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FIELD TRIALS TO EVALUATE THE EFFECTIVENESS OF THE BIOGENTS®-SWEETSCENT LURE IN COMBINATION WITH SEVERAL COMMERCIAL MOSQUITO TRAPS AND TO ASSESS THE EFFECTIVENESS OF THE BIOGENTS-MOSQUITAIRE TRAP WITH AND WITHOUT CARBON DIOXIDE

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ABSTRACT. A series of field experiments was conducted in Florida, California, and Louisiana in order to investigate whether adding the Biogents® (BG)-Sweetscent lure to several commercially available mosquito traps increases their *Aedes albopictus* catch rates and to evaluate the BG-Mosquitaire trap with and without CO_2. Adding the BG-Sweetscent to the SkeeterVac Bite-Guard SVE6211, MosClean UV LED (ultraviolet light-emitting diode), Flowtron® Galaxie PV 75, Dynatrap® DT2000XL, Bite Shield Protector, and Black Flag® BZ-40 increased their *Ae. albopictus* catch rates up to 4.2-fold. The catch rates of the BG-Mosquitaire and the BG-Sentinel did not differ significantly for *Ae. aegypti* and *Culex quinquefasciatus*. The BG-Mosquitaire without CO_2 and only with BG-Sweetscent caught 1.2 times more *Ae. albopictus* than the CO_2- and Lurex3-baited Mosquito Magnet® Patriot and 2.6 times more than the CO_2- and Sweetscent-baited SkeeterVac, respectively. The BG-Mosquitaire baited with Sweetscent and CO_2 collected 6.8 times more *Ae. albopictus* than the Mosquito Magnet Patriot and 11.9 times more than the SkeeterVac. We conclude that BG-Sweetscent increases the tiger mosquito catch rates of many commercially available mosquito traps. We proved that the BG-Mosquitaire is as efficient as the well-known BG-Sentinel and that it can outperform mosquito traps that are baited with propane-generated CO_2.

KEY WORDS BG-Mosquitaire, BG-Sweetscent, mosquito attractant, mosquito trap, skin scent

INTRODUCTION

The growing spread of the invasive mosquito species *Aedes aegypti* (L.) and *Ae. albopictus* (Skuse) in the United States increases the complexity of mosquito control in the country. In contrast to several other mosquito species that are found in the home environment, including *Culex quinquefasciatus* Say, one of the vectors of West Nile virus, the container-inhabiting tiger mosquitoes are day active. Adulticidal operations at daytime are not feasible, and reaching all breeding sites in larviciding operations is practically impossible.

Maybe partially owing to the lack of a perceived effect of area-wide applied mosquito control measures, the lack of dedicated mosquito control programs, and because of concern about contracting mosquito-borne diseases, such as West Nile, dengue fever, chikungunya, and Zika, many American home owners use mosquito traps to reduce mosquito populations in their houses and backyards. Many mosquito traps with different attraction mechanisms and price categories are commercially available, but few scientific studies have been conducted to evaluate their effectiveness (e.g., Brown et al. 2008, Jackson et al. 2012). Furthermore, no studies have evaluated whether adding an attractant to commercially available traps can impact the capture of Asian tiger mosquitoes.

The Biogents® BG-Sentinel trap has been used by researchers for over a decade to monitor dengue vectors and is generally recognized as one of the best mosquito traps, especially for yellow fever and Asian tiger mosquitoes. This is reflected by the fact that the Centers for Disease Control and Prevention (CDC) recommends the use of the BG-Sentinel for *Ae. aegypti* and *Ae. albopictus* surveillance (CDC 2016) and that large-scale research projects, such as the World Mosquito Program (Eliminate Dengue no date) that operates in 12 countries, rely on BG-Sentinels for monitoring (Schmidt et al. 2017). The BG-Sentinel also catches high numbers of *Cx. quinquefasciatus*, especially when operated with CO_2 (Ázara et al. 2013). The trap uses the BG-Lure, an artificial human skin scent that contains lactic acid. The BG-Sweetscent was reformulated for home use and also contains lactic acid. It is packed in a sachet instead of a cartridge, has a shorter time span of effectiveness (up to 2 months, instead of up to 5 months), and is as efficient for catching *Ae. albopictus* as the BG-Lure (Akaratovic et al. 2017). The BG-Sentinel can additionally be operated with CO_2 to increase catch rates and species spectrum (Farajollahi et al. 2009), but even without carbon

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dioxide, it can catch more *Ae. aegypti* and *Ae. albopictus* than CO_2-baited encephalitis virus surveillance (EVS) traps (BioQuip®, Rancho Dominguez, CA) and CDC traps (Williams et al. 2006, Meeraus et al. 2008).

The BG-Mosquitaire trap uses the same mosquito attraction and collecting mechanisms as the BG-Sentinel, but instead of being lightweight and collapsible for scientific or public health purposes, it was designed to be more robust and visually pleasing, for use in fixed positions throughout the whole mosquito season in backyards, restaurants, hotels, and similar locations. The BG-Mosquitaire has been used in scientific studies before, including for monitoring of invasive mosquito species (Medlock et al. 2017) and studies of mosquito fauna (Beleri et al. 2017) and host preferences (Schönenberger et al. 2016), but an evaluation of the BG-Mosquitaire with and without CO_2 in comparison to the well-known BG-Sentinel and other commercial mosquito traps has not been published before.

The aim of the present study was to investigate whether *Ae. albopictus* and *Ae. aegypti* catch rates of commercially available mosquito traps could be increased when they are operated with the BG-Sweetscent lure, to demonstrate that the BG-Mosquitaire is as effective for catching *Ae. aegypt*i and *Cx. quinquefasciatus* as the BG-Sentinel, and to compare the BG-Mosquitaire without CO_2 with the CO_2-baited BG-Mosquitaire, Mosquito Magnet, and SkeeterVac mosquito traps.

MATERIALS AND METHODS

Study sites, used traps, and experimental design

BG-Sweetscent efficacy study: The efficacy of the BG-Sweetscent (Biogents AG, Regensburg, Germany) was tested in 2 field experiments, one in Gainesville, FL, and the other in Lake Charles, LA.

In Gainesville, 5 different traps were evaluated with and without BG-Sweetscent in July and August 2016: MosClean UV LED (ultraviolet light-emitting; Seoul Viosys Co., Ltd., Seoul, South Korea), Dynatrap DT2000XL (Dynamic Solutions Worldwide LLC, Milwaukee, WI), Bite Shield Protector (Koolatron, Ontario, Canada), Flowtron Galaxie PV 75 (Flowtron®, Malden, MA), and SkeeterVac Bite-Guard SVE6211 (Blue Rhino®, Winston Salem, NC). All of these electric traps use heat, UV light, and TiO_2 (to produce minimal amounts of CO_2 through a photocatalytic reaction) to attract mosquitoes. Insects are pulled into the traps by a suction fan and retained in a catch bag or chamber, where they die by dehydration. The SkeeterVac additionally uses a black-and-white sticky TacTrap as a supplemental capture system for attracted mosquitoes.

Five locations (distance between locations >50 m) were selected for the experiment, and 2 traps of the same type (1 with and 1 without BG-Sweetscent) were tested in 2 positions (minimum distance between positions = 10 m) at the same location. The traps' positions at each location were switched after 24 h, and after 4 days (e.g., after 4 repetitions on the same location), traps changed to another location, so that each trap configuration was tested 20 times in a modified Latin Square design.

In Lake Charles, 3 trap types were tested with and without BG-Sweetscent from July to September 2016 (peak population time for *Ae. albopictus*) in older city neighborhoods with mature trees and vegetation: Dynatrap DT2000XL, SkeeterVac Bite-Guard SVE6211, and Black Flag® BZ-40 (Spectrum Brands, Inc., Middleton, WI). The Black Flag BZ-40 is a bug zapper, which attracts mosquitoes by UV light and kills them by electrocution. The Black Flag trap was modified with an under tray to collect insects that were electrocuted. The traps were evaluated in a 6 × 6 Latin Square trial where trap positions were switched every 24 h.

Comparison of BG-Sentinel and BG-Mosquitaire: The comparison of the BG-Sentinel and the BG-Mosquitaire took place in Clovis, CA, and in New Orleans, LA. In Clovis, 2 residential locations were selected, and at each location a BG-Sentinel version 1 (BG-Sentinel-1) with BG-lure cartridge was compared with a BG-Mosquitaire with BG-Sweetscent (all attractants and traps from Biogents AG). The traps were additionally baited with CO_2 from dry ice and operated for 20 h every 7 days for a total of 10 wk (end of July until beginning of September 2017). Traps at the same location were visually separated and had a minimum distance of 5 m between each other, and their positions were switched weekly.

In New Orleans, the BG-Sentinel version 2 (BG-Sentinel-2, Biogents AG) with BG-lure cartridge was compared with the BG-Mosquitaire with BG-Sweetscent at 2 routine surveillance sites: The New Orleans Police Department horse stables and a local backyard, both with lush vegetation. The traps had a minimum distance of 10 m between each other and were operated at fixed positions without CO_2 for 24 h once per week from September to November 2017.

Comparison of BG-Mosquitaire with and without CO_2 and 2 other CO_2-baited traps: This experiment was conducted in Lake Charles in August and September 2014 in older neighborhoods with mature vegetation. The BG-Mosquitaire without CO_2 and with BG-Sweetscent was compared with a CO_2- and BG-Sweetscent–baited BG-Mosquitaire, a SkeeterVac SV3100 (Blue Rhino, Winston Salem, NC) with BG-Sweetscent, and a Mosquito Magnet Patriot with Lurex3 (Woodstream Corp., Littiz, PA) in a 4 × 4 Latin Square trial. The SkeeterVac SV3100 and the Mosquito Magnet Patriot use a catalytic converter to generate electricity and CO_2 from propane. The electricity is used to run a fan that expels heat, moisture, and CO_2, as well as the smell of an optional lure, and to pull mosquitoes

Table 1. Number of observations (*N*), sum, and mean numbers (in parentheses) of collected Culicidae (*Aedes albopictus* and *Ae. aegypti*) per trap in Gainesville, FL; Lake Charles, LA; and Clovis, CA, field experiments.

Experiment and trap	*N*	*Ae. albopictus* female	*Ae. albopictus* male	*Ae. aegypti* female	*Ae. aegypti* male	Total Culicidae
BG-Sweetscent efficacy (Gainesville, FL)						
Bite Shield Protector	20	8 (0.4)	3 (0.2)	3 (0.2)	0 (0.0)	1830 (91.5)
Bite Shield Protector + Sweetscent	20	34 (1.7)	10 (0.5)	12 (0.6)	3 (0.2)	2283 (114.2)
Dynatrap XL DT2000XL	20	21 (1.1)	4 (0.2)	3 (0.2)	0 (0.0)	7588 (379.4)
Dynatrap XL DT2000XL + Sweetscent	20	46 (2.3)	9 (0.5)	18 (0.90)	0 (0.0)	8855 (442.8)
Flowtron Galaxie PV 75	20	1 (0.1)	1 (0.1)	3 (0.15)	0 (0.0)	78 (3.9)
Flowtron Galaxie PV 75 + Sweetscent	20	4 (0.2)	1 (0.1)	1 (0.1)	0 (0.0)	14 (0.7)
MosClean UV LED	20	6 (0.3)	7 (0.4)	4 (0.20)	0 (0.0)	3742 (187.1)
MosClean UV LED + Sweetscent	20	27 (1.4)	17 (0.9)	39 (2.0)	11 (0.6)	5272 (263.6)
SkeeterVac Bite-Guard SVE6211	19	13 (0.7)	4 (0.21)	5 (0.3)	0 (0.0)	793 (41.7)
SkeeterVac Bite-Guard SVE6211 + Sweetscent	18	29 (1.6)	5 (0.28)	6 (0.3)	4 (0.2)	652 (36.2)
BG-Sweetscent efficacy (Lake Charles, LA)						
Black Flag	36	5 (0.1)	2 (0.1)	—	—	179 (5.0)
Black Flag + Sweetscent	36	19 (0.5)	2 (0.1)	—	—	104 (2.9)
Dynatrap	36	53 (1.5)	16 (0.4)	—	—	422 (11.7)
Dynatrap + Sweetscent	36	107 (3.0)	8 (0.2)	—	—	670 (18.6)
SkeeterVac Bite-Guard SVE6211	36	47 (1.3)	21 (0.6)	—	—	509 (14.1)
SkeeterVac Bite-Guard SVE6211 + Sweetscent	36	145 (4.0)	11 (0.3)	—	—	835 (23.2)
BGS vs BGM (Clovis, CA)						
BG-Sentinel-1 + BG-Lure + CO_2	19	—	—	166 (8.7)	217 (11.4)	—
BG-Mosquitaire + Sweetscent + CO_2	19	—	—	237 (12.5)	222 (11.7)	—

into the traps, where they are retained in a catch bag. The SkeeterVac SV3100 additionally uses a black-and-white sticky TacTrap as a supplemental capture surface. Of the 2 BG-Mosquitaire traps, 1 was baited with CO_2 from dry ice. Trap positions were changed every 24 h.

Data analysis

Statistical and exploratory data analyses were performed using R studio version 1.1.453 (Rstudio Team 2016), based on R version 3.3.2 (R Core Team 2016). Data from all experiments were analyzed, using generalized linear mixed models (GLMMs) and the libraries lme4 (Bates et al. 2015) and MASS (Venables and Ripley 2002). The fixed main effect was the variable *trap,* which included all trap configurations that were evaluated in each experiment. Owing to experimental design, the random factors *position* and *date* were chosen a priori in order to account for spatial and temporal correlation. The dependent count variable was either the number of female and male *Ae. albopictus*, *Ae. aegypti*, *Cx. quinquefasciatus*, or the total number of all Culicidae collected in *trap t* and on *date d*. Poisson models were first fitted, and when these were overdispersed, negative binomial models with a log-link were adjusted. Models' adequation was assessed through diagnostic residual plots and through evaluation of overdispersion. Tukey multiple comparisons of means of the GLMMs was performed using the emmeans package (Lenth 2018).

RESULTS

BG-Sweetscent efficacy: In Florida, *Ae. albopictus* females and males and *Ae. aegypti* females were collected by all traps, while only 3 out of 10 traps collected at least 1 *Ae. aegypti* male during the 20 trapping days (Table 1). All evaluated traps collected more total *Ae. albopictus* when they were baited with the BG-Sweetscent lure (Table 1; Fig. 1). The Poisson GLMM estimates that the SkeeterVac Bite-Guard collected on average 2 times more ($P = 0.35$), the MosClean 3.3 times more ($P < 0.01$), the Flowtron 2.4 times more ($P = 0.98$), the Dynatrap 2.4 times more ($P = 0.01$), and the Bite Shield 4.2 times more ($P < 0.001$) (Table 2). With the exception of the Flowtron, all traps also collected more *Ae. aegypti* when operated with the BG-Sweetscent lure (Table 1). No formal statistical analysis is presented on *Ae. aegypti* data, since residual plots of negative binomial GLMMs indicated major problems, probably due to the high number of zero observations (157 out of 197). In terms of total mosquitoes, the Bite Shield Protector, Dynatrap DT2000XL, and the MosClean UV LED collected more specimens when operated with BG-Sweetscent (Table 1); the differences, however, were insignificant ($P > 0.9$).

In Louisiana, all 3 evaluated traps collected more total *Ae. albopictus* when operated with the BG-Sweetscent lure (Fig. 1; Table 1). The negative binomial GLMM indicates that the Dynatrap collected 1.9 times more ($P = 0.16$), the SkeeterVac Bite-Guard 2.3 times more ($P = 0.011$), and the Black Flag collected 3.2 times more ($P = 0.17$) (Table 2).

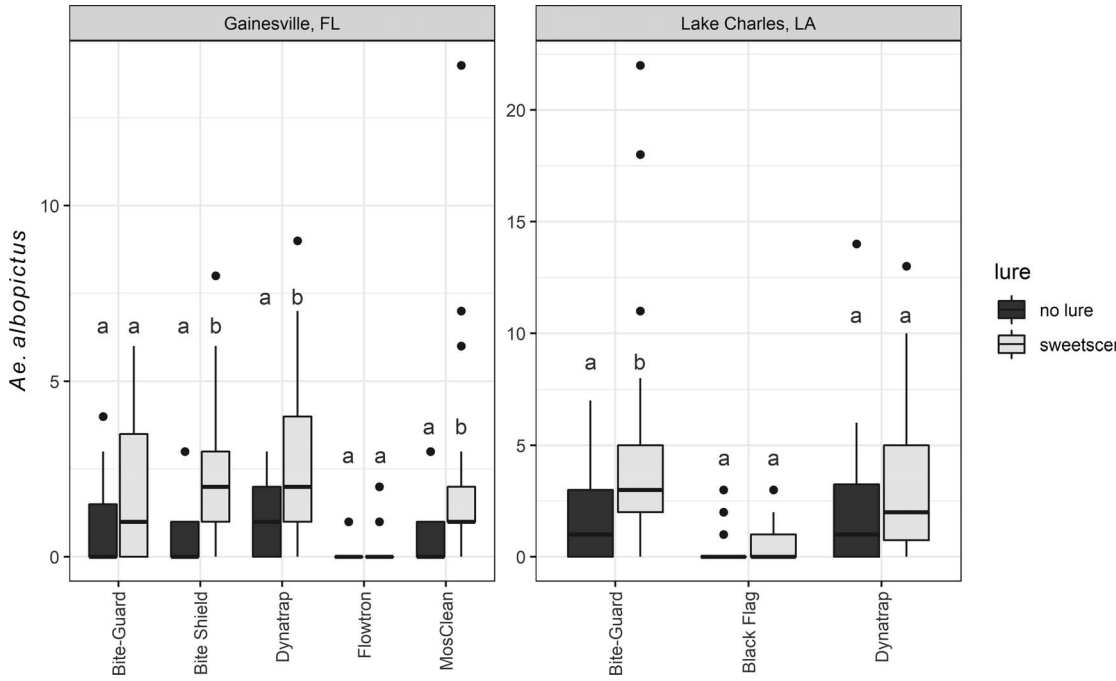

Fig. 1. Boxplots of *Aedes albopictus* (female and male) catches in several traps with and without BG-Sweetscent in Gainesville, FL, and Lake Charles, LA. Different letters indicate significant different catch rates of the same trap used with or without BG-Sweetscent lure.

Table 2. Pairwise differences of combinations of traps and Sweetscent or different traps, based on the results of generalized linear mixed models with Poisson or negative binomial distribution. Results are given on the log (not the response) scale. Significant comparisons are in bold.

Response variable/experiment	Trap + lure (comparison)	Estimate	SE	Z	*P*
BG-Sweetscent efficacy (*Aedes albopictus*; Gainesville, FL)	**Bite Shield + BGL (Bite Shield)**	**1.44**	**0.33**	**4.32**	**<0.001**
	Dynatrap + BGL (Dynatrap)	**0.87**	**0.24**	**3.58**	**0.012**
	Flowtron + BGL (Flowtron)	0.89	0.82	1.08	0.98
	MosClean + BGL (MosClean)	**1.20**	**0.31**	**3.85**	**<0.01**
	SkeeterVac Bite-Guard + BGL (SkeeterVac Bite-Guard)	0.68	0.29	2.31	0.38
BG-Sweetscent efficacy (*Aedes albopictus*; Lake Charles, LA)	Black Flag + BGL (Black Flag)	1.15	0.49	2.36	0.17
	Dynatrap + BGL (Dynatrap)	0.62	0.26	2.38	0.16
	SkeeterVac Bite-Guard + BGL (SkeeterVac Bite-Guard)	**0.85**	**0.25**	**3.33**	**0.011**
BGM vs CO_2-baited traps (*Aedes albopictus*; Lake Charles, LA)	**BG-Mosquitaire + CO_2 (BG-Mosquitaire)**	**1.54**	**0.28**	**5.44**	**<0.0001**
	BG-Mosquitaire + CO_2 (Mosquito Magnet)	**1.92**	**0.27**	**7.10**	**<0.0001**
	BG-Mosquitaire + CO_2 (SkeeterVac SV3100)	**2.48**	**0.28**	**8.81**	**<0.0001**
	BG-Mosquitaire (Mosquito Magnet)	0.38	0.29	1.32	0.55
	BG-Mosquitaire (SkeeterVac SV3100)	**0.94**	**0.30**	**3.09**	**0.011**
	Mosquito Magnet (SkeeterVac SV3100)	0.55	0.29	1.91	0.23
BGS + CO_2-vs BGM (*Aedes aegypti*; Clovis, CA)	BG-Mosquitaire + CO_2 (BG-Sentinel + CO_2)	0.18	0.13	1.36	0.175
BGS vs BGM (*Aedes aegypti*; Clovis, CA)	BG-Mosquitaire (BG-Sentinel2)	0.16	0.33	0.49	0.62
BGS vs BGM (*Culex quinquefasciatus*; New Orleans, LA)	BG-Mosquitaire (BG-Sentinel2)	0.09	0.45	0.20	0.84

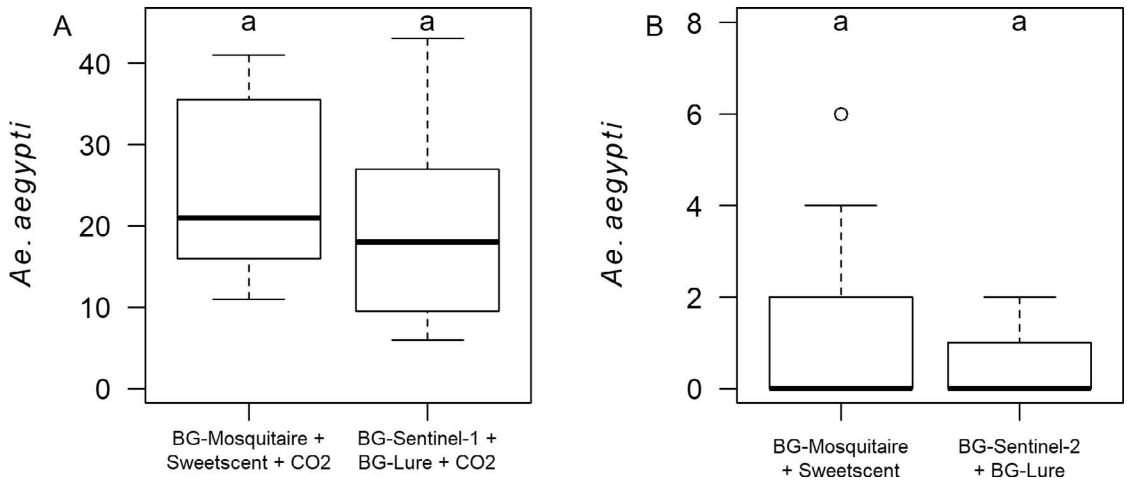

Fig. 2. Boxplots of *Aedes aegypti* (female and male) catches in BG-Mosquitaire and BG-Sentinel traps (A) in Clovis, CA, and (B) New Orleans. The same letters indicate insignificant different catch rates.

Comparison of BG-Sentinel and BG-Mosquitaire: In the BG-Sentinel version 1 versus BG-Mosquitaire trial in California, only *Ae. aegypti* were collected. Both CO_2-baited traps collected almost the same number of male *Ae. aegypti*, while the number of females collected was slightly higher in the BG-Mosquitaire (Table 1). Overall, the BG-Mosquitaire collected 1.2 times more *Ae. aegypti* ($P = 0.175$) than the BG-Sentinel (Table 2; Fig. 2A).

In New Orleans, where both traps were operated without CO_2, mainly *Cx. quinquefasciatus* and *Ae. aegypti* were collected (Table 3). The BG-Mosquitaire collected 1.2 times more *Ae. aegypti* ($P = 0.62$) than the BG-Sentinel (Fig. 2B), and the BG-Sentinel collected 1.1 times more *Cx. quinquefasciatus* ($P = 0.84$) than the BG-Mosquitaire (Table 2).

Comparison of BG-Mosquitaire with and without CO_2 and 2 other CO_2-baited traps: In this trial, the BG-Mosquitaire with CO_2 collected by far the highest number of *Ae. albopictus*, *Cx. quinquefasciatus*, and total mosquitoes (Table 4). For total *Ae. albopictus* (Fig. 3A), the CO_2-baited BG-Mosquitaire collected 11.9 times more ($P < 0.0001$) than the SkeeterVac Propane, 6.8 times more ($P < 0.0001$) than the Mosquito Magnet Patriot, and 4.7 times more ($P < 0.0001$) than the BG-Mosquitaire without CO_2 (Table 2). The BG-Mosquitaire without CO_2 collected 2.6 times more total *Ae. albopictus* than the SkeeterVac ($P = 0.011$), and the catch rates of the Mosquito Magnet and the BG-Mosquitaire were similar ($P = 0.55$). The Mosquito Magnet collected 1.7 times more than the SkeeterVac ($P = 0.225$). For total *Cx. quinquefasciatus* (Fig. 3B) and total Culicidae, the BG-Mosquitaire with CO_2 also collected significantly more specimens (3.6–17.8 times more, $P < 0.001$) than the 3 other evaluated traps, and the BG-Mosquitaire without CO_2 collected significantly more than The SkeeterVac and the Mosquito Magnet (1.8–4.4-fold; $P < 0.05$). The maximum number of species collected per 24 h trapping period was 3, 4, 7, and 12 for the Mosquito Magnet, SkeeterVac, BG-Mosquitaire, and BG-Mosquitaire + CO_2, respectively.

DISCUSSION

In this manuscript we demonstrated that the BG-Sweetscent lure increases the tiger mosquito catch rates of several commercially available mosquito traps. We also showed that the BG-Mosquitaire is as effective for catching *Ae. aegypti* and *Cx. quinquefasciatus* as the BG-Sentinel trap, a recognized gold-standard monitoring device for dengue vectors. Furthermore, the BG-Mosquitaire without CO_2 was proved to be as efficient for catching *Ae. albopictus* as the CO_2-baited Mosquito Magnet Patriot and significantly better than the CO_2-baited SkeeterVac SV3100. Adding CO_2 to the BG-Mosquitaire significantly increased its *Ae. albopictus* and other

Table 3. Number of observations (*N*), sum, and mean numbers (in parentheses) of collected Culicidae (*Culex quinquefasciatus* and *Aedes aegypti*) per trap in New Orleans, LA, field experiment.

Trap	*N*	*Cx. quinquefasciatus* female	*Cx. quinquefasciatus* male	*Ae. aegypti* female	*Ae. aegypti* male	Total Culicidae
BG-Sentinel-2 + BG-Lure	18	28 (1.6)	6 (0.3)	12 (0.7)	5 (0.3)	57 (3.2)
BG-Mosquitaire + Sweetscent	18	22 (1.1)	8 (0.4)	16 (0.9)	4 (0.2)	59 (3.3)

Table 4. Number of observations (*N*), sum, and mean numbers (in parentheses) of collected Culicidae (*Aedes albopictus* and *Culex quinquefasciatus*) per trap in Lake Charles, LA, field experiment.

Trap	*N*	*Ae. albopictus* female	*Ae. albopictus* male	*Cx. quinquefasciatus* female	*Cx. quinquefasciatus* male	Total Culicidae
BG-Mosquitaire + Sweetscent	14	209 (14.9)	97 (6.9)	191 (13.6)	60 (4.3)	579 (41.4)
BG-Mosquitaire + Sweetscent + CO_2	16	1095 (68.4)	858 (53.6)	1056 (66.0)	96 (6.0)	3751 (234.4)
SkeeterVac SV3100 + Sweetscent + CO_2	16	114 (7.1)	45 (2.8)	57 (3.6)	7 (0.4)	230 (14.4)
Mosquito Magnet Patriot + Lurex3 + CO_2	16	268 (16.8)	55 (3.4)	92 (5.8)	6 (0.4)	435 (27.2)

mosquito catch rates and increased the number of collected species.

The BG-Lure, which is essentially the same attractant as the BG-Sweetscent, was previously shown to increase the *Ae. albopictus* catch rates of BG-Sentinel (Pombi et al. 2014, Roiz et al. 2016) and CDC light traps (Urquhart et al. 2016), especially when used together with CO_2. The performance of

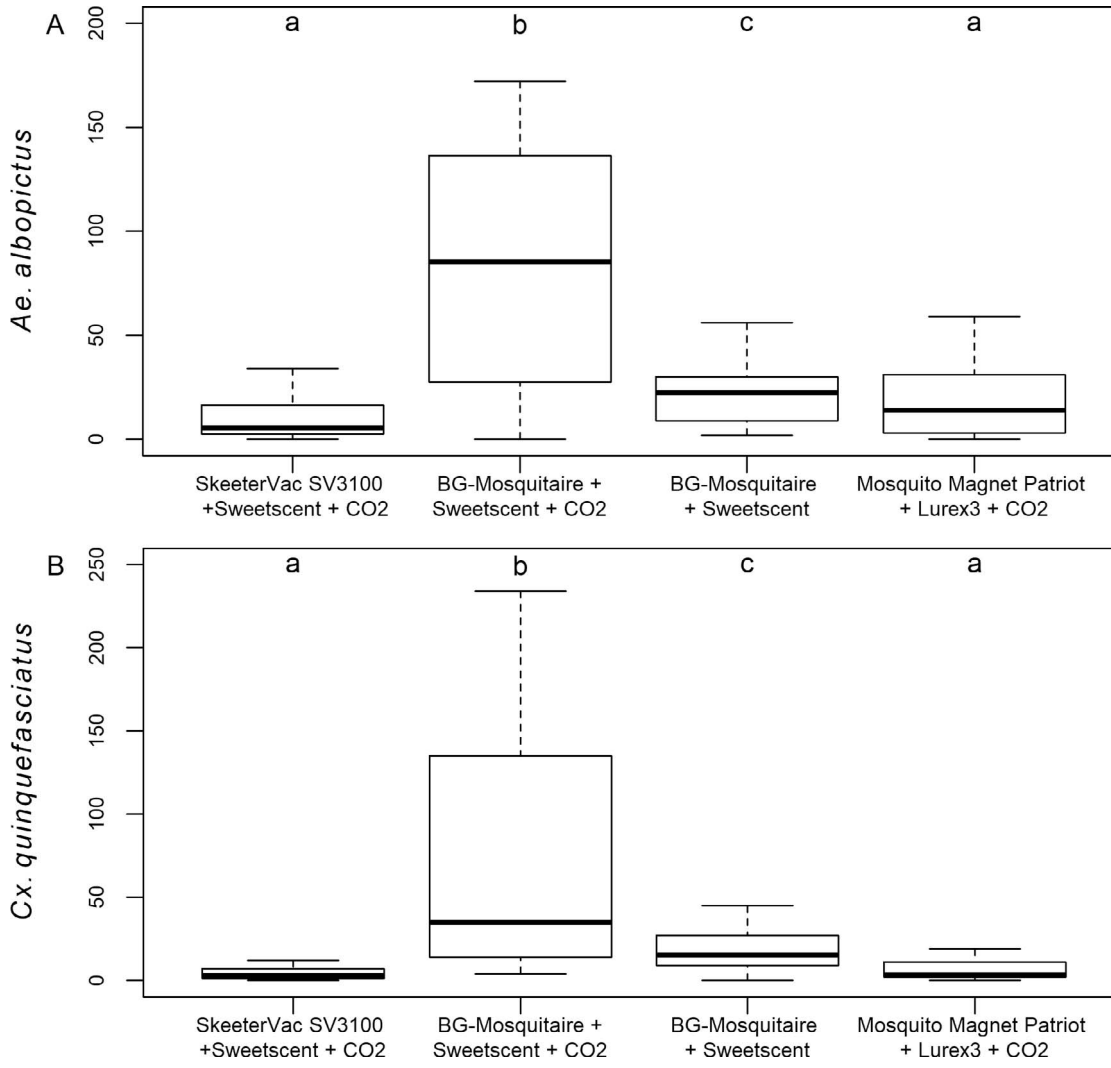

Fig. 3. Boxplots of (A) *Aedes albopictus* (female and male) and (B) *Culex quinquefasciatus* catches in 4 different mosquito traps in Lake Charles, LA. Please note that in Fig. 3A, 2 outliers (302 and 523 *Ae. albopictus* in the BG-Mosquitaire + Sweetscent + CO_2) are not shown in order to facilitate visual comparison between boxes. Different letters indicate significantly different catch rates.

the BG-Lure in homeowner mosquito traps, however, was not previously evaluated. Most of the traps that were evaluated in the Sweetscent efficacy trials collected low numbers of dengue vectors, but the Bite Shield Protector, Dynatrap DT2000XL, MosClean UV LED, and SkeeterVac Bite-Guard SVE6211 trapped considerable numbers of total mosquitoes (mainly *Uranotaenia* spp., *Cx. erraticus*, and *Anopheles crucians*). With the exception of the SkeeterVac Bite-Guard in 1 of 2 experiments, adding the BG-Sweetscent lure to these traps increased their total mosquito and dengue vector catch rates. Since all of the six traps that were evaluated in the BG-Sweetscent efficacy experiments use UV light as an attractant, they could be expected to have a higher number of insects other than mosquitoes in the catch. Studies by Surgeoner and Helson (1978), Nasci et al. (1983), and Frick and Tallamy (1996) on UV electrocution traps found only a small proportion of trapped specimens (<10%) as blood-sucking insects. It might be exactly this high amount of by-catch nontarget insects that makes trap owners satisfied, because what they perceive is that the trap catches a lot of "bugs."

The BG-Mosquitaire was compared with the BG-Sentinel in 2 trials: In California, we used the BG-Sentinel-1, and both traps were operated with CO_2, while in Louisiana we used BG-Sentinel-2 and did not add CO_2 to the traps. The BG-Sentinel-1 was previously compared with version 2, and there was no difference between them regarding their *Ae. albopictus* catch rates (Arimoto et al. 2015, Akaratovic et al. 2017). In both present trials, the BG-Mosquitaire collected only slightly more *Ae. aegypti* than the BG-Sentinel, and in Louisiana, the BG-Sentinel collected slightly more *Cx. quinquefasciatus*, indicating that both traps are equally efficient for trapping these mosquito species.

In the present study, the catch rates and the species spectrum of the BG-Mosquitaire were substantially increased through addition of CO_2, in agreement with previous results for the BG-Sentinel (Farajollahi et al. 2009). The *Ae. albopictus* catch rates of the BG-Mosquitaire without CO_2 were still slightly higher than those of the Mosquito Magnet Patriot and significantly higher than those of the SkeeterVac SV3100, which are both operated with propane-generated CO_2. When considering all collected mosquitoes, the BG-Mosquitaire without CO_2 achieved significantly higher catch rates than the other 2 traps, and the species spectrum collected per 24 h was also higher. The Mosquitaire without CO_2, therefore, clearly outperformed 2 CO_2-baited traps. In agreement with our results, previous studies showed that the BG-Sentinel without CO_2 outperformed CO_2-baited EVS and CDC traps. Rochlin et al. (2016), however, found that the Mosquito Magnet baited with BG-Lure and R-octenol collected significantly more *Ae. albopictus* than a BG-Sentinel without CO_2 but with BG-Lure and R-octenol in Suffolk County, NY. This strong discrepancy between the results of our study might be due to the different Mosquito Magnet models that were used. We used the Mosquito Magnet Patriot, while Rochlin and coauthors used the Liberty and Executive models. Another big difference is that Rochlin and colleagues used R-octenol in addition to the BG-Lure. R-octenol is not a good attractant for *Ae. albopictus* in BG-Sentinel traps (Unlu et al. 2016) and the potential repellent effect of R-octenol might be stronger in the absence of CO_2 as an additional lure. Since the use of CO_2 is expensive and can be logistically challenging, it is of great importance to have a trap that catches high numbers of mosquitoes without it. The BG-Mosquitaire can be operated with CO_2, but unlike the Mosquito Magnet and the Skeetervac SV3100, it does not have to. In this way, it is much more flexible, and the question of adding CO_2 or not can always be adapted according to many factors, such as mosquito density and CO_2 availability.

We conclude that the BG-Sweetscent lure can be used in a wide spectrum of commercially available mosquito traps in order to increase their *Ae. albopictus* catch rates. Addition of the BG-Sweetscent is therefore recommended for improving trap performance, especially when aiming for increased dengue vector collections. We also conclude that the BG-Mosquitaire is as efficient as the BG-Sentinel, which is already recognized by researchers as one of the most effective mosquito traps for dengue vectors. Therefore, a trap of scientifically proved effectiveness is commercially available for private use. The BG-Mosquitaire can also be recommended for scientific and public health purposes, especially when the intent is to use the trap in a fixed position.

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