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Mango Farmers' Perception on the Effect of Fruit Flies Infestation

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Abstract

The reductions in quality and quantity of marketable mango fruits due to fruit fly infestation have impact on farmers through revenue losses. The study identified the common fruit flies on mango plantation; assessed the control measures of fruit flies' infestation; among others. Interviewers administered questionnaire was used to elicit information from 200 mango farmers. Data were analyzed using descriptive statistics and Pearson Product Moment Correlation. The results revealed that majority of the respondents were male (55.5%), had non-formal education (47.5%), with mean age of 60 years, mean household size of 4 members and years of farming experience was 20 years. The study further revealed that marula fruit fly (92.5%) was ranked first. Hand picking of falling mango (94.0%) was identified as the most prominent control measure. The respondents perceived fruit flies as causing premature dropping of fruits (62.0%) as the major effect of fruit flies on mango. The result further revealed that at $p<0.05$, age ($r=0.267$), household size ($r=-0.297$) and years of experience ($r=-0.158$) were significant to farmers' perception on the effect of fruit flies infestation. The study concluded that fruit flies infestation affect mango farmers in several ways. The study therefore, recommended that extension training in orchard management should be organized for the mango farmers especially regarding fruit fly.

Keywords: Fruit flies, Mango, perception, farmers

1. Introduction

The move from cereal production towards high-value horticulture crops is an important contributor to employment opportunities in developing countries (Rao *et al*, 2004). Moreover, on average, horticultural crop production provides twice the amount of employment per hectare of production compared to cereal crop production (Ali *et al*., 2002).

Fruits and vegetables contribute to the income of both rural and urban dwellers. Besides, fruit consumption is crucial to the availability of micronutrients to the body. This is because these food items are a rich source of vitamins and minerals which are required for normal functioning of the human body. Apart from providing micronutrients, fruits and vegetables are known to provide dietary fibres (soluble and insoluble) which are vital for optimal functioning of the gastro-intestinal tract (Hart *et al.*, 2005). They also enable the body to use other nutrients required for its normal functioning the energy from fats and carbohydrates.

Mango (*Mangifera indica*) is an important fruit and cash crop and plays an important role in agricultural development in many countries in sub-Saharan Africa. It originated from the Indian subcontinent and reached East Africa by 10th Century (Lux *et al.*, 2003). It is commercially grown in more than 90 countries worldwide and is consumed both in fresh and processed form (FAO, 2011). Over one hundred varieties are produced worldwide which have similar properties but with specific differences peculiar to each variety (Gregoratti, 2011).

The mango tree produces a fruit with great diversity with respect to form, size, colour and quality (Chiebonam, *et al*, 2019). The fruit can placed for a number of uses or the fruit has many uses. For instance, ripe fruits can be made into juice and can be preserved, while unripe fruits can be processed for pickles and chutney (Rodriguez & Amaya, 1997). However, in Nigeria, most of the fruits produced are consumed as fresh fruit. Although Nigeria occupies the 9th position among the ten leading mango producing countries of the world, but could not find place among the ten leading mango fruit exporters (Tubiello *et al.*, 2013) Fruit flies (Drosophila) are recognised worldwide as the most important insect pests to fruits, especially mangos (Drew *et al*., 2005, Ekesi *et al*., 2009). Fruit flies are one of the most economically damaging pests of fleshy fruits world-wide (Boulahia- Kheder 2021). Female fruit flies lay eggs under the skin of the fruit, which hatch into larvae that feed in the decaying flesh of the fruit. Infested fruits quickly rot and become inedible or drop on the ground, thus causing direct loss to the farmer. Beside the direct damage to fruit, indirect losses are associated with quarantine restrictions, because infestation and sometimes the mere presence of the flies in a particular country could restrict the trade and export of fruit to markets abroad (Bissdorf, 2005). The rapid spread and devastating impact of Fruit flies (*Bactrocera invadens)* is serious concern to mango production in Nigeria and Africa at large. Trade in several horticultural produce between Africa and the United States of America (USA) has been severely hampered by a United State Federal Order banning importation of several cultivated fruit and vegetables from African countries where *B. invadens* has been reported (Kibira *et al*., 2015). Therefore, Fruit flies threaten the production and marketability of fruits and vegetables by reducing their quantity and quality. This limits the expansion of domestic and international trade for these fruits, triggering huge economic losses that deprive producers from massive revenue. Moreover, the farmers lack expertise in the control of fruit flies. The objectives of the study are to;

i. describe the socioeconomic characteristic of mango farmers;
ii. identify the common fruit flies on mango plantation by the farmers;
iii. assess the control measure of fruit flies infestation used by the farmers;
iv. determine the perceived effect of fruit flies infestation on mango production;
v. identify the constraints to the control of fruit flies by the farmers;

Hypothesis of the Study

$H0_1$: There is no significant relationship between socioeconomic characteristic of the respondents and the perceived effect of fruit flies infestation on mango.

2. Materials and Methods

2.1 The Study Area

The study area is Oyo State, Nigeria. Oyo, usually referred to as Oyo State to distinguish it from the city of Oyo, is an inland state in south-western Nigeria, with its capital at Ibadan. It has 33 local governments and is bounded in the north by Kwara State, in the east by Osun State, in the south by Ogun State and in the west partly by Ogun state and partly by the Republic of Benin. Oyo state covers approximately 28,454 $km^2$with a total population of about 5,580,894 based on the last conducted general census. (National Population Commission, 2006). Some principal rivers such as Ogun, Oba, Oyan, Otin, Ofiki, Sasa, Oni, Erinle and Osun river originate in this highland. Oyo state is blessed with various types of soils and varied agro-climatic conditions as a result of which the state has the advantages of growing a variety of horticultural crops in particular and other crops in general. The occupation of the state includes; farming, trading, artisan among others. Crops grown in the state are maize, yam, plantains, cashew, mango, millet etc. The climate conditions of Oyo-State favours mango production and farmers in the state utilize the opportunity to cultivate mango to earn a living. Oyo state is blessed with plant genetic resources for several fruit bearing tress crop which favour mango production in the area. The mango spread rapidly throughout the area where it is grown for its fruit and as a shade and as an ornamental tree. It is known to be among the nutritious fruits. Each variety has is distinct from others in colour and flavour and therefore, varies in its suitability in processing into different products such as juices and chutney. However, in some part of Nigeria, Oyo state mango is a popular cultivar sought genotype primarily for its fruit flesh quality.

2.2 Sampling procedure and sample size

The population of the study comprised all mango farmers in Oyo state. Multi stage sampling techniques was used in the study. The first stage involved the purposive selection of Ogbomosho Agricultural Development Programme (ADP) agricultural zone and Oyo ADP agricultural zone based on their high cultivation of mango. The second stage was random selection of 50% of local governments from each selected zone. Out of 5 local governments in Ogbomoso ADP zone, 3 were selected while out of 4 local governments in Oyo ADP zone 2 were selected. The selected local government in Ogbomosho ADP zone were Surulere, Orire, Ogooluwa, while selected local government in Oyo ADP zone were Afijio and Atiba. The last stage involved random selection of 40 respondents from each of the selected local government areas based on the sampling frame. Out of 83 mango farmers in Surulere, 40 were selected, out of

86 in Ogo oluwa 40 were selected, out of 78 farmers in Orire, 40 were selected, out of 48 farmers in Afijio, 40 were selected and out of 46 farmers in Atiba, 40 were selected. A percentage ranging from about 50 – 100 was used to select the respondents based on sampling frame in each location. A total sample size of 200 respondents was selected for the study.

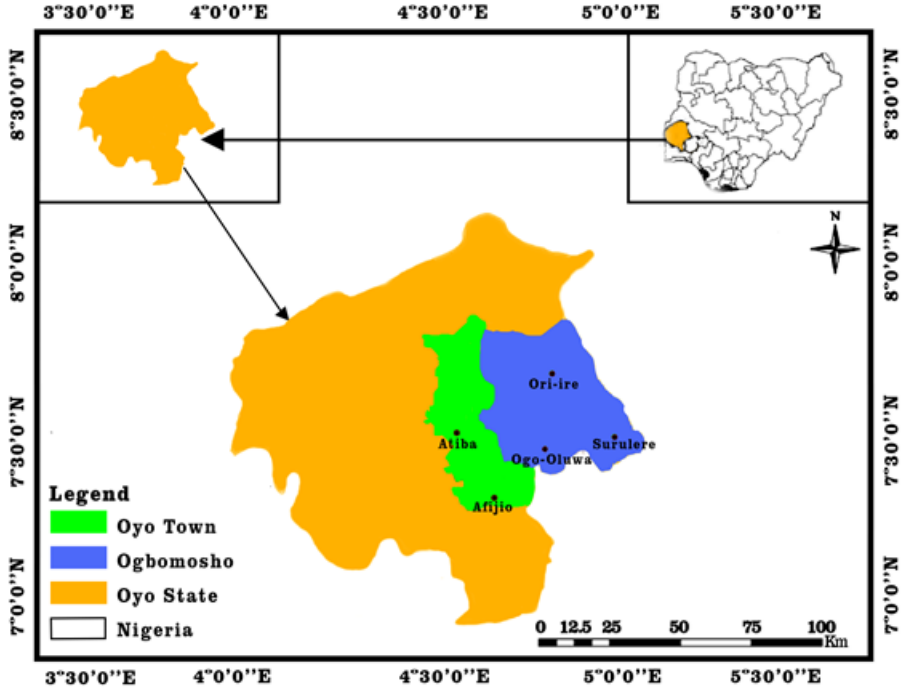

Figure 1: Map of Oyo state showing the study area

2.3 Data collection and analysis

Primary data were collected using a structured questionnaire on the socio-economic characteristics of mango farmers, common fruit flies on mango plantations, control measures for fruit flies infestation, perceived effect of fruit fly infestation and constraint to the control of fruit flies infestation by farmersin the study area. Prior to the administration of questionnaires, the questionnaires were pre-tested and necessary corrections were made. Content validity was used to determine the adequacy of the research instrument. In the process, the instrument was thoroughly and independently examined by appropriate experts in the Department of Agricultural Extension and Rural Development and Department of Crop Protection to ensure both face and content validity.The experts gave their critical opinion on the adequacy and relevance of the instrument to the objectivesof the study. The observation was harmonized and necessary corrections were made on the instrument before the start of the survey. The test retest method was used to determine the reliability of the research instrument. Twenty-five copies of the researchinstruments were administered twice to the respondents at two weeks intervals. The two results were correlated and a reliability coefficient of 0.87 was obtained. The data collected for this study were analyzed using both descriptive and inferential statistics. Pearson Product Moment Correlation (PPMC) was used to test the hypotheses of the study

3. Results and Discussion

3.1 Socio-economic characteristic of Mango farmers

Table 1 showed the socio-economic characteristics of mango farmers. The mean age of respondents was approximately 60 years. This implies that mango farmers were quite elderly. 55.5% of respondents were male while the remaining 44.5%were female. This result indicates that there were more men involved in mango production than female. Furthermore, the result shows that more than half of the mango farmers were married (54%). This implies mango production could generate household income to cater for the farming household responsibilities. It therefore validates the claim by Ugese *et al*. (2012) that mango production enterprise plays an important role in the economy of families. The result shows that 51.50% had either primary or secondary education. This implies that the farmers were fairly educated. The finding corroborates the finding of Ravani & Joshi (2013) who reported that majority of mango farmers in India had secondary or primary education and thus understands training through innovation and extension.

The result shows that majorityof the mango farmers (78.5%) had average household size of four members and average farm size 0.53 hectares. This indicates that mango fruit production in the study area was still on small scale.

The average farming experience was 25 years.This shows the respondents have been long in mango cultivation and can identify fruit flies infestation. All respondents indicated that they had extension contact. However, 80.50% had extension contact fortnightly. This is in contrast to Oerke (2006) position that the demand-driven approach for extension service provision does not appeal to most mango farmers.

Table 1. Distribution of Respondents by Socio-economic Characteristics (n=200)

Variables	Frequency	Percentages	Mean	SD
Age (years)				
≤40	6	3.0		
41 – 50	41	20.5	59.74	9.15
51 – 60	98	49.0		
>60	55	27.5		
Gender				
Male	111	55.50		
Female	89	44.50		
Marital Status				
Single	3	1.50		
Married	108	54.0		
Widowed	82	41.00		
Divorced	7	3.5		
Level of Education				
No Formal Education	95	47.50		
Primary Education	83	41.50		
Secondary Education	20	10.00		
Tertiary Education	2	1.00		
Household Size				
≤2	42	21.00		
3 – 8	157	78.50	4.20	1.91
>8	1	0.50		
Farming Experience				
≤10	14	7.00		
11 – 20	71	35.50	25.90	9.90
21 – 30	58	29.00		
>30	57	28.50		
Farm size (hectares)				
≤0.80	196	98.00		
1.21 – 2.42	3	1.50	0.53	0.27
>2.42	1	0.5		
Sources of Credit				
Personal Savings	196	98.00		
Loan From Friends	4	2.00		
Annual Income (N)				
<40,000	1	0.50		
40,001 – 90,000	10	5.00	156,150	158,414.49
90,001- 140,000	77	38.50		
>140,000	112	56.00		
Extension Contact				
Yes	200	100.00		
Extension Schedule				
Fortnight	161	80.50		
Monthly	35	17.50		
Three Months Interval	4	2.00		

Source: Field Survey, 2020. S.D=Standard Deviation

3.2 Common fruit flies identified by mango farmers

Table 2 shows that out of all the six common fruit flies identified by the farmers, marula fruit fly (*Ceratitiscosyra*) was ranked1st. Africa Invader Fly (*Bactrocera invadens*) was ranked 2nd and Medfly (*Ceratitis capitates*) and Caribbean Fruit Flies (*Anastrephaludens*) were ranked 3rd and 4th respectively. However, Natal Fly (*Ceratitisrosa*) was not readily known to respondents in the study area. The finding corroborates Kibira *et al*., (2015) that the economically important fruit fly species belong to the genera *Bactrocera*, *Ceratitis*, *Dacus* and *Trirhithrum*. Furthermore, Mayamba *et al*., (2014) reported that *Bactrocera invadens* was responsible for causing extensive economic loss since its first detection in the African continent in 2003.

Table 2. Common Fruit Flies identified by farmers on Mango Plantation

English Name	Scientific Name	Local Name	Frequency	Percentage	Rank
Marula Fruit Flies	*Ceratitis cosyra*	Esin ode	185	92.5	1st
Africa Invader Fly	*Bactrocera invadens*	Esin	184	92.0	2nd
Medfly	*Ceratitis capitates*	Esin cholera	180	90.0	3rd
Caribbean Fruit Fly	*Anastrephaludens*	Esiniru	165	82.5	4th
Oriental Fruit Fly	*Bactrocera dorsalis*		83	41.5	5th
Natal Fly	*Ceratitis rosa*		39	19.5	6th

Source: Field Survey, 2020.

3.3 Control Measure of Fruit Flies by the Farmers

Table 3 shows the various control measures used by mango farmers to manage fruit flies infestation. Handpicking of fallen mangoes in isolated area and depositing in an augumentorium (M.S=3.92) is a cultural method mostly used by farmers in the study area. This agrees with Ekesi (2010) who reported that orchard sanitation is a cultural method used to prevent fruit flies build up. Destruction of all fruits on infected trees (M.S=2.16) was also another control measure employed by farmers to reduce fruit flies population on the farm. Furthermore, prevention of raw untreated fruit from being taken out of the orchard (M.S=2.02), isolation of affected areas were effective methods used by respondents to mitigate fruit flies infestation on mango farm (M.S=2.02). However, use of chemicals and traps, biological control measures such as the introduction of sterile males and bait spotting with M.S= 1.37, 1.25 and 1.38 respectively were not commonly used methods in the study area.This may be partly due to the high technical know-how required. Jemmazi, (2019) reported that Sterile Insect Technology is an efficient and cost effective pest control technology that is environmental friendly and does not pose any health concerns unlike chemical control tactics.

Table 3. Control Measure of Fruit Flies by the Farmers.

Control measure	Mean	SD
Cultural method (Hand picking of fallen fruits)	3.92	0.31
Use of chemicals (e.g insecticides)	1.74	1.01
Physical Control (use of traps as bait)	1.37	0.91
Biological Control (introduction of sterile male)	1.25	0.71
Seed Inoculation	1.99	1.16
Destruction of all fruits on infected trees	2.16	1.31
Bait spotting (adding substance to attract flies)	1.38	0.91
Confinement of raw fruit within farm	2.02	1.24
Isolation of affected areas	2.02	1.26

Source: Field Survey, 2020. cut –off point of 2.5

3.4 Perceived Effect of Fruit Flies Infestation on Mango

Table 4 highlights the perceived effects of fruit flies infestation by the farmers. Respondents perceived fruit flies as causing skin irritation (MS=4.08). This implies that during ploughing and transportation of mango fruit the fruit flies surrounds the environment which causes irritation to the farmers. Mango farmers in the study area agreed that fruit flies helps in pollination (MS=3.00) and Reduction in the quality of mango fruits (M.S= 3.01). This implies that as the fruit flies (larvae) feed on mango pulp, the fruit quality declines and become inedible or drop to the ground, thus causing direct loss to farmers. Fruit flies caused reduction in farmers' income in the study area (M.S= 3.02). Respondents agreed that fruit flies also caused premature fruit drop in their orchard (M.S=3.31). This is in line with Oerke (2006) who found that fruit fly damage was the greatest contributor to harvest rejections, far more than the combined contribution of other causes.

Table 4. Perceived Effect of Fruit Flies Infestation on Mango

Effects	S.D	D	U	A	S.A	Mean
Helps in pollination	0(0.0)	2(1.0)	7(3.5)	70(35.0)	121(60.5)	3.00
Reduces quality of mango fruits	0(0.0)	2(1.0)	1(0.5)	103(51.5)	94(47.0)	3.01
Agent of biological Control	96(48.0)	103(51.5)	0(0.0)	1(0.5)	0(0.0)	1.53
Pre-mature fruit drop off	0(0.0)	0(0.0)	3(1.5)	124(62.0)	73(36.5)	3.31
Reduced production	83(41.5)	115(57.5)	0(0.0)	1(0.5)	1(0.5)	1.61
Reduces farmers income	0(0.0)	0(0.0)	0(0.0)	129(64.5)	71(35.5)	3.02
Serve as diseases vector	75(37.5)	94(47.0)	26(13.0)	2(1.0)	3(1.5)	1.82
Discomfort for farmers	96(48.0)	102(51.0)	0(0.0)	2(1.0)	0(0.0)	1.54
Causes irritation	10(5.0)	4(2.0)	33(16.5)	65(32.5)	88(44.0)	4.08
Allows termites	101(50.5)	98(49.0)	0(0.0)	1(0.5)	0(0.0)	1.50

S.D = Strongly Disagree, D= Disagree, U= Undecided, A= Agree, S.A= Strongly Agree,
Source: Field Survey, 2020. cut –off point of 3.0

3.5 Constraints to control of fruit flies infestation

Table 5 shows the constraints to control of fruit flies by mango farmers. Lack of skill in biological control (ranked 1st) was the most severe constraint of farmers faced in the study area. This implies that high technical know-how is required. High cost of insecticide is also very severe closely followed by delayed maturity of fruit due to weather. Boulahia-Kheder et al., (2018) found out that lack of support by technical staff and the insufficient training are major constraints to IPM programme by the farmers

Table 5. Distribution of Respondents by Constraints to Control of Fruit Flies infestation

Constraints	N. S	S	V.S	M	Rank
Lack of skill in biological control	21(10.5)	1(0.5)	178(89.0)	2.78	1st
High cost of insecticide	8(3.9)	72(36.5)	120(60.0)	2.56	2nd
Weather delayed maturity	11(5.5)	126(63.0)	63(31.5)	2.26	3rd
Doubtful efficacy of insecticide	18(9.0)	125(62.5)	57(28.5)	2.19	4th
Scarcity of insecticide	26(13.0)	122(61.0)	52(26.0)	2.13	5th
Stress during handpicking and orchard sanitation	53(26.5)	101(50.5)	46(23.0)	1.96	6th
Soil type affects substances added to seedling	89(44.5)	101(50.5)	10(5.0)	1.60	7th
Setting trap is time consuming	94(47.0)	105(52.5)	1(0.5)	1.53	8th
Inadequate extension support	187(93.5)	12(6.0)	1(0.5)	1.07	9th

N.S = Not Severe, S= Severe, V.S= Very Severe, Percentages are in parenthesis, Source: Field Survey, 2020.

3.6 Result of hypothesis

Result in Table 6 shows the correlation analysis between selected socio-economic characteristics of mango farmers and the perceived effect of fruit flies on mango production. Result shows that at $P<0.05$, age of the farmer ($r= 0.267$, $p<0.05$), annual income ($r=-0.158$, $p<0.05$) and farming experience ($r= 0.316$, $p= 0.05$) significantly influenced farmers' perception on the effect of fruit flies infestation. Accordingly, the inverse relationship between household size ($r= -0.297$, $p<0.05$) and perceived effect of fruit flies infestation on mango production implies that as the household size of the farmer increases, the perceived effect of fruit flies infestation on the farm reduces. On the contrary, age, and farming experience have a positive relationship with farmers' perceived effect of fruit flies on mango production. This implies that older respondents have over the years witness several cases of fruit flies infestation.

Table 6. Result of the Correlation between Socio-economic Characteristics and Perceived Effect of Fruit Flies Infestation on Mango

Socio-economic characteristics	r – value	p – value	Remarks
Age	0.267**	0.000	Significant
Gender	-0.092	0.196	Not Significant
Household size	-0.297**	0.000	Significant
Farming experience	0.316**	0.000	Significant
Farm size	-0.102	0.153	Not Significant
Annual income	-0.158**	0.025	Significant

Source: Field survey, 2020.**. Correlation is significant at 0.05 level (2-tailed).

4. Conclusion and Recommendation

The study concluded that mango farmers experience fruit flies infestation which causes mainly premature dropping off of fruit and skin irritation in the study area. This make fruit flies a threat to mango production. Moreover, marula fruit fly (*Ceratitis cosyra*) was the most common fruit fly in the study area. Handpicking of fallen mangoes in isolated area is a common control measure of fruit flies. Lack of skill in biological control was the most severe constraints faced by farmers in the study area

Based on the findings of the study, the following recommendations were made:

I. Extension training in orchard management should be sustained in the study area to expose the farmers to integrated pest management strategies.

II. Effective pesticides and various agro chemicals should be subsidized to make them readily available for farmers on cheaper rates.

III. Mango farmers should be trained on biological control method through Agriculture extension Department.

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