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Original article – Thematic Issue

Bactrocera dorsalis, an invasive fruit fly species in Mauritius

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Summary

The Oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) is a highly polyphagous fruit fly species and key pest of fruits in regions of the world where it has established. *B. dorsalis* was first detected in Mauritius in 1996 and then declared eradicated in 1999. A second interception was made in 2013 and it was eradicated. The insect was recorded for a third time in 2015 and since then, it has spread to the whole island. Sample of both wild and cultivated fruits were collected from January 2016 to February 2020 to determine the infestation indices for the different fruit fly species. Fruits were collected across the island from 63 plant species representing 28 families. The fruits were weighed and incubated in the laboratory to determine the infestation levels. Eight fruit fly species namely: *B. dorsalis*, *Bactrocera zonata* (Saunders), *Ceratitis capitata* (Wiedemann), *Ceratitis quilicii* De Meyer, Mwatawala et Virgilio, *Dacus ciliatus* Loew, *Neoceratitis cyanescens* Bezzi, *Zeugodacus cucurbitae* (Coquillett) and *Caropmyia vesuviana* Costa were reared from the collected fruits. Results showed that *B. dorsalis* displaced *B. zonata*, *C. quilicii* and *C. capitata* in mango *Mangifera indica* L., carambola *Averrhoa carambola* L., guava *Psidium guajava* L. and Indian almond *Terminalia catappa* L. among other fruits with the exception of plant species from the family Cucurbitaceae.

Keywords
fruits, fruit fly, hosts, larval surveillance

Significance of this study

What is already known on this subject?

- Fruit flies (Family Tephritidae) are key pests of fruits and vegetables worldwide. However, different fruit fly species have different host preference and the level of damage they cause also varies from fruits to fruits.

What are the new findings?

- *Bactrocera dorsalis* displaced *Bactrocera zonata*, *Ceratitis quilicii* and *C. capitata* in mango *Mangifera indica* L., carambola *Averrhoa carambola* L., guava *Psidium guajava* L., Indian almond *Terminalia catappa* L. and citrus. However, *Zeugodacus cucurbitae* remained the main fruit fly species that attacked the cucurbits namely: pumpkin *Cucurbita pepo* L., cucumber *Cucumis sativus* L., snakegourd *Trichosanthes cucumerina* L. ridgegourd *Luffa acutangula* (L.) Roxb. and bittergourd *Momordica charantia* L. *B. dorsalis* has a wider host range compared to the other fruit flies that attack fruits in Mauritius.

What is the expected impact on horticulture?

- *Bactrocera dorsalis* is more aggressive than *B. zonata.* If no fruit fly control measure is implemented, the level of damage by *B. dorsalis w*ould be high. Hence, growers should monitor the fruit fly population and start the bait application technique and male annihilation technique as soon as the population of *B. dorsalis* in traps begins to rise.

Introduction

The oriental fruit fly, *Bactrocera dorsalis* (Hendel), (Diptera: Tephritidae) is an invasive species of Asian origin which was first detected in Kenya in 2003 (Lux *et al*., 2003) and has now invaded most countries on the African continent (Drew *et al*., 2005; Khamis *et al*., 2009). After two successful eradications of *B. dorsalis* in 1996 (Seewooruthun *et al*., 2000a, b) and in 2014 (Sookar *et al*., 2016) from Mauritius, the fly was trapped for the third time in October 2015 in one mango orchard found in the western part of the island. An eradication programme using the bait application technique and the male annihilation technique was implemented. Unfortunately, infested fruits were sold outside the eradication area. In 2017, *B. dorsalis* was present island-wide. Fruit fly trapping and larval surveillance were pursued (MAIFS, 2017).

Prior to 2016, economically important fruit flies of fleshy fruits in Mauritius, in order of importance, were the peach fruit fly *Bactrocera zonata* (Saunders), *Ceratitis quilicii* De Meyer, Mwatawala et Virgilio, the Mediterranean fruit fly *Ceratitis capitata* (Wiedemann) and the ber fly *Carpomya vesuviana* Costa. Preferred cultivated hosts for the first three species were mango *Mangifera indica* L., guava *Psidium guajava* L., peach *Prunus persica* (L.) Batsch, loquat *Eriobotrya japonica* (Thunb.) Lindl., water apple *Syzygium samarangese*, citrus *Citrus* spp., and custard apple *Annona reticulata* L., while the most heavily attacked wild fruit was the Indian almond *Terminalia catappa* (L.) Ridley. *C. vesuviana* was specific to jujube *Ziziphus jujube* Lam. (Sookar *et al*., 2008). Furthermore, fruit flies attacking vegetables included the tomato fruit fly *Neoceratitis cyanescens* (Bezzi), which infested tomato *Solanum lycopersicum* L., while the Ethiopian fruit fly *Dacus ciliatus* (Loew), the Indian Ocean cucumber fly *D. demmerezi* (Bezzi) and the melon fly *Zeugodacus cucurbitae* (Coquillett) damaged cucurbits (Sookar *et al*., 2012).

B. dorsalis is an invasive species of Asian origin which invaded and expanded its range on the African continent since 2003 (Lux *et al*., 2003; Drew *et al*., 2005; Khamis *et al*., 2009; Theron *et al*., 2017; Pieterse *et al*., 2020). It is a multivoltine

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species and does not enter a diapause phase (Goergen *et al*., 2011). In Africa, *B. dorsalis* has been recorded on more than 80 host plants (De Meyer *et al*., 2012). Mango (*Mangifera indica* L.; Anacardiaceae) is the primary host in several African countries (Mwatawala *et al*., 2004; Ekesi *et al*., 2006) while guava (*Psidium guajava* L.; Myrtaceae) (Vargas *et al*., 2007; Hussain *et al*., 2015) and Indian almond (*Terminalia catappa* L.; Combretaceae) being suitable reservoir hosts for the species to survive well (Mwatawala *et al*., 2006, 2009).

The main objective of this study was to determine the infestation levels of wild and cultivated hosts due to fruit flies following the accidental introduction of *B. dorsalis* in 2015 and later its establishment.

Materials and methods

Host fruit survey was carried out across the island from January 2016 to February 2020. Fruits were collected as far as possible on a fortnightly basis from cultivated fields, backyard gardens, roadside shrubs and forested areas. Both fruits and vegetables from the Cucurbitacea and Solanacea families were collected. Fruit samples included ripe to overripe fruit, including those with visible symptoms of fruit fly damage both from the tree and from the ground. Attempts were made to sample large quantity of fruits with a minimum of 10 fruits per fruiting species although in some cases this sample size could not be maintained due to unavailability of fruit. Mature ripe fruits were sampled in most cases with the exception of the cucurbits where young fruits were collected. Fruit collections of the different plant species were separately placed in perforated polyethylene bags in the field for transport to the laboratory.

In the laboratory, the fruits were counted, weighed and incubated at room temperature on a layer of moistened sterilised sand in plastic trays covered with cloth. The sand served both as the pupation medium for the larvae that popped out of the fruit in addition to soaking up fruit juices. Then after 3 to 5 days, the sand was sieved for the first time and a second sieving was done after 7 to 8 days. Collected pupae were counted and placed in Perspex cages (15 × 15 × 20 cm). Emerging tephritids were provided with an artificial diet that consisted of a volumetric mixture of 1:3 enzymatic yeast hydrolysate and sugar, and water was provided in a sponge placed in a container. Flies were allowed to feed for four days until full adult development and body colorations were attained. They were then killed by placing them in a freezer and later preserved in 70% alcohol. All flies, including the parasitoids, were identified and counted.

Statistical analysis

Data for field surveys are presented according to plant species, family, number of fruits collected and weighed, number of adults and number of parasitoids recovered. Infestation by *B. zonata*, *B. dorsalis*, *C. quilicii*, *C. capitata*, *D. ciliatus*, *C. vesuviana*, *Z. cucurbitae* and *N. cyanescens* followed the methodology of Cowley *et al.* (1992), and it was calculated as the ratio of number of adults per kilogram of fruit collected (infestation index).

Results

B. dorsalis was reared from 37 plant species, followed by *B. zonata* from 36 plant species, *Z. cucurbitae* from 15 plant species, *D. ciliatus* from 12 plant species, *C. quilicii* and *C. capitata* from 13 plant species, *N. cyanescens* from two plant species (*Solanum melongena* L. and *Lycopersicum esculentum* L.), and *C. vesuviana* from one plant species (*Ziziphus mauritiana* Lamarck) out of 63 plant species that were collected across the island from January 2016 to February 2020 (Table 1). The infestation index for *B. zonata* for the 36 plant species varied from 0.02 flies kg^{-1} (*Carica papaya* L.) to 3.64 flies kg^{-1} (*Dimocarpus longan* Lour.) while the infestation index for *B. dorsalis* varied from 0.01 flies kg^{-1} (*Capsicum frutescens* L.) to 105.56 flies kg^{-1} (*Syzygium jambos* L. (Alston)). 15 plant species had infestation indices for *B. dorsalis* above the maximum infestation index for *B. zonata* (3.64 flies kg^{-1}).

Among the plant species sampled, *B. dorsalis* infestation was recorded from *Spondias dulcis* Parkinson and *Mangifera indica* L. (Anacardiaceae), *Annona squamosa* L., *Annona muricata* L., *Annona reticulata* L. (Annonnaceae), *Carissa carandas* L. (Apocynaceae), *Hylocereus undatus* (Haw.) Britton & Rose (Cactaceae), *Carica papaya* L. (Cariaceae), *Terminalia catappa* L. (Combretaceae), *Cucurbita pepo* L. (Cucurbitaceae), *Tamarindus indica* L. (Fabaceae), *Sea americana* Miller (Lauraceae), *Punica granatum* L. (Lythraceae), *Malpighia glabra* L. (Malpighiaceae), *Musa* spp. (Musaceae), *Psidium cattleyanum* Sabine, *Psidium guajava* L., Syzygium *samarangense* (Blume) Merr. & L. M. Perry, *Syzygium jambos* L. (Alston) (Myrtaceae), *Elaeocarpus serratus* L. (Oleaceae), *Averrhoa carambola* L. (Oxalidaceae), *Passiflora edulis* Sims (Passifloraceae), *Ziziphus mauritiana* Lamarck (Rhamnaceae), *Eriobotrya japonica* (Thunb.) Lindley, *Prunus persica* (L.) Batsch (Rosaceae), *Citrus limon* (L.) Burm. F., *Citrus aurantifolia* (Christm.) Swingle × Fortunella spp., *Citrus reticulata* Blanco, *Citrus sinensis* (L.) Osbeck, *Citrus* × *pradisi* Macfad., *Citrus bergamia* Risso, *Citrus aurantium* L., *Citrus japonica* Thunb. (Rutaceae), *Litchi chinensis* Sonnerat (Sapindaceae), *Pouteria campechiana* (Kunth) Pierre, *Mimusops coriacea* (A.DC.) Miq. (Sapotaceae) and *Capsicum frutescens* L. (Solanaceae) (Table 1). The families Rosaceae and Myrtaceae had the highest number of species infested, with *B. dorsalis* reared from all the eight species of Rutaceae family and four species of Myrtaceae family. The most heavily infested Myrtaceae was *S. jambos*, with infestation reaching 105.56 flies kg^{-1} fruit. The second most heavily infested fruit fly host was *P. persica* from the Rosaceae family (39.68 flies kg^{-1} fruit). Among the Rutaceae, *Citrus aurantifolia* (Christm.) Swingle × Fortunella spp. was the most infested (10.42 flies kg^{-1} fruit). Of the wild host fruit sampled, the highest level of infestation was recorded on *T. catappa* L. (14.59 flies kg^{-1} fruit).

In 25 out of 27 plant species where at least two fruit fly species were reared, the infestation index for *B. dorsalis* was above those for *B. zonata*, *C. quilicii* or *C. capitata.*

Fruit species positive for *B. dorsalis* included both cultivated and wild host plants. The majority of *B. dorsalis* infested samples were from cultivated fruits. Out of the 9 plant species of the Cucurbitaceae family, *B. dorsalis* was recovered from only one sample of the plant species *Cucurbita pepo* L. *Z. cucurbitae* were the most damaging fruit flies for the plant species in the Cucurbitaceae family with the infestation level ranging from 19.87 to 98.54 flies per kg fruit followed by *D. ciliatus* with infestation levels varying from 0.15 to 22.22 flies kg^{-1} fruit (Table 1). Out of the 63 plant species, only one plant species, namely, *Sechium edule* (Jacq.) Sw., did not yield any fruit fly pupa.

From January 2016 to February 2017, *B. zonata* was the most devastating pest of *M. indica* (Figure 1). As from March 2017 onwards, *B. dorsalis* displaced *B. zonata* so much so that as from March 2018 to February 2020, the latter was not recovered from the fruit. When *B. dorsalis* displaced *B. zonata,* the infestation index for *B. dorsalis* was far higher

Table 1. Host fruit infestation indices for *Bactrocera dorsalis* (Hendel), *Bactrocera zonata* (Saunders), *Ceratitis quilicii* De Meyer, Mwatawala et Virgilio, *Ceratitis capitata* (Wiedemann), *Zeugodacus cucurbitae* (Coquillett) and *Dacus ciliatus* and level of parasitism by *Fopius arisanus* Loew (Sonan, 1932) from January 2016 to February 2020.

Plant species	Plant family	No. samples	No. fruits	Fruit weight (kg)	Pupae kg^{-1}	Bd kg^{-1}	Bz kg^{-1}	Cq kg^{-1}	Cc kg^{-1}	Zc kg^{-1}	Dc kg^{-1}	% Parasitism
Spondias dulcis Parkinson	Anacardiaceae	559	4,121	252.54	2.11	3.83	0.32	0	0.02	0.02	0.02	5.08
Mangifera indica L.	Anacardiaceae	1,641	10,616	1,143.86	1.61	18.46	0.41	0.02	0	0	0	6.93
Annona cherimola Mill.	Annonnaceae	13	33	5.73	2.09	0	0.52	0	0	0	0	0
Annona squamosa L.	Annonnaceae	25	79	8.13	3.08	1.6	0.12	0	0	0	0	0
Annona muricata L.	Annonnaceae	10	38	12.04	1.33	0.75	0	0	0	0	0	6.25
Annona reticulata L.	Annonnaceae	63	200	32.87	1.98	2.65	0.27	0.37	0	0	0.03	3.08
Carissa carandas L.	Apocynaceae	12	40	0.1	30	20	0	0	0	0	0	0
Phenix dactylifera L.	Arecaceae	5	49	0.55	7.27	0	1.82	0	0	0	0	0
Hylocereus undatus (Haw.) Britton & Rose	Cactaceae	19	110	21.65	1.11	22.91	0.51	0	0	0	0	0
Carica papaya L.	Caricaceae	92	227	511.85	0.18	0.3	0.02	0	0	0	0	2.17
Terminalia catappa L.	Combretaceae	1,518	23,006	595.33	2.52	14.59	0.95	0.2	0.04	0.01	0.01	18.18
Momordica charantia L.	Cucurbitaceae	51	452	33.975	25.84	0	0	0	0	19.87	0.15	0
Lagenaria leucaritha (Dush) Pusby	Cucurbitaceae	31	187	29.555	45.51	0	0	0	0	37.12	0	0
Sechium edule (Jacq.) Sw.	Cucurbitaceae	7	48	3.79	0	0	0	0	0	0	0	0
Cucumis sativus L.	Cucurbitaceae	84	627	83.255	89.4	0	0	0	0	56.45	0.89	0
Cucurbita maxima Duchesne ex Lam.	Cucurbitaceae	23	103	46.815	107.2	0	0	0	0	98.54	2.91	0
Trichosanthes cucumerina L.	Cucurbitaceae	74	605	55.355	128	0	0	0	0	60.72	22.22	0
Luffa acutangula (L.) Roxb.	Cucurbitaceae	85	641	64.97	78.64	0	0	0	0	60.4	1.14	0
Citrullus lanatus (Thunb.) Matsun & Nakai	Cucurbitaceae	8	20	2	3	0	0	0	0	0	0	0
Cucurbita pepo L.	Cucurbitaceae	12	298	43.275	53.19	0.55	0	0	0	36.14	6.38	0
Phyllanthus acidus (L.) Skeels	Euphorbiaceae	177	4,394	45.93	3.9	0	0.17	0	0	0	0	0.56
Millettia pinnata / *Pongamia pinnata* (L.)	Fabaceae	4	128	1.12	4.46	0	0	0	0	0	0	0
Tamarindus indica L.	Fabaceae	113	2,136	18.85	5.99	0.05	0.6	0	0	0	0	0
Persea americana Miller	Lauraceae	70	252	39.68	1.79	4.18	0	0	0	0	0	5.63
Punica granatum L.	Lythraceae	289	1,159	96.17	3.1	2.12	0.34	0	0	0.01	0	1.01
Malpighia glabra L.	Malpighiaceae	8	273	1.34	5.97	31.34	0	0	0	0	0	0
Artocarpus altilis Fosb.	Moraceae	13	28	7.21	1.8	0	0.42	0	0	0	0	0
Musa spp.	Musaceae	12	45	3.01	3.65	39.87	0	0	0	0	0	9.09
Eugenia brasiliensis Lamarck	Myrtaceae	3	80	0.48	6.25	0	2.08	0	2.08	0	0	0
Psidium cattleyanum Sabine	Myrtaceae	52	982	10.08	5.26	17.16	1.39	2.88	0	0	0	5.66
Psidium guajava L.	Myrtaceae	550	4,453	213.73	2.62	31.73	1	0.95	0.06	0	0	16.58
Syzygium *samarangense* (Blume) Merr. & L. M. Perry	Myrtaceae	216	6,930	121.41	3.57	7.87	0.46	0.28	0.02	0	0	5.53
Syzygium *cumini* (L.) Skeels	Myrtaceae	4	80	0.6	6.67	0	3.33	0	0	0	0	0
Syzygium malaccense (L.) Merr. & Perry	Myrtaceae	10	117	2.95	3.39	0	0.34	0	0	0	0	0
Syzygium jambos L. (Alston)	Myrtaceae	4	30	0.18	22.22	105.56	0	72.22	0	0	0	25.0
Eugenia uniflora L.	Myrtaceae	9	231	1.3	6.92	0	0.77	0	3.08	0	0	0
Elaeocarpus serratus L.	Oleaceae	25	499	9.9	2.53	7.07	0.61	0.3	0	0	0	0
Averrhoa bilimbi L.	Oxalidaceae	37	513	7	4.86	0	0.29	0	0	0	0	0
Averrhoa carambola L.	Oxalidaceae	445	3,295	186.5	2.69	1.33	0.36	0	0.01	0.01	0.01	0.85
Passiflora edulis Sims	Passifloraceae	50	290	12.04	4.24	1.66	0.33	0.08	0	0.08	0	0
Phyllanthus emplica L.	Phyllanthaceae	23	499	2.97	7.41	0	0	0	0	0	0	0
Ziziphus mauritiana Lamarck	Rhamnaceae	337	9,642	79.61	4.52	0.97	1.87	0.05	0.05	0.04	0.05	21.67
Eriobotrya japonica (Thunb.) Lindley	Rosaceae	9	149	1.22	7.38	30.33	0	2.46	0.82	0	0	11.11
Prunus persica (L.) Batsch	Rosaceae	12	120	3.1	3.87	39.68	0.32	1.94	0	0	0	25.0
Vangueria madagascariensis J. F. Gmel.	Rubiaceae	11	130	2.05	5.37	0	0	0	0	0	0	0
Citrus limon (L.) Burm. F.	Rutaceae	16	248	13.98	2.58	0.29	0	0	0	0	0	0

Table 1. Continued.

Plant species	Plant family	No. samples	No. fruits	Fruit weight (kg)	Pupae kg^{-1}	Bd kg^{-1}	Bz kg^{-1}	Cq kg^{-1}	Cc kg^{-1}	Zc kg^{-1}	Dc kg^{-1}	% Para-sitism
Citrus aurantifolia (Christm) Swingle × Fortunella spp.	Rutaceae	121	243	22.94	2.35	10.42	0.04	0	0	0	0	9.26
Citrus reticulata Blanco	Rutaceae	84	574	27.64	3.04	4.2	0.43	0	0.04	0	0	5.95
Citrus sinensis (L.) Osbeck	Rutaceae	29	140	17.02	1.7	2.35	0.47	0	0	0	0	10.34
Citrus x *paradisi* Macfad.	Rutaceae	59	212	79.94	1.5	0.95	0.25	0	0	0	0	1.67
Citrus bergamia Risso	Rutaceae	129	934	146.21	1.79	3.47	0.47	0.25	0.01	0	0	17.56
Citrus aurantium L.	Rutaceae	113	483	56.73	2.22	10.31	0.07	0	0.04	0.02	0.02	20.63
Citrus japonica Thunb.	Rutaceae	4	138	3.15	3.81	1.27	2.54	0	0	0	0	16.67
Flacourtia indica (Burman f.) Merrill	Salicaceae	17	796	3.6	4.72	0	0.83	0	0	0	0	0
Litchi chinensis Sonnerat	Sapindaceae	218	5,911	108.58	2.01	0.05	0	0	0	0	0	0.46
Dimocarpus longan Lour.	Sapindaceae	3	66	0.28	10.91	0	3.64	0	0	0	0	0
Manilkara zapota (L.) P. Royen	Sapotaceae	4	30	1.45	2.76	0	2.76	0	0	0	0	0
Pouteria campechiana (Kunth) Pierre	Sapotaceae	15	61	5.18	2.9	7.34	0	0	0.19	0	0	6.67
Mimusops coriacea (A.DC.) Miq.	Sapotaceae	107	1,183	22.48	4.89	21.31	0.4	0	0	0	0	4.55
Capsicum frutescens L.	Solanaceae	4	41	75.12	0.2	0.01	0	0	0	0	0	0
Solanum melongena L.	Solanaceae	11	59	6	2.5	0	0	0	0	0.5	0	0
Lycopersicum esculentum L.	Solanaceae	49	634	26.08	48.71	0	0	0	0	21.94	0	0
Solanum mauritianum Scop.	Solanaceae	8	926	3.19	5.33	0	0	0	0	0	0	0

Bd: *Bactrocera dorsalis*; Bz: *Bactrocera zonata*; Cq: *Ceratitis quilicii*; Cc: *Ceratitis capitata*; Zc: *Zeugodacus cucurbitae*; Dc: *Dacus ciliatus*.

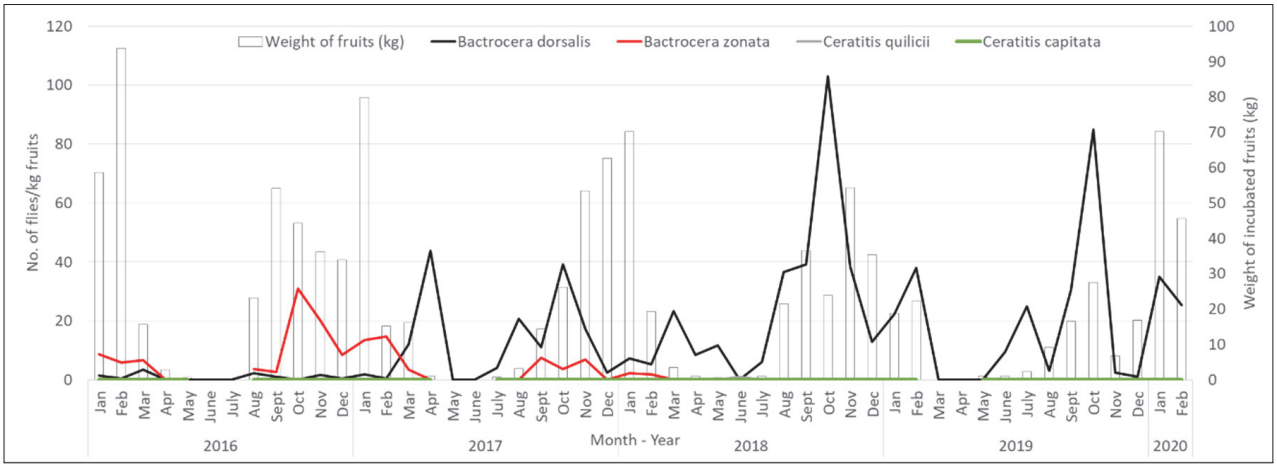

Figure 1. Infestation levels of *Mangifera indica* L. with *Bactrocera dorsalis* (Hendel), *Bactrocera zonata* (Saunders), *Ceratitis capitata* (Wiedemann) and *Ceratitis quilicii* De Meyer, Mwatawala et Virgilio from January 2016 to February 2020.

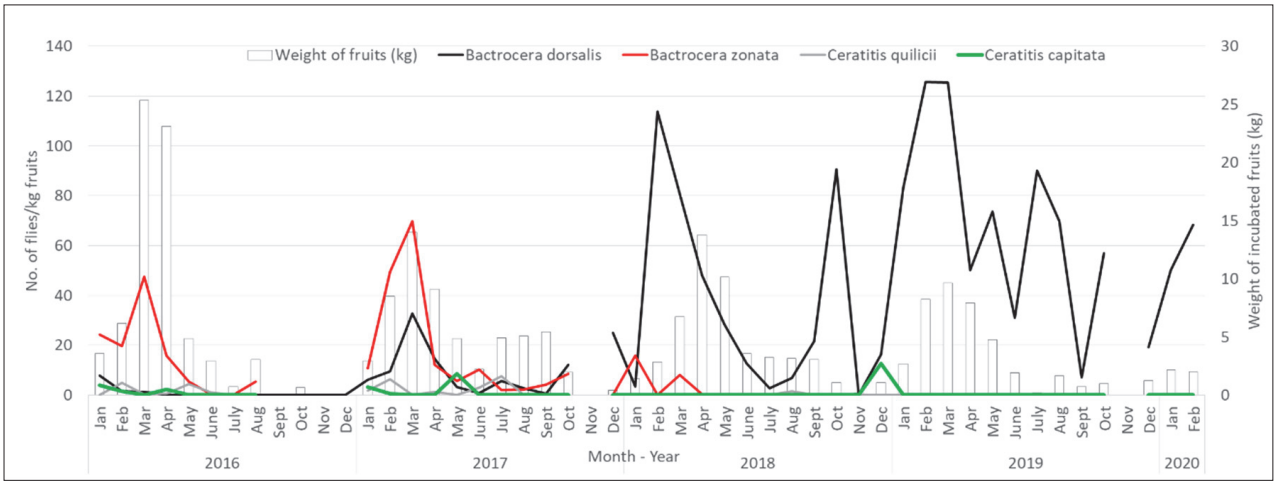

Figure 2. Infestation levels of *Psidium guajava* L. with *Bactrocera dorsalis* (Hendel), *Bactrocera zonata* (Saunders), *Ceratitis capitata* (Wiedemann) and *Ceratitis quilicii* De Meyer, Mwatawala et Virgilio from January 2016 to February 2020.

than that for *B. zonata.* Similar trend was obtained for *P. guajava* (Figure 2), *S. jambos* L. (Figure 3), *M. coriacea* (Figure 4), *S. dulcis* (Figure 5) and *T. catappa* (Figure 6). Only *B. dorsalis* was reared from *S. dulcis* in 2016. The following year, both *B. zonata* and *B. dorsalis* were recovered from the fruit. As from October 2017, *B. dorsalis* displaced *B. zonata* in the host *S. dulcis.* All the above-mentioned fruits are seasonal and, in most cases, the highest infestation index for *B. dorsalis* was obtained mid-season.

The introduced parasitoid, *Fopius arisanus* (Sonan, 1932) was recovered from 28 plant species out of the 51 plant species that were infested with either *B. dorsalis* or *B. zonata* or both (Table 1). Level of parasitism in the different hosts varied from 0.56% for *Phyllanthus acidus* (L.) Skeels to 25% for both *P. persica* and *S. jambos.* The highest levels of parasitism in the wild fruits were 21.67% for *Z. mauritiana* and 18.18% for *T. catappa.*

Discussion and conclusion

B. dorsalis was reared from 37 plant species, representing 28 plant families which are new host plant records in Mauritius. The Animal and Plant Health Inspection Service

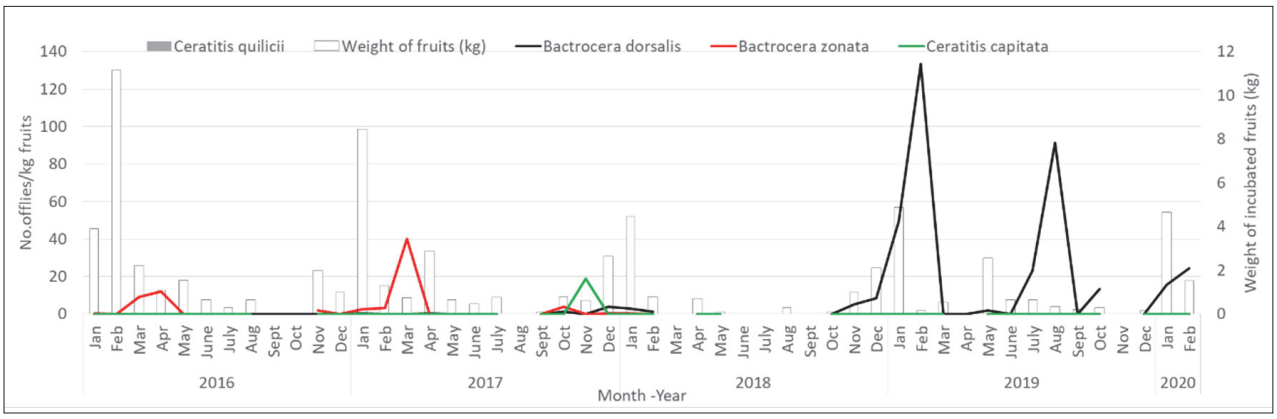

Figure 3. Infestation levels of *Syzygium jambos* L. (Alston) with *Bactrocera dorsalis* (Hendel), *Bactrocera zonata* (Saunders) and *Ceratitis capitata* (Wiedemann) from January 2016 to February 2020.

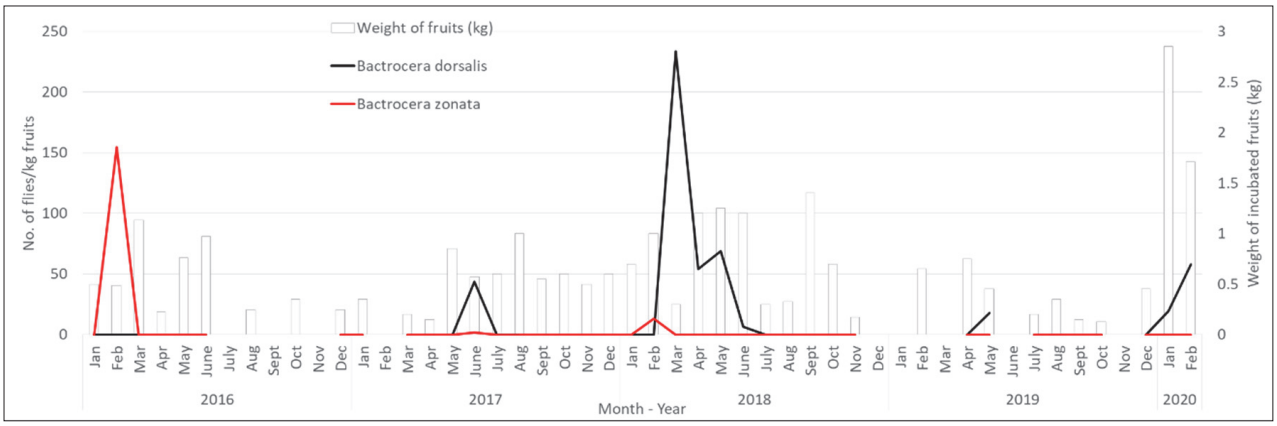

Figure 4. Infestation levels of *Mimusops coriacea* (A.DC.) Miq. with *Bactrocera dorsalis* (Hendel) and *Bactrocera zonata* (Saunders) from January 2016 to February 2020.

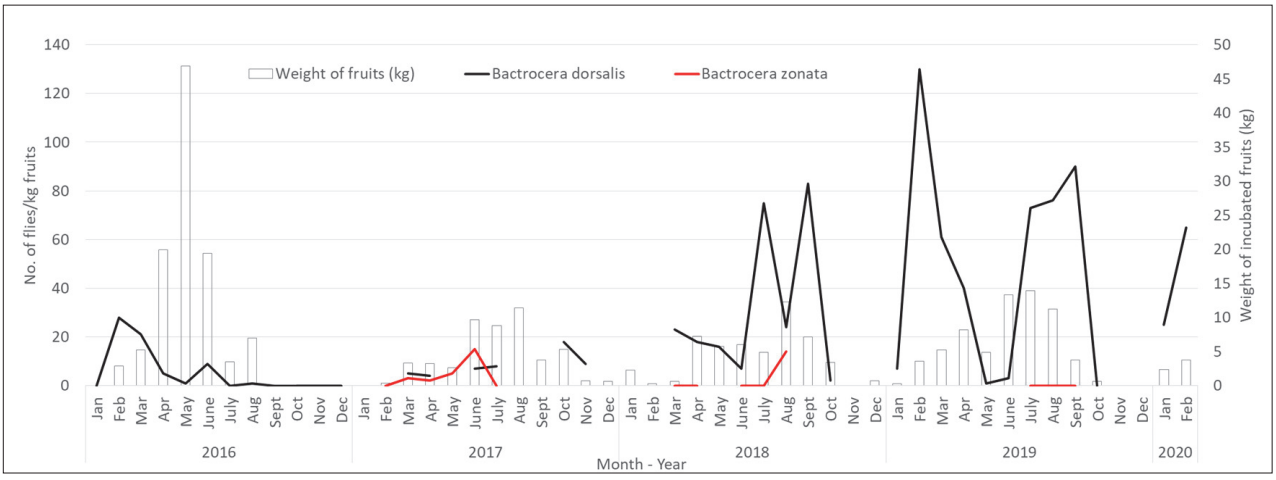

Figure 5. Infestation levels of *Spondias dulcis* Parkinson with *Bactrocera dorsalis* (Hendel) and *Bactrocera zonata* (Saunders) from January 2016 to February 2020.

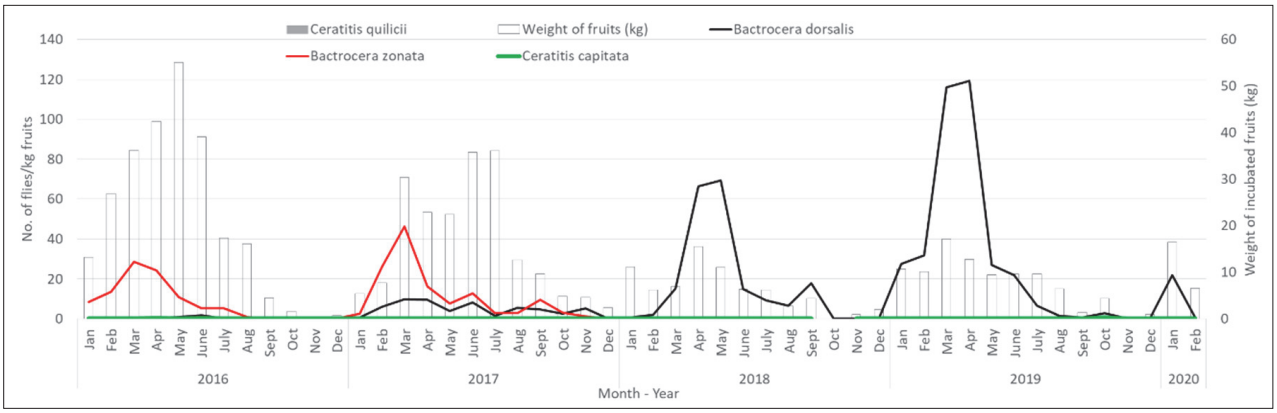

Figure 6. Infestation levels of *Terminalia catappa* L. with *Bactrocera dorsalis* (Hendel), *Bactrocera zonata* (Saunders), *Ceratitis capitata* (Wiedemann) and *Ceratitis quilicii* De Meyer, Mwatawala et Virgilio from January 2016 to February 2020.

of the United States Department of America has listed 351 plant species as suitable hosts for *B. dorsalis* (APHIS/USDA, 2016). More than 300 plant species of commercial/edible and wild hosts are recorded as main hosts for this pest in the Invasive Species Compendium of the Centre for Agriculture and Bioscience International (CABI, 2021). De Meyer *et al*. (2014) reported 69 plant species, representing 28 plant families as host plant records in Africa. In our study, *B. dorsalis* was found to infest fruit species within the families Anacardiaceae, Annonnaceae, Apocynaceae, Cactaceae, Cariaceae, Combretaceae, Cucurbitaceae, Fabaceae, Lauraceae, Lythraceae, Malpighiaceae, Musaceae, Myrtaceae, Oleaceae, Oxalidaceae, Passifloraceae, Rhamnaceae, Rosaceae, Rutaceae, Sapindaceae, Sapotaceae and Solanaceae suggesting that *B. dorsalis* is an emerging polyphagous pest that is capable of sustaining its population through reproduction on a range of cultivated and wild fruits. Invasive *B. dorsalis* has been shown to be highly competitive with native fruit flies where it has established, quickly becoming the dominant fruit fly pest (Vargas *et al*. 2007, Vayssières *et al*. 2015). In many African countries, *B. dorsalis* is the predominant species attacking cultivated crops and is known to dominate indigenous species in those countries (Ekesi *et al*. 2006, Mwatawala *et al*. 2009).

B. dorsalis was recorded in Mauritius in October 2015 and it became a pest of *S. dulcis* as early as February 2016. While for *M. indica*, *B. dorsalis* took 15 months to displace *B. zonata* which was the main fruit fly pest. Within 29 months after introduction of *B. dorsalis*, *B. zonata* was relegated to a minor fruit fly pest for *P. guajava*, *S. jambos*, *M. coriacea*, *S. dulcis* and *T. catappa. C. quilicii* and *C. capitata* remained minor fruit fly pests.

The most cultivated fruit in Mauritius is *M. indica.* Unfortunately, the latter was the most important host of *B. dorsalis* among the fruit sampled within the Anacardiaceae. In October 2016, the number of *B. dorsalis* and *B. zonata* flies per kg *M. indica* fruit was 0.11 and 30.92, respectively. In October 2017, the number of *B. dorsalis* per kg of fruit rose to 39.11 while that for *B. zonata* went down to 3.66 flies per kg of fruit. Afterwards, *B. zonata* was rarely recovered from *M. indica.* In Tanzania, Mwatawala *et al*. (2006) reported 15 host plants for *B. dorsalis* and identified *M. indica* amongst the favoured hosts. *B. dorsalis* was recorded as the most damaging pest of *M. indica* in the Indian Ocean Islands, namely: Comoros, Madagascar, Mayotte, Réunion and Seychelles (Franck and Delatte, 2020).

S. jambos of the Myrtaceae family was the most infested by *B. dorsalis* (105.56 flies kg^{-1} fruit) followed by *P. guajava* (31.73 flies kg^{-1} fruit), *P. cattleyanum* (17.16 flies kg^{-1} fruit) and *S. samarangense* (7.87 flies kg^{-1} fruit). Infestation index for the above fruits for *B. zonata* varied from 0.46 to 1.39 flies kg^{-1} fruit. However, only *B. zonata* was reared from *Eugenia brasiliensis* Lamarck, *Eugenia uniflora* L., *Syzygium cumini* (L.) Skeels and *Syzygium malaccense* (L.) Merr. & Perry. The infestation index for these four fruits ranged from 0.34 to 3.33 flies kg^{-1} fruit. It was observed that when *B. dorsalis* was present in a fruit, the infestation index was far higher than that for *B. zonata.*

T. catappa (Combretaceae) is generally known to harbour a complex of fruit fly species of the genus *Bactrocera*, including *B. dorsalis*, *B. zonata*, *B. correcta*, *B. kadiensis* and *B. papaya* (Clarke *et al*., 2005; Mwatawala *et al*., 2006; Rwomushana *et al*., 2008; De Meyer *et al*., 2014). The high infestation levels recorded in our study (119.22 per kg *B. dorsalis* in samples of April 2019) confirm the status of *T. catappa* as an important host plant of *B. dorsalis.* Our records show that the fruits are available almost year-round with low season from October to December and it probably harbours successive generations of this pest, which infest the cultivated fruits. *B. dorsalis* was reared from only one sample of plant species of the Cucurbitaceae family, namely *Cucurbita pepo* L. Thus, *B. dorsalis* is considered to be a minor pest of cucurbits in Mauritius. This finding corroborates with results obtained in the Indian Ocean islands, namely, Comoros, Madagascar and Reunion island where *Z. cucurbitae*, *D. ciliatus*, *D. demmerezi* are major pests of cucurbits while *B. dorsalis* is of lesser economic importance (Franck and Delatte, 2020).

In conclusion, our results suggest that *B. dorsalis* is a polyphagous species, so far recorded in 37 plant species from 28 plant families in Mauritius. However, this list is unlikely to be exhaustive, and host surveys should be pursued. Eight fruit fly species were reared from the collected fruits. Results showed that after its introduction in Mauritius in October 2015, *B. dorsalis* has displaced *B. zonata*, *C. quilicii* and *C. capitata* in several fruit species, resulting in higher infestation indices. We also acknowledge that the sample size for some of the fruit species collected in the current study may be low, but results presented here may still be useful in taking pest management decisions.

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