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EVALUATION OF FOOD LURES FOR ORIENTAL FRUIT FLY *BACTROCERA DORSALIS* (DIPTERA: TEPHRITIDAE) TRAPPING ON *CHRYSOPHYLLUM ALBIDUIM* IN IBADAN, NIGERIA.

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ABSTRACT

Damage caused by tephritid fruit flies has been recognized as a key limiting factor to fruits and vegetables production in many parts of the world including Nigeria. The oriental fruit fly, *Bactrocera dorsalis* Hendel (Diptera: Tephritidae**)** is the most devastating tephritid fruit flies attacking fruits all over the world. The potential of three food-based juice lures (pineapple, orange, banana) in trapping B. *dorsalis* on *Chrysophyllum albidum* were evaluated during 2019 fruiting season at two locations (viz:Forestry Research Institute of Nigeria (FRIN) and Alafara) in Ibadan south west Nigeria. The lures were baited with cypermethrin and were applied at 40ml/trap/week while methyl eugenol (standard check) was applied at 10 ml/trap/week. Data collected were transformed using square root transformation (vX+0.5), then subjected to analysis of variance (ANOVA) at 5% level of probability The results showed that *B. dorsalis* was trapped on *C. albidum* at both study location. The percentages of trapped flies after 9 weeks were 73.61% - 77.61% (Methyl Eugenol) > 13.04%- 19.65 % (Pineapple juice) > 4.35% - 7.38% (Orange juice) > 0.97% - 3.10 % (Banana juice) > 0.97% -2.18% (control) at the study sites. The density of flies trapped at FRIN was significantly higher than those trapped at Alafara. The densities of trapped *B. dorsalis* significantly differed among the different treatments at both location. Food bases lures trapped both male and female flies while methyl eugenol trapped only male. Pineapple juice was more potent that other food lures in trapping *B. dorsalis*. The food-based lures evaluated has shown potential in trapping *B. dorsalis*, hence increased dosage and frequency of application could be suitable part of integrated pest management programs for fruit fly control.

Keywords: oriental fruit fly, lures, african star apple, monitoring, control

Introduction

Fruit flies of family Tephritidae are important phytosanitary pests of several agricultural fruits and vegetables as well as wild fruits. They are responsible for significant losses of fruit production in many parts of the world including Nigeria. The damage is caused by female oviposition and larval feeding, which destroy the fruit's pulp by hastening fruit ripening that subsequently lead to premature fruit droppings (Aguiar-Menezes *et al.* 2004). Tephritidae family are more than 4500 species from 500 genera worldwide of which about 1400 develop to maturity in fleshy fruits (Qin *et al.* 2015).

The genera *Bactrocera* contains of at least 75 species, of which *Bactrocera dorsalis* (Hendel) Diptera: Tephritidae**)** is considered a major biosecurity concern and one of the most important insect pest species in global agriculture by entomologists and quarantine biologists (Shen *et al.* 2011, Clarke *et al.* 2005). *B. dorsalis* is known to have the widest host range among other *Bactrocera species*, it has been recorded from 478 species of fruit and vegetables including avocado, banana, citrus, coffee, fig, guava, loquat, mango, papaya, passion fruit, and tomato as well as wild fruits such as *Chrysophyllum albidum* (Sapotaceae) (USDA, 2016). *Chrysophyllum albidum* is a forest tree found mostly in tropical Africa and their various parts such as roots and leaves are very useful for medicinal purposes (Emudainohwo *et al*., 2015). The fruits are commonly consumed in all parts of Nigeria, especially by pregnant women in South east Nigeria (Ihekwereme *et al* , 2017). The *C. albidum* fruits have shown a high industrial potential in their physical, chemical and nutritional characterization (Falade, 2001). The fruits are seriously infested in the wild by fruit flies especially *B. dorsalis* if allowed to ripe naturally on the tree rendering them unsafe for consumption and resulting to economic losses. One major vital aspect of fruit fly management is population monitoring to provide information on pest population in the monitored area (Bortoli *et al,* 2016). Fruit fly detection, monitoring, and suppression strategies have relied intensely on the use of food-based attractants from proteins and fermenting sugars (Roessler, 1989; IAEA, 2003). Hydrolyzed proteins and Torula yeast are among the commercial available attractants for fruit fly monitoring in orchards (Pogerre 2007; Azevedo *et al.* 2012). *B. dorsalis* has been trapped in commercial crops using food-based attractants such as Nulure and Biolure (Ekesi *et al.* 2007, Rwomushana 2008, Mwatawala *et al.* 2009).

The cost of imported protein hydrolysate and shipping problems constitute a major challenge in their use for monitoring fruit flies in many developing countries (Rasamimanana, 1997). Presently 25% solution of grape juice are recommended as the standard attractant for monitoring South American fruit flies in apple and other fruit orchards (Kovaleski 2004; Fioravanço and Santos 2013). Waste brewer's yeast has been successfully modified into bait for fruit fly control in Queensland, Australia (Lloyd and Drew 1997). Modified food bait from banana, pineapple and mango fruits were reported to be potent in attracting fruit flies in India (Nagaraj *et al.*, 2014) In Nigeria the spray of protein bait from brewery waste has been reported to minimize fruit fly attack and damage on sweet oranges (Umeh and Onukwu, 2011). Ugwu *et al.* (2018) also reported that the use of locally made Protein bait from brewery waste showed great potential in trapping *B. dorsalis* on mango. The ability to develop a locally food based lures could contribute immensely in reducing cost and enhancing the sustainability of fruit fly control in Nigeria. Thus, this study evaluated the efficacies of three locally made food based lures for trapping *B. dorsalis* on *Chrysophyllum albidium* plantation and homestead trees.

Materials and Methods

Experimental site

The study was carried out in Ibadan South west Nigeria during the 2019 fruiting season of *Chrysophyllum albidum*. The area is located within Latitude $7^{o}24'$ 7.0632′′N Longitude $3^{0}55'$2.3268′′E (GMT) with annual rainfall range of 1,300-1500mm, average relative humidity of about 80 to 85 %, and average yearly temperature of 26· 2^{o} C. (FRIN, 2018). The two study locations used are Forestry Research Institute of Nigeria (FRIN) in Ibadan North West Local Government Area and Alafara in Ido Local Government Area of Oyo state, Nigeria.

Three food lures (pineapple, orange and banana) were evaluated for their potential in capturing *B. dorsalis*. Methyl eugenol was used as a standard check while water served as control. The pineapple and orange baits were prepared by peeling 1kg of each of the fruit and blend them into a smooth slurry paste using an electric kitchen blender. The juices were extracted separately with 1litre of water each and sieved with muslin cloths to obtain a homogenous solution as described by Ugwu *et al.*, (2018). The banana paste was prepared by blending 1 kg of banana with 500 ml of water. The preparations were refrigerated until when used. Modified Lynfield traps (MLT) were used in setting the traps. A Lynfield trap is a bucket type trap composed of a cylindrical plastic container with four equidistant holes on the upper third and the lid of the trap contains a hook to which an methyl eugenol (ME) dispenser such as Invader Lure must be fitted (Copeland, 2012). Methyl eugenol a commercial hydrolyzed protein for trapping *B. dorsalis* was used as a standard check while water served as control.

Cypermethrin (2 ml) was added to each prepared fruit juice lures to knock down the trapped flies. Three trees were selected from each location at a distance of 10- 20 m from each other to obtain three independent replicates per site. Setting of traps commenced at the onset of fruit ripening and five traps were hung per tree in all the sites. Forty milliliters (40ml) of each prepared food baits was dispensed with the aid of 10 ml injection syringe and carefully dropped on 0.5 gm of absorbent cotton wool and placed at the bottom of the trap while twenty milliliters of Methyl eugenol were used following the same procedure. All the prepared food lures were vigorously shaken before dispensing. Five traps containing lures including control were hung on each tree at 15m above the ground within the tree canopy.

Data were collected on the number of fruit flies trapped per trap every week at both locations for 9 weeks consecutively. The trapped flies were taken to the laboratory for counting, identification and sexing. Data collected were subjected to Analysis of Variance (ANOVA) in Randomized Complete Block Design (RCBD).Significant means were separated at 5% level using Tukey's Honestly Significant Difference (HSD). Analysis was done with ASSISTAT version 7.6 beta 2011 software

Results

Effect of treatments on the weekly catch of *Bactrocera dorsalis* at FRIN location

Bactrocera dorsalis were trapped by the different food lures at diverse proportion starting from the first week to the 9th week (Fig.1). At first week, flies were caught in only two lures, viz: orange juice bait and methyl eugenol. Pineapple juice bait started catching flies from the second week and persisted until 9th week with mean values (0.33- 1.69) though in small proportion compared to methyl eugenol. Banana juice bait trapped very small proportion of *B. dorsalis* only at the third week with mean value of 0.33. Methyl eugenol trapped higher population of flies ranging from 0.67 – 6.09 mean values from the first week to the 9th week compared to other treatments. Pineapple juice bait caught higher density of flies compared to other food based lures and control. Control trapped *B. dorsalis* only at the 9th week of mean value 0.33.The effect of the treatments on the density of flies caught were significantly ($p<0.05$) different at weeks 3, 4, 6 7, 8 and 9. The density of flies trapped increased as the week progressed peaking at week 9.

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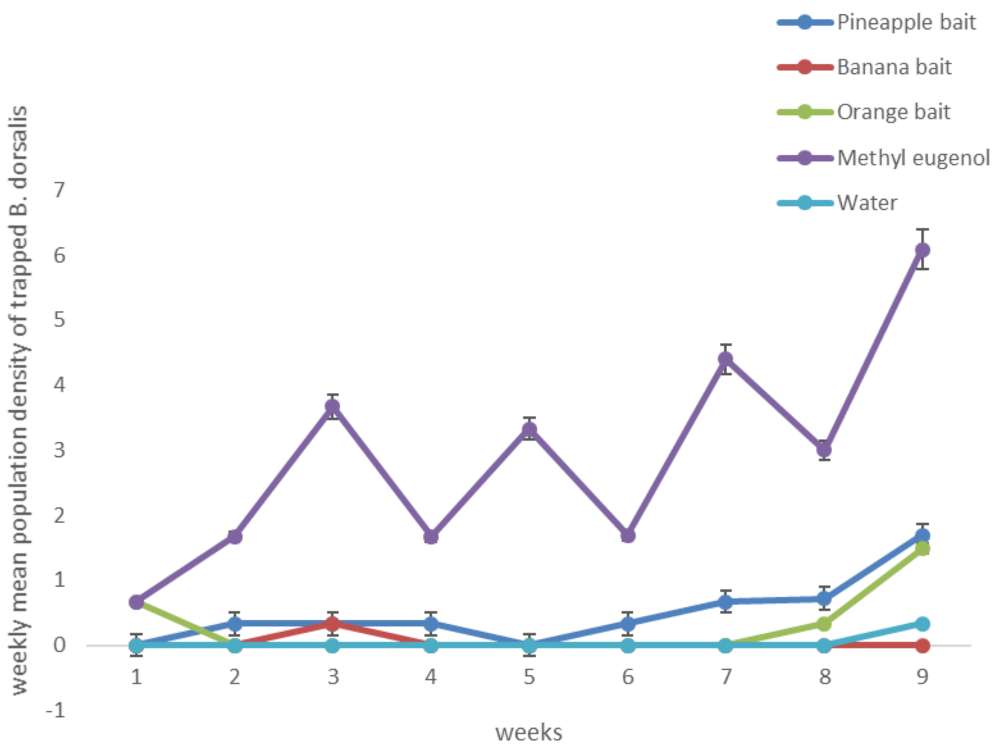

Fig. 1. The weekly catch of *B. dorsalis* by the various lures at FRIN location

Effect of treatments on the weekly catch of *Bactrocera dorsalis* at Alafara Location

The trapping of *B. dorsalis* by the tested food lures at Alafara location followed similar pattern as observed at FRIN. Flies were trapped by the various lures from first week to the last week of observation. At first week, four treatments including control trapped *B. dorsalis* at diverse rates. Pineapple juice bait was persistent in trapping the flies from first week to the 8th week of the study. Orange and banana juice baits trapped relatively small flies only at first and third weeks respectively. Methyl eugenol trapped significantly ($p<0.05$) higher densities of *B. dorsalis* from week two to week 9 of study compared to other attractants. The highest population of flies was trapped at week 4 at the peak of *C. albidum* fruits ripening .

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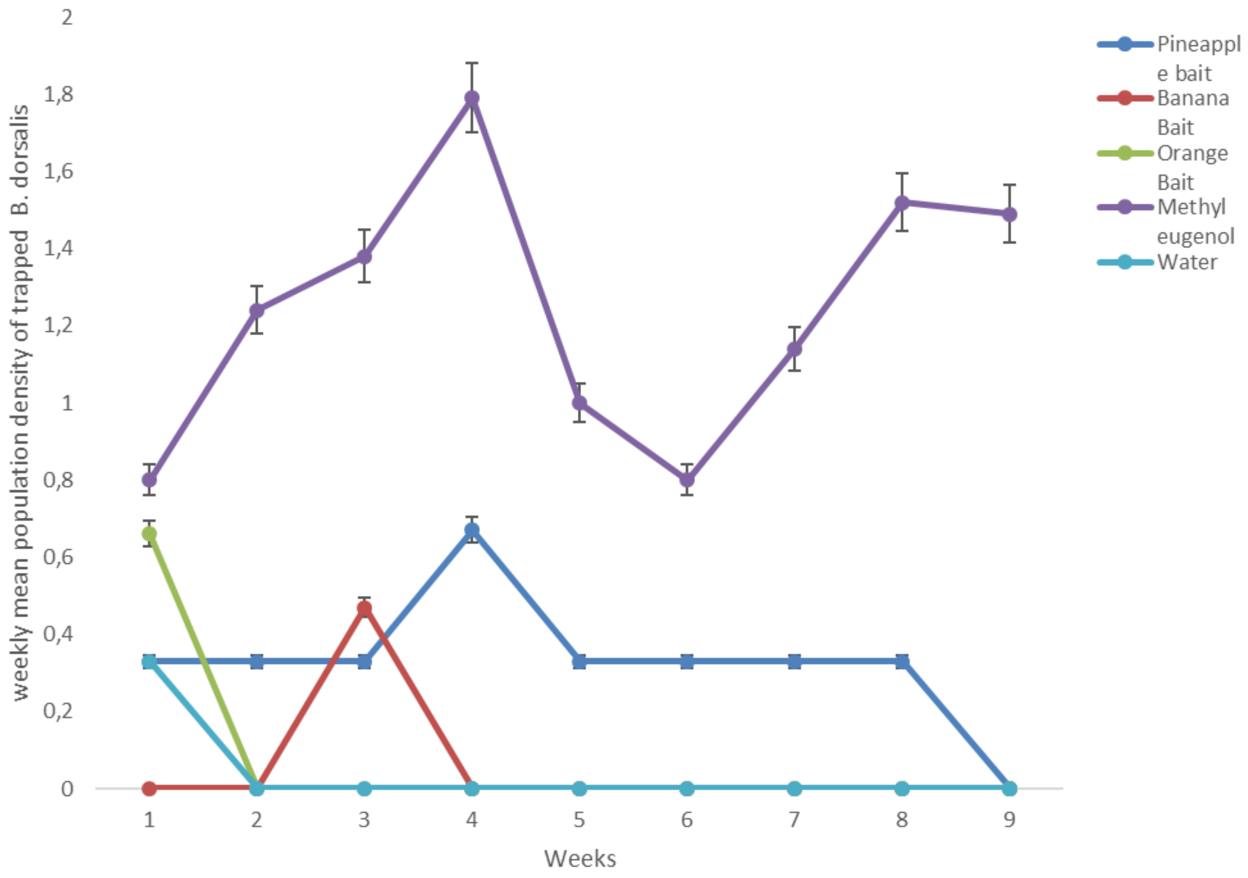

Fig. 2. The weekly catch of *B. dorsalis* by the various lures at Alafara location

Mean density of trapped *B.dorsalis* at both study sites

Bactrocera dorsalis were trapped at both study sites by the various lures evaluated. All the lures trapped *B. dorsalis* at both study sites (Fig.3). Pineapple juice bait, orange juice bait and Methyl eugenol trapped higher densities of *B. dorsalis* at FRIN with mean values 4.4,2.49 and 26.19 respectively than in Alafra area. Methyl eugenol significantly ($p<0.05$) trapped higher densities of *B. doralis* at FRIN and Alafara with 77.62% and 73.6% population respectively of all the trapped flies during the study. Pineapple juice bait trapped higher population of flies at Alafara than FRIN with 13. 04 % and 19. 65% respectively for the total densities of flies trapped. Orange juice recorded 7.38% and 4.35 % from FRIN and Alafara respectively. Banana bait and control trapped very low population of flies at both location (1% and 4% for FRIN and Alafara respectively). Ninety percent (90 %) of all the *B. dorsalis* trapped during the study were from FRIN site (Fig 4)

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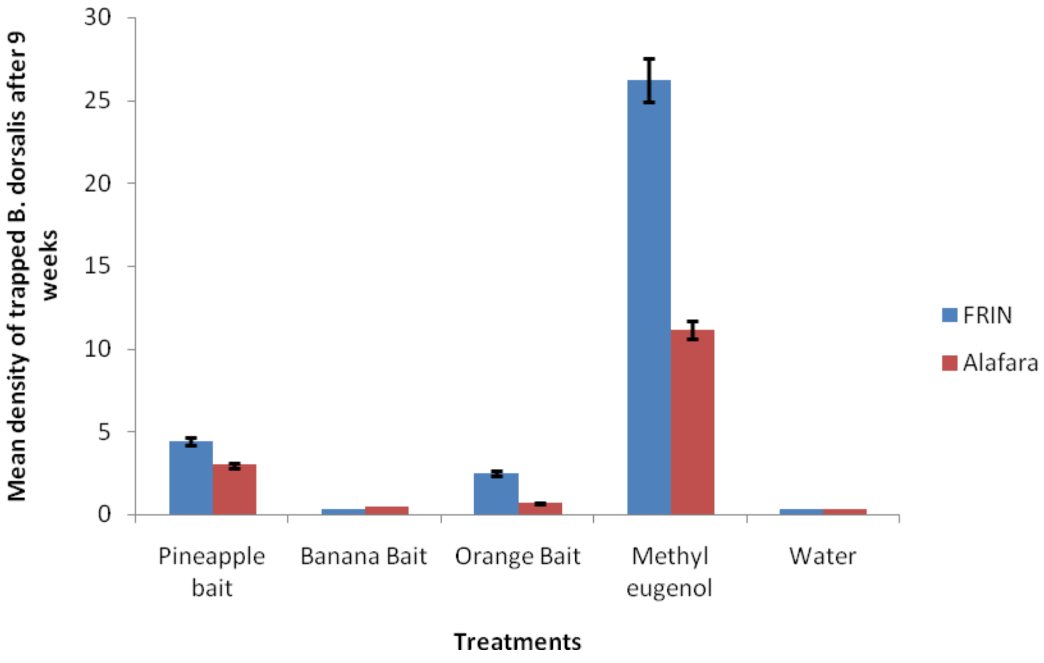

Fig 3. Mean density of trapped *B.dorsalis* at both sites after nine weeks

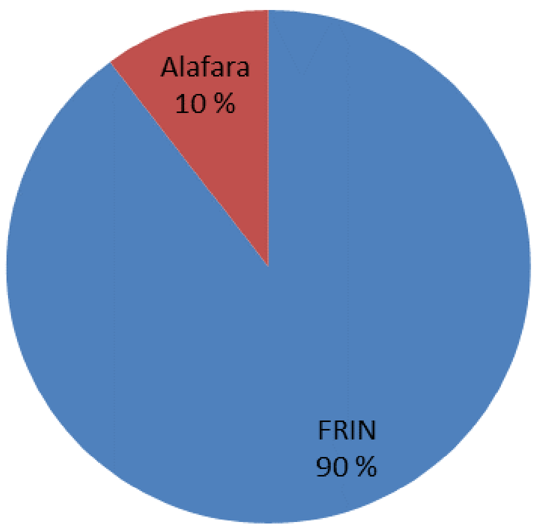

Fig. 4. The percentage density of *B. dorsalis* trapped from both sites.

Percentage density of male and female *B. dorsalis* trapped at the two study sites

Male and female *B. dorsalis* were trapped on *C. albidum* at both sites in different ratio by the different lures used (Fig. 5). All the local food lures evaluated trapped both male and female flies while the methyl eugenol trapped only male flies (100%). The food based lures trapped more female flies than male flies. Pineapple and orange baits rapped 20% and 80 % of male and female flies respectively.. Banana bait trapped 33% male and 67% female while control trapped 50% for each male and female. The percentage density of male *B. dorsalis* trapped by methyl eugenol was significantly ($p<0.05$) higher than other treatments.

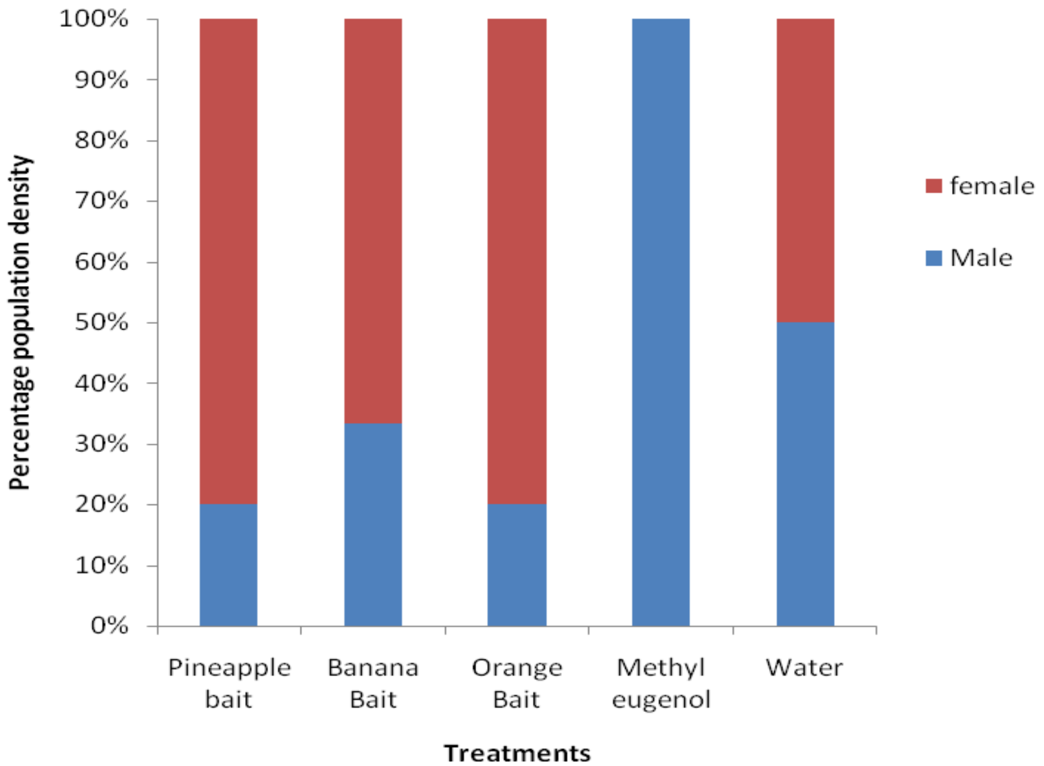

Fig.5 Percentage density of female and male *B. dorsalis* trapped at the three study sites

Discussion

All the food lures evaluated attracted and caught adult *B. dorsalis* with variations in their level of attractiveness by different lures. This corroborates the earlier report of Vargas *et al*. (2003) that the type of protein in food-based bait can influence the attractiveness of the bait to fruit flies. Similarly, Ugwu *et al.* (2018) recorded that different food attractants trapped adult *B. dorsalis* on bush mango at varied proportion. *Bactrocera dorsalis* were trapped on *Chrysophyllum albiduim* at both location during the study which implies that *C. albidium* is suitable host for *B. dorsalis* This confirms the earlier submission that *C. albidum* is one of the wild hosts of *B. dorsalis* (CABI, 2015, USDA 2016). All the food lures trapped both male and female adult *B. dorsalis* flies in diverse proportion though in small number at both study sites while methyl eugenol caught only male adult flies in large quantity This corroborates the earlier study by Ekesi *et al*. (2014) who reported that various food attractants evaluated attracted both sexes of *B. invadens* at different fraction on mango. The methyl eugenol (ME) has been reported to be very efficient para-pheromone that captures a large number of different *Bactrocera* species including; oriental fruit fly (*B. dorsalis),*peach fruit fly (*B. zonata),* carambola fruit fly (*B. carambolae*), philippine fruit fly (*B. philippinensis*), and banana fruit fly (*B. musae*) (IAEA, 2003). Similarly, Jiji *et al.* (2009) reported that Methyl eugenol is very effective in mass trapping of *Bactrocera* species in mango. A study by Ugwu *et al.* (2018) revealed that methyl eugenol was very effective in mass trapping *B. dorsalis* on mango in South west Nigeria. The densities of flies trapped were higher at the peak of fruit ripening at both locations. This corroborate the earlier reports that correlated the population of fruit flies with the ripening of crops (Liu and Yeh,1982; Shukla and Prasad 1985 ; Tariq *et al*.2002). The density of flies trapped at FRIN location was higher than those trapped at Alafara sites. This could be attributed to the vegetation densities at FRIN site. This supports the finding of Toukem *et al.*, (2020) that the vegetation productivity determined influences catches of *B. dorsalis Bactrocera dorsalis* forages on different plant hosts, thus they could be more concentrated where vegetation is very dense.

Conclusion

This study has contributed to the knowledge about the presence of *B. dorsalis* in the study area and has confirm that C. *albidum* is one of the major wild hosts of *B. dorsalis.* Food-based lures have shown potential in trapping of *B dorsalis.* The study is thus very important for the development of efficient local food base lures for sustainable management of fruit flies infestations in homestead trees, orchards and home gardens in Nigeria However, further studies is required in the areas of increased dosage, modification of food-based lures and application frequency to enhance efficiency and sustainability.

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