Biology of *Cylindralcides sauteri* (Coleoptera: Curculionidae), a new pest of *Cinnamomum camphora*

Kong Huaqing[1] · Zhao Danyang[2] · Qin Changsheng[2] · Xu Jinzhu[2]

Abstract A weevil, *Cylindralcides sauteri* (Coleoptera: Curculionidae) was found to infest *Cinnamomum sulphuratum* seriously. The adults broke the tender stems, and the larvae fed on xylems inner side of tender shoots. The morphological characteristics and biology of the pest were studied.

Keywords Biology · Morphological characteristics · *Cylindralcides sauteri* · Pest · *Cinnamomum camphora*

Cylindracides sauteri was established under the genus *Alcides* by Heller in 1922 based on holotypes from China (Taiwan), Cambodia and Vietnam (Tonkin). But *Alcides* was a junior homonym of *Alcides* Sahlberg (1823), and a junior homonym of a lepidopteran *Alcides* Hubner (1822), Marshall (1939) proposed the replacement name *Alcieodes* of *Alcides*. Subsequently the species was placed under *Sternuchopsis* Heller, 1918 by Andrew (2010) and under *Cylindralcides* Heller, 1918 by Löbl (2013) respectively, two genera were both belonged to tribe *Mecysolobini*. The tribe is predominantly tropical with 57 species of 7 genera known from Oriental and Palaearctic regions, of which 23 species of 4 genera occur in China and 16 are endemic Chiinese species (Löbl & Smetana, 2013). The genus *Cylindralcides* contains 4 Chiinese species, eg. *aemulus*, *saundersii*, *sauteri* and *takahashii*, except for a few isolated descriptions, no comprehensive studies of these species have been undertaken recently. The classification of the paper follows Löbl & Smetana (2013).

As the economically important weevils, Marshall's *Alcidodes* is a large mecysolobine genus feed as larvae on non-germinative parts of plants, for instance, *A. gmelinae* damages to young green shoots of *Buddleia madagascariensis* and *Gmelina arborea* (Beeson, 1964), *A. leeuweni* attacks shoots and twigs of *Ceiba pentandra* (Kalshoven, 1984), *Sternuchopsis trifida* attacks stems of *Pueraria lobata* and *Lespedeza* sp. (Chao et, 1980), etc. *C. sauteri* was reported to cause serious damage to *Zanthoxylum bungeanum* at Fujian, Guangdong, Hunan, Jiangxi, Sichuan, Taiwan, Yunnan, Zhejiang Province. Recently, the weevil was found to feed as larvae as young green twig-borers of *Cinnamomum camphora* also, and the adults snapped off the tender twigs with its long beak, which led to the twigs died back.

For many years, only the simply morphological characteristics of *C. sauteri* were described (Heller, 1922; Chao, 1980; Zhou, 1993), the studies on the genitalias

✉ Zhao Danyang
85040875@qq.com

1 Guangdong Provincial Forest Management Station, Guangzhou, Guangdong 510173, China

2 Guangdong Provincial Key Laboratory of Silviculture, Protection and Utilization / Guangdong Academy of Forestry, Guangzhou, Guangdong 510520, China

of both sexes is lacking. The biology, the evolutionary association of *C. sauteri* and *C. camphora*, and their potential damage as no information are available on these aspects. Therefore, the study of biology of the pest is essential for a reliable pest population monitoring system and management strategies, assessing the relative importance of weevils in the hosts is required, the research of genitalias is imminent for the taxonomy of the group. With these objectives the present study has been carried out.

Materials and methods

Field: The study was carried out during 2013 to 2015 in Lechang county, Guangdong, China. The host plants were 3–5 years old. 80 infested sampling trees were examined weekly from early March to late October to determine field development of *C. sauteri*, notes were taken on the presence of eggs, larvae, pupae, and adults.
Laboratory: In April, Damaged shoots were cut and placed in a clear plastic container covered with fine insect netting for adequate ventilation. Once the emergence of virgin adults, four pairs were released into rearing cages (3 m×3 m ×6 m), the cages were covered with 14-mesh aluminum screening, one side contained a door. 4 3-years-old camphor trees with young green twigs were placed the cages also as the host of the pest. Mating and oviposition were observed round-the-clock, the damaged twigs were dissected for the presence of larvae and pupae. Longevity, fecundity, adult behaviors were noted.

The weevils for this study were kept in 55% ethanol before study. Dissections and observations were made under a Leica MZ75 dissecting microscope. Dissected genital pieces, including the median lobe and parameres of aedeagus, were glued on small paper cards and then pinned under the specimen from which they were removed. Digital pictures were taken by using a Canon EOS 40D camera, and then processed by means of Adobe Photoshop CS5 software.

Result and discussion

Morphological characteristics

Adult (Fig.1-2): Elongate and robust species, length 17.0–20.0 mm, width 5.0–6.4 mm. At the early stage of eclosion, the body black besides the basal half of femora reddish brown; with the adult maturing, the body becoming khaki, but head, anterior margin of pronotum, posterior half part of femora, tibia more darker in color; elytron with one darker transversal band, the anterior margin with "√"in middle, posterior margin with "◠"at three-fourths.

Head with irregular punctate smaller than that on pronotum and elytra, RL/RW = 3.1–3.3. Rostrum evenly curved, longer, and slender, densely irregular punctate, longer than that of head and pronotum. Antennae before middle part of rostrum, antennomeres 1 longer than antennomeres 2–4, suddenly dilated at anterior part; antennomeres 9–11 dilated also, club.

Prothorax with large and umbilicate bumps, PW/PL=2.0, widest on middle, evenly constricted to cylindrical shape from basal two-thirds to apex, the side of basal margin circular. Scutellum round button type.

Elytra slightly wider than prothorax, EL/EW = 2.0; parallel at sides except for reducing from basal six-sevenths to apex, reduced portion strongly projecting in dorsal view, a row of brownish hair transverse projecting protion; semicircle at anterior sides. Elytral interstriae covered with regular and deep punctures, interval with irregular wrinkles.

Fig.1 First eclosion adult

Fig.2 Mature adult

Fore femur with ventral tooth mounted on bulbous expansion of femur, roughly triangular, apex hooked.

Abdomen with ventrite 5 smoothly convex, without depressions in male, with weak lateral depression if female.

Male terminalia: Aedeagus with apex rounded and with small patch of setae medially on dorsum; sides weakly diverging from base until subapical convergence; distance from ostium to apex greater than width of ostium; depression in dorsal surface between apex and sotium, with sclerotized "tongue" running ventrally into ostium from dorsal surface; dorsal and ventral surfaces unsclerotised over most of length of aedeagus, ventral surface sclerotized apically and at base, dorsal surface not sclerotized at base; ostiolar sclerites narrow, continuous with long endophallic sclerites. Endophallus with pair of long narrow sclerites.

Female terminalia: Hemisternites lying in short membranous genital pocket and longer than plate of strnite VIII; sclerites of hemisternites contiguous ventrally and appearing fused, although plate from right hemisternite continues dorsally and laterally to that of left hemisternite; no separate plate dorsally between hemisternites; styli relagively short, circular in cross-section. Vagina with membranous pouches present.

Specimens examined: 30♀,45♂, Shaoguan city (Lechang county), E 113.73, N 25.11, April-August 2014—2015, Zhao Danyang leg. from *C. camphora*.

Biology

The pest had one generation in one year, its life cycle was not inequality, the adults were visible from March to October. It overwintered as egg, larvae, and adults, but mainly by adult in pupal chambers in the stem of host plants. In 2014 and 2015, overwintering adults were observed outside in the host tree in mid-March when temperatures exceeded 10 °C, number peaked in May to June and September to October. Adults are not good at flying, often clung tenaciously on the braches when disturbed, but could feign death and resembling guano after falling to the ground. Most adults began to mate after feeding for 1–2 weeks, but some late-emerging adults mated as soon as emerging from the branches, mating was observed during the day and night.

The adult female selected the tender shoot and made a long channel with a row of 1–7 oviposition holes by using its rostrum, the channel located in shade stem, then she turned and probed the hole with her ovipositor and laid a single egg in it, normally only a single egg was found in a hole, the holes were covered with yellow colloidal materials during ovipositor 5 days to larvae hatching. Freshly laid eggs were ivory-white, length 2.7–3.2, width 1.6–1.9, elongate-elliptic; eggshells were thin, soft, and smooth. The egg stage lasted for about 15–17 days.

There are five larval instars all of which remain within the shoots, the newly hatched larvae were found to start feeding on the internal contents of the stem around the hole in which the eggs were laid, and soon began to excavate their tunnels, the width and depth of the tunnels increased with size of the larvae. The larvae fed on xylem from lower to upper insider of the stems, as feeding progressed, strip stool discharged from the harmful hole were visible, the length of the tunnels was 3.0–14.0 mm. The larvae were found feeding inside the shoot for a period of about 20–26 days. The mature larvae were 15.0–17.0 mm in length, 'C' shaped, white in color and apodous; the head was suborbicular in front view, yellowish brown in color; mandibles were dark brown; pronotum rectantular, pale yellowish brown.

The fifth instars larvae constructed its pupal chamber at the terminal end of each feeding gallery of the shoot

and built a cover in the hole. The pupae were yellowish white, oblong, 12.0–14.5 mm; small spines on the surface, a pair of gluteus spines on the apical abdomen. Pupation required 16–18 days.

Pest incidence and nature of damage

The weevil was reported to be a serious pest as both grubs and adults caused damage to the tender shoots of *Zanthoxylum bungeanum*, our studies on the incidence of the pests in *C. camphora* showed the presence of the weevil also. Grubs caused more damage than the adults. The adults usually broke the tender stems for supplementary nutrition to cause the tender shoot death (Fig.3), the larvae fed on xylems inner side of tender shoots to cause it die back (Fig.4).

Fig.3 Adult infestation

Fig.4 Larval infestation

Discussion

C. sauteri were reported to attack only two host plants, *Z. bungeanum* belonged to Rutaceae of Sapindales, *C. camphora* belonged to Lauraceae of Laurales, there is no relationship between the two host plants, so it's worth studying why the pest fed on them, perhaps the two plants can release the same volatile odor which can attracted the pest.

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