Seasonal occurrence of *Riptortus pedestris* (Hemiptera: Alydidae) and its egg parasitism

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Abstract

Riptortus pedestris (Fabricius) (Hemiptera: Alydidae) is one of the major pests of soybean in Korea. *Ooencyrtus nezarae* Ishii (Hymenoptera: Encyrtidae) and *Gryon japonicum* (Ashmead) (Hymenoptera: Scelionidae), two important egg parasitoids of *R. pedestris* may play an important role in controlling the pest. *R. pedestris* is mobile stink bug which colonize various crops, but seasonal occurrence of *R. pedestris* as well as the parasitoids is poorly known. Understanding seasonal occurrence and movement of *R. pedestris* and its parasitoids is important to develop biological control program against the stink bug. We placed aggregation pheromone traps added with *R. pedestris* eggs in a field where a series of crops including barley, sesame, and soybean were cultivated and in an apple orchard in Andong, Korea to record seasonal occurrence of *R. pedestris* and its egg parasitism from March to December in 2009. In the field crops *R. pedestris* appeared from second week of April in barley and peaked during third and last week of August in soybean whereas in the apple orchard it appeared in May and peaked during August. *G. japonicum* started to appear in May and was dominant until the first week of August in the field crops. However, from the beginning of August and September *O. nezarae* became dominant in apple and soybean, respectively. These results suggest that *R. pedestris* population occurs from April in barley and reach highest in August in soybean. *G. japonicum* is dominant in spring while *O. nezarae* is more common in the fall.

Introduction

Riptortus pedestris (Hemiptera: Alydidae) one of the most important pests of soybean feeds on wide range of host plants in Korea and Japan.[1,2] *Ooencyrtus nezarae* (Hymenoptera: Encyrtidae) and *Gryon japonicum* (Hymenoptera: Scelionidae) are major egg parasitoids of *R. pedestris.*[1,3]

Information is available on seasonal distribution of *R. pedestris* and its field parasitism of its eggs in soybean. Most of the studies were done for a season by trapping *R. pedestris* using aggregation pheromone and collecting natural eggs from the field. But occurrence of *R. pedestris* before/after soybean culturing is rarely reported.

The aggregation pheromone of *R. pedestris* produced by males is known to attract not only conspecific adults and nymphs, but also the egg parasitoid *O. nezarae.*[4,5] We integrated non-viable refrigerated eggs of *R. pedestris* with aggregation pheromone trap and investigated the temporal dynamics of both *R. pedestris* population and parasitism by its egg parasitoids aiming differential occurrence of *G. japonicum* and *O. nezarae* before soybean cultivation and after soybean harvest.

Objective of this study is to find out occurrence of *R. pedestris* and its egg parasitoids before and after soybean cultivation in order to develop suitable management practice against the pest.

Materials and methods

Insect rearing : *R. pedestris* was reared as described by Alim and Lim[6] by keeping adults and nymphs in separate acrylic cages (40L×40W×40Hcm) with windows in three lateral sides covered with meshed screens for ventilation in the laboratory (24.1 to 28.8ºC). Eggs oviposited on a piece of gauge were collected daily and kept in zipper plastic bags for storage at 2.1±0.7ºC in a refrigerator. Eggs refrigerated for 30-35 days were used for the experiment.

Field sampling : Experimental fields for monitoring on barley, sesame, and soybean were in Songcheon (36º23'23.54"N, 128º47'29.42"E), Andong, and for apple orchard at Giran, Korea. Fish traps containing aggregation pheromone (50 µl/lures) [Myristyl isobutyrate, (E)-2-hexenyl (E)-2-hexenoate and (E)-2-hexenyl (Z)-3-hexenoate at the ratio of 1:5:1] of *R. pedestris* were placed on the edges of barley, sesame, and soybean fields and an apple orchard at Giran, Korea.

Each trap was provided with 50 refrigerated eggs of *R. pedestris* in a netted pouch (20L×15Dcm) attached to a hole of the trap such that only one opening of pheromone trap allows *R. pedestris* to enter. Traps were investigated weekly to record the number of *R. pedestris* attracted in the trap. The released host eggs were collected and brought into laboratory to keep them in micro tubes (2ml cap.) individually at 29.8±0.1˚C in a growth chamber. Hatching of *R. pedestris* eggs and emergence of adult parasitoids from the eggs were recorded daily.

Aggregation pheromone trap installed in barley field

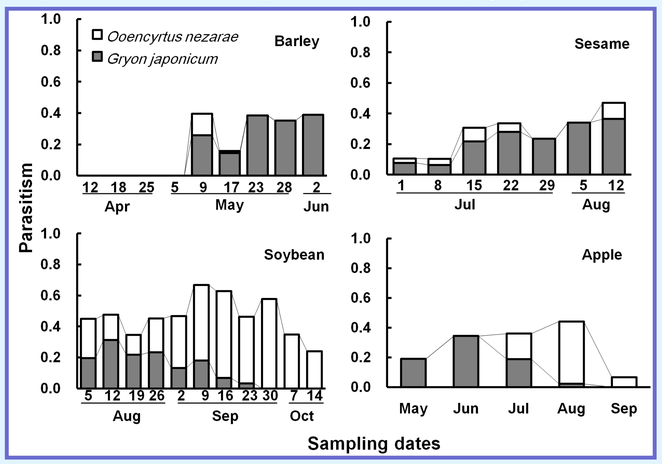
Results

Parasitism was first recorded on the released eggs collected on 9 May from barley field. Though parasitism by both *O. nezarae* and *G. japonicum* was recorded then, parasitism by *O. nezarae* was not found after the 2nd week of May. Very few parasitism by *O. nezarae* was recorded in sesame too. Parasitism by *G. japonicum* was found to be higher during May (Z_c=12.79, P<0.001), June (Z_c=7.23, P<0.001), and July (Z_c=7.87, P<0.001) than that by *O. nezarae*. However, there was no statistical difference in parasitism rate between *G. japonicum* and *O. nezarae* in August (Z_c=1.79, P=0.074). Parasitism by *O. nezarae* became significantly higher from September (Z_c=18.70, P<0.001) until October (Z_c=10.84, P<0.001).

After 2nd week of October parasitism was not recorded. When seasonal total parasitism was compared, parasitism by *O. nezarae* was found significantly higher than that by *G. japonicum* (Z_c=2.79, P=0.005). Parasitism rate by *G. japonicum* was as high as 39% in barley and highest parasitism rate by *O. nezarae* was 58% in soybean (**Fig. 1**).

In apple orchard, we found similar trend of parasitism. *G. japonicum* was found to be dominant in May (Z_c=5.66, P<0.001) and June (Z_c=8.22, P<0.001). Unlike parasitism in field crops, no statistical significance in parasitism between *G. japonicum* and *O. nezarae* was recorded (Z_c=0.28, P=0.770) in July, and dominance of *O. nezarae* was found from August (Z_c=8.92, P<0.001) to September (Z_c=3.07, P=0.002). There was no significant difference in seasonal total parasitism by *G. japonicum* and *O. nezarae* (Z_c=3.07, P=0.530). However, no parasitism by either species was recorded in apple orchard in October (**Fig. 1**).

Fig. 1. Parasitism by *O. nezarae* and *G. japonicum* in barley, sesame, soybean fields and apple orchard



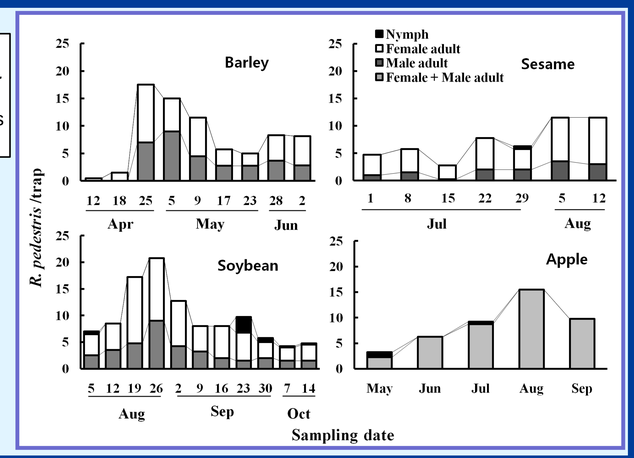
R. pedestris was found in the trap installed on barley field as early as the beginning of the second week of April. Population increased from the last week of April to second week of August without significant fluctuation. Population peaked during the last week of August in soybean (21 per trap), and sharply decreased after the first week of October. In apple orchard, density of *R. pedestris* increased through June, July and peaked in August (**Fig. 2**).

Table. 1. Mean temperature and relative humidity (2009) recorded in Andong, Korea

	May	Jun	Jul	Aug	Sep	Oct
Mean temp (ºC)	18.5±2.01**D**	22.2±2.39**B**	23.6±1.94**AB**	23.9±1.68**A**	20.5±1.74**C**	14.2±2.21**E**
Mean RH (%)	59.8±15.57**D**	65.7±11.13**CD**	78.4±6.87**A**	75.4±7.49**AB**	74.7±6.88**AB**	69.2±6.99**BC**

Means with the same letter are not significantly different

Fig. 2. Changes in population density of *R. pedestris* in barley, sesame, soybean fields and apple orchard



Discussion

O. nezarae is known to be attracted to the components of aggregation pheromone of *R. pedestris.*[7,8,9] Interestingly, we found refrigerated eggs in the traps parasitized by both *G. japonicum* and *O. nezarae*.

We confirmed that *G. japonicum* appears in the field as early as May whereas occurrence of *O. nezarae* was recorded generally from July. Son *et al.*[9] reported parasitism by *O. nezarae* from early August to early October. Parasitism by both parasitoids declined and was negligible after second week of October. Early occurrence of *G. japonicum* and late occurrence of *O. nezarae* is first found in this study which has not been reported before. Occurrence of *G. japonicum* was recorded from July to August in Kyushu, Japan.[10, 11]

Discrepancy in the occurrence pattern of the parasitoids could be because of preference on differential environmental conditions such as temperature and humidity (**Table 1**).

Occurrence of *R. pedestris* population was recorded from April and often became higher during August and September. The invasion period of *R. pedestris* would be affected by available host plant species.[9]

Conclusions

(1) Parasitism by *G. japonicum* occurs earlier than that by *O. nezarae*.

(2) *G. japonicum* probably can perform better in spring and early summer with lower humidity and mild temperature compared to *O. nezarae*, whose abundance was recorded during summer and fall when higher humidity.

(3) *R. pedestris* may use barley or other grains in early spring as alternative host until they migrate into sesame and soybean fields.

Acknowledgements

This study was carried out with the support of Cooperative Research Program for Agricultural & Technology Development (Project no. 200901OFT102966074), RDA, Republic of Korea. Bishwo P. Mainali was supported by the 2nd Stage BK21 program of Ministry of Education, Science, and Technology, Republic of Korea.

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