STATUS OF FALL ARMY WORM (Spodoptera frugiperda (JE Smith) IN WESTERN KENYA

Findings from field surveillance in Trans Nzoia County, March 6th to 11th 2017
Fall armyworm late instar caterpillar feeding on off season maize at Trans nzoia county.

Note: Such eating result to total failure of maize. Note the way the caterpillar cuts the maize; and the worm frass (feces) deposited on the leaves haphazardly and in large amounts.

Photo: Muo Kasina

Front page: Trans Nzoia county. Image, Muo Kasina
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Executive summary

Maize is the most important food security crop in Kenya. It is also a major commercial crop by most rural households. Its seasonal yields pretty much determine the food security situation in the country. In the recent past, maize has faced serious production and post harvest challenges. Locally, the African maize stalk borer (*Busseola fusca* (Fuller), Lep.: Noctuidae) has for long been a serious maize pest that continue to receive massive research attention. While it has been the most serious field pest in highland Kenya, the spotted stalk borer (*Chilo partellus* (Swinhoe), Lep.: Crambidae) has been very devastating in lowland Kenya. This pest was introduced into the country. In early 1980s, the larger grain borer (*Prostephanus truncatus* (Horn), Col.: Bostrichidae) invaded Kenya through the Tanzania route and caused massive grain loss. It has continued to be very devastating on harvested grains. Aflatoxin invasion of Kenyan-land is also a recent challenge for growing maize. For example, it was noted that in 2004, 317 cases of aflatoxicosis were reported in Kenya and 125 people died. In 2012, the maize lethal necrosis disease, which is a co-infection of maize by two viruses, the maize chlorotic mottle virus and sugarcane mosaic virus (or any of its family members), found its way into Kenya, causing huge economic losses to many households, and the country economic situation was done a blow. Since then, MLND has continued to attract series of international research aimed at solving its problems. For long, maize has been affected by African armyworm (*Spodoptera exempta* (Walker), Lept.: Noctuidae) outbreaks. It is even expected that this season will see the armyworm outbreak, which the state agency responsible for its control, is ready to combat, the way it has done in the past. Yet cutworms (*Agrotis* spp, Lep.: Noctuidae) are also serious occasional pests of maize capable of decimating a whole maize plantation.

The fall armyworm, FAW (*Spodoptera frugiperda* (JE Smith), Lep.: Noctuidae) is pest of western hemisphere, occurring mainly in the Americas. It has been detected in Europe several occasions but has not established there owing to effective actions taken against it. It closely resembles the cutworms in color (at late stages of larval development) and behaves similar way when held, i.e. coiling in a ‘c’ shape. No wonder farmers are easily taken to believe the fall armyworm are cutworms, hence taking laid-back position instead of actively managing the invasion. The FAW is a serious pest of more than 80 plant species. In Kenya, we noted its preference for maize. The findings show that the pest invaded Kenya in December with a possibility of its arrival late November. First notification by farmers interviewed was December 25th, 2016. At this time, the worms were heavily feeding, indicating that the pest might have invaded much earlier, to lay eggs and have time to grow the young stages that go unnoticed. The surveillance reviewed the pest is present in large numbers across the county and in the neighbor counties. Considering that the pest is infesting off-season crop, and the population is high, there is a reason to believe that infestation for the long season crop may be high.

It should be noted that fall armyworms are not gregarious like the African armyworms. However, a female lays eggs in batches, a single batch of 200 eggs can be deposited per
plant, and up to about 10 laying can be achieved by a single female. Therefore, more than one worm attacks one maize plant. Further, the pest life cycle is quite short during high temperature periods, which were common during the time of invasion. It can complete life cycle in two (2) weeks. Therefore, we note that these worms may be into their third generation since invasion in Kenya. It is also a strong flyer and can migrate long distances to invade new areas.

It is strongly recommended that all counties to form a FAW management strategy that should include strong farmer FAW identification and alert system. Farmers can easily recognize the pest (caterpillar) presence by checking damage (windows caused by young worms, and plant shredding by large worms), mass of frass on the plant (saw dust like substance when worms are small; large brown pellets at 5th and 6th instar); and presence of the worm (baby bluish and green when small; dark green 3rd and 4th; brownish at 5th and 6th instar). Farmers can easily differentiate this pest with stalk borers because the FAW does not bore into the stem and stay there; they bore, get in and continue to come out while at the same time shredding the plant haphazardly. In contrast, stalk borers have less frass on the maize and once they bore on the stem, they remain in. In comparisons to cutworms; the cutworms are serious on young crop and would cut it on the ground level. They will be found during the day on the ground underneath the cut seedling. The FAW targets above ground parts mainly the foliage and reproductive structures.

The suggested county led response should also include identification of effective pesticides; formation of village based spray teams to provide services to farmers who otherwise would not make any application-hence posing threat to the other farmers in terms of becoming breeding grounds for the pest; development of spray regime that includes monitoring infestation, early detection; preventive pesticide use; at least three(3) pesticide application across the season; and developing action for sensitization of farmers.

At the national front, we are recommending urgent action to combat the pest spread and effects on the food security. This should include, but not limited to, urgent insecticide research to identify best formulations and how to effectively use them; identify biocontrol strategy that includes use of egg parasitoids and entomopathogens such as NPV and Bt; enhancing predator presence in the farm; carryout economic studies that shall inform decision making on the pest management strategy to adopt; national strategy for sensitization of extension and farmers; developing pest management guidance documents; initiate country wide FAW surveillance program; use of pheromones for monitoring and control and initiate studies to understand bioecology of this pest for purposes of instituting proper and efficient management plan.

Even as we respond to FAW, it should be noted that the other pest challenges exist, and a holistic management system shall be needed for sustainable growing of maize.
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**Surveillance Purpose**

To ascertain the status (identity and economic importance) of the pest infesting maize in target farm in Trans Nzoia County, and its possible spread in other parts of the county and neighbor counties

**Surveillance Outcome**

**Target Farm: Mr. Edward Kairo**

Mr. Kairo had complained about the persistent pest problem on his maize plantation planted in late November 2016. He had used three pesticides: thunder, pentagon and alpha tata and none provided him with acceptable results. He thus neglected the crop under heavy infestation end January 2017. The pest damage was noted in December 25th, 2016 and since then it continued to intensify.

**Findings from the team:**

There was no effort in searching for the damaged maize, and the pest. About 98% of the maize was infested and damaged. Maize was generally wilting, due to neglect of management (lack of irrigation, while it has been very hot).

The caterpillars were observed and identified to be similar to the fall armyworm caterpillars: showing clear inverted yellow mark on the head, the four almost square dots at the 8th abdominal segment, and the characteristic color of the worm. Further, the damage was characteristic of fall armyworm, which includes the haphazard feeding/chewing of maize leaf tissue within the whorl and around the stem of maize, resulting to cutting its growing shoot. In addition, the characteristic frass, which is dust-like and sawdust like from young instars, and, large pellets from the large/mature instars. The worm seem not to like staying close to its frass, preferring to place it out side when it bores into the stem. However, it does not stay in the bore all through. Based on all these characteristics, the team declared it the FAW. Samples were collected for lab incubation and further identification.

**Notice:** The farmer noted infestation when already the damage was too high. He thought they were either cutworms or stem borers and therefore used the common effective pesticides that he has used in the past. He invited Bayer Crop Science (EA) for advise and complain about their product (Thunder) which he thought was ineffective.
Surveillance team (from left: Mr. Kairo, Dr Kasina, Jeremiah Ngure, Bore Emmanuel, Hellen Heya

*Photo: Joseph Mulwa*

Note the crop has been neglected due to massive infestation and inability to control the pest. In this farm, out of 120 plants randomly selected, 118 had high infestation and damage by the pest.

The farmer was utilizing the neglected crop to feed his dairy animals, at a distance of about 2km from the farm. The feed was carried by cart. This is one of the easiest way of spreading the infestation by this pest in new zones.
Maize stover carried for dairy fodder. This is a sure way of pest spread

*Photo: Muo Kasina*

**Sampling results from neighbor farms**

**Farmer: Mr. Oluoch**

A one-month old maize, planted about 300 m from Mr Kairo farm, had infestation by the FAW. Both caterpillars and their damage were observed. The farmer had also capsicum and kales but the pest did not infest these. Farmer had not used any form of pest control product.

**Notice:** The farmer had not seen the infestation as well as the damage. At a distance, it was not possible to notice the damage as well as the infestation. However, our keenness ensured we got to see.

*Photo: Muo Kasina*

One-month old infested crop. Note from a distance infestation can easily be overlooked

*Photo: Muo Kasina*
**Farmer: Mary Waweru**

This farmer neighbors Mr. Oluoch, and about 350m from Mr. Kairo. Maize was planted at start of December, but the crop was highly varied in age because of loss to the pest. The farmer noted first damage in December 25th, 2016, same period with Mr. Kairo. At this time, more than 60% of the crop could not go on hence she gapped. She also sprayed, in her own explanation, ‘plant by plant, ensuring full coverage’. She used Albaz, Alpha tata, Pentagon. At the time of visit, the crop looked good, with little infestation, less than 25%, which she intended to repeat a spray application.

**Notice:** The farmer thought these are cutworms but then later realized they could be different though she had no idea what it is. Also she noted infestation when it was too late.

![Picture of a maize field]

Note the crop looks quite good and infestation can be overlooked. The crop was also infested though at low levels, which required urgent control.

*Photo: Muo Kasina*

The farmer has experience in pest control, having worked in the past at flower farms in Naivasha. She adopted targeted spray application, which worked to her advantage.

**Further observations in the farms**

The team visited other maize farms located about 5 km and 15 km far from Mr. Kairo farm. The first farm was along the same valley while the other farms (2) were in another valley. All the sites were west of the first farm. In the first farm, maize was about same age as that...
of Mr. Kairo and it was positive of the pest infestation. The maize in last two farms was about 1 month old and both had positive infestation by FAW. The two farms were about 500 m apart within the same valley.

**Emergency meeting at the County Director of Agriculture, Trans Nzoia County**

The team urgently convened a meeting with the County Director of Agriculture, Mr. Kagai, for purposes of briefing and developing action plan against the pest. The following participated in the meeting:

1. Kagai, CDA
2. Dr Muo Kasina
3. Teresia Karanja
4. Hellen Heya
5. Joseph Mulwa
7. County agriculture officers (2): Jeremiah Ngure and Carolyne

The team updated participants on the findings. It was agreed that

1. CDA shall arrange an urgent County stakeholder sensitization on the pest comprising of all sub county Agriculture Officers, Ward Agriculture Officers, Sub County Crop Officers, selected Field extension officers, Plant doctors serving the county and all seed companies that have contract farmers or maize farms. The meeting was scheduled on Thursday 9th, 2017

2. The team to develop three(3) surveillance teams to cover the whole county and possible neighbor counties for confirming the pest. The teams were formed and three routes were identified. It composed of the Nairobi team leaders and the sub county crops officers as the guide

3. Two country agriculture officers (Mr. Jeremiah Ngure and Ms. Carolyne) were mandated to collect information on insecticides available at the county level for purpose of developing insecticide management strategy against the pest. Information required was the molecules (trade names and active ingredients), and quantities (kg, l) per each molecule
4. The Plant Protection Service Division was tasked to implement the sprays on Mr. Kairo farm and those along the valley, as the team generates more information about the pest spread in the county.

Meeting participants outside the County Director of Agriculture office, Trans Nzoia County

**Results of the within Trans nzoia county and neighbor County surveillance**

**Team 1: Kitale-Endebes-Kwanza**

The area has about 3 weeks old crops particularly in the Kenya Seed Company farms and ADC farms, as well as some other large growers. There was positive identity of the pest. Infestation was very high. Some farmers were dusting with Nova, spraying diazinon, rocket, tremor, duduthrin, bulldock, dursban. Farmers had detected the pest in February 2017.

In Kwanza, there was also high infestation of maize by stalk borer, Buseeola fusca

**Notice:** farmers thought the pest is not new but the damage was very strange.
**Team 2: Kitale-Kiminini-Kimilili (Bungoma)**

In all the farms visited, the pest was positively identified. In some maize plants, damage was noted but the worm was not present. In such cases, a predator was noted. In one of the farms, there was high presence of predators, which contributed to reduced infestation.

In Kimilili (a scheme called the Promise), one farmer had used diazinon when the infestation was noted. This crop was much better in terms of reduced damage compared with border farms, which had very high infestation levels.

**Notice:** in all the farms, farmers thought the infestation is by same pests (stem borers or cut worms). Infestation was also noted when damage was already high.

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**Team 3: Kitale-Cherengani-Birimbiet-Tuigoin-Cheuta (Uasin Gishu)-Kapsara-Munyaka**

The pest was recorded in most of the areas and it is fully spread. Farmers in Tuigoin noticed the pest infestation first on 4th march 2017 and sprayed Duduthrin. In Cheuta, the farmers noticed infestation 27-28th February 2017 and were now planning to apply an insecticide.

**In conclusion**

It was noted that the pest is across Trans Nzoia county and the neighbor counties: Bungoma, West Pokot, Uasin Gishu and there is high likely it is in all border counties with Uganda and it is spreading inward Kenya.
Highly infested fields of irrigated maize at Promise, Kimilili Sub county, Bungoma County. Note the caption of close-up look of one of the infested maize.

*Photo: Muo Kasina*

Further meeting at the county director of agriculture office, bringing together members of the surveillance team, noted the urgency to sensitize lead extension service providers that will ensure farmers are fully prepared as the season begin.
Fall Armyworm sensitization workshop for Trans Nzoia county at Iroko Boulevard Hotel, Kitale

The meeting was undertaken on March 9th, 2017. It was attended by 98 participants that included 75 ministry of Agriculture county officers drawn across the county, seed company representatives, pest control company representatives and the team from Nairobi (KALRO, KEPHIS, PPSD-SDA MOALF). Amongst all the participants, females were 27 while male were 71.

Presentations done focusing on

1) Notification and management of fall armyworm
2) Taxonomic identification of the fall armyworm
3) Pest ID card developed by KEPHIS

Participants following on the presentations

(Attached are the presentations and pest ID card from KEPHIS)

The outcome of the workshop included, but not limited to:

1. County wide knowledge about the pest and how to differentiate from stalk borers and cutworms
2. Initiating pesticide recommendation procedures
3. County government to develop best response mechanism against the pest
4. Seed companies to immediately start controlling the pest their farms
5. Two (2) pesticide companies present advised the participants that their products are working in South Africa. These products include
   a. Thunder OD 145 (Imidacloprid 100g/L + Betacyfluthrin 45g/L) recommended at higher rate (0.4 l/ha (30-40 ml/20l pump).
   b. Belt 480 SC (Flubendiamide 480g/L), recommended at a rate of 0.22 l/ha (5ml/20l pump).
   c. Engeo 247 SC (Thiamethoxam 141 g/L + Lambda-cylothrin 106 g/L) recommended at a rate of 150 ml/ha (8-10 ml/20l pump).

It should be noted that this pesticide information is based on the owner recommendations since no tests have been undertaken in the country. We cannot guarantee their efficiency and we have no experience on their use.

Implications of findings
I. The occurrence of fall armyworm is now confirmed in Trans Nzoia, Bungoma and Uasin Gishu and neighboring counties. This demonstrates the ability of this pest to spread very fast.

II. Field observations reveal the insect caterpillars are in the second/third generation, which indicates this insect pest is getting established within this locality.

III. The caterpillar populations observed in the few farms sampled are high and this point to the likelihood of fall armyworm reaching a population explosion within a few weeks which unfortunately will coincide with the March main maize planting season.

IV. A combination of favorable weather, presence of susceptible host plants in abundance and an insect pest, which is multiplying very fast signals serious threat to food security.

V. The likely widespread occurrence of this new pest across many maize growing counties implies spraying of maize crop to mitigate against the pest is going to be an involving and continuous activity. This therefore calls for concerted efforts from National and County Government besides the individual farmers who also have a critical role to play.
Suggested recommendations

1. The Multi-institutional consortium to consolidate, package and develop technical information materials (Brochures, Posters) on fall army worm for dissemination to counties

2. Strengthen national and county capacity in surveillance, diagnostic skills and management of fall army worm by training public-private extension service providers, seed inspectors, agrochemical dealers, spraying teams and scientists

3. Undertake intensive public awareness / sensitization campaigns through mass media channels targeting the March planting season

4. Upload the fall armyworm technical information and fact sheet into all relevant websites e.g. KALRO, KILIMO, KEPHIS to enhance access by all

5. Encourage the agrochemical companies to undertake efficacy trials to fast track possible registration for insecticides and Pheromone lures against this pest.

6. Consolidate and disseminate guidelines to farmers on range of insecticides, which they can apply and possible spraying regime. The field observations gives projections farmers will need to apply a minimum of three sprays to adequately protect the crop; First at two weeks after emergence, 2nd spray at knee high and 3rd spray when crop is just before tassling.

7. The seed companies to undertake routine spraying and eradicate this pest from all the seed farms including those of their contracted farmers

8. Although majority of farmers may be able to spray their farms, the vulnerable farmers may not be able. This calls for assistance by counties to contract village-based spray teams to assist poor farmers. Unless appropriate measures are taken, such neglected farms become breeding grounds for the insect which ultimately negates the efforts of all neighboring farmers

9. There is need to demarcate infestation borders to safeguard spread of this pest to other counties where it has not yet been observed. This will entail mounting of pheromone at strategic borderline. High-density pheromone traps can be used for mass trapping and possible eradication of pest populations in outbreak areas hence preventing spread to new areas.

10. Scientist to urgently undertake pest management research, including germplasm screening for resistance/tolerance, biology and ecology of the pest, biocontrol, efficacy trials and other pest control strategies
11. Urgent national surveillance to be undertaken to determine spread of the pest with possible prevention of its inroad into the country. This includes deployment of pheromone traps

12. Green maize trade is currently the most fasted pathway for this pest to spread across the country. Ways to prevent this pest spread through this means should be immediately explored and implemented

**Recommended quick actions by county governments**

Further to the above recommendations the County Governments are also encouraged to do the following

1) Counties/regions to synchronize their sowing calendar and discourage late sowing as a strategy to help minimize effects of this pest.

2) Counties/regions to discourage movement of infested maize materials from one area to another even within the same farm or long distance.

3) Farmers be advised to directly allow livestock to graze on infested materials instead of cutting and carrying such materials

4) Mechanical control through hand squashing of caterpillars when maize is planted on very small plots can help reduce population build up

5) For sustainable management of this pest, deployment of IPM packages will be critical to avoid over reliance on pesticides

6) Farmers to be encouraged to undertake regular scouting for early invasion detection and timely application of appropriate measures