

Małgorzata KŁYŚ<sup>1</sup>

**EMIGRATION ACITIVITY OF RICE WEEVIL  
*Sitophilus oryzae* L. (Coleoptera, Curculionidae)  
IN CONDITIONS OF REDUCED TEMPERATURE**

**AKTYWNOŚĆ EMIGRACYJNA WOŁKA RYŻOWEGO  
*Sitophilus oryzae* L. (Coleoptera, Curculionidae)  
W WARUNKACH OBNIŻONEJ TEMPERATURY**

**Abstract:** The subject of the research was rice weevil *Sitophilus oryzae* L. – dangerous pest of grain crops storage. Research was held in a laboratory at the temperature 31 °C, optimal for this insect species, and reduced to 22 °C, and 70 ± 5 % relative humidity (R.H.). The main research problem concerned the emigration activity of *S. oryzae* in conditions of temperature reduction. Population dynamics and sex structure of population were also analyzed. It was affirmed that rice weevil shows a very high emigration activity in temperatures both 31 °C and 22 °C. Whereas the temperature reduction to 22 °C causes drop of emigration activity to 40 % only in two time ranges after 60 and 120 days of raise ing. A higher female emigration was also observed.

**Keywords:** *Sitophilus oryzae* L., emigration activity, population dynamics, sex ratio

Each population during its lifetime is a subject of fluctuations in number and rate and intensity of changes depend on biological characteristic of species, environmental factors and also development stage of the population. Environmental factors which influence a the population numbers are mainly the temperature and humidity. They determine the rate and process occurring in the population and also influence the possibility of its occurrence, reproduction and survival.

Research included rice weevil *Sitophilus oryzae* L. – an insect which in the mild climate lives mainly in granary and storehouse groceries. In countries of the subtropical and tropical climate it is a dangerous pest of grain crops. It is brought to Poland mainly with rice and corn grains and is passively spread with the infected products [1]. The main target of presented research was learning about the emigration activity of population of *S. oryzae* in conditions of the reduced temperature in relation to optimal

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<sup>1</sup> Institute of Biology, Department of Ecology, Wildlife Research and Ecotourism, Pedagogical University of Krakow, ul. Podbrzezie 3, 31–054 Kraków, Poland, phone: +48 12 662 67 05, fax: +48 12 662 66 82, email: klysgosia@poczta.onet.pl

for developing of this insect species. Furthermore dynamism of number and sex structure of the population were analyzed.

## Materials and methods

Research was carried out in laboratory conditions at the temperature 31 °C (known as optimal for this species) later reduced to 22 °C and at relative humidity about 70 %. A set of experimental raising vessels was used, allowing emigration of *S. oryzae* adult individuals. The set consisted to two plastic vessels. 40g of wheat was placed in a bottom of the smaller vessel, with a diameter of 28 cm<sup>2</sup> in the presence of 40 adult weevils of the same age, obtained from the basic cultures. The vessel was placed in to a bigger one with 50 cm<sup>2</sup> bottom surface. The bottom of the big vessel was covered with glycerine layer, which was a trap for insects emigrating from the small vessel. The inner vessel was closed with perforated lid, which allowed the air to come in [2]. The experiment lasted seven months and was repeated six times. The influence of the reduced temperature on migration activity of *S. oryzae* population was estimated according to analysis of the population number, migration rate and sex ratio. Analysis of statistic indexes was conducted using Chi-square test from Statistica 8.0 program.

## Results and discussion

In applied environmental conditions allowing one way movement of *S. oryzae* individuals shows a very high emigration activity both at the temperature 31 °C and at 22 °C. A very high emigration takes place in optimal for this insect thermal-humidity space conditions ie at the temperature of 31 °C and *relative humidity* (RH) 70 % it is 97 % as early as after 30 days of the test. This leads to disappearance of the population in a small vessel as early as after 60 days of the culturing. By that time every insect has emigrated from the initial population. However, at the temperature of 22 °C emigration of initial population does not lead to total leaving the mother vessel. In spite of 100 % emigration after 30 days the experiment duration, insect eggs are laid in wheat seeds in small vessel and the population spreads although its number is low. However the number of emigration groups is high, mainly in time range from 150 to 210 days of raising. That time emigration index is about 90 %. The temperature reduction to 22 °C causes lower emigration activity to 40 % within two time ranges after 60 and 120 days of raising. However, in the other time ranges emigration keeps on a high level (Fig. 1, Table 1). Chi-square test analysis shows that the difference between emigrant number at the temperature of 31 °C comparing with emigrant number at the temperature of 22 °C are statistically significant. Only after 60 days the results were statistically insignificant.

Beckett et al [3] studied *R. dominica* and *S. oryzae* mortality at moderate temperature. The data obtained indicate that all life cycle stages survive longer at a given temperature as grain moisture increases and the effect of moisture on survival increases as temperature decreases.

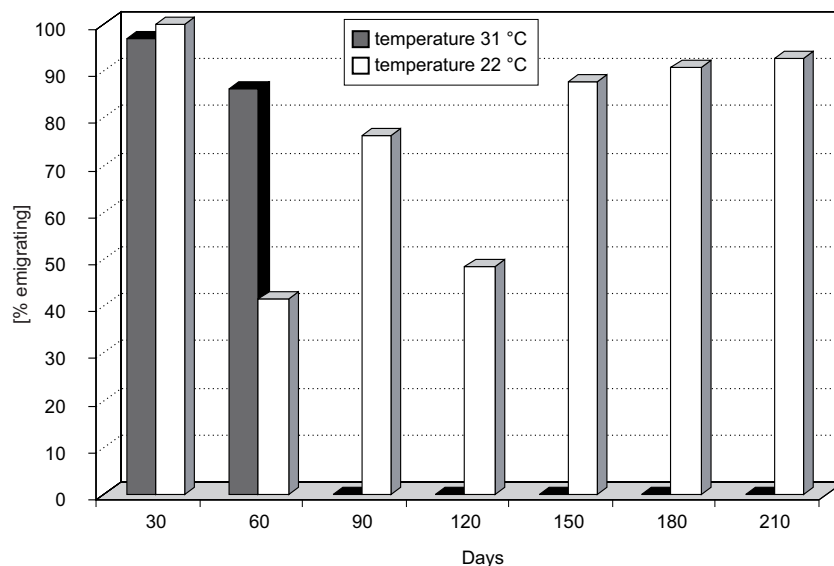


Fig. 1. Emigrational activity of the population *S. oryzae*

Table 1

Numbers of individuals in initial populations and in emigrating groups of *S. oryzae*

Days	Temperature 31 °C				Temperature 22 °C			
	Initial population	SD	Emigration groups	SD	Initial population	SD	Emigration groups	SD
30	0	0	38.7	1.9	0	0	49	1.9
60	0	0	25.3	1.5	32	4.7	22.7	2.8
90	0	0	3.3	1.7	19	6.4	61	5.6
120	0	0	0	0	33.3	0.9	32.3	4.7
150	0	0	0	0	44.7	4.8	350.3	34.7
180	0	0	0	0	34.7	4.0	370	27.4
210	0	0	0	0	44	6.1	568	43.6

SD – standard deviation.

In turn Ciesielska [4] testing emigration process of *Sitophilus oryzae* L., *Sitophilus granarius* L. and *Oryzaephilus surinamensis* L. at the temperature 27 °C affirmed a big migration activity of this species but only at the first period of the colonisation of grain.

Also Kłysz [5] testing influence of the temperature reduced to 22 °C on *Rhizopertha dominica* F. migration activity shows increase in emigration of this pest during the first four months of the research. That time insects intensively move outside the area of the initial population in spite of the food excess.

Table 2

Sex ratios in emigratin condition of *S. oryzae*

Days	Temperature 31 °C		Temperature 22 °C	
	Initial population	Emigration groups	Initial population	Emigration groups
30	0	0.5	0	0.9
60	0	1.1	1	0.6
90	0	2	1.1	0.5
120	0	0	1.3	0.9
150	0	0	1.5	0.7
180	0	0	1.1	0.9
210	0	0	1	0.8

One of the mechanisms controlling population number is its sex structure. It has an influence on a rate of reproduction and on a population number [6]. Results which were gained in research on population of *S. oryzae* sex structure show a very high emigration activity of the females confirmed by the sex ratio  $< 1$  (Table 2). Ciesielska [7] affirmed that *S. oryzae* females are twice as active as males and more likely that female will infect stored grain.

## Conclusions

1. *S. oryzae* shows a very high emigration activity both at the temperature of 31 °C and at 22 °C.
2. The temperature reduction to 22 °C causes reduction of the emigration activity to 40 % only in two time ranges after 60 and 120 days of the conduct culture.
3. At the temperature of 22 °C females show a very high emigration activity.

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Zakład Ekologii, Badań Łowieckich i Ekoturystyki, Instytut Biologii  
Uniwersytet Pedagogiczny im. Komisji Edukacji Narodowej w Krakowie

**Abstrakt:** Obiektem badań był wołek ryżowy *Sitophilus oryzae* L. – groźny szkodnik magazynowanego ziarna zbóż. Badania prowadzono w laboratorium w temperaturze 31 °C optymalnej dla tego gatunku owada i w obniżonej do 22 °C, oraz w wilgotności względnej powietrza  $70 \pm 5$  % r.h. Główny problem badawczy dotyczył aktywności emigracyjnej wołka ryżowego w warunkach obniżonej temperatury. Analizowano także dynamikę liczebności i strukturę płciową populacji *S. oryzae*. Stwierdzono, że wołek ryżowy wykazuje bardzo dużą aktywność emigracyjną zarówno w temperaturze 31 °C, jak i 22 °C. Obniżenie temperatury do 22 °C powoduje spadek aktywności emigracyjnej do 40 % tylko w dwóch przedziałach czasowych po 60 i 120 dniach prowadzenia hodowli. Zaobserwowano również większą emigrację samic.

**Słowa kluczowe:** wołek ryżowy, aktywność emigracyjna, liczebność populacji, wskaźnik płci