RESEARCHES CONCERNING THE MORPHOLOGICAL ASPECTS OF SEXUAL DIMORPHISM IN THE GRANARY WEEVIL (*SITOPHILUS GRANARIUS* L.), MAJOR PEST OF THE STORED CEREALS

CERCETĂRI PRIVIND ASPECTELE MORFOLOGICE ALE DIMORFISMULUI SEXUAL LA GĂRGĂRIȚA GRÂULUI (*SITOPHILUS GRANARIUS* L.), DĂUNĂTOR MAJOR AL STOCURILOR DE CEREALE DEPOZITATE

ADRIAN DINUȚĂ*, HORIA BUNESCU, ILONKA BODIS**, OANA POP****

**Magnolia Garden Center, Apahiha (Cluj-Napoca), Romania*
***University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania*

Abstract: *To solve the multiple practical aspects raised by the achieving of cereals stocks protection (especially wheat and corn) against granary weevil Sitophilus granarius L., the research aimed a complex study on the sexual dimorphism at this species, aspect which help to prevent the weevils damages using non-polluting methods (with the aid of sexual pheromones, ovogenesis inhibitors, etc.). Due to the summarily data in the scientific literature of the world refering to the sexual dimorphism of the species, a detailed study was made within the Entomology Laboratory at the Faculty of Agriculture of USAMV Cluj-Napoca and at the Center of Electronical Microscopy of Babeş-Bolyai University in Cluj-Napoca (Romania), during 2005-2007.*

***Rezumat*:** *Pentru rezolvarea multiplelor aspecte practice care sunt ridicate de realizarea protecției stocurilor de boabe de cereale (în special de grâu şi porumb) împotriva gărgăriței grâului Sitophilus granarius L., cercetările efectuate au avut drept scop studiul complex al dimorfismului sexual la această specie, pe baza caracterelor de morfologie, aspect care sa vină în ajutorul combaterii prin metode nepoluante (cu ajutorul feromonilor sexuali, inhibitorilor de ovogeneză, etc.). Datorită datelor sumare din literatura de specialitate la nivel mondial cu referire la dimorfismul sexual al speciei, s-a trecut la un studiu minuțios care a fost întreprins în cadrul Laboratorului de Entomologie de la Facultatea de Agricultura a USAMV Cluj-Napoca şi la Centrul de Microscopie Electronică a Universității Babeş-Bolyai din Cluj-Napoca (România), în perioada 2005-2007.*

Key words: *sexual dimorphism, granary weevil, pest, stored cereals*
Cuvinte cheie : *dimorfism sexual, gărgărița grâului, dăunător, cereale depozitate*

INTRODUCTION

In most cases the two sexual forms of the insects can`t be differentiated without analyzing the genital organs. There are many species at which the differences between male and female are obvious after the secondary characters as: the size of body, the form of antennae and oral elements, the color, etc.

At some species the sexual differences are seen through ornamental characters, which can be very varied: the color of body, a more developed appendices, etc.

Also there are differences concerning the functional sexual characters, which have a role in reproduction and show by their development level of the sensorial organs (more developed antennae, a larger number of olfactive sensors), a bigger abdomen, etc. (ANDERSEN,1938; SĂVESCU, 1962; BERATLIEF & BOGULEANU, 1975; ALONSO-ZARAGAZA & CHRISTOPHER, 1999).

At the species from the *Sitophilus* genus the morphological characters which make the sexual differences are difficult to be noticed, although these are present at the level of reproductive elements, abdominal elements and rostrum (BALACHOWSKY, 1936; EL-SAYED & ROSTOM, 1962; LUM & BAKER, 1975; PEREZ-MENDOZA et al, 2004; DINUȚĂ, 2006).

MATERIAL AND METHODS

The biological material was raised in special raising-rooms in controlled atmosphere at t = 26º C (± 2º C) and a relative humidity of 75 % (± 5%).

The species of *Sitophilus granarius* L. were selected at age of 14 days (necessary for the sexual maturation), by collecting the insects which recently went out from the seeds in which they developed. These insects are different by the rest of specimens in the culture, having a fair color, compared to the dark brown or black of the older ones (48 hours). The weevil group was isolated in raising-rooms until they were 14 days old.

The preliminary research which aimed sexual separation (distinguishing the male and female) was made with the aid of some stereoscopically microscopes MBS-1 and SM-XX by determining the few distinct morphological characters mentioned in the scientific literature.

In order to avoid any error, there were made male and female genitalia preparations (after the dissection under stereomicroscope and the male and female genital system were identified). This preliminary study was made in the Laboratory of Entomology of the Faculty of Agriculture of USAMV Cluj-Napoca.

After this first step a detailed analysis of the morphological aspects was made with the aid of optical and scanning electron microscope. By optical microscopy (Olympus BX 51 with CCD camera) the samples were studied in natural state, while in case of scanning electron microscope, they required a special preparation. The granary weevils were washed in alcohol in order to eliminate the impurities of the tegument before the metallizing process.

The metallization has the purpose to free with the aid of a wolfram wire the atoms of a fine plate of silver or gold by detaching them in vacuum and depositing on the material which will be studied.

After this process structural and morph-structural studies were made at the scanning electron microscope "SEM" Jeol-JSM 5510 LV in the Center of Electronic Microscopy of Babeş-Bolyai University in Cluj-Napoca.

RESULTS AND DISCUSSION

In case of granary weevil (*Sitophilus granarius* L.), the morphological characters of the sexual dimorphism are less obvious and there are observed only after a detailed study.

The general aspect of the body is different, the male being more curved then the female (Fig. 1 a, b). This aspect can be noticed only at the insects studied by profile (lateral view). At insects in activity, this aspect is very difficult to be distinguished.

There aren't any differences between male and female concerning the length of insect. This is influenced only by the trophic factor.

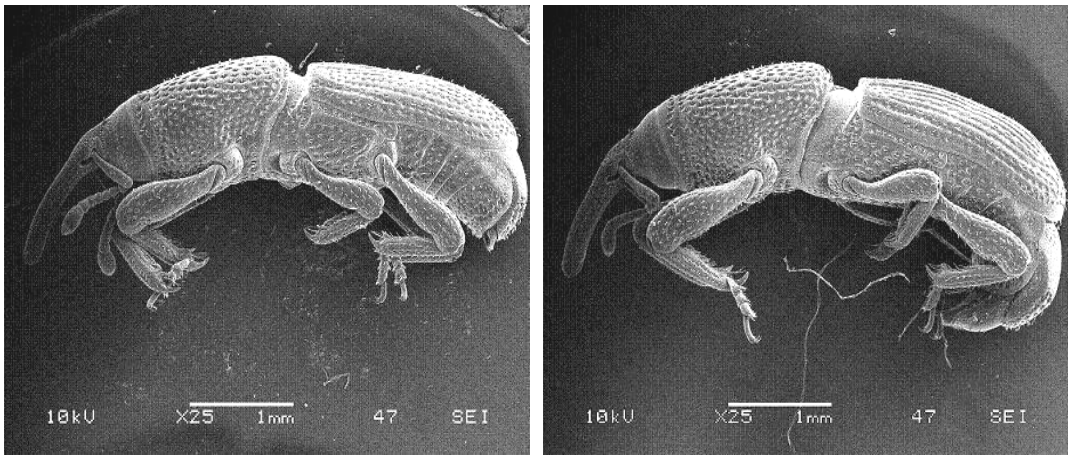
The morphological differences at the level of cephalic capsule are distinguished in case of rostrum which is longer in female (0,9-1,1mm) than in male (0,7-0,9mm). The rostrum in female is thinner than in male, which is thicker and less curved. Concerning the rostrum ornamentation, there are not any notable differences (Fig. 2 a, b).

The weevil's antennae have the same number of articles with the same dimensions except the last article of the flagellum which presents more and longer olfactory sensillae in case of the female (Fig. 3 a, b).

The length of the composed eyes (which are oval) is the same of about 375 µm in the case of both sexes, differences can be noticed at the level of ommatidia, the female having a number of about 92 (with the diameter of 22 µm) and the male a number of about 108 (with the diameter of 20 µm) (Fig. 4 a, b; 5a, b).

The morphological differences can be observed at the level of thorax, in female the pronotum is separated from mesonotum, by a large and deep ,,belt" (represented by the visible part of the mesonotum), while in male this has the form of a narrower belt (Fig. 6 a, b). In the dorsal part of the female body, this belt presents a fine punctuation and on this belt it can be distinguished the place of elytrae's insertion.

The female abdomen is flattened while the male one is curved (Fig. 7 a, b). The male genitalia (*aedeagus*) are made by two telescopic segments. The first segment strongly chitinised is deeply inserted in the abdomen, with the aid of four prolongations on which there are inserted muscles and tendons well defined.

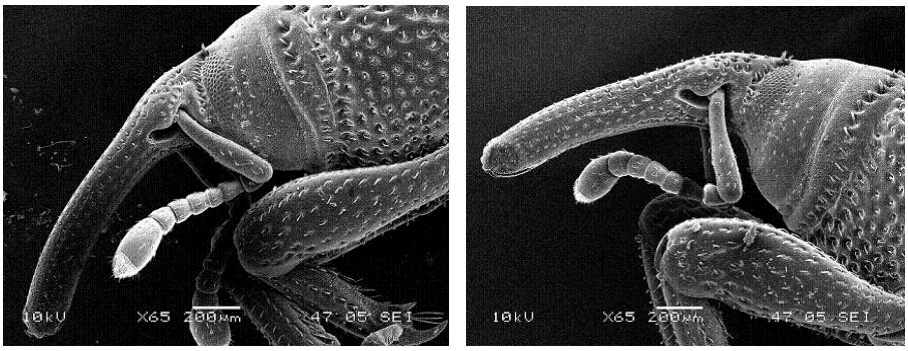


a **b**

Fig. 1 - Granary weevil, *Sitophilus granarius* L. : a) female; b) male
(original, Cluj-Napoca, 2006)

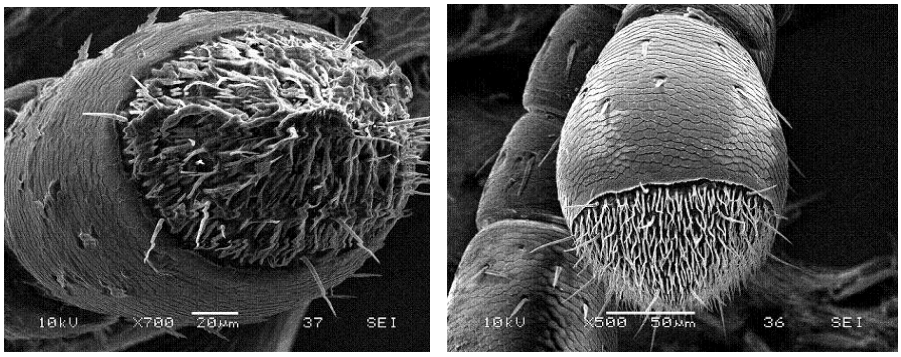
There are two external genitalia annexes and have the form of some chitinised overlapped plates and between there is the second segment of the aedeagus. This is poor chitinised and has a yellow color, it is soft and maintained by own muscles.

Aedeagus is centrally traversed by the ejaculating canal. It achieved the transfer of seminal liquid by its entering to the copulatory bursa of the female. The two chitinised plates which protect this soft segment of aedeagus present a characteristic pubescence on their external top and an ornament with a reticulate form.



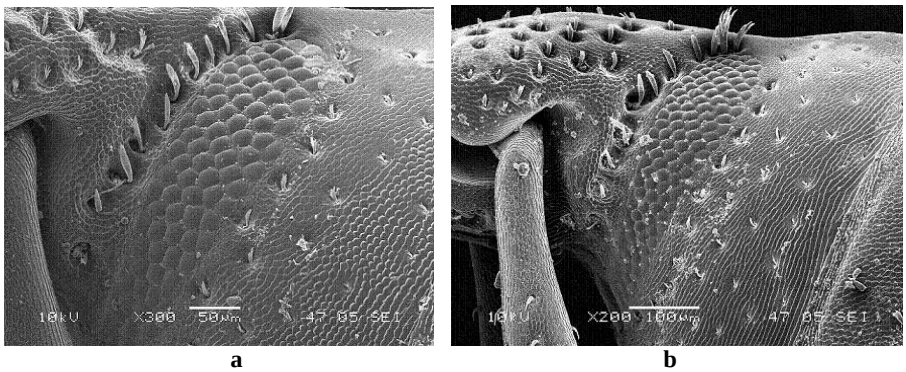
a **b**

Fig. 2 - The rostrum of *Sitophilus granarius* L. adults: a) female; b) male (original, Cluj-Napoca, 2005)



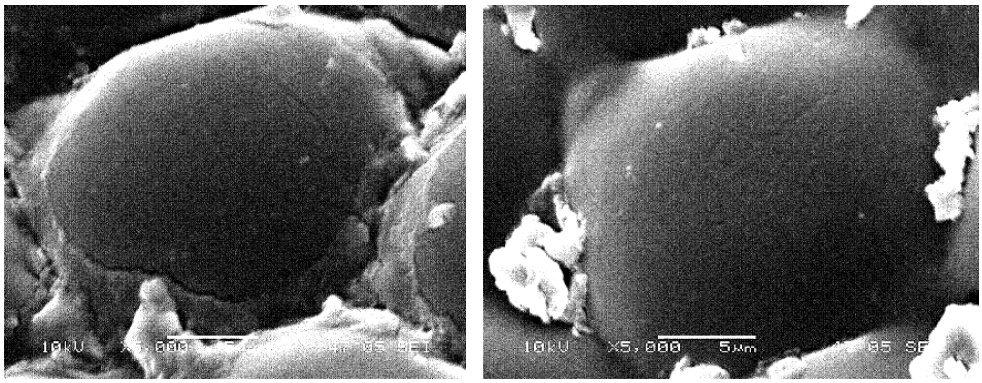
a **b**

Fig. 3 - Olfactory sensilla on the antennae of *Sitophilus granarius* L.: a) female; b) male (original, Cluj-Napoca, 2006)



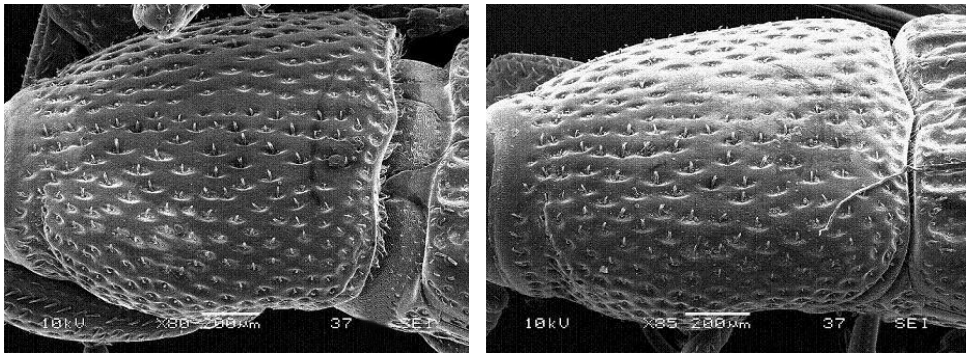
a **b**

Fig. 4 - The compound eye of the granary weevil – *Sitophilus granarius* L.: a) female; b) male (original, Cluj-Napoca, 2005)



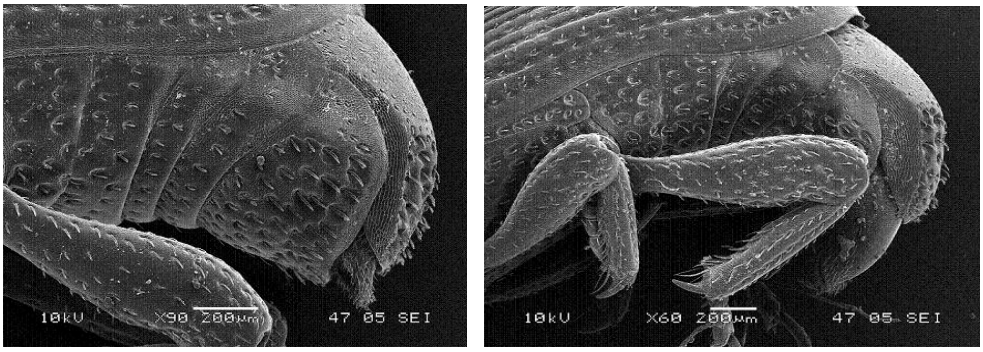
a **b**

Fig. 5 - The compound eye's ommatidia of *Sitophilus granarius* L. adults: a) male; b) female (original, Cluj-Napoca, 2005)



a **b**

Fig. 6 - The belt separating the pronotum and mesonotum of granary weevil, *Sitophilus granarius* L.: a) female; b) male (original, Cluj-Napoca, 2007)



a **b**

Fig.7 - The abdomen of *Sitophilus granarius* L. adults: a) female; b) male (original, Cluj-Napoca, 2005)

CONCLUSIONS

After the studies which aimed the morphological characters of the sexual dimorphism in the granary weevil (*Sitophilus granarius* L.) were finalised, the conclusions are the following ones:

- the morphological characters which make the differences between the two sexes of the granary weevil, can be distinguished only with the aid of optical implement (microscopes, stereo microscopes, binoculars)**;**

- the differences between sexes are due to: the shape of body (more curved in case of male), rostrum (longer and thinner in female), number of ommatidia in the structure of compound eye (the female has 92 and the male 108), the number of the olfactory sensillae on the antennae (more and longer in case of female), the belt which separates the pronotum from the mesonotum (larger and deeper in the female), the abdomen of female is flat, while the abdomen of male is curved, etc.;

- after identifying these characters it is no longer necessary to prove the obtained results by genitals determination.

BIBLIOGRAPHY

1. ANDERSEN K. TH., 1938, Der Kornkäfer (*Calandra granaria* L. – Biologie und Bekämpfung, Teză de doctorat), Verlag von Paul Parey, Berlin, 105 pp
2. ALONSO-ZARAGAZA M. A., H. C. L. CHRISTOPHER, 1999, A World Catalogue of Families and Genera of Curculionidea (Insecta, Coleoptera), Entomopraxis, Barcelona, Spain, 315
3. BALACHOWSKY. S., 1936, Entomologie appliquée a l`agriculture, Ed. Masson et Cie, Paris, 1070-1099
4. BERATLIEFC., GH. BOGULEANU, 1975, Dăunătorii produselor agroalimentare depozitate, Ed. Ceres, Bucureşti, 324 pp
5. EL – SAZED M. T., Z. M. F. ROSTOM, 1962, Studies on the granary weevils *Sitophilus granarius* L. I External morphology of the adult stage, Bulletin de la Société Entomologique D'Egypte, Imprimerie Mondiale, Cairo, vol. 46, 119 – 132
6. DINUŢĂ A., 2006, Cercetări de combatere neconvenţională a gărgăriţelor din genul *Sitophilus*, dăunătoare cerealelor depozitate (Teză de doctorat), Universitatea de Ştiinţe Agricole şi Medicină Veterinară Cluj-Napoca, Facultatea de Agricultură, 355 pp
7. LUM P. T. M., J. E. BAKER, 1975, Sexual dimorphism in the sixth abdominal sternite of *Sitophilus oryzae* L. (Coleoptera: *Curculionidae*), Journal of Stored Products Research, vol. 11, 57-59
8. PEREY-MENDOZA J., J. E. THRONE, J. E. BAKER, 2004, Ovarian physiology and age-grading in the rice wevil *Sitophilus oryzae* L. (Coleoptera: Curculionidae), Journal of Stored Products Research, vol. 40, 179-196
9. SPVESCU A., 1962, Album de protecţia plantelor, Centrul de Material Didactic şi Propagandă Agricolă, Bucureşti, vol. 3, 238 – 239