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https://doi.org/10.5109/22051

出版情報：九州大学大学院農学研究院紀要. 57 (1), pp.73-77, 2012-02. Faculty of Agriculture, Kyushu University
バージョン：
権利関係：

J. Fac. Agr., Kyushu Univ., **57** (1), 73–77 (2012)

Taxonomic and Bionomic Notes on *Sycanus sichuanensis* Hsiao (Hemiptera: Reduviidae: Harpactorinae)

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(*Received October 7, 2011 and accepted October 12, 2011*)

The harpactorine assassin bug *Sycanus sichuanensis*, a large diurnal natural enemy of insect pests, is redescribed. The male genitalia and morphological characteristics of nymphs are described and illustrated for the first time. Some biological characters of this reduviid, such as life history, predatory behavior, mating and molting, etc., are noted based on laboratory rearing and field observations.

Key words: bionomics, redescription, *Sycanus sichuanensis*, taxonomy

INTRODUCTION

Sycanus Amyot and Serville is one of the largest genera in the reduviid subfamily Harpactorinae. Seventy–six species have been known up to date (Putshkov and Putshkov, 1985; Maldonado–Capriles, 1990; Putshkov and Putshkov, 1996; Ishikawa *et al*., 2007). All the species are distributed in Oriental Region except one species, *S. harpactorides* Signoret, from Madagascar. Most species of this genus are large sized important potential biological control agents in agricultural and forestry systems. The bionomics and biocontrol use of ten *Sycanus* species have been reported: *S. affinis* (Satpathy *et al*., 1975), *S. aurantiacus* (Ishikawa *et al*., 2007), *S. collaris* (George *et al*., 1998; Singh, 1998; George, 2000), *S. croceovittatus* (Kershaw, 1909; Hoffmann, 1934; Huang *et al*., 1991; Sajap *et al*., 1999), *S. dichotomus* (Zulkefli *et al*., 2004), *S. indagator* (Greene, 1973; Bass and Shepard, 1974; Greene and Shepard, 1974), *S. macracanthus* (Tiong, 1996), *S. pyrrhomelas* (Ambrose and Paniadima, 2000), *S. reclinatus* (Vennison and Ambrose, 1992), and *S. versicolor* (Kumaraswami and Ambrose, 1992).

Sycanus sichuanensis was named by Hsiao (1979). It is a common predator found on trees in the forests of southern China. As it attacks many species of lepidopteran larvae, this reduviid may have the potential for biological control. The purpose of this paper is to provide the useful morphological characters to identify the nymph and adult of this species. Herein, we describe and illustrate the adult and present photographs of the different instars. Some biological features of this reduviid are noted based on laboratory and field observations.

MATERIAL AND METHODS

A laboratory colony established in 2009 from specimens captured in Guizhou Province was used. This colony was reared in Beijing, in plastic cases, under a temperature of 25±2˚C and RH of 50±7%, and fed every 3 days with yellow mealworms, *Tenbrio molitor*. Eggs laid were collected to secure the eclosion rate. After eclosion, 20 first instar nymphs were separated individually into plastic cups with an upcenter support of absorbent cardboard and they were offered feed every third day. These individual bugs were maintained in a light incubator at 25±2˚C and 60±5% RH, and were checked daily for ecdysis or death. Any special behaviors were observed.

Male genitalia of the reduviid were soaked in hot 10% KOH solution for approximately 5 minutes to remove soft tissue, rinsed in distilled water, and dissected under a Motic binocular dissecting microscope. Dissected genitalia were placed in vials with glycerin and pinned under the corresponding specimens. All drawings were traced with the aid of a camera lucida. Morphological terminology mainly follows those of Lent and Wygodzinsky (1979) and Davis (1966). Measurements were obtained using a calibrated micrometer. Body length was measured from the apex of the head to the tip of the hemelytron in resting position. Maximal width of the pronotum was measured across the humeral angles. All measurements are in millimeters.

RESULTS

Taxonomy

Sycanus sichuanensis Hsiao, 1979
(Figs. 1–22)

Sycanus sichuanensis Hsiao, 1979: 153, 154; Hsiao and Ren, 1981: 520; Maldonado–Caprilies, 1990: 313; Putshkov and Putshkov, 1996: 260.

Sycanus szechuanensis (sic): Hsiao and Ren, 1981: 520.

Redescription. Coloration: Body dark brown to black,

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apical half corium and basal membrane dull yellow; an elongate oblong spot on each of third to seventh connexival segments basally red or dull red; eyes brown with black splash; spots outside ocelli and on ventral head between eyes yellow to yellowish brown; last two rostral segments, fore coxae brown to dark brown; annulation on sub–basal femur yellowish brown to brownish black (Fig. 1).

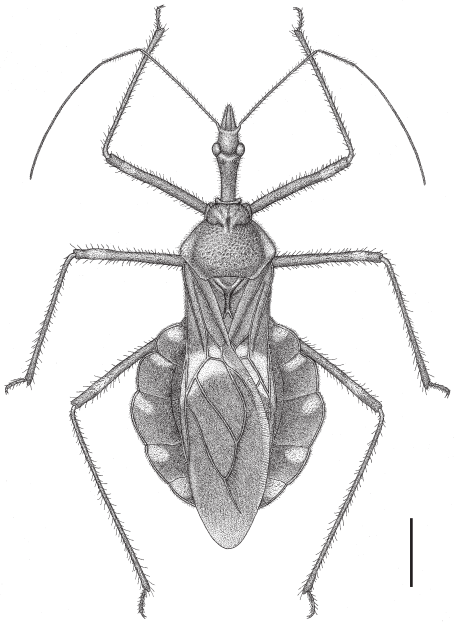

Fig. 1. *Sycanus sichuanensis* Hsiao, ♂. Habitus. Scale bar = 2.64 mm

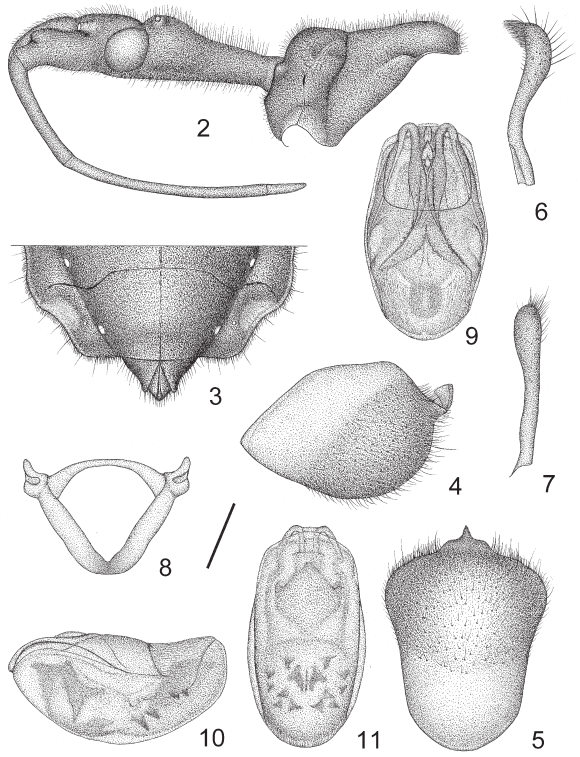

Fig. 2–11. *Sycanus sichuanensis* Hsiao, ♂. 2, Head and pronotum, antennae removed; 3, 4, 5, pygophore; 6, 7, paramere; 8, phallobase; 9–11, phallosoma; 3, 5, 11, ventral view; 2, 4, 10, lateral view; 9, dorsal view. Scale bar of 2 = 1.25 mm; of 3 = 2.0 mm; of 4, 5 = 0.62 mm; of 6–11 = 0.5 mm

Structure: Big–sized; head above, pronotum, scutellum, thoracic pleuron and sternum, legs, abdomen beneath clothed with dense short and long fuscous thick setae; first antennal segment and basal half of second, head beneath with short and long thin setae; apical half of second antennal segment with dense short thin setae; last two antennal segments with dense short fuzz; rostrum (except basal part of first segment and apical part of third segment) hairless (Fig. 2); hemelytron with curved short setae. Head slender, anteocular portion shorter than postocular, apical half of postocular portion slightly bulgy; ocelli small, far away from each other; rostrum surpassing fore coxa, first rostral segment slightly longer than half of second; first antennal segment longest. Collar processes short cone–shaped; anterior pronotal lobe bulgy with unobvious sculpture, posteriorly centrally slightly concave; posterior lobe reticulate ridged, anterior portion with two short longitudinal ridges; lateral angles round and blunt; posterior margin nearly straight or slightly convex; scutellum with a long spine apically, its apex forficate. All femora subequal in thickness; male hemelytron surpassing abdominal tip, female hemelytron reaching or surpassing abdominal tip; connexivum nearly semicircular extending bilaterally; first valvifer triangular, apart from base, mostly first valvula visible, styloid undeveloped (Fig. 3). Pygophore oblong, apical half distinctly bulgy; median 1/3 of posterior margin convex, median pygophore process sheet–shaped, apex nearly straight in lateral view (Figs. 4, 5); paramere clavate, sub–median portion bent, apex blunt with a cluster of soft setae on inner surface, outer surface with 10–12 long thick setae (Figs. 6, 7); basal plate evenly thick, apex slightly bulgy, basal plate bridge unevenly arc–shaped with median portion slender (Fig. 8); phallosoma oblong, apical 2/3 covered by ossified dorsal phallothecal sclerite; ventral phallothecal sclerite less ossified; struts apart, nearly reaching middle of phallosoma, base hooked curved, apex attached with a oblique sclerite, pointed at lateral side, endosoma with six small hooked processes each side (Figs. 9–11), apex with a big cone–shaped vesica process.

Measurements [♂(n=6)/♀(n=7), in mm]: Body length 17.68–18.55/22.13–22.56; abdomen width 7.12–7.55/8.27–9.60. Length head 4.49–4.62/5.02–5.56; length anteocular portion 1.44–1.64/1.63–1.70; length postocular portion 2.13–2.17/2.16–2.56; interocellar space 0.21–0.29/0.30–0.41; length synthlipsis 0.61–0.73/0.87–0.99; length antennal segments I–Ⅳ=5.20–5.46/5.46–5.59, 1.64–2.10/2.54–2.62, 1.47–1.63/1.79–2.07, 5.73–6.74/4.50–4.77; length rostral segments I–Ⅲ=1.73–2.14/ 2.13–2.20, 2.96–3.34/3.59–3.66, 0.54–0.63 / 0.70–0.83; length anterior pronotal lobe 1.03–1.13/1.21–1.27; length posterior lobe 1.91–2.03/2.42–2.43; width thorax 3.12–3.56/4.59–4.94; length hemelytron 10.92–11.87/13.35–14.19.

Material examined: 7 ♀, 6 ♂: China, Guizhou,

Rongjiang, Pingyang, Xiaodanjiang, 2–VI–2007, Zhao Ping leg.

Distribution: China (Guizhou, Guangxi, Hubei, Hunan, Sichuan, Yunnan).

Morphology of eggs and nymphs
(Figs. 12–19)

Egg (Figs. 12, 13). Yellowish brown. Endo–lateral of ochorion yellow, exo–lateral brown; operculum milky white. Cylindrical in shape. Basal potion wider than apical potion; endo–lateral smooth, exo–lateral with snicks. Operculum extended and serrated. The surface of ochorion slimy.

First instar (Fig. 14). Body length 2.98–3.58 mm; abdomen width 0.73–0.97 mm. Body yellow to brown. Apical part of femora and base of tibiae, median spots on abdominal terga, posterior angle of each connexival segment black, basal three antennal segments brown, last segment red. Head with several thick black setae, legs with thick yellow or brown setae; head much longer than pronotum, anteocular portion shorter than postocular, the latter even in thickness; ocelli absent; first antennal segment as long as head; tibiae longer than femora, apical part of tibiae much bulgy.

Second instar (Fig. 15). Body length 4.05–4.87 mm; abdomen width 1.05–1.57 mm. Body yellow to brown, apical part of femora, basal part of tibiae and annulations on them, abdominal center black; first to third antennal segments dark brown, last segment and eyes red. Abdomen with thick black setae, legs with yellow setae; head much bigger and wider, anteocular portion shorter than postocular, ocelli absent, shape of pronotum same as that of first instar, tibiae longer than femora.

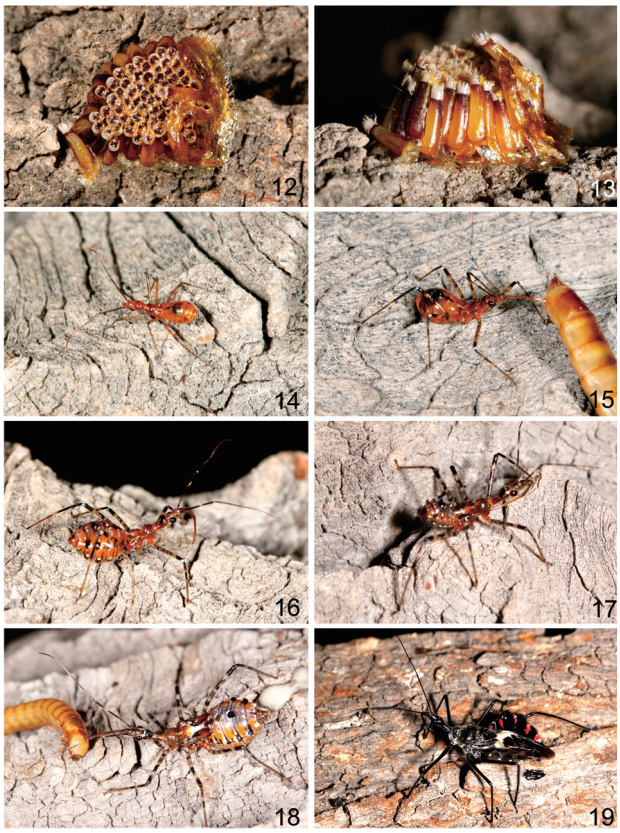

Fig. 12–19. Life history of *Sycanus sichuanensis* Hsiao. 12, 13, Egg mass; 14–18, nymph, first to fifth instars; 19, Adult.

Third instar (Fig. 16). Body length 4.95–7.78 mm; abdomen width 1.73–2.9 mm. Body yellow with red color; eyes, dorsal surface of postocular portion, apical part of femora and basal part of tibiae and spots or annulations on them, three processes on abdominal center, annulations on first antennal segment, second and third antennal segments black; head and pronotum with several thick black setae, abdomen with erect short yellow setae, shape of head similar to that of adult, ocelli absent; three processes on central 3–5 abdominal terga erect, gradually enlarged; fore and hind femora subequal in length, mid femora much shorter.

Fourth instar (Fig. 17). Body length 10.23–10.97 mm; abdomen width 3.38–3.87 mm. Body yellow with orange; eyes, dorsal anterior half of postocular portion, apical part of femora and basal part of tibiae and spots or annulations on them, three processes on abdominal center, spots on each connexival segment and tergum black. Body with long erect thick black setae; legs with long yellow setae, shape of head similar to that of adult, ocelli absent; forewing small, reaching first abdominal tergum; three processes on central third to fifth abdominal terga cone–shaped; connexivum round and blunt.

Fifth instar (Fig. 18). Body length 13.03–13.55 mm; abdomen width 4.28–4.87 mm. Color pattern similar to that of fourth instar, inner side of wing bud black; body with long erect thick black setae; head, legs with long yellow setae; shape of head similar to that of adult, ocelli appeared; pronotum round bulgy; forewing reaching middle of third abdominal tergum; three processes on central third to fifth abdominal terga cone–shaped; angles of connexivum round protruding.

Bionomics

Life history (Figs. 12–19). *Sycanus sichuanensis* is a univoltine assassin bug living in medium height shrubs in Guizhou Province, and has 5 instars (Figs. 14–18). This species overwinters as fifth instars in cohorts in the laboratory. Matured nymphs disperse from overwintering sites in early April of the following year. The peak emergence occurs in late April, and by early May the populations are mostly adults (Fig. 19). Mating always occurs in early to mid May. The females lay eggs in late May and June. The eggs (Figs. 12, 13) hatch from mid–June to early August, and then nymphs develop from first to fifth instars from June to late October. The fifth instars start to overwinter in late October (Table 1). There are significant differences between different stages in development duration. Because of the overwintering, the fifth instars live the longest time as nymphs. Furthermore, the

Table 1. Life history of *Sycanus sichuanensis* Hsiao (2009–2010, Beijing)

Month	1~3	4	5	6	7	8	9	10	11~12
	●●●	●●							
		☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆			
				⊙⊙⊙	⊙⊙⊙	⊙			
				△△	△△△	△△△			
						○○○	○○○	○○○	
								●	●●●

Eggs, ⊙; 1st to 4th instars, △; 5th instars, ○; overwintering 5th instars, ●; Adults, ☆.

Table 2. The development duration of *Sycanus sichuanensis* Hsiao

Stage	Development Duration (Days)		
	minimum	maximum	average
egg	13	16	15.37
1st–instar	12	16	12.84
2nd–instar	12	22	15.43
3rd–instar	18	35	22.69
4th–instar	46	66	56.25
5th–instar	102	172	145.78

fourth instars take 56.25 d to develop, obviously longer than other the instars (Table 2).

Predatory behavior (Figs. 15, 18). Both nymphs and adults of this assassin bug have a long rostrum and are more likely to feed on the sluggish larvae of Lepidoptera (Figs. 15, 18). The predatory process keeps to almost the same pattern as *Agriosphodrus dohrni* (Luo *et al*., 2010), involving the following steps: arousing and locating, approaching, paralyzing, sucking, releasing, and cleaning. They are always attracted by prey movement, and attack them using their long rostrum and fore legs. After capturing prey, they always choose the soft intersegmental membrane to stab. If interrupted at this time, they will leave and drag the food with their long rostrum. Sharing of food is observed in nymphs and adults, and they always suck from different parts of one prey together.

Mating (Figs. 20, 21). We know from laboratory rearing that the mating process of *S. sichuanensis* is similar to *A. dohrni*, especially in the clasping and riding behavior. We believe that similar clasping and riding behavior is associated with the significant similarities of morphology, such as the long rostrum and the extending connexivum.

Sexually mature males excite when they encounter females, swaying antennae and lifting fore legs. The male then climbs onto the back of the female, and inserts its rostrum into the gap between the neck and pronotum of the female to fix his body (Figs. 20, 21). The male's fore legs catch the propleural episternum, the mid legs hold the connexivum, and the hind legs catch the abdominal tip. Finally the male inclines its body to one side and curves the tip of its abdomen towards to female's genitalia, and then copulation takes.

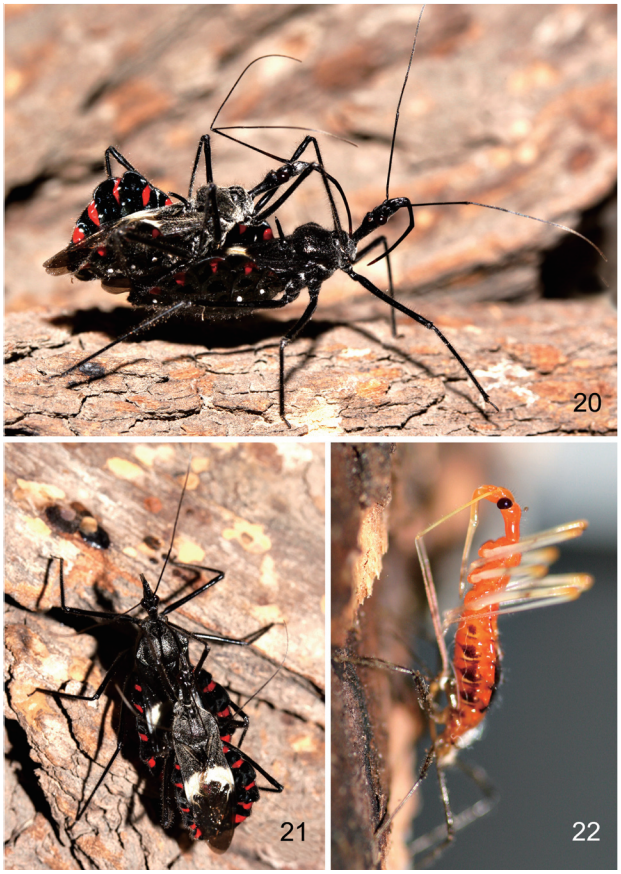

Fig. 20–22. Behaviors of *Sycanus sichuanensis* Hsiao. 20, 21, The clasping and riding process of mating behavior; 22, moulting.

Oviposition, hatching and molting (Figs. 12, 13, 22). Under laboratory conditions, the gravid females lay eggs as a mass and the mass consists of about 55–70 eggs which are glued closely to one another with slime (Fig. 12). The base and lateral portions of such egg masses have a lot of mucus from the female's accessory glands (Fig. 13), and this is conducive to the fastness of the egg mass. The females prefer the surface of bark to deposit

an egg mass rather than the dry floor covering or some other materials.

About 20 days later, the nymphs hatch from the egg mass, and the process is the same as *A. dohrni*. The hatching time of an egg is about 10–15 min, and the total time for an entire egg mass to hatch is about 30–50 min. The newly hatched nymphs are yellow and they become darkened and hardened about one day later.

Nymphs grow up by molting several times. In laboratory observations we found that different species of assassin bugs exhibit similar molting behaviors despite being from different subfamilies (Luo *et al*., 2010; Li *et al*., 2010). Before moulting, the nymphs need to be satiated and stop feeding, and usually take a position of heading downwards. At first the nymph makes a dorsal fissure on the pronotum extending from the front edge of the eyes to the first abdominal segment, then the new head and the pronotum will be stretched out of the fissure. After that, the appendages are stretched out (Fig. 22). The newly molted nymphs are orange with some black markings.

ACKNOWLEDGEMENTS

This is a contribution from the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka (Ser. 6, No. 106). This work was supported by grants from the international cooperative project jointly supported by NSFC–JSPS (No. 31111140015), the National Natural Science Foundation of China (Nos. 30825006, 30970394, 31061160186), the Doctoral Program of Higher Education of China (No. 200800190015), and Global COE Program (Center of excellence for Asian conservation ecology as a basis of human–nature mutualism), MEXT, Japan. We are grateful to Drs. T. Yahara, S. Kamitani, M. Maruyama and L. Westover of Kyushu University for their kind help in many ways.

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