Original article

Fruit phenology of citruses, mangoes and papayas influences egg-laying preferences of *Bactrocera invadens* (Diptera: Tephritidae)

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Fruit phenology of citruses, mangoes and papayas influences egg-laying preferences of *Bactrocera invadens* (Diptera: Tephritidae)

Abstract – Introduction. African fruit production, as well as regional and international fruit trade, have experienced heavy economic losses over the past decade due to the damage caused by fruit flies, especially *B. invadens* Drew Tsuruta & White (Tephritidae: Diptera). *Bactrocera invadens* attacks fruits belonging to numerous botanical families, several of which are of great economic importance. The females of these flies generally lay their eggs in mature fruits, but some can lay in green-immature fruits. **Materials and methods**. The influence of the species, variety and phenology of fruits on the fruit attractiveness to *B. invadens* and the elicitation of *B. invadens* egg-laying behaviour were studied in the laboratory. Fruits harvested regularly during the years 2008 and 2009 from orchards in the Niayes area (Senegal) were exposed to gravid females in cages set for the different factors tested. The exposed fruits were then incubated and the pupae emerging from them were counted. **Results and discussion**. *Bactrocera invadens* females laid eggs in ripe fruits. Within the same fruit species, the variety plays an important role in egg-laying preference. Hence, among the mango varieties tested, the Pêche variety hosted the highest number of pupae per fruit, while the Palmer variety hosted the lowest number. Comparison among different fruit species showed that mature papaya was more infested than mature mango or citrus. Furthermore, flies were unable to develop on lime. **Conclusion**. Our study showed that *B. invadens* can infest green and ripe host fruits, and even immature abscised fruits. Consequently, management of this pest must include preventive measures in the development and implementation of an integrated management system.

Senegal / *Mangifera indica* / *Carica papaya* / *Citrus* / fruits / phenology / maturity / Tephritidae / *Bactrocera invadens* / oviposition

La phénologie des fruits d'agrumes, mangues et papayes influence les préférences de ponte de *Bactrocera invadens* (Diptera : Tephritidae).

Résumé – Introduction. La production fruitière ainsi que le commerce régional et international des fruits enregistrent de lourdes pertes économiques ces dix dernières années en Afrique, imputables aux dégâts causés par les mouches des fruits, notamment par *B. invadens* (Tephritidae : Diptera). *Bactrocera invadens* s'attaque à des fruits appartenant à de nombreuses familles botaniques dont plusieurs ont une grande importance économique. Les femelles de ces mouches pondent généralement dans les fruits matures mais certaines peuvent pondre dans les fruits immatures. **Matériel et méthodes**. L'influence de l'espèce fruitière, de la variété de fruit, et de la phénologie des fruits sur l'attractivité de *B. invadens* et la stimulation de son comportement d'oviposition ont été étudiées au laboratoire. Des fruits récoltés régulièrement au cours des années 2008 et 2009 en vergers de la zone des Niayes (Sénégal) ont été exposés à des femelles gravides dans des cages affectées à chacun des facteurs testés. Les fruits exposés ont ensuite été incubés et les pupes qui en étaient extraites ont été comptées. **Résultats et discussion**. Les femelles de *B. invadens* pondent préférentiellement dans les fruits mûrs. Au sein d'une même espèce fruitière, la variété joue un rôle important sur la préférence de ponte. Ainsi, parmi les variétés de mangues testées, la variété Pêche a hébergé le nombre de pupes par fruit le plus élevé alors que la variété Palmer en a hébergé le plus faible. La comparaison entre les différentes espèces fruitières a montré que la papaye mûre était plus infestée que la mangue et les agrumes mûrs. En outre, les mouches des fruits ont été incapables de se développer dans les fruits de lime (*Citrus aurantifolia*). **Conclusion**. Notre étude a montré que *B. invadens* peut infester les fruits-hôtes verts et mûrs et même les fruits tombés encore immatures. Par conséquent, la gestion de ce bioagresseur doit inclure des mesures préventives pour le développement et la mise en œuvre d'un système de gestion intégrée.

Sénégal / *Mangifera indica* / *Carica papaya* / *Citrus* / fruits / phénologie / maturité / Tephritidae / *Bactrocera invadens* / ponte

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1. Introduction

Fruit value chains play a predominant economic and social role by contributing to the needs of populations [1]. Fruit arboriculture is a major source of revenue for farmers. Edible fruit trees have considerable potential in resolving the shortage of essential micronutrients and energy essential for human nutritional balance.

In Senegal, the horticultural sector has considerably increased, with fruit production rising from 95,075 t in 1986 to more than 150,000 t in 2003 [2]. Mango alone represented 60% of this production.

However, fruit fly infestation, especially by *Bactrocera invadens* Drew Tsuruta & White (Tephritidae: Diptera), represents one of the biggest threats which African fruit production and regional and international trade have been confronted with over the past decade. This pest, initially reported in East Africa, originates from Sri Lanka. It is now well-established in most Sub-Saharan African countries. In West Africa, it has caused a decline in regional fruit exports [3]. *Bactrocera invadens* host plants are diverse and numerous. They belong to a number of botanical families which are mostly of great economic importance.

In Kenya, cultivated or wild fruit species such as the mango *Mangifera indica* L. (Anacardiaceae), banana *Musa* sp. (Musaceae), lemon *Citrus limon* (L.) Burm. [tangerine *Citrus reticulata* Blanco, sweet orange *Citrus sinensis* Osbeck (all Rutaceae)], the marula *Sclerocarya birrea* (A. Rich) Hochst. (Anacardiaceae) and Indian almond *Terminalia catappa* L. (Combretaceae) have been identified as *B. invadens* host plants [4].

In Benin, Vayssières *et al.* observed the following plants as additional hosts of *B. invadens*: *Capsicum annuum* L. (Solanaceae), *Cucurbita* spp. (Cucurbitaceae), *Annona muricata* L. (Annonaceae), *Psidium guajava* L. (Myrtaceae), *Carica papaya* L. (Caricaceae), *Diospyros montana* Roxb. (Ebenaceae), *Vitellaria paradoxa* C.F.Gaertn (Sapotaceae) and various species of citrus (Rutaceae) [5]. Further studies on a more exhaustive list of *B. invadens* hosts were conducted by Goergen *et al* [6].

Females of the *Bactrocera dorsalis* Hendel complex, including *B. invadens*, lay their eggs under the skin of the host fruits using their ovipositor, just like most Tephritids. They can lay 1 to 20 eggs per site [7].

The attractiveness of fruits and stimulation of adult female egg-laying behaviour in the Oriental fruit fly (*B. dorsalis*) was evaluated at three stages of papaya (*Carica papaya*) maturity by Eric and Douglas in a wind tunnel [8]. This showed that females were attracted more by fully ripe papayas than by green ones. In south Benin, Vayssières *et al.* noted that it was primarily ripe papayas that were attractive to *B. invadens* females around citrus orchards [9].

To obtain further information on the bioecology of *B. invadens* with regard to potential host fruits, the effects of fruit species, fruit variety and the phenology state of fruits on egg-laying preference and larval development were investigated.

2. Materials and methods

2.1. Fruit flies

Bactrocera invadens pupae were initially extracted from infested mangoes (cv. Kent), collected from orchards situated in Notto Gouye Diama, Senegal, in West Africa. The first fruit flies extracted from these infested mangoes were bred on papayas in order to increase the size of the population and obtain the large number of flies required for the tests. This provided us with a sufficient quantity of fruit flies to conduct egg-laying preference tests. During the rearing period, as during the various tests, the adults were fed with water, sugar, brewing yeast and mango or banana puree. This food is placed separately within Petri dishes in each cage.

Bactrocera invadens were reared in environmental conditions inside cages, in the entomology laboratory of the Advanced National School for Agriculture (ENSA), Thiès University (Senegal). This fruit fly is gravid on average 15 days after its emergence. Females of this species can be distinguished from males by the presence of an ovipositor at the end of their abdomen.

2.1.1. Host fruits

Seventeen mango varieties, three citrus species and one papaya variety (Solo) were chosen to determine the influence of the phenology of fruits on the egg-laying preference of *B. invadens*. The choice of mangoes was based on the fact that they are the most representative fruit tree group cultivated in the area of study where major attacks attributed to *B. invadens* are observed. As for citrus and papaya, they represent the predominant orchard fruits in the absence of mangoes.

All the fruits used for exposure in the trial were harvested from orchards which had not undergone any pesticide-based treatment. They were situated in one of Senegal's main mango production zones and, more particularly, in Notto Gouye Diama, Sindia, Poute and Keur Moussa. To obtain the ripe stage of fruits, the papayas and mangoes were harvested at the turning stage, and then kept at ambient temperature (between 20 °C and 35 °C) until they fully ripened.

Fruits were chosen with great care, making especially sure that flies had not previously infested them, by meticulous visual inspection for any traces of ovipositor boring. However, to evaluate the infestation rate of fruits collected in the orchard prior to their exposure in each trial, around fifteen fruits of these samples were not exposed to fruit flies.

2.1.2. Fruit characteristics: phenology

The description of fruit phenology was based primarily on fruit size and fruit colour. Hence, three phenological stages were defined for papayas and mangoes. The green stage corresponded to immature fruits, which could not ripen and be consumed after picking, even after protracted storage. The turning stage corresponded to green fruits which had reached their maximum size, which would ripen and could be consumed after picking and storage for a few days. Finally, the ripe stage corresponded to fruits which had reached complete maturity and which could be consumed immediately. For citrus, four phenological stages were defined: the 'green1' stage, which encompassed small-sized immature fruits; 'green2' stage, which encompassed immature fruits around the size of ripe fruits; 'green-yellow' stage, which represented fruits that had reached maximum size with light green coloration and the appearance of yellow colour on different areas of the fruit; and finally, the 'yellow' stage, which encompassed fruits that had reached complete maturity, represented by a uniform yellow colour.

The physiological state of fruits was defined only for mango, and two states were adopted. The 'aborted' state corresponded to abscised and fallen immature mangoes which were collected from the ground. The 'on tree' state corresponded to immature growing mangoes picked from the tree.

2.1.3. Experimental set-up

The experiment consisted of an estimate study of egg-laying preference under various factors, including fruit species, fruit variety and fruit phenology stages. For each factor, fruits of the different categories studied (one fruit per category) were simultaneously exposed to 25 pairs of gravid fruit flies for 48 h in a cage of 50 cm × 50 cm × 50 cm. The experimental design consisted of five cages and the cage was the experimental unit. This device was repeated at least three times (3 × 5 cages = 15 cages).

After each exposure, fruits were removed from the cage and placed separately in buckets with sand until the development of larvae into pupae (pupation). These pupae were extracted from the sand and counted. The egg-laying preference of *B. invadens* was assessed based on number of pupae.

2.1.4. Effect of fruit phenology on egg-laying preference of *B. invadens*

The egg-laying preference of *B. invadens* for the different phenological stages (green, turning and ripe for papaya and mango; and green1, green2, green-yellow and yellow for citrus) was evaluated on one papaya variety [*Carica papaya* (Solo variety)], three citrus species [mandarin (*Citrus deliciosa*), kumquat (*Fortunella japonica*) and Key lime (*Citrus aurantifolia* Swing)], and two mango varieties [*Mangifera indica* (Kent and Irwin varieties)].

2.2. Effect of the physiological state of mango on egg-laying preference of *B. invadens*

For the physiological stage factor we used two fruits per category because of the small size of these fruits. The egg-laying preference of *B. invadens* for the different physiological states ('aborted' and 'on tree') was evaluated on the Kent, Keitt, Colombo and Irwin mango varieties. This test focused exclusively on immature fruit of the four varieties of mango. Four fruits of the same variety were simultaneously exposed to fruit flies in cages: two were abscised aborted fruits and the other two were immature harvested fruits.

2.2.1. Effect of mango variety on egg-laying preference of *B. invadens*

For the mango variety factor, the various categories were tested by groups of four fruits. The egg-laying preference of *B. invadens* for the different mango varieties was evaluated on ripe mangoes only. Fifteen varieties were compared. All the mangoes used for these varietal comparisons had reached complete maturity (*i.e.*, fruits were ripe). The fifteen varieties could not be tested simultaneously in one single cage, but in groups of three varieties, with the variety Kent as a reference. Consequently, each cage contained the Kent variety plus three other varieties.

2.2.2. Effect of fruit species on egg-laying preference of *B. invadens*

The egg-laying preference of *B. invadens* for the different fruit species was evaluated only on fruits that had reached complete maturity. Three species were compared (mango, cv. Kent; papaya and mandarin). The egg-laying preference was assessed based on the count of pupae collected from fruits of the different fruit species sensitive to fruit fly holing.

2.3. Data processing

A one-way analysis of variance (ANOVA) was conducted to evaluate the effect of each of the factors studied (fruit species, variety and phenology state) on the egg-laying preference of *B. invadens*. When a significant effect was detected, two-by-two comparisons of means were performed using a Newman-Keuls multiple comparison test (α = 0.05) to separate the factor modalities. All the data analyses were carried out with XLSTAT (6.1.9) software.

3. Results

3.1. Effect of fruit phenology on egg-laying preference of *B. invadens*

The mean numbers of pupae of *B. invadens* obtained from turning and ripe fruits of papaya (158 and 190 pupae per fruit, respectively) were significantly higher than those obtained from green fruits (12 pupae per fruit) (*figure 1*). Just one immature green fruit was infested, while the other green fruits were sound. Therefore, the egg-laying preference of *B. invadens* appears to be for the turning and ripe phenological stage of *Carica papaya* fruits.

In the *Citrus* spp. tests, Key lime (*C. aurantifolia*) was not attacked by *B. invadens* regardless of the fruit phenological stage (green1, green2, green-yellow or yellow) (*table I*). Additional tests were conducted on fruits whose state was artificially degraded by various treatments, such as freezing the fruits or heating them in boiling water after

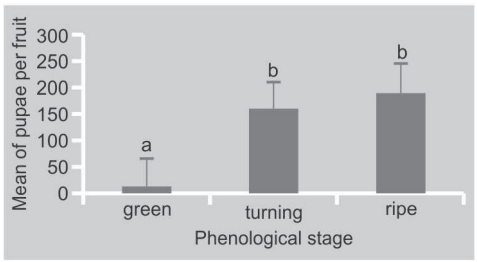

Figure 1.
Effect of the phenological stage of papaya fruit on the egg-laying preference of *Bactrocera invadens*, as evaluated from the number of pupae per fruit (mean ± standard error, n = 15). The bars with different letters on top represent significantly different values (Newman-Keuls test: α = 0.05) (F = 3.385, df = 2; P = 0.012).

Table I.
Effect of the phenological stage of citrus fruits on the egg-laying preference of *Bactrocera invadens*, as evaluated from the number of pupae per fruit (mean ± standard error; *n* = 15) on three *Citrus* species.

Phenological stage	*Citrus aurantifolia*	*Fortunella japonica*	*Citrus deliciosa*
Green1	0	4 b	34 b
Green2	0	76 a	34 b
Green-yellow	0	78 a	100 a
Yellow	0	71 a	64 ab

Means in the same column with the same letters are not significantly different (Newman-Keuls test: $\alpha = 0.05$)

Table II.
Effect of the phenological stages of mango fruit on the egg-laying preference of *Bactrocera invadens,* as evaluated from the number of pupae per fruit (mean ± standard error, *n* = 15) on two mango varieties.

Phenological stage	Kent	Irwin
Green	0 b	0 b
Turning	0 b	19 ab
Ripe	42 a	36 a

Means in the same column with the same letters are not significantly different (Newman-Keuls test: $\alpha = 0.05$)

peeling. After the boiling water treatment, the *B. invadens* cycle was completed on a few fruits.

With the kumquats (*Fortunella japonica*), all the phenological stages revealed fruit fly attacks (*table I*) (F = 9.272, df = 3; *P* = 0.000). However, the preference levels differed. The mean number of pupae extracted from fruits at the stage green1 (4 pupae per fruit) was significantly lower than that observed for the stages green2 (76 pupae per fruit), green-yellow (78 pupae per fruit) and yellow (71 pupae per fruit). The latter three phenological stages had no significant difference among them.

With the common mandarin (*Citrus deliciosa*), the green-yellow phenological stage was the most fly-infested and had a significantly higher number of pupae than the stages green1 and green2, which had the least pupae. The yellow stage had levels of fruit fly infestation intermediate to these two groups (*table I*) (F = 2.388, df = 3, *P* = 0.087).

The tests conducted on mangoes (*Musa indica*) showed that green (immature) mangoes were not infested by fruit flies, regardless of variety (*table II*) (F = 4.009, df = 2, *P* = 0.036). Infestation in the Kent variety was exclusively concentrated on ripe mangoes, with on average 42 pupae per fruit. In the Irwin variety, the ripe stage was also the most preferred phenological stage for the flies (36 pupae per fruit), but the turning stage was also infested (19 pupae per fruit) (F = 5.115, df = 2, *P* = 0.012).

3.2. Effect of the physiological state of mango on egg-laying preference of *B. invadens*

The Irwin variety exhibited a significant difference between the physiological states for the number of pupae collected (*table III*) (F = 13.605; df = 1; *P* = 0.001). Tree-picked immature mangoes had a lower mean number of pupae (21 pupae per fruit) than the aborted mangoes that were collected from the ground (109 pupae per fruit).

The infestation levels in the Keitt (F = 0.163; df = 1; *P* = 0.688), Kent (F = 2.383;

Table III.
Effect of the physiological state of mango fruit on egg-laying preference of *Bactrocera invadens*, as evaluated from the number of pupae per fruit (mean ± standard error, n = 15) on four mango varieties.

Physiological states	Colombo	Irwin	Keitt	Kent
Aborted fruits	106 a	109 a	23 a	76 a
"On tree" fruits	164 a	21 b	17 a	44 a

Means in the same column with the same letters are not significantly different (Newman-Keuls test: α = 0.05)

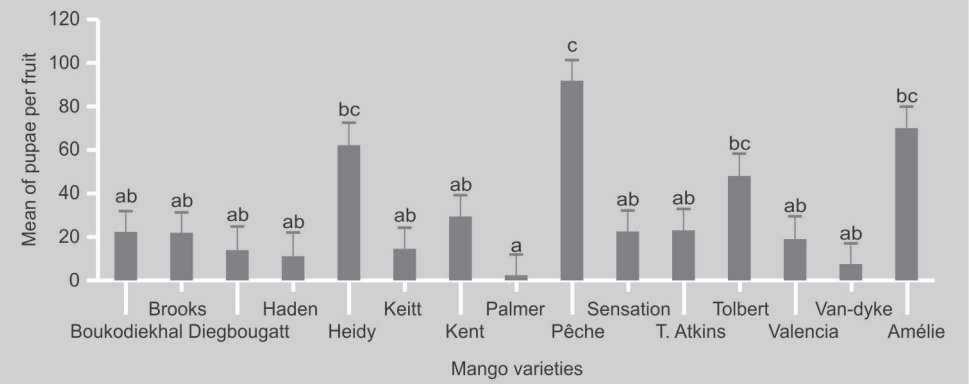

Figure 2.
Effect of mango variety on egg-laying preference of *Bactrocera invadens*, as evaluated from the number of pupae per fruit (mean ± standard error, n = 15) on ripe mangoes. The bars with the same letters are not significantly different (Newman-Keuls test: α = 0.05).

df = 1; P = 0.130) and Colombo (F = 2.632; df = 1; P = 0.115) varieties were not significantly different between the two physiological states of mango. However, apart from the Colombo variety the mean number of pupae was greater on aborted immature fruits than on harvested immature fruits.

3.3. Effect of mango variety on egg-laying preference of *B. invadens*

Observations made on ripe mango fruits showed that the mean number of pupae per fruit was significantly lower in fruits of the Palmer variety (2 pupae per fruit) (*figure 2*) compared with Pêche, Amélie, Heidy and Tolbert. The highest mean number of pupae was obtained in the fruits of the Pêche variety (90 pupae per fruit). The remaining varieties exhibited intermediate infestation levels between Palmer and Pêche (F = 2.872; df = 14; P = 0.001).

3.4. Effect of fruit species on egg-laying preference of *B. invadens*

The laying preferences of *B. invadens* with regard to fruit species showed that the mean number of pupae per fruit was significantly different among the three species studied (*Mangifera indica*, *Citrus* spp., *Carica papaya*) (F = 12.648; df = 2; P = 0.0001) (*table IV*). The highest number of pupae was obtained on papaya (190 pupae per fruit), whereas mangoes hosted the lowest number of pupae (28 pupae per fruit).

4. Discussion

The influence of the fruit phenology on the egg-laying preference of *B. invadens*, evaluated from the numbers of pupae extracted from each fruit, was studied on fruit species belonging to three families. Out of all the fruits exposed to gravid females in a cage, the lowest mean numbers of pupae were obtained from green fruits. In some fruit species or varieties, no infestation was recorded for this stage. By contrast, many more pupae were counted in mature fruits. Indeed, Rattanapun *et al.* observed that *B. dorsalis* females were more attracted to turning and ripe fruits than to immature fruits [10]. In nature, in different fruit species the ripe fruits are selectively infested by fruit

Table IV.
Effect of fruit species on the egg-laying preference of *Bactrocera invadens*, as evaluated from the number of pupae per fruit (mean ± standard error, n = 15) on mango, papaya and *Citrus* spp. fruits.

Fruit species	Number of pupae per fruit
Mangifera indica	28 c
Citrus spp.	66 b
Carica papaya	190 a

Means in the same column with the same letters are not significantly different (Newman-Keuls test: α = 0.05).

flies even if there are often initially more green fruits than ripe fruits, which implies an influence of the host fruit maturity stage on its attractiveness to fruit flies [8]. Thus, *Rhagoletis pomonella* (Walsh), *Ceratitis capitata* (Wiedemann) and *Bactrocera dorsalis* favour laying their eggs on ripe fruit than on turning or immature fruit [11–13]. However, Gikonyo *et al.* reported that wild females of *Ceratitis cosyra* (Walker) were more attracted to and laid preferentially on green-coloured immature and turning mangoes than on ripe and yellow mangoes in the natural environment [14]. Furthermore, yellow mandarins and kumquats exhibited lower mean numbers of pupae than green-yellow fruit. These results corroborate those of Garcia-Ramirez *et al.* which showed that, in laboratory conditions, *Anastrepha ludens* (Loew) was more attracted to volatile extracts of green *Citrus aurantium* than to those from ripe fruits [15].

Eggs were laid and pupae were obtained both on immature tree-picked mangoes and immature abscised mangoes in the comparative test of physiological states. This shows that mangoes can be infested by fruit flies at an early stage of development. Indeed, De Laroussilhe emphasises that mangoes are prone to attacks by fruit flies from the growth stage to maturity [16]. This also indicates that *B. invadens,* in the absence of mature fruits, can use immature fruits as a laying site. Aborted fruit represents a major breeding substrate for fruit flies. In Benin, Vayssières *et al.* showed that very young mangoes, after abscission, could host *B. invadens* larvae very early in the season [17]. These studies confirm that orchards can be breeding grounds for *B. invadens* well before the mangoes reach the turning stage.

The numbers of pupae collected from immature mangoes in the comparative test of physiological states were much greater than those collected on ripe mangoes in the comparative test of phenological stages, despite *B. invadens*' preference for ripe mangoes. This difference could be explained by higher larval mortality in ripe mangoes than in immature mangoes during the incubation period, indicating that immature fruits seem to be more favourable environments for larval development. Furthermore, the number of pupae on immature fruits harvested on trees differed between the physiological state tests and phenological stage tests. The immature fruits were not infested, or were to a small degree, in the fruit phenological stage comparative tests, whereas they were heavily infested in the physiological state tests. This difference could be explained by the lack of choice in the physiological state tests, where only immature fruits were presented to *B. invadens* females, while, in the maturity stage tests, three different stages were presented to the flies, one of which was generally preferred by the female fruit flies [10]. However, in the absence of laying sites it was common to see *B. invadens* females lay their eggs along the cage sides. Moreover, this difference observed could be due to the fact that the two tests were conducted at two different times of year.

Comparison of 15 mango varieties and various fruit species belonging to three families demonstrated an effect of mango variety and fruit species on egg-laying preference of *B. invadens*. The Pêche variety,

known in India as "Paheri" or "Peter Passand", hosted the highest mean number of pupae, whereas the Palmer variety had the lowest mean number of pupae.

Papaya (*Carica papaya*) was preferred over *Citrus* spp. and mangoes (*Mangifera indica*). These differences could be due to fruit physiology or to the physical and olfactory characteristics specific to each fruit type. The physical traits of the fruit, such as the colour and thickness of the pericarp, or the mango's shape, could be factors determining egg-laying. *Bactrocera tryoni* (Froggatt) prefers infesting the tomato varieties 'Grosse Lisse' and 'Roma', which have a soft pericarp, than the 'cherry' variety with its harder pericarp [18, 19]. Polyphagous Tephritidae, such as *B. invadens*, respond to a wider range of volatile extracts and visual stimuli from host plants and organs, *i.e.*, influenced by physiology, than oligophagous Tephritidae [20]. Studies of polyphagous Tephritidae such as *Anastrepha suspensa* (Loew) [21], *Ceratitis capitata* [22, 23] and *Bactrocera dorsalis* [24] have demonstrated that these species respond to a wide range of chemical compounds from ripe fruits on host plants. Further studies are needed to understand better which physical or chemical traits exhibited by the Pêche variety or papaya fruits make them more attractive to *B. invadens* flies.

Furthermore, flies were unable to develop on lime. Although eggs were observed during incubation of the fruits, no pupae or larvae were recorded upon extraction. The processing of ripe fruits by various treatments (freezing, peeling followed by heating in boiling water) enabled the complete development of larvae to be observed in some cases. This appears to point to the existence in the lime of an inhibiting factor of *B. invadens* development, since upon incubation there were traces of holes and eggs on the exposed fruit.

5. Conclusion

Our present study was able to show that *B. invadens* can attack fruits at nearly all maturity stages. Indeed, immature aborted fruits or immature tree-picked fruits are just as sensitive to fly holing. However, the results indicate that *B. invadens* prefers ripe fruits to immature and turning fruits. The variety factor plays an important role in susceptibility of fruits to fruit fly attacks. The Pêche variety is the most preferred mango variety, and hosted the highest mean number of pupae per fruit, unlike the Palmer variety, which registered the lowest mean number of pupae per fruit. In addition to the variety, the fruit species has a big influence on attractiveness for egg-laying; hence, in laboratory tests, the ripe papaya is attacked more than mangoes and citrus at the same stage.

Lime is not a potential host for *B. invadens*, despite its great polyphagy.

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Fenología de frutos cítricos, mangos y papayas influye preferencias de ovoposición de *Bactrocera invadens* (Diptera: Tephritidae).

Resumen – Introducción. La producción de fruta, así como su comercio regional e internacional, han supuesto fuertes pérdidas económicas en los últimos diez años para África, imputables a los daños causados por las moscas de la fruta, concretamente *B. invadens* (Tephritidae: Diptera). *Bactrocera invadens* ataca a frutas pertenecientes a numerosas familias botánicas, varias de ellas con una gran importancia económica. Las hembras de estas moscas suelen poner huevos en las frutas maduras, pero algunas pueden hacerlo en las inmaduras. **Material y métodos.** Se estudiaron en laboratorio la influencia de la especie, la variedad y la fenología de las frutas en la atracción para *B. invadens* y la estimulación de su comportamiento de oviposición. Se expusieron frutas recogidas regularmente a lo largo de los años 2008 y 2009 en cultivos de la zona de las Niayes (Senegal) a hembras preñadas en jaulas afectadas por cada uno de los factores de estudio. A continuación, las frutas expuestas se incubaron y se contaron las larvas extraídas de. **Resultados y discusión.** Las hembras de *B. invadens* ponen huevos preferiblemente en las frutas maduras. Dentro de una misma especie de fruta, la variedad desempeña un importante papel en la preferencia de oviposición. Así, entre las variedades de mango del experimento, la variedad Melocotón presentó el número de larvas más elevado, mientras que la variedad Palmer presentó la cantidad menor. La comparación entre las diferentes especies de frutas demostró que la papaya madura estaba más infestada que el mango y los cítricos maduros. Asimismo, las moscas de la fruta fueron incapaces de desarrollarse en la lima (*Citrus aurantifolia*). **Conclusión.** Nuestro estudio ha demostrado que *B. invadens* es capaz de infestar frutas huésped tanto verdes como maduras, e incluso frutas caídas aún sin madurar. Por tanto, la gestión de dicho bioagresor debe incluir medidas preventivas de su desarrollo, y la puesta en práctica de un sistema de integrado.

Senegal / *Mangifera indica* / *Carica papaya* / *Citrus* / frutas / fenología / madurez / Tephritidae / *Bactrocera invadens* / oviposición