillage. In a 68 ha plot severely infested by larvae occuring in soil (6,050 larvae/sq.m) cropped both with wheat (20 ha) and maize (48 ha), sharp differences have been noted in pupation dynamics, which was slow in the plot sown with wheat and accelerated by soil tillage in maize crop.

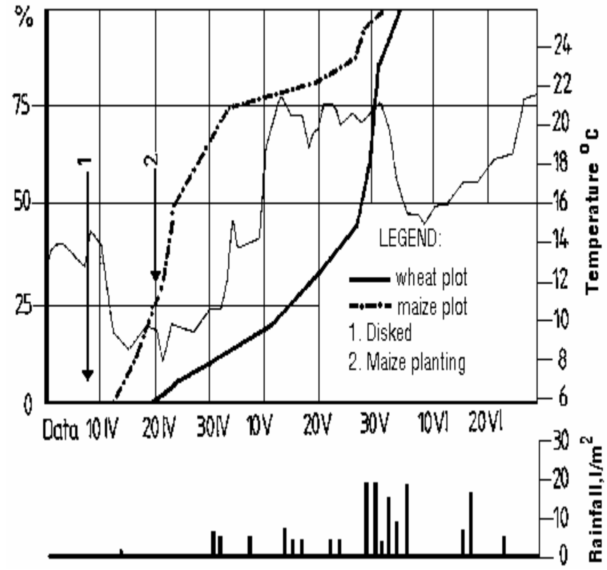

Figure 4. Pupation dynamics of *Haplodiplosis marginata* as depending on spring soil tillage

Analysis on influence of *H. marginata* attack upon the productive ability revealed the substantial decrease of the kernel number per ear and the weight of 1000 grains according as the number of larvae per plant becomes higher (Table 5).

Table 5. Influence of *H. marginata* attack on some biological parameters defining wheat production (multiannual average)

Attack limits (no. of larvae/plant)	Plant height		Grains in ear		Weight of 1000 grains	
	cm	%	no.	%	g	%
no attack	83	-	35	-	39	-
4 – 5	74	89	33	94	35	89
8 – 10	70	84	28	80	30	77
14 – 16	63	76	25	71	26	67
24 –26	60	72	19	54	20	51
more than 30	56	67	13	37	14	36

When infested by more than 30 larvae/plant, plant height represents merely 67% of that of the healthy plants, the number of grains per ear 37%, and the weight of 1000 grains only 36%. These data explain why some plots attaked to an extent of 100% by more than 20 larvae/plant have been compromised, the "harvest" of only some hundreds of kg/ha being unusable, being in fact constituted by mixture of shrivelled kernels and dead larvae still on straw at harvest, before getting down for diapause.

Under such conditions, prevention and control of this pest is acutely imposed in the infested area, otherwise its damaging potential correlated with the existing biological supply, in the presence of some favourable climate factors can cause significant losses.

As already shown, crop rotation combined with a suitable crop structure, allowing not only a rational sequence, but also the separation of wheat plots at 2-3 km far from plots identified as having high biological supply, can contribute to prevent occurence of heavy outbreaks. Likewise, chemical control is able to solve situations where preventive measures had not been applied.

In a first step, feasibility of pest control by soil treatments in plots containing high biological supplies has been tested. As it could be seen in table 6, both sprayings with various insecticides (Lorsban, Lindatox 20, Sinoratox 35) and dusting powders (PEB + Lindan, PEB + Oltitox or Oltitox + Lindan) or granulated insecticides (Sinoratox 5 G) were not satisfactory, their efficacy being usually below 50%. This metod, which can be used only in plots with severe infestation in spring before sowing other crops than wheat (maize, soybean etc), is inapplicable under monoculture conditions.

Table 6. Efficacy of chemical treatments applied to soil for controlling the saddle gall midge

Variants	Dose l or kg f.p./ha	Mortality
Sprays:		
Lorsban	5.0	52.6
Lindatox 20	5.0	30.4
Sinoratox R 35	4.0	28.7
Dusts:		
PEB + Oltitox	2.5 + 1	35.0
PEB + Lindan	1.5 + 1	32.3
Oltitox + Lindan	2.0 + 0.5	24.4
Granules:		
Sinoratox 5G	40.0	33.5
Untreated	-	2.0

Chemical control by seasonal spraying showed much better efficacy, however differences have been induced by the type of insecticide and the number of applications and their timing, this strongly depending on warning accuracy.

Investigations have revealed that control efficiency during cropping season relies on warning of their application upon the adults. Among the methods for recording the dynamics of the adult stage, liquid traps proved to be the best (water + detergent) with 47.3% efficacy. This is preferable (Table 7), due to its simplicity, to glued entomological traps, equally with good efficiency (38.2%).

Table 7. Efficacy of various methods for collecting *H. marginata* adults to develop treatment warnings (average 1990-1994)

Variants	*H. marginata* adults	
	Total number	%
Net-sweeping	26,883	14.5
Liquid traps	87,695	47.3
Entomological glued traps	70,822	38.2

As it results from table 8, the number of applications varies, as depending on the length of period of adult emergence. Thus, under pest favourable conditions the adult phasing emergence takes longer time, requiring 3 applications (1986).

Table 8. Influence of time of application and number of treatments to control saddle midge (*Haplodiplosis marginata*) under different climatic conditions

Number and time of application	Efficacy (%)		
(Fastac 10 EC - 0.1 l/ha)	1986	1992	1993
1 Treatment (I) 5.V/11.V/19.X	62.7	68.4	90.1
1 Treatment (II) 17.V/22.V/-/	58.2	64.9	90.1
1 Treatment (III) 3.V/-/-	35.4	-	-
2 Treatments (I+II)	83.4	92.5	-
2 Treatments (I+III)	70.5	-	-
2 Treatments (II+III)	71.6	-	-
3 Treatments (I+II+III)	90.5	-	-
Untreated (% attacked plants)	(90.2)	(48.3)	(18.8)
Climatic conditions for pest	very favourable	normal	unfavourable

It was found that efficacy of one treatment under these conditions, irrespective of its timing, is relatively slight (62.7% at first application, 58.2% at the second and only 35.4% at the third). Some better results have been obtained when applying 2 treatments (83.4%

for applications I + II; about 70% in treatments I + II and II + III). The best efficacy has been achieved with 3 applications (90.5%) in the case of a particularly high infestation, with 90.2% of plants being attacked. In the years less favourable to the pest, as shown by the untreated check (48.3% in 1992 and merely 18.8% in 1993), chemical intervention can consist in two applications, or even a single one. These data also confirm the significance of proper warning of treatments on the basis of the biological factor and under the particular conditions of every year, depending on soil pest density and thermal and humidity regime in April – June.

Tests with a pesticide assortment applied in the cropping season revealed good efficacies with a number of insecticides (Table 9).

Table 9. Efficacy of some insecticides in controlling the saddle gall midge (*Haplodiplosis marginata*) – three year average

Variants	Dose (g/ha)		Efficacy
	a.i.	f.p.	(%)
Carbetox 37.5 CE	1125	3000	87.5
Decis 2.5 EC	7.5	300	86.5
Fastac 10 EC	10	100	90.2
Karate 2.5 EC	7.5	300	86.4
Sinoratox 30 CE	1200	4000	84.0
Sinoratox 35	1225	3500	84.3
Sinoratox 40 CE	1200	3000	83.8
Sinoratox 50 CE	1250	2500	85.0
Sumi-Alpha 2.5 CE	7.5	300	83.7
Sumithion 50 CE	500	1000	83.5
Untreated (% attacked plants)	-	-	(58.3)

In general, synthetic pyrethroids (Fastac 10 EC, Decis 2.5 EC, Karate 2.5 EC, Sumi-Alpha 2.5 EC) induced mortalities superior to organo-phosphorus insecticides and particularly to various dimethoate formulations of Sinoratox type. At the same time, one could appreciate that the efficacy level of cropping season treatments against the saddle gall midge usually ranged between 80 and 90%. This is due to emergence distribution over a long period of time (25 – 35 days) and on the other hand to its short life-span (5 – 7 days), when egg laying occurs. Under these circumstances, treatments (1 – 3) can only partially cover the whole adult population, therefore proper treatment warning is particularly important.

CONCLUSIONS

The damaging area of the saddle gall midge (*H. marginata*) is relatively restricted to about 250,000 ha in the centre of the Romanian Plain. Its damage level, favoured by prolonged monoculture and excessive humidity during April 15 – June 15, can lead to significant harvest losses, and even crop compromise.

Chemical control is feasible with synthetic pyrethroids (Fastac 10 EC, Karate 2.5 EC, Decis 2.5 EC, Sumi-Alpha 2.5 EC). When properly warned, 1-3 treatments can be applied within the period of adult emergence.

REFERENCES

Baier, M., 1964. Zur Biologie und Gradologie des Stattelmücke *Haplodiplosis equestris* Wagner (*Diptera, Cecidomaidae*), Zeitscrift für Angewandte Entomologie, 53, 3: 217-273.

Baniță, E., Popov, C., Paulian, F., 1973. Cercetări privind zonele de dăunare ale speciei *Haplodiplosis equestris* Wagner – musculița viemelui roșu al paiului în România, Analele ICCPT, IX: 233-242.

Bjegović, P., 1967. Seldata musca - *Haplodiplosis equestris*. Zascita blija, 1967, 39-40: 3-11.

Csörgö, A., Pataki, E., Toth, J., 1967. A nyereggubacsszunyog (*Haplodiplosis equestris*) fellepese Magyarorozagon. Növenydelem, p. 4: 145-155.

DeClerq, R., D'Herde, J., 1966. Waarnemingen in verband met het optreden van de tarwestengelgalmug *Haplodiplosis equestris* Wagner in België. Mededelingen van de Rijksfaculteir Landbouwwetenschappen to Gent. 31, 3: 694-705.

DeClerq, R., D'Herde, J., 1792. Bijdrage tot de Studie van de Biologie de Werspreiding, de Pathogeniteit en de Bestrijding van de Tarwesstengel-galmung *Haplodiplosis marginata* (von Roses 1840, Rubsaamen 1911), 130.

Faber, W., 1959. Untersuchungen über ein katastrophales Auftreten der Sattelmücke (*Haplodiplosis equestris* Wagner) in Ostirol. Pflanzenschutzber, 23: 65-90.

Genov, G., 1977. Prognosis of the saddle gall midge, Rastitelna zașcita, 25, 10: 35-37.

Heddergott, H., 1970. Zur Biologie und Bekämpfung der Satelmücke (*Haplodiplosis equestris* Wagner), Höfchen-Briefe, 13: 93-128.

Hulshoff, A.J.A., 1968. Wearnemingen inzake de tarwestengelgalmug *Haplodiplosis equestris* Wagner in Nederland. Optrede en bestrijding van tarwestengelgalmug. Centrum voor Landbouwpublikaties en Landbouedocumentatie, Wageningen: 39-68.

Petcu, L., Popov, C., 1978. Cercetări privind biologia viermelui roșu al grâului (*Haplodiplosis marginata*) în România, Analele ICCPT, 43: 387-392.

Petcu, L., Popov, C., Bărbulescu, A., 1986. Aspecte privind biologia, ecologia și combaterea viermelui roșu al paiului (*Haplodiplosis marginata* von Roser), An. ICCPT, LIV: 363-374.

Petcu, L., Popov, C., Bărbulescu, A., Gheorghe, M., Cristea, G., 1991. Date noi privind combaterea chimică a viemelui roșu al paiului (*Haplodiplosis marginata*). Probl. Prot. Pl., 19,1: 205-211.

Popov, C., 1974. *Haplodiplosis marginata* – un dăunător important al cerealelor păioase din Europa. Probl. Prot. Pl., 2,3: 299-319.

Popov, C., 1991. Cotribuții la stadiul relațiilor producător principal – dăunător în agrobiocenozele de cereale păioase. Probl. Prot. Pl., 19,1: 31-37.

Popov, C., Bărbulescu, A., Petcu, L., Udrea, A., Baniță, E., Luca, E., Vilău, F., Bucurean, E., Luca, M., 1994. Realizări recente privind protecția culturilor de cereale păioase împotriva principalilor dăunători prin tratamente aplicate în vegetație, Proplant Călimănești, 48-59.

Skuhravy, V., 1982. The saddle gall midge (*Haplodiplosis marginata*), an important pest of wheat and barley in Czechoslovakia. Biolgia, 23,7: 133-135.

Thygensen, T., 1970. La mouche de la tige du froment (*Haplodiplosis equestris*) en Danmark, VII-e Congrès International de la Protection des Plantes, Paris, 25 sept. 1970, 158.

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Croped plant		Attack level	
Species	Cultivar	I	II
Wheat	Fundulea 29	75.4	22.5
	Iulia	72.8	20.4
	Albota 69	66.4	18.7
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2 Treatments (I+II)	83.4	92.5	-
2 Treatments (I+III)	70.5	-	-
2 Treatments (II+III)	71.6	-	-
3 Treatments (I+II+III)	90.5	-	-
Untreated (% attacked plants)	(90.2)	(48.3)	(18.8)
Climate conditions for pest	very favourable	normal	unfavourable

Table 9
Efficacy of some insecticides in controlling the saddle gal midge (*Haplodiplosis marginata*) - tree year average

Variant	Dose (kg/ha)		Efficacy
	a.i.	f.p.	(%)
Carbetox 37.5 CE	1125	3000	87.5
Decis 2.5 EC	7.5	300	86.5
Fastac 10 EC	10	100	90.2
Karate 2.5 EC	7.5	300	86.4
Sinoratox 30 CE	1200	4000	84.0
Sinoratox 35	1225	3500	84.3

Sinoratox 40 CE	1200	3000	83.8
Sinoratox 50 CE	1250	2500	85.0
Sumi-Alpha 2.5 CE	7.5	300	83.7
Sumithion 50 CE	500	1000	83.5
Untreated (% attacked plants)	-	-	(58.3)