JOURNAL OF PLANT PROTECTION RESEARCH
Vol. 41, No. 1 2001

THE STUDY ON DEVELOPMENT CYCLE OF *SITONA HUMERALIS* IN SOUTH-EASTERN POLAND

MARTA PISAREK

KRAKÓW AGRICULTURAL UNIVERSITY,
CHEMIZATION OF AGRICULTURAL PRODUCTION DEPARTMENT,
RZESZÓW, ĆWIKLIŃSKIEJ 2, 35-601 RZESZÓW, POLAND

Abstract. *Sitona humeralis* Steph. has one generation per year. Adults survive through the winter. Full life cycle from egg to adult lasts 54 days on average, including about 10 days for embryo, 30 days for larval and 14 days for pupa stage.

Key words: *Sitona humeralis* Steph., life cycle

I. INTRODUCTION

Sitona humeralis Steph. is closely connected with alfalfa (*Medicago sativa* (L.) crops. Despite its common occurrence all over Poland, neither its biology nor its ecology as yet, are sufficiently known. Therefore, it was advisable to research the developmental cycle of *S. humeralis*, which will subsequently serve for determining the periods for effective control of this pest.

II. MATERIAL AND METHODS

The research on developmental cycle of *S. humeralis* was conducted in field conditions and in laboratory. In 1992–1995, adult *Sitona* were collected on alfalfa crops, in Miłocin, in early April and transferred to laboratory for detailed observations on their biology. After confirming copulation, each pair was placed separately into a conical flask. Young sprouts of alfalfa were provided as food. To preserve freshness, alfalfa food was kept in slightly humid paper and lignin plugs or cones which were exchanged daily. The experiment was carried out in room temperature until all specimens died. Twenty pairs of *S. humeralis* were tested altogether.

In order to observe its embryonic development, eggs laid by females were put into Petri dishes. 25 eggs laid by females on the same day ware put into one dish. In total, 1,000 eggs were used in the experiment. Half of the Petri dishes were lined up with dry and the other half with humid filtration paper.

In the next part of the research on life cycle of *S. humeralis*, observations on their post-embryonic development were conducted. A portion of freshly hatched larvae were left on Petri dishes and observed in their first larval stage. Vases according to modified method of Kwong et al. (1980) were also prepared.

In June, when root nodules with *Rhizobium* bacteria developed on their roots, alfalfa plants were cut at the height of 5 cm and 20 freshly hatched larvae of *S. humeralis* per plant were applied around the neck. Altogether, 160 plants (10 per vase) were used in the experiment. After 7 days from larva application, the soil and alfalfa roots from 2 containers were tested regularly once per week, and the specimens were counted in their various stages of development.

The autumnal copulation, egg laying and egg development, as well as observations of larvae were observed on 100 of perfect young individuals, not fully coloured, with still soft cuticles. These specimens were collected each time from alfalfa in the third decade of July in 1993 and 1994 and in the second and third decade of September 1995 in Miłocin. *Sitona* beetles were transferred to laboratory and, with similar procedures as in spring, after observing the pairs of sexually mature individuals, they were put into Erlenmayer's flasks, and laid eggs were put into Petri dishes.

Some observations on the development cycle of *S. humeralis* were also conducted in field conditions. The time of commencement of spring and autumnal reproduction, as well as the periods of dying of old adult individuals and times of appearance of new adults were determined. The research on the intensity of occurrence of adult individuals was continued during the entire growing season and daily variations in numbers were observed. Daily fluctuations were analysed on the basis of catches over the period of 1993-1995, every 2 hours in the middle of: May, June, July, August, September and October. Sampling was carried out from 8 am to 8 pm.

To determine wintering location of this insect 20 samples of soil were taken from two different depths 0-5 cm and 5 to 10 cm on 17 and 26 November 1992 from plantation situated in Przybyszówka, and from its surroundings (nearby meadow and balk with a row of trees). The sample surface of dimensions 25 x 25 cm was defined by a wooden frame. In laboratory the samples were put into plastic containers and covered with mill gauze. Once the soil has dried, it was sieved through screens of 2, 4 and 10 mm in order to isolate insects.

III. RESULTS AND DISCUSSION

S. humeralis has one generation per year. Polish researchers studying *Curculionoidea* mention adult insect as a wintering stage of *S. humeralis* (Czerniakowski 1988; 1991). Besides, Burakowski et al. (1993) report that eggs may also survive through the winter in addition to perfect individuals, likewise in the development cycle of *Sitona lineatus* (L.) (Fedorko 1965) or *Sitona sulcifrons* (Thunb.) (Czerniakowski 1992a).

My experiments in field conditions, in 1994 only confirm autumn copulation of new generation of *S. humeralis* in the beginning of the 2nd decade of October. Copulation and egg laying in laboratory (1993-1994) were also limited to 8-10% of the studied population. It justifies the statement that *S. humeralis* overwinters in its perfect stage in the climate conditions of south-eastern Poland.

Aeschlimann (1979; 1980) reports that in southern Europe, where the average annual temperature is between 13-19°C, and total annual precipitation ranges from 200 to 600 mm,

egg laying begins as early as August. It allows for overwintering of all development stages of this insect.

There are no reports on wintering sites of *S. humeralis* in Polish references. Miczulski and Olszewski (1973) carried out quite extensive observations of wintering sites of *Curculionoidea*. However small legume seed plantations were excluded from their study. Their analysis of collected entomological material showed that *Sitona* spp., along with *S. humeralis*, overwintered readily both in the open (balks and grassland) and wooded areas.

In my studies, I found adult specimens present in soil sampled from balk and meadow but most – as much as 75.0% of the analysed population overwintered on alfalfa plantations.

In the laboratory conditions one female of *S. humeralis* laid approximately 708 eggs (maximum 1,556 eggs) in its reproductive period, which last 65 days on average. Polish references provide no reports on this subject. Abroad, Nadasy and Saringer (1987) reported that 600 eggs were the mean fertility of *S. humeralis* in Hungary. According to Aeschlimann (1979) there may be as many as 2,160 eggs of this insect on each m^2. References indicate that only as such as *Sitona* spp.: *Sitona cylindricollis* (Fahr.), *S. lineatus* were characterised by markedly higher fertility (Schotzko and O'Keeffe 1988b).

No effect of the *S. humeralis* female longevity on the number of laid eggs was observed. No such relation was neither discovered by Schotzko and O'Keeffe (1988a), who studied the fertility of *S. lineatus*, or Nadasy and Saringer (1987), who studied on *S. humeralis*. The above mentioned authors believe that the main factor determining the number of laid eggs is the type of food available.

The analysis of dynamics of laying egg by females of *S. humeralis* shows that their daily fertility becomes reduced with the time length of their reproductive cycle. For the majority of females the maximum daily number of eggs (up to 52) was laid at the beginning of their reproductive cycle while at its end, frequent intervals appeared.

During the research, *Sitona* individuals mated daily from the moment of starting of their spring laboratory observations until the end of their reproductive activity or until male's death. It was observed that males died earlier than females by an average of 21 days (Tab. 1). The males of *S. lineatus* also lived shorter as showed by Schotzko and O'Keeffe (1988a). After their males' death, females of *S. humeralis* continued laying eggs and larvae hatched out of them. Similar phenomenon was observed by Opyrchałowa (1957) in the life cycle of *Hypera postica* (Gyll.) (Tab. 1).

Table 1

Longevity of females and males of the wintering generation of *Sitona humeralis* as observed in spring observations, in 1992-1995

Sex	Longevity in days				
	1992	1993	1994	1995	average
female	75.4	90.4	107.0	79.0	87.9
male	67.4	71.0	66.6	63.4	66.9

Table 2

Development of pre-imaginal stages of the summer generation of *Sitona humeralis*

Developmental stage	Duration in days			Dates of appearance in breeding
	minimum	maximum	average	
eggs	7	15	10.5	1.05-5.08
larvae	21	49	30	7.05-17.07
pupae	7	21	14	21.06-17.07
adults	–	–	–	28.06

In field conditions females of *S. humeralis* laid spherical eggs individually, directly onto the plant surface from which they rolled down onto the surface of soil below or into any soil cavities. Initially white eggs changed its colour to grey and then became black and shiny. The time of this colour changing process depended, among others, on the humidity of environment. On moist tissue in the laboratory, the colours change last for 12 hours. However, on a relatively dry tissue after seven days about 80% of eggs put on Petri dishes became mat, oval and concave along their lengths. Similar phenomenon was described by Schotzko and O'Keeffe (1986) for *S. lineatus*, as well as by Czerniakowski (1992a; b) for *Sitona sulcifrons* and *Sitona waterhousei* Walt.

It was confirmed that in laboratory condition the embryonic development finished by larvae hatching only when eggs of *S. humeralis* were put on moist tissue. In average temperature of 18°C this period last for 10.5 days (Tab. 2).

The hatching larvae had lengths of 1.1 to 1.5 mm. Their heads were clearly marked and covered by a tiny shield of brownish-black colour. The remaining parts of larvae were of creamy colour and had long, rare hairs. The larvae had no legs. The entire larval development (4 juvenile stages) last from 21 to 49 days (Tab. 2).

The pupation took place in soil cradles. Young pupae had initially white creamy colour. Then, light-brown spots eye appeared on head sides. Subsequently, snout, head, antennae and finally feet and limbs changed colour. Such parts as prothorax and covers darkened at last. Pupae development in quasi-natural conditions last from 7 to 21 days (Tab. 2).

In laboratory observations, first adults appeared on the 45th day of the vase experiment. *S. humeralis* development from egg to adult insect last for an average of 54 days. There are no reports on this subject in Polish references.

Since *S. humeralis* occurred in large numbers on alfalfa crops used as green fodder, it became necessary to determine the relation between the appearance of this pest on alfalfa crop and the phenological stages of alfalfa plant development.

Observations carried out in consecutive years of research showed that first specimens were caught as early as the very beginning of alfalfa plant growth but an increase in numerical intensity came at the time when alfalfa grew offshoots (branches) and had first flower buds (primordia). Most often peak numbers were observed in the second and third decades of May (Fig. 1).

The adults of next generation of *S. humeralis* appeared on the crops mainly in the second half of July. At that time alfalfa was again in the initial phase of flowering. They differed from old individuals by incomplete colours, intact hair and clearly contrasting pattern on their wing covers, as well as soft cuticles which were hardening gradually.

A steady increase in numbers of individuals from new generation last from 30 to 80 days with a peak in September, or in the last decade of August when alfalfa plants had a height of approx. 25 cm or were again growing new offshoots. A second autumnal in-

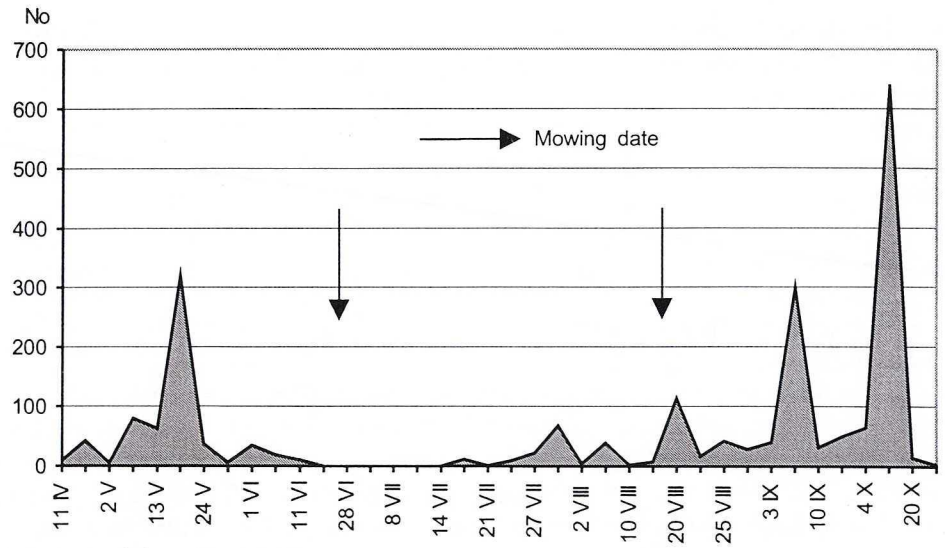

Fig. 1. Seasonal dynamics of *Sitona humeralis*

crease in numbers of *S. humeralis* occurred in the first decade of October. Near the end of the growing season the intensity of *S. humeralis* gradually decreased because they started to look for winter hiding places (Fig. 1).

Multiple observations consistently showed that during the growing season this insect was most numerous in the field in the evening and in the morning (average of 19.1-22.5% and 16.5%, respectively). Least numbers were met at noon (average between 7.7 and 8.0%) (Fig. 2).

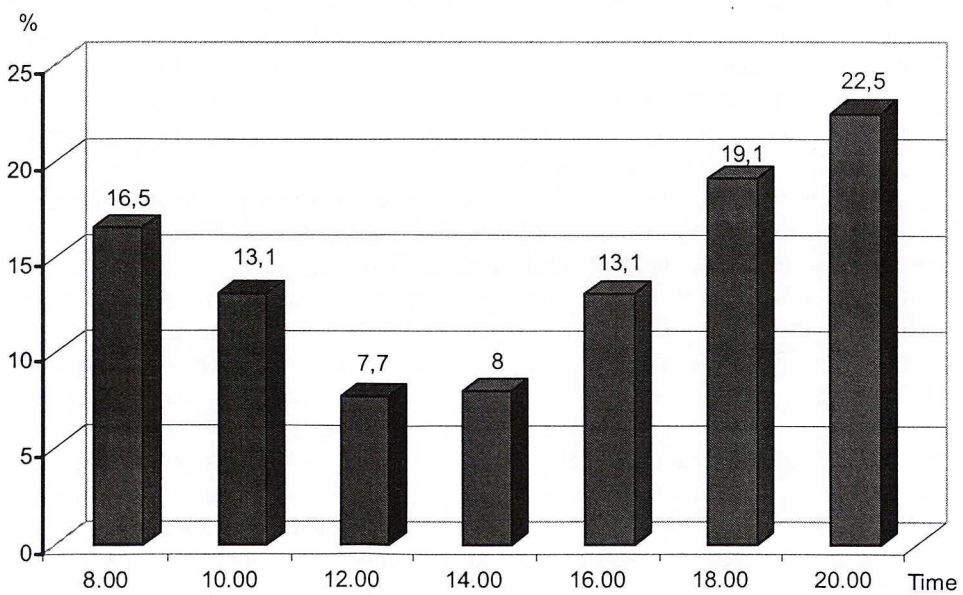

Fig. 2. Numbers of *Sitona humeralis* at specific times of day (1993-1995)

The knowledge of the occurrence periods of *S. humeralis* in the growing season and in the 24-hour cycle may have significant effects on decisions concerning pest control operations.

IV. REFERENCES

1. Aeschlimann J.P. 1979. Sampling methods and construction of life tables for *Sitona humeralis* populations (*Col., Curculionidae*) in Mediterranean climatic areas. J. Appl. Ecology 16 (2): 405-415.
2. Aeschlimann J.P. 1980. The *Sitona* (*Col.: Curculionidae*) species occurring on Medicago and their natural enemies in the Mediterranean region. Entomophaga 25 (2): 139-153.
3. Burakowski B., Mroczkowski M., Stefańska J. 1993. Katalog Fauny Polski. Chrząszcze. Część XXIII, t. 19.
4. Czerniakowski Z. 1988. Skład gatunkowy ryjkowców (*Curculionidae*) występujących na plantacjach lucerny siewnej (*Medicago sativa* L.) w południowo-wschodniej Polsce. Rzesz. Zesz. Nauk. Prawo – Ekonomia – Rolnictwo: 130-142.
5. Czerniakowski Z.W. 1991. Dynamika występowania oprzędzika wilżynowego (*Sitona humeralis* Steph.) na plantacjach lucerny siewnej w południowo-wschodniej Polsce. Materiały 31. Sesji Nauk. Inst. Ochr. Roślin, cz. 2: 28-31.
6. Czerniakowski Z.W. 1992a. Obserwacje nad biologią *Sitona sulcifrons* Thunb. (*Col. Curculionidae*) w południowo-wschodniej Polsce. Materiały XLI Zjazd PTEnt.: 23-24.
7. Czerniakowski Z.W. 1992b. Wprowadzenie do biologii oprzędzika komonicowego (*Sitona waterhousei* Walt.), (*Col., Curculionidae*). Materiały z Konf. Nauk. "Wiodące problemy rozwoju rolnictwa w płd.-wsch. Polsce" Rzeszów 6: 63-64.
8. Fedorko J. 1965. Badania nad ryjkowcami (*Col. Curculionidae*) na uprawie koniczyny czerwonej (*Trifolium pratense* L.) w okolicach Lublina. Ann. Univ. Mariae Curie-Skłodowska, ser. C, 20 (5): 45-69.
9. Kwong S., Ferro D.N., Emberson R.M. 1980. A rearing method for *Sitona humeralis* Stephens (*Coleoptera: Curculionidae*) and its development unter controlled conditions. Bull. ent. Res., 70: 97-102.
10. Miczulski B., Olszewski T. 1973. Obserwacje nad miejscami zimowania chrząszczy ryjkowcowatych (*Curculionidae*). Biul. Inst. Ochr. Roślin nr 56: 221-230.
11. Nadasy M., Saringer G. 1987. Ecological studies on *Sitona humeralis* Steph. (*Col., Curculionidae*) in Hungary. Streszczenie 39 International Symp on Crop Protection.
12. Opyrchałowa J. 1957. Ziołomirek zmienny – *Phytonomus variabilis* Herbst (*Coleoptera, Curculionidae*) jako szkodnik lucerny na Śląsku. Pol. Pismo Ent., 26 (23): 331-365.
13. Schotzko D.J., O'Keeffe L.E. 1986. Ovipositional rhythms and egg melanization rate of *Sitona lineatus* (L.)(*Coleoptera: Curculionidae*). Environ. Entomol., 15(3): 601-606.
14. Schotzko D.J., O'Keeffe L.E. 1988a. Effects of food plants and duration of hibernal quiescence on reproductive capacity of pea leaf weevil (*Coleoptera: Curculionidae*). J. Econ. Entomol., 81(2): 490-496.
15. Schotzko D.J., O'Keeffe L.E. 1988b. Effects of food type, duration of hibernal quiescence, and weevil density on longevity of *Sitona lineatus* (*Coleoptera: Curculionidae*). J. Econ. Entomol., 81(6): 1631-1636.

Marta Pisarek

BADANIA CYKLU ROZWOJOWEGO *SITONA HUMERALIS* W POŁUDNIOWO-WSCHODNIEJ POLSCE

STRESZCZENIE

Sitona humeralis daje jedno pokolenie w ciągu roku. Zimuje owad dorosły. Pełny rozwój od jaja do osobnika doskonałego wynosi średnio 54 dni, w tym okres embrionalny około 10 dni, larwalny – 30 dni, poczwarki – 14 dni.