Zusammenfassung

Zur Bekämpfung der Mehlmotte, *Ephestia kuehniella* Zell. mit Hilfe von Sexualpheromonen in Mühlen

Es wurden von 1986 bis 1992 in norditalienischen Mühlen Versuche zur Bekämpfung von *Ephestia kuehniella* durch Massenfang, Kopulationsverhinderung und Anlockung/Vergiftung durchgeführt. Es ergaben sich beachtliche Erfolge mit dem Sexualpheromon Z9E12-14Ac (= TDA). Es konnte damit eine drastische Verminderung der chemischen Bekämpfung erreicht werden, woraus wirtschaftliche Vorteile und ein besseres Image bei den Verbrauchern resultierten.

References

BARRER, P. M., 1976: The influence of delayed mating on the reproduction of *Ephestia cautella* (Walker) (Lepidoptera, Phycitidae). J. stored Prod. Res. **12**, 165–169.

BRADY, U. E.; NORDLUND, D. A.; DALEY, R. D., 1971a: The sex stimulant of the Mediterranean flour moth *Anagasta kuehniella*. J. Ga. Ent. Soc. **6** (4), 215–217.

BRADY, U. E.; TUMLINSON, J. H.; BROWNLEE, R. B.; SILVERSTEIN, R. M., 1971b: Sex stimulant and attractan in the Almond Moth. Science **171**, 802–804.

BRADY, U. E., 1973: Isolation, identification and stimulatory activity of the second component of the sex pheromone system (complex) of female almond moth, *Cadra cautella*. Life Sci. **13**, 227–235.

HAINES, C. P.; READ, J. S., 1977: The effect of synthetic female sex pheromones on fertilization in warehouse population of *Ephestia cautella* (Walker) (Lepidoptera, Phycitidae). Rap. L 45, Trop. Prod. Inst., London: 10pp.

HODGES, R. J.; BENTON, F. P.; HALL, D. R.; DOS SANTOS SERODIO, R., 1984: Control of *Ephestia cautella* (Walker) (Lepidoptera, Phycitidae) by synthetic sex pheromones in the laboratory and store. J. stored Prod. Res. **20**, 191–197.

KUWAHARA, Y.; CASIDA, J. E., 1973: Quantitative analysis of the sex pheromone of several phycitid moths by electron capture gas chromatography. Agric. biol. Chem. **37**, 681–684.

LEVINSON, H. Z., 1983: Integrated manipulation of storage pests involving insectistasis. Mitt. Deut. Ges. All. Ang. Ent. **4**, 101–103.

LEVINSON, H. Z.; BUCHELOS, C. TH., 1981: Surveillance of storage moth species (Pyralidae, Gelechiidae) in a flour mill by adhesive traps with notes on the pheromone-mediated flight behaviour of male moths. Z. ang. Ent. **92**, 233–251.

SOWER, L. L.; VICK, K. W.; TUMLINSON, J. H., 1974: (Z, E)-9,12-tetradecadien-1-ol: a chemical released by female *Plodia interpunctella* that inhibits the sex pheromone response of male *Cadra cautella*. Environ. Ent. **3**, 120–122.

SÜSS, L.; TREMATERRA, P., 1986: Control of some Phycitidae infesting store-products with synthetic sex pheromone in Italy. Proc. 4th Intern. Working Conf. stored-product prot., Tel-Aviv, 606–611.

TREMATERRA, P., 1988: Suppression of *Ephestia kuehniella* Zeller by using a mass-trapping method. Tecnica molitoria **18**, 865–869.

TREMATERRA, P., 1990: Population dynamic of *Ephestia kuehniella* Zeller in flour mill: three years of mass-trapping. Proc. 5th Intern. Working Conf. stored-product prot., Vol. III, Bordeaux, 1435–1443.

TREMATERRA, P.; BATTAINI, F., 1987: Control of *Ephestia kuehniella* Zeller by mass-trapping. J. Appl. Ent. **104**, 336–340.

TREMATERRA, P.; CAPIZZI, A., 1987: Esperienze di controllo delle infestazioni di *Ephestia kuehniella* Zeller nei mulini mediante feromoni. Atti IV Simposio "Difesa antiparassitaria nelle industrie alimentari", Piacenza, 511–518.

TREMATERRA, P.; CAPIZZI, A., 1991: Attracticide method in the control of *Ephestia kuehniella* Zeller: studies on effectiveness. J. Appl. Ent. **111**, 451–456.

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On parasites and predators of Cleoninae weevils (Col. Curculionidae) in Ukrainian steppe

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With one table

Abstract

The data on natural enemies of 19 species of Cleoninae (genera *Cleonis, Chromoderus, Cyphocleonus, Rhinocyllus, Lixus, Larinus*) are given. They were parasitized by Ichneumonidae, Braconidae (Hymenoptera), Erythraeidae (Acariformes) and fungi. Weevils fell victim of ants (Formicidae), beetles (Tenebrionidae, Elateridae, Scarabaeidae) and probably *Orius* bugs (Anthocoridae).

1 Introduction

Subfamily Cleoninae includes a number of comparatively well known real and potential pests and herbivores. Some of them were tested and used as biocontrol agents of weeds. Our knowledge about their natural enemies are rather poor and were summarized in some reviews (SCHERF, 1964; BATRA et al., 1981). Detailed data have been published only on few species (POSPELOV, 1913; AUERSCH, 1953/54; ZWÖLFER & HARRIS, 1984). In the following the results of observations on the natural enemies of Cleoninae weevils in the Ukrainian steppe are given.

2 Methods and material

The root galls, stems, flowing and fading heads were collected in 56 points of Ukrainian steppe from early May to late September in 1981 to 1990. This material was taken to the laboratory. Stems and heads were gingerly dissected. Those of them which contained the larvae (total number over 500) held in eclectors (textil knape-sack with a glass tube). The root galls (n = 180) were held in such eclectors too. Each of the plant specimens was in the separate eclector. Emerging parasites were collected from glass tubes every day until no further emergence occurred.

Imagine from museum collections and nature were examined to find ectoparasites. Field material infested by fungi kept dry until identification.

All data about predators are based on the direct observations in nature.

3 Results and discussion

3.1 Parasitic Hymenoptera

Hymenopterous parasites for 10 weevil species have been found (see Table 1).

The most common parasite was *Exeristes roborator* (F.). When one head of *Cirsium uncrainicum* Bess. is occupied by several larvae of *Rhinocyllus conicus* the parasite *E. roborator* can destoy all, some or one of them. Infestation of *Rh. conicus* by *E. roborator* was up to 35%. Like its host the parasite emerges from the head through a circular exit hole and hibernates out of plants.

It is worthy to note that two species of the braconid genus *Zavipio* as the parasites of weevils were found (table 1). Substantial work by TOBIAS (1986) includes in the range of *Zavipio* hosts only Cerambycidae, Buprestidae and Lymexylonidae. The adults of *Z. terrefactor* overwinter in the host gall and leave it next year from mid May to early June.

3.2 Acariformes

At first we found the mites on dry beetles in a museum collection. These were larvae of Erythraeidae (Trombidiformes). They were known as parasites of locusts, spiders (BECKER & WARTON, 1952) and bank beetles (MOSER, 1979). Mites were founded in 9 specimens of *Cyphocleonus altaicus* Gebl. (collected in Poltava region by KISTYAKOVSKY, 1925). There were found from 1 to 5 mites on 1 beetle. Furthermore 3 mites were found on 2 weevils *C. tigrinus* (collected in Poltava, 1965).

In August 1983 in the man-made forest near Tarutino (Odessa region) 2 *C. tigrinus* with 3 mites on their body were collected. These mites also lived on toroise beetles (Chrysomelidae, Cassidinae) and especially on harvestmen (Arachnida, Opiliones) in the same habitat. Mites kept on the weevils not with legs but only with probosces which were thrusted between pleurites on the front margin of prothorax. 23 mites were located on the "museum" weevils: 14 between pro- and nesosternum (or nearly), 6 on the legs and 3 on prosternum, mesosternum and the 1st segment of abdomen.

Table 1. Hymenoptera as parasites of cleonine weevils in Ukrainian steppe.

Host	Parasite	Data	Plant
Larinus sturnus Schall.	*Exeristes roborator* (F.) (Ichn.)	8.83	*Cirsium ucrainicum* Bess.
L. vulpes Ol.	*Bracon urinator* F. (Brac.)	8.83	*Echinops ritro* L.
L. canescens Gyll.	*E. roborator* (F.)	8.82	*Centaurea orientalis* L.
L. turbinatus Gyll.	*E. roborator* (F.)	8.82	*Cirsium setosum* (Willd.) Bess.
Rhinocyllus conicus (Froel.)	*E. roborator* (F.) *Temelucha* sp. (Ichn.)	9.82	*C. ucrainicum* Bess.
Lixus canescens F.-W.	*Bracon chrysostigma* Gr. (Brac.)	8.82	*Crambe pontica* Stev. ex Rupr.
Cyphocleonus achates (Fåhr.)	*Zavipio terrefactor* (Vill.) (Brac.)	5.83	*Serratula radiata* (Walldst. ex Kit. Bieb.)
	Bracon sp. (Brac.)	9.83	*Atriplex hastata*
Lixus incanesceus Boh.	*Bracon intercessor* Nees (Brac.)	7.83	
Chromoderus fasciatus Müll.	*Zavipio apellator* Nees (Brac.)	7.83	*Chenopodium album* L.
Lixus subtilis Boh.	*E. roborator* (F.) *Scambus* sp. (Ichn.)		*Amaranthus retroflexus* L.

3.3 Fungi

Parasitic fungi were found on 8 Cleoninae species (in brackets infested stages: l larva, p pupa, a adult): *Cleonis piger* Scop. (p); *Cyphocleonus achates* Fåhr. (p); *Lixus cardui* Ol. (l); *L. canescens* F.-W. (l, p, a); *L. algirus* L. (a); *L. albomarginatus* Boh. (l, a); *L. subtilis* Boh. (l); *L. incanescens* Boh. (l).

According to our data larvae are the most infected stage in *Lixus* species. It is remarkable that there were no *Rhinocyllus*- and *Larinus*-species among infected weevils. It is not unlikely that flowering heads, where they develop, secrete a kind of antifungal substances.

3.4 Formicidae

The cornfield ant, *Lasius niger* L. penetrates into tunnels which larvae of *Lixus cardui* burrows in the stems of *Onopordum acanthium* L. Ants climbed up to 65 cm above ground and devoured larvae and pupae of weevils.

Larvae of *Larinus vulpes* Ol. develop within flowers heads of *Echinops*. The head may be so small that wall of pupae cell juts out of head. This wall are hard but thin and brittle so it often cracks. After this the ant, *Formica imitans* Ruzsky penetrates into the cells and destroys weevils, larvae or pupae.

It is interesting that *Lasius alienus* (Först.) can live within root cavities of *Centaurea* as a neighbour of pupae of *Cleonis piger* and *Cyphocleonus achates*. There was only a thin wall of pupae cell between predators and their potential victims but ants did not try to get to the pupae. When this wall was destroyed, ants immediately attacted the pupae.

Sometimes adults of weevils fed on the plants where aphid colonies were located. If these colonies were under guardianship of ants the last persecute the weevils until they leave the plant. This protects the plants from their enemies which can sufficiently reduce seed production (or destroy 100% of seeds, *Rhinocyllus, Larinus*). This aspect of ant activity directed to another phytophagous insect was recorded by BENTLY (1977), FRITZ (1983) and others.

3.5 Coleoptera

Larvae of the click beetle, *Selatosomus latus* (F.) (Elateridae) and of the darkling beetle, *Opatrum sabulosum* L. (Tenebrionidae) gnowed through root galls of corn-

flower, *Centaurea diffusa* Lam. and fed on lavae and pupae of the weevil, *Cyphocleonus achates.*

Feeding on flowering heads of *Echinops* the rose beetle, *Potosia metallica* Hbst. (Scarabaeidae) damaged larvae of *Larinus vulpes* developing within the heads.

There were larval burrows where dead larvae of *L. vulpes* and alive larvae or adults of *Orius* sp. (Hemiptera, Anthocoridae) were found together, through the bug feeding on the weevil larvae have not observed. It was reported that *Orius* spp. attacked the eggs of *Rhinocyllus conicus* (ZWÖLFER & HARRIS, 1984) and its larvae in laboratory conditions (DOUD & KOK, 1981).

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Zusammenfassung

Beobachtungen in der ukrainischen Steppe über die natürlichen Feinde von verschiedenen Rüsselkäfer (Cleoninae-)Arten

Es werden Beobachtungen von 56 Stellen der Ukrainischen Steppe mitgeteilt über natürliche Feinde von 19 Rüsselkäfer-(Cleoninae-) Arten der Gattungen *Cleonis, Chromoderus, Cyphocleonus, Rhinocyllus, Lixus* und *Larinus*. Die Rüsselkäfer und ihre Stadien werden vor allem von Ichneumonidae, Braconidae (Hymenoptera), Erythraeidae (Acariformes) und Pilzen angegriffen. Des weiteren werden sie auch zu Opfern von Ameisen (Formicidae), Käfern (Coleoptera) und wahrscheinlich Wanzen (*Orius* spp., Anthocoridae).

References

AUERSCH, O., 1953/54: Über die Verbreitung, Biologie, Histologie und Epidemiologie des Rübenderbrüsslers (*Bothynoderes punctiventris*). Wiss. Z. Martin-Luther Univ., Halle-Wittenberg, Math.-naturwiss. Reihe **3**, 601–658.

BATRA, S. W. T., COULSON, J. R.; DUNN, P. H.; BOLDT, P. E., 1981: Insects and fungi associated with *Carduus* thistles (Compositae). U.S.D.A. Tech. Bull. **1616.**

BAKER, E. W.; WARTON, G. W., 1952: An introduction to acarology. N. Y.

BENTLEY, B. L., 1977: Extrafloral nectaries and protection by pugnacious bodyguards. Ann. Rev. Ecol. Syste. **8**, 407–427.

DOWD, P. F.; KOK, L. T., 1981: Predators of *Rhinocyllus conicus* (Coleoptera: Curculionidae) in Virginia. Environ. Ent. **10**, 136–138.

FRITZ, R. S., 1983: Ant protection of a host plant's defoliator: Consequence of an ant-membracid mutualism. Ecology **64**, 789–797.

MOSER, J. C., 1979: Parasitengona mites (Acarina: Prostigmata) associated with flying adults of the southern pine beetle. Int. J. Acarol. **5**, 24–28.

POSPELOV, V. P., 1913: Shugar beet weevil and measures against it. St. Petersburg (in Russian).

SCHERF, H., 1964: Die Entwicklungsstadien der mitteleuropäischen Curculioniden (Morphologie, Bionomie, Ökologie). Abh. Senckenb. naturf. Ges. **506**, 1–335.

SWEETMAN, H. C., 1958: The Principles of Biological Control. Dubuque, Iowa.

TOBIAS, V. T., 1986: Subfamily Braconinae, in: Key to insects of European part of USSR, **3**, 94–149.

ZWÖLFER, H.; HARRIS, P., 1984: Biology and host specificity of *Rhinocyllus conicus* (Froel.) (Col., Curuclionidae), a successful agent for biocontrol of the thistle, *Carduus nutans*. Z. ang. Ent. **97**, 36–62.

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