ADVANCES IN MONITORING *PROSTEPHANUS TRUNCATUS* (HORN) (COL.: BOSTRICHIDAE) AND *TERETRIOSOMA NIGRESCENS* LEWIS (COL.: HISTERIDAE) POPULATIONS.

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Abstract

In parts of East and West Africa, a recently introduced Mesoamerican bostrichid *Prostephanus truncatus* (Horn) has become a pest of major importance on maize and dried cassava stored by subsistence producers. To monitor its spread, "delta" flight traps are used in fields and natural habitats, and crevice traps are used in stores, baited with the synthetic aggregation pheromone of *P. truncatus* (Trun-call 1 and 2). In Mexico and Central America such traps also capture the histerid *Teretriosoma nigrescens* Lewis, a known predator and potential bio-control agent of *P. truncatus*.

A plastic crevice trap, a commercial product designed to capture *Tribolium* sp., was as effective at detecting either species in farm-stored maize-cobs as the insecticide-coated card trap used earlier. The plastic trap was more versatile to use than the previous one. Not containing insecticide, it was more pleasant and probably safer to handle.

The placement of flight traps within farm and village compounds was as effective in detecting populations of both species as the deployment of crevice traps within stores. Marked *P. truncatus* were recaptured in flight traps up to 250m upwind from the point of release. Assuming constant wind direction and speed, this suggests a zone of attraction for each trap of about one to two hectares. The implications of the apparent mobility of this pest outside stores are discussed.

Introduction

The Larger Grain Borer (LGB) *Prostephanus truncatus* (Col.: Bostrichidae) is a pest of Mesoamerican origin which has been introduced accidentally into parts of East and West Africa. There it has become a pest of major importance on farm-stored maize and dried cassava (Dick *et al.* 1989, Hodges *et al.* 1983, Krall 1984, 1986, Golob 1988).

Insecticide-coated cardboard crevice traps baited with "Dominicalure", the synthetic aggregation pheromone of *Rhyzopertha dominica* (Col.: Bostrichidae), were initially used in Africa to detect *P. truncatus* infestations in farm-stores (Hodges 1984). A male-produced aggregation pheromone, 1-methylethyl (E)-2-methyl 2 pentenoate ("Trun-call 1" or T1), of *P. truncatus* was identified and was found to be more attractive than "Dominicalure" (Hodges 1986, Hodges *et al.* 1984). Crevice-traps baited with T1 have since been widely used to monitor *P. truncatus* in Africa (Golob 1988). Recently, a second component of the pheromone, 1-methylethyl (E)-2,(E)-4-2, 4-dimethyl-2-heptadienoate ("Trun-call 2" or T2) has been isolated. Mixtures of 1:1 or 1:4 T1:T2 were found to be more attractive than T1 alone (Dendy *et al.* 1989a). In Tanzania, T1/T2 baited flight traps captured large numbers of *P. truncatus* in maize fields away from farm buildings (Dendy *et al.* 1989a, 1989b). Funnel (Graham 1970) and delta-type flight traps were most effective (Dendy *et al.* 1989b). *P. truncatus* was detected for the first time in Ghana with T1/T2-baited flight- and crevice-traps (Dick *et al.* 1989). The infestations located by trapping were not detected by visual inspection carried out at the same time.

In Costa Rica, T1-baited traps caught large numbers of the histerid *Teretriosoma nigrescens* (Schulz and Laborius 1986, Boye *et al.* 1988), a known predator and possible bio-control agent of *P. truncatus* (Rees 1985, 1987, 1990). In traditional on-farm maize stores in Yucatan, Mexico, both species were captured in T1/T2-baited crevice-traps. They were also detected, using flight-traps, in natural habitats away from maize or cassava (Rees *et al.* 1990).

This paper summarizes recent investigations undertaken to develop a trapping system, using commercially available traps, to detect *P. truncatus* and *T. nigrescens* both in and outside the storage environment.

Comparison between effectiveness of insecticide-coated card and sticky-surface plastic crevice traps for the detection of *P. truncatus*

<u>Method</u>

Insecticide-coated card traps (Hodges 1986) and plastic sticky-surface crevice traps, baited with T1/T2 pheromone, were compared to see which was more able to detect infestations of *P. truncatus* in farm-stored maize in the Volta region of South-east Ghana. The plastic trap, designed and produced by Agrisense BCS Ltd, for the detection of *Tribolium* spp., is made of relatively waterproof materials and, not containing insecticide, is safer and more pleasant to handle than the previous design.

The plastic trap consisted of two pieces of corrugated plastic, 10 X 6cm (corrugations 2.5mm square), from the centre of which a rectangle, 7.5 X 3cm, had been removed. The corrugated material was sandwiched between a piece of clear plastic (through which the sticky surface could be viewed) and a rectangle of stiff card coated on the inner surface with a non-drying glue, on which the insects were trapped and to which pheromone lures could be stuck.

Two plastic and two card traps, baited with T1/T2, were placed in each of six maize cribs (Table I). After one week the numbers of *P. truncatus* present were recorded.

<u>Results</u>

P. truncatus was captured in four stores with card traps and in five stores using plastic traps. Except at one site, equal or greater numbers of insects were captured with plastic as card traps (Table I).

Table I. Comparison between mean numbers of *P. truncatus* captured using T1/T2 baited crevice traps in on-farm maize stores in Volta Region, Ghana.

Village	Card trap*	Plastic trap*
Wudome	0.5	0.5
Akpokope	0.0	0.0
Kpeduhoe	0.5	0.25
Ziope	0.0	0.5
Vitorkope	13.5	42.5
Akato	0.0	0.0

Notes:- * Two traps of each type used per store. Traps left in place for one week.

Comparison between pheromone-baited flight and crevice traps to detect *P. truncatus* and *T. nigrescens* in farm compounds containing stored maize cobs

Method

The deployment of crevice-traps can be very time-consuming. Stores have to be located and permission obtained before traps are inserted. Flight-traps may be more acceptable to farmers as maize cribs need not be disturbed in their deployment. Such traps can instead be quickly hung, amongst trees etc., in the farmyard or village compound. An attempt was therefore made to see if flight traps could be used instead of in-store crevice traps to detect *P. truncatus* at farms and villages in Volta Region, Ghana, West Africa and Yucatan state, Mexico (and also *T. nigrescens* at the latter location).

Four card crevice traps were inserted in each maize store. Variable numbers of delta-flight traps[1] were hung in the surrounding farm or village compound (Table II). All traps were baited with T1/T2 and left in place for one week.

Results

Flight traps detected each species at more sites than did crevice-traps (Table II). *P. truncatus* was captured in flight-traps at all locations in Ghana and Mexico. In crevice traps it was caught at all Mexican locations but only two out of the six Ghanaian sites. *T. nigrescens* was only captured in Mexico: in flight-traps at all locations but at only one site with crevice traps. At all Ghanaian sites and all but two Mexican locations, equal or larger numbers of *P. truncatus* were captured in flight-traps as in crevice-traps.

Observation of the distance over which *P. truncatus* is attracted to a pheromone-baited flight trap

Method

Knowledge of the distance over which *P. truncatus* is attracted to pheromone-baited flight traps will allow recommendations to be made on optimum flight-trap density. It may also help in the search for the actual origin of the captured insects. Pheromones and traps are relatively expensive, so use at optimum density is important. If traps are placed too close together insects may become confused by a multiplicity of pheromone sources leading to a reduction in catch.

1 *ex* Agrisence BCS ltd., Pink Bollworm traps.

An investigation was undertaken to see over what distance *P. truncatus* could be attracted to flight-traps baited with T1/T2 and placed in a henequen *(Agave fourcroydes)* plantation and maize field in Yucatan, Mexico. Henequen plantations were used because distances of several hundred metres across flat land with good access and uniform vegetation could be tested. Several releases were also made into maize. Traditional maize production in Yucatan is by a shifting slash and burn system (Rees *et al.* 1990). Plots, often cut out of forest, were small (about 3ha) and lacked the uniformity and ease of access of fields of henequen.

For each release 500 adult *P. truncatus* were dusted with a red, yellow or green fluorescent dye. Marked insects were added to 40g of disinfested insect-damaged maize held in a 90 x 130mm bag made of plastic mesh (hole size 3mm). The bag was placed between two plastic plates, 150mm dia., held 50mm apart by four wire clips: this protected the insects from rain and direct sun. The whole assembly was secured to a concrete block, 400mm above ground level, at the release site. To allow for variable wind direction, flight traps were hung 1.5m above the ground roughly north, south, east and west from the release point, initially at a distance of 10m. After three days, captured insects were examined under UV light for marker dye. The test was repeated with a progressively larger distance between release point and traps.

Results

Marked *P. truncatus* were caught in both situations at all distances (10 to 250m) tested. The proportion of marked insects recaptured declined with the distance they had to fly. Traps placed upwind of the release point caught most insects (Table III).

Table II. Comparison between mean numbers of *P. truncatus* and *T. nigrescens* captured in Flight and crevice traps.

	Crevice traps			Flight traps		
		Mean number / trap			Mean number / trap	
Town or village	Number of traps (stores)	LGB	*T. nig.*	Number of traps	LGB	*T. nig.*
Volta Region, Ghana						
Batome Jct.	4 (1)	0.0	-	3	2.0	-
Akpokope	4 (1)	0.0	-	3	1.0	-
Ziope	22 (5)	0.05	-	5	3.0	-
Bobia	8 (2)	0.0	-	9	1.0	-
Dzayime	8 (2)	0.13	-	5	6.4	-
Akato	12 (3)	0.0	-	10	3.8	-
Yucatan state, Mexico						
Cansahcab (A)	4 (1)	0.3	0.0	6	30.6	0.5
Cansahcab (B)	4 (1)	16.0	0.0	4	16.0	0.8
Yaxcaba	4 (1)	0.5	0.0	7	0.4	6.3
Tixcacalcupul	4 (1)	13.0	0.0	6	29.0	1.0
Mahas	4 (1)	12.5	0.25	7	0.7	13.4

Discussion

The use of both crevice and flight traps baited with T1/T2 permits the detection of *P. truncatus* and *T. nigrescens* in a wide variety of situations. Detection by other means may often be difficult or impossible. The use of traps has played an important part in our understanding of the distribution and movement of these insects.

Card crevice traps can only be positioned horizontally otherwise insects killed by the insecticide coating will fall out and become lost. With a sticky surface retaining captured insects, the new trap can used amongst shelled grain or vertically stacked cobs: situations in which horizontal placement is difficult or impossible.

Flight-traps appear very effective at detecting *P. truncatus* and *T. nigrescens* within farm or village compounds. The trap, by being exposed to air currents, may attract insects from a wider area than one buried within a bulk of grain. While flight-traps may not pin-point infested stores, if *P. truncatus* is detected by them then nearby stocks of maize and cassava are likely to be at risk.

Table III. Observations of the distance over which adult *P. truncatus* can be attracted to a T1/T2 baited flight-trap.

Distance (m) from release point to trap	Number which left release point[1]	Number of marked insects captured Orientation of trap to release point				Total (%) recaptured		Wind direction and force[2]
		N	**S**	**E**	**W**			
		Insects released in henequen plantations						
10*	320	7	0	11	1	18	(5.6)	NE-SE 2-3
25	287	0	0	5	4	9	(3.1)	SE 3
100	423	3	0	2	0	5	(1.2)	NE-SE 1-3
150	**	**	3	2	**	5	**	SE 3
250	414	0	0	0(NE)	1(SE)	1	(0.24)	SE 1-3
		Insects released in a maize field						
62	358	4	0	5	1	10	(2.7)	SE 2-3
95		-	-	4(NE)	1(NW)			
	435					7	(1.6)	SE 0-3
133		2	-	-	-			

Key

1 = initial number (500) minus number remaining at release point at end of test.

2 Mean windspeed (Beaufort Scale) over test period. Mean temperature over release period:- $31^{\circ}C$ day, $23^{\circ}C$ night.

* Traps left in place four days

** Traps and release points stolen

At times when little or no maize is in store, and in market-places and transhipment centres where turnover of grain makes visual inspection difficult and the use of crevice-traps impractical, flight traps are of particular use. They can also be used to detect the insects prior to harvest and in non-crop habitats. Transects, with the deployment of a flight trap at regular intervals, could be set up along roads, allowing large areas to be rapidly checked for the presence of either insect. More detailed searches, involving farm visits and use of crevice traps, could be undertaken on the basis of results obtained.

The density of flight-traps needed to provide good coverage appears to be low. If *P. truncatus* can be attracted to a trap from 250m, then (assuming fairly constant wind direction) the area of ground from which it may have originated is about one to two hectares. Pheromone plumes from traps placed less than 250m apart may interfere with each other. Climatic conditions and density of vegetation, amongst many factors, may affect the size of the zone of attraction and need to be the subject of investigation. The release of a larger number of insects and the deployment of more traps for longer periods of time may show that *P. truncatus* can be recaptured at distances greater than those used in the present study.

Observations of the distance *P. truncatus* can fly in a few days will have implications for the action needed to prevent its spread across international frontiers. If it can fly several hundred metres in such a short time it may be able to travel several kilometres over its life-span of several months. This, coupled with an apparent ability to live in non-crop habitats (Rees *et al.* 1990), may mean it can cross such barriers unaided, even if total control of the trade in infestable commodities was attempted.

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LES PROGRES EN MATIERE DE SURVEILLANCE DES POPULATIONS DE *PROSTEPHANUS TRUNCATUS* (HORN) (COL.: BOSTRICHIDAE) ET DE *TERETRIOSONA NIGRESCENS* (LEWIS) (COL.: HISTERIDAE)

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Résumé

Dans certaines parties de l'est et de l'ouest de l'Amérique, un bostryche d'Amérique centrale récemment introduit, *Prostephanus truncatus* (Horn) (Col.: Bostrychidae) est devenu un des principaux ravageurs du maïs et de la cassave séchée stockés par les producteurs de vivres. Afin de surveiller son extension, des pièges "delta" sont utilisés aux champs et dans ses habitats naturels, ainsi que des pièges "crevasse" pour les magasins, appâtés aux phéromones synthétiques, les phéromones d'agrégation que produisent les mâles de *P. truncatus*, (Truncall 1 et 2). Au Mexique et en Amérique centrale, de tels pièges capturent aussi le coléoptère histéridé *Teretriosoma nigrescens* (Lewis) : un prédateur connu et un moyen de lutte biologique contre *P. truncatus.*

On donne les informations indiquant la distance que les adultes marqués des deux espèces peuvent parcourir en vol pour gagner les pièges appâtés aux phéromones lorsqu'on les relâche. La connaissance de cette distance permettra la détection des infestations et nous servira à donner des recommandations objectives sur la densité de pièges optimale nécessaire pour couvrir une zone de surveillance avec un minimum de matériel ou de ressources.

Un piège à crevasse, conçu sur la base d'un produit du commerce pour la capture de *Tribolium sp*, à la phéromone d'agrégation, peut être utilisé pour détecter les deux espèces dans les stocks de maïs. Ces pièges sont en général laissés en place pendant une semaine : des études ont été faites dans les stocks des fermes qui contenaient des épis de maïs pour savoir si cette durée était la période optimale.