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NOTES ON THE BIOLOGY OF LARIOPHAGUS DISTINGUENDUS (FOERSTER) (HYM. PTEROMALIDAE) AS A PARASITE OF SITOPHILUS ORYZAE (L.) (COL. CURCULIONIDAE)

by

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ABSTRACT

Some aspects of the biology of Lariophazus distinguendus as a parasite of Sitophilus oryzae . were studied.

Most of the adult male and female parasites emerge from the wheat kernels 17 and 18 days respectively after oviposition. Maximum longevity for males and females is 7 and 12 days, respectively. The preferred hosts are mature larvae before pupation. The mean number of offspring per female is 39.6, and oviposition is distributed over the entire life span of the female. Two parasite- eggs were' found on about 1/3 of the hosts attacked, but usually only one parasite develops.

The significance of the results obtained was discussed with emphasis on the parasite's ability to serve as a natural regulating factor of the population, of the . rice weevil.

INTRODUCTION

The use of insecticides is still the most accepted method for the control of stored products insects. However, the problem of insecticide residues and the evidence of development of resistance to the common insecticides among stored products insects (Busvine, 1962; Parkin, 1965), have focused attention on the possibility of alternative control measures. One of the possible methods is biological control. For this it is important to know the role of parasites of stored products insects in regulating and reducing their host populations.

The larval stages of the rice weevil, Sitophilus oryzae (L.) which is a most serious pest of stored products in tropical and sub-tropical countries, serve as a host for several hymenopterous parasites. One of the most common

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of these parasites is Lariophagus distinguendus (Foerster).
Kashef (1959a, b, 1961, 1964, 1965) and Ryabov (1926a, b) studied some aspects of the biology of this parasite, and the latter author even suggested its use for biological control in cases where chemical treatment is impossible.

Lariophagus distinguendus is also known as a parasite of other stored products pests such as Sitophilus granarius L. (Col. Curculionidae) (Goodrich, 1921; Kashef, 1959b, 1964; Ruschka, 1921; Ryabov, 1926a; Vucasovic, 1932), Rhizopertha dominica F. (Col. Bostrychidae) (Goodrich, 1921; Kashef, 1959b, 1964). Stegobium paniceum L. (Col. Anobiidae) (Champ. 1966; Hase, 1924; Kashef, 1956, 1959b, 1964; Ruschka, 1921), Ptinus tectus Boiled (Col. Ptinidae) (Kashef, 1959b, 1961, 1964) and Gibbium psylloides Czemp. (Col. Ptinidae) (Kashef, 1964).

The purpose of this work was to obtain more information on the biology of this wasp as a parasite of the rice weevil, especially those aspects which might influence its efficiency as a natural control agent.

MATERIALS AND METHODS

a) Rearing method

The insects were reared at a constant temperature and relative humidity of 26 ± 1°C and 60-70%, respectively. The hosts were cultured on lots of 250 g of wheat grain at 11-13% moisture content, in two-liter glass jars. All cultures were started by placing 180-200 adult weevils in each jar. In order to obtain S. oryzae larvae of a known and homogenous age, the adult weevils were removed 36-48 hours later.

The parasite stock was started from a few specimens found in samples of infested wheat taken from a warehouse in the Tel-Aviv area. The parasites were identified by Dr. Z. Boucek (Dept. of Entomology, British Museum of Natural History).

For rearing the parasite, specimens of both sexes were introduced into jars containing adults, eggs and all stages of larvae of the rice weevil. The weevil cultures were started 24-26 days earlier by introducing adults into jars containing sterilized wheat grains.

Each culture jar was kept for not more than two generations, to prevent crowded populations and infestation by mites. After that period, the culture was destroyed.

b) The life-cycle of the parasite

Infested wheat kernels, for which the day of parasitization was known, were dissected every day, and the developmental stage of the parasite was determined.

c) Longevity of the parasite

Thirty-four males and sixty-five females, 0-4 hours old, were placed in a jar containing wheat grains infested by S. oryzae larvae, 24-26 days old. The dead adult parasites were removed and recorded daily.

d) The preferred host age for parasitization

In order to determine the preferred age of the host for parasitization, females of the parasite were given the choice between five different host ages: 14, 18, 26, 32 and 36 days. Five lots of 5 g of wheat kernels, each infested with S. oryzae larvae of one of the mentioned ages, were placed in petri-dishes divided into 5 compartments. The divisions in the petri-dish were sufficient to separate the lots of grain, but allowed free movement of the parasites between compartments. Ten females and 5-8 males of the parasite were then placed in each dish for 24 hours. After this period the parasites were removed and the wheat kernels of each lot were kept separately. When emergence started, daily recordings of emerging hosts and parasites were made. The experiment was repeated 17 times.

e) Productivity of the parasite

Fourteen separate couples of the parasite, 0-4 hours old, were placed on wheat kernels infested by S. oryzae larvae 25-26 days old, and then transferred daily to similar infested kernels.

Daily counts of emerging parasites were made from each oviposition lot.

RESULTS

a) The life-cycle of the parasite

The developmental time from ovipositon to adult emergence of the parasite is shown in Fig. 1.

All parasite eggs hatched during the 1st day after being laid. The larval period lasted five more days, and on the 7th day after oviposition the parasites entered the pre-pupal stage. On the 8th day, the vast majority were already pupae. From the 14th day on, adult males were found inside the wheat kernels. Adult females began to appear inside the kernels one day later. This difference of one day was found also when the emergence of adults from the wheat kernels was studied.

Most of the males emerged on the 17th and 18th day after oviposition (range 16-23 days). The females started to appear one day later, most of them on the 18th and 19th days (range 17-23 days).

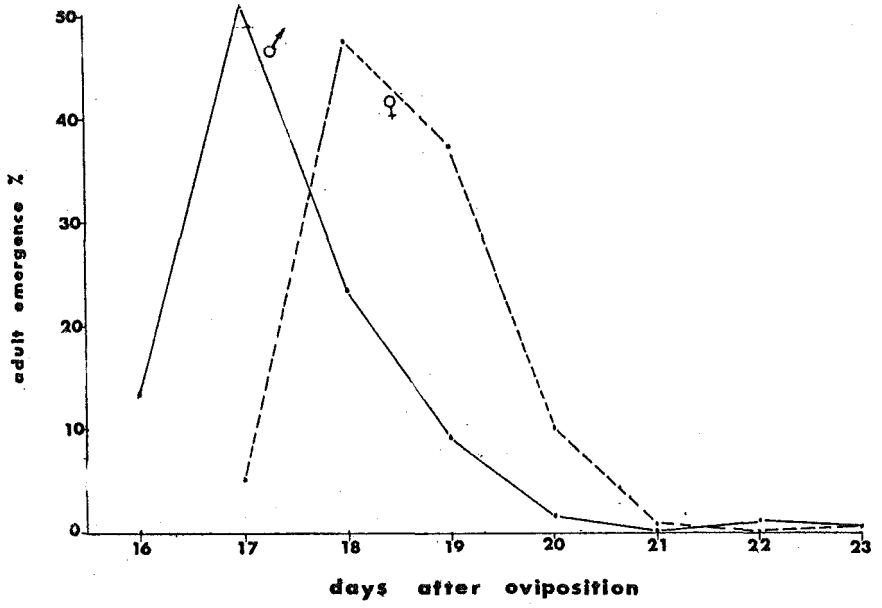

Fig. I. The developmental time of L. distinguendus on S. oryzae larvae.

b) Longevity of the parasite

Fig. 2 shows the difference in longevity between the sexes of the parasite. Ninety percent of the males died during the first 5.5 days, at which time female death had reached only 30%. Maximum longevity of males and females was found to be 7 and 12 days, respectively.

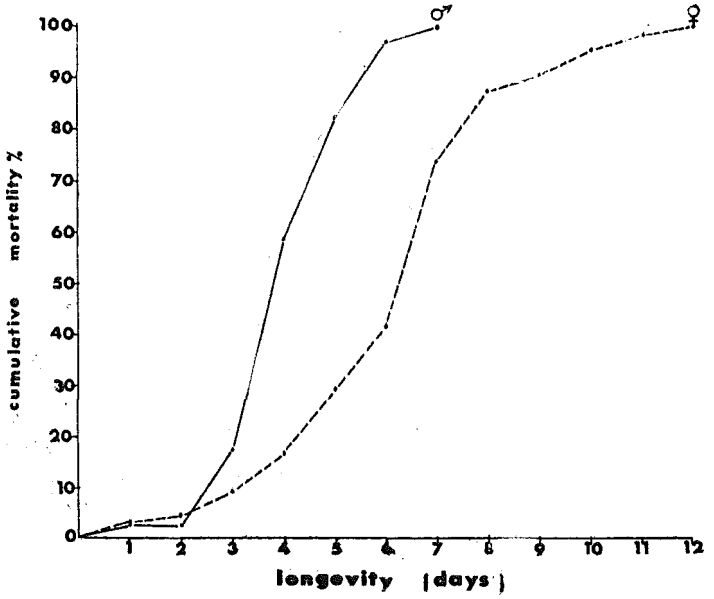

Fig. 2. Longevity of L. distinguendus.

c) The preferred host age for parasitization

Fig. 3 shows an increase in parasitization from 0.0% in hosts 14 days old, to 57.4% in 26 days old hosts. This peak is followed by a decrease in parasitization to 5.2% in 36 days old hosts.

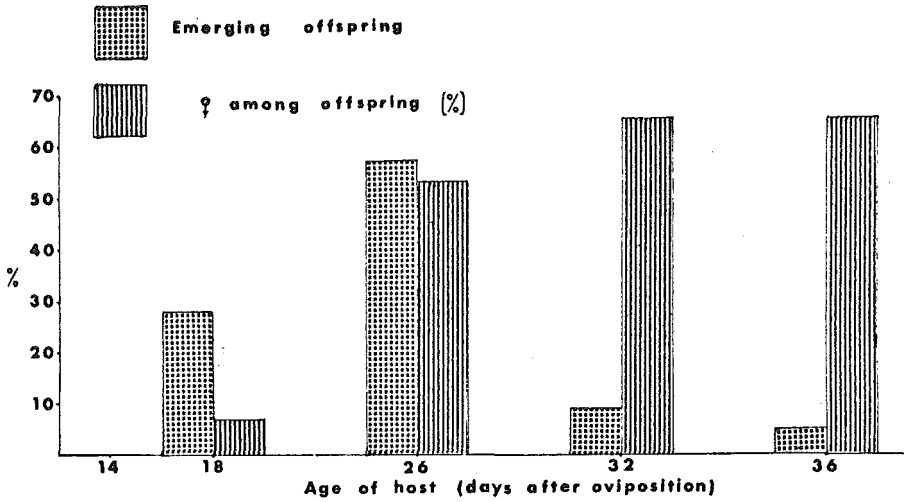

Fig. 3. Distribution of emerging adult parasites from hosts of different ages and % of female parasites.

Table 1

Developmental stage of S. oryzae at different times after oviposition

Age (days)	No. Kernels examined	Developmental stage (%)		
		Larvae	Pre-pupae	Pupae
18	53	100.0	0.0	0.0
26	66	81.8	18.2	0.0
32	86	23.2	33.8	43.0
36	74	9.4	20.3	70.3

A comparison of these results with those shown in Table 1 shows that the most susceptible stage for parasitization is the mature larva.

Another evident correlation exists between the age of the host and the sex ratio among adult parasites (Fig. 3). The proportion of females among emerging adult parasites increases with host age at time of parasitization.

d) Productivity of the parasite

The results are given in Fig. 4. The mean number of offspring per female was 39.4 (range 2-58). This low number of offspring was distributed among the entire series of groups of wheat kernels used for daily oviposition, though there was a tendency for decrease in emergence from wheat kernels used during the last days of adult female life.

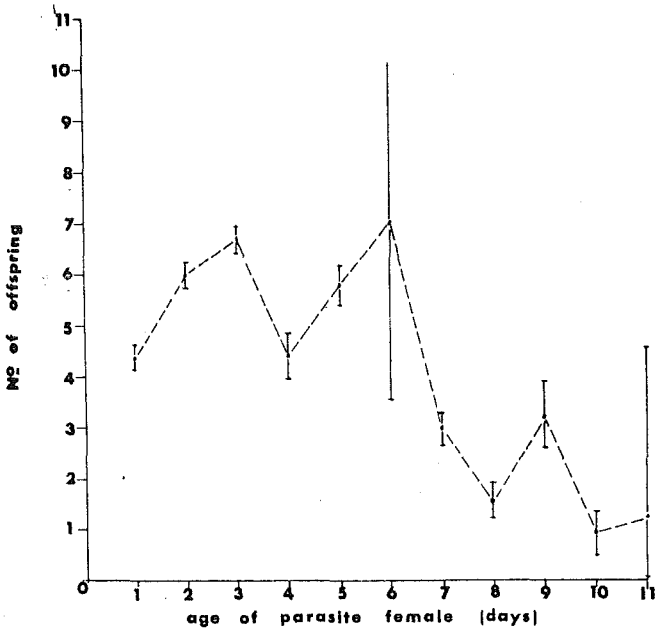

Fig. 4. Distribution of emerging parasite adults among lots of wheat kernels used for daily parasitization.

e) Superparasitism

More than one parasite egg was found on each S. oryzae larva in 31 out of 103 infested kernels that were opened 1-2 days after parasitization.

A hundred and eighty-four wheat kernels, from which adult parasites had emerged, were opened and the meconiae in each grain were counted. Only in two cases were two meconiae found.

Evidently, only in very few cases more than one parasite larva finished its development on a single host.

DISCUSSION

The longevity of L. distinguendus is very short in comparison with that of S. oryzae, and as pointed out by Burnett (1960), such a great difference in longevities might be of disadvantage to the parasite in controlling the host population.

The productivity of L. distinguendus is low not only in comparison with that of its studied host, but also in comparison with other Pteromalidae (Clausen, 1940; Nagel and Pimental, 1963, 1964; Noble, 1932). This low productivity is a second factor which might reduce the parasite's effectivity in controlling the host population. As the difference in rate of reproduction between the parasite and host increases, the parasite becomes unable to cope with the rate of increase of the host population, which is a most important factor if effective control is to be achieved (Burnett, 1959).

Two further phenomena render it more difficult for the parasite to control the host population:

a) The fact that eggs which were oviposited on 18-days old host larvae produce mainly males (90%) (Fig. 3), has an important influence on the sex ratio between adult parasites. This is important from the standpoint of biological control.

b) The relatively high frequency of cases of two eggs deposited on a single host, from which usually only one parasite developed, resulted in the waste of eggs and a decrease in the number of hosts attacked.

In spite of these findings, it seems that more biological and ethological characteristics of the parasite are worth being investigated, before final conclusions can be drawn.

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