Bionomics of *Lariophagus distinguendus* (Föerster) (Hymenoptera: Pteromalidae) parasitizing *Callosobruchus chinensis* (Coeoptera: Bruchidae)

Deng Wangxi¹, Yang Shicheng², Li Ruhai³

**Abstract**
In Wuhan, observations reveal that *Lariophagus distinguendus* (Förster) is one of the major parasitoids in larvae and pupae of *Callosobruchus chinensis* L. and *Callosobruchus maculatus* (Fabricius) in warehouses. The natural parasitization rate is 39.2%. The pupae overwinter in the tunnel of *C. chinensis*. The sex ratio of female to male is 7:3. At 25±20°C and 75±5% R.H. The longevity of female and male adults is 6.3±1 days and 55.5±1 days, respectively. The entire life cycle from egg hatch to adult takes 16 to 20 days with an average of 18 days. The adults can emerge at day and night, but emergence at night occupies 67.6% of all. Both female and male adults copulate many times, and copulation and oviposition take place alternately. Each female lays 15 to 19 eggs during its entire life span. Each larva of *C. chinensis* can be parasitized by 1 to 11 parasite wasps. After parasitized, the young instar larvae of hosts turn into drying, then to death. Old instar larvae can emerge to deformed adults because of the disability to bore out of emergence hole. *L. distinguendus* is sensitive to Malathion. The corrected mortality reaches to 100% after 24 hours at 10ppm concentration. Whereas it isn't sensitive to K-Othrine, the corrected mortality is only 7.9% after 48 hours at 0 ppm concentration.

**Materials and Methods**

**Origin of insects**
*Lariophagus distinguendus*, *Callosobruchus chinensis* and *C. maculatus* were collected from Experimental and Teaching Ranch Warehouse of Huazhong Agricultural University.

**Cultivation method**
Group cultivation was carried on in jars (500ml, Ø100mm) containing 100g sterilized Chinese cowpea with 13.5% moisture content. *C. chinensis* and *C. maculatus* and *L. distinguendus* were raised in the jars sealed with copper 70# sieves.

**Bionomics of *L. distinguendus***
10g Chinese cowpea infested by hatched eggs of *C. chinensis* and *C. maculatus* and 1 pair of latest emerged female and male adults of *L. distinguendus* were mixed into a 15 × 2cm cultivation tube for experiments. Oviposition, mating behavior, life cycle and span of the adults were under observation. 20 cubes were set up and a random sampling was undertaken day by day. Samples were soaked and sectioned and data of parasitoid progress and parasitoid density could be obtained.

**Tests of sensitivities to pesticides**
A solution containing 50% Malathion (provided by Ningbo...
Pesticide Plant) at 10 and 15 ppm concentration and 2.5% K-Othrine (provided by Roussel UCLAF) at 0.5 and 1 ppm concentration respectively was applied to blend with Chinese cowpea. The treated peas were exposed to air to dry up and then were placed into jars. 30 *L. distinguendus* adults emerged 1 or 2 days before were introduced into the jars thereafter. Each procedure mentioned above was repeated 3 times. Clean water spray was used during the experiment. Calculation of dead parasitoids was carried out every 24 or 48 hours. The corrected mortality was hence obtained.

**Results and Analysis**

**Life history**

In the natural environment, the parasitoid larvae overwinter in the tunnel dug by hosts in the peas. Overwintering larvae emerge to adults in early April and subsequently bore out and complete mating and oviposition. At 25 ± 2°C, this cycle takes 16 to 20 days with an average of 18 days. The longevity of adults is 2 to 7 days, 4.3 days for female and 3.1 days for male. While fed with nutrition liquid with 10% bee honey, the longevity extended obviously. The longevity of female reached to 11.3 days and male 8.2 days.

**Emergence**

Before emergence, the parasitoid uses its mouth to bite out a 1 mm diameter hole at the thinnest part of the tunnel dug by the hosts. While emerging, its head and upper body bore out of the emergence hole first with swing of its whole body. Its upper body then bends over its abdomen and pulls out the rest of the body. Even if a *C. chinensis* can be parasitized by over one parasite, it only makes one emergence hole. The adults can emerge day and night, however, 67.6% of all emergence is at night. In the day, emergence happens most frequently in the morning.

**Mating and oviposition**

Adults start mating immediately after their emergence from peas. While mating, male adult climbs upon female adult and licks the antenna of female adult with its mouth parts. The female adult paralyzes soon. The male inserts its penis into the end of the female's abdomen. At this time the mating adults gesture vertically. The penis stays in the female's body for 1 to 5 seconds for each insertion, which repeats 3 to 5 times. Both female and male can mate many times. Mating and oviposition take place alternatively. The adults are moving around to search for their hosts. The female adults could lay eggs immediately after mating. Before oviposition, the female adults frequently search the hosts with their antennae on the surface of the pea pile. They stop moving once they find the trace of *C. chinensis* in the peas. They probe their ovipositors into the pea and move down vertically. The eggs are laid on the surface of larvae of *C. chinensis* or beside the wing tips of the moth. Female adults can oviposit even without mating. The male adult can thereafter emerge from the egg. Mating also happens inside the pea. If female and male co-exist in one tunnel, the female will not mate any longer after it bore out of the pea. The progeny could be both male and female. In some cases, the ratio of female is relatively larger (Table 1).

**Table 1. Comparison of sex ratio of progeny produced by solitary female and mating of female and male.**

<table>
<thead>
<tr>
<th>Form of female and male in the tunnel</th>
<th>Mating</th>
<th>Female adult</th>
<th>Female progeny</th>
<th>Sex ratio (F:M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-existence</td>
<td>No more mating after emerging of the hole</td>
<td>10</td>
<td>67</td>
<td>4:43</td>
</tr>
<tr>
<td>Solitary female</td>
<td>No mating after emerging out of the hole</td>
<td>10</td>
<td>67</td>
<td>0:51</td>
</tr>
</tbody>
</table>

**Reproduction ability**

Autopsy was undertaken in the ovipositors of female adults and it was found that there were 16 to 25 eggs with an average of 19.3 in each pregnant female adult. However, each female adult only lays 15 to 19 eggs with an average of 17. The sex ratio of the progeny is 7:3.

**Searching and parasitoid behavior**

While *L. distinguendus* was placed into the jars containing peas infested and not-infested by *C. chinensis* respectively, it was found that there were frequent searching activities occurring in both jars. However, 3 hours later, *L. distinguendus* adults' activities were only found in those infested peas. 30 days later, it was observed that the progeny of *L. distinguendus* was only found in infested jars. It indicated that *L. distinguendus* found peas by its smell function and then only oviposited after further detection. The autopsy undertaken demonstrated that *L. distinguendus* can parasitize during all life span of the larvae and moths of *C. chinensis*. It can also carry out cross-span, namely larvae-moth parasitization. The parasite larvae feed on body liquid of the hosts. When the host larvae are parasitized by many *L. distinguendus* or the young instars are parasitized, the body of *C. chinensis* dries up and only skins are remained. The dead body is scattered.
with brown spots. Both heads and tails could not be distinguished. When the host larvae are parasitized by small amount of *L. distinguendus* or the older instars or moths are parasitized, the host larvae can emerge to moths and hence the adults. However, the emerged adults are underdeveloped in smaller sizes, which are not able to bore out of the peas and will die in the end.

**Tests of sensitivity to pesticides**

The test results of Malathion and K-Othrine can be referred to in Table 2. The results indicate that *L. distinguendus* is highly sensitive to Malathion. The corrected mortality reached to 100% at 10ppm concentration after 24 hours’ exposure. It is not so sensitive to K-Othrine. The corrected mortality is 4.2% at 1ppm concentration after 24 hours and 14.2% after 48 hours.

**Table 2. Anti-drug tests of *L. distinguendus*’ sensitivity to Malathion and K-Othrine.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Corrected Mortality after 24 hours(%)</th>
<th>Corrected Mortality after 48 hours(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10ppm Malathion</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>15ppm Malathion</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>0.5ppm K-Othrine</td>
<td>-2.7</td>
<td>7.9</td>
</tr>
<tr>
<td>1ppm K-Othrine</td>
<td>4.2</td>
<td>14.2</td>
</tr>
</tbody>
</table>

**Discussions**

The natural parasitization rate of *Lariophagus distinguendus* can reach to 39.2%. The population of *C. chinensis* can be effectively controlled if a certain amount of *Lariophagus distinguendus* is introduced into the warehouse. Once infested with *C. chinensis*, Chinese cowpeas will lose its economic value with empty hulls left. When *Lariophagus distinguendus* parasitizes *C. chinensis*, it only bites out 1mm diameter large hole in the pea. The life circle of *Lariophagus distinguendus* is short and can produce two generations during one life circle of *C. chinensis*. It has strong capability to search for hosts and thereafter oviposit inside the hosts. The cultivation method is not sophisticated. It is feasible to apply *Lariophagus distinguendus* in control of *C. chinensis* if an efficient approach to cultivate *Lariophagus distinguendus* in large amount is tabulated out.

**References**

