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Research Application Summary

Assessment of groundnut yield loss due to the groundnut leaf miner, *Aproaerema modicella* infestation in Mozambique

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Abstract

The groundnut leaf miner, *Aproaerema modicella* Deventer (Lepidoptera: Gelechiidae), is an invasive alien Asian species in Mozambique. *A. modicella* was reported for the first time in 1998 in Uganda. In Mozambique, Groundnut leaf miner was first reported in 1999 in Zavala district, Inhambane province. Levels of infestations of 100% and complete yield losses and withdrawal from groundnut cultivation by farmers have been reported in the southern provinces. To establish the level of yield losses due to infestations by *A. modicella*, two experiments on screening of insecticides were conducted in Nhacoongo and Chidenguele South of Mozambique. The results showed that this invasive species occurs at high population densities in the southern region (>30 larvae/plant). Yield losses of 62.9% and 86.2% were recorded respectively in Chidenguele (Gaza province) and Nhacoongo (Inhambane province). The current results suggest that this species is well established in groundnut production areas in the study area. This posses a potential threat to groundnut production and food security in the country.

Key words: *Aproarema modicella*, groundnut, groundnut leaf miner, infestation, yield loss

Résumé

La mineuse des feuilles d'arachide, *Aproaerema modicella* Deventer (Lepidoptera: Gelechiidae), est une espèce asiatique exotique envahissante au Mozambique. *A. modicella* a été signalée pour la première fois en 1998 en Ouganda. Au Mozambique, la mineuse de feuille d''arachide a d'abord été signalée en 1999 dans le district de Zavala, en province d'Inhambane. Les niveaux d'infestation de 100% et les pertes de rendement totales ainsi que le retrait de la culture de l'arachide par les agriculteurs ont été signalés dans les provinces méridionales. Pour établir le niveau des pertes de rendement dues à des infestations par *A. modicella*, deux expériences sur le dépistage des insecticides ont été menées à Nhacoongo et à

Chidenguele au sud du Mozambique. Les résultats ont montré que cette espèce invasive se produit à forte densité de population dans la région sud (> 30 larves / plante). Les pertes de rendement de 62,9% et 86,2% ont été enregistrés respectivement à Chidenguele (province de Gaza) et à Nhacoongo (province d'Inhambane). Les résultats actuels suggèrent que cette espèce est bien établie dans les zones de production de l'arachide dans le milieu d'étude. Ceci possède une menace potentielle pour la production d'arachide et la sécurité alimentaire dans le pays.

Mots clés: *Aproaerema modicella*, arachide, mineuse des feuilles d'arachide, infestation, des pertes de rendement

Background

The groundnut leaf miner, *Aproaerema modicella*, is a serious pest of groundnut and soybean in South and Southeast Asia that has recently invaded Africa. Yield losses of up to 30–50% are reported (Shanower *et al*., 1993) from India. In Africa, *A. modicella* was first reported in Uganda in 1998 (Makankusi *et al.*, 2000). In Mozambique, Groundnut leaf miner was first reported in 1999 in Zavala district, Inhambane province causing significant damage to groundnut crop and has become an important concern to farmers.

In Southern Mozambique, levels of infestations of 100% and complete yield losses and withdrawal from groundnut cultivation by farmers have been reported. Current attempts to control this pest in Mozambique have been based on chemical control, without technical recommendations and do not take into consideration economic thresholds. Also, no crop loss assessments have been done in Mozambique. Thus, there is lack of information on the pest status and yield losses in Mozambique. This paper reports on groundnut leaf miner population densities, yield losses and population densities at which pesticides should be applied.

Literature Summary

In Africa, the groundnut leaf miner, *Aproaerema modicella* is known to occur in Uganda Mozambique, Malawi, Democratic Republic of Congo and South Africa. The pest is spreading rapidly, reaching outbreak densities and causing serious damage and severe yield losses to groundnut, particularly in Mozambique and Uganda (Kenis and Cugala, 2006). In Mozambique, *A. modicella* was observed in Inhambane Gaza, Maputo, Sofala, Nampula and Manica provinces (Kenis and Cugala, 2006).

The threshold levels for insecticide application in India are reported to be as 5–10 larvae per plant (Wightman and Ranga Rao, 1993). These levels are low compared to the 29–38 larvae per plant recorded in southern Mozambique (Kenis and Cugala, 2006) and indicate the high infestation levels that GLM can attain outside its area of origin. In its area of origin, the levels of yield loss due to *A. modicella* infestations are relatively low compared to the losses in the areas of invasion. Shanower *et al*. (1993) reported 35% and 44% pod yield losses and grain yield losses of 65% and that each 1% infestation of *A. modicella* resulted in 1.2% yield loss. The high population levels in the areas of invasion suggest that this species was able to successful adapt to environmental field conditions and establish in the areas of groundnut production in the Southern region of Mozambique.

Study Description

The studies were conducted in Chidenguele and Nhacoongo, Southern region Mozambique. A completely randomized block design with four treatments and four repetitions was used in each experiment. The treatments were three different insecticides (Cypermethrin, Pyrethroid) and a control treatment (without pesticide application). Insecticides were applied at 15th, 30th, 45th and 75th days after emergence. All plots were monitored for pest densities and at harvest for grain yield. Samples of 20 plants were randomly selected and observed in each plot before application of any insecticide. All larvae and pupae found in each plant were counted.

The grain was sun-dried and then weighted and mean grain yield of each treatment estimated. Yield losses due to *A. modicella* infestation were estimated as the difference between yield from Cypermethrin treatment and the yield from the control treatment and expressed as a percentage.

The ETL was estimated in relation to Cypermethrin cost of application at 30 and 45 days after crop emergence (DAE) at both places according to the procedures described by Seshu Reddy and Sum (1992).

Loss kg/ha = Cost of treatment (per ha)/Price of crop (per kg), while ETL = Loss (in kg/ha)/b where b = is the regression coefficient of linear regression of yield and pest population densities. Data were subjected to analysis of variance (ANOVA) (PROC ANOVA, SAS).

Research Application

The insecticide application against groundnut leaf miner at both sites significantly reduced the pest population densities

compared to untreated plots. While in Chidenguele, a mean density of 29.8±14.1 larvae/plant was recorded from unsprayed plots, in Nhacoongo 22.7±8.1 and 0.5±1.2 larvae/plant were recorded (Table 1). Pyrethroid insecticides were also evaluated in India by Shanower *et al*. (1993) and they found these insecticides to be highly effective, but they are more expensive than many other insecticides.

Significantly higher grain weight was recorded in the insecticides sprayed plots ($P<0.05$) compared to unsprayed plots at both sites (Table 1). The highest yield of grain was observed on Cypermethrin treated plots at both study locations (5.2±0.9 and 6.5±0.3 g/plot respectively in Chidenguele and Nhacoongo). These results are associated with low groundnut leaf miner populations levels observed in Cypermethrin treated plots compared to unsprayed plots. Table 1 shows the yield losses comparing yield from Cypermethrin treated plots with yield from untreated plots. Yield losses of 86.2% (in Nhacoongo) and 62.9% (in Chidenguele) were observed on unsprayed plots. Shanower *et al*. (1993) reported yield losses of 60% in the area of *A. modicella* origin. These levels of yield loss are relatively low compared to the levels obtained in this study.

AETL of 4.6 and 5.1 larvae/plant was estimated to cause yield losses equals to cost of *A. modicella* control at 30 DAE respectively at Chidenguele and Nhacoongo (Table 2). These values are almost similar to the 5 active larvae per plant at 30 DAE reported by Wightman and Ranga Rao (1993) and in use in India.

The present results show that groundnut leaf miner, *A. modicella* is well established in the Southern region of Mozambique and is associated with high population densities and causing economic damage to groundnut crop production. The high yield losses reported is an indication that this species is a key factor limiting groundnut production as well as a potential threat to groundnut production and food security in this region. Pesticides application remains an important control measure and insecticides such as Cypermethrin should be used before sustainable management strategies are recommended. However, considerations should in the future be given to the study of Integrated Pest Management (IPM) sustainable strategies for the control of *A. modicella*.

Table 1. The impact of insecticides on the groundnut leaf miner population densities and groundnut yield losses.

Treatment	Percent infestation	Number of mines	Number of individuals per plant	Grain quality	Grain weight kg/plot	Grain weight t/ha	Yield losses (%)		
							Control	Dimethoate	Endosulfan
(a) Chidenguele, Gaza province									
Control	100±0.0a	197.9±10.4a	29.8±14.1a	36.2±2.4b	1.6±0.3c	0.28	-	-	
Dimethoate	97.3±0.2a	42.2±12.3b	10.6±25.3b	39.9±4.3ab	2.9±0.7b	0.52	47.0	-	
Endosulfan	83.3±0.2b	30.8±4.3b	4.6±14.6c	40.8±2.4a	4.0±0.4a	0.71	60.9	26.2	
Cypermethrin	16.8±0.1c	14.8±4.2c	0.0±0.0d	38.8±3.7ab	5.2±0.9a	0.75	62.9	29.9	5.0
Df	3, 319	3, 319	3, 319	3, 319	3, 319				
F	212	60.9	26.7	18.6	12.6				
P-values	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				
(b) Nhacoongo, Inhambane province									
Control	100±0.0a	176.5±17.8a	22.7±8.1ba	23.2±2.2b	0.9±0.3b	0.28	-	-	-
Dimethoate	88,9±14.7b	126.7±28.8b	5.5±5.7b	33.9±2.1a	5.7±0.7a	0.52	84.2	-	-
Endosulfan	66.4±22.1c	61.5±36.8c	2.8±4.3bc	35.6±2.7a	6.1±0.1a	0.71	85.1	5.0	-
Cypermethrin	9.4±8.3d	11.7±6.4d	0.5±1.2c	32.9±0.7a	6.5±0.3a	0.75	86.2	12.3	7.7
Df	3, 319	3, 319	3, 319	3, 319	3, 319				
F	370.8	776.5	202.3	28.8	25.2				
P values	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				

Means followed by the same letter within column are not significantly different at $P<0.05$ (SNK)

Table 2. Economic threshold levels at the two experimental sites.

Location	DAE	Regression parameters			ETL
		b	P	r^2	
Chidenguele					
	30	-0.62	0.0004	0.6049	4.6
	45	-0.42	0.0804	0.9329	8.9
Nhacoongo					
	30	-0.59	0.0005	0.9713	5.1
	45	-0.24	0.0124	0.5698	9.2

ETL = economic threshold level; DAE = days after emergence.

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