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FRUIT FLIES (DIPTERA: TEPHRITIDAE: DACINAE: DACINI) SPECIES DIVERSITY IN NEPAL: A REVIEW

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ABSTRACT

The tribe Dacini, within the sub-family Dacinae of the Tephritidae family, includes major fruit flies within the genera *Zeugodacus*, *Bactrocera*, and *Dacus*. The *Bactrocera* spp., which were previously grouped into sub-genera *Zeugodacus* and *Bactrocera*, have been treated as separate genera in recent years. These dacine flies are widely spread in fruits and vegetables. The first dacine fruit fly, i.e. *D.* (*Callantra) nepalensis* reported in 1964 from Nepal is still a holotype. Altogether, 27 species have been reported in Nepal from three genera–*Dacus* (6), *Zeugodacus* (8), and *Bactrocera* (13), of which 10 species are attracted to cue-lure, 7 species to methyl eugenol, 2 species to zingerone, 1 species to lati-lure and 5 species to more than one lure, while lure for 2 species are unknown. Among them, 7 species are oligophagous pests, 6 species are polyphagous pests, and the pest status of 14 species is unknown. Fruit fly infestation and damage have been recorded in different crops such as; 5 species on cucurbits, 2 species on different fruits, 4 species on different fruits and vegetables, 1 species on citrus fruits, and 1 species on solanaceous vegetables. Three species; *Z. cucurbitae*, *Z. tau,* and *B. minax,* have been recorded from infested fruit cultures of cucurbits and sweet orange too. However, pest status, preferred hosts, and biology of many species remain yet to be explored and reported from Nepal. Further studies are necessary focusing on fruit fly species of economic importance concerning host preference for developing appropriate management strategy. Efforts are needed to identify the fruit fly species that inflict actual damage to the hosts.

Keywords: Cucurbits, damage, distribution, flies, monitoring

INTRODUCTION

Fruit flies (Diptera: Tephritidae) are economically important worldwide except in extreme desert and polar areas. Korneyev (1999) classified that the Tephritidae family

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into six sub-families (Blepharoneurinae, Dacinae, Phytalmiinae, Tachiniscinae, Tephritinae and Trypetinae) comprises of over 469 genus, 62 sub-genus and over 4700 recognized species worldwide (Han et al., 2017; ITIS, 2023). Of them, nearly 325 species of fruit flies are known to occur in Indian sub-continent in four sub-families; namely Dacinae, Phytaminae, Tephritinae and Trypetinae (Nair et al., 2018). The tribe Dacini is the most species rich clades (reported 932 species worldwide) within the family Tephritidae (Doorenweerd et al., 2018). More than 92 dacine fruit fly species have reported from India (Vasudha et al., 2019) while 26 are reported from Nepal (Leblanc et al., 2019).

Of the recognized dacine fruit flies, around 10% are pests of commercially cultivated fruits and vegetables, with cucurbits being their major hosts. Dacine fruit flies are polyphagous in nature, exhibiting high reproduction potential, wide climatic tolerance, and a high dispersal capacity. Cucurbits represent number of crops within the family Cucurbitaceae (~100 genera and ~1000 species), 50 species are being cultivated for various purposes worldwide (Chomicki et al., 2020). Dacine fruit fly causes enormous devastation to both production and trade of fresh cucurbits. However, the preference for the host is important, and the damage extent may vary with species and host (Prabhakar et al., 2007). In Nepal, *Bactrocera, Zeugodacus* and *Dacus* are most common genera of dacine fruit fly affecting both vegetables and fruits. Among them, *Z. cucurbitae* (Coquillett) and *Z. tau* (Walker) are major pests in cucurbits (Nair et al., 2017; Sawai et al., 2019). The extent of yield-loss due to fruit flies in cucurbits ranges from 30–100%, depending upon host species, locality and the season (Dhillon et al., 2005).

Majority of dacine fruit flies reported in Nepal were collected from fruit and cucurbits growing areas. Studies on population density, yield loss and management measures of dacine fruit flies are typically limited to one season and focus on a specific crop only. Systematic review is needed for better understanding of fruit flies to devise effective management measures. This study aims to document the chronological studies reported on dacine fruit fly diversity in Nepal and identify the research gaps, with special reference to cucurbitaceous vegetables as hosts.

A. The tribe Dacini

Dacine fruit flies are characterized by black to brown scutum with or without yellow vittae and primarily hyaline wing a with well-developed costal band and anal streak (David and Ramani, 2019). Fabricius first reported the genus *Dacus* in 1805, while *Z.* (*Dacus*) *cucurbitae* was first described by Coquillett in 1899. Dacine fruit flies have been variably assigned to species complexes, species groups, and sub-genera; Drew (1989) proposed four groups of Dacini: *Bactrocera, Zeugodacus, Melanodacus* and *Queenslandacus.* Furthermore, Drew et al. (1998) and Drew and Hancock (1999) classified four genera within Dacini: *Dacus*, *Bactrocera*, *Ichneumonopsis* and *Monacrostichus*. Norrbom et al. (1999) reported the tribe Dacini which comprises the subtribes; Ceratitidina, Dacina and Gastrozonina. Korneyev (1999) studied the

morphological framework for the phylogenetic relationships and concluded that the relationships among sub-families and tribes have not yet been satisfactorily defined.

Dacine fruit flies are phenotypically very similar, making them one of the most difficult groups of Tephritidae to identify at species level. *Bactrocera* was considered a sub-genus of *Dacus* until Drew (1989) elevated both taxa to the status of genera, based on distinguished characteristics in abdominal tergites. *Zeugodacus* was also regarded as a sub-genus of *Dacus* but was later considered as a sub-genus under *Bactrocera* (Drew 1989). White (2006) claimed that the sub-genus *Zeugodacus* might be sister group to *Dacus*. Krosch et al. (2012) provided strong phylogenetic evidences supporting the relationship between the *Zeugodacus* group of sub-genus and the genus *Dacus*. Drew and Romig (2013) considered *Ichneumonopsis* to be a member of Dacini, while Freidberg et al. (2017) included this genus in the tribe Gastrozonini.

Diagnostic attributes (e.g. patterns in body color) used to distinguish species have been confounded by intraspecific variation, leading to a long history of unstable classification. However, phylogenetic studies at the molecular level have provided valuable insights, resulting in a general consensus that morphology-based classifications need revision. The majority of species belonging to *Bactrocera* and *Dacus* have been divided into several sub-genera. With over 930 described species within the genus *Bactrocera* including *Zeugodacus* and *Dacus* within the tribe Dacini (Table 1). Based on the recent phylogenetic studies and increased use of molecular data, the large genus *Bactocera* splited into *Zeugodacus* and *Bactorcera* (Krosch et al., 2012; Virgilio et al., 2015). Virgilio et al. (2015) grouped few *Bactrocera* species into a new generic rank *Zeugodacus* Hendel stat. nov. Considering the advancement in species identification, four genera, viz. *Dacus* Fabricius, *Bactrocera* Macquart, *Zeugodacus* Hendel and *Monacrostichus* Bezzi are now recognized within the tribe Dacini (Doorenweerd et al., 2018).

Table 1. Number of described dacine fruit fly species per region (Doorenweerd et al., 2018)

Category	Worldwide	Africa	Asia-pacific
Bactrocera	461	13	451
Dacus	273	193	81
Zeudodacus	196	1	195
Monacrostichus	2	0	2
Dacini	932	207	730

Five species (*D. ciliates, B. oleae, B. dorsalis, B. latifrons* and *Z. cucurbitae*) share both Africa and Asia-pacific regions.

B. Distribution of the tribe Dacini fruit flies

The dacine fruit flies are primarily concentrated in two regions of the world; Afrotropical region and Southeast Asia to Northeastern Australia (Table 2). The Asian-Pacific Dacini; *Bactrocera* and *Zeugodacus* species are predominately found in Southeast Asia and Papua New Guinea (Drew and Romig, 2013). *Dacus* species, on the other hand, are widely distributed throughout the Afrotropical region. Papua New Guinea has the greatest diversity of dacine fruit fly species, with 188 species described, 18 of which are of economic importance and over 50 species awaiting description (Allwood et al., 2001). Similarly, Solomon Island has more than 48 described species of tribe Dacini, including at least four economically important species (Hollingsworth et al., 2003). Vasudha et al. (2019) reported 92 dacine fruit fly species in India, 28 of which are endemic. This includes 51 species of genus *Bactrocera*, 10 species of *Dacus* and 31 species of *Zeugodacus*. Species such as *Zeugodacus caudatus*, *Z. tau*, *Z. diversus*, *Z. scutellaris* and *Dacus longicornis* are widely distributed in Southeast Asia. Five species namely: *D. ciliates*, *B. oleae*, *B. dorsalis*, *B. latifrons* and *Z. cucurbitae* are found in both Africa and Asia-pacific regions (Table 2; Figure 1). In Nepal, out of the total reported dacine fruit fly species, only four are found in Africa region, with the majority belonging to the genus *Bactrocera* (52%) followed by *Zeugodacus* (30%) (Figure 1).

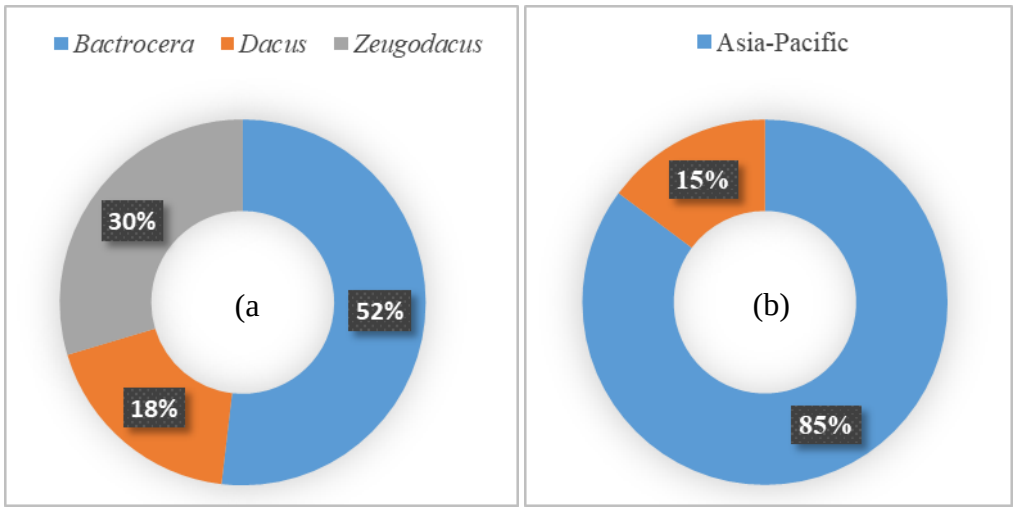

Figure 1. Species identified within three genera (a) and category of species based on their global distribution (b) of 27 dacine fruit flies found in Nepal.

C. Fruit fly species of the tribe Dacini in Nepal

The first information regarding Tephritidae fruit flies (Dacinae: Dacini) in Nepal was reported in 1964 based on the 20 specimens collected from eastern part of Nepal during 1961-62 (Hardy, 1964). This study reported four sub-families (Dacinae, Aciurinae,

Trypetinae and Tephritinae), six tribes, nine genera and eleven species, including tribe Dacini. The first fruit fly species, i.e. *Dacus* (*Callantra) nepalensis* (Hardy, 1964) reported from Nepal within the tribe Dacini is still holotype (NHM, 2023). Kapoor et al. (1979) reported two species, *D. (Zeugodacus) caudatus* Fabricius and *D. (Zeugodacus) scutellaris* Bezzi of fruit flies within the tribe Dacini from specimens collected in the Kathmandu valley. Subsequently, numerous studies have discussed fruit fly species, although taxonomic studies on species diversity and identification have been made by only a few researchers. Leblanc et al. (2019) conducted a comprehensive study on dacine fruit fly species identification, reporting 26 species with new country records of 11 species including *B. tuberculata.* However, Tiwari (2016) had reported the *B. tuberculate* in the earlier study. A chronological order of studies over time regarding dacine fruit flies, conducted either from preserved specimens, fruits or field level monitoring/management studies, is presented in Table 2.

Table 2. Reported fruit fly species within the tribe Dacini, Nepal

SN	Fruit fly within Dacini	Samples	Location	References
1	*Dacus (Callantra) nepalensis* (Hardy 1964)	Collected specimen	East shore of River Arun, Eastern Nepal	Hardy (1964) NHM (2023)
2	**D. dorsalis* Hendel	Collected specimen	Different part of Nepal	Pradhan (1970)
3	**Dacus (Zeugodacus) caudatus* Fabricius, **D. (Z.) scutellaris* Bezzi	Collected specimen	Kirtipur, Kathmandu	Kapoor et al. (1979)
4	*Bactrocera cucurbitae* Coquillett	Monitoring and field management in cucurbits	Western hills	Manjunathan (1997), Jaiswal et al. (1997), Gautam et al. (1998) GC (2001)
5	*Bactrocera (Dacus) dorsalis* complex	Citrus	Western hills	Pandey et al. (1997)
	**D.* sp. Prob. *Tsuneonis* Miyaka; **D. diversus* Coq., *D. cucurbitae, D.* sp. Nr. *Dorsalis, D. scuttellaris*, **D. zonatus* Hend, **D. tau* Walker	Collected specimen in 1964, 1965, 1968 & 1984 AD	Kathmandu and its vicinity	Khatri and Sthapit (1997)
6	*B. cucurbitae, B. diversus* Coq., *B. dorsalis* Hendel, *B.* sp. Nr. *Dorsalis* Hendel, *B. scutellaris* Bezzi, *B. tau, B. tsuneonis (?)* Miyaka, *B. zonatus* Saud.	Collected specimen at NARC	Different parts of the country	Joshi and Manandhar (2001)
7	*B. cucurbitae, B. dorsalis, B. zonatus, B. tau, B. scutellaris and B. yoshimotoi*	Cucurbits and fruits	Kavre and Kathmandu	Shrestha (2006)
8	*B. cucurbitae, B. tau and two unidentified* spp.	Cue-lure in Zucchini	Lamjung	Sapkota (2009)
9	*B. minax (*earlier reported *as B. tsuneonis)*	Citrus Orchard	Dhankuta	NCRP (2006)
10	*D. succaelestis/nepalensis; B. scutellaris B. luteicinctuta/yoshimotoi* Ito sp. Nov.	Field collection	Northeast Nepal	Ito (2011)

SN	Fruit fly within Dacini	Samples	Location	References
11	*B. cucurbitae, B. dorsalis, B. tau, B. scutellaris, B. zonatus, B. yoshimotoi, B. diversus, B. minax, B. caudatus and B. correcta.*	Collected specimen at NARC and Fruit development directorate	Entomology division, NARC Entomology Lab, Kirtipur	Entomology Division NARC cited in Sharma et al. (2015)
12	*B. cucurbitae, B. dorasalis, B. zonata, B. tau and B. scutellaris*	Collected specimen	Sindhuli and Syangja	Sharma et al. (2015)
13	*B. nigrofemoralis, B. latifrons, B. atrifacies, B. tuberculata and D. ciliates*	Collected specimen	Entomology division, NARC	Gautam et al. (2015)
14	*B. cucurbitae, B. scutellaris and B. caudatus*	Cucumber field	Kathmandu	Maharjan et al. (2015)
15	*B. cucurbitae, B. scutellaris, B. tau, B. nigrofemoralis, B. dorsalis, B. zonata, B. minax, B. yoshimotoi, D. longicornis and other D. spp.*	Collected specimen in different lures	Syangja, Sindhuli and Kaski	PPD (2016)
16	*B. dorsalis, B. tuberculata, B. tau, B. scutellaris, B. minax, B. cucurbitae, B. atrifacies, and B. yoshimotoi*	Cue-lure, methyl eugenol and protein bait traps	Eastern hill-Paripatle citrus orchard	Bhandari et al. (2017)
17	*B. minax* Enderlein, *B. cucurbitae, B. dorsalis, B. zonata, B. tau, B. scutellaris, D. longicornis*	Cue-lure and methyl eugenol monitoring, rearing sweet orange	Sindhuli	Adhikari and Joshi (2018)
18	*B. dorsalis, B. zonata, B. tau, B. correcta, B. cucurbitae, B. minax, B. diversus, B. scutellaris, B. caudatus, B. tuberculate, B. latifrons, B. atrifacies, B. yoshimotoi, B. tsuneonis, B. nigrofemoralis, D. longicornis and D. ciliates*	Monitoring, field specially citrus	Different parts of the country	Adhikari et al. (2019)
19	*B. dorsalis, B. zonata, B. correcta, B. minax, B. latifrons, B. nigrofemoralis, Z. cucurbitae, Z. tau, Z. scutellaris, Z. diversus, Z. caudatus, Z. yoshimotoi, D. longicornis, Z. atrifacies, D. ciliatus, B. tuberculata, B. abbreviate, B. aethriobasis, B. digressa, B. nigrifacia, B. rubigina, B. syzygii, Z. duplicatus, D. feijeni, D. maculipterus* and *D. trimacula*	Fruit fly male lures; cue-lure, methyl eugenol, and Zingerone	Different parts of the country	Leblanc et al. (2019)
Total	27 species			

Genus and species with bold text within 2nd column were reported 1st time in Nepal by the respective author(s)/ organization and date. The genus/species name with asterisk (*) was later updated into new genus/species name [e.g. G J Steck, Florida State Collection of Arthropods, USA in 2007 confirmed that *B. minax had been misidentified as *B. tsuneonis* in earlier reports].

D. Distribution and host range of the tribe Dacini fruit flies

In Nepal, identification of the most fruit fly species is based on morphology of specimen monitored using lures such as methyl eugenol, cue-lure, and citronella. The majority of fruit fly species (>80%) are known to infest commercial and/or edible fruits and fleshy vegetables, while 8 species are known to infest cucurbits (Leblanc et al., 2013). Mostly, *Zeugodacus* species are highly polyphagous, and some of them have repeatedly invaded and even established in non-native ranges (Vargas et al., 2015). The pest status of 14 identified dacine fruit flies in Nepal has not been reported (Figure 2). *B. nigrifacia* and *B. rubigina* are considered potential pest (Drew and Romig, 2013). The distributions within the tribe Dacini of known species in Nepal are presented in Table 3.

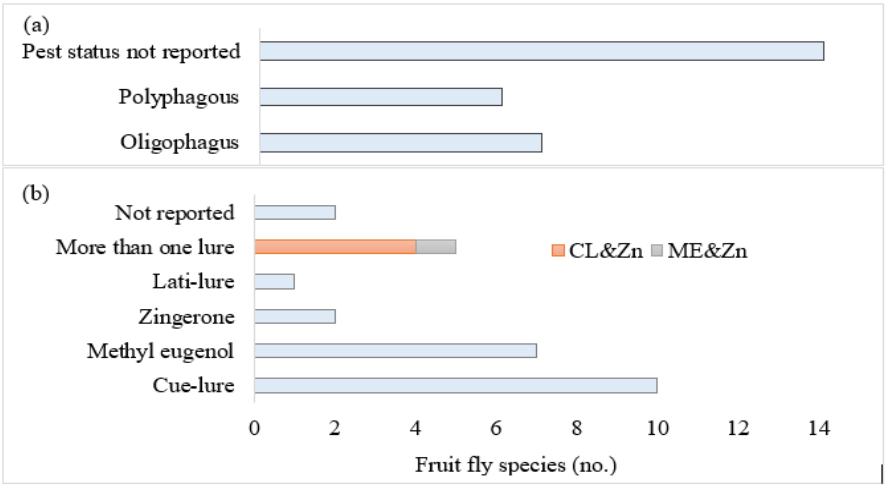

Figure 2. Pest status (a), and lures (b) reported to monitor dacine fruit flies globally and in Nepal as presented in Table 3.

Table 3. Identified fruit fly species in Nepal within the tribe Dacini with their attractant, pest status, distribution and host ranges.

SN	Fruit fly species reported in Nepal	ttractant eported	Pest status	Distribution	Infested fruit cultured, Nepal	Potential host reported globally
1.	*Dacus (Callantra) nepalensis* (Hardy 1964)	NR	NP	Eastern Nepal	Holotype	No specific record. Potentially synonym of *Dacus polistiformis* (Leblanc et al., 2019)
2.	*Zeugodacus cucurbitae* (Coq.1899) CN: Melon fruit fly	CL*; Zn*	PP; mainly cucurbit fruit & flower	Asia-Pacific; Africa and Oceania, USA	Cucumber and Zucchini (Sapkota et al., 2010)	136 hosts of 30 families; different cucurbit crops and *Carica papaya* (Allwood et al., 1999; Drew, 1989; Vargas et al., 2015; Leblanc et al., 2019)

SN	Fruit fly species reported in Nepal	ttractant eported	Pest status	Distribution	Infested fruit cultured, Nepal	Potential host reported globally
3.	*Bactrocera dorsalis* (Hendel 1912). CN: Mango/Oriental fruit fly	ME*; Zn*	PP; mainly fruits	Asia-Pacific; Africa, Oceania Europe	NYR	More than 478 kinds of fruits and vegetables (USDA, 2016); 490 hosts in 81 families (Allwood et al., 1999; Leblanc et al., 2013).
4.	*Z. diversus* (Coq. 1904) CN: Three-striped fruit fly	weak ME#, ME*	OP; cucurbit flowers	Asia-Pacific	NYR	Bred from flowers of nine species of Cucurbitaceae (Allwood et al., 1999; Vasudha et al., 2019)
5.	*Z. scutellaris* (Bezzi 1913)	CL*	OP; cucurbit flowers	Asia-Pacific	NYR	Bred from flowers of *Cucurbita* sp., *Lagenaria siceraria*, and *Zehneria wallichii* (Allwood et al., 1999; Vasudha et al., 2019)
6.	*Z. tau* (Walker 1849). CN: Pumpkin fruit fly	CL*	PP; mainly cucurbits	Asia-Pacific	Cucumber (Sharma and Tiwari, 2020)	77 hosts of 23 families; major are*: Cucumis* sp., *Cucurbita* sp., *Luffa* sp., *Manilkara* sp., *Momordica* sp., *Psidium* sp. (Allwood et al., 1999; Vasudha et al., 2019)
7.	*B. zonata* (Saunders 1842) CN: Peach fruit fly	ME*	PP; mainly fruits	Asia-Pacific; introduced in USA and Africa	NYR	54 hosts of 23 families; Major are*: Prunus persica, Malus* sp., *Mangifera* sp., *Psidium* sp. (Allwood et al., 1999; Culliney et al., 2017)
8.	*Z. yoshimotoi* (Hardy 1973)	CL*	NP	Asia-Pacific	NYR	No specific record. Potentially synonym of *Z. luteicinctutus* (Doorenweerd et al., 2018)
9.	*B. minax* (Enderlein 1920) CN: Chinese citrus fly	weak ME¥	OP; citrus fruits	Asia-Pacific	Sweet Orange (Adhikari and Joshi, 2018)	*Citrus* spp. (Allwood et al., 1999; Jaleel et al., 2021).
10.	*Z. caudatus* (Fabricius 1805)	CL*	OP; cucurbit flowers	Asia-Pacific	NYR	Male flowers of *Cucurbita moschata* (Allwood et al., 1999); cucurbit flower (Vasudha et al., 2019)
11.	*B. correcta* (Bezzi 1916) CN: Guava fruit fly	ME*	PP; fruits	Asia-Pacific	NYR	73 hosts of 35 families; Major are*: Anacardium* sp., *Averrhoa* sp., *Mangifera* sp., *Psidium* sp., *Syzygium* sp., *Ziziphus* sp. (Culliney et al., 2017; Jaleel et al., 2021).
12.	*B. latifrons* (Hendel 1915); CN: Malaysian/Solanum fruit fly	Lati-lure¥	OP; fruit vegetables	Asia-Pacific	NYR	*Capsicum* sp., *Solanum* sp. (Allwood et al., 1999)
13.	*Z. atrifacies* (Perkins 1938)	CL*	NP	Asia-Pacific	NYR	No specific record.
14.	*D. ciliatus* Loew 1862 CN: Lesser pumpkin fly	NR	OP; cucurbit fruits	Africa	NYR	Various cucurbit crops (White and Elson-Harris, 1992)
15.	*B. nigrofemoralis* White & Tsuruta 2001	CL*	NP	Asia-Pacific	NYR	*Cucumis sativus* (Devi et al., 2018)

SN	Fruit fly species reported in Nepal	ttractant eported	Pest status	Distribution	Infested fruit cultured, Nepal	Potential host reported globally
16.	*D. longicornis* (Wiedemann 1830)	CL*	OP; cucurbit fruits	Asia-Pacific	NYR	*Luffa* spp., *Trichosanthes* sp., *Trichosanthes* sp. and *Zehneria* sp. (Allwood et al., 1999; Nair et al., 2017)
17.	*B. tuberculata* (Bezzi 1916)	ME*	PP; fruits	Asia-Pacific	NYR	Hosts in 8 families; Major are*: Mangifera* sp., *Carica* sp., *Prunus* sp., *Manilkara* sp.; *Syzygium* sp. (Allwood et al., 1999; Jaleel et al., 2021).
18.	*B. abbreviata* (Hardy 1974)	Zn*	NP	Asia-Pacific	NYR	*Chionanthus* sp. and *Olea* sp. (Allwood et al., 1999)
19.	*B. aethriobasis* (Hardy 1973)	ME*	NP	Asia-Pacific	NYR	*Azadirachta* sp. (Drew and Romig, 2013)
20.	*B. digressa* Radhakrishnan 1999	CL*; Zn*	NP	Asia-Pacific	NYR	*Alangium* sp. (David and Ramani, 2011)
21.	*B. nigrifacia* Zhang, Ji and Chen 2011	CL*	NP	Asia-Pacific	NYR	*Callicarpa* sp., *Capparis* sp., *Zehneria* sp.and *Flueggea* sp. (Drew and Romig, 2013)
22.	*B. rubigina* (Wang and Zhao 1989)	CL*; Zn*	NP	Asia-Pacific	NYR	*Litsea* sp. (Liang et al., 1993)
23.	*B. syzygii* White and Tsuruta 2001	Zn*	NP	Asia-Pacific	NYR	*Syzygium* sp. (Tsuruta and White, 2001)
24.	*Z. duplicatus* (Bezzi 1916)	CL[@]	NP	Asia-Pacific	NYR	No specific record.
25.	*D. feijeni* White 1998	CL*	NP	Asia-Pacific	NYR	No specific record.
26.	*D. maculipterus* Drew and Hancock 1998	ME[@]	NP	Asia-Pacific	NYR	No specific record.
27.	*D. trimacula* Wang 1990	CL*, Zn*	NP	Asia-Pacific	NYR	No specific record.

CN: Common Name; NR: Non-Recorded; NP: Non-pest; ME: Methyl Eugenol; CL: Cue-lure; OP: Oligophagous; PP: Polyphagous; NYR: Not Yet Reported; *Doorenweerd et al. (2018); [#]Drew and Roming (2013); [@]Leblanc et al. (2019); [¥]Vasudha and Agrawal (2019).

In 13 identified pests of dacine fruit flies in Nepal, six are polyphagous and seven are oligophagous, but none of them are strictly monophagous (Figure 2). Most of them prefer fruit, while a few prefer flowers only (Figure 2, Table 2). Doorenweerd et al. (2018) and Vasudha et al. (2019) reported that *B. nigrofemoralis* is considered as non-pest while Devi et al. (2018) was reported as pest of cucumber.

Various lures are being investigated and some species are specific to one lure, while others attracted to more than one lure. More attractive male lures such as (isoeugenol, methyl-isoeugenol, dihydroeugenol, lati-lure and zingerone) are being studied for several non-responsive and weak responsive species to cue-lure and methyl eugenol (Manoukis et al., 2019; Royer et al., 2019). Many fruit fly species which are non-responsive to any lure are reported to be managed by using Zingerone while lati-lure

is now suggested for *B. latifrons* (Vasudha and Agarwal, 2019). *B. minax* has become a dominant pest in citrus orchard, particularly in sweet orange (Acharya and Adhikari, 2019; Adhikari et al., 2022; Sharma et al., 2015) and is not attracted in lures (Doorenweerd et al., 2018). However, Vasudha and Agarwal (2019) reported methyl eugenol is a weak lure for this pest. Prabhakar et al. (2007) reported that *B. scutellaris* is a new threat to cucurbit, with females laying eggs in tender stems, leaf axils and floral axils while Doorenweerd et al. (2018) reported it as a pest of cucurbit flowers only. *B. diversus* appears to have a weak attraction to methyl eugenol (Drew and Roming, 2013, Vasudha and Agarwal, 2019) while Royer et al. (2018) reported that *Z. (B.) diversus* is better attracted in methyl-isoeugenol than in methyl eugenol.

CONCLUSION

The first fruit fly species reported from Nepal, *Dacus* (*Callantra) nepalensis* (Hardy, 1964), is still holotype preserved in the British Museum. Over time, a chronological study of fruit flies in Nepal has revealed 27 species belonging to three genera *Bactrocera*, *Zeugodacus* and *Dacus* within the tribe Dacini reported through collected specimens, monitoring with different lures, and observations of infested fruit culture. Among these, two closely related fruit fly species, *Z.* (*B.) cucurbitae* (Coq.) and *Z. (B.) tau* (Walker) are widely reported in cucurbits across Nepal, spanning from the east to west and from the terai to mid-hill region while *B. minax* has been reported from citrus fruits only. Much of the knowledge regarding these fruit fly species from infested fruit cultures remains limited in Nepal. Therefore, there is a pressing need for studies focused on seasonal distribution, geological distribution and host specific fruit fly species to develop better management practices of fruit flies. Further studies should be directed towards species that inflict actual damages to the host, in order to develop management strategy of dacine fruit flies. Economically important hosts, particularly cucumber, pumpkin, sponge gourd, bitter gourd and citrus fruits need special consideration for the effective management of dacine fruit fly species.

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