HABROBRACON HEBETOR SAY (HYMENOPTERA: BRACONIDAE), THE MOST IMPORTANT PARASITOID OF HOMOEOSOMA NEBULELLUM HB.

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Homoeosoma nebulellum Hb. (Lepidoptera: Pyralidae) is a significant pest in Europe, feeding on the seeds of sunflower and causing serious crop loss. A related species, Homoeosoma electellum Hulst. is also a significant pest on sunflower in the USA. The natural enemies of these species are mainly parasitoids which live on the larvae and decrease thus their individual number and also their damage. According to the results of extensive research in Hungary, among the parasitoids the ectoparasitoid Braconid (Hymenoptera) Habrobracon hebetor Say (syn.: H. vernalis Széplig.) can be taken into consideration. The adults of this species, that appear early spring (end of March beginning of April) prefer to lay their eggs (among other hosts) onto the cuticle of fuul-grown larvae of H. nebulellum and the parasitoid larvae feed on the body fluids of the paralyzed host. The efficiency of Habrobracon hebetor reached 90 % between 11 and 17 August 1991. In late sowings (sowing at the begin of June) the H. nebulellum populations reach high densities, when the larvae of the 2nd and partial 3rd generations live in the sunflower heads. In these late sowings the activity of habrobracon hebetor may be as high as 20-30 %. Under Hungarian conditions the parasitoid appears in 6-7 generations and the development of each generation takes about 12-14 days. H. hebetor is not too "particular" about its hosts, so it can be reared on other hosts as well; its use against H. nebulellum in a biological control may be well considered.

INTRODUCTION

H. nebulellum is common everywhere in Hungary and its adults can be collected from May to September (Gozmány, 1959). This is in accord wit the statement of Kadocsa (1947) who mentioned 2-3 generations yearly influenced by the weather. The adult swarmings may overlap and mix due to the protracted development and long swarming. As Kadocsa described (1947) the first generations develop mainly in the flowers of Compositae, like in the favoured host plants Carduus nutans L., Onopordum acanthium L. but also in Carthamus lanatus L., C. tinctorius L., Chrysanthemum vulgare L. Beruh, Cirsium spp., Arctium spp. and even in Silybum Marianum L., a plant which grows wild in some places. In Germany it has been found only in the flowers of Carduus nutans L. (Schmidt, 1955). According to our investigations the L_1-L_2 larvae feed on all parts of the flowers (stamina, ovary etc.) even in the moth-resistant sunflower varieties and hybrids.

The L_3 larvae ere not limited to feed in the flowers and cause thus big damage in the seeds (Horváth, 1989). Besides the seeds, they also damage the squama and other outer parts of the sunflower head and gnaw galleries into the spongous texture of the head. The attacked head becomes permeated by web-like tubes where the larvae move easily and in which their gnawings and faeces get stuck (Plavilcsikov 1950, Scsegolev 1951, Szarukán 1979). In humid weather the damaged heads may rot due to fungal infection (Sclerotinia sclerotiorum Lib. de Bary). The damage caused by H. nebulellum significantly decreased in the last 10 years as a result of appearence of moth-resistant "hard-shell" sunflower varieties and hybrids (Bujáki, 1980). Horváth (1991) stated that H. nebulellum was the only pest insect which it had become possible to be controlled with improvement of plant resis-

tance (phytomelan carbon layer in the seed wall). It is an interesting fact that in different sunflower varieties (with striped seeds, grown for human consumption) or in their restorer liner - into which resistance genes could not be introduces - the susceptibility to dodder (Orobanche cumana L) also appeared as an "attached" characteristic (Horváth, 1991). The special literature on the life cycle of H. nebulellum hardly mentions its natural enemies (parasitoids, predators). The literature mentions Habrobracon vernalis Szépligeti (syn.: H. hebetor Say., Hym.: Braconidae), as ectoparasitoid and an other Braconid (Apanteles sp.) as an endoparasitorid. The efficacy of the former was 19 % and of the latter 12,5 %, so their total percentage made 31,5 % (Reichart, 1955c). Russian literature data mention Exorister roborator F. (syn.: Pimpla exorister roborator Schmied., Ichneumon roborator Fabricius, Iseropus roborator Meyer, Hym. Ichneumonidae), as the enemy of the sunflower moth. The Schnefelt World Catalogue (1978) also mentioned H. hebetor as a sunflower moth parasitoid (Papp, 1991). Horváth (1981) reared H. hebetor from the heads of Carthamus tinctorius L., from larvae of the fly Acanthophilus helianthi Rossi and of H. nebulellum as well.

MATERIAL AND METHODS

We carried out our investigations on the 40 hectare experimental farm containing 4000 microplots and 450 hybrids) of the Bácsalmás State Farm. The investigations were carried out partly on microplots (35 m^2) and on larger plots (0,5 hectare). In the research 6 sunflower varieties were included, sown at different dates: April 15th, May 15th and June loth and we surveyed both the damage caused by the larvae and the effectiveness of parasitoids. We reared under laboratory conditions the larvae of the ectoparasitoid Habrobracon hebetor, which were collected together with the attacked moth larvae. To complete the field surveys, we observed the life cycle and ethology of this beneficial hymenopterous parasitoid.

RESULTS

a./ The damage caused by Homoeosoma nebulellum Hb.

The damage caused by the different generations of H. nebulellum

was very different even in case of the same sunflower variety but sown at different dates (April 15, May 15, June 10). For example in case of the Toma consumpion hybrid sown at the normal sowing time the infestation was 1,27 % (in the infested head 1-2 larvae appeared), while the same hybrid has shown in the May 15 plots 6,83 % (3,42 larvae per infested head) and in the late (June 10) sowing the infestation reached 76,42 %, with 13,45 larvae per head. This tendency manifested itself in all sunflower varieties and hybrids susceptible to H. nebulellum (e.g. IS-8008, Bajai White, Iregi Grey Striped etc.). The late sowings (May-June) were thus favourable for the second and partial third generation, which contribute to the damage caused by different fungi (especially Sclerotinia sclerotiorum). This circumstance draws our attention to the importance of the optimal sowing time, which can also be considered as an agrotechnical control method in case of moth-susceptible sunflower varieties and hybrids.

b./ The effectiveness of parasitoids

Horváth (1991) found the first H. hebetor adults on July 11, 1991 on H. nebulellum larvae that were damaging on Toma consumption hybrids and between 11 an 17 August of the same year all larvae were found parasitized. At this time the activity of the parasitoid approaches 90 % efficiency and it is capable of decreasing significantly the damage caused by the second larval generation. Hybrids, that are sown on June loth ripe between 10-20 September, when the third generation larvae cause considerable damage (20-30 larvae may appear per head) until the first autumnal frosts. At this time the effectiveness of H. hebetor is about 25-30 %. The number of H. hebetor individuals significantly decreases (although the adults are still active by the end of September and beginning of October). Some predators, like Coccinella septempunctata L. and Adalia bipunctata L., Nabis ferus L. and some Orius bugs contributed to their natural control. Nevertheless, their common activities were not sufficient to prevent the outbreak of the H. nebulellum population.

c./ Life cycle and ethology

Habrobracon hebetor Say (syn.: H. vernalis Szépligeti, H. brevicornis Wesmael, H. juglandis Ashmead, H. flavus Telenga, T. turceta-

tern Europe, America, Georgia, Armenia, Azerbaidzhan and Central Asia Narzikulov (1982). According to Zerova (1989) it is a typical geopolitan species. It leads an ectoparasitic life, living on 10 different hosts, both of hidden and open life cycles. The adult attacks the full-grown larvae of H. nebulellum and paralyzes them (fig. 1) then lays a varied number of eggs on their victims. According to Narzikulov (1982) it lays 1-12 or even sometimes as much as 40 eggs on a caterpillar. In our investigations we did not find a higher number than 10, because on the average 5-6 pink larvae fed on the paralyzed H. nebulellum larva (fig. 1-2). According to Zerova (1989) the egg-production of the female (fecundity) can reach 300. After feeding on the body fluids of the host, the parasitoid larvae finish their feeding after 5-6 days. They form then white, loose cocoons on the victim itself, on the "shoulder" of surrounding seeds or in the protection of the squama. Zerova reported (1989) that the pupation period lasted for 12-15 days, in our investigations we found only 5-9 days. According to Narzikulov (1982) a generation develops for 10-12 days in the summer in South-Tadzhikistan and for 14-18 days in the autumn. In Hungary it takes 12-14 days. The number of annual generations is 8-9 (Narzikulov, 1982) according to Zerova (1989) 2-3 and under Hungarian conditions we have found 6-7 generations. This species does not show a summer diapause or quiescense. The adults overwinter between fallen leaves, in bark cracks of trees, where they retire from the end of October; the full-grown larvae can overwinter also in the loose pupal cocoon (Zerova, 1989). Spring flight starts at the end of March.

d./ The hosts

The hosts of H. hebetor are known from the literature. According to Zerova (1989) the following species have to be mentioned: Archips rosana L., A. xylosteana L., Pandemis cerasana Hb., Spilonota ocellana E., Laspeyresia pomonella L. (Lep.: Tortricidae), Pexicopia malvella Hb., Anarsia lineatella Z. (Lep.: Gelechiidae), Etiella zinckenella Tr. (Lep.: Phyticidae), Helicoverpa armigea Hb., Heliothis peltigera Den. et Schiff. (Lep.: Noctuidae). Narzikulov (1982) adds to the list of hosts Heliothis armigera Hb., Reichart (1959), Shenefelt (1978), Horváth (1981) Homoeosoma nebulellum Hb.

DISCUSSION, CONCLUSSIONS

Habrobracon hebetor Say is a polyphagous, ectoparasitic braconid, that develops under Hungarian conditions in 6-7 generations. Its hosts are mainly lepidoptera, some of them cause considerable damage in the agricultural plants. The effectiveness of this species reached 90 % in our studies in the 2nd host generation, whereas it reached 25-30 % in the high-density 3rd generation. It can be reared well under laboratory conditions and it is quite polyphagous about its hosts. The relatively slow movement of adults makes laboratory work comparatively easy. This species is used in biological control in Russia on a large territory against Heliothis armigera Hb. and Pexicopia malvella Hb. According to Narzikulov (1982) the effectiveness of Habrobracon hebetor Say is about 40-50 % on the average (min. 5-10 %, max. 80 %) in case of a release of 1000 individuals per hectare. This species seems to be able to prevent outbreaks of the sunflower moth, so according to our opinion it merits by all means to be saved and protected.

We hope that later on the American entomologists will also be able to work with this species as for its ability to decrease the density of Homoeosoma nebulellum and Cochylis hospes.

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REFERENCES

1. BUJÁKI G. /1980/: A napraforgó kártevői és ..., Doktori értekezés, Gödöllő, 91 p. - **2. GOZMÁNY L.** /1959/: Microlepidoptera VII. Fauna Hungariae, XVI. Nr. 5. - **3. HORVÁTH Z.** /1981/: A sáfrányos szeklice (Carthamus tinctorius L.) fészekvirágzatából kinevelt hártyásszárnyú (Hymenoptera) paraziták. A Bácsalmási Napraforgótermelési Rendszer Technológiai Kiadványa, Bácsalmás, 1981. Kézirat - **4. HORVÁTH Z.** /1989/: A napraforgó kártevői. In: Frank J. - Szabó L. (Ed.): A napraforgó. Magyarország Kultúrflórája. 208-221. pp. VI. kötet, 15. füzet, Akadémiai Kiadó, Budapest, 1-413. - **5. HORVÁTH Z.** /1991/: A napraforgóban előforduló Orobanche fajok. Napraforgótermesztési Tudományos Tanácskozás, Szeged, 1991. december 11., 20. p. - **6. KADOCSA GY.** /1942/: Védekezés a napraforgómoly ellen. Köztelek. LII. Nr. 45., Budapest - **7. NARZIKULOV, M. N.** /1982/: Annotirovannüj szpiszok parazitov i his'csnikov osznovnüh vreditelej hlopcsatnika v szrednej azii. In: International Organization For Biological Control Of Noxious Animals And Plants. Information Bulletin. EPS IOBC 5. Leningrad, 1982. 31-32. pp. - **8. PLAVILSCSIKOV, N. N.** /1950/: Opreditel' naszekomüh. Moszkva, 1950. 442. p. 1-543. - **9. SCHMIDT, M.** /1955/: Landwirtschaftlicher Pflanzenschuts. Zweite, erwiterte Auflage. p. 238. Berlin - **10. SCSEGOLEV, V. N.** /1951/: Mezőgazdasági rovartan. Akadémiai Kiadó, Budapest, 461-462. p. 1-695. - **11. SZARUKÁN I.** /1979/: Növényvédelmi állattani gyakorlatok. III/1. Debreceni ATE. p. 32-33. - **12. ZEROVA, M. D.** /1989/: Annotirovannüj szpiszok naszekomüh - parazitov lisztovertok, povreszdajuscsih jávlonju na jugo-zapade evropejszkoj csaszti CCCP. 28-29. p. In: International Organizatica For Biological Control Of Noxious Animals And Plants. Information Bulletin. EPS IOBC 28. Leningrád, 1989.