

ENTOMOLOGY

First report: *Spermatodes variolosus* (Walker, 1867) in Indian rice ecosystem along with taxonomy of pentatomid bugs in Terai rice fields, West Bengal, India

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Abstract

Pentatomid bugs, commonly known as stink bugs, are typically herbivorous insects known for their piercing-sucking feeding habits on crops and wild plants. Among these stink bugs, *Spermatodes variolosus* (Walker, 1867) stands out as the smallest species, measuring 2.6-2.9 mm, and is also known to be phytophagous. In this study, we report the presence of seven species from six different genera of stink bugs in the rice fields of Cooch Behar, West Bengal. Notably, this research marks the first documented occurrence of *Spermatodes variolosus* (Walker, 1867) in the rice ecosystem of India, raising concerns about its potential pest status. Furthermore, this study includes taxonomic keys for the six genera identified.

Introduction

Stink bugs or Pentatomid bugs are represented by 160 genera and 387 species pertaining to 4 subfamilies, Asopinae, Pentatominae, Phyllocephalinae, and Podopinae from India (Salini, 2019). About 29 species and 16 genera belonging to the family Pentatomidae have so far been reported from rice ecosystems of India as occasional pests (Nayar *et al.*, 1976; Heinrichs, 1994; Rajpoot *et al.*, 1996; Pal, 2006; Joshi *et al.*, 2007; Ghosh, 2008; Salini, 2019). Worldwide 17 species from 9 genera of the family Pentatomidae are reported as major pests of rice (Singh & Tiwari, 2020). Stink bugs could be identified by 5 segmented antennae, scutellum reaching at least to the base of the membrane and tarsi with three joints. During their active season, they damage plants; most of them release volatile chemicals when they are disturbed, through a pair of scent glands' openings on the metathorax.

Rice (*Oryza sativa* L.) is one of the most important cereal crops and is consumed by more than 50% of the world's population (Zhang *et al.*, 2016). Throughout the growing period, paddy is attacked by several insect pests. During surveys at the farm of Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Cooch Behar, the infestations of paddy earheads by seven different species of stink bugs belonging to the family Pentatomidae have been recorded. Both nymphs and adults of these stink bugs were found to infest developing rice grains and to suck milky juice from earheads. Feeding by rice stink bugs on kernels of developing grains results in empty grains due to partial or complete removal of grain content. Such grains partially or wholly get stained by bacteria or fungi and are called 'Pecky grains' (Heinrichs, 1994). This leads to quantita-

tive losses due to a decrease in numbers of filled grains and average grain weights that ultimately lower overall rice yields (Patel *et al.*, 2006). In this present study, we have reported for the first time the occurrence of *Spermatodes variolosus* (Walker, 1867) from rice ecosystem as a minor pest.

Materials and Methods

During the field survey at the farm of UBKV, Pundibari, Cooch Behar, seven different species of stink bugs were collected using the sweep net method. Collected specimens were killed using a killing jar having ethyl acetate. After that specimens were brought to the laboratory for setting-pinning and then the genitalia of male specimens were dissected following the methods by Ahmad (1986), for proper identification with the help of suitable literature. The photographs were taken under a Leica M205A stereomicroscope using a Leica DMC-4500 camera. The photographs were processed in LAS V4.12 software. Photographs were edited using Adobe Photoshop CS (Version 8.0).

Results

A total of seven species and six genera belonging to the family Pentatomidae were collected from rice fields of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, along with the first report of *Spermatodes variolosus* (Walker, 1867) from rice ecosystem.

Taxonomic hierarchy

Order Hemiptera
Suborder Heteroptera
Infraorder Pentatomorpha
Superfamily Pentatomoidea
Family Pentatomidae
Subfamily Pentatominae
Tribe Agonoscelidini Atkinson, 1888
Genus *Agonoscelis* Spin, 1837

Agonoscelis nubilis (Fabricius, 1775) (Figure 1)

Diagnosis: body yellowish with a tinge of orange in color; covered with coarse black punctures, except a central fascia of head, antero-lateral margins and an irregular central fascia of pronotum and apex of scutellum; a small region in front of compound eyes and posterior disc of compound eyes pale yellow; transverse stripes on hemelytra and longitudinal bands on membrane black; mandibular plates usually reaching or extending past the clypeus; a small internode present between antennal segment III and IV; rostrum reaches up to 4th abdominal segment.

Material examined: India: West Bengal: 1♂, 2♀, Cooch Behar, Pundibari, UBKV Campus (26.403602° N, 89.385648° E), 16.vi.2023, Col. A. Pal, Registration No: 16769/H15; 1♂, 1♀, Cooch Behar, Pundibari, UBKV Campus (26.40145° N, 89.386148° E), 17.vi.2023, Col. A. Pal, Registration No: 16770/H15.

Distribution: *Oriental* (India [BR, JK, KL, MP, MH, NL, OD, TN, UP, WB], Malayan Peninsula, Myanmar, Pakistan, Sri Lanka) (Distant, 1902; Fletcher, 1920; Chatterjee, 1934; Chakraborty *et al.*, 1994; Azim, 2011; Salini & Viraktamath, 2015). *Palaeartic* (China, Japan) (Distant, 1902).

Tribe Carpocorini Mulsant & Rey, 1866

Genus *Dolycoris* Mulsant & Rey, 1866

Dolycoris indicus Stål, 1876 (Figure 2)

Diagnosis: Dorsal coloration pale yellow or orange-yellow;

coarsely blackly punctate; lateral margins of head black; clypeus distinctly shorter than the mandibular plates; antennae black with pale yellowish narrow ring-like portion at bases and apices of segments II-V, segment I, pale yellow with lateral stripes and apex black; anterolateral margins of pronotum and basal lateral margin of corium orange-yellow; disk of scutellum with orange-yellowish Y-shaped mark; rostrum reaches up to metacoxae and pale yellow in color with apex black.

Material examined: India: West Bengal: 1♂, 1♀, Cooch Behar, Pundibari, UBKV Campus (26.403602° N, 89.385648° E), 16.vi.2023, Col. A. Pal, Registration No: 16771/H15; 6♂, 1♀, Cooch Behar, Pundibari, UBKV Campus (26.40145° N, 89.386148° E), 17.vi.2023, Col. A. Pal, Registration No: 16772/H15.

Distribution: *Oriental* (India [AP, BR, GJ, NL, OD, PB, TN, UP, WB]) (Distant, 1902; Kirkaldy, 1909; Fletcher, 1920; Chatterjee, 1934; Azim, 2011). *Palaeartic* (Afghanistan, China) (Rider, 2006).

Tribe Eysarcorini Mulsant & Rey, 1866

Genus *Eysarcoris* Hahn, 1834

Eysarcoris montivagus (Distant, 1902) (Figure 3)

Diagnosis: Dorsal coloration dark brown with a tinge of yellow; thickly darkly punctate; two transverse brassy black annulations present on anterior area of pronotum; lateral margin of pronotum, large spots on each basal angle of scutellum and the apical portion of scutellum, somewhat levigate and pale yellow; antennae ochraceous, except segments IV and V, slightly brown; abdomen with a large, black central triangulate fascia, lateral margin of abdomen brownish yellow; rostrum yellowish brown with apex black and reaching up to the metacoxae.

Material examined: India: West Bengal: 4♂, 1♀, Cooch Behar, Pundibari, UBKV Campus (26.403602° N, 89.385648° E), 16.vi.2023, Col. A. Pal, Registration No: 16777/H15; 1♂, 2♀, Cooch Behar, Pundibari, UBKV Campus (26.40145° N, 89.386148° E), 17.vi.2023 Col. A. Pal, Registration No: 16778/H15.

Distribution: *Oriental* (India [AP, AS, GJ, KL, ML, NL, PB, TN, UP], Myanmar) (Distant, 1902; Chakraborty *et al.*, 1994; Mathew, 1986; Kaur *et al.*, 2012; Salini & Viraktamath, 2015). *Palaeartic* (Afghanistan, China) (Rider, 2006).

Eysarcoris ventralis (Westwood, 1937) (Figure 4)

Diagnosis: Dorsal coloration dark brown with a tinge of yellow; anterior area of pronotum pale yellow with two transverse black annulate spots, sparsely blackly punctate; head brassy black and coarsely darkly punctate; lateral margin of pronotum and a large round spot on each basal angle of scutellum pale yellow and levigate; apical margin of scutellum margined with black punctures; abdomen with a central black triangulate band and pale-yellow lateral margin; antennae ochraceous with last two segments brown.

Material examined: India: West Bengal: 1♀, Cooch Behar, Pundibari, UBKV Campus (26.403602° N, 89.385648° E), 16.vi.2023, Col. A. Pal, Registration No: 16779/H15; 1♂, 1♀, Cooch Behar, Pundibari, UBKV Campus (26.40145° N, 89.386148° E), 17.vi.2023 Col. A. Pal, Registration No: 16780/H15.

Distribution: *Oriental* (India [AP, BR, JH, KA, KL, MH, ML, OD, PB, TN, UP], Malayan Peninsula, Myanmar) (Distant, 1902; Fletcher, 1920; Chakraborty *et al.*, 1994; Salini & Viraktamath, 2015). Whole *Palaeartic* region (Rider, 2006). *Ethiopian* (Tropical Africa, Cape Verde Islands) (Rider, 2006). *Nearctic* (Hawaii) (Rider, 2006).

Genus *Spermatodes* Bergroth, 1914

Spermatodes variolosus (Walker, 1867) (Figures 5-10)

Diagnosis: Body yellowish brown, thickly darkly punctate; head, anterior area of pronotum, basal margin of scutellum and

ventral of body dark brown, sometimes with tinge of green; a small spot in front of each eye and anterior-lateral margin of pronotum levigate and pale yellow; two central spots on anterior portion of pronotum and three spots on basal margin of scutellum, luteous; a series of small marginal spots on abdomen, pale yellow; basal portion of femora dark brown; a broad transverse band on scutellum brownish black.

Male genitalia: (Figures 7-10). Dorsal rim of pygophore (=genital capsule) widely and slightly concave with a median short bifid process; ventral rim nearly straight with a median shallow notch. Paramere nearly S-shaped, apex of crown beak-shaped, setae of paramere present apically at the inner portion of beak-like apex. Phallosome of phallus little sclerotized and roughly tubular shaped.

Material examined: India: West Bengal: 1♂, 2♀, Cooch Behar, Pundibari, UBKV Campus (26.40145° N, 89.386148° E), 17.vi.2023, Col. A. Pal, Registration No: 16773/H15.

Distribution: *Oriental* (India [KA, TN, WB (New record)], Myanmar) (Distant, 1902; Salini & Viraktamath, 2015). *Palaeartic* (China) (Rider, 2006).

Remarks. The occurrence of *Spermatodes variolosus* (Walker, 1867) has been reported for the first time in rice ecosystem. This species also has been recorded for the first time from West Bengal. An illustration of male genitalia also has been provided.

Tribe Menidini Atkinson, 1888

Genus *Menida* Motsch., 1861

Menida versicolor (Gmelin, 1790) (Figure 11)

Diagnosis: Body yellowish or reddish-orange in dorsal coloration; blackly punctate, anterior sub-marginal region and two transverse annulate markings on anterior area of pronotum, black; scutellum punctate except two basal angles; apical area of corium reddish-orange containing a black spot; ventral surface of body black, lateral margins and sub-median longitudinal band yellowish-orange; basal abdominal spine reaches the mesocoxae; rostrum passing the mesocoxae.

Material examined: India: West Bengal: 1♂, Cooch Behar, Pundibari, UBKV Campus (26.401019° N, 89.39035° E), 16.vi.2023, Col. A. Pal, Registration No: 16776/H15; 8♂, 6♀, Cooch Behar, Pundibari, UBKV Campus (26.40145° N, 89.386148° E), 17.vi.2023, Col. A. Pal, Registration No: 16775/H15.

Distribution: *Oriental* (India [BR, KA, KL, OD, SK, TN], Myanmar) (Distant, 1902; Fletcher, 1920; Chakraborty *et al.*, 1994; Hegde, 1995; Azim, 2011); *Palaeartic* (China, Japan, Taiwan) (Distant, 1902; Rider, 2006).

Tribe Strachiini Mulsant & Rey, 1866

Genus *Bagrada* Stål, 1862

Bagrada hiliaris (Burmeister, 1835) (Figure 12)

Diagnosis: Dorsal coloration shiny black; somewhat elongated triangulate spot on mandibular plate before each compound eye, basolateral portion of compound eyes yellow with a tinge of orange; anterior and lateral margins and a central elongated band of pronotum, a central elongated strip of scutellum and a spot near each basal angle of scutellum, an elongated marginal band which becomes sub-marginal a little beyond base of corium and terminates into a rounded discal spot before apex bright yellow sometimes fused with tinge of reddish orange; legs black with pale-yellow longitudinal band on femora and tibiae; antennae black.

Material examined. India: West Bengal: 1♂, 1♀, Cooch Behar, Pundibari, UBKV Campus (26.40145° N, 89.386148° E), 17.vi.2023, Col. A. Pal, Registration No: 16774/H15.

Distribution: *Oriental* (India [BR, HP, JH, KA, MH, PB, RJ, TN, UP, UK], Sri Lanka) (Distant, 1902; Fletcher, 1920; Chatterjee, 1934; Kaur *et al.*, 2012; Salini & Viraktamath, 2015; Salini, 2019).

Palaeartic (Europe: Italy, Malta, Macedonia; North Africa: Algeria, Egypt, Libya, Morocco; Asia: Afghanistan, China, Iran, Iraq, Israel, Saudi, Arabia, Syria, Yemen) (Rider, 2006). *Ethiopian* (Tropical Africa, Cape Verde Islands) (Rider, 2006).

Key to the genus of stink bug pests on rice reported from Cooch Behar

1. Clypeus equal to or slightly longer than mandibular plates . . . 2
 - Clypeus distinctly shorter than mandibular plates 5
2. Body pilose *Agonoscelis* Spinola, 1837
 - Body not pilose 3
3. Base of abdomen with a well developed spine
 - *Menida* Motsch., 1861
 - Base of abdomen without spine 4
4. Scutellum reaching apex of abdomen
 - *Spermatodes* Bergroth, 1914
 - Scutellum more than half the length of abdomen
 - *Eysarcoris* Hahn, 1834
5. Head coarsely punctate dorsally; anterior collar of pronotum well developed *Dolycoris* Mulsant & Rey, 1866
 - Head impunctate dorsally; anterior collar of pronotum not well developed *Bagrada* Stål, 1862

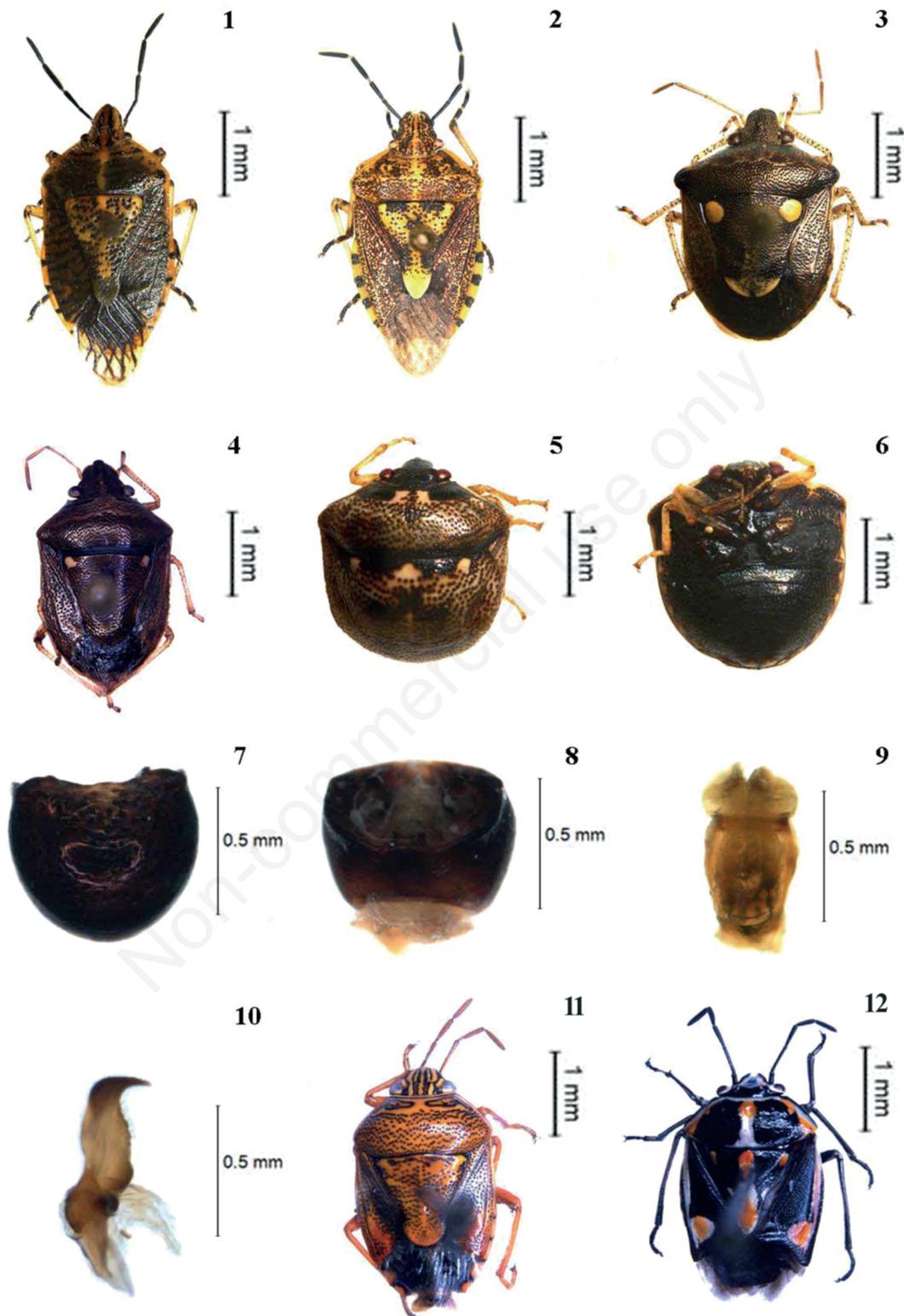
Discussion

During the field survey in rice fields of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar (Figure 13), seven different species of stink bugs infesting paddy earheads have been collected. Among them the population of *Menida versicolor* (Gmelin, 1790) was the highest, followed by *Dolycoris indicus* Stål, 1876, *Eysarcoris montivagus* (Distant, 1902), *Agonoscelis nubilis* (Fabricius, 1775), *Spermatodes variolosus* (Walker, 1867) and *Eysarcoris ventralis* (Westwood, 1837). The population of *Bagrada hiliaris* (Burmeister, 1835) was the lowest. The study of the rice stink bugs has implications for all rice-growing areas throughout the globe. Heteropteran bugs that feed on rice panicles are a serious problem in Asia, North and South America posing a serious threat. Worldwide different species of stink bugs infest the paddy earheads and cause identical damage to the developing grains by sucking through their piercing and sucking mouthparts. The rice stink bug, *Oebalus pugnax* (Fabricius, 1775), has been reported as an important pest of rice in the southern United States resulting in yield losses and reduction in grain quality, which in turn had a significant economic impact on rice producers (Bhavanam *et al.*, 2021). Earlier, according to one record, the stink bugs *Menida versicolor* (Gmelin, 1790) and *Eysarcoris guttiger* (Thunberg, 1783) were found moderately abundant during earhead stage of rice in this Terai region (Pal, 2006). Likewise, *O. poecilus* (Dallas, 1851) in Brazil (Kriniski & Foerster, 2017) and *O. insularis* Stål, 1872 in Central American countries (Zachrisson *et al.*, 2019) are serious pests of rice.

The genus *Spermatodes* Bergroth, 1914 is represented by a single species from India (Chatterjee, 1934, listed as *Sepontia variolosa* Walker) and three other species from Australia (McDonald, 1989). The newly recorded stink bug *Spermatodes variolosus* (Walker, 1867) along with other pentatomids recorded on paddy earheads during the present investigation may be of minor importance from damage perspective they are presently doing but have the chance to change their pest status in future if any significant changes occur in the ecological factors as these insects have been reported to be sensitive to temperature and reported to survive better and develop faster under warm temperatures (Naresh & Smith, 1984; Rashid *et al.*, 2005). Moreover, injudicious insecticide application may lead to

the killing of naturally occurring parasites which have been reported to be very sensitive to pesticides (Bhavanam *et al.*, 2021). Therefore, it is imperative to keep on monitoring these earhead bugs at regular

interval under specific agroclimatic conditions as well as to conduct in detail bioecological studies for their proper understanding towards devising suitable management strategies against these pests.



Figures 1-12. Stink bug pests on rice reported from Cooch Behar. 1) *Agonoscelis nubilis* (Fabricius, 1775); 2) *Dolycoris indicus* Stål, 1876; 3) *Eysarcoris montivagus* (Distant, 1902); 4) *Eysarcoris ventralis* (Westwood, 1937); 5-10) *Spermatodes variolosus* (Walker, 1867); 5) Habitus (dorsal view); 6) Habitus (ventral view); 7) Pygophore (ventral); 8) Pygophore (dorsal); 9) Phallus; 10) Paramere; 11) *Menida versicolor* (Gmelin, 1790); 12) *Bagrada hilaris* (Burmeister, 1835).

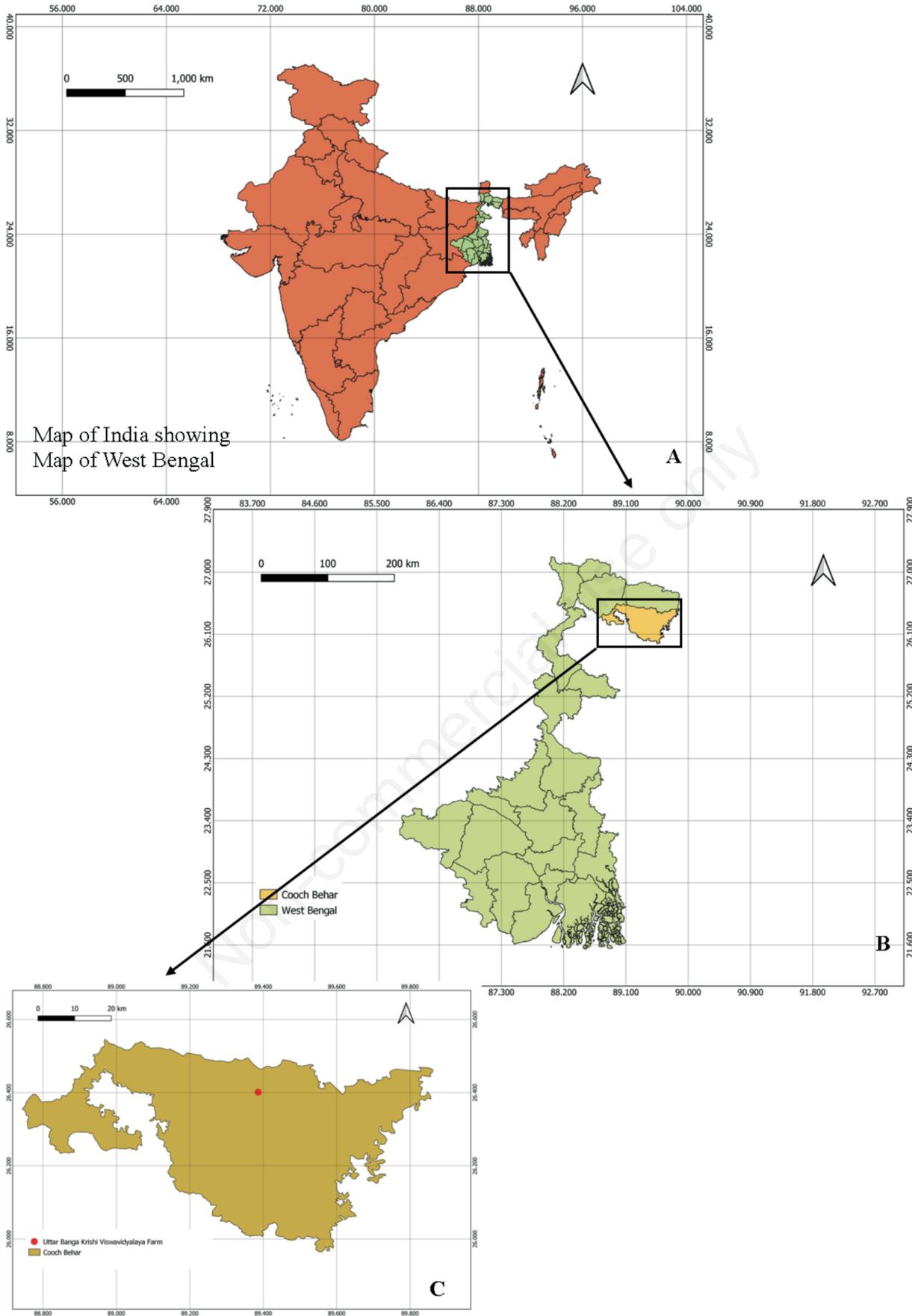


Figure 13. A) Map of India showing West Bengal; B) map of West Bengal showing Cooch Behar district; C) map of Cooch Behar district showing sampling site.

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