Characteristics of *Etiella hobsoni* (Butler), the Newly Recognized Podborer of Soybean in Indonesia, as Compared with *E. zinckenella* (Trei.)

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Introduction

Etiella podborers (Lepidoptera Pyraridae) of soybean have been thought to be a single species, *Etiella zinckenella* (Trei.), since it was first recorded by van Hall in 1920[9] in Indonesia. However, we found another species of podborer belonging to the same genus in 1982, in pursuing "the investigation on soybean insect pests", a research subject of Indonesia-Japan Joint Agricultural Research Project ATA 218. This was confirmed to be *E. hobsoni* (Butler), a new podborer of soybean. The morphology of each developmental stage of this insect and damage symptoms it causes on soybean are closely similar to *E. zinckenella*. Consequence is that *E. hobsoni* has long been confused with *E. zinckenella* in this country.

E. hobsoni causes serious damage as *E. zinckenella* does to soybean in Java. Up to 80% of the soybean pods in the field have been observed to be damaged by the podborers. In order to establish an effective control method of these insects, we started a series of studies on methods of discriminating them, ecology, chemical control and varietal resistance among some soybean varieties, etc., in 1981.

These results were reported in several papers separately.[1,6,7,8] In the present paper, these studies are reviewed to provide a reference material in the regions of Southeast Asia where both the podborers are distributed.

Morphological comparison

1) *Larva*

The larvae can be identified after carefully examining following external characters with a microscope.

Head: Adfrontal sutures of *E. hobsoni* are extending to the vertical triangle; those of *E. zinckenella* meet on epicranical stem at a point about one fifth between front and vertical triangle (Fig. 1).

Prothoracic shield: Posterior black patches are usually bigger and more conspicious in *E. hobsoni* than in *E. zinckenella* (Fig. 1).

Abdominal spiracles: Spiracles of *E. hobsoni* are rather small and rounded.

Setae: The setae of *E. hobsoni* are, in genral, slightly finer and longer than those of *E. zinckenella*. But it is difficult to identify individual specimens on the basis of the difference of setae.

2) *Adult*

Both adult moths are distinguished without so much difficulty by checking following points.

The ground color of the forewing of *E. hobsoni* is dark reddish brown, without white costal streak. Antemedial transverse

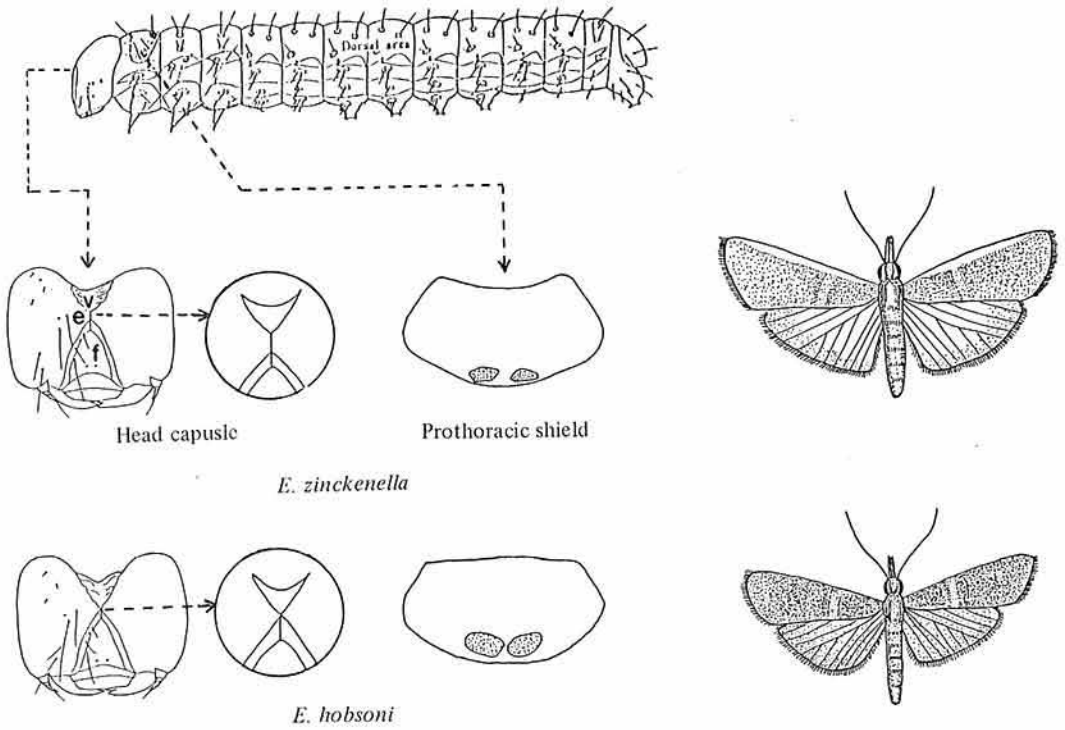

Fig. 1. Distinguish points of *E. zinckenella* and *E. hobsoni*
e: epicranial stem, f: front, v: vertical triangle

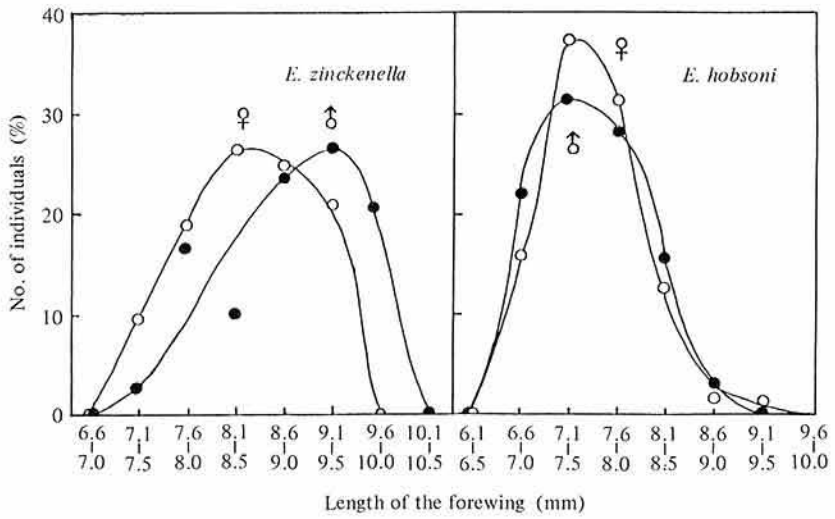

Fig. 2. Difference in size of the adult moth between male and female of *E. zinckenella* and *E. hobsoni*

fasca is orange edged with metallic scales. On the other hand, the forewing of *E. zinckenella* is variably colored from reddish brown to purplish gray, but not dark, and usually with an obvious white costal streak. When the adult moths are folding their wings, the ante-

medial bands in the forewings of *E. hobsoni* are seen as a straight transverse band across the wing, while those of *E. zinckenella* are not straight.

E. hobsoni is generally smaller than *E. zinckenella*: the length of the forewing of the former is 7.5 ± 0.6 mm, while that of the latter 8.7 ± 0.7 mm in Indonesia specimens.

3) Egg and pupa

To distinguish the two species in egg and pupal stages is quite difficult. The eggs of both species are elliptical, slightly flat and almost of the same size (about 0.5×0.3 mm). However, mesothorax of the pupa of *E. zinckenella* is rather strongly curved posteriorly than that of *E. hobsoni*.

4) Differences of size between male and female in both species

The male adult moth and pupa of *E. zinckenella* are usually bigger than the female, while the sizes are nearly the same in both sexes in *E. hobsoni* as shown in Fig. 2. The same phenomenon is seen in the data of pupal weight in the reports of Naito[4] and Hattori and Sato.[2] With *E. hobsoni*, these features were not observed.

Comparison of the geographical distribution

E. zinckenella is widely distributed throughout the tropical and temperate zones,[5,10] while *E. hobsoni* is distributed from Southeast Asia to Australia as shown in Fig. 3. *E. hobsoni* is so far known in Australia (Queensland, North and South Australia), New Guinea, Wetar, Timor, Solomon, New Britain, Caroline, Truck Is., and Formosa.[10] In our survey, this insect was also confirmed in Sumatera, Java and Sulawesi in Indonesia as mentioned below. It may also be distributed in Kalimantan, Malaysia and Philippines.

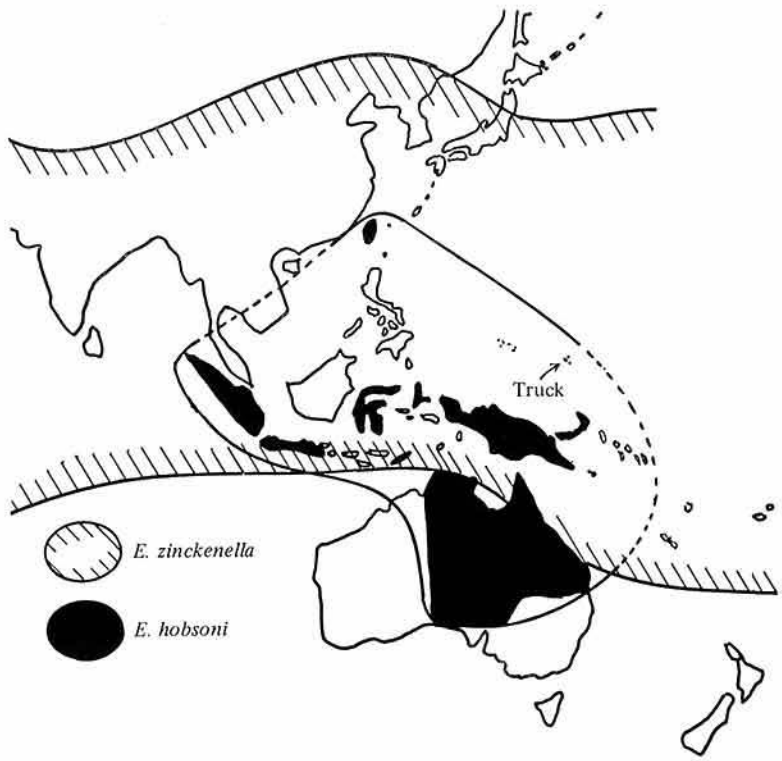

Fig. 3 Geographical distribution of *E. zinckenella* and *E. hobsoni* in Southeast Asia and its surrounding areas

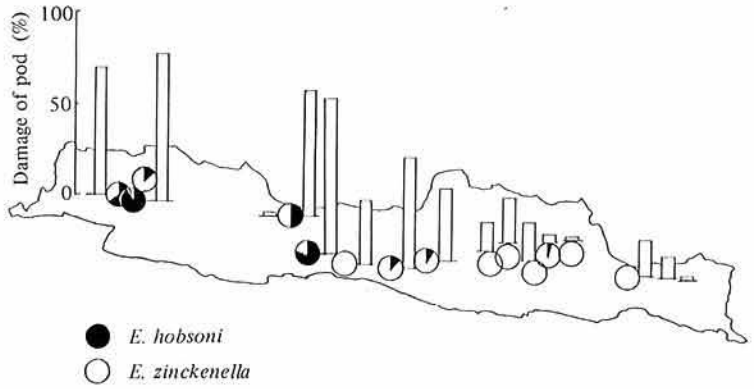

Fig. 4. Distribution and abundance of *E. zinckenella* and *E. hobsoni* in Java

Java: The relative abundance of the two species and total amount of the damage caused by them in each district are shown in Fig. 4. *E. zinckenella* is distributed all over Java, while *E. hobsoni* is mainly restricted to West and Central Java. In East Java *E. hobsoni* is seldom found.

The damage caused by the borers is generally heavy in West and Central Java, especially in the Banyumas area, where both species occur abundantly. Damage is not severe in East Java where only E. *zinckenella* is present. In the vicinity of Bogor in West Java, *E. hobsoni* was dominant at Cikeumeu Farm of the Bogor Research Institute for Food Crops throughout the year.

Sumatera: *E. hobsoni* was found in all the places observed; Patara Tani Farm near Palembang in East Sumatera, Sitiung and EC Project Farm in West Sumatera and Sukoharjo near Metro in Lampung. However *E. hobsoni* was not so abundant as compared with *E. zinckenella.*

Sulawesi: A small number of *E. hobsoni* were collected at Gowa and Takalar which are located in the south of Ujungpandang, but not found at Tonasan and Boloci Utara situated in the north of the city. *E. zinckenella* was common in all places.

Comparison of ecology of the two species

1) Duration of development stages

The duration of the egg stage is about 4 days irrespective of the species. When newly deposited, eggs of both species were white, then changed to pink in the following 2 days. A slight difference is observed in the duration of the larval stage. It is about 15 days in *E. hobsoni*, nearly a day longer than that of *E. zinckenella.* Opposite relation is found in the larval period between both sexes of *E. zinckenella* and *E. hobsoni.* The period of *E. hobsoni* is longer in female than male, while that of *E. zinckenella* is slightly shorter in female (Fig. 5). The duration of the pupal stage is about 11 days for both species. These data were similar to the former report[4] for the Japanese population, in the same temperature range.

2) Behavior of newly hatched larvae

Some differences in walking behavior are found between *E. zinckenella* and *E. hobsoni.* Generally, the newly hatched larvae of *E. zinckenella* move around on the pod for a longer time and cover a greater distance with more complex routes than *E. hobsoni.* Some examples of the routes are shown in Fig. 6.

Walking speed of the larva of *E. hobsoni* is slightly faster than *E. zinckenella.* In a test on paper, the former walks 5.6 cm/min and the latter 4.5 cm/min on the average.

Sites of entrance hole of the newly hatched larvae on the soybean pod are a little different between the two species. The holes are

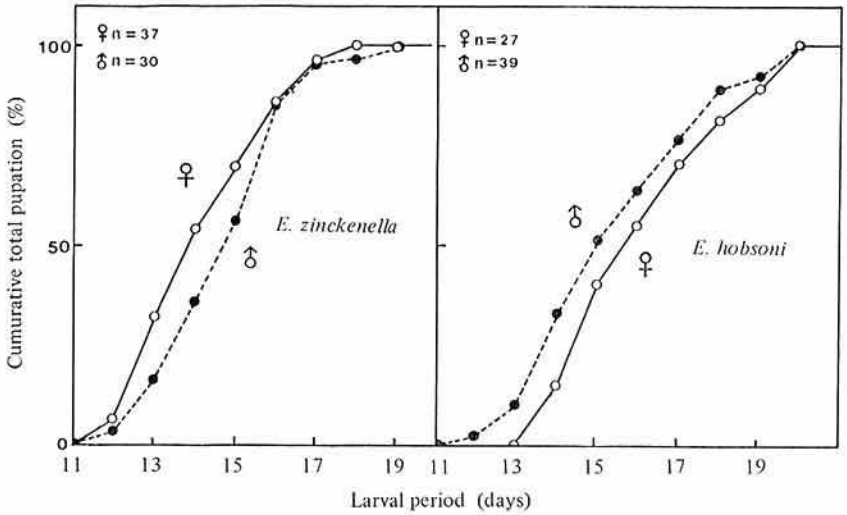

Fig. 5. Difference in larval period between male and female of *E. zinckenella* and *E. hobsoni*

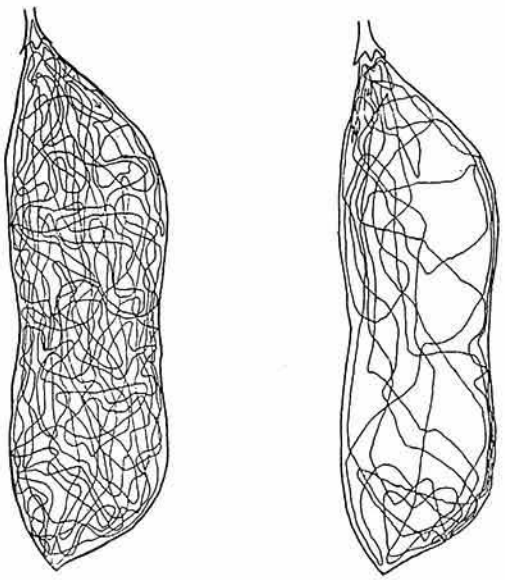

Fig. 6. Representative examples of routes of movement of newly hatched larvae
Left: *E. zinckenella*, Right: *E. hobsoni*

more aggregated on the marginal parts of the seed pods in *E. zinckenella*.

3) *Intraspecific and interspecific competition*

In both species the survival rate was negatively correlated to the number of larvae that had been inoculated on soybean pods, with higher mortalities at higher population densities, especially in *E. hobsoni*. The mortality of first inster larvae from the inoculation until entering the pod was higher at higher population densities, and the competitive mortality of *E. zinckenella* was slightly higher than that of *E. hobsoni*. It is thought that this mortality is due to cannibalism. Cannibalism is frequently observed when the first inster larvae are on the surface of the pod, especially near the entrance holes. The percentage of pods damaged tended to be higher at high larval populations but the final average number of matured larvae survived inside each pod was nearly 1 even when 2, 4 and 8 larvae had been inoculated. When the larvae of both species were inoculated at the same time on the same soybean pod, the mortality of *E. zinckenella* was 60%, while that of *E. hobsoni* was about 77%. These mortalities were little different from those when the two species were inoculated separately.

4) *Host range and host specificity*

From the field survey, soybean, crotalaria and *Tephrosia* were found to be the host plants of *Etiella* podborers (Table 1). Larvae of *E. zinckenella* were found on the wild plants of crotalaria and *Tephrosia*. Sometimes a high percentage of pod damage was

Table 1. Host plant survey and feeding test of *E. zinckenella* and *E. hobsoni*

Legume species	Host plant survey		Feeding test	
	E. zinckenella	*E. hobsoni*	*E. zinckenera*	*E. hobsoni*
Cassia sophora L.	—	—	×	×
Centrosena pubescense Benth	—	—		
Crotalaria juncea L.	++	—	○	○
Crotalaria sturiata L.	++	±		
Dolichos lablab L. (hyacinth bean)	—	—	△	△
Glycine max Merrill (soybean)	+++	+++	◎	◎
Phaseolus aureus (Roxb.) (mungbean)	—	—	○	○
Phaseolus vulgaris (L.) (red kidney bean)	—	—	○	○
Pisum sativum L. (peas)			○	○
Psohocarpus tetragonolobus (L.) (winged bean)	—	—	×	×
Pueraria phaseoloides Benth (dadap bean)	—	—		
Vigna hybrida (L.) (bush bean)	—	—		
Vigna sesquipedalis Frew (long bean)	—	—	○	○
Vigna unguiculata Walp. (cowpea)	—	—	○	○
Tephrosia purpurea Pers	++	++		

—: Not recognized as a host plant
±: Recognized only in a rare case
+: Few cases
++: Common
+++: Common, high percentage of pods damaged

×: Larvae did not develop
△: Larvae developed, but high mortality
○: Larvae developed normally
◎: Most larvae developed

observed. According to Kalshoven,[3] *Phaseolus* and *Vigna* were regarded as host plants of this insect, but these plants were not recognized as host plants in our survey. *E. hobsoni* was found on soybean and *Tephrosia*, while crotalaria was not a usual host plant of the insect.

As host plants of *E. zinckenella* in the world, 21 genera and 30 species of legumes were listed in the literature (Naito).[5] However, host plants of this insect vary considerably from area to area; for instance, soybean is a very important host plant in Far East and Southeast Asia, but it is not a host plant in North America. Conversely *Phaseolus* beans are damaged by this insect in North America but no damage is known in most of East and Southeast Asia. This fact suggests the existence of some ecologically different types.

On the other hand, when the larvae were reared on the pod of several legumes, both *E. zinckenella* and *E. hobsoni* were able to develop to the pupal stage on *Phaseolus* and *Vigna* which are not recognized as host plants in the field. Thus the significant differences in the host and host specificity of the two species seem to be related to the oviposition behavior.

Table 2. Oviposition preference of *E. zinckenella* and *E. hobsoni* on soybean and red kedney bean (Bogor)

	No. of eggs laid	
	Soybean	Red kidney bean
E. zinckenella	137.3	0
E. hobsoni	102.0	0

Average of 3 replications using one plant of each crop species.

5) Oviposition preference

From the oviposition tests in the laboratory and the field on soybean and red kidney bean (*Phaseolus vulgaris*), it was made clear that both *E. zinckenella* and *E. hobsoni* laid their eggs on the soybean plants, but not on the red kidney bean (Table 2).

6) Seasonal prevalence of occurrence of Etiella podborers in soybean field

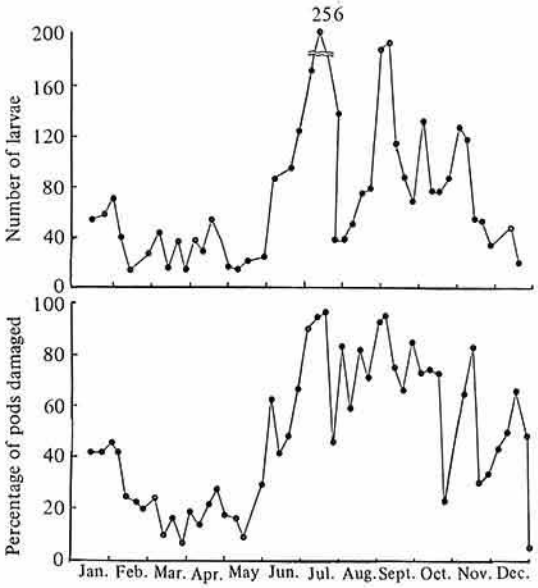

Fig. 7. Seasonal prevalence of occurrence of *Etiella* podborers and seasonal fluctuation in percentage of soybean pods damaged by these insects (1982, Bogor)

The seasonal prevalence of *Etiella* larvae and the damaged pods showed a similar trend in both species as shown in Fig. 7. A low population of larvae is observed in the wet season (January to May). The populations increase in the dry season (from the end of May or the beginning of June) and attains peaks in the end of June or in early July. The high population level continues until December. The percentage of damaged pods is also lower in the wet season, but increases in the dry season in accordance with the increase of the larval population.

Summary

General appearance of *Etiella hobsoni* (Butler) and symptoms of soybean pods caused by its larvae were quite similar to those of *Etiella zinckenella* (Treitschke). Morphological characteristics to identify the two species were made clear for each developmental stage. *E. hobsoni* is distributed from Southeast Asia including Indonesia to Australia, while *E. zinckenella* is widely distributed throughout the tropical and temperate zones in the world. Some ecological differences, such as a development period, larval movement, intraspecific competition and host plants, were found between the two species. The population density of *Etiella* larvae is low in the wet season, but it increases in the dry season.

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