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Research Application Summary

Invasions by insects in Mozambique – a threat to agricultural production and food security

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Abstract

Biological invasions or invasive alien species (IAS) are those plants and animals which are introduced, establish and spread outside of their home range, causing economic, social and environmental harm. The term ''biological invasion'' highlights the negative consequences of population migration represented by the impact on biodiversity, human economy and/or health. Biological invasions are emerging as one of the major threats to sustainable development, impacting agriculture, biodiversity, ecosystem services and human health, and increasing human vulnerability. In the recent years, the rate of introduction of invasive species in Mozambique is increasing. The most recent introductions include the papaya mealybug, *Paracoccus margitatus* and the melon fly*, Zeagodacus cucurbitae* (both detected in 2013) posing a serious threat to food security and income for the small and large scale farmers. Because most introductions are due to human activities, reinforcing national phytosanitary legislation, especially inspection services may reduce the movement of insect species from their native range to new habitats, reducing biological invasions. It is therefore essential to develop efficient national phytosanitary legislation to prevent or minimize adverse impacts of invasive plants. This paper reviews the threat of biological invasion by insect pests in Mozambique.

Keywords: Biological invasions, invasive species, Mozambique, *Paracoccus margitatus*

Résumé

Les invasions biologiques ou les espèces exotiques envahissantes sont ces plantes et animaux qui introduits, s'installent et se propagent en dehors de leur habitat, causant ainsi des problèmes économiques, sociaux et environnementaux. Le terme «invasion biologique» met en exergue les conséquences négatives des migrations des populations d'espèces à travers les impacts sur la biodiversité, l'économie humaine et/ou la santé. Les invasions biologiques émergent comme l'une des menaces majeures pour le développement durable, impactant l'agriculture, la biodiversité, les services écosystémiques et la santé humaine, et augmentant la vulnérabilité humaine. Au cours des dernières années, le taux d'introduction des espèces envahissantes au Mozambique a augmenté. Les introductions les plus récentes sont celles de la papaye, *Paracoccus margitatus* et la mouche à melon, *Zeagodacus cucurbitae* (toutes deux détectées en 2013) présentant une menace sérieuse pour la sécurité alimentaire et le revenu des petits et grands agriculteurs. Comme la plupart des introductions sont dues aux activités humaines, le renforcement de la législation phytosanitaire nationale, en particulier les services d'inspection peut aider à réduire le

mouvement des espèces d'insectes de leur habitat naturel vers de nouveaux habitats, réduisant ainsi les risques d'invasions biologiques. Il s'avère donc essentiel de développer une législation phytosanitaire nationale efficace pour prévenir ou minimiser les effets adverses des plantes envahissantes. Cet article a donc examiné la menace de l'invasion biologique par des insectes nuisibles au Mozambique.

Mots-clés: invasions biologiques, espèces envahissantes, Mozambique, *Paracoccus margitatus*

Introduction

The most damaging agricultural pests are the introduced invasive species, which represent a major threat to agricultural production and food security. Introduced to new regions without natural enemies that control their population at their native home, invasive species can easily reproduce, increase their population density and spread over vast areas, infesting crops (Witt, 2014).

Economic losses due to invasive pests in Southern Africa were estimated to be at US$1 billion per year due to artropod pests (Witt, 2014). More recently the impact of the arrival in Africa of the Orienatal invasive fruit fly, *Bactrocera dorsalis*, was estimated to amount to US$ 2 billion annually (Ekesi *et al.,* 2011). Much attention should therefore be given to understanding the invasion mechanism and measures to prevent future invasions. The aim of this paper is to discuss the threat that biological invasions of insect species represent on agriculture and food security in Mozambique and to consider recommendations to prevent the risk of future invasions.

Biological invasions progress. The introduction of an insect species to a new area progress through four main distinct population processes: 1) arrival (the process by which individuals are transported and Introduced to new areas outside of their native range), 2) integration (process of species adaptation and/or ecological adjustment to the local environmental conditions), 3) population growth and establishment (the process by which populations grow to sufficient levels such that extinction is highly unlikely), 4) spread (the expansion of an invading species' range into new areas) (Liebhold and Tobin, 2008), and 5) economic impact (damaging stage and interfering with human activities).

Species that maintain high rates of growth, maturation and reproduction over a wide range of environmental conditions are more likely to become established once introduced into a new habitat. Specific management strategies can be implemented to mitigate the risk posed by an invasive species at each phase (Huber *et al.*, 2002).

Biological invasions in Mozambique

Many invasive insect species which have been introduced and established in Mozambique have become a major agricultural, ecological, social and economic pest problem,

undermining national economy development, increasing human vulnerability and threatening food security of the population in rural areas (Cugala, 2016). In the recent years, several invasive species have been accidentally introduced and established in Mozambique including the invasive oriental fruit fly, *Bactrocera dorsalis,* melon fly, *Zeugodacus cucurbitae*, the papaya mealybug, *Paracoccus margitatus*, coconut whitefly, *Aleurotrachelus atratus,* among others. Although invasions are old as life itself, there is no doubt that biological invasions will continue to increase in frequency as global trade increases (Malacrida *et al.*, 2007). Without appropriate management measures, Mozambique will be at high risk of entry of exotic pests which may have serious social and economic consequences.

The impact of biological invasions. Invasive species have many potential direct and indirect effects, which can be categorized as deleterious to (1) human health, (2) agricultural and forest production, (3) biodiversity, ecosystem services and natural resources (Huber *et al.,* 2002). Crop losses due to invasive species in Southern Africa were estimated to be at US$1 billion due to artropod pests (Witt, 2014). More recently the impact of the arrival in Africa of the invasive fruit fly, *Bactrocera dorsalis*, was estimated to amount for US$ 2 billion annually (Ekesi *et al.*, 2011). Losses of 100% on tomato have been reported in Ethiopia due to the tomato leafminer, *Tuta absoluta* (Meyrick), recently introduced in Africa (Belay and Siyoum, 2013). In Tanzania, the price of tomato has increased 375% as a consequence of low tomato production due to *Tuta absoluta* infestation and losses of about US$176.5 million
per year (Adams, 2015).

In Mozambique, invasive species with impact to agriculture include Larger grain borer, *Prostephanus truncatus,* Oriental fruit fly, *Bactrocera dorsalis,* Coconut white fly, *Aleurotrachelus atratus,* Papaya mealybug, *Paracoccus marginatus*, Spiraling whitefly, *Aleurodicus disperses* and Cassava mealybug (*Phenacoccus manihoti)* (Cugala, 2016). A temporal suspension of fruit exports to South Africa for three weeks resulted in the loss of US$2.5 million and virtual cessation of investiments on fruit production in the central region of Mozambique (Cugala *et al.*, 2011). The Larger grain borer (LGB), has caused losses up to 62% on maize grain weight and reduced maize storage period from 10-12 to 6-8 months in small scale farmer granaries (Cugala *et al.*, 2007). Without appropriate phytosanitary measures, Mozambique will be at high risks of entry and establishment of exotic invasive pests which may have serious social and economic consequences.

Globalization, population growth, increased human movement and accelerated trade are likely to increase the threat of invasive species and their impact is likely to worsen. Therefore, cost effective measures must be taken to prevent introductions of such species into the country.

The status of Mozambique vulnerability and the challenge of new invasions

Mozambique has enormous potential for agricultural production and favorable agro-climatic conditions for a diversified agricultural production (Cugala, 2011) which

may favor the establishment of introduced species. There are many pests with high potiential of introduction in Mozambique. These include: the tomato leaf miner, *Tuta absoluta* (Meyrick) (Lepidoptera Gelechiidae), native to South America which has recently spread to Tanzania and Kenya (Tonnang *et al*., 2015) and the polyphagous fruit fly, *Bactrocera zonata* Tinsley (Diptera: Tephritidae), which is devastating fruits in Sudan (Salah *et al*., 2012). Therefore, the focus of the national phytosanitary authorities should rather be on improving the measures aimed at preventing such species from crossing into Mozambique. Thus, the national phytosanitary authorities should strengthen phytosanitary measures to prevent introduction and establishment of potential exotic damaging insect pests through the importation of plants and plant products.

Conclusions and recommendations

A developed means of transport, the increased mobility and human interaction through trade, travel for tourism and agricultural products are some of the most important pathways that contribute to the increasing rates of introduction of invasive species in Mozambique. The current tendency of increasing rate of introductions of new invasive species indicate that the present status of national phytosanitary regulation and phytosanitary inspection services need reinforcement. Because long-distance dispersal is often caused by human activity reinforcing national inspection services may reduce long-distance dispersal and thus reducing biological invasions. Without appropriate phytosanitary measures, Mozambique will be at a high risk of introduction and establishment of exotic invasive pests which may have serious social and economic consequences. It is therefore essential to develop efficient national phytosanitary legislation to prevent introduction of invasive species and minimize their adverse impacts on the national economy.

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