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Full Length Research Article

Evaluation of Fruit-Based attractants and Methyl Eugenol for Mass Trapping of Fruit Fly (*Bactrocera dorsalis*) in Mango Orchards of Kaduna State, Nigeria

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Abstract
Mango (*Mangifera indica* L.) production in Nigeria is severely constrained by fruit fly infestation, particularly *Bactrocera dorsalis*, which causes substantial yield and quality losses. This study evaluated the effectiveness of fruit-based attractants and methyl eugenol (ME) for mass trapping of mango fruit fly (*B. dorsalis*) in mango orchards of Kaduna State. The experiment was arranged in a Randomized Complete Block Design (RCBD) with six treatments and three replications. Bucket traps baited with the attractants were installed in mango orchards and trapped flies were collected weekly, identified and quantified. Data obtained from this study were subjected to the analysis of variance. Methyl eugenol consistently recorded the highest trap catches throughout the study period (5.0±1.9 to 12.2±0.9) in both locations, confirming its high efficiency as a lure for *B. dorsalis*. Among the fruit-based attractants, mango bait produced the highest (4.8±1.9 to 12.8±1.2) captures, followed by orange (6.0±1.4 to 6.5±0.7) and pineapple (5.0±0.3 to 5.8±1.1), while banana (4.0±1.5 to 4.3±0.9) and water (1.2±0.4 to 1.5±0.4) recorded the lowest catches. Although fruit-based attractants were less effective than ME, they attracted fruit flies and showed moderate trapping potential, ranging from 4.0±1.5 to 12.8±1.2 catches. Unlike the fruit attractants used, Trap catches across the weeks did not differ consistently between locations, indicating similar fruit fly population dynamics in the two areas. The study demonstrates that ME is the most effective attractant for mass trapping of *B. dorsalis*in mango orchards. However, locally available fruit-based attractants, particularly mango, orange and pineapple, can complement ME in integrated fruit fly management programs.

Keywords: Mango, fruit fly, attractants, *B. dorsalis*

Introduction

One of the most commercially significant tropical fruit crops grown in Nigeria and other sub-Saharan African countries is the mango (*Mangiferaindica* L.). However, fruit fly infestations, especially species from the genera *Bactrocera*, *Ceratitis*, and *Dacus*, significantly limit its productivity. The most damaging of them is the invasive, highly polyphagous species *Bactroceradorsalis* (Hendel) Diptera: Tephritidae, which results in early fruit drop, poormarket quality and large output losses (Math, 2017: Fan *et al.,* 2022).

According to Lux *et al*.(2003) and Fan *et al.*(2022), they described *B. dorsalis* as one of the most damaging insects to fruits and vegetables worldwide.*B. dorsalis* was identified as a new species in 2003, when it was first reported in Kenya (Drew *et al.,* 2005: Kakar*et al.,* 2014). It quickly expanded throughout Africa after being discovered in Kenya; by 2005, it has been found in Senegal, Ghana, Togo, Benin, Nigeria, Cameroun, Sudan, Uganda, and Tanzania (Drew *et al*., 2005). *B. dorsalis* has extended as far North as Southern Mauritania, Southern Mali, and Southern Niger, and is widespread in around 40 African countries, including the island of Madagascar, Cape Verde, Comoros, and Mayotte (Meyer *et al*., 2012; EPPO, 2015). Mango production is severely constrained by fruit fly infestations which cause significant yield losses through egg laying in the fruits, larval feeding, premature fruit drop and post- harvest deterioration(Fan *et al.,* 2022). These damages reduce both fruit quality and market value, thereby affecting farmers'income and limiting profitability and export potential of mango production (Maula*et al.,* 2022)

Depending on the cultivars, location, and season, *B. dorsalis* could directly harm 30 to 80% of the mangoes (Ekesi*et al*., 2006). The previously common native fruit flies, *Ceratitis* spp., appear to have been displaced by *B. dorsalis* (Maula*et al.,* 2022). In Nigeria, fruit fly infestation can result in the loss of over 70% of the fruit set (Ugwu*et al*., 2018).Seventy-two (72) plant species from 28 families make up the host range of *B.dorsalis* in Africa (Umeh*et al.,* 2021). According to Kakar*et al*. (2014), *B. dorsalis*is highly polyphagous in west and central Africa, infesting both wild and cultivated fruit of approximately 46 species from 23 families. The preferred hosts are guava, mango, and citrus, while the main wild hosts with high infestation incidence are *Terminaliacatappa* (Tropical almond) and *Irvingiagabonensis* (Africa bush mango). The species' strong polyphagy makes it easier for them to target a variety of fruits (Goergen*et al*., 2011).Since the introduction of the African invasion fly, Nigeria's ability to produce healthy and saleable bush mango fruits has been severely limited. Fruit fly infestation causes farmers in Nigeria to lose almost 50% of their harvest each year (Maula*et al.,* 2022). When female flies deposit their eggs beneath the fruit's skin, the larvae feed inside the fruit, causing deterioration and significant crop losses (Ugwu*et al.,* 2018).

Chemical management has historically been used to manage mango fruit flies, but growing worries about pesticide residues, environmental contamination, and the emergence of resistance have highlighted the need for safer and more sustainable alternatives (Bajaj and Singh, 2018: Maula*et al.,* 2022). One of the eco-friendly methods used in integrated fruit fly management is mass trapping. To reduce fruit fly populations before fruit maturation, attractants are used in traps. While food-based attractants usually attract both sexes and several fruit fly species, methyl eugenol (ME) is very successful at attracting male *B. dorsalis* (Vargas *et al*., 2015).There is little data on the comparative performance of locally accessible fruit-based baits in Nigerian fields, and the efficacy of few that were reported vary between agro-ecological zones. Therefore, as part of integrated pest management (IPM) methods for mango production in Nigeria, this study evaluated the effectiveness of fruit-based attractants and methyl eugenol (ME) for mass trapping of mango fruit fly (*B. dorsalis*) in mango orchards of Kaduna State.

Materials and Methods

Study Area

During the 2025 mango fruiting season, the experiments were carried out at the Department of Agronomy Orchard, Institute for Agricultural Research (IAR) Ahmadu Bello University, SabonGari Local Government (110 11" N, 070 38" E, and 686 m above sea level) and Fatika village, Giwa Local Government, Kaduna State in the Northern Guinea Savanna Zone of Nigeria. Mango production was well-known in the selected areas (Figure 1).

Preparation of Fruit Bait

Mango (*Mangiferaindica*(L.), Orange (*Citrus senensis*(L.), Pineapple (*Ananascomosus*(L), andBanana (*Musa paradisiaca*(L.) slurry baits, the standard (methyl eugenol (ME), and control (water) were among the six (6) attractants that were assessed. These were made by peeling 500g of each fruit sampleand an electric blender (Silver Crest Industrial Blender 8500w model) was used to crush them into a homogeneous slurry paste. To create a homogeneous solution, this juice was extracted in one liter of water and sieved using muslin cloths. Before being used, the samples were kept in a refrigerator at 5°C.

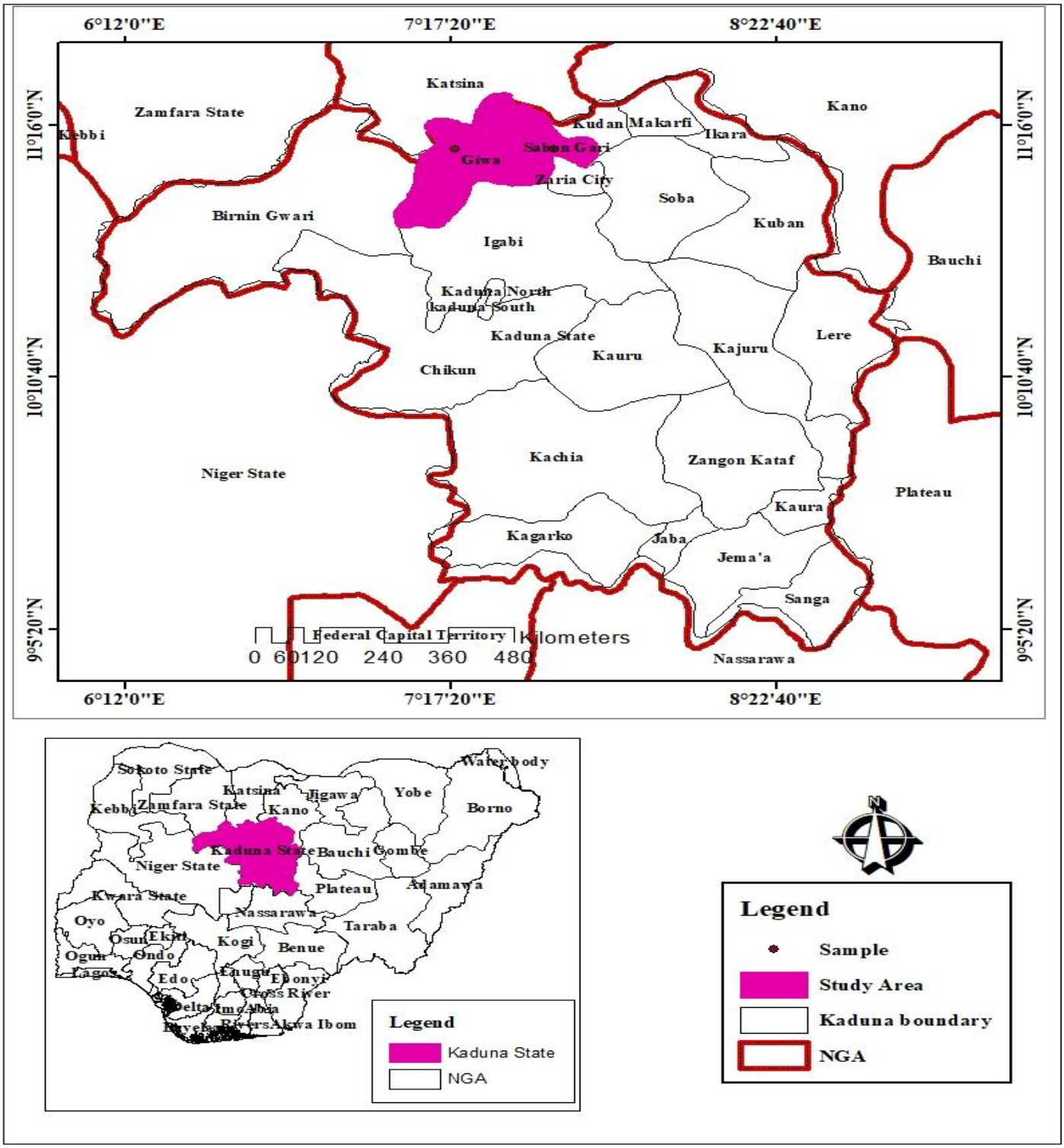


Figure 1:Map showing study area for the population of *B. dorsalise* in Giwa and SabonGari Local Government Areas, Kaduna State

Source: GIS and remote sensing software Arc map 10.1. Department of Geography ABU, Zaria

Construction of the Insect Trap

The trap used for this studyis a bucket type (BT) made of a plastic container measuring approximately 20 cm in height and 16 cm in diameter with a capacity of about 1 litre with four (4) equally spaced holes of approximately 2-3 cm diameter in the upper third portion of the bucket to allow the entry of *B. dorsalis*. The lid of the trapused as standardhas a hook that was attached to a Methyl Eugenol (ME) dispenser, such as an invader lure (Maula*et al.,* 2022). To kill the trapped flies, 5 millilitres of cypermethrin were added to each attractant. To prevent the lure from interfering, six (6) mango trees were randomly selected from each location at a distance of roughly 20 meters. Within the canopy of each mango tree, the traps were suspended at a height of approximately 10 meters.Using a 10 ml injection syringe, ten (10 ml) of prepared fruit baits were gently deposited onto 0.5 g of absorbent cotton wool and set at the bottom of the trap.

Experimental Design and Sampling

Experimental Design and Sampling

The study used a Randomized Complete Block Design (RCBD) with three replications and six treatments. Each treatment was represented by one trap in each copy, for a total of eighteen traps. ME dispensers were changed every two weeks, whereas the fruit-based attractants were changed every seven days. After being extracted and preserved in 75% ethanol, the fruit flies were transported to the Insect Museum, Department of Crop Protection, ABU Zaria, for identification. Standard morphological keys as described by Ekesi and Billah (2007) and White and Elson-Harris (1992) were used to identify fruit flies to the species level. The quantity of flies in each species and each trap was noted.

Data Analysis

Data collected on the mean population of *B. dorsalis*and meteorological parameters were transformed using the square root transformation $\sqrt{(X+0.5)}$, and data on weekly trap catches were subjected to one-way Analysis of Variance (ANOVA) using SAS Software, 2003. Treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% probability level.

RESULTS

Effect of fruit attractants on the mean population of *B. dorsalis* trapped in 2025 at Giwa and SabonGari Local Government, Kaduna State

Table 1 displays the findings of the impact of several food attractants on the *B. dorsalis* population. There was a significant difference ($p<0.05$) between the fruit baits tested at week two after the trap was set up. Compared to orange, pineapple, and banana fruit baits, methyl eugenol (12.2±0.9) and mango fruit bait (12.8±1.2) had more *B. dorsalis*. Water was found to have the fewest (1.5±0.4) *B. dorsalis*cases. When compared to mango fruit bait, methyl eugenol substantially ($p<0.05$) recorded more (14.0±0.7) *B. dorsalis* at 4 weeks after the trap was installed. Water (1.3±0.4) and bananas (3.3±0.6) were found to contain the fewest *B. dorsalis*.

When compared to orange and pineapple fruit baits, methyl eugenol(13.5±0.7, 9.2±1.0) and mango (11.8±0.7, 7.8±1.0) food baits had considerably ($p<0.05$) larger numbers of *B. dorsalis* population at 6 and 8 weeks after placing the trap, while banana (3.0±0.5, 3.3±0.7) and water fruit (1.5±0.4) baits had

the lowest numbers. When compared to mango fruit bait, methyl eugenol had a considerably higher population (9.5±0.7) of *B. dorsalis* at 10 weeks after trap placement ($p<0.05$), but there were no statistically significant differences between orange, pineapple, banana, and water fruit bait. All fruit baits had significantly more *B. dorsalis* at12 weeks after the trap was set, with the exception of the water and banana, which statistically had the lowest population of fruit flies.

Table 1. Effect of fruit attractants on the mean population of *B. dorsalis* trapped in 2025 at Giwa and SabonGari Local Governments, Kaduna State

Treatment	Mean population of fruit fly at various weeks after trap setting					
	2	**4**	**6**	**8**	**10**	**12**
Fruit Bait (FB)						
Methyl	12.2±0.9^{a}	14.0±0.7^{a}	13.5±0.7^{a}	9.2±1.0^{a}	9.5±0.7^{a}	5.0±1.9^{a}
Mango	12.8±1.2^{a}	11.7±1.0^{b}	11.8±0.7^{a}	7.8±1.0^{a}	7.2±0.4^{b}	4.8±1.9^{a}
Orange	6.5±0.7^{b}	7.5±0.9^{c}	6.7±0.6^{b}	5.2±1.1^{b}	3.2±0.4^{cd}	6.0±1.4^{a}
Pineapple	5.8±1.1^{b}	5.8±0.7^{c}	5.5±0.9^{b}	3.8±1.1^{bc}	3.0±1.8^{cd}	5.0±0.3^{a}
Banana	4.3±0.9^{b}	3.3±0.6^{d}	3.0±0.5^{c}	3.3±0.7^{c}	3.8±1.1^{c}	4.0±1.5^{ab}
Water	1.5±0.4^{c}	1.3±0.4^{d}	1.5±0.4^{c}	1.5±0.4^{d}	1.3±0.4^{d}	1.2±0.4^{b}
SE	0.72	0.78	0.71	0.59	0.68	1.05
Location (L)						
Giwa	8.7±1.9^{a}	7.3±1.9^{a}	7.2±2.0^{a}	4.1±1.1^{b}	4.8±1.5^{a}	2.3±0.9^{b}
SabonGari	5.7±1.3^{b}	7.2±1.8^{a}	6.7±1.5^{a}	6.2±1.6^{a}	4.5±1.5^{a}	6.4±1.5^{a}
SE	0.41	0.45	0.41	0.34	0.39	0.61
FB*L	**	*	NS	**	NS	NS

Note: SE=Standard Error, and FB*L =Fruit Bait*Location
Mean values followed by different superscript letters within the same column, among fruit baits and between locations are significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level.

Effect of fruitattractants on the mean population of *B. dorsalis*trapped in GiwaLocal Government, Kaduna State

Figure 2 showed the *B dorsalis* population density found in Giwa LGA. Among the attractants employed, the mean population of *B. dorsalis* captured in Giwa LGA differed considerably. Over the course of the trapping period, methyl eugenol had the highest number (15±0.3) of fruit flies and was substantially different ($p<0.05$) from all other treatments. Water caught the fewest (1.7±0.4) flies, orange and pineapple fruit baits produced modest captures, and mango significantly ($p<0.05$) produced more (16.7±0.5) *B. dorsalis* at two weeks after trap placement. The population of fruit flies captured using orange juice bait and pineapple bait did not differ significantly ($p>0.05$). Over the course of the experiment, the control group trapped the fewest 0.9±0.7) *B. dorsalis*.

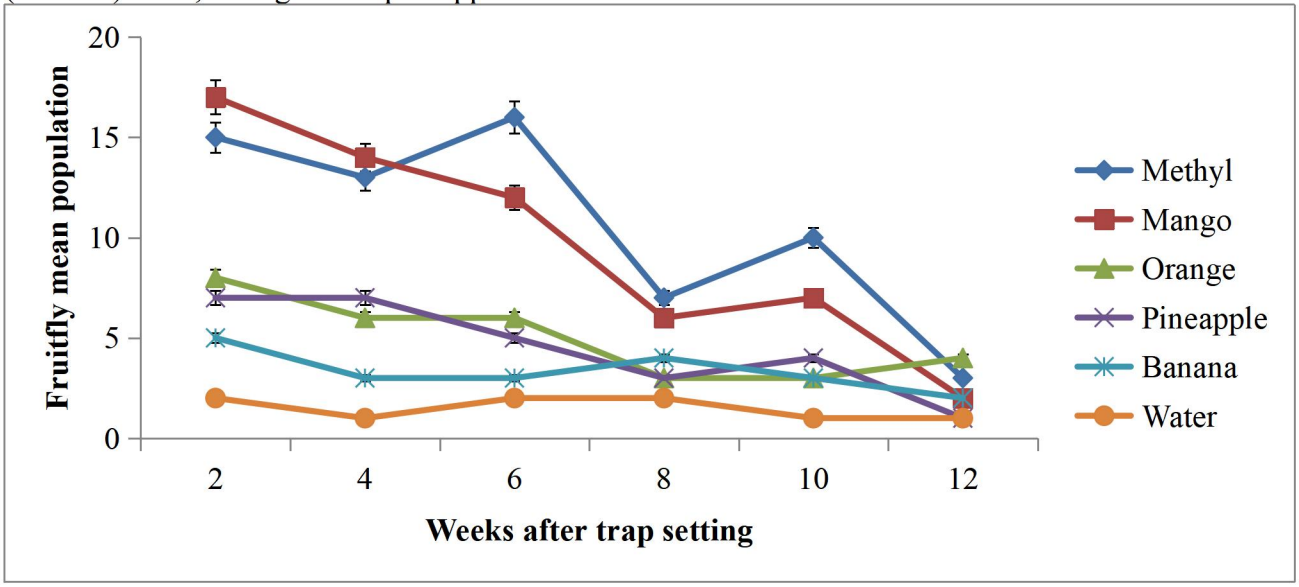


Figure 2: Effect of different fruit attractants on the mean population of *B. dorsalis* trapped in 2025 at Giwa Local Government, Kaduna State

Effect of fruit attractants on the mean population of *B. dorsalis* trapped in Sabon Gari Local Government, Kaduna State

Food attractants in Samaru, SabonGari LGA varied significantly over the course of the study period, according to the influence of fruit bait on the mean population of *B. dorsalis*. Over the course of the trial, methyl eugenol had the highest mean population of *B. dorsalis* (9.3±0.4), followed by pineapple, orange, and mango. Fruit flies were consistently caught in the least amount (1.3±0.5) in water bait (Figure 3). The population of flies captured on the orange juice and pineapple juice baited traps did not differ significantly ($p>0.05$).

Effect of Different Food Attractants on the Mean Population of *Bactrocera*

***dorsalis* in Giwa and Sabon Gari Local Governments Kaduna State, Nigeria**

Figure 4 depicts the population of *B. dorsalis* trapped by the various attractants in Giwa and Sabon Gari LGA. Methyl eugenol had the maximum catch (11±0.8, 11±0.8) of *B. dorsalis* flies at both local governments during the study period, followed by mango food attractant (10±0.8, 9±0.6. Water, on the other hand, captured a few fruit flies at both local administrations over the course of the trial (2±0, 1±0.1).

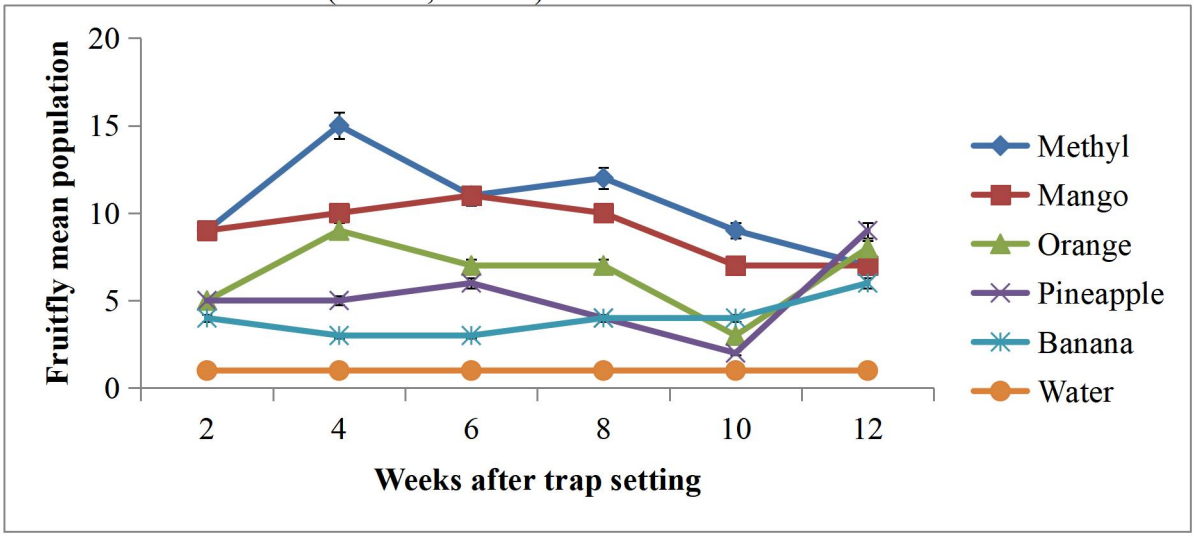


Figure 3: Effect of food bait on mean population of *B. dorsalis* trapped in 2025 at SabonGari Local Government, Kaduna State

Methyl eugenol remained the most effective attractant, recording the highest trap catches throughout the study period. Based on the combined result from the LGAs, the orange-based attractant ranked second, while pineapple attractant ranked third. The number of flies captured with pineapple did not significantly change between Giwa (5±1.0) and SabonGari (5±1.0), suggesting a similar population response in both areas. In both LGAs, water attracted very few insects.

There were no significant differences observed when Methyl eugenol, pineapple and mango attractant were used to attract the insect during May to June, when temperature, rainfall and relative humidity were 25.3– 34.3°C, 99.2 mm and 63 - 49 % (Table 2), respectively. When fruit flies were fed bananas and water food attractant, the fewest *B. dorsalis* (4±0.5; 1±0.1) respectively were found.

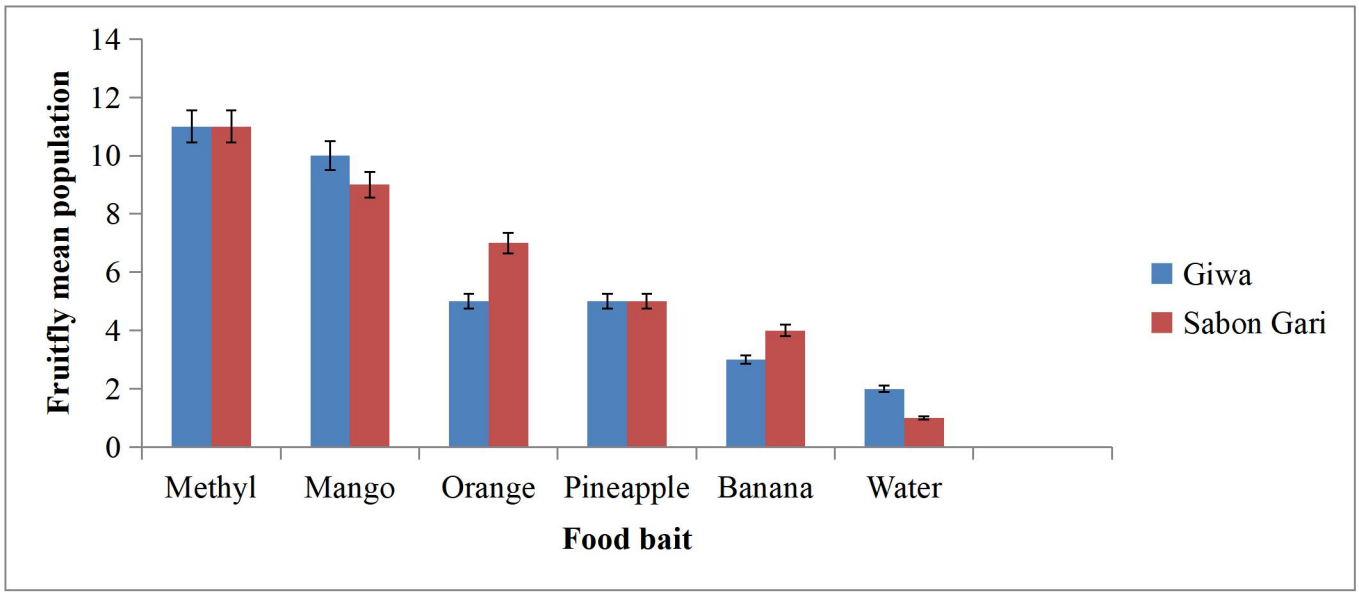


Figure 4: Effect of fruit bait on mean population of *B. dorsalis* trapped in Giwa and SabonGari Local Government, Kaduna State

Table 2: Meteorological Data at Two Local Government Areas of Kaduna State

Months	Temperature (°C)		Rainfall (mm)	Relative humidity (%)	Wind Speed km/hr
	Max.	Min.			
January	29.9	15.9	0	15.1	1.24
February	32.5	20.2	0	15.1	0.65
March	37.6	24.1	26.9	15.8	0.58
April	37	26.0	73.2	33.3	0.47
May	34.3	25.3	99.2	49.7	0.33
June	30.9	23.5	149.5	63.4	0.45

Source: IAR Meteorological unit, ABU Zaria.

Discussion

All of the attractants examined attracted adult *B. dorsalis*, according to the study; however, the degree of attraction differed depending on the fruit baits used. The results showed that in both Giwa and Sabon Gari LGAs, methyl eugenol was the best attractant for *B. dorsalis*. This is in line with previous studies by Ugwu *et al.* (2018) who reported that *Bactrocera* species, especially males, are strongly attracted to methyl eugenol because of its inherent pheromone-

like qualities. This supported a previous study by Vargas *et al*. (2003), which found that the kind of protein in food-based bait can affect how appealing the baits are to fruit flies. Fruit-based attractants like orange and pineapple yielded moderate captures, indicating that the volatiles released by these fruits resemble the natural host cues that fruit flies employ for oviposition and foraging. The constant performance throughout both LGAs suggests that they can function as substitute lures in circumstances where methyl eugenol is unavailable, costly, or restricted, even if their efficacy was significantly lower than that of methyl eugenol. When it came to attracting *B. dorsalis*, methyl eugenol, a parapheromone, outperformed other food-based attractants; orange and banana food baits were only moderately successful and pineapple baits were the least successful.

In the majority of West African mango orchards, *B. dorsalis* is currently the most prevalent and commercially significant fruit fly as demonstrated by the study's findings (Lux *et al.*, 2003; Ekesi and Billah, 2007). According to Ekesi and Billah (2007),Navarro-Llopis*et al.* (2015), food lures are excellent for broader monitoring or when targeting animals that are not receptive to ME because they usually attract both sexes and various species. Giwa and SabonGari appear to have similar ecological circumstances, host availability, climatic factors and fruit fly population pressures, as evidenced by the lack of a substantial difference in pineapple captures. Similar mango production practices throughout Kaduna State are reflected in this homogeneity, which may sustain stable fruit fly populations.

Mango is a suitable host for *B. invadens*, as evidenced by the fact that *B. invadens* was captured on homestead mango trees in every area throughout the investigation. This supports the earlier finding (Ugwu *et al*., 2018) that one of the main wild hosts of *B. invadens* is the African bush mango. Mango is unquestionably the ideal host plant, but it has been reported that *B. invadens* has been produced from over 30 host plant species (Goergen*et al*., 2011: Khn*et al.,* 2015). Few flies were drawn to water, which was used as a control. This indicates that any catches may have been the consequence of accidental contact and that the presence of water alone has little to no attractive value for *B. invadens*. The findings show that *B. dorsalis* populations in both LGAs react poorly to non-attractant controls, moderately to fruit-based baits and powerfully to methyl eugenol. The statistical significance across treatments showed that these variations were caused by each treatment’s varying degrees of appeal rather than by chance.

Conclusion

In both Giwa and Sabon Gari LGAs, the study showed that methyl eugenol was the most successful attractant for *B. dorsalis*, with larger (11.63%) captures than all other food baits. Mango, orange and pineapple baits also showed a reasonable level of appeal, with orange often outperforming pineapple. Integrated pest management (IPM) techniques that incorporate methyl eugenol and mango food attractants with average temperature and relative humiditywould enhance fruit fly suppression

and lower financial losses in mango production.

Conflict of Interest

The authors declared no conflict of interest in this work.

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Author's contribution

The study was conceived and designed by Musa, N. who also carried out the data collection, performed data analysis and prepared initial draft of the manuscript. Other authors provided overall supervision throughout the research process, critically reviewed and revised the manuscript for intellectual content and provided the final version for publication before submission.

References

Bajaj, K. and Singh, S. (2018). Response of fruit flies, *Bactrocera* spp. (Diptera: Tephritidae) todifferent shapes of methyl eugenol-based traps in guava orchards of Punjab. *Journal of Entomology and Zoology Studies*. 6:2435-2438.

Drew, R.A.I., Tsurutu, K. and White, I. M. (2005). A new species of pest fruit fly (Diptera: Tephritidae: Dacinae) from Sri Lanka and Africa. *African Entomology,* 13: 149–154.

Ekesi, S. and Billah, M. K. (2007). A Field Guide to the Management of Economically Important Tephritid Fruit Flies in Africa. ICIPE Science Press, Nairobi, Kenya. 60 pp.

Ekesi, S., Nderitu, P. W. and Rwomushana, I. (2006). Field infestation, life history and demographic parameters of *Bactrocera invadens* in Africa. *Bulletin of Entomological Research*, 96: 379–386.

Ekesi, S., Mohammed, S. and Tanga, C.M. (2014). Comparison of food-based attractants for *Bactrocerainvadens* (Diptera:Tephritidae) and evaluation of Mazoferm, Spinosad bait spray for field suppression in Mango. *Journal of Economic Entomology*, 107(1):299- 309

EPPO (2024). PQR-EPPO Database on quarantine pests. Available online at http://www.eppo.int (accessed February 2024).

Fan, Y., Zhang, C., Qin, Y., Yin, X., Dong, X., Desneux, N., and Zhou, H. (2022). Monitoring themethyleugenol response and non-responsiveness mechanisms in *Bactroceradorsalis* in China. *Insects*, 13(11): 1004. https://doi.org/10.3390/insects13111004

Goergen, G., Vayssieres, J. F., Gnanvossou, D and Tindo, M. (2011). *Bactroceradorsalis* (Diptera:Tephritidae), a new invasive fruit fly pest for the Afrotropical region: Host plant range and distribution in west and Central Africa. *Entomology Society of America.* 40(4): 844-854.2011. DOI:10.163/en11017

Kakar, M. Q., Ullah, F., Saljoqi, A. U. R., Ahmad, S., Ali, I. (2014). Determination of fruit flies

(Diptera:Tephritidae) infestation in guava, peach and bitter gourd orchards in Khyber Pakhtunkhwa. *Sarhad Journal of Agriculture*. 30:241-246

Khan, S., Hussain, S., Maula, F., Khan, M. A., and Shinwari, I. (2015). Efficacy of different lures in male annihilation technique of peach fruit fly, *Bactrocerazonata* (Diptera: Tephritidae). *Journal of Entomology and Zoology Study*. 3(4):164-168.

Lux, S. A., Copeland, R. S., White, I. M., Manrakhan, A. and Billah, M. K. (2003). A new invasive fruit fly species from the *Bactroceradorsalis* complex in Africa: causes and implications. *Insect Science and its Application*, 23(4): 327–334.

Math, M. (2017). Development and standardisation of fruit fly traps against *Bactroceradorsalis* Hendel in Custard apple. *Journal of Entomology and Zoology Studies*.5(4):462-465.

Maula, F., Khan, A. A., Ali, A., Younus, I. M.,Israr, M.,Rauf, M. A. and Khan, I. A.(2022). Evaluation of different traps and lures combinations for monitoring and eco-friendly management of fruit fly (*Bactrocera* Spp) in peach orchards. *Journal of Entomology and Zoology Studies*; 10(1): 105-110

Navarro-Llopis, V., Primo, J., Vacas, S. (2015). Bait station devices can improve mass trapping performance for the control of the Mediterranean fruit fly. Pest management science. 71(7):923-927.

Susanto, A., Sudarjat, S., Yulia, E., Permana, A. D., Gunawan, A., and Yudistira, D. H. (2020). Effectiveness of modified traps for protection against fruit flies on Mango. *Journal Biodiversity.* 5(1):99-106.

Ugwu, J.A., Omoloye, A. A., and Ogunfumilayo, A. O. (2018). Effect of two food base attractants and methyl eugenol for mass trapping of African invader fly, *Bactrocerainvadens* (Diptera: Tephritidae) on bush mango in Ibadan Southwest. *Nigeria. Nigerian Journal of Entomology*, 34: 51-59

Vargas, R. I., Piñero, J. C. and Leblanc, L. (2015). An overview of pest fruit flies and the use of Methyl eugenol for their management. *Proceedings of the Hawaiian Entomological Society*, 47: 1–30.