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INFESTATION RATE AND POPULATION DYNAMICS OF MELON FLY, *Zeugodacus curcubitae* ON CUCUMBER IN IBADAN, NIGERIA

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Abstract

In 2022, two field trials investigated the Melon Fly (MF) infestation in cucumber varieties, Marketer, Poinsett-76 and Marketmore. Fruit fly captures from Torula® yeast lures in locally made traps and fruit damage/and yield were used to assess infestation rates from 7 to 10 weeks after planting (WAP). Other insects were collected using sweep nets, visual searching and pitfall traps. Correlation analyses determined insect demographics' and plant characteristics' relationship with weather. Melon fruitfly populations ranged from 0 to 5 flies/trap/week in both trials, and cucumber damage varied from 25.2% to 44.9%. Infestation peaked at 9 WAP. Marketmore had the highest number of pupae (176.5±38.14) and emerging adult melon fruit flies (147.0±19.23) from infested fruits. Infestation rate was positively correlated with fruit damage in the first (r=0.77) and second trial (r= 0.74), respectively. Besides *Zeugodacus cucurbitae* (65.0%), other significant cucumber pests were *Aulacophora africana* (6.34%), *Aulacophora fovecollis* (3.43%), and *Diaphania hyalinata* (8.23%). Fruit yields in both trials did not significantly differ, but Poinsett-76 was selected as the preferred cucumber variety due to lower melon fruit fly presence, reduced infestation, and higher yield potential. To minimize damage caused by fruit flies, controlling their populations on cucumbers before 9 WAP is essential. Further research could be conducted to determine the most effective control methods for managing the Melon Fruit Fly (MFF) infestation on cucumber crops.

Keywords: Cucumber varieties, *Diaphania hyalinata,* Infestation rate, Nigeria.

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INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a climbing plant belonging to the Cucurbitaceae family and is one of the major vegetable crops grown in tropical and subtropical regions (FAOSTAT, 2020). They are native to India but are widely cultivated in every part of Nigerian agroecology, with a concentration in the northern part of the country. Nigeria's savannah and rainforest regions are also used for cucumber growing, with regional variations in production pattern and volume (Okafor and Yaduma, 2021). Cucumber is a vegetable crop that is high in polyphenolics and cucurbitacin, which are regarded to be anti-carcinogenic, anti-inflammatory, antimicrobial, antioxidant, diuretic and anti-hyperglycemic but low in calories as a food (Uthpala *et al*., 2020). Due to its nutritional and economic worth, cucumber is in high demand and is considered to be one of the top ten major crops globally (FAOSTAT, 2021).

Major hindrances to cucumber production in Nigeria include lack of sowing seeds, storage issues, financial limitations, climatic factors, perishable nature of the fruits, farmers' inexperience and literacy level, high cost of labour, infestation and damage by insects and other disease-causing organisms (Umeh and Orjiako, 2018). Insect pests are the main obstacles to sustainable cucumber cultivation in Nigeria. The first major challenges the cucumber producers in Rivers State pass through, according to Elum *et al*. (2016), are insect and disease attack. They directly harm the fruit by penetrating the epidermis to lay their eggs, which introduces bacteria from their digestive flora into the fruit. These biological agents also cause losses (though not directly) by leaving significant pollutants like body parts or exoskeletons, insect eggs, and frass on the produce, along with the direct damage they cause to system of the plant, fruit and seeds (Garcia-Lara and Saldivar, 2016).

Key insect pests that attack the crop comprise melon fruit fly (*Zeugodacus curcubitae* Couquillett), thrips (*Thrips tabaci* Lindeman), flea beetle (*Podagrica uniforma* Jac.), aphids (*Aphis gossypii* Glover), squash vine borers (*Melliatia curcubitae* Harris), whiteflies (*Bemisia tabaci* Gennadius), variegated grasshopper (*Zonocerus variegatus* Linnaeus), crucifer flea beetle (*Phyllotreta cruciferae* Spinola), squash bugs (*Anasa tristis* De-Geer), melon ladybird beetle (*Epilachna chrysomelina* Fabricius) and monolepta leaf beetles (*Monolepta* spp.) (Alao *et al*., 2016; Emeasor and Ndumele, 2019; Pitan and Filani, 2019).

The melon fly, *Zeugodacus cucurbitae* Coquillett (Diptera: Tephritidae), is a major agricultural pest of cucurbit crops. It is regarded as an aggressive species and is widely distributed across tropical, subtropical, and temperate regions worldwide (Umeh *et al.*, 2008; Asimakis *et al*., 2019; Meenakshi and Rashmi, 2021). It is a dominant species that poses a significant risk to the production of fresh fruits and vegetables, particularly in sub-Saharan region (Zida *et al*., 2025). Over 81 different fruits and vegetables such as cucumber, watermelon, squashes, pumpkin, bitter gourd, and other fleshy vegetables are infested by melon fruit flies (Dhillion *et al*., 2005). It has a preference for infesting young, green, soft skinned fruits; and thus lowers the output and quality of the fruits. The female directly harms immature fruits by ovipositing and placing eggs inside of them. When the eggs hatch, larvae initiate feeding on the fruit's internal tissues, completely destroying mature fruits (*Sarkar et al*., 2018). Because they can rapidly spread in favourable environmental conditions and are often transported as pupae, larvae or even eggs concealed within vegetables, fruits, and packaged foods, this species directly damages vegetables, which can result in up to 90- 100% yield loss (Louzeiro *et al*., 2021).

With cucumber being considered as a significant vegetable crop on a global scale, its demand is increasing daily in Africa as more people become aware of the many benefits the crop offers. (Umeh and Ojiako, 2018). Fruit fly damage has diminished farmer's determined efforts to increase fruit yield (Umeh and Onukwu, 2016). Mwatawala *et al*. (2010) reported melon fruit fly to be the primary pest of three economic hosts, cucumber and melons while according to Shinde *et al*. (2018), infestation on cucumbers by fruit fly can vary widely between 35.71% and 100%. Damages inflicted by the fruit flies has not only caused reduction in farm produce, but as also led to countries that import fruits being forced to impose quarantine regulations and eradication measures for crop products originating from regions where specific species of fruit flies are prevalent. They also require vegetables and fruits to undergo treatment in quarantine facilities before they are allowed for importation. Due to the expense of these quarantine, restriction and eradication measures, export markets and the associated revenue derivation have dwindled. (Khan *et al*., 2020; Vargas *et al*., 2008).

Apart from being global pests of various agricultural products, fruit flies are also referred to be a quarantine pest since cucurbit vegetables and fruits are significant food sources and income for exporting countries (Saeed *et al*., 2022); there is need to research on the appropriate control measures to limit the activities of melon fly on the crops. One of the basic and important prerequisites for establishing an integrated pest management (IPM) program for effective, long term melon fly control is monitoring the pest population (Usman *et al*., 2021); while studying the infestation rate gives an insight or provides information on the appropriate time to keep the pest population at tolerable levels. This crucial information is scare as they aren't many recent studies on infestation rates and population dynamics of melon fly on varieties of cucumber in Nigeria. The main objective of this study was therefore to investigate infestation rate and population dynamics of the melon fly on three most cultivated varieties of cucumber in Nigeria so as to be able to formulate appropriate management strategies to reduce the presence and activities of melon flies and to determine the relative abundance of other species of insect that were encountered and identified on the cucumber field.

MATERIALS AND METHODS

The study was carried out at the National Horticultural Research Institute (NIHORT), situated in the rainforest agro-ecological zone of southwestern Nigeria, at an elevation of 144 meters above sea level (latitude 7.4°N, longitude 3.9°E). The first field trial was done from the start of the rainy season (March – May 2022) while the second trial took place (June – August 2022). Ibadan has a dual rainfall pattern which commences in March, peaks in June with break for few weeks in August and September.

Field plot layout and propagation

Twelve plots of 2 meters x 3 meters with 2 meters spacing between the plots were mapped out in a randomized complete block design (RCBD). Before planting, all plots were enriched with equal amounts of organic fertilizer. Cucumber seeds were obtained from the seed unit of NIHORT. The three varieties of cucumber used were pointsett-76, market more and marketer. For the first field trial, cucumber seeds were planted on 7 March 2022, and for the second trial, they were planted on 20 June 2022. Three seeds were sown per hole 2-3 cm deep with a 0.5 m by 0.5 m spacing. The germinated seeds were thinned down to one after two weeks, each plot was comprised of five rows of plants and a total of 35 stands out of which the centre two rows were earmarked for insect sampling. All standard agronomic practices such as weeding and watering was carried out during the experiment when needed. Staking of the cucumber plant was carried out 3-4 weeks after planting in order to minimize soil diseases.

Experimental set up

Locally made bucket fruit fly traps were installed on the field to assess population dynamics of melon fly. The traps were hung (1.0 m high above the ground) on stakes placed in the middle of each cucumber plot. Inside each trap, 5 g torula yeast pellet mixed with 100 ml of water was used as the bait (as it is effective in trapping all species of fruit flies). These traps were inspected and changed weekly; while fruit flies trapped per trap was identified, counted and recorded in NIHORT laboratory using identification keys (White, 2006).

The total number of melon fly counts per trap per week (FTW), were calculated to access the melon fruit fly population on each plot using the formula of Praveen *et al.* (2012)

$$\text{FTW} = \frac{Total\ number\ of\ trapped\ fruit\ fly}{Number\ of\ trapping\ weeks \times Number\ of\ traps}$$

Data Collection

Data were obtained from the tagged sample plants in each plot, starting from onset of fruiting until the end of harvest. Harvesting period ranged from April to May and July to August respectively during the first and second trials in 2022. The criteria used to identify damaged and infested fruits included fruits with oviposition holes (necrosis surrounding the puncture mark), distortion, and visible presence of larvae. Before being transported to the insect laboratory to be weighed and counted, all fruit samples were bagged and counted. Infestation rate of fruit flies was accessed by collecting and randomly incubating 5 mature fruit samples from each plot of the three cucumber varieties planted and then calculated with the formula:

$$\text{Infestation}(\%) = \frac{Number\ of\ fruits\ infested\ by\ fruit\ flies \times 100}{Total\ number\ of\ fruits\ collected}$$

Incubation of sample fruit

Samples of fruit were taken to the insectary lab, placed in plastic or synthetic containers (each having one fruit) atop a metal mesh, then set on sterile sand for incubation period. Pupae were collected after 10 days of incubation, counted, weighed and placed directly in a separate fruit fly cages using petri dishes for adult emergence. Adult flies were retrieved after 3 days, counted, sexed, and kept inside vials with 70% ethanol after emergence for subsequent identification in the laboratory. The data on weight of incubated fruits, total number of fruit fly pupae recovered from each fruit per plot and variety of cucumber were recorded, Similarly, fruit fly sex ratio, total fruit flies that emerged from each variety, the different fruit fly's species and presence or absence of parasitoids were also recorded.

Sampling of other insect pests

Sweep nets, hand, visual searching and pitfall traps were used to collect insect species that were found in the plots. This operation was carried out early in the morning from 7 am - 9 am when most of the insects are less active. Insect samples were transferred into 5ml plastic collecting vial containing 70% ethanol for preservation. Pitfall traps consisted of a hole dug and a plastic container sunk into the ground so that its rim is levelled or slightly below that of the surrounding ground. Two pitfall traps were placed per plot with 2 m spacing resulting to a total of 24 pitfall traps on the field.

Cucumber fruit yield

Fruit yield was calculated by weighing all the cucumber fruits harvested from the field with upper scale loader in kilograms (kg) using the formula according to Oke *et al*. (2020) to determine the yield of cucumber at different cropping seasons and the degree of losses caused by the fruit flies:

$$\text{Yield} = \frac{Plot\ yield\ (kg)}{Plot\ area(m2) \times 1000}$$

Data Analysis

Fruit fly data were analyzed using DSAASTAT (2012 Version) for ANOVA. Significant differences between means were determined at the 5% probability level using the Tukey HSD test. To compute Pearson's correlation co- efficient, IBM SPSS version 17 (2008 version) statistical software was used.

RESULTS

Weekly weather data recorded during the planting duration in NIHORT

The weekly weather data during the planting durations were both presented in Table 4.1. Mean temperature during the first field trial was 28.64°C, mean relative humidity was 86.55%, while the average rainfall was 6.41 mm. For the second field trial, mean temperature was 25.36°C, mean relative humidity was 90.34%, while the average rainfall is 9.68 mm.

Table 1: Weekly weather data recorded during the planting duration in NIHORT

Planting duration	Observation date	Week	Temperature (°C)	Relative humidity (%)	Rainfall(mm)
First-field (March-May)	07 Mar- 13 Mar	1	29.42	88.42	9.86
	14 Mar - 20 Mar	2	29.50	90.00	0.00
	21 Mar - 27 Mar	3	29.50	87.00	0.00
	27 Mar - 03 Apr	4	30.00	84.57	13.31
	04 Apr - 10 Apr	5	28.71	87.28	2.00
	11 Apr - 17 Apr	6	29.33	84.00	12.29
	18 Apr - 24 Apr	7	28.71	83.85	1.49
	25 Apr - 01 May	8	27.00	88.00	13.43
	2 May - 08 May	9	27.00	85.85	7.43
	9 May - 15 May	10	28.93	88.14	4.29
Second-field (June-August)	20 Jun - 26 Jun	1	26.36	91.00	17.99
	27 Jun - 03 Jul	2	26.43	90.85	9.79
	04 Jul - 10 Jul	3	26.64	90.28	6.29
	11 Jul - 17 Jul	4	26.86	89.71	4.89
	18 Jul - 24 Jul	5	27.86	87.42	18.63
	25 Jul - 31 Jul	6	27.29	92.57	12.57
	01 Aug - 07 Aug	7	25.43	91.71	0.00
	08 Aug - 14 Aug	8	25.21	90.71	1.56
	15 Aug - 21 Aug	9	25.21	88.85	0.00
	22 Aug - 28 Aug	10	25.29	91.71	18.69

Population dynamics of melon fly on three selected varieties of cucumber cultivated in two field trials

Figure 1 shows the dynamics of melon fly populations on three cultivated cucumber varieties. In the first field trial, marketer had the overall maximum mean number (4.5±0.64) and minimum mean number (0.3±0.25) of melon fly trapped per week at 7 WAP and 10 WAP, respectively. Maximum melon fly mean number per week for marketmore (1.8±0.47) was observed at 7 WAP and 8 WAP and its minimum (1.0±0.40) was observed at 10 WAP. Maximum melon fly per week for poinsett-76 (1.8±0.47) was observed at 8 WAP, 9 WAP and 10 WAP, and its minimum (0.5±0.28) was observed at 7 WAP.

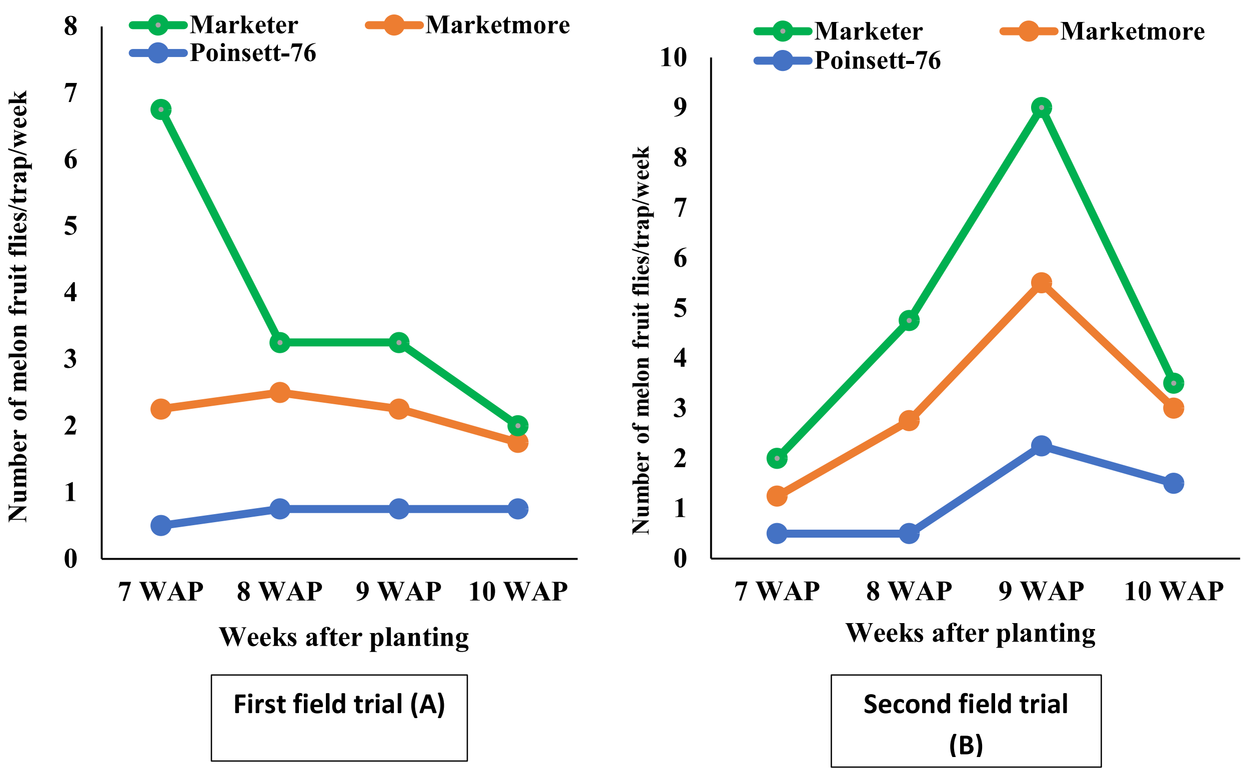


Figure 1: Weekly population dynamics of melon fruit fly across three cucumber varieties in the first field trial (A) from March-May, 2022 and Second field trial (B) from June-August, 2022.

During the second field trial, number of melon fruit flies trapped per week varied from 0.5±0.28 to 3.5±0.64. Marketer had the overall maximum (3.5±0.64) and minimum (0.5±0.28) melon fruit fly trapped per week at 9 WAP and 10 WAP, respectively. Poinsett-76 also had the overall minimum (0.5±0.28) population at 7 WAP and 8 WAP and had a maximum value (2.3±0.47) at 9 WAP. Maximum melon fruit fly per week for marketmore (3.3±0.75) was observed at 9 WAP and its minimum (0.8±0.25) was observed at 7 WAP.

Figure 2 shows the dynamics of melon fruit fly population during the two field trials. For the first field trial, highest population of melon fruit flies recorded was at the 7 WAP. There was subsequent decline after the 7 WAP, gradually reaching the lowest population by the 10 WAP. For the second field trial, population of melon fruit fly started increasing steadily from 7 WAP and reached a peak population at 9 WAP where there was a drastic change in the population at 10th week after planting.

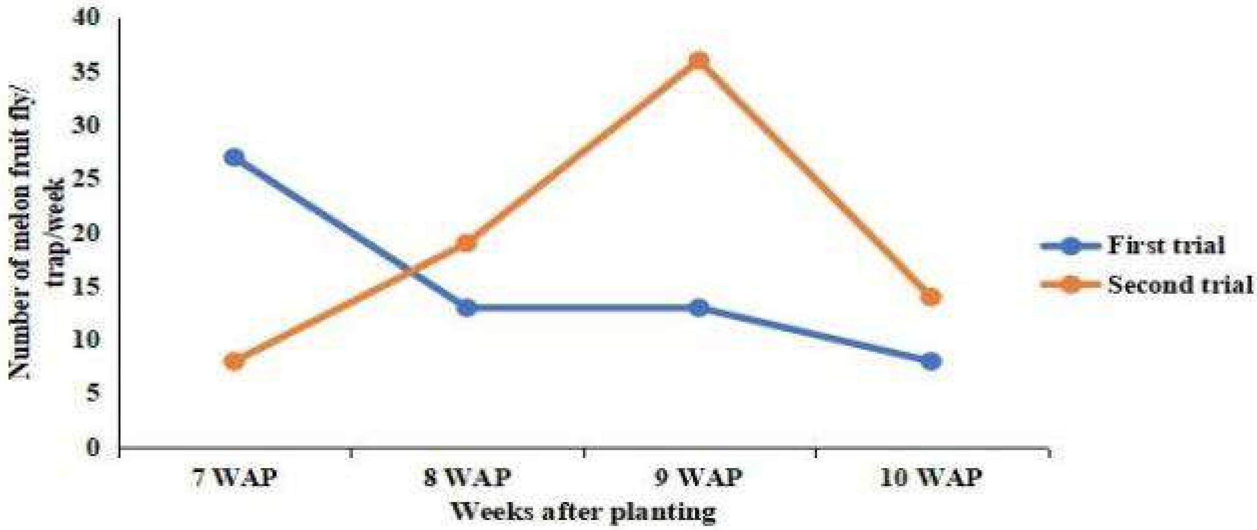
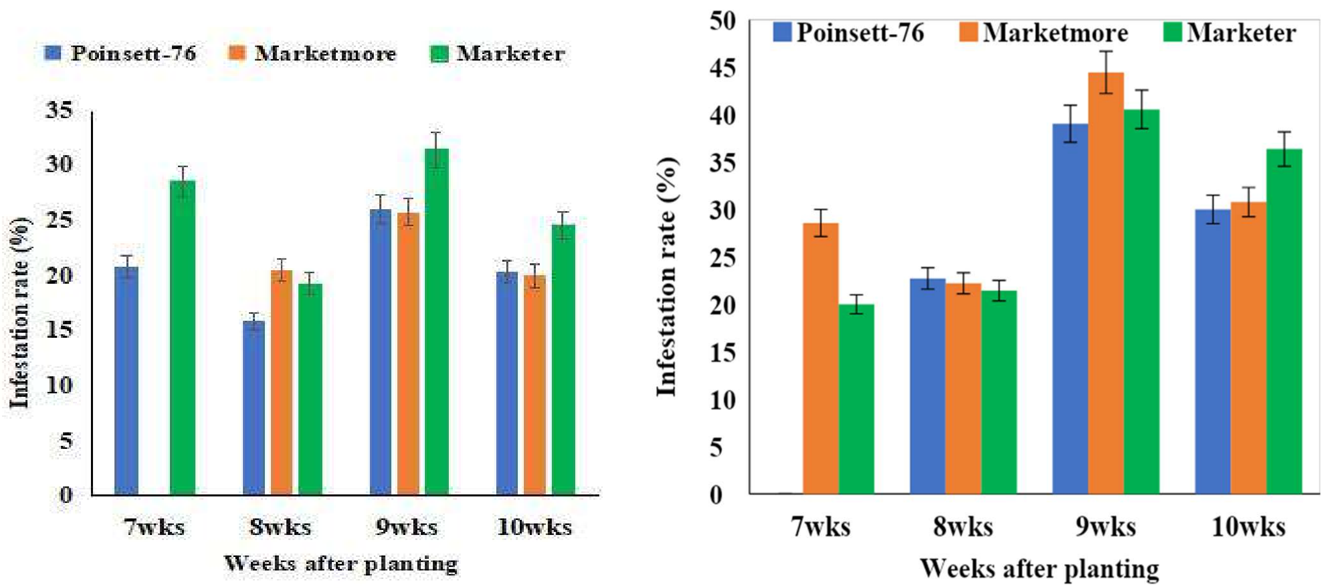


Figure 2: Population dynamics of melon fly in the two field trials

Figure 3 illustrates the infestation rate of fruit flies infesting three cucumber varieties in the two field trials. In the first field trial (A), infestation of fruit flies was first observed only in poinsett-76 and marketer variety at 7 WAP. At 8 WAP, infestation was then observed in all three cucumber varieties. Poinsett-76 had the maximum mean percent infestation (7.1±1.37), followed by marketmore (5.1±0.00) while marketer had the minimum mean percent infestation (4.8±0.83). At 9 WAP, there was peak activity of infestation among the cucumber varieties. Marketer had the maximum mean percent infestation (7.8±0.41), followed by poinsett-76 (6.5±0.34) while marketmore had the minimum mean percent infestation (6.5±1.13). There was decrease in infestation activity at 10 WAP. Marketer had the maximum mean percent infestation (6.1±0.47), followed by poinsett-76 (5.1±0.58) while marketmore had the minimum mean percent infestation (5.0±1.29). Infestation rate from 7 WAP to 10 WAP did not significantly differ ($p=0.05$) among the varieties.



First field trial (A)

Second field trial (B)

Figure 3: Infestation rate of fruit fly on three varieties of cucumber in the two field trials

In the second field trial (B), infestation was first observed only in marketmore and marketer variety at 7 WAP. At 8 WAP, infestation was observed in all three cucumber varieties. Poinsett-76 had the maximum mean percent infestation (5.7±1.13), followed by marketmore (5.6±3.92) while marketer had the minimum mean percent infestation (5.4±1.78) At 9WAP, there was peak activity of infestation among the cucumber varieties. Marketmore had the maximum mean percent infestation (11.1±0.00), followed by marketer (10.1±1.29) while poinsett-76 had the minimum mean percent infestation (9.8±0.99). There was also decrease in infestation activity at 10 WAP. Marketer had the maximum mean percent infestation (9.1±3.71), followed by marketmore (7.7±0.00) while poinsett-76 had the minimum mean percent infestation (7.5±4.78) but they did not significantly differ (p=0.05).

Pupae and emergent adults from infested fruits harvested from cucumber plants in the field trials

Table 2 shows the total fruit sampled, incubated fruit weight, pupae recovered, pupae weight, adult melon fly that emerged and their sex ratio in first field trial. A total of 120 infested cucumber fruits were incubated from three cucumber varieties planted. Incubated fruit weight, pupae recovered, pupae weight and adult fruit flies that emerged among the cucumber varieties in both trials did not significantly differ (p=0.05).

Table 2: Pupae and emerging adults from infested cucumber fruits harvested from the first field trial

Cucumber Varieties	Fruit sampled	Incubated fruit weight (kg)	Total pupae Recovered	Pupae weight (g)	Emergent Adult flies	Sex ratio (M: F)
Poinsett-76	20	3.5±0.4a	98.3±16.9a	1.3±0.2a	70.3±10.6a	1:1.3
Marketmore	20	2.3±0.8a	59.3±5.6a	0.8±0.1a	48±1.8a	1:1.1
Marketer	20	3.3±0.2a	83.3±13.6a	1.2±0.2a	60.5±11.5a	1:1.2

Means ± standard error within a column containing the same letter(s) indicate no significant difference at P ≤ 0.05 using Turkey HSD test.

Table 3: Pupae and emerging adults from infested cucumber fruits harvested from the second field trial

Cucumber varieties	Fruit sampled	Incubated fruit weight(kg)	Total pupae recovered	Pupae weight (g)	Adult flies emerged	Sex ratio (M: F)
Poinsett-76	20	1.8±0.4a	87.5±9.2a	1.2±0.2a	65.5±12.7a	1:1.6
Marketmore	20	2.2±0.5a	176.5±38.1b	2.4±0.5b	147±19.2a	1:1.0
Marketer	20	2.1±0.5a	95.5±7.2a	1.3±0.1a	77.3±8.1a	1:1.1

Means ± standard error within a column containing the same letter(s) indicate no significant difference at P≤0.05 using Turkey HSD test.

Number of different fruit fly species and their relative abundance in the study area during the two field trials.

Result shows the number of different fruit fly species trapped over the course of the study and their relative abundance in two field trials. In the study area, seven species of fruit fly were found which include *Dacus vetebratus* (Jointed pumpkin fly), *Zeugodacus cucurbitae* (Melon fruit fly), *Dacus bivittatus* (African pumpkin fly), *Bactrocera dorsalis* (Oriental fruit fly), *Dacus ciliatus* (Ethiopian fruit fly), *Ceratitis cosyra* (Mango fruit fly), and *Dacus punctatifrons* (Orange brown fruit fly).

For the first field trial (Table 4), six species of fruit fly were recorded. *Zeugodacus cucurbitae* had the highest relative abundance (64.9%) followed by *Dacus bivittatus* (13.8%) and *Dacus punctatifrons* (10.6%).

Other species of fruit fly such as *Dacus ciliatus* (5.3%), *Dacus vetebratus* (3.2%) and *Bactrocera dorsalis* (2.1%) had the least abundance.

For the second field trial, seven species of fruit fly were recorded. *Zeugodacus cucurbitae* had the highest relative abundance (65.3%) followed by *Dacus bivittatus* (11.9%) and *Dacus punctatifrons* (6.8%). Other fruit fly species such as *Ceratitis cosyra* (5.1%), *Dacus ciliatus* (4.2%), *Dacus vetebratus* (3.4%) and *Bactrocera dorsalis* (3.4%) had the least abundance.

Table 4: Number of different fruit fly species and their relative abundance at the experimental site during the two field trials

Fruit fly species	First field trial				Second field trial			
	Number of fruit fly species			**Relative abundance (%)**	**Number of fruit fly species**			**Relative abundance (%)**
	P	**MM**	**M**		**P**	**MM**	**M**	
Zeugodacus cucurbitae	11	24	26	64.9	19	31	27	65.3
Dacus ciliatus	2	0	3	5.3	2	0	3	4.2
Dacus bivittatus	3	5	5	13.8	5	4	5	11.9
Dacus punctatifrons	2	3	5	10.6	1	4	3	6.8
Dacus vetebratus	1	2	0	3.2	1	2	1	3.4
Bactrocera dorsalis	0	1	1	2.1	1	1	2	3.4
Ceratitis cosyra	0	0	0	0	1	3	2	5.1

P= Poinsett-76, MM= Marketmore, M= Marketer

Correlation between population dynamics, infestation rate, percentage damage, yield and weather parameters in the two field trials

Population dynamics showed no significant correlation with infestation rate and percentage damage in both field trials, whereas, Infestation rate showed positive significant correlations with fruit damage in the first (r=0.74), and second (r=0.60) field trials.

Table 5: Correlation matrix between population dynamics, infestation rate, percentage damage, yield and weather parameters for the first field trial

	T.(max)	T.(min)	RH	RF	PD	IR	FD	FY
T.(max)	1							
T.(min)	0.89**	1						
RH	-0.21	-0.14	1					
RF	-0.88	-0.70*	0.62*	1				
PD	-0.19	-0.33	0.22	0.19	1			
IR	-0.14	-0.33	0.09	0.07	0.28	1		
FD	0.25	0.07	0.47	-0.04	0.33	0.74**	1	
FY	-0.61*	-0.80**	0.36	0.56	0.19	0.59*	0.26	1

A Significant correlation was observed at the 0.01 level**
A Significant correlation was observed at the 0.05 level*

The variables represent the following; Highest (T. Max) and lowest (T. Min) Temperature, Relative Humidity (RH), Rainfall (RF), Population Dynamics (PD), Infestation Rate (IR), Fruit Damage (FD), Fruit Yield (FY).

Table 6: Correlation matrix between population dynamics, infestation rate, percentage damage, yield and weather parameters for the second field trial

	T.(max)	T.(min)	RH	RF	PD	IR	FD	FY
T.(max)	1							
T.(min)	0.99**	1						
RH	0.53	-0.47	1					
RF	-0.28	0.37	0.48	1				
PD	-0.16	0.16	-0.00	0.11	1			
IR	-0.58*	0.59*	-0.60*	0.20	0.29	1		
FD	-0.47	0.51	-0.03	0.56	0.38	0.77**	1	
FY	-0.64*	0.58*	-0.92**	-0.43	0.19	0.60*	0.14	1

A Significant correlation was observed at the 0.01 level**
A Significant correlation was observed at the 0.05 level*

The variables represent the following; Highest (T. Max) and lowest (T. Min) Temperature, Relative Humidity (RH), Rainfall (RF), Population Dynamics (PD), Infestation Rate (IR), Fruit Damage (FD), Fruit Yield (FY).

Additional Insect pests recorded in the cucumber field at NIHORT

Table 7 shows the other insect pests that were encountered in the cucumber field. The insect species were classified according to their functional guild (Pest, Predators, Pollinators, parasitoids) and were grouped in the sequence of their common name, order, family and species. In all, twenty-four insect species from five orders and fifteen families were encountered and obtained in the cucumber field. Out of these, twelve species belong to the order "coleoptera" while three species each belong to the order "Orthoptera", "Hymenoptera", "Lepidoptera" and "Hemiptera".

Table 7: Insect species identified on the cucumber field

Species	Family	Order	Common name	Functional guild
Aulacophora africana	Chrysomelidae	Coleoptera	Red melon beetle	Pest
Podagrica malvae	Chrysomelidae	Coleoptera	Orange-blue cucumber beetle	Pest
Aulacophora fovecollis	Chrysomelidae	Coleoptera	Red pumpkin beetle	Pest
Cryptocephal us bifasciatus	Chrysomelidae	Coleoptera	Black-banded cucumber beetle	Pest
Epilachna chrysomelina	Coccinelidae	Coleoptera	Twelve-spotted pumpkin ladybird beetle	Predator
Cheilomenes propinqua vicina	Coccinelidae	Coleoptera	Predatory ladybird beetle	Predator
Cheilomenes lunata lunata	Coccinelidae	Coleoptera	Lunate ladybird beetle	Predator
Chilocorus spp.	Coccinelidae	Coleoptera	Ladybird beetle	Predator
Pterolophia caudata	Cerambycidae	Coleoptera	Longhorn beetle	Pest
Aphanobius spp.	Elateridae	Coleoptera	Click beetle	Pest
Gonocephalum simplex	Tenebrionidae	Coleoptera	Dusty brown beetle	Pest
Epicauta spp.	Meloidae	Coleoptera	Blister beetle	Pest
Apis mellifera	Apidae	Hymenoptera	Western honey bee	Pollinator
Camponotus spp.	Formicidae	Hymenoptera	Predatory ant	Predator
Lasius niger	Formicidae	Hymenoptera	Garden ant	Predator
Chrotogonus hemipterus	Pyrgomorphidae	Orthoptera	Grasshopper	Pest
Zonocerus variegatus	Pyrgomorphidae	Orthoptera	Variegated grasshopper	Pest
Acrotylus blondeli	Acrididae	Orthoptera	Grasshopper	Pest
Celaenorrhinus galenus	Pyrigidae	Lepidoptera	Common orange sprite butterfly	Pest
Diaphania hyalinata	Crambidae	Lepidoptera	Melon worms	Pest
Bicyclus sandace	Satyridae	Lepidoptera	Dark vulgar bush brown	Pest
Bemisia tabaci	Aleyrodidae	Hemiptera	Silverleaf whitefly	Pest
Halyomorpha halys	Pentatomidae	Hemiptera	Brown marmorated stink bug	Pest
Rhyncoris camelita	Reduviidae	Hemiptera	Assassin bug	Predator

Fruit yield and fruit damage of three cucumber varieties grown in two field trials

Table 8 shows that the fruit yield of the three cucumber varieties grown in the two trials were not significantly different. Result also shows that the percentage of fruit damage varied from 25.29% to 33.37% with no significant difference among the cucumber varieties in the first field trial, and 31.35% to 44.88% with no significant difference among the varieties of cucumber in the second trial.

Table 8: Fruit yield and fruit damage of three cucumber varieties grown in two field trials

Cucumber varieties	Fruit yield (kg/ha)		Fruits damaged (%)	
	First trial	**Second trial**	**First trial**	**Second trial**
Poinsett-76	693.7±131.0a	183.8±86.7a	26.1±5.0a	31.4±10.9a
Marketmore	450±176.1a	254.7±99.1a	25.3±9.1a	44.9±3.3a
Marketer	691±170.1a	169.4±81.7a	33.4±4.6a	42.7±4.1a

DISCUSSION

Fruit fly populations in the studies showed peak activity at 9 WAP in the second field trial but showed peak activity at 7 WAP in the first field trial. This could be attributed to the fact that there was also peak activity at 9 WAP at the first trial but the fruit flies trapped were mostly from other fruit fly species which were not included in melon fruit flies population. Also, range of melon fruit fly population recorded during the study was 0.3- 4.5 fruit flies/trap/week which was low compared to results of Nahid *et al*. (2021), Vignesh and Viraktamath (2015) and Abhilash *et al*. (2017) who recorded population dynamics to range from 0.33 to 55.67 fruit flies/trap/week. Alim *et al*. (2012) also recorded average melon fruit fly /trap in two consecutive years ranging from 18.37 fruit flies/trap/fortnight to 472 fruit flies/trap/fortnight in cucurbits crops grown in Bangladesh. The study recorded a low population of melon fruit flies which could be attributed to the size of the cucumber field, and the duration of the study as most of the findings cited above took a longer duration of time and also generalized on infestation rate of cucurbits grown on a field.

Infestation rate of fruit flies on cucumber on the field was observed at 7 WAP to 10 WAP with peak activity at 9 WAP in the field trials. This supports the results of Abhilash *et* al. (2017), who noticed an increase in melon fruit fly activity on the ninth week of the ridge gourd's fruiting stage. Infestation rate of fruit flies ranged from 0% to 44.44% in the two field trials. This deviated from the findings of Vignesh and Viraktamath (2015) who observed and reported a severe melon fruit fly infestation (70.90%) on cucumber in India and Alao *et al*. (2016) who documented low melon fruit fly infestation (1%) on cucumber in Ogbomosho, Nigeria. Furthermore, when infested fruits were collected and observed for pupae and adult emergence, marketmore had the highest total pupae recovered, pupae weight and emergent adult fruit flies. The genetic makeup of the variety, as well as the fruit's morphological and physical characteristics, could be responsible for the female fruit fly's predilection for marketmore variety for oviposition (Mwatawala *et al*., 2015).

In both trials, infestation rate and fruit damage showed a significant positive correlation. This means that as infestation rate of melon fruit flies on cucumber increases, fruit damage also increases. This confirms related research by Tarimo *et al.* (2025) who reported the melon fruit fly as the primary pest in terms of infestation rate and severity, potentially causing substantial economic losses in cucurbit production. Number of insect species encountered during the study period in the cucumber field confirms similar studies by Falade (2022) who reported twenty-three insect species from fifteen insect families and seven orders. The study showed the functional guild of different insect species that visited the cucumber field and they were classified into pests, predators and pollinators. About 67% of the insect species identified were regarded as insect pests based on their activities on the field. This percentage is very alarming as they tend to cause more nuisance and damage to the cucumber at different growth stage depending on their population and their frequency of visits on the field. *Aulacophora africana, Aulacophora fovecollis and Diaphania hyalinata* were three major insect pests of cucumber with high relative abundance after the melon fruit fly during the two field trials. This confirms related research by Alao *et al.* (2016) and Ratnakar *et al.* (2016) who listed these three insects as major insect pests of cucumber that caused damage to the cucumber plant at different phenological stages.

The result presented on the percentage damage of cucumber fruits aligns with the findings of Sapkota *et al*. (2010), Raghuvanshi *et al*. (2012) and Dubale *et al*. (2018) who recorded percentage damage of cucurbits (squash, bitter gourd and ridge gourd) to range from 16.67% to 62.70%. The use of torula yeast was effective, as it reduced the percentage of fruit fly infestation compared to the results reported by Krishna *et al*. (2006), who recorded a high infestation rate (73.83%) of melon fruit fly on cucumber while according to Amin *et al*. (2011), different cucurbitaceous crops in Bangladesh suffered *Bactrocera cucurbitae* infestations ranging from (21.0) to (71.5 %).

With regards to fruit yield, there was no significant differences in the total yield among the varieties in both field trials, hence, other parameters such as infestation rate and population of melon flies were considered to determine the most desirable variety for cucumber production. Marketmore and marketer had high infestation rate and harboured greater number of melon fruit flies compared to poinsett-76. As a result of this, poinsett-76 variety is the most desirable variety for cucumber production as it harboured less melon fruit flies, low infestation rate, low number of pupae and adult emergent and also a great yield potential. This conforms to the results of Adinde *et al*. (2016) who observed that compared to marketer, super-marketer and ashley varieties, poinsett-76 seemed to possess optimal genotype and environmental relationship with regards to crop yield production. However, it contradicts the findings of Iwalewa and Amujoyegbe (2019) who reported that marketmore performed best compared to marketer and poinsett-76 in respect to yield in Ile-Ife, Nigeria.

CONCLUSION

The study established that Poinsett-76 is the most suitable variety for local cultivation due to its lower susceptibility to infestation and superior yield potential. Insect pest activity peaks at nine weeks after planting, marking a vital window for targeted pest management intervention. Melon fly is the dominant species, accounting for nearly two-thirds of the total insect population, the presence of other pests like *Diaphania hyalinata* and *Aulacophora* species necessitates a multi-species management approach. Ultimately, integrating these variety-specific insights and strategic timing will enable farmers to minimize losses, navigate quarantine regulations, and ensure sustainable cucumber production.

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