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Research Article

KwaZulu Natal Regional Agricultural Policy (RAP) EDF 11 Project Report

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Abstract

Transboundary plant pests and pathogens damage cultivated and naturally growing plants by interfering with their growth that can lead to substantial losses for farmers and threaten food security. Projects on general surveillance provide growers and the broader public with information about pests and encourages them to report of any unusual symptoms on crops. Northern KwaZulu Natal was targeted for 5 priority pests. The activities to determine pest presence involved scouting for symptoms, collecting samples for diagnostic analysis and use of trap to lure pests to verify their presence within an area. Of the five priority pests only 3 were found to be present. The insect plant pests were the ones detected due to their mobile ability to spread at a higher rate. Plant pest control measures are important to maintain good health of plants. Field observations also provide essential information that could assist on pest management e.g. cultural methods. This project was highly valuable in concluding the interventions that farmers could utilise to protect their crops.

Keywords: *Surveillance, Fall armyworm, Plant Pests, KwaZulu Natal, Disease Management*.

Introduction

To conduct pest surveillance of 5 transboundary pests namely exotic fruit flies, *Tuta absoluta* (Tomato Leaf Miner), Panama disease (TR4), Maize Lethal Necrosis Disease (MLND), and Fall armyworm (*Spodoptera frugiperda*) as part of the Food and Agricultural Organisation (FAO) regional Regional Agricultural Policy (RAP) EDF11 project. Targeted areas in Northern KwaZulu Natal province, South Africa will include Kosi Bay, Manguzi, Makhathini, Jozini, Pongola, Ndumo and Vryheid. The project is aimed at supporting activities and implementation of modalities to successfully manage pests and reduce negative impact in the agricultural industry (SADC, 2022). The project has been involved in strengthening capacity within different institutions to ensure sustainable agriculture. The programs under the EDF 11 project have also allowed training of officials involved in the agricultural sector including the advisory services, procurement of trapping material to optimise operationalisation within agriculture and rural development among other services.

Background

Pest surveillance is the early detection of emerging pests and diseases before they can become widely established (McCallum. *et al*., 2021; Suckling. *et al*., 2022). This includes quarantine pests due to their potential economic importance to the area whether not yet present there, or present but not widely distributed and being officially controlled. Surveillance of pest incursions increases a chance of containment responses such as eradication to ensure that the pests are managed (Suckling. *et al*., 2022). Importantly also, surveillance demonstrates to trading partner's evidence of the presence or absence of the pest for market access (Lemes. *et al*., 2021). High-risk areas and high-risk pathways need to be identified and managed to determine the occurrence of pests and to enhance management options (Dean. *et al*., 2021). Efforts to contain pests involve ports of

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entries e.g. airports, borders and inland activities to reduce the likelihood of pests establishing in a particular area (Nelson. *et al*., 2021). Where host species in the agricultural systems are available observations and surveillance should be conducted for any pest detection and management actions. Land users and extension officers need to be informed through awareness mechanisms to enhance potential of vial pest detection and to allow pest notification. The National Plant Protection Organisation of South Africa (NPPOZA) have a responsibility to ensure that biosecurity measures such as surveillance activities are carried out in specific areas where there is targeted hosts (Rambauli, 2021). The data collected from survey activities e.g. trapping or sample collection the results of the survey will have a statistical basis and be easier to interpret.

Globally, in recent years, the introduction of novel pests and diseases into plant, animal and human ecosystems has accelerated (Jactel. *et al*. 2020). The majority of novel pests and diseases are found in plant ecosystems linked to climate change (Boyd. *et al*. 2015). Various horticultural crops (e.g. citrus, stone fruit) have required rapid response management techniques from exotic fruit flies including *Bactrocera dorsalis*, Mediterranean fruit fly (*Ceratitis capitata*) among others (Dominiak. *et al*., 2016).

The fall armyworm (FAW) was detected earlier in the southern parts of Africa in 2017 after the first incursion in 2016 making it a major international pest and is a notifiable quarantine pest in South Africa (Day. *et al*., 2017). The fast spread of the pest resulted to a shock in the agricultural sphere. Fall armyworm is known to travel up to 2000km long-distance migration and benefits from strong and persistent wind patterns to infest new areas (Early. *et al*., 2018). Surveillance for FAW is important considering the need:

1. For effective pest control, it is important to determine the occurrence of pests as early as possible.
2. In order to determine when FAW emerges or migrates to the colder maize production areas.
3. To determine the presence and density of the FAW in cooler and warmer areas.
4. For making informed decisions regarding the procurement of chemicals for control purposes.
5. To prevent production losses which could lead to food insecurity in some communities.

The indicated considerations for surveillance also apply for other pests. *Tuta absoluta* has very rapidly become a massive pest to home gardeners and commercial growers alike for *Solanum Linnaeus* (Solanaceae) species in South Africa. *Tuta absoluta* can produce in excess of 10 generations in a single season, with an individual female can lay 200-300 eggs. There are a few crops that are affected by *Tuta absoluta*, including tomatoes, peppers, brinjals, and potatoes. Losses typically start at 60% and very rapidly increase to a point where the entire crop is lost (Rhoda. *et al*., 2015; González-Cabrera. *et al*., 2011).

The sharing of uncertified seeds and infected plant propagation material e.g. banana suckers is among the big spreaders of plant diseases that poses high risk through movement by people. Plant diseases have a negative impact that can affect yield and result to direct and indirect to farmers including the agricultural industry at large. While MLND is known to be transmitted by different vectors a study by Jenson. *et al*., (1991) confirmed that MLND is also transmitted by seed. The sharing of banana suckers places in the industry to other diseases such as Black Sigatoka (fungal), Banana Bunchy Top Disease (viral) and the prioritised viral disease Panama Disease. Banana plants need to be regularly scouted for the presence of unusual disease symptoms.

Northern KwaZulu Natal borders Mozambique and Swaziland that offers a landscape for new and emerging pests. Northern KwaZulu Natal is a risk-targeted area therefore, surveys are conducted to confirm the presence of the pests, particularly at an early stage and to confirm the absence of the pests. The presence of pests is followed by management practices, population estimation and mapping.

Methodology

Surveillance initiatives raise awareness about specific pests among growers and the wider community. Awareness about pests also results to most land users (i.e. farmers and advisory officers) observing and reporting pests. The increased access to technology e.g. mobile phones, emails has been quite useful in reporting. The use of applications such as the Fall Armyworm Monitoring and Early Warning Systems (FAMEWS) has played an important role when it comes to reporting and pest mapping (Niassy. *et al*., 2021; Buchaillot. *et al*., 2020). In this report, the aim is to indicate challenges that arise during surveillance and the status of the priority pests under the RAF EDF11 project in Northern KwaZulu Natal. Being informed about the possible challenges during a survey can assist with mitigation measures for things to take into consideration when planning. Knowing the pest status of the priority pests can also assist the NPPOZA to diversify programmes that farmers can use to manage the pests. Additionally, this project aims to identify and develop sustainable practices (cultural, biological and chemical) to prevent the spread of the pests. The priority pests can be surveyed in different ways:

FAW

While visible symptoms can be seen in the affected crops, FAW adults can be trapped using either a bucket infused with a lure and a killing strip or Delta trap that employs a sticky surface with a lure. Traps should be placed 300mm above the crop on a pole / support. Traps are best placed up wind of, and at the start of the crop. The area where the trap is placed is noted and geo-mapped. In Mkhanyakude district FAW pheromone lures were worked in November – February 2022 in the maize growing farms. Traps were placed mainly along the edges of the maize field, suspended on poles that were atleast 1.5m high. The plan was to service the lures after a month but heavy rainfalls and logistical challenges prevented the operation to service after 4 weeks. Fortunately all the traps were found, maize had been harvested and stalks dried off. The traps did indicate moth catches. Traps were not further placed in the surrounding area as no new maize plantings were found. Traps were placed in a new area in Vryheid in Northern KwaZulu Natal Province from the 16-17th February 2022. There were hosts including maize and sorghum. Traps were serviced on the 15-16th March 2022.

Tuta absoluta

Tuta absoluta traps can be placed in tomato fields using a pheromone trap that employs a sticky surface with a lure. The trap functions best close to soil level. The area where the trap is placed is noted and geo-mapped.

Exotic Fruitflies

Fruitflies are trapped using a yellow bucket, a species-specific lure is place together with a killing strip inside the bucket. The trap should atleast be 1.2m above ground in a preferably shady environment. The area where the trap is placed is noted and geo-mapped. Traps are best serviced after 4 weeks. There is an ongoing survey with 248 traps in total for Biolure and (methyl eugenol) ME in Northern KwaZulu Natal targeting production areas, areas where wild hosts are prevalent, points of entries such as border gates. Cuelure (C-L) traps were placed as additional pheromone traps to detect for in three border gates (Kosi Bay, Golela and Onverwacht), one bordering Mozambique and two bordering Swaziland. The infestation of fruit fly *Zeugodacus cucurbitae* previously called *(Bactrocera cucurbitae)* is known to be severe in all the cucurbit crops (Mkinga. *et al*., 2015). With increasing travel and foreign trade, the possibility of accidentally importing *B. cucurbitate* is a matter of continuing concern to the agricultural community. Cuelure, is an effective attractant and should be used to quickly detect any flies that may gain entry and become established. In an established infestation Cuelure traps would be invaluable in guiding eradication operations.

MLND/ TR4
Plantations are scouted for unusual symptoms. Leaves that show disease are usually sampled, placed in brown envelopes, can be refrigerated and sent to the lab for diagnostic verification.

Results and Discussion

Pheromone traps are primarily used to provide early warnings for possible FAW egg and larval abundance. Scouting remains important to accurately assess the presence of eggs and larvae.
Pheromone traps may hold potential for predicting ahead of time when outbreaks will occur. Weekly scouting in young cane is generally adequate for catching infestations in time to prevent severe defoliation.

In Jozini, Makhathini, Ndumo
There were no new maize plantings observed only adult maize was found. Symptoms of FAW were seen in every field visited however the cobs were not affected meaning maize yield was not affected by the presence of FAW. The condition of moth samples found in FAW traps were not in a conducive state to be sent to the lab for polymerase chain reaction (PCR) analyses. While larvae was detected when traps were placed due to dry conditions of maize no further larvae were found. Importantly while FAW is known to affect sugarcane in other countries there has been no evidence of FAW affecting sugarcane in South Africa even in instances where affected maize was nearby.

Ndumo Irrigation farm was visited of all the traps placed only one FAW trap was found on dried maize. The fields had all been harvested; some with new cabbage plantings and in others long grass. From the FAW trap found about 10 unusable moth catches were found, suspected to be FAW. In Mjindi irrigation farm in Makhathini the FAW trap was found with 8 unusable moth catches suspected to be FAW see Table1. FAW pheromone trap counts in Mkhanyakude district Numbers in the table are standardised counts for seven weeks trap nights, whereas for Vryheid it was within the recommended 4 weeks trap nights.

Table 1: Showing a number of FAW specimens collected in uMkhanyakude district, KwaZulu Natal

District	Location	Week starting	Week ending	Number of specimens
uMkhanyakude, KwaZulu Natal	Ndumo Irrigation farm	8-12th November 2021	13-18th February 2022	10
uMkhanyakude, KwaZulu Natal	Mjindi irrigation farm	8-12th November 2021	13-18th February 2022	8

In Vryheid
Findings of FAW varied within farms. One farmer with early maize planting had no FAW damage just a few plants were affected by Maize stalk borer (*Busseola fusca*) with minimal damage, farmer (A). The late plantings in the same farm had no damage, the late planted maize was planted in the heart of the field and not on the border sides. This can be one of the best methods farmers adopt for late plantings to also minimise the use of chemicals in the fields. The other farmer (B) within less than 2km radius had significant damage on his maize particularly for late plantings. Damage was mainly on the boundary sides. Two other farms (C and D) in the area experienced the similar trend as farmer (B). However, farm (C) showed signs of water deprivation, in farm (D) affected maize was very young. Farm (E) had maize and sorghum; from observation, sorghum was not affected by FAW whereas visible damage symptoms and larval populations were found in maize. A similar trend of late maize plantings was severely affected, almost 100% damage was noted for that farm should there be no recovery. The earlier maize plantings were at tasselling stage showing good recovery even though FAW damage was observed. The traps were observed after 4 weeks, moth numbers are indicated in Table 2. The maize in all farms showed great growth improvement except farm (D), maize remained shorter and FAW damage could still

be observed even though the trap had been lost, see Fig.1. For optimal resistance to diseases soil needs to be healthy. In Farm (D) due to poor soil quality the maize remained quite shorter and had not reached tasselling stage after the next visit with maize still showing visible symptoms of FAW.

Figure 1: Showing FAW damage in Farm (D) with very limited growth development after a month of infestation

The ongoing rains led to maize recovery, no visible damage of FAW on cobs in Farm (E), see Fig.2.

Figure 2: Showing Farm (E) where maize was heavily infested, on the left and due to rains managed to recover back fully, on the right

Given that it was the first report of FAW in the area suggests that the FAW specimens captured in the traps were a first generation in the area. Continuous weekly monitoring during the upcoming maize seasons will provide the detection of increases in the weekly captures of FAW. Farmers in the area may notice the drop in the number of worms and an increase again once a second generation produces more worms. The threshold level for insecticide application varies with each crop. Effective control can only be obtained if the larvae are sprayed during the early development stages as control of adult larvae is very difficult. This pest does not have diapause and therefore must begin a new series of migratory flights northward each spring in order to re-infest temperate other cropping areas. Therefore once the pest is in an area it is likely to remain as a resident pest as it pupates and develops into further generations when environmental conditions are conducive.

Table 2: Showing a number of FAW specimens collected in Zululand district, KwaZulu Natal

District	Location	Week starting	Week ending	Number of specimens
Zululand, KwaZulu Natal	Nyandeni Farm (A)	14-18th February 2022	14-18th March 2022	19
Zululand, KwaZulu Natal	Glakstad area (B)	14-18th February 2022	14-18th March 2022	26
Zululand, KwaZulu Natal	Vaalskop (C)	14-18th February 2022	14-18th March 2022	12
Zululand, KwaZulu Natal	Golden Valley (D)	14-18th February 2022	14-18th March 2022	Missing trap
Zululand, KwaZulu Natal	eSikhaleni seNgonyama (E)	14-18th February 2022	14-18th March 2022	7

Tuta absoluta was prevalent in the area, just when the trap had been set over 100 specimens were counted, flocking into one trap. All other traps had over 300 specimen saturation collected which suggests a high infestation in the area, see Fig.3. In tomato fields, the trap catches clearly did not indicate growers' use of pesticide applications. Farmers were encouraged to use different modes of actions on pesticides applications each season.

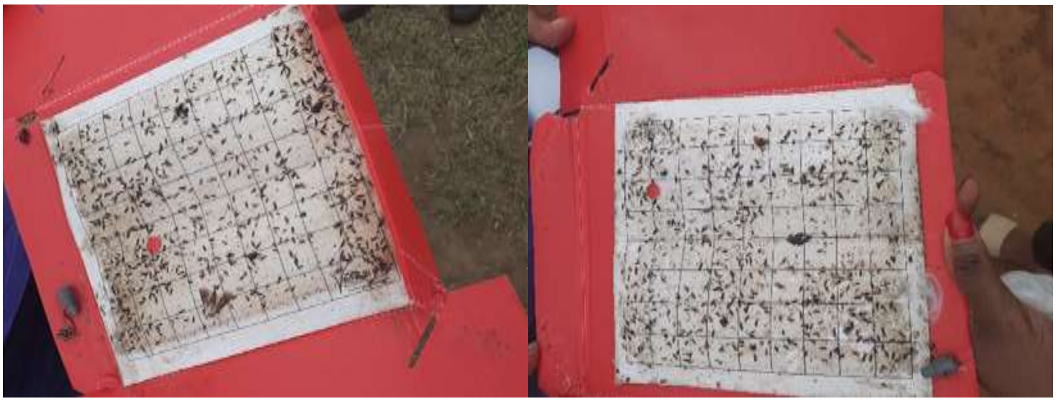

Figure 3: Showing specimens of *Tuta absoluta* that were caught in the sticky trap.

There was mainly Pisang Awak cultivar in most banana plantations in northern KwaZulu Natal. No visible symptoms of TR4 visible. However, in one plantation symptoms that resemble Black Sigatoka (fungus) were taken for lab diagnostics (verification), where the results were negative to the disease. In Vryheid only one farmer had banana plantings and it was in good health, growing well despite the climate variation.

Maize Lethal Necrosis resembling leaves that were sent for diagnostics proved negative. This indicates that there were no verified farms in northern KwaZulu Natal presenting the symptoms of MLND. The farmers do however need to be encouraged to optimise the health of soil as most other maize plants had symptoms of Boron deficiency.

Fruitflies, *B. dorsalis* in northern KwaZulu Natal continue to be high in catches exceeding all other districts in the province whereas no positive *Z. cucurbitae* have been confirmed. Monthly fruitfly trapping will be ongoing.

Conclusion

Pests and plant disease management is crucial in ensuring food security and securing environmental sustainability for subsistence and commercial farmers. Awareness, knowledge sharing and understanding are crucial interventions to engage different stakeholders towards disease management and sustainable agriculture within countries.

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