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# Ground-inhabiting Spiders (Araneae: Arachnida) of Streamsides in Agricultural Landscape in Hwasung Areas, Gyeonggi-do, Korea

Kim, Seung-Tae, Myung-Pyo Jung, Hun-Sung Kim and Joon-Ho Lee*

*Entomology Program, Department of Agricultural Biotechnology, Seoul National University, Seoul 151-921, Korea*

# 경기 화성지역의 농업경관 내 하천유역에 서식하는 토양성거미류

김승태 · 정명표 · 김헌성 · 이준호*

(서울대학교 농업생명과학대학 농생명공학부)

**ABSTRACT**

The fauna of spiders in streamsides were surveyed by pitfall trapping at three sites (Gichun-ri, Duckwoo-ri and Haechang-ri) in Paltan-myun in Hwasung areas, Gyeonggi-do. Total 83 spider species and 63 genera belonging to 20 families were identified from 3,128 spiders collected. Species richness and abundance are high in Linyphiidae and Lycosidae and these two groups comprised 60.7% of total collected spiders. Thirty-six species (43.4%) were web builders and 47 species (56.6%) were hunters. This study was the first survey on streamside spiders form Korea and will be valuable in the management of biological resources and description of biodiversity, and augment for utilizing them as a biological control agent in agricultural landscape.

**Key words :** Spider, fauna, streamside, agricultural landscape, Korea

## INTRODUCTION

Streams in agricultural landscape play an important role in agricultural practices and are reservoir of biological resources in Korea. Agricultural streams provide agricultural fields with water for crops and other animals and plants, and agricultural stream areas are not usually cultivated much by agricultural management as agricultural fields. In the sides of the stream, there are approximately 5-10 plant species which are identified as weeds such as Gramineae and Leguminosae. These vegetations are valuable because they supply various habitats and preys for many invertebrates including insects and spiders. However, these sites are often disturbed by flooding during summer, and insects and spiders which inhabited there often are forced to escape by dispersal. These species, therefore, may be important biological components in agricultural landscape since they moved in or out of the adjacent paddy and upland fields.

Of the invertebrates, spiders are ubiquitous and a major component of predator community in many agroecosystem (Howell and Pienkowski 1971, Shepard *et al.* 1974, Roach 1980, Nyffeler and Benz 1987) as well as in natural environment. Nevertheless, spider species composition and its relative abundance are poorly understood in most cropping systems and agricultural habitats (Luczak 1975, Culin and Rust 1980, Agnew and Smith 1989). Before meaningful evaluation and advanced research of spiders in streamsides can be made, there must be considerable information on their composition. Thus, this study was conducted to identify species composition of spiders inhabiting in streamsides in agricultural landscape.

## MATERIAL AND METHODS

Surveyed areas were selected in Gichun-ri, Duckwoo-ri and Haechang-ri in Paltan-myun, Hwasung-shi, Gyeonggi-do, Korea which sustain typical agricultural landscape in Korea. Sampling for collecting ground-inhabiting spiders was con-

* Corresponding author
Phone) +82-2-880-4705, Fax) +82-2-873-2319
E-mail) jh7lee@snu.ac.kr

ducted in approximately two week intervals from November to December in 2000, March to October in 2001 and 2002. Sampling in 2002 was only conducted in Gichun area because Duckwoo and Haechang areas were destroyed by the bank construction. Total 33 samplings were made from all sites.

For sampling, pitfall traps were used. Five pitfall traps (15 cm diameter, 25 cm depth) were set up in each area at about 3 m apart each other. The traps were buried in the soil with

**Table 1.** Spider taxa from streamsides in agricultural landscape in Hwasung areas, Gyeonggi-do in 2000-2002

| | |
|---|---|
| **Amaurobiidae Thorell, 1870** | *Alopecosa virgata* (Kishida, 1909) |
| *Ambanus kayasanensis* Paik, 1972 | *Arctosa ebicha* Yaginuma, 1960 |
| *Ambanus lunatus* Paik, 1976 | *Pardosa astrigera* L. Koch, 1878 |
| *Asiacoelotes songminjae* (Paik et Yaginuma, 1969) | *Pardosa brevivulva* Tanaka, 1975 |
| **Dictynidae O. P.-Cambridge, 1871** | *Pardosa laura* Karsch, 1879 |
| *Cicurina japonica* (Simon, 1886) | *Pirata piratoides* (Bösenberg et Strand, 1906) |
| *Dictyna felis* Bösenberg et Strand, 1906 | *Pirata procurvus* (Bösenberg et Strand, 1906) |
| **Theridiidae Sundevall, 1833** | *Pirata subpiraticus* (Bösenberg et Strand, 1906) |
| *Chrosiothes sudabides* (Bösenberg et Strand, 1906) | *Pirata yaginumai* Tanaka, 1974 |
| *Coleosoma octomaculatum* (Bösenberg et Strand, 1906) | *Trochosa ruricola* (De Geer, 1778) |
| *Enoplognatha caricis* (Fickert, 1876) | **Oxyopidae Thorell, 1870** |
| *Paidiscura subpallens* (Bösenberg et Strand, 1906) | *Oxyopes licenti* Schenkel, 1953 |
| *Stemmopes nipponicus* Yaginuma, 1969 | **Clubionidae Wagner, 1887** |
| *Takayus takayensis* (Saito, 1939) | *Clubiona kurilensis* Bösenberg et Strand, 1906 |
| *Yaginumena castrata* (Bösenberg et Strand, 1906) | **Corinnidae Karsch, 1880** |
| **Nesticidae Simon, 1894** | *Castianeira* sp. |
| *Nesticella mogera* (Yaginuma, 1972) | *Orthobula crucifera* Bösenberg et Strand, 1906 |
| **Linyphiidae Blackwall, 1859** | *Phrurolithus coreanus* Paik, 1991 |
| *Bathyphantes gracilis* (Blackwall, 1841) | *Phrurolithus pennatus* Yaginuma, 1967 |
| *Collinsia inerrans* (O. P.-Cambridge, 1885) | *Phrurolithus sinicus* Zhu et Mei, 1982 |
| *Erigone koshiensis* Oi, 1960 | *Trachelas japonicus* Bösenberg et Strand, 1906 |
| *Erigone prominens* Bösenberg et Strand, 1906 | **Ctenidae Keyserling, 1877** |
| *Gnathonarium dentatum* (Wider, 1834) | *Anahita fauna* Karsch, 1879 |
| *Gonatium japonicum* Simon, 1894 | **Zoridae F. O. P.-Cambridge, 1893** |
| *Hylyphantes graminicola* (Sundevall, 1830) | *Zora nemoralis* (Blackwall, 1861) |
| *Neriene oidedicata* Helsdingen, 1969 | **Gnaphosidae Pocock, 1898** |
| *Nippononeta projecta* (Oi, 1960) | *Drassodes serratidens* Schenkel, 1963 |
| *Nippononeta ungulata* (Oi, 1960) | *Drassyllus truncatus* Paik, 1992 |
| *Oedothorax insulanus* Paik, 1980 | *Gnaphosa kompirensis* Bösenberg et Strand, 1906 |
| *Ummeliata angulituberis* (Oi, 1960) | *Odontodrassus hondoensis* (Saitō, 1939) |
| *Ummeliata feminea* (Bösenberg et Strand, 1906) | *Sernokorba pallidipatellis* (Bösenberg et Strand, 1906) |
| *Ummeliata insecticeps* (Bösenberg et Strand, 1906) | *Zelotes asiaticus* (Bösenberg et Strand, 1906) |
| **Mimetidae Simon, 1881** | *Zelotes davidi* Schenkel, 1963 |
| *Ero cambridgei* Kulczyński, 1911 | *Zelotes wuchangensis* Schenkel, 1963 |
| *Ero japonica* Bösenberg et Strand, 1906 | **Thomisidae Sundevall, 1833** |
| **Anapidae Simon, 1895** | *Ebrechtella tricuspidata* (Fabricius, 1775) |
| *Conoculus lyugadinus* Komatsu, 1940 | *Ozyptila nongae* Paik, 1974 |
| **Tetragnathidae Menge, 1866** | *Xysticus ephippiatus* Simon, 1880 |
| *Pachygnatha clercki* Sundevall, 1823 | *Xysticus hedini* Schenkel, 1936 |
| *Pachygnatha quadrimaculata* (Bösenberg et Strand, 1906) | *Xysticus saganus* Bösenberg et Strand, 1906 |
| *Pachygnatha tenera* Karsch, 1879 | **Salticidae Blackwall, 1841** |
| *Tetragnatha maxillosa* Thorell, 1895 | *Asianellus festivus* (C. L. Koch, 1834) |
| **Agelenidae C. L. Koch, 1837** | *Carrhotus xanthogramma* (Latreille, 1819) |
| *Agelenea* sp. | *Evarcha albaria* (L. Koch, 1878) |
| **Hahniidae Bertkau, 1878** | *Helicius* sp. |
| *Hahnia corticicola* Bösenberg et Strand, 1906 | *Mendoza canestrinii* (Ninni, 1868) |
| **Pisauridae Simon, 1890** | *Myrmarachne formicaria* (De Geer, 1778) |
| *Dolomedes sulfureus* L. Koch, 1877 | *Myrmarachne inermichelis* Bösenberg et Strand, 1906 |
| *Pisaura lama* Bösenberg et Strand, 1906 | *Phintella arenicolor* (Grube, 1861) |
| **Lycosidae Sundevall, 1833** | *Sibianor pullus* (Bösenberg et Strand, 1906) |
| *Alopecosa licenti* (Schenkel, 1953) | *Sitticus* sp. |
| | *Talavera trivittata* (Schenkel, 1963) |

plastic plate roofs which were placed approximately 3 cm above the trap to protect from the rainfall. Also, a plastic lid with holes (1.5 cm diameter, 33 holes per lid) covered the top of the trap to prevent large animals. The solution in the pitfall trap was mixture of 95% ethanol, distilled water, and ethylene glycol in a ratio of 70 : 15 : 15.

Spiders collected in pitfall traps were brought to the laboratory and identified to species level under a dissecting microscope. Specimens were stored in 75% ethanol in Laboratory of Insect Ecology, Entomology Program, Seoul National University. Species names followed Platnick's catalogue (Platnick 2005).

## RESULTS

Total 3,128 spiders were collected, from which 83 species, 63 genera belonging to 20 families were identified (Table 1). Species number was high in Linyphiidae (14 species), Lycosidae (11 species) and Salticidae (11 species). Most spiders belonged to Theridiidae, Linyphiidae, Lycosidae, Corinnidae, Ctenidae and Salticidae, and the relative abundance of these families were 5.0%, 36.6%, 24.1%, 7.7%, 7.1% and 5.0%, respectively. These groups comprised 85.5%, and Linyphiidae and Lycosidae comprised 60.7% of the total spiders collected. Dominant spiders were *Bathyphantes gracilis, Ummeliata feminea, U. insecticeps, Pardosa laura, Pirata procurvus, Orthobula crucifera* and *Anahita fauna.* Relative abundance of these species were 4.6%, 9.2%, 3.8%, 13.9%, 4.1%, 6.4% and 7.1%, respectably (Table 2). Of the 83 spider species collected, 36 species (43.4%) were web builders and 47 (56.6%) were hunters.

**Table 2.** Species richness and collection of spider families in agricultural streamsides in Hwasung areas, Gyeonggi-do in 2000-2002

| Families | Species richness | No of individuals |
|---|---|---|
| Amaurobiidae | 3 | 39 |
| Dictynidae | 2 | 8 |
| Theridiidae | 7 | 156 |
| Nesticidae | 1 | 72 |
| Linyphiidae | 14 | 1,145 |
| Mimetidae | 2 | 35 |
| Anapidae | 1 | 1 |
| Tetragnathidae | 4 | 73 |
| Agelenidae | 1 | 1 |
| Hahniidae | 1 | 3 |
| Pisauridae | 2 | 33 |
| Lycosidae | 11 | 754 |
| Oxyopidae | 1 | 2 |
| Clubionidae | 1 | 38 |
| Corinnidae | 6 | 240 |
| Ctenidae | 1 | 222 |
| Zoridae | 1 | 13 |
| Gnaphosidae | 8 | 45 |
| Thomisidae | 5 | 91 |
| Salticidae | 11 | 157 |
| Total | 83 | 3,128 |

## DISCUSSION

Experimental field work has shown that herbivore populations may be limited by spiders (Kajak *et al.* 1968). Spiders are usually the first predators found in most of cropping systems in early spring and presumably begin to exert some pressure on assemblage of the phytophagous insect pests present early in the season. Spiders which inhabit at streamside or hillock in agricultural landscape are very important since they may move into agricultural fields faster than those in outer places of agricultural landscape.

Dominant families, Linyphiidae and Lycosidae, which showed high species richness and relative abundance in this study, are the most important predators in agroecosystem in general (Bailey and Chada 1968, Culin and Rust 1980, Thornhill 1983, Agnew and Smith 1989, Winder *et al.* 1994). Linyphiid spiders, which has sit and wait foraging strategy (Enders 1974), probably has little direct effect on the populations of major soil-inhabiting pests such as aphids (Luczak 1979, Thornhill 1983). Lycosid spiders, which has pursue and kill strategy, are active and abundant group, and considered to be the most effective predators of insects such as planthopper, leafhopper and other medium sized insect preys in agroecosystem. Many environmental factors may affect the dynamics of this family. Many researches have demonstrated that lycosid spiders exhibit selection and distribution and abundance patterns based on variety factors, including prey availability, capture efficiency, mating probability (in males), herbaceous vegetation cover, temperature, humidity and soil moisture content (Cherrett 1964, Kronk and Riechert 1979, Cady 1984, Moring and Stewart 1994). Wenninger and Fagon (2000) also demonstrated that spider abundance regimes in river regions depend chiefly upon moisture and temperature.

Web builders are usually a major component of the spider fauna in agroecosystems, but streamside, though this site is the important part of agricultural landscape, was found to be an exception. The low and dense vegetation of streamside restricts opportunities for building effective webs as observed by Luczak (1979), and Agnew and Smith (1989). Though Linyphiidae is a web builder, many of them, especially erigonids, were often captured on the ground in this study. Most of these spiders make a small and delicate sheet web close to ground in litter and are considered to wander searching preys and mates leaving their webs. This trait may be the reason why this family has been thriving in streamside and captured by pitfall traps.

It is difficult to establish a standardized sampling method to quantify potential differences in spider diversity and abundance between streamsides which have some different environmental factors. Pitfall traps for collection of ground-inhabiting spiders near the streamside are highly likely to be flooded during rainy season, and it happened during our study, but it seems still to be the best way for sampling ground inhabiting spiders, by considering the cost and labor. The advantages of pitfall trap for collecting ground-inhabiting invertebrates have been discussed by Southwood and Henderson (2000). Though pitfall trap has been criticized because trap capture can be influenced by various factors other than abundance (Topping and Sunderland 1992), it has the obvious advantage in species community study of ground inhabiting spiders from different habitats as long as trapping period is sufficiently long.

This study was the first survey on streamside spiders in agricultural landscape in Korea. Faunistic studies are inventories, which not only help to establish biodiversity, but also serve as fundamental material for more detailed ecological, biological, and agricultural study. Fauna lists must be established at different scale and environment, not only for whole countries or regions, but also for agroecosystem or urban environment. In this regard, these data could be useful for further studies in the management of biological resources, description and conservation of biodiversity and biological control agents in agricultural landscape, and development of bioindicators for detecting the agroecological change.

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