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## Species composition of Dacine fruit flies (Diptera: Tephritidae: Dacinae: Dacini) associated with Cucurbits in Tripura, a North Eastern state of India

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### Abstract

Incidence of fruit flies in different cucurbitaceous crops were studied during the present research work. Nine species of Dacine fruit flies viz., *Bactrocera (Bactrocera) dorsalis (Hendel)*, *Bactrocera (Bactrocera) latifrons (Hendel)*, *B. (Hemigymnodacus) diversa (Coquillett)*, *B. (Sinodacus) hochii (Zia)*, *B. (Zeugodacus) caudata (Fabricius)*, *B. (Zeugodacus) cucurbitae (Coquillett)*, *B. (Zeugodacus) tau (Walker)*, *B. (Parasinodacus) cilifera (Hendel)*, and *Dacus (Callantra) longicornis (Wiedemann)* associated with cucurbit crops have been recorded for the first time from Tripura, a North Eastern state of India. *B. (Sinodacus) hochii* and *B. (Parasinodacus) cilifera* are the new country records for India. Brief description of the species recorded and taxonomic keys for identification of these fruit flies are provided.

**Keywords:** Cucurbits, fruit fly, *Bactrocera*, *Dacus*, Tripura, North East India

### Introduction

Cucurbits constitute an important group of vegetable crops widely grown in India and many other countries. Infestation of Dacine fruit flies is a major constraint in profitable farming of these crops<sup>[9]</sup> and depending on the environmental conditions and susceptibility of the crop species, the extent of losses varies between 30 to 100%<sup>[11]</sup>.

The tribe, Dacini, primarily comprised of species of 2 genera (*Bactrocera* Macquart and *Dacus* Fabricius), form a major group of the subfamily Dacinae under the family Tephritidae which is one of the largest families of Cyclorrhaphan Diptera. Many species of fruit flies belonging to these two genera (nearly 10%) are economically and agriculturally important because of the serious damage caused by them on commercial fruits and vegetables. 21 species of Dacines were reported from the Western Ghats of India, of which eight were new to science<sup>[13]</sup>. 54 species of Dacines were reported from peninsular India (Kerala, Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra, Orissa and Madhya Pradesh) and also Andaman and Nicobar Islands<sup>[10]</sup>. 13 species of Dacine fruit flies were recorded from north western Himalaya of India of which 4 species were new records from the region<sup>[32]</sup>. Little information is available on existence of fruit fly species in North East India. Earlier eight species of Dacine fruit flies namely *Bactrocera dorsalis*, *B. cucurbitae*, *B. tau*, *B. scutellaris*, *B. diversa*, *B. zonata*, *B. minax* and *B. caudata* were reported from some states of North-Eastern India<sup>[3, 5, 6, 10, 15, 18, 22]</sup>. The cucurbits are the major vegetables being widely grown in Tripura and these crops suffer from ravages of Fruit flies in this North- Eastern state of India. Data/information on fruit fly menace from the State of Tripura is lacking. Therefore, an attempt has been made to identify the fruit fly pests associated with cucurbit crops in Tripura. Identification keys have also been prepared for identification of fruit fly pest species of genus *Bactrocera* and *Dacus*, associated with cucurbit crops in this state.

### Materials and Methods

The present study was carried out in research farms of College of Agriculture, Lembucherra, and Tripura as well as nearby village areas of Lembucherra (West Tripura District, Tripura) from May, 2015 to October, 2016.

### Crop studied

Different cucurbitaceous crops such as cucumber (*Cucumis sativus*), bitter melon (*Momordica charantia*), spiny melon (*Momordica dioica*), sponge melon (*Luffa cylindrica*), ridge melon

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(*Luffa acutangula*), bottle gourd (*Lagenaria siceraria*), snake gourd (*Trichosanthes cucumerina*), pointed gourd (*Trichosanthes dioica*), ash gourd (*Benincasa hispida*), pumpkin (*Cucurbita moschata*) and water melon (*Citrullus lanatus*) were grown in the Experimental farms of the College of Agriculture, Lembucherra, Tripura for attracting fruit flies associated with cucurbit plants by offering them food and habitat.

#### Collection of specimen and recording of data

Fruit flies associated with cucurbit crops were collected by following three methods modified after Ukey, *et al.*, 2013<sup>[37]</sup> and Verghese, *et al.*, 2005<sup>[39]</sup>.

1. Fruit fly infested fruits and flowers were collected from farmers' fields as well as college farms during reproductive stage of the crops and brought to the laboratory and were placed in plastic containers with sand at the bottom and markin cloth covers. After emergence of adult flies, they were fed with sugar solution for few days for their survival and development of colour patterns used for identification<sup>[37]</sup>.
2. Traps baited with para- pheromone lures (cue-lure and methyl eugenol)<sup>[29]</sup> were installed at ten sites for catching male fruit flies from the fields. At each site, two traps, separately baited with two lures, were hung about 1.5 meters above the ground. Cashed flies were brought to the laboratory at every seven days intervals for identification.
3. Both male and female fruit flies of different species were also collected by using food baits constituted of molasses and/or over ripe banana<sup>[39]</sup>. The food bait traps were reinstalled at every seven days intervals.

#### Identification of fruit fly species

Fruit fly specimens collected by all the three methods stated above were identified to species level based on morphological characters using the keys of Drew and Raghunath (2002)<sup>[13]</sup>, Lin *et al.* (2005)<sup>[27]</sup> and Leblanc, *et al.* (2014)<sup>[26]</sup> and also by studying full description of species from Drew and Romig (2013)<sup>[15]</sup>.

#### Results and discussion

Fruit fly species associated with cucurbitaceous crops in Tripura are represented in table-1. Nine species of Dacine fruit flies viz., *Bactrocera (Bactrocera) dorsalis (Hendel)*, *Bactrocera (Bactrocera) latifrons (Hendel)*, *B. (Hemigymnodacus) diversa (Coquillett)*, *B. (Sinodacus) hochii (Zia)*, *B. (Parasinodacus) cilifera (Hendel)*, *B. (Zeugodacus) caudata (Fabricius)*, *B. (Zeugodacus) cucurbitae (Coquillett)*, *B. (Zeugodacus) tau (Walker)*, and *Dacus (Callantra) longicornis (Wiedemann)* associated with cucurbit crops have been recorded for the first time from Tripura. Specimens of all recorded fruit fly species were deposited at Zoological Survey of India, Kolkata. Out of these, two species viz., *B. (Zeugodacus) cucurbitae (Coquillett)* and *B. (Zeugodacus) tau (Walker)* were found to damage fruits of all the cucurbitaceous crops studied, whereas *D. (Callantra) longicornis* was recorded to cause serious damage to snake gourd and pointed gourd only. Two species of fruit flies viz., *B. (Hemigymnodacus) diversa* and *B. (Parasinodacus) cilifera*, were observed to infest only the flowers of cucurbitaceous plants. Male flies of *B. (Bactrocera) dorsalis*, *B. (Sinodacus) hochii* and *B. (Zeugodacus) caudata* were captured in para-pheromone traps installed in various cucurbit crops. Both males and females of

*B. dorsalis* and *B. latifrons* were collected in food bait traps installed in various cucurbit crops. *B. (Sinodacus) hochii* and *B. (Parasinodacus) cilifera* are the new records from India.

***B. (Bactrocera) dorsalis (Hendel) [Fig. 3; 12; 21; 30]***: Wide spread from the Indian subcontinent, across Southeast Asia and the northern Pacific. Within India, *B. dorsalis* is widespread but appears more common in the subtropical zones<sup>[13]</sup>. A very wide range of wild and commercial fruits are infested by this pest species<sup>[2]</sup>. It is a serious pest of a wide variety of unrelated fruit crops, but seldom cucurbits. Large numbers of male flies were attracted to Methyl eugenol and females together with some males were collected from food bait traps installed in various cucurbit crops.

***Bactrocera (Bactrocera) latifrons (Hendel) [Fig.8; 15; 24; 31]***

*B. latifrons* has a predominantly south and south-east Asian distribution including Pakistan, India, Bangladesh, Sri Lanka, Burma, China, Thailand, Laos, Vietnam, Malaysia, Singapore, Brunei and Taiwan. It has a limited host range and it mainly infests solanaceous and cucurbitaceous plant species<sup>[1, 21, 28, 30,31]</sup>. This species is neither attracted to Methyl eugenol nor to cue lure traps. During the present study both male and female adults were collected in food bait traps installed in cucurbit crops.

***B. (Hemigymnodacus) diversa (Coquillett) [Fig.2; 11; 20; 29]***

*B. diversa* is distributed in India, Bangladesh, Sri Lanka, Nepal, China, Thailand, Bhutan, Pakistan and Southern Vietnam. Flowers of many plant species in the family Cucurbitaceae are infested by this species<sup>[2]</sup>.

During the present study this species has been reared from flowers of pumpkin, ash gourd, ridge gourd and bottle gourd. Females and some males were also collected from food bait traps. Males were weakly attracted to methyl eugenol traps. Earlier this species was reared from male flowers of pumpkin<sup>[36]</sup>.

***B. (Sinodacus) hochii (Zia) [Fig. 4; 13; 22; 35]***

It is present in China, Vietnam, Thailand, Peninsular Malaysia, Indonesia and Bangladesh<sup>[25]</sup>. New record from India. This species infests cucurbits and bred among others from smooth luffa (*Luffa aegyptiaca Mill.*)<sup>[2]</sup>.

During the present study males of *B. hochii* were captured in cue lure traps in cucurbit ecosystem. From the available literature it appears that the occurrence of this species in India is recorded for the first time from Tripura during the present study.

***B. (Zeugodacus) caudata (Fabricius) [Fig. 1; 10; 19; 28]***

It is distributed in Sri Lanka, India, Bangladesh, China, Indonesia, Malaysia, Myanmar, Taiwan, Thailand, Vietnam, and Brunei. It infests cucurbit flowers<sup>[38]</sup>. Larvae have been reared from male flowers of *Cucurbita moschata*<sup>[2]</sup>. During the present study large number of males was attracted to cue lure traps in cucurbit ecosystem.

***B. (Zeugodacus) cucurbitae (Coquillett) [Fig. 9; 17; 26; 34]***

This species is widely distributed in south-east Asia and spread to many parts of the world<sup>[12]</sup>. It attacks mostly cucurbits but sometimes also infests other plants<sup>[2, 23]</sup>.

During the present course of investigation this species has been recorded to infest fruits of all the cucurbitaceous crops

under study. Some flowers of ridge gourd, pumpkin, bottle gourd and ash gourd were also found infested by this pest. Males were attracted to cue lure. Large number of females and some males were also caught in food bait traps.

***B. (Zeugodacus) tau* (Walker) [Fig. 6; 16; 25; 32]**

It is present in China, India, Bangladesh, Sri Lanka, Taiwan, Indonesia, Bhutan, Brunei, Malaysia, Thailand, and Vietnam. It is a major pest of cucurbit crops in Southeast Asia [14]. It has been recorded from 9 plant families but commonly attack fruits of plant species within the family Cucurbitaceae [2]. The species is fairly well distributed across the whole of the Indian subcontinent [7, 19, 33, 35].

Throughout the course of present study this species has been recorded to cause severe damage to fruits of all the cucurbitaceous crops under study. Some flowers of ridge gourd, pumpkin, bottle gourd, sponge gourd and ash gourd were also found infested by this pest. Males were attracted to cue lure. Large number of females and some males were also caught in food bait traps. Earlier presence of this species in Tripura was reported by Bhattacharya *et al.* (2013) [5].

***Bactrocera (Parasinodacus) cilifera* (Hendel) [Fig. 5; 14; 23; 33]**

It is present in Taiwan, Vietnam, Thailand, China, Laos, Malaysia, Indonesia, and Sumatra, Bangladesh. During the present study maggots were reared and adults were emerged from flowers of spiny gourd. Males were attracted to cue lure. Some females and males were also caught in food bait traps installed in Spiny gourd crop. From the available literature it appears that this species is recorded for the first time to infest flowers of spiny gourd from India during the present study. Earlier it was recorded from flowers of *Thladiantha hookeri* (family Cucurbitaceae) [2].

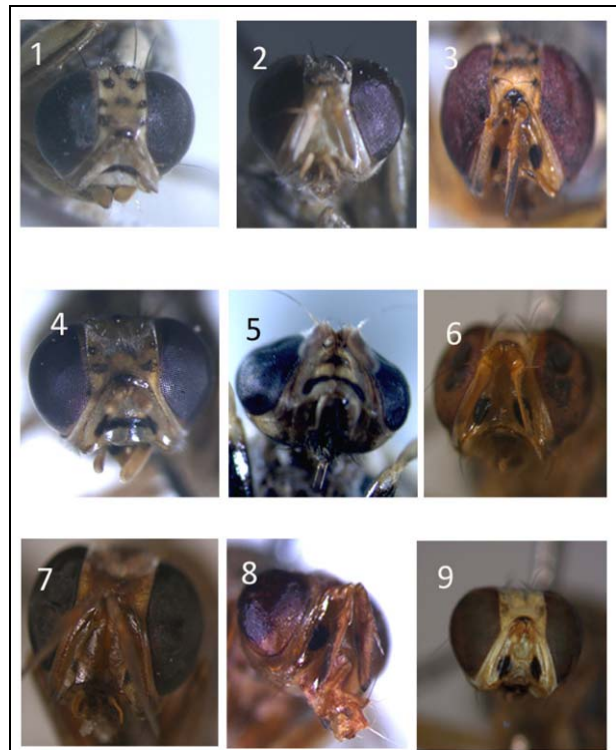
This species can be recognized by fulvous face with two parallel transverse black bands; scutum black with lateral post sutural yellow vittae ending behind intra-alar setae, no yellow spot anterior to notopleural suture; a narrow fuscous costal band confluent with  $R_{2+3}$  and expanded slightly into an elongate spot across apex of  $R_{4+5}$ ; fore femora black and mid and hind femora basally fulvous and apically black; abdominal terga III to V black.

***D. (Callantra) longicornis* (Wiedemann) [Fig. 7; 18; 27; 36]**

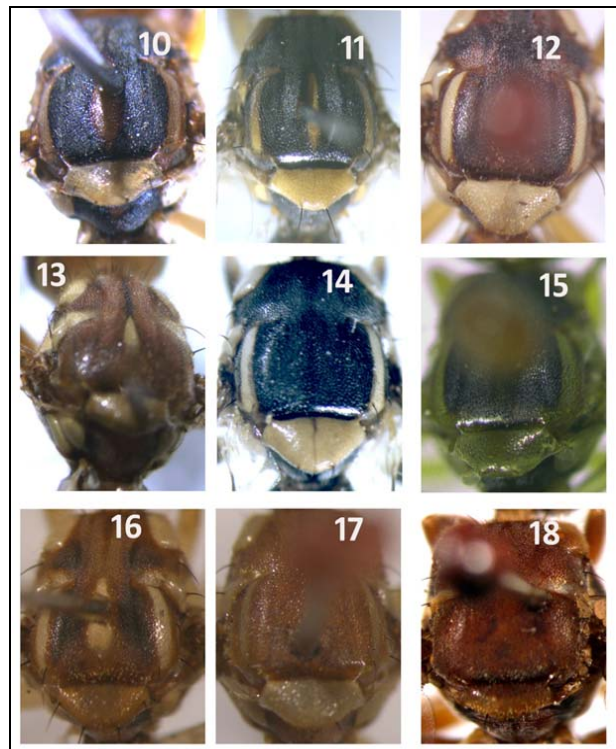
Wide spread across the region from southern Asia to Southeast Asia and recorded from 4 species in family cucurbitaceae [16].

During the present study it has been recorded to infest large numbers of fruits of snake gourd and pointed gourd. Males were attracted to Cue lure.

Earlier *B. cucurbitae*, *B. tau*, *B. scutellaris*, *Dacus ciliatus* and *Bactrocera dorsalis*, were reported to be associated with cucurbit vegetables in different parts of India [4, 8, 17, 19, 20, 24, 34]. However, in the state of Tripura the diversity of cucurbit-infesting fruit fly pest species has not been studied so far. Thus the present finding of the presence of nine species of Dacine fruit flies associated with cucurbit crops is new record for the state of Tripura which represent the North Eastern region of India. *B. (Sinodacus) hochii* and *B. (Parasinodacus) cilifera* are the new country records for India.

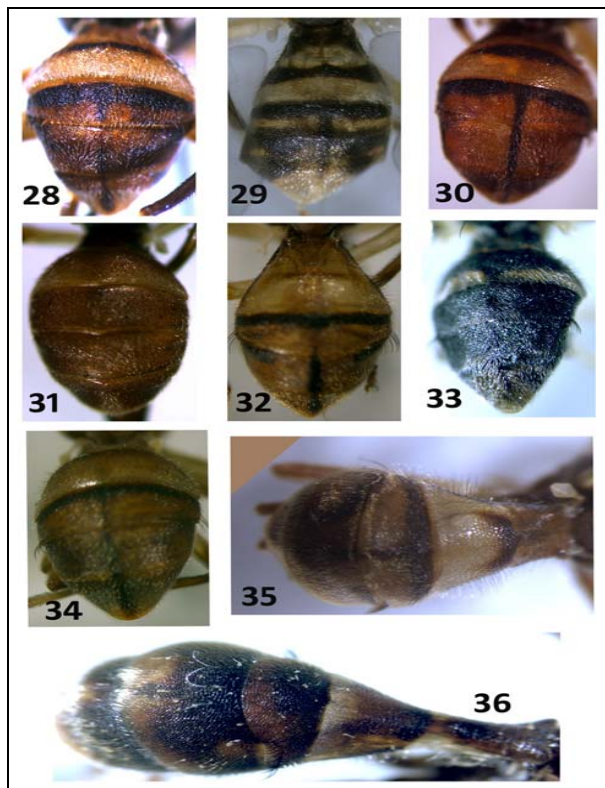
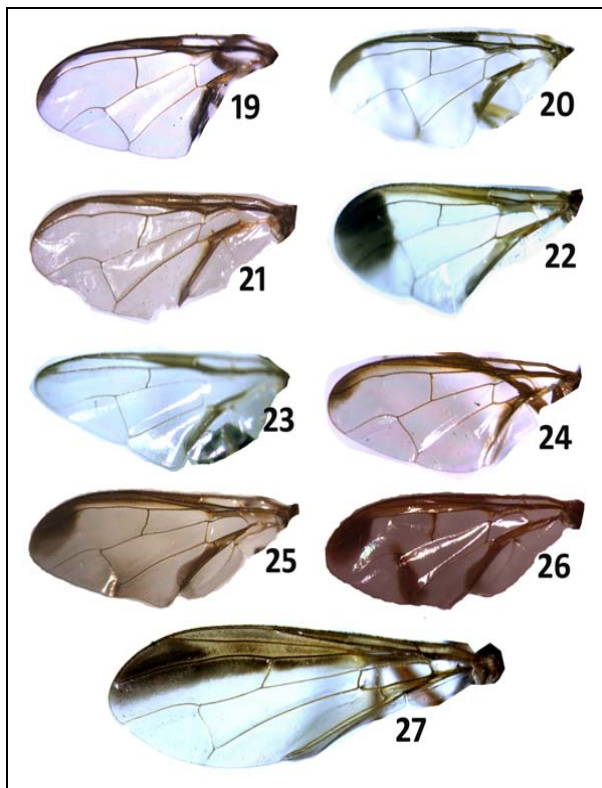


**Fig 1-9:** Heads Of Dacines Showing Frons: 1, *B. (Zeugodacus) Caudata*, 2, *B. (Hemigymnodacus) Diversa*, 3, *B. (Bactrocera) Dorsalis*, 4, *B. (Sinodacus) Hochii*, 5, *B. (Parasinodacus) Cilifera*, 6, *B. (Zeugodacus) Tau*, 7, *Dacus (Callantra) Longicornis*, 8, *B. (Bactrocera) Latifrons*, 9, *B. (Zeugodacus) Cucurbitae*.



**Fig 10-18:** Thorax Of Dacines: 10, *B. (Zeugodacus) Caudata*, 11, *B. (Hemigymnodacus) Diversa*, 12, *B. (Bactrocera) Dorsalis*, 13, *B. (Sinodacus) Hochii*, 14, *B. (Parasinodacus) Cilifera*, 15, *B. (Bactrocera) Latifrons*, 16, *B. (Zeugodacus) Tau*, 17, *B. (Zeugodacus) Cucurbitae*, 18, *Dacus (Callantra) Longicornis*





**Fig 19-27:** Wings Of Dacines: 19, *B. (Zeugodacus) Caudata*, 20, *B. (Hemigymnodacus) Diversa*, 21, *B. (Bactrocera) Dorsalis*, 22, *B. (Sinodacus) Hochii*, 23, *B. (Parasinodacus) Cilifera*, 24, *B. (Bactrocera) Latifrons*, 25, *B. (Zeugodacus) Tau*, 26, *B. (Zeugodacus) Cucurbitae*, 27, *Dacus (Callantra) Longicornis*.

**Fig 28-36:** Abdomens Of Dacines: 28, *B. (Zeugodacus) Caudata*, 29, *B. (Hemigymnodacus) Diversa*, 30, *B. (Bactrocera) Dorsalis*, 31, *B. (Bactrocera) Latifrons*, 32, *B. (Zeugodacus) Tau*, 33, *B. (Parasinodacus) Cilifera*, 34, *B. (Zeugodacus) Cucurbitae*, 35, *B. (Sinodacus) Hochii*, 36, *Dacus (Callantra) Longicornis*.

**Table 1:** Summary of Fruit fly species associated with cucurbitaceous crops in Tripura

Species	Collection method [37, 39]	Number of specimens	Sex of species collected and studied	Host plant recorded
<i>Bactrocera (Bactrocera) dorsalis</i> (Hendel)	Methyl eugenol, food bait traps	7768	Male and female	Not recorded
<i>B. (Bactrocera) latifrons</i> (Hendel)	Food bait traps	47	Male and female	Not recorded
<i>B. (Hemigymnodacus) diversa</i> (Coquillett)	Methyl eugenol (weakly attracted), food bait traps, infested flowers	436	Male and female	Flowers of pumpkin, ridge gourd, ash gourd and bottle gourd.
<i>B. (Sinodacus) hochii</i> (Zia)	Cue-lure.	58	Male	Not recorded
<i>B. (Zeugodacus) caudata</i> (Fabricius)	Cue-lure	835	Male	Not recorded
<i>B. (Zeugodacus) cucurbitae</i> Coquillett)	Cue-lure, food bait traps, infested fruits and flowers.	5540	Male and female	Cucumber, bitter gourd, spiny gourd, sponge gourd, ridge gourd, bottle gourd, snake gourd, ash gourd, pumpkin, pointed gourd and water melon.
<i>B. (Zeugodacus) tau</i> (Walker)	Cue-lure, food bait traps, infested fruits and flowers.	6730	Male and female	Cucumber, bitter gourd, spiny gourd, sponge gourd, ridge gourd, bottle gourd, snake gourd, ash gourd, pumpkin, pointed gourd and water melon.
<i>B. (Parasinodacus) cilifera</i> (Hendel)	Cue-lure, food bait traps, infested flowers.	35	Male and female	Flowers of spiny gourd.
<i>Dacus (Callantra) longicornis</i> (Wiedemann)	Cue-lure, infested fruits	223	Male and female	Snake gourd and pointed gourd.

**Key to the species associated with cucurbitaceous crops recorded in Tripura**

1. Wasp-like larger fly, reddish brown in colour, abdominal tergites fused and abdominal tergite I longer than broad (Fig. 36); wing costal band broad dark fuscous, overlapping vein R<sub>4+5</sub> and becoming darker at apex (Fig. 27); males attracted to cue-lure.....*Dacus longicornis*  
 - Smaller fly with abdominal tergites not fused and abdominal tergite I broader than long; wing costal band narrow and confluent

with R<sub>2+3</sub> or at most overlapping vein R<sub>2+3</sub> ..... 2  
 2. Scutum with medial post sutural yellow vitta present.....3  
 - Scutum with medial post sutural yellow vitta absent.....8  
 3. Wing with a distinct spot at the apex of costal band and infuscations around the r-m and dm-cu cross veins (Fig. 26); scutum predominantly reddish brown (Fig. 17); one pair of scutellar setae present; males attracted to cue-lure..... *Bactrocera cucurbitae*  
 - Wing with infuscations on costal band and anal streak but without infuscations around r-m and dm-cu cross veins.....4

4. Face fulvous with a broad transverse black band (Fig.4); scutum reddish brown with very short medial post sutural yellow vitta (Fig. 13); lateral post sutural yellow vittae absent or very reduced; prescutellar setae absent; one pair of scutellar setae present; apex of costal band on wing greatly expanded into an enlarged circular dark fuscous spot (Fig. 22); males attracted to cue-lure.....*Bactrocera hochii*  
– Prescutellar setae present; medial and lateral post sutural yellow vittae present; apex of costal band on wing not so greatly expanded.....5
5. Face fulvous with a pair of circular to oval black spots (Fig. 6); wing costal band overlapping vein R<sub>2+3</sub> and expanded into an apical spot (Fig. 25); scutum black with large areas of red-brown centrally and anterocentrally (Fig.16); two pair of scutellar setae present; males attracted to cue lure.....*Bactrocera tau*  
– Face fulvous, with or without a transverse black band; scutum colour black; apex of wing costal band at most slightly expanded.....6
6. Face entirely fulvous in male (Fig. 2) and fulvous with transverse dark band in female; scutellum with one pair (rarely two pairs in male) of scutellar setae; male abdomen without pecten; abdominal targa III –V orange-brown with each segment having a black ‘T’ pattern (black ‘T’ pattern prominent on abdominal targa III and IV in males) (Fig. 29); males weakly attracted to methyl eugenol.....*Bactrocera diversa*  
– Face fulvous with transverse black band across oral margin in both sexes (Fig. 1); scutellum with two pairs of scutellar setae; male abdomen with pecten and single black ‘T’ pattern; males attracted to cue-lure .....*Bactrocera caudata*
8. Face fulvous with two parallel transverse black bands (Fig. 5); wing costal band confluent with vein R<sub>2+3</sub> and slightly expanded into an elongate spot across apex of R<sub>4+5</sub> (Fig. 23); fore femora black and mid and hind femora basally fulvous and apically black; abdominal terga III to V black (Fig. 33); males attracted to cue-lure.....*Bactrocera cilifera*  
– Face fulvous with a pair of oval black spots .....9
9. Wing costal band confluent with R<sub>2+3</sub> vein, and not expanded apically (Fig. 21); scutum colour pattern highly variable, almost entirely black or black with variable orange-brown patterns or entirely orange-brown; abdominal tergites III-V with a black ‘T’ pattern (Fig. 30); males attracted to methyl eugenol.....*Bactrocera dorsalis*  
– Wing costal band overlapping R<sub>2+3</sub> and expanding into a small spot around apex of R<sub>4+5</sub> (Fig. 24), abdomen orange-brown, without a black ‘T’ pattern (Fig. 31); males neither attracted to methyl eugenol nor to cue lure.....*Bactrocera latifrons*

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