A bizarre Pentatomid, *Phricodus hystrix* (Germer, 1838) (Hemiptera: Pentatomidae) on *Ocimum* spp.

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Abstract: *Phricodus hystrix* (Germer, 1838), a bizarre looking Pentatomid, was found feeding on seeds of various species of Tulsi plants such as *Ocimum tenuiflorum* L. and *Ocimum gratissimum* L. The species is redescribed based on male and female genitalia, which were illustrated along with life cycle of the bug for the first time.

Key words: Parandria, sesamum, samiaceae, pedaliaceae

Phricodus hystrix (Germer, 1838) is a rare pentatomid bug possessing the four segmented antennae unlike the usual five segmented state found in other members of Pentatomidae. Germar (1838) originally described *P. hystrix* from Cape of Good Hope, South Africa. This species is distributed in Saudi Arabia, Yemen, Africa, India, Mauritius and Seychelles (Rider, 2006). Cachan (1952) redescribed this species based on specimens from Madagascar and later, Linnavuori (1975) redescribed *P. hystrix* as a variable species with respect to the length and thickness of antennal segments, denticulation on lateral margins of pronotum as well as the shape of lateral angles of parandria (=paratergites) based on materials collected from an unidentified plant belonging to Lamiaceae.

Distant (1918) recorded *P. hystrix* for the first time from Coimbatore, Tamil Nadu, India while examining the specimens sent to him by Mr. T. B. Fletcher, who collected those from Coimbatore on Sesame plants (*Sesamum indicum* L., F. Pedaliaceae) as well as at light. This is the only species known from India for the genus *Phricodus* Spinola, 1839. This species was recorded from Bangalore, Karnataka for the first time by Salini and Viraktamath (2015). Recently, *P. hystrix* was recorded as a pod feeder of Sesame by Dilipsundar *et al.* (2019) in their checklist of insect pests of Sesame. In this paper, *P. hystrix* was found feeding on seeds of various species of Tulsi plants such as *Ocimum tenuiflorum* L. and *Ocimum gratissimum* L. (Family: Lamiaceae). Besides, the male and female genitalia of this species is illustrated for the first time. DNA barcode sequence of *P. hystrix* is obtained and reported.

Material and Methods

The bugs were collected by sweep net and hand collection from various species of Tulsi plants at NBAIR Attur farm, Yelahanka, Bengaluru during May, 2020. Collected bugs (nearly 55 specimens) were killed using ethyl acetate and were later brought to laboratory for processing. The separated bugs were mounted singly on triangular card points on the right side of the thorax by using Fevicol® to facilitate identification. The procedure to dissect the

male and female genitalia was detailed by Salini (2016) was followed. Dissections were done using Leica S8 APO. Photographs were made using Leica DFC 420 camera mounted on a Leica M205A sterozoom microscope and by using the software Automontage® (LAS). Photographs were edited using Adobe Photoshop CS (Version 8.0). The field images were taken using Canon EOS 77D DSLR camera. Terminology of general morphology, male and female genitalia follows Tsai *et al*. (2011), egg structure follows Matesco *et al.* (2014) and those associated with metathoracic scent glands follow Kment & Vilímová (2010). The procedure for DNA extraction and partial gene sequencing of COI follows David *et al*. (2020).

Specimens studied for this research work are deposited in the Indian Council of Agricultural Research- National Bureau of Agricultural Insect Resources (ICAR-NBAIR), Bangalore, Karnataka, India.

Taxonomy

Tribe: Phricodini Cachan, 1952

***Phricodus* Spinola, 1839**

Phricodus Spinola, 1839: 331

Stenotoma (Westwood, 1846): 284 (Synonymised by Signoret, 1849: 327. Type species by monotypy: *Stenotoma desjardinsii* Westwood, 1846 (= *Aradus hystrix* Germar, 1838).

Type species: *Phricodus hystrix* (Germar, 1837) by monotypy.

Diagnosis. Brownish bugs with white peg-like structure uniformly covered all over the body except antennomere I and membrane. Head acuminated apically with a pair of long, acute spinous process in front of compound eyes; base of ocelli partially concealed by anterior pronotal margin. Antennae four segmented with segment I slightly shorter than acute apex of mandibular plates; first antennal segment stout, heavy, pivoted on narrow cylindrical pedicel. Antenniferous tubercle modified into elongate processes. Bucculae slightly longer than the labiomere I, with anterior apex rounded, lacking tooth. Anterolateral margins concave at middle, explanate, slightly reflexed with spinous process; humeri modified into triangular spinous process. Genital capsule almost triangular with ventral side possessing one pair of parandria; paramere minute, club-shaped; phallus with phallotheca moderately sclerotized and constricted towards distal end; dorsoapical emargination of apical part of phallotheca modified into cup-like expansion, encompassing endosoma; valvifers VIII roughly rectangular, with inner lateral margins almost straight; laterotergites IX short not reaching apex of abdomen; spermatheca externally fluted to form a single bulb-like dilation; apical receptacle elongate oval without ductules.

Remarks. Members of this genus possess four segmented antennae. The antenniferous tubercles, lateral margins of head and pronotum modified into long spines.

Göllner-Scheiding (1999) discussed the systematic position of the genus *Phricodus* Spinola and proposed the tribe Phricodini for the genus *Phricodus*. This genus is represented by the lone species, *P. hystrix* (Germer) from India.

***Phricodus hystrix* (Germar, 1838) (Figs. 1–31)**

Aradus hystrix Germar, 1838: 134.

Stenotoma desjardinsii Westwood, 1846: 285 (Synonymized by Stål, 1865: 92)

Phricodus fasciatus Signoret, 1861 (Synonymized by Stål, 1865: 92). Lectotype designation by Göllner-Scheiding, 1999: 154).

Phricodus ornatus Villiers, 1952: 1206 (Synonymized by Roche, 1977: 570

Phricodus incisiforceps Linnavuori, 1975: 22 (Synonymized by Göllner-Scheiding, 1999: 154)

Colouration. Brownish coloured with white patches on pronotum, scutellum and hemelytra (Fig. 1). Head disc ochraceous, paler towards outline including spinous process. Antennae brown except pedicel of segment III and IV, small, narrow ring-like mark at anterior apex of segment II, III and IV, black. Pronotal disc brownish, posterior pronotal disc with mosaics of pale white areas and anterolateral margins including humeri pale white. Scutellum with basal gibbous triangular region dark brown, apical 1/3rd and lateral margins pale white. Hemelytra with proximal 2/3rd pale white; membrane whitish with mosaics of dark brown to black markings. Connexivum with alternate bands of pale white and brown.

Ventral side ochraceous with numerous brownish or black small spots scattered uniformly on all ventrites; labium with labiomere III & IV, black. Outline of spiracle and trichobothria black. Legs concolourous to ventral side, apical half of claws black.

Body pilose; whole body including antennomere I, compound eyes and legs, (except antennomeres II–IV and membrane) covered with short, stout white peg-like structure; short, black tubercle-like structure possessing short erect spines, scattered over pronotum, scutellum and hemelytra. Antennae hirsute with nearly erect and moderately elongate setae sparsely distributed on antennomeres II–IV; labium and tibiae and tarsi of all legs covered with short, dense pale setae.

Redescription

Structure. *Head:* (Figs. 7–9) flat dorsally, not declivous, apex and lateral margins reflexed; apex of mandibular plates modified into elongate, acuminate processes (ap), much longer than clypeus, not meeting in front of clypeus, lateral margins of mandibular plates with a pair of long acute processes in front of compound eyes. Apex of mandibular plates on ventral side, provided with additional elongate ridge-like and apically acuminate sclerite (aas), in front of bucculae, enclosing apex of clypeus; ventral ridge like sclerite shorter than apex of mandibular plates. Ocelli situated wide apart at base of head; in dorsal view, the base of ocelli partially concealed by anterior pronotal margin. Antennae four segmented, with segment I slightly shorter than acute apex of mandibular plates, distinctly surpassing apex of clypeus; first antennal segment stout, heavy, pivoted on narrow cylindrical pedicel; segment II longest, proximal 3/4th narrow and thin, gradually swollen towards apex; III longer than IV; each segment III and IV with short, cylindrical pedicel to attach with preceding segments and provided with narrow, indistinct, longitudinal groove both on

dorsal and on ventral side; Antenniferous tubercle (at) modified into elongate processes, proximal half of antenniferous tubercle broad and distal half abruptly narrowed towards apex as acuminate processes, but shorter than apex of mandibular plates. Bucculae slightly longer than the labiomere I, with anterior apex rounded, lacking tooth. Labium reaching hind coxae.

Pronotum: Anterolateral margin concave at middle, explanate, slightly reflexed with spinous process; spines adjacent to anterolateral angles longest; posterior and posterolateral margins straight; humeri modified into triangular spinous process. Pronotal disc transversely impressed in anterior half.

Scutellum: Longer than broad at base, 1/3 rd apex narrowed abruptly, scutellar apex obtuse; disc of scutellum basally modified into elevated inverted triangle and continued as a central ridge-like carina to apex.

Hemelytra: Distal 1/3rd of lateral margins of hemelytra explanate, membrane reaching apex of abdomen.

Thoracic pleuron and sternum: Mesosternum with faint, central, longitudinal carina. External scent efferent system with peritreme (p) spout-shaped, reaching mid metapleuron (Fig. 10). Evaporatorium developed as roughly rectangular patch on metapleuron and as short, transverse stripe on mesopleuron, above metathoracic spircle. Metathoracic spiracle long and well developed.

Legs: Femora unarmed, dorsal surface of tibiae with central, longitudinal groove; inner angles of fore tibial apex with stout angulate process possessing short, acute spine; inner lateral margins of foretibial apex with a row of comb-like short setae. All tarsi with segment II shortest, III nearly as long as I.

Pregenital abdomen: Connexivum well exposed and explanate; ventrites smooth, devoid of groove or ridge; posterolateral angles of ventrites III–VII explanate and obtusely angulate.

Male genitalia (Figs. 14–21): *Genital capsule:* Almost quadrangular, dorsal rim of genital capsule provided with hood-like convex central emargination occupying most of its margin (Fig. 14); ventral side with a pair of parandria (a pair of expansions of external wall of genital capsule in lateroventral position), parandria (pr) triangular in cross section, as long as or slightly longer than central length of genital capsule (Figs. 14–15), gradually narrowed towards distal end, outer angles of each parandrium ends in acute tooth-like structure at distal end, directed laterad, inner angles rounded. Proximal end of each parandrium with small angulation on inner margin and a bulbous projection on outer margin. Ventral rim concave. *Paramere*: Minute, club-shaped with narrow stem (Figs. 16–17). Articulatory apparatus: elongate, oval capitate processes (cp) attached to trapezoidal plate by a short and narrow dorsal connective. *Phallus:* Dorsoapical emargination (de) of apical part of phallotheca pale and cup-like, encompassing endosoma in inflated form (Fig. 21); 2 pairs of conjunctival process, ventral pair fused into one membranous, pale, moderately sclerotized broad structure, apically truncate with V-shaped notch ventrally; dorsal pair fused medially leaving U-shaped notch on

dorsal surface; aedeagus slightly sclerotized, narrow, tubular.

Female genitalia (Figs. 11–13). *Terminalia:* Valvifers VIII (vlf VIII) roughly rectangular, with inner lateral margins almost straight (Fig. 12); posterior margin straight, inner posterior angles angulate; valvifers IX (vlf IX) fused to single plate, with anterior margin slightly concave; antero-lateral angles elongate and strap-like produced laterad; laterotergites IX (lt IX) broader anteriorly and narrowed towards posterior end with rounded apex, short not reaching apex of abdomen, outer lateral margins convex; laterotergite VIII (lt VIII) roughly quadrangular, caudal margin of laterotergites VIII angulate at middle (Fig. 12). *Spermatheca:* Externally fluted to single bulb-like dilation (Fig.13), external wall smooth; proximal and distal spermathecal duct, narrow, tubular; proximal flange one third in diameter of distal flange; apical receptacle elongate oval without any processes.

DNA barcode. GenBank accession number MZ540897 (1♂, INDIA: Karnataka, Attur, Yelahanka, 08.v.2020, N 13° 5' 37.4568", E 77° 33' 38.7252", Rabbani, M. K.)

Bionomy

The adults lay the eggs on seeds or on glumes of the mature floret in 2-3 numbers/floret (Figs. 25–27). Eggs are barrel-shaped with a round, convex operculum (Fig. 28). The aero-micropylar processes (amp) are circularly arranged in a row around the anterior pole, white, short, and clubbed (Figs. 28–29). The freshly laid eggs are creamy in colour (Fig. 28) and later, changed to pink or light purple colour before hatching (Fig. 29). The first instar nymphs are red in colour, resembling red velvet mite (Trombididae) in colour and appearance (Figs. 5–6). Posterolateral angles of abdominal sternites with spine-like projection in nymphs towards later stage (Figs. 3–4). Legs and antennae of nymphs provided with profuse white setae and body with sparse setae. Nymphs and adults suck the sap from the seeds (Figs. 30–31) and the affect the germinability of seeds. The infestation of these bugs were found usually during the later stage of the crop. This might be because of the seed feeding behaviour of the species.

Remarks. These are medium sized bugs (5.00 to 6.70 mm body length). This is the first record that this species is feeding on various species of *Ocimum* (Tulsi) plants (Figs. 22–24). Previously, it was recorded as a pod feeder of Sesamum. Very remarkable species with white peg-like, short and stout structures covering all over the body, which gives a powdery coated appearance to the specimens.

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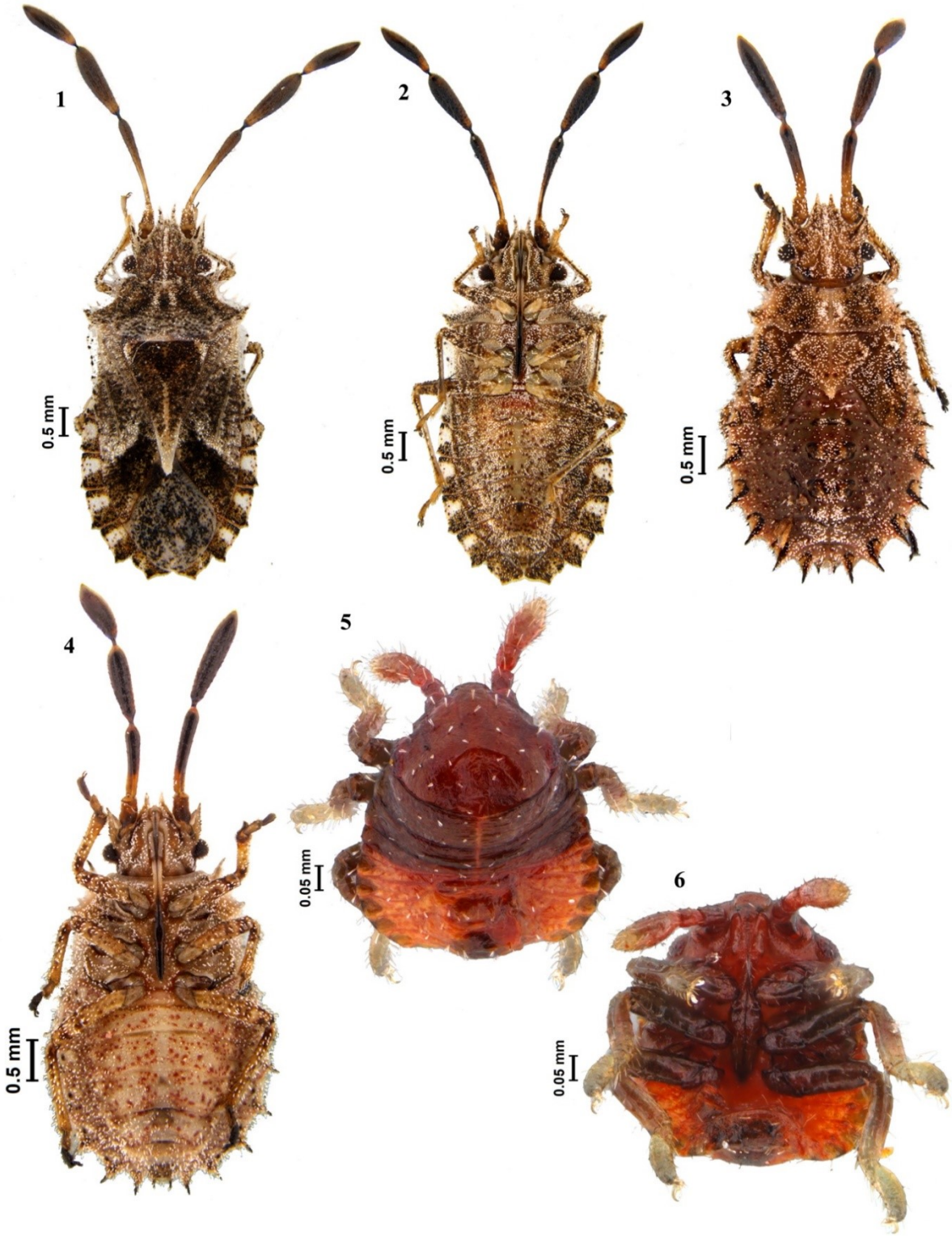
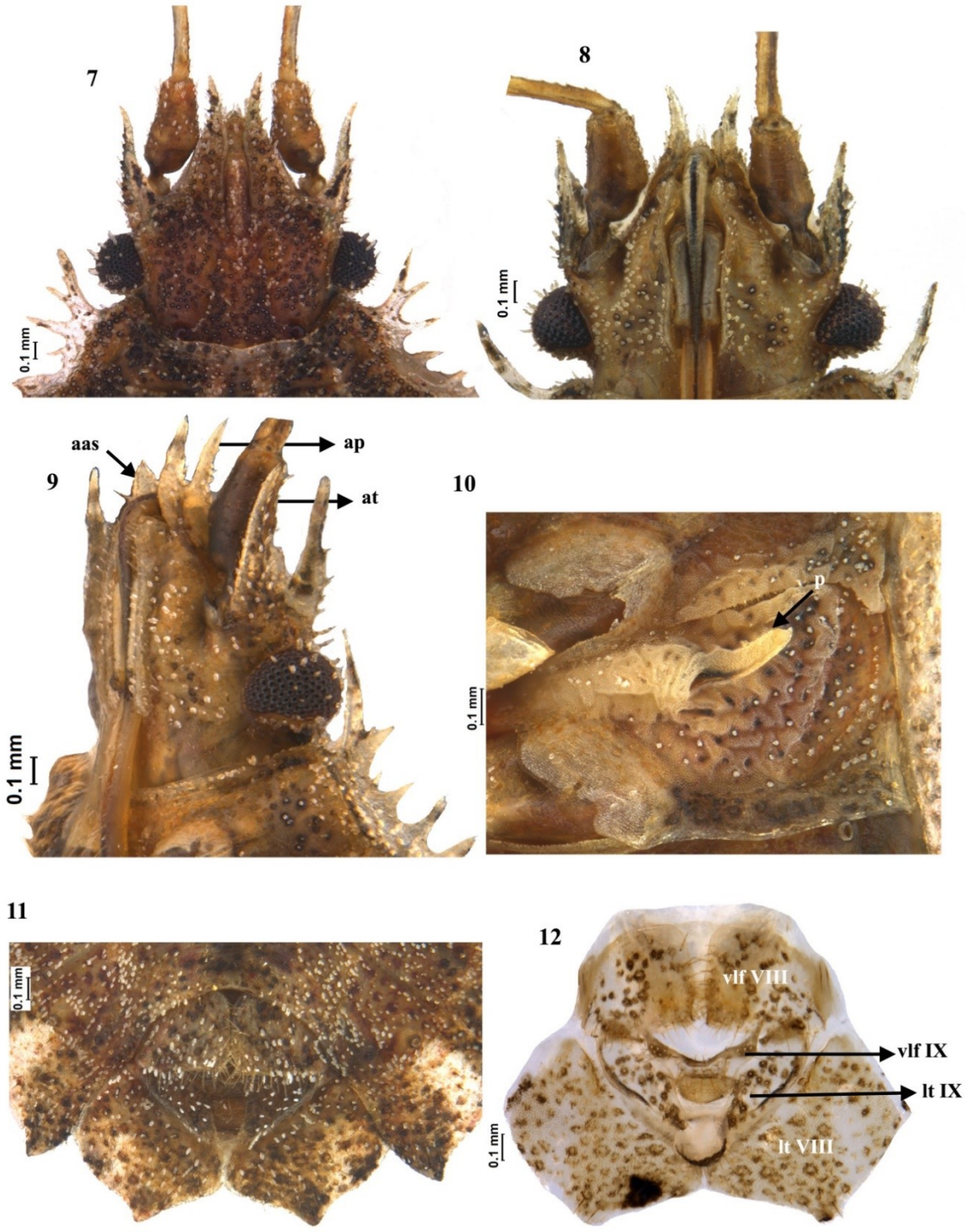
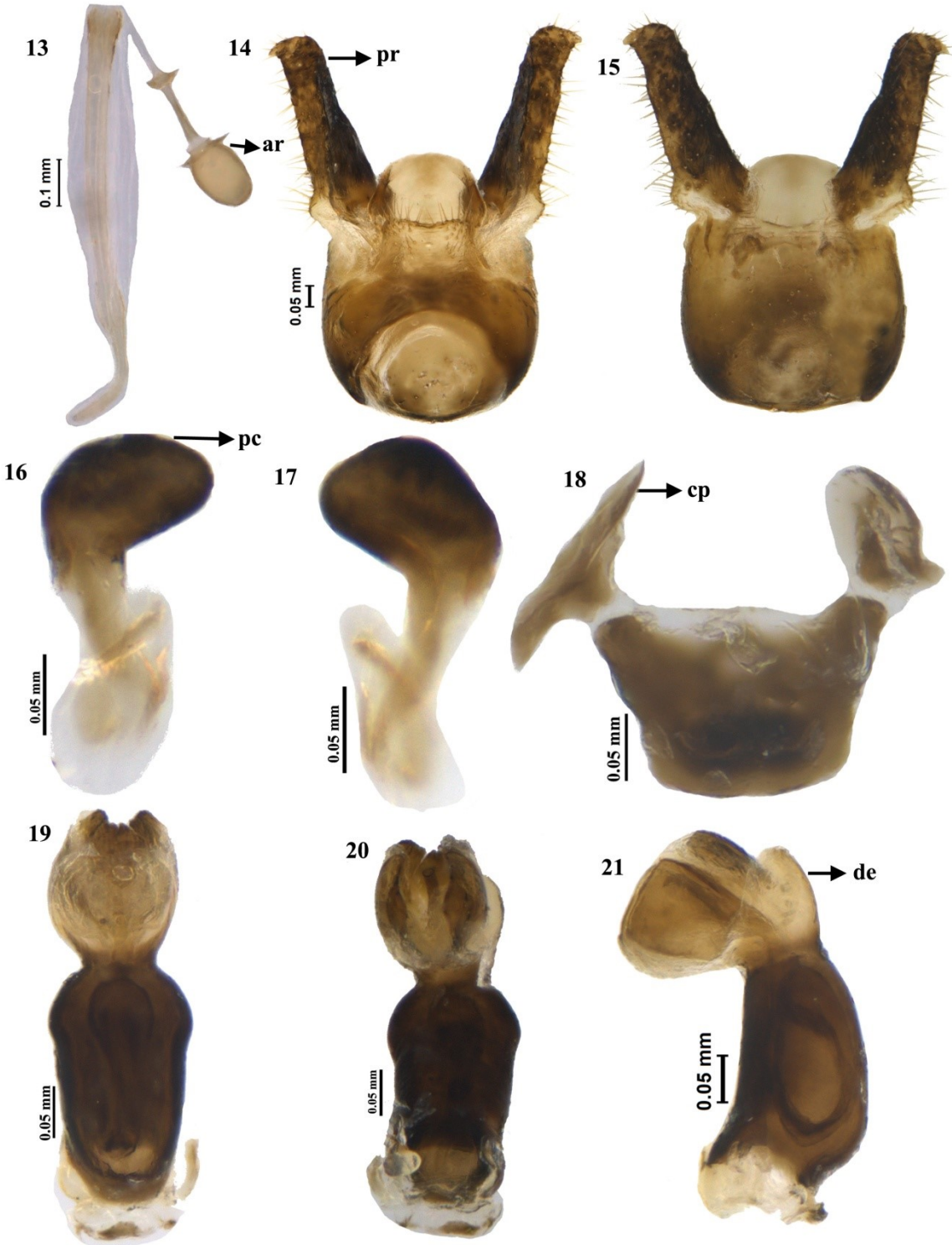


Figs. 1-6 *Phricodus hystrix* (Germer). 1, adult (doral); 2, adult (ventral); 3, later stage instar (dorsal); 4, later stage instar (ventral); 5, first instar (dorsal); 6, first instar (ventral).

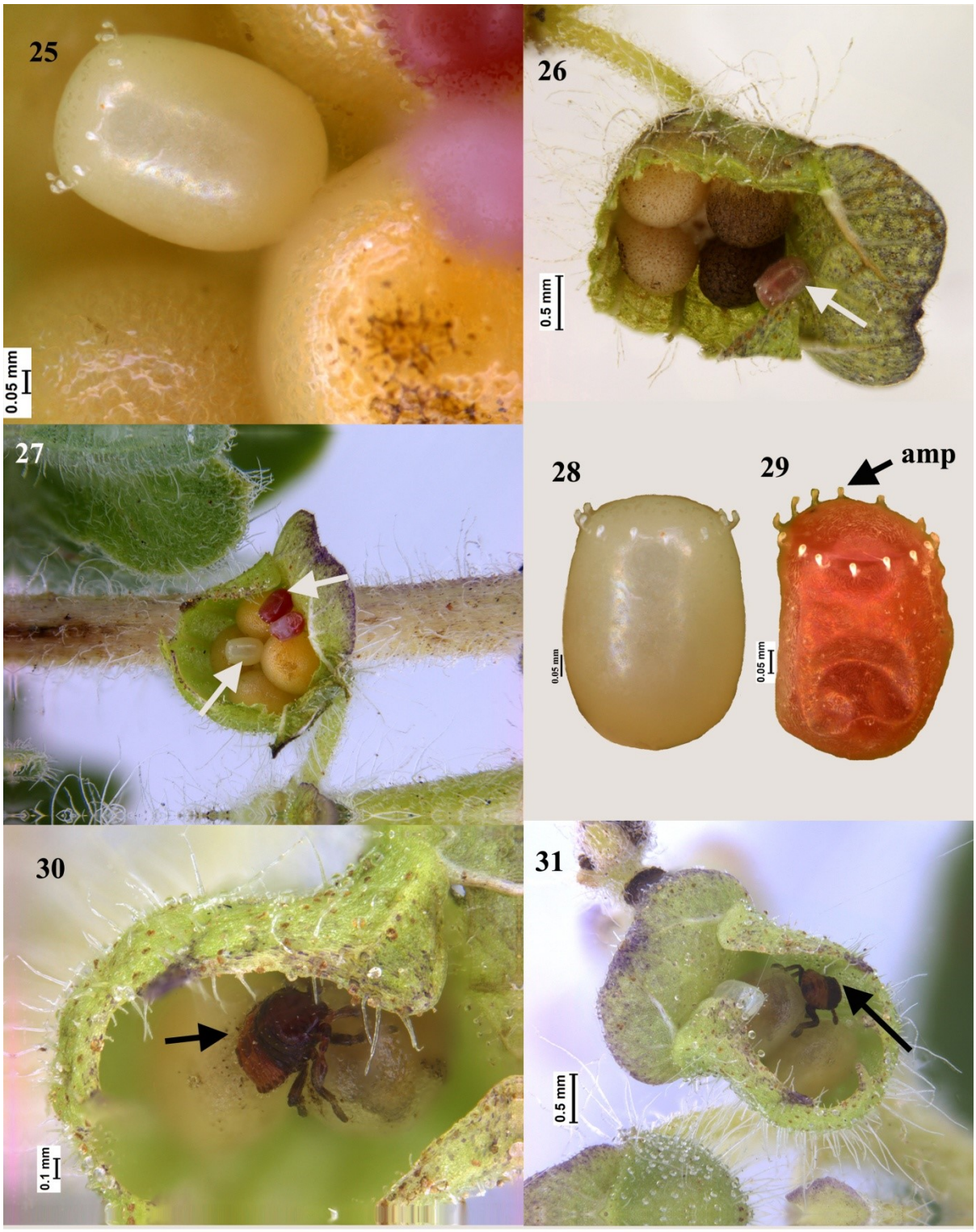


Figs. 7-12. ***P. hystrix*** **(Germer). 7, head (dorsal); 8, head (ventral); 9, head (lateral); 10, external scent efferent system; 11, female terminalia before dissection; 12, female terminalia after dissection. Lettering. p- peritreme; ap- acuminte process; at- antenniferous tubercle; aas- apically acuminate sclerite; lt VIII- laterotergite VIII; lt IX- laterotergite IX; vlf VIII- valvifers VIII; vlf IX- valvifers IX.**



Figs. 13-21. *P. hystrix* (Germer). 13, spermatheca; 14, genital capsule (dorsal); 15, genital capsule (ventral); 16-17, paramere (differenet planes); 18, articulatory apparatus; 19, phallus (dorsal); 20, phallus (ventral); 21, phallus (lateral). Lettering. ar- apical receptacle; cp-capitate processes; de- dorsoapical emargination of phallotheca; pc-parameral crown; pr- parandria.

Figs. 22-24. Host plant-*Ocimum* spp. 22-23, *Ocimum gratissimum* L. 24, *Ocimum tenuiflorum* L.



Figs. 25-31. *P. hystrix* (Germer)- bionomics. 25, freshly laid egg on Ocimum seeds; 26-27, Ocimum floret showing eggs; 28, freshly laid egg; 29, egg just before hatching; 30-31, first instar nymph feeding on Ocimum seeds. Lettering. amp- aero-micropylar processes.