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Morphometric comparison of three populations of *bactrocera dorsalis* from mango (*Mangifera indica*; *Anacardiacea*), mandarin (*Citrus deliciosa*; *Rutaceae*) and cashew apple (*Anacardium occidental*; *Anacardiacea)*

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Abstract

The fruit fly *Bactrocera dorsalis*, an insect belonging to the Tephritidae family, causes enormous damage to fruits and attacks several host plants to maintain its population. Quarantined species, it causes significant economic losses and could intervene in environmental pollution due to polyphagia morphological adaptation and a rapid orchard reinfestation. The objective of this study is to morphometrically characterize *B. dorsalis* from different host plants. Methodology and results: sampling is done in three localities in the Niayes area in Senegal in several orchards. Three populations were defined according to the host fruits (mango, mandarin and cashew apple). Each population consists of 30 young fasting males born within 24 hours. The number of variables measured for morphometry on each individual is 35. Of the eight head variables, only the thickness of the head (EpTe) and the length of the antenna (An) show significant differences. There is a significant difference on all ten chest variables except chest length (Th) and lateral spot thickness (EpTaLa). There is no significant difference for the size (Tai) which is not the case for the length and the thickness of the abdomen (Ab and EpAb) of the 3 populations. The variables of the front leg show a significant difference as well as those of the hind leg except the tarsus 1 (PPT1). The middle leg shows only a significant difference in the variable representing tarsi 2, 3, 4 and 5 (PMTS). Ultimately, the population of *B. dorsalis* from the cashew apple is morphometrically closer to that from the mango while the population from the mandarin is morphometrically different of that from the cashew apple.

Keywords: fruit fly; tephritidae; *Bactrocera dorsalis*; host plants; niayes area; senegal; morphometry

Introduction

Agriculture is one of the essential links in achieving food security. As a result, the intensification of production and trade at the global level is increasing and is also becoming a risk for pest infestation [1]. These insects such as *B. dorsalis* attack several host plants to maintain its population. This species is found on 17 plants of different categories [2]. Very polyphagous, this insect causes enormous damage on fruit plants, especially for the Mangifera indica mango [3, 4, 5] thus becoming the most important of the Tephritidae in terms of mango varieties and citrus cultivars studied [6, 5].

The direct damage it causes to fruits and its quarantine status leading to the loss of market due to the strict measures imposed by importing countries [2]. The different control methods are insecticide sprays on foliage and soil, bait sprays, male annihilation techniques, release of sterilized flies and parasitoids, and control cultures [7]. As a result of intra-species transformations, the fittest individuals are favored by selection and survive and the less fit are disadvantaged and disappear. This perpetual natural selection on individuals over generations leads to the gradual appearance of new morphological forms, betteradapted to their environment [8]. This adaptation is only the result of strong morphological and/or genetic diversity between trophic populations [9]. Thus, morphometrics relies on statistical procedures to analyze variations in the size and shape of organs and organisms [10]. Some of these criteria, among others, are used to identify, on an intraspecific scale, the differences between individuals related to age (growth), sex (dimorphism), environmental conditions (food, disease, climate) or even space and time (chrono-populations) [10]. We will study the impact of host plants on the morphology of *B. dorsalis* populations. In other words, compare the parameters of *B. dorsalis* population’s morphometrically.

Material and Methods

Sampling

The biological materials used for this work are infested fruits and young adults of *B. dorsalis*. The samples of *B. dorsalis* which are the subject of this study were collected in three localities of the Niayes area which are Sangalkam (14° 47'58"N and 17° 14'17"W), Sébikotane (14° 44' 17"N and 17° 00' 15"W) and Notto (14° 57' 56.8"N and 17° 00'25"W). It was done during the period of July-November 2018 and that of July-November 2019. Several orchards were sampled without taking into account the area to have heterogeneous individuals and avoid family ties. The targeting of these localities was done according to the zone of maximum production, infestation of the insect and taking into account the geographical distance between the localities.

This sampling of *B. dorsalis* was done on mangoes, tangerines and cashew apples in shepherds to be incubated in the laboratory at room temperature. The choice of fruits was made according to the successive ripening season for the three species, their infestation rate and the economic and nutritional interest. The end of the cashew apple season overlaps the mango season and the end of the mango season corresponds to the beginning of the mandarin season.

Mass breeding

Batches of fruit infested with mangoes, mandarins and cashew apples are incubated in tents or in buckets of five or twenty liters.

After eight to ten days of incubation, the eggs pass from the L1, L2 and L3 stage larvae to the pupa stage in the sand. The extraction of the pupae is done every two days. The imagoes that have not reached their period or reproductive phase born within twenty-four hours and not fed are collected and put in 7 ml tubes containing alcohol 70 ° for morphological studies.

Morphometric study

The identification of the species obtained was made visually in order to recover the *B. dorsalis* whose identification criteria are their translucent wings, the two lateral lines at the level of the scutum and their T-shaped band at the level of their abdomen. The morphometric study was carried out using an LED light model MIC-209 stereomicroscope at 2048×1536 magnification to measure the length and width or thickness of various parameters (see table 1). These are the length and width or thickness of the head (Te), thorax (Th), abdomen (Ab), wings (Ai), eye (Oe), antennae (An), the yellowish lateral spot (TaLa) of the prothorax, the yellowish spot of the metathorax (TaTh); the length or size (Tai) of the insect, the length of the yellowish dorsal spot (TaDo) of the mesothorax; the distance between the two dorsal spots(EnTaDo) of the mesothorax, the length of the forehead (Fr). For the forelegs (PA), the length of the femur (PAF), tibia (PATi), and tarsus one (PAT1) were calculated separately, while the length of tarsus two, three, four, five and adhesive pad have been combined or added (PATS) because they are very small and confusing items. This same process was used for the median or middle legs (PM) where we will have PMF, PMTi, PMT1, PMTS; ditto for the hind legs (PP) which will give PPF, PPTi, PPT1, PPTS. A total of 33 variables are measured (Table 1). The one-millimeter (1mm) scale of a decimeter ruler was used to set up the measurements of the device and the margin of error is ±1mm.

Table 1: measured variables

Head	
Te: head length (forehead to neck)	EpTe: head thickness
Fr: forehead length (eye base-antenna base)	EpFr: forehead thickness (maximum distancebetween the eyes)
Oe: eye length or height	EpOe: eye thickness
An: antenna length	EpAn: antenna thickness
Thorax (spots: yellowish spots)	
Th: chest length	EpTh: chest thickness
TaDo: length of dorsal spot of mesothorax	EpTaDo: distance between dorsal spots of mesothorax
TaTh: metathorax spot length	EpTaTh: metathorax spot width
TaLa: lateral prothorax spot	EpTaLa: lateral spot thickness of the prothorax
Abdomen	
Ab: length of the abdomen	EpAb: thickness of the abdomen
Size	
Tai: length or size of the insect	forehead-last abdominal rings
Legs	
PAF: length of the femur (front leg)	PATi: length of the tibia (front leg)
PAT1: tarsus length 1 (front leg)	PATS: length of the tarsus 2, 3, 4 and 5 (front leg)
PMF: length of the femur (middle leg)	PMTi: length of the tibia (middle leg)
PMT1: Tarsus length 1 (middle leg)	PMTS: length tarsus 2, 3, 4 and 5 (middle leg)
PPF: length of the femur (hind leg)	PPTi: length of the tibia (hind leg)
PPT1: tarsus length 1 (hind leg)	PPTS: length of the tarsus 2, 3, 4 and 5 (hind leg)

Statistical analysis

Our dataset contains several populations (3) after applying shapiro to all variables to test their normality, ANOVA is used on those that follow normality (p-value >0.05: non-significant) and the Kruskal Wallis test on other variables that do not follow the normal distribution (p-value<0.05: is significant).

When the p-value found is significant: with Kruskal Wallis we apply the Dunn.test on these variables to see the difference in means, and for ANOVA it is the pairwaise.t.test that is applied with the R software version 6.3.1 [11], the results of the ANOVA are directly displayed. The comparison of the means between population variables has been done and the results are assigned in contingency tables. Finally, the minima and maxima of each variable between populations were also compared.

Results

Descriptive analysis: comparison of variables Comparison of head variables

The majority of the means of the head variables do not show a significant difference for the three (3) populations of *B. dorsalis* except the head thickness (EpTe) with slightly different measurements within populations and antenna length (An) (Table 2). The latter are higher in populations of mango and tangerine (Table 2). The cashew apple has the lowest averages for these 2 variables (Table 2). The thickest head is observed in an individual from the mango population (Table 3). The greatest measurement of antenna length is found in two individuals from the mango and tangerine population (Table 3).

Table 2: Comparison of mean head variables of *B. dorsalis* populations from mango, tangerine and cashew apple

Head				
Variables (mm)	**Mango**	**Tangerine**	**Cashew apple**	**Total population**
Te	1.21±0.06a	1.25±0.13a	1.21±0.08a	1.23±0.10
EpTe	2±0.14a	1.97±0.16a	1.92±0.11b	1.96±0.14*
An	1.25±0.06ab	1.29±0.06b	1.23±0.06a	1.26±0.06**
EpAn	0.17±0.01a	0.17±0.01a	0.17±0.01a	0.17±0.08
Oe	0.79±0.07a	0.79±0.06a	0.76±0.05a	0.78±0.06
EpOe	1.31±0.09a	1.31±0.06a	1.29±0.08a	1.30±0.08
Fr	0.77±0.10a	0.77±0.07a	0.76±0.06a	0.77±0.08
EpFr	0.61±0.05a	0.60±0.04a	0.58±0.04a	0.60±0.04

a, b and c: bold black for the comparison of the mean of variables between populations: same letter for differences in non-significant means and different letters for significantly different means. *: degree of significance of the P value = 0.05 *: significant; **: very significant; ***: highly significant.

Table 3: Comparison between minima and maxima of significant head variables of *B. dorsalis* populations from mango, tangerine and cashew apple

Head			Extreme values (mm)	
Variables	**Mango**	**Tangerine**	**Cashew apple**	**Total population**
Te	1.03-1.31	1.15-1.80	1.11-1.48	1.03-1.80
EpTe	1.74-2.45	1.21-2.13	1.68-2.13	1.21-2.45
An	1.10-1.40	1.12-1.40	1.11-1.32	1.10-1.40
EpAn	0.15-0.19	0.16-0.20	0.16-0.19	0.15-0.20
Oe	0.62-0.98	0.67-0.98	0.67-0.87	0.62-0.98
EpOe	1.10-1.46	1.18-1.42	1.13-1.40	1.10-1.40
Fr	0.56-1.00	0.63-1.02	0.65-0.91	0.56-0.91
EpFr	0.50-0.68	0.51-0.68	0.52-0.65	0.50-0.65

Comparison between measured chest variables

Among ten (10) variables measured (Table 4), 8 have a significant difference between population. Only: the length of the thorax (Th) and the thickness of the side spot (EpTaLa) has non-significant means between populations. The thickness of the thorax (EpTh), the spot on the chest (metathorax) (TaTh) and the lateral spot (TaLa) have mean differences only significant. They have slightly homogeneous measurements with moderately small standard deviations (0.2 to 0.5) with the exception of the thickness of the thorax (0.13 to 0.20). The thickness (width) of the spot on the metathorax (EpTaTh), the length and thickness of the wing (Ai, EpAi), the length of the dorsal spot (TaDo) and the distance between the dorsal spots (EnTaDo) show highly significant differences in means. These measurements are homogeneous within the populations except the length and thickness of the wing (Ai, EpAi) that have moderately high standard deviations. The tangerine population has the highest and most homogeneous averages except for the length of the wing, which is moderately heterogeneous. However, TaTh, Ai and EpAi have the largest measurements compared to other individuals in other populations (Table 5).

Table 4: Comparison of means of thorax variables of *B. dorsalis* populations from mango, tangerine and cashew apple

Thorax Variables	Mango	Tangerine	Cashew apple	Total population
Th	2.76±0.15a	2.80±0.15a	2.70±0.23a	2.75±0.18
EpTh	2.29±0.13a	2.29±0.20a	2.21b±0.14b	2.26±0.16*
TaTh	0.56±0.04a	0.57±0.03a	0.54±0.05b	0.55±0.04*
EpTaTh	1.21±0.08a	1.27±0.05b	1.21±0.07a	1.23±0.08***
Ai	5.67±0.31a	5.84±0.23b	5.44±0.27c	5.65±0.31***
EpAi	2.28±0.14ab	2.35±0.09b	2.21±0.13a	2.28±0.13***
TaDo	1.08±0.06a	1.13±0.05b	1.07±0.07a	1.09±0.07***
EnTaDo	1.44±0.07a	1.46±0.05a	1.37±0.10b	1.43±0.08***
TaLa	0.52±0.03a	0.53b±0.02b	0.54±0.03b	0.53±0.03*
EpTaLa	0.43±0.02a	0.43±0.03a	0.42±0.03a	0.43±0.03

Table 5: Comparison of minima and maxima of thorax variables of *B. dorsalis* populations from mango, tangerine and cashew apple

Thorax		**Extreme values (mm)**		
Variables	Mango	Tangerine	Cashew apple	Total population
Th	2.42-2.98	2.51-3.07	1.87-3.12	1.87-3.12
EpTh	2.04-2.58	1.39-2.55	1.95-2.51	1.39-2.58
TaTh	0.42-0.63	0.52-0.64	0.41-0.63	0.41-0.64
EpTaTh	1.00-1.39	1.13-1.40	1.08-1.41	1.00-1.41
Ai	4.82-6.14	5.24-6.20	4.83-6.07	4.82-6.20
EpAi	1.98-2.53	2.07-2.53	1.96-2.51	1.96-2.53
TaDo	0.92-1.19	1.03-1.27	0.94-1.23	0.92-1.27
EnTaDo	1.30-1.59	1.34-1.57	1.04-1.55	1.04-1.59
TaLa	0.38-0.59	0.49-0.57	0.50-0.62	0.38-0.62
EpTaLa	0.35-0.48	0.31-0.49	0.35-0.47	0.31-0.49

Comparison between Average Height and Abdomen

The average population size of *B. dorsalis* from tangerine is higher than that of the other two populations, but the moderately small standard deviation shows that there is a slight difference in the means within this population. However, this difference is not significant. The same observation is noted in individuals of *B. dorsalis* from mango while heterogeneity is more pronounced in size for the cashew apple population (Table 6). The length (Ab) and thickness of the abdomen (EpAb) are significantly different form populations of *B. dorsalis*. This length is higher in the cashew apple population (3.10mm) and smaller in the tangerine population (2.21mm) (Table 7). However, the smallest thickness is found in the cashew apple population (1.66mm) (Table 7).

Table 6: Comparison of means of abdominal variables and population size of *B. dorsalis* from mango, tangerine and cashew apple

Abdomen, size Variables (mm)	Mango	Tangerine	Cashew apple	Total population
Ab	2.64±0.15ab	2.62±0.18a	2.75±0.18b	2.67±0.18*
EpAb	2.19±0.20a	2.22±0.18a	2.00±0.21b	2.14±0.22***
Tai	6.58±0.32a	6.60±0.32a	6.55±0.37a	6.57±0.34

a, b and c: bold black for the comparison of the mean of variables between populations: same letter for differences in non-significant means and different letters for significantly different means. *: degree of significance of the P value = 0.05 *: significant; **: very significant; ***: highly significant.

Table 7: Comparison between minima and maxima of abdominal and population size variables of *B. dorsalis* from mango, tangerine and cashew apple

Abdomen, size			**Extreme values (mm)**	
Variables (mm)	**Mango**	**Tangerine**	**Cashew apple**	**Total population**
Ab	2.33-2.92	2.21-2.93	2.25-3.10	2.21-3.10
EpAb	1.86-2.73	1.93-2.52	1.66-2.44	1.66-2.73
Tai	5.98-7.05	5.54-7.04	5.58-7.30	5.54-7.30

Comparison of the Means of the Variables Measured on the Legs

For all leg variables, the averages for the population of *B. dorsalis* from tangerine are higher than those from the mango population (except tarsus 1 of the foreleg (PAT1)) as well as for the population from the cashew apple. A low homogeneity of measurements is observed on all these variables with small standard deviations (0.03 to 0.10) (Table 8). This same observation is noted on the measurements of the population variables from the cashew apple (Table 8) with a majority of the smallest measurements (Table 9).

Table 8: Comparison between averages of *B. dorsalis* population leg variables from mango, tangerine and cashew apple populations

Legs Variables	Mango	Tangerine	Cashew apple	Total population
PAF	1.45±0.09ab	1.47±0.07b	1.41±0.07a	1.44±0.08**
PATi	1.26±0.08ab	1.28±0.05b	1.23± 0.08a	1.26±0.07**
PAT1 PATS	0.64± 0.05a 0.61±0.05a	0.63±0.03ab 0.64±0.04b	0.61±0.04b 0.61±0.04a	0.63±0.04* 0.62±0.05*
PMF PMTi	2.01±0.11a 1.91±0.12a	2.04±0.08a 1.94±0.10a	1.99±0.10a 1.90±0.10a	2.01±0.10 1.92±0.11
PMT1 PMTS	0.76±0.07a 0.67±0.05ab	0.78±0.05a 0.69±0.05b	0.76±0.05a 0.65±0.04a	0.77±0.06 0.67±0.05**
PPF PPTi	1.83±0.15a 1.69±0.09ab	1.89±0.07b 1.74±0.07b	1.81±0.10a 1.66±0.10a	1.84±0.11*** 1.70±0.09**
PPT1	0.81±0.06a	0.84±0.04a	0.82±0.05a	0.82±0.05
PPTS	0.66±0.05ab	0.68±0.04b	0.64±0.04a	0.66±0.05*

a, b and c: bold black for the comparison of the mean of variables between populations: same letter for differences in non-significant means and different letters for significantly different means. *: degree of significance of the P value = 0.05 *: significant; **: very significant; ***: highly significant.

Table 9: Comparison of minima and maxima of leg variables of *B. dorsalis* populations from mango, tangerine and cashew apple.

Legs Variables	Mango	Tangerine	Cashew apple	Total population
PAF	1.25-1.66	1.34-1.60	1.27-1.53	1.25-1.66
PATi	1.10-1.44	1.18-1.39	1.10-1.38	1.10-1.44
PAT1	0.55-0.74	0.56-0.72	0.51-0.68	0.51-0.74
PATS	0.51-0.72	0.57-0.75	0.55-0.73	0.51-0.75
PMF	1.79-2.19	1.85-2.24	1.78-2.18	1.78-2.24
PMTi	1.58-2.11	1.68-2.15	1.69-2.12	1.58-2.15
PMT1	0.64-0.96	0.70-0.87	0.69-0.84	0.64-0.96
PMTS	0.55-0.76	0.59-0.79	0.57-0.73	0.55-0.79
PPF	1.34-2.07	1.77-2.02	1.62-2.04	1.34-2.07
PPTi	1.47-1.81	1.61-1.90	1.50-1.85	1.47-1.90
PPT1	0.69-0.91	0.77-0.95	0.73-0.94	0.69-0.95
PPTS	0.56-0.77	0.58-0.76	0.59-0.76	0.56-0.77

Discussion

The cashew apple population has the means of the smallest variables except the length of the abdomen (Ab) with a heterogeneity (moderately high standard deviation: 0.18) noted within the population and that of the side spot (TaLa) whose measurements are homogeneous (low standard deviation). Based on the comparison between the means of the head length (Te) variables, abdominal length (Ab), antenna thickness (EpAn), size (Tai) and side spot thickness (EpTaLa) they do not differ significantly from *B. dorsalis* populations. Note that the size distribution within each population is heterogeneous with slightly large standard deviations for all 3 populations. However, among 33 variables, 20 of them have a significant difference in average depending on the population. Those with higher averages in the mango population are: EpTe and PAT1, but the average of PAT1 is not significantly different compared to that of the tangerine population. The variables whose means are significantly higher in the population of *B. dorsalis* from tangerine are 15 in number: EpAb, An, TaTh, EpTaTh, Ai, EpAi, TaDo, EnTD, PAF, PATi, PATS, PMTS, PPF, PPTi and PPTS. Among them: TaTh, EpAi, EnTaDo PAF, PATi, PMTS, PPTi and PPTS are not significantly elevated between the populations of mango and cashew apple. The variables with higher averages in the cashew apple population are Ab and TaLa, and the average of TaLa is not significantly high compared to that of tangerine. There is only one variable whose average is tied for tangerine and mango: EpTh. Thus, there are morphological differences (size and shape) in these strains (populations) studied. Considering the averages for the abdomen and the length of the wings, the population with the longest abdomen has the shortest wing (cashew apple) and vice versa: the one with the longest wing has the shortest abdomen (tangerine). This could be explained by a voracity of this population (long abdomen) which makes them heavy and therefore they have difficulty to fly. Especially since the cashew apple is very rich in nutrients. Thus, following an adaptation, the wings must have shrunk due to lack of movement or this narrowing would be due to astringency. Indeed, the tannin concentration is between 6.6 ± 0.071 to 13,745 ± 0.926 (mg / 100ml) [12] and this substance limits its consumption in humans. This same observation can be made for the population from the cashew apple. Similarly, according to Ciqual-Anses [13], the energy value (kcal/100g) of tangerine (45.5) or orange is higher than that of cashew apple (38.5). This could be at the origin of the size of the wings thus allowing greater mobility to the one who has consumed the most energy. This statement has a limitation since mango has the highest energy value (74) but less vitamin C (25) and its individuals do not have the longest wings and the calcium content for tangerine (49.2) is much lower than that of cashew apple (556). However, despite their long abdomen, the population of B. dorsalis from the cashew apple has an average of the thickness of the smallest abdomen. Overall, the population of *B. dorsalis* from tangerine includes mainly the largest individuals followed by the population from mango while that from cashew apple has the smallest individuals. Thus, the size of individuals is not proportional to the size of the fruit. In other words, the morphology of the populations is not correlated with the size of the fruits. Indeed, mango samples are 4 to 5 times larger in size than cashew apple and tangerine and Boinahadji, [2] found that mango has significantly more soluble matter (14.11±0.74) than tangerine (11.46±0.87) with pH that do not show significant differences (4.10±0.08 and 3.70±0.08 °Brix). These findings are in line with that of Sembene [14] who had found the strain obtained from the larger Tamarind tree, followed by that from peanuts, then come the strain from *Piliostigma reticulatum*, the strain obtained from *Cassia sieheriana* and finally that from *Bauhinia rufescens* while the last seeds are the largest. It appears that the different weights of adults show that egg-laying substrates do not have the same nutritional value [15]. Thus, the nature and chemical composition of the host plant could be a discriminating factor observed with the variables between these populations of *B. dorsalis*. As Ndiaye [3] says, the effect of nutrients on insect size should not be overlooked; these size differences are likely due to differences in nutritional quality rather than the size or weight of the host seeds. Indeed, mango has: more sugar (14.3) than tangerine (8.6) and cashew apple (8.2), more energy value (74) than tangerine (45.5) or orange and cashew apple (38.5). Tangerine (0.61) has less protein than mango (0.63) and cashew apple (0.79) the water content is higher in tangerine (88.5) followed by cashew apple (87.3) and finally comes mango (81.1). The lipid composition for mango (0.5) is higher imago than in the other two fruits (0.11) (energy in kcal/ 100g constituents in mg/100g) [13]. The discrimination between these three populations could also be explained by population dynamics. Indeed, in the densest populations, there is a high intraspecific competition causing a less important development than in the less dense populations where the competition is less so the individuals develop normally. For Sembene *et al*. [15], females sought to provide their larvae with a greater amount of food. According to the experiments of Sanou *et al*. [16], the mass of larvae and pupae varies significantly depending on the amount of their developmental support. According to Sembene *et al*. [15], the laying of females is done in a privileged way on the plant where the original development takes place. Hence the results of Boinahadji [2] demonstrates a laying preference and a significant larval performance of *B. dorsalis* on mango compared to tangerine it. He probably has gained an experience that allowed him to choose mango (Mangiferaindica) to the detriment of other fruits because of its predominant availability in the Niayes area [2]. Indeed, the latter found densities of 13.46, 3.10 and 2.77 insects per kg of fruit respectively in mango, cashew apple and mandarin. For the development of *B. dorsalis* in the laboratory, it appears that enzymatic hydrolysate is the most favorable to egg-laying and brewer's yeast is a source of local protein. The development of yeasts requires sugars, minerals and oxygen. The latter is involved in the constitution of water and organic compounds. In the works of Baumann and Von Deschwanden we see that glutathione has an anti-infectious and detoxifying action [17]. Thus, among the three fruits, it seems that the decaying mango best provides these substances that the larvae of *B. dorsalis* need for their development according to Boinahadji [2], it contains the densest population. It must also be noted that the abiotic factors favorable to *B. dorsalis* (mango) with a population peak coinciding with the mango harvest and abiotic conditions unfavorable to *B. dorsalis* of tangerine (production out of rainy season, irrigation). *B. dorsalis* preference for mango is thought to be related to the soft pericarps and volatile compounds of these fruits that play an important role in the egg-laying decision of this pest [2]. Mango is said to have nutrients necessary for the development of *B. dorsalis* larvae. In addition, the high sugar content present on the mango would contribute to making this fruit a favorable substrate for the development of *B. dorsalis* [2]. Morphometric groups would be more in favor of the organoleptic composition of fruit types [18] and that *B. dorsali*s is a specie that develops best under conditions of high humidity [2]. It attacks to the same degree the different stages of ripening of the fruits of mango and tangerine [5]. Therefore, individuals from mango are be the smallest compared to other populations since there must be intraspecific competition. Indeed Sanou *et a*l. [16] demonstrated that when the amount of substrate is not sufficient, competition leads to poor growth of larvae and therefore pupae. This leads to smaller flies with fairly small ovaries that can only contain a few eggs. Our results are contradictory with respect to the morphology of these two populations; a dominance in size of the individuals of the population derived from the tangerine over the individuals of the population derived from the mango is noted. And that the population from the cashew apple contains the smallest individuals on average. The very high calcium content of the cashew apple (556) [12] and its astringency could be a determining factor for the small size of most variables in this population of *B. dorsalis*. Indeed, the tannin concentration is between 6.6 ± 0.071 to 13.745 ± 0.926 (mg/100ml) [12]. However, it should be noted that despite the smaller averages for most of the variables in the cashew apple population, it presents some large individuals as shown in the table of maxima and minima as well as the graphs in bands. Indeed it presents the individual that has the largest size (Tai), the longest thorax (Th), the longest abdomen (Ab). Thus, despite the astringency of the cashew apple, these individuals develop adequately. Note that the cashew apple has characteristics that may explain the large size of these individuals: 3 to 6 times more vitamin C than orange, 3 times richer in vitamin A than orange, 23 times more Magnesium than orange; 28 times more than mango and 2 times potassium more than orange [19]. It turns out that some cashew apple fruits have less astringency than others, therefore very juicy, from which these large individuals would come. The morphological diversities within the populations could be due to the fact that the fruits differ from each other in terms of size, quantity of chemical constituents and soluble matter. Thus, the nature of the substrate has discriminating effects on the measurements of individuals within and between populations.

Conclusion

At the end of this work we can say that the three populations of *B. dorsalis* have different morphologies from each other. The population of *B. dorsalis* from the cashew apple has on average the smallest individuals contains also the one with the longest thorax and abdomen. Although the mango is the favorite fruit for *B. dorsalis* the majority of individuals from tangerine surpass them in size. Individuals from tangerines have the longest legs. However, they have the smallest head length and the largest width. Thus we can conclude that the food support has an effect on the different groups of individuals. Biological conditions act on the morphology of *B. dorsalis* individuals. The population of *B. dorsalis* from the tangerine (large size) is morphologically different from the population from the cashew apple (small size) as well as it varies from the mango (medium size). This last population is morphologically at the interval of the other two populations.

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