ISSN 2521 – 0408
AEXTJ
AGRICULTURAL EXTENSION JOURNAL

Available Online at www.aextj.com
Agricultural Extension Journal 2018; 2(2):89-94

RESEARCH ARTICLE

The Fall Armyworm Endemic: Contriving the perspicacity in the outbreak of Fall Armyworm (*Spodoptera frugiperda*) in relation to push–pull technology

Nicholas O. Ogot

International Centre of Insect Physiology and Ecology, P.O. BOX 30772-00100 Nairobi, Kenya

Received: 01-02-2018; Revised: 10-03-2018; Accepted: 20-04-2018

ABSTRACT

Fall armyworm (FAW) is a moth native to tropical and subtropical regions of the Americas whose larva causes damage to crops. As of May 23, 2017 it has affected more than 143,000 hectares of land in major maize- and wheat-producing counties in Kenya. In response to its severity, this study was conducted to determine the perception of farmers in respect to; the challenges they faced through FAW endemic; the differences depicted between FAW and stemborers; and strategies farmers apply to attempt controlling them. This study was descriptive, and it was conducted in Homabay and Migori using a sample size of 51 households (push–pull technology [PPT] - 25 and non-push–pull technology [NPPT] - 26). It was found that 7 push–pull households and 8 non-push–pull households expressed FAWs outbreak as a threat to cereal production. The ratio statistics across the sub-counties interviewed indicated that the spread of FAW was higher among the non-push–pull farms by 69.9% when push–pull farms showed 63.1%. Moreover, the ratio statistics of FAWs to stemborers negatively impacting on crop production among the push–pull farms yielded a 34.2% in comparison to non-push–pull farms that had 74.2%. Furthermore, farmers explained that FAW was quicker, bigger, and uncontrollable compared to stemborers. The common strategies that farmers had used to control FAW included spraying of crops, uprooting of the infected crops, and application of ash. Unfortunately, they did not seem to work effectively both among the PPT and NPPT farms. The regression model provided showed acceptable significance level. Therefore, FAW outbreak was determined to be a danger disease to crops both on PPT and NPPT farms. However, push–pull technology reflected a slight control, but further research would be essential for a further recourse on eliminating FAW.

Key words: Fall armyworms, non-push–pull technology, push–pull technology, stemborers

INTRODUCTION

The fall armyworm (FAW) (also known scientifically as, *Spodoptera frugiperda*) is a specimen of the order Lepidoptera and the larval life stage of a FAW moth. It is regarded as a pest that can wreak havoc on crops if left to multiply.[7] FAW is a moth native to tropical and subtropical regions of the Americas, whose larva causes damage to crops. It mainly affects maize, with potential hosts from 26 plant families. Significant yield loss can be caused by FAW if not well managed. FAW has several generations per year, and the moth can fly up to 100 km per night. FAW was first detected in Central and Western Africa in early 2016 and later in Southern Africa (except Lesotho and the Island States). In 2017, it was detected in Eastern Africa and is expected to spread further. For the time being, its modality of introduction and its spread to Africa and adjustments of its bio-ecology are still speculative.[3]

FAW can be one of the more difficult insect pests to control in field corn.[6] The moth is a severe pest of maize and other grass family crops such as sorghum. It poses a serious threat to African agriculture and food security as well as international trade through quarantine restrictions.[2]

Endemic to the Americas, FAWs can fly long distances, and females can lay up to 1000 eggs at a time, according to scientists. They proliferate in tropical climates, making Africa a choice

Address for correspondence:
N. O. Ogot,
E-mail: nicholasogot@gmail.com

destination; however, experts are still unclear as to how the pests got here in the first place.[1]

The pest has been recently detected in Kenya and is suspected to have entered the country from Uganda. It is also known to be present in Burundi, Ethiopia, and Rwanda. The FAW was first reported in Western Kenya by farmers in March 2017 and immediately confirmed by the Kenya Plant Health Inspectorate Service and Kenya Agricultural and Livestock Research Organization. The initial counties infested were Busia, Trans Nzoia, Bungoma, Uasin Gishu, and Nandi.[3]

As of May 23, FAW has affected more than 143,000 hectares of land in major maize- and wheat-producing counties (in Kenya). The FAO and the Ministry of Agriculture have adopted a planning response figure of 800,000 hectares, which requires US$33.5 million for pesticides and awareness campaigns in the medium term. US$6.6 million is required for an immediate response.[4]

In response to the severe effects perceived from the FAW in the entire agricultural practices, this study was determined to find how FAW was perceived among the push–pull technology (PPT) farmers; how they posed a challenge on cereals production between the PPT households and the non-push–pull technology (NPPT) households; how they impacted differently from Stemborers; and the practices that farmers strategize to control the infestation of FAW.

METHODOLOGIES

This study employed a descriptive research design to elaborate on the perception of farmers in the outbreak of FAWs. Descriptive research designs help provide answers to the questions of who, what, when, where, and how associated with a particular research problem; a descriptive study cannot conclusively ascertain answers to why. It is used to obtain information concerning the current status of the phenomena and to describe "what exists" with respect to variables or conditions in a situation.[7] A cross-sectional survey was therefore a definite and appropriate establishment for this study as it could compare different population groups at a single point in time under descriptive design. It could compare between the PPT and the NPPT with the relativity of variables linked to identifying the outbreak of FAW.

It was conducted in two counties of Kenya: Homabay and Migori. FAW was lately discovered in these two counties after its outbreak in other regions. The majority of the push–pull farmers had a new challenge from which they sought answers. This was on the basis of the experienced sudden infestation and fall of production. This came after the confidence of alleviated pests' infestation (Stemborers and Striga) by PPT after some period of time.

Sample size used to collect data was obtained in response to the FAW case studies in Kenya. This study selected 51 households from where respondents were questioned. Moreover, these were taken from Homabay and Migori Counties for precision. Semi-structured questionnaires were used to probe for the accurate data.

This study analyzed the data obtained from the field using SPSS version 22. Ratio statistics, correlations, regressions, and other statistical parameters were

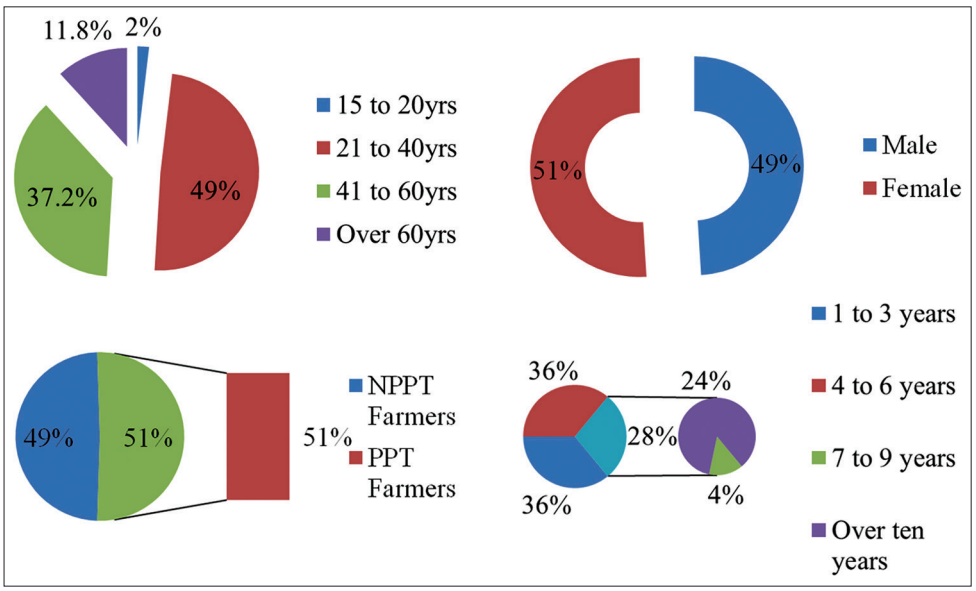

Figure 1: Pie charts of age, gender, push–pull, and years of push–pull technology farming

used. Data presentations and interpretations were then done by use of graphs, pie charts, and tables.
Validity of the study was tested by running the data on the explore statistics to find out its normality. Validity is arguably the most important criteria for the quality of a test. The term validity refers to whether or not the test measures what it claims to measure. On a test with high validity, the items will be closely linked to the test's intended focus. Reliability test was carried out to find if the data were consistent, reproducible, and performing.

RESULTS

The data provided a range of findings that depicted a source of knowledge on push–pull and FAW. Validity test showed significant statistics. Table 1 provides a descriptive summary that proves the validity of the data obtained.

Demographic study

The demographic statistics was composed of regions of survey, age, gender, push–pull analysis, and years of PPT farming [Table 2].

Household studies

In this study, 49% of the household heads interviewed were aged between 21 and 40 years, which formed the majority. The minority 2% were aged between 15 and 20 years. Males formed 49% of the sample as female were 51%. Farmers who were practicing PPT were 51% as the NPPT had 49% of the sample population. Of the PPT farmers interviewed, 36% had practiced push–pull for a range of 1–3 years, and another 36% also had practiced for 4–6 years. 7 and above years of PPT farming had 28% of PPT farmers, where over 10 years had the least of 4% sample population.

Does FAW impose challenge to the farmers?

The distribution of the FAWs was expressed by farmers as indicated in Table 3. 7 push–pull farmers and 8 non-push–pull farmers expressed FAW as a threat to cereal production. However, majority had not been infested by FAWs (18 PPT and 18 NPPT households).
The ratio statistics across the sub-counties indicated that the spread of FAW was higher among the non-push–pull farms by 69.9%. The push–pull farms showed a relatively less prevalence of 63.1%. Table 4 presents the ratio statistics.

Table 1: Correlations of age, gender, and PPT/NPPT

Variables	Age	Gender	PPT or NPPT
Age			
Pearson correlation	1	−0.065*	−0.342*
Significant (two-tailed)		0.650	0.014
N	51	51	51
Gender			
Pearson correlation	−0.065*	1	0.058*
Significant (two-tailed)	0.650		0.684
N	51	51	51
PPT or NPPT			
Pearson correlation	−0.342*	0.058*	1
Significant (two-tailed)	0.014	0.684	
N	51	51	51

*Correlation is statistically significant at the 0.05 level (2-tailed). PPT: Push–pull technology, NPPT: Non-push–pull technology

Table 2: Regions of survey

County	Sub-county	Villages
Migori	Awendo	Ringa Nyambija Kabar Wawaga Kadongo
	Rongo	Kamondi Rare Kabuoro Mtue
Homabay	Ndhiwa	Kombe Bwanda
	Mbita	Ogongo Agulo Kiuwo Bung Kwach Sigulei Gamba
	Rachuonyo South	Aolo
	Kasipul	Bonde

Table 3: Fall armyworm to PPT/NPPT cross-tabulation

Variables	PPT or NPPT		Total
	PPT	NPPT	
Fall armyworm			
Yes	7	8	15
No	18	18	36
Total	25	26	51

PPT: Push–pull technology, NPPT: Non-push–pull technology

Impact comparison between FAW and stemborer

The impact of FAW in relation to stemborers showed significant percentages between push–pull and non-push–pull. The ratio of FAWs to stemborers negatively impacting on crop

production among the push–pull farmers yielded a 34.2% in comparison to NPPT that had 74.2%. Table 5 depicts the ratio statistics as provided by the data obtained from the field.

In an analysis of this study by descriptive design, the explanations of the farmers (both PPT and NPPT) relating to the differences between FAW and stemborers were reviewed. The common answers given during the study provided a frame for a better analysis. Table 6 (descriptive statistics) shows the responses obtained from farmers on the differences between FAW and stemborers.

Farmers' practices of controlling FAWs

Table 7 shows the strategies tried by farmers to control FAW infestation. It includes the shortcomings that were expressed by farmers on applying the strategies. The answers obtained from the farmers as in Tables 6 and 7 were derived from the pretrial survey tool (Unstructured questionnaire).

Table 4: Ratio statistics for fall armyworm/sub-counties

Group	Price-related differential	Coefficient of dispersion	Coefficient of variation
			Median centered
PPT	1.453	0.444	63.1
NPPT	1.626	0.538	69.9
Overall	1.540	0.492	66.0

PPT: Push–pull technology, NPPT: Non-push–pull technology

Table 5: Ratio statistics for fall armyworm/stemborer

Group	Price related differential	Coefficient of dispersion	Coefficient of variation
			Median centered
PPT	1.066	0.210	34.2%
NPPT	1.176	0.596	74.2%
Overall	1.134	0.275	41.2%

PPT: Push–pull technology, NPPT: Non-push–pull technology

Regression

The significance of this study was placed in regression analysis as in the models below. ANOVA proves no significance for the variables in question, i.e. knowledge on FAW, imposed challenge, and difference between FAW and stemborer. However, correlations provides significance in FAW imposed challenge to PPT/NPPT. Further significances are found in differences of FAW and stemborers to FAW as a challenge and FAW as a challenge to PPT/NPPT correlations [Table 8].

DISCUSSIONS

The implication of FAWs outbreak is seen in its extended reach to farmers' fields in Migori and Homabay Counties. The cross-tabulation of FAW and PPT/NPPT farming practices indicates that farmers from both push–pull and non-push–pull households are affected at an almost equal number; 7 of push–pull and 8 of non-push–pull farmers' fields were affected. However, many of the farmers from both farming practices had not yet been reached by this havoc-wreaking pest. However, strangely, they also showed some fear over FAW extending out to their farms sooner or later.

The rate through which FAWs could spread at a certain time was tried on a ratio statistics model across the sub-counties. The outcome was that the PPT households had a relatively lower prevalence of 63.1% compared to NPPTs 69.9%. This depicted that PPT, to some extent, can slow the rapidness of the FAW. However, FAW still remains a bigger challenge worrying the push–pull farmers.

Comparatively, stemborers were found to have a lesser impact than FAW. A ratio statistic model providing for FAW against stemborer indicated

Table 6: Differences between FAW and stemborers as perceived by PPT and NPPT farmers

PPT farmers' responses		NPPT farmers' responses	
FAW	Stemborers	FAW	Stemborers
They act on entire plant (leaves, stems, and roots) Does a lot more damage and one can lose everything planted They act very fast They are bigger They have remained uncontrollable They burrow into the ground	They act on stems majorly The damage is on the stems They act much slower They are smaller Can be controlled by push–pull technology The effect remains on the stem	Feed on the tip of the crop Is voracious in its feeding pattern It destroys a plant much faster Totally prevents growth and is very dangerous It affects cob more than stemborers Majorly affects the young crops Has a lot of eggs associated/laid on leaves It affects all types of crops	Mostly feeds on stalks It breaks the stem in its feeding pattern Destroys a plant much slower Reduces the growth rate of a plant but does not totally prevent Slightly affects the cob Majorly affects the old crops Has comparatively less eggs Majorly affects the cereal crops

PPT: Push–pull technology, NPPT: Non-push–pull technology, FAW: Fall armyworm

Table 7: Strategies of FAW control practiced by farmers and the shortcomings

PPT households (strategies)	NPPT households (strategies)
Using buffer zones	Pesticides/insecticide spraying
Pesticides and insecticides spraying	Uprooting of the affected crops
Using push–pull technology	Using their indigenous technical knowledge
Uprooting of affected crops	Ash application
Ash application	Trying an early farming
Application of herbal concoction	
Intercropping method	
Shaking off of leaves	
Cutting off of the crops and killing the worms	
The shortcomings:	
Spraying did not work for many workers	
Ash did not work	
Some could not afford the pesticides or insecticides	
Some had no effective control and did not know what to do	

PPT: Push–pull technology, NPPT: Non-push–pull technology,
FAW: Fall armyworm

Table 8: Regression model for FAW and PPT/NPPT

Model summary				
Model	**R**	**R^2**	**Adjusted R^2**	**Standard error of the estimate**
1	0.189[a]	0.036	−0.026	0.511

ANOVA[a]					
Model	**Sum of squares**	**df**	**Mean square**	**F**	**Sig.**
1					
Regression	0.455	3	0.152	0.580	0.631[b]
Residual	12.290	47	0.261		
Total	12.745	50			

a. Dependent variable: PPT or NPPT
b. Predictors: (Constant), Do you know FAW? FAW as a challenge, can you tell the difference between FAW and stemborer?

Correlations					
		PPT or NPPT	**Can you tell the difference between FAW and Stemborer?**	**FAW as a challenge**	**Do you know FAW?**
Pearson correlation	PPT or NPPT	1.000	0.163	−0.030**	0.139
	Can you tell the difference between FAW and stemborer?	0.163	1.000	0.007**	0.355
	FAW as a Challenge	−0.030**	0.007**	1.000	0.091
	Do you know FAW?	0.139	0.355	0.091	1.000
Sig. (1-tailed)	PPT or NPPT		0.126	0.416	0.166
	Can you tell the difference between FAW and stemborer?	0.126		0.480	0.005
	FAW as a challenge	0.416	0.480		0.262
	Do you know FAW?	0.166	0.005	0.262	
N	PPT or NPPT	51	51	51	51
	Can you tell the difference between FAW and stemborer?	51	51	51	51
	FAW as a challenge	51	51	51	51
	Do you know FAW?	51	51	51	51

PPT: Push–pull technology, NPPT: Non-push–pull technology, FAW: Fall armyworm

that the PPT households had greatly reduced effects of infestation by 34.2% as the NPPT occupied largely at 74.2%. It is likely that both the pests totally diminish any cereal production by the non-push–pull farmers.

An understanding between both the farming groups regarding FAW and stemborer showed common behaviors of the pests. For instance, they explained that FAWs were quick, bigger, and uncontrollable while stemborers were slower, smaller, and controllable (controllable to push–pull farmers).

To complete the farmers' perception on this outbreak of FAW, the farmers' domestic strategies/practices for controlling them were focused on. Several common strategies used among the PPT and NPPT farmers were the use of insecticide/pesticide sprayers, uprooting of the infected crops, and application of ash. Using PPT method still remained a unique approach by the push–pull farmers. However, there were shortcomings involved over the strategies that the farmers tried to control the FAWs. Spraying and ash application did not seem to work for farmers. Moreover, some of the farmers could not afford the pesticides/insecticides for spraying onto their farms. Furthermore, some had no effective control and hence did not know what to do.

The regression model having three variables studied (Do you know FAW?, FAW as a challenge, and Can you tell the difference between FAW and stemborer?) showed that PPT/NPPT provided a great significance on FAW ($P < 0.05$; −0.030). The indication of the impact of FAW as expressed by farmers is real and hence is the significance level of this study.

CONCLUSION AND RECOMMENDATION

Farmers' perception on FAW outbreak is apprehensive. Explanations obtained from both the push–pull farmers and the non-push–pull farmers reveal the scary perception that FAW infestation has impacted on the fields and that has reduced the yields substantially in a brisk of time. The spread and action of FAW are quick, making it a more dangerous pest than stemborers. As a new outbreak, FAW infestation has surprised many farmers. Push–pull farmers have tried the PPT on their plots to control the FAW as used earlier to control the stemborers, but the result has proven a slight control compared to the non-push–pull; PPT derived a slight impact.

Therefore, this study gives way (or recommends) to further research on PPT, that is, to invent a further recourse that can help deal with this havoc-wreaking pest, the FAW.

REFERENCES

1. Craig J. Fall Armyworms Descend on East Africa; 2017. Available from: https://www.voanews.com/a/armyworms-east-africa/3853083.html. [Last retrieved on 2017 Jul 14].
2. Kruger K. Why it's Hard to Control the Fall Armyworm in southern Africa. The Conversation; 2017. Available from: theconversation.com/why-its-hard-to-control-the-fall-armyworm-in-southern-africa-72890. [Last retrieved on 2017 Jul 14].
3. Report From Food and Agriculture Organization of the United Nations; 2017.
4. Report from UN Office for the Coordination of Humanitarian Affairs, UN Country Team in Kenya;2017.
5. Species Spodoptera Frugiperda - Fall Armyworm Moth - Hodges#9666. Available from: https://bugguide.net/node/view/40787/bgimage. [Last retrieved on 2017 May 25].
6. UK Cooperative Extension Service: University of Kentucky-College of Agriculture. Available from: https://www.entomology.ca.uky.edu/files/efpdf1/ef110.pdf. [Last retrieved on 2017 Jul 14].
7. University of South California Libraries, Research Guides Link. Available from: http://www.libguides.usc.edu/writingguide/researchdesigns. [Last retrieved on 2017 Jul 14].
8. Professional testing intranet. Available from: http://www.proftesting.com/test_topics/pdfs/test_quality.pdf. [Last retrieved on 2017 July 04]