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Development of the Leaf-Footed Bug, *Molipteryx fuliginosa* (Hemiptera: Coreidae)

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큰허리노린재 (노린재목: 허리노린재과)의 발육

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ABSTRACT

Molipteryx fuliginosa (Uhler, 1860) is a plant juice sucker which feeds on new tips of *Rubus oldhami* Miquel and *Zelkowa serrata* Makino, and it has a strong preference for these two plants in Korea. *M. fuliginosa* has one generation a year and hibernates as a young adult. Most of the winter survivors emerge in early May. It is the first time their host plants were found and reported. Females mainly lay their eggs one by one separately on the leaves of *R. oldhami*, and even on the steel wire, the lid guaze and the ground in the laboratory. Nymphs do not gather, but stay on the hatching site. Nymphs except the non-feeding first instar feed on young shoots. From the second to the fifth instar nymphs migrate to the upper part of the shoot and congregate in part on an expanded leaf. The new adults first appeared on 11 August, and remained in the host plant, and fed on until mid October. The duration of the hatching and molting, and the survivorship curve based on the laboratory rearing were determined.

Key words: Coreinae, Development, Hemiptera, Host plants, *Molipteryx fuliginosa*, Survivorship curve

INTRODUCTION

Molipteryx fuliginosa (Uhler, 1860) is generally known as a phytophagous insect, a plant feeder. It is a primary consumer and mostly large, dark coloured bug of the sub-family Coreinae, about 19~25 mm in body length (Lee 1971). Fig. 1 gives relative dimension of immature stages for *M. fuliginosa*. It gives off a distinct odor when handled.

Until recently, Cho (1963), Esaki (1950), Hasegawa (1960), Lee (1971), Miyamoto (1965), Miyamoto et Lee (1966), Nagaoka (1940) and Tanaka (1938, 1942), and some other entomologists reported studies on the morphological and taxonomical descriptions of *M. fuliginosa* from Korea. However, they did not study the development and bionomics.

This study examines host plants not reported, seasonal history, habits, duration of nymphal stadia and survivorship curve of *M. fuliginosa* based on the field observations and laboratory rearings.

MATERIALS AND METHODS

Field history

Populations of *M. fuliginosa* were monitored at irregular intervals from April to November in the vicinity of Taegu, South Korea during 1994 and 1995. Each time the host plants were examined, the presence of adults and eggs was noted. Any nymphs observed were collected and transported to the laboratory, and they were brought to proper nymphal stadium.

Laboratory biology

M. fuliginosa adults which survived the winter were collected from late April from the suburbs of Taegu. Their age was uncertain but they were reared on *Rubus oldhamii* Miquel (Rosaceae) within rearing pot planted with fresh host plants in a ventilated laboratory and permitted to lay eggs for 3 months. The eggs were checked for eclosion twice a day at 0900 and 2100 hours. During nymphal development, the host plant was monitored twice a day for exuviae to determine when ecdysis occurred, and to remove dead nymphs. The first newly hatched instar nymphs were placed individually on fresh host plant in rearing pot. If molting or hatching was anticipated, an additional observation was made in the late evening. The colonies were maintained at laboratory with ≈ 25℃, a photoperiod of ≈ 12 : 12 (L:D) h and ≈ 65% RH.

RESULTS

M. fuliginosa has one generation a year and passes the winter at the young adult stage in unknown sheltered places. It leads an active life from early May to late September. Accurate winter passing sites were not found. However in this study, overwintered adults of *M. fuliginosa* were collected in the field on 8 May and could be used for laboratory rearings there after.

The first eggs were observed on 11 May in laboratory. The present author did not observe egg laying in the field. In laboratory rearing, however, eggs were laid one by one separately on the surface of a fully hardened fresh leaf near the base of *R. oldhami*. *M. fuliginosa* scatters eggs at random. Females may also lay eggs one by one separately on steel wired surface, the lid guaze and the ground. In laboratory rearing, the female can produce at least 23 eggs during her life span. She lays but a single, medium sized egg on the upper surface of a leaf in the daytime, once a day for the consecutive 12 days. Number of eggs deposited per time varies from 1 to 3. Eggs did not hatch in the order of

Fig. 1. Relative dimension of *M. fuliginosa* egg, five nymphal stages and adult.

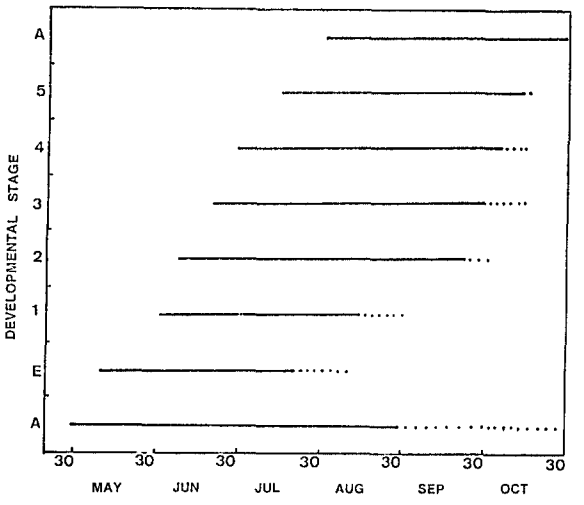

Fig. 2. *M. fuliginosa* occurrence.

oviposition. The eggs were more or less rectangular (Fig. 1). *M. fuliginosa* passes through 5 instars. Data on growth analysis of *M. fuliginosa* will be presented elsewhere. Nymphs first appeared on 2 June in laboratory. They hatched 21.38 ± 1.76 (mean ± SD) days later, and first instar nymphs stayed on the hatching site without feeding for ca. 6 days, and then moulted to the second instar. The second instar nymphs appeared as early as 9 June in laboratory. Fig. 2 shows the period of occurrence of im-

mature stage and adult of *M. fuliginosa*. A molt may last about 20 minutes. During the period of this molt, the insect is vulnerable to attack. The nymph moults on a leaf, and the bug, when ready to molt, hangs head downwards, thus utilising gravity to help in the process (Fig. 3C). Nymphs which did not develop into adult until mid October eventually died.

R. oldhami, *R. coreanus* Miquel, *R. crataeagifolius* Bunge, *Zelkowa serrata* Makino, and *Ulmus davidiana* Planchon var. *japonica* Nakai were observed as the insect's host plants for food and they are reported for the first time in this paper. Of these host plants, *M. fuliginosa* strongly preferred *R. oldhami*. Most nymphs except the non-feeding first instar

Fig. 3. A : Pitting by the adult *M. fuliginosa* on a young leaf of *R. oldhami*.
B : Congregation in part on a young shoot tip of *R. oldhami*.
C : Molting of *M. fuliginosa*.

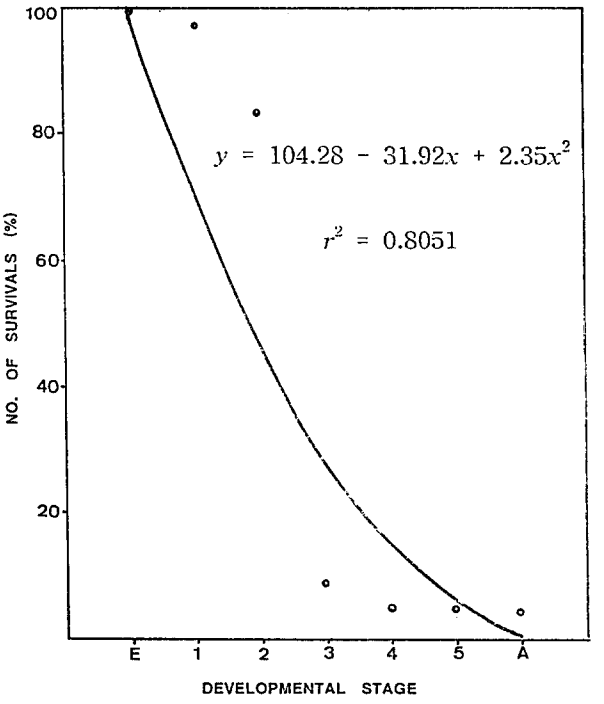

Fig. 4. Survivorship curve of *M. fuliginosa* for immature stages. Regression equation is as follows: $y = 104.28 - 31.92x + 2.35x^2$ ($r^2 = 0.8051$).

fed on young shoots of the host plants as mentioned above (Fig. 3A). From the second to the fifth instar nymphs migrate to the upper part of the host shoots and congregate in part on an expanded leaf (Fig. 3B). Lee (1971) reported that *M. fuliginosa* only came on leaf of *Cirsium japonicum* var. *ussuriense* Kitamura, *Petasites japonicus* Max. and *Potentilla fragarioides* var. *major* Max., and did not use them as the host plant or food plant. However, the present author is not yet certain whether this is correct and a confirmation may be required.

Initially, most nymphs died after their first molt. Of 90 eggs, only 4 adults were obtained from laboratory rearing. Table 1 gives the number of eggs used in rearing, and survival percentage for the immature instar stages of *M. fuliginosa*. The rates of egg hatch and adult emergence were 97 and 4%, respectively. The survivorship curve of *M. fuliginosa* was concave. The regression equation describing the relationship between survivals and developmental stages is given in Fig. 4.

Data on duration of nymphal stadia listed in Table 2 were based mainly on the laboratory rearing of the *M. fuliginosa* nymphs that originated from the 90 eggs deposited in laboratory on 11 May-24 June 1995. The development duration in days from egg to adult of *M. fuliginosa* totaled 88.67 days (Table 2). Significant differences were detected in the developmental times between instars ($P<0.05$).

Table 1. Survival percentage for the immature stages of *M. fuliginosa*[a]

No. of	Instar					
eggs	1	2	3	4	5	Adult
90	97.7	84.4	8.8	4.4	4.4	4.4

[a] The percentages are those entered at each stage.

Table 2. Duration in days of immature stages of *M. fuliginosa* in laboratory[a]

	Egg	Instar					Total
		1	2	3	4	5	
Mean	21.38A	6.12	14.35	8.17	17.09	21.56A	88.67
SD[b]	1.76	0.42	2.58	0.51	0.66	5.00	

Means in a row followed by the same capital letters are not significantly different (P=0.05, t-test).

[a] Immature stages : F=794.26, F(df=5, 178)=4.42, P<0.001.

[b] Standard deviation

DISCUSSION

The phenomenon of host plant selection is a behavioral sequence by which an insect distinguishes between host and non (unsuitable) host plants and chooses some plants and not others within its host range. Such distinct food preferences are, to a large extent, attributable to the insect's ability to identify preferred host plants on the basis of allelochemicals acting as attractants and/or stimulants. The process of host plant selection by phytophagous insect is a lock-key system, in which the lock refers to the host plants and the key stands for the complex sensory pattern of the insect. Finding a host plant of appropriate quality for the neonate larvae of phytophagous insects greatly depends on the gravid female's ability to be a "phytochemist" in selecting a suitable plant substrate for oviposition. Oviposition preference and larval performance may be correlated within populations and may vary among individuals such that females prefer the plant species on which their larvae should have the greatest chance of surviving during their first 10 days of growth (Panda and Khush 1995).

The adults of *M. fuliginosa* can be found feeding near the young shoots (whose soft tissues are suitable for food) of host plants, and remain in this situation for a week or more, before copulation occurs. Molting took about four or more hours, but in all cases studied, the couples were no longer present on the shoot the day after the mating had been observed. No more than one pair has been found on a shoot tip, though sometimes two of the same and one of the other were present.

Hoffman (1975) reported the collection of a winter surviving adult *Leptoglossus fulvicornis* from an emergence trap placed in a deciduous woodland habitat in South Carolina, U.S.A. Park (1995) reported that winter passing sites of *Anoplocnemis dallasi* were not found in the field. Again, no winter passing sites of *M. fuliginosa* were found in this study.

Wheeler and Miller (1990) reported a mean clutch size of 20.3 ± 2.0 egg (mean ± SE; n=21), and Mitchell and Mitchell (1983) reported an average of 29.6 eggs in 44 clutches in *L. fulvicornis*. Park (1995) reported that *A. dallasi* produced a clutch size of 13.1 ± 0.5 egg (mean ± SE; n=9). Park (1995) also reported that *A. dallasi* females can produce at least 83 eggs in 5 batches during her life span and lays eggs once a day. However, *M.*

fuliginosa female can produce at least 23 eggs during the same period and lay eggs in the day time, once a day for the 12 consecutive days.

Wheeler and Miller (1990) also reported a double chain laying manner on three occasions in *L. fulvicornis*. Park's (1995) experiments with *A. dallasi* indicated that they may also lay eggs end-to-end in double chain. However, *M. fuliginosa* females did not lay eggs in a chain, as in the case of *A. dallasi,* but one by one separately.

Schaefer and Mitchell (1983) tabulated feeding preferences for coreoid families. Chatterjee (1936), Golding (1927), Park (1995), Singh *et al.* (1978) and Villiers (1952) reported leguminous plants as hosts for *Anoplocnemis* spp. In this study, however, Rosaceae and plants not belonging to legume family also served as the food host plants for *M. fuliginosa*. Tanaka (1938) reported *Bidens bipinnata* Linne as food plant of *M. fuliginosa*. However, the present author did not confirm it in this study.

Wheeler and Miller (1990) reported that *L. fulvicornis* was difficult to rear in the laboratory, regardless of whether nymphs were maintained separately or in groups, and that only 2 adults were obtained by rearing nymphs individually. Park (1995) reported that only 2 *A. dallasi* adults were obtained from 118 eggs by rearing nymphs individually. In this study, 4 *M. fuliginosa* adults were obtained from 90 eggs by rearing nymphs individually.

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적 요

큰허리노린재(*Molipteryx fuliginosa*)는 한국에서 주로 덩굴딸기 (=줄딸기)(*Rubus oldhami* Miquel), 느티나무 (*Zelkowa serrata* Makino)의 신초의 즙액을 가장 선호하여 흡입하는 1차소비자의 생태적 지위를 가진 곤충이다. 큰허리노린재는 년 1세대를 경과하며, 성충으로서 월동하고, 월동한 성충은 5월 초에 출현한다. 기주식물을 처음으로 기재한다. 암컷은 주로 한개씩 분리하여 덩굴딸기외 상기 기주식물의 잎, 철망, 뚜껑인 가제 및 땅위에 산란한다. 즙액을 섭취하지 않는 1령을 제외한 모든 유충은 신초를 가해한다. 1령유충은 산란 부화된 그 장소에서 지낸다. 새로운 성충은 8월 초에 처음으로 나타나며, 10월 중순까지 섭식한다. 실험실 사육을 근거로 한 알과 각 유충의 발육기간과 생장곡선이 제시되었다.

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