

Evaluation of the Efficacy of Beetle Lure (BFL 225) and Bullet Synthetic Multi-Attractant as Insect Baits in Untreated Grain Storehouses

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Abstract
An experiment was carried out to evaluate the efficacy of synthetic general beetle lure and bullet synthetic multi attractant in trapping insects in untreated grain stores. Four grain stores (two each) in two major markets within Calabar metropolis, were sampled at random and selected for this research. Three groups of four traps each with sticky bases were treated as follows: Trap group "A" was treated with BFL225 pheromone multi-attractant, Trap group "B" was treated with bullet lure multi-attractant pheromone and Trap group "C" was untreated (control). This experiment was replicated on monthly basis for a period of eight months to also ascertain the influence of weather conditions on trapped insect population. Insects caught were identified base on the different trap efficacy and recorded following the method in Ukeh and Mordue, (2009). All traps were re-treated monthly for efficient trapping. Data obtained from the experiment were laid out as factorial in CRD and subjected to analysis of variance using GenStat statistical software (Version 6). Significant means were compared using LSD and DNMRT at 5 percent level of probability. Insects trapped and identified include *Sitophilus spp*, *Corcyra ciphilonica, Tribolium castaneum and Callosobrochus maculatus.* The treated trap groups (A and B) significantly ($p<0.05$) caught more insects than the untreated trap group (control). However, between the treated trap groups, the BFL 225 significantly ($p<0.05$) caught more insects than the bullet lure treated trap. The number of insets caught also varied significantly ($p<0.05$) with different months. The wet month of August significantly had the highest number of insects followed by June. The dry months of January and February also had high number of insects relative to the other months. The least number of insects caught were obtained in the months of April and May. The interaction between the trap treatment type and month was significant ($p<0.05$). Generally, higher number of insects were caught in both treated and untreated trap groups in the wet month (June – August) compared to other months. BFL 225 treated trap groups significantly caught the highest number of insects in August, followed by the bullet treated trap group and the untreated in the same month. The bullet lure treated traps caught the least number on insects in April and May and was not significantly ($p<0.05$) different from the number caught by untreated trap (control) in the month of April. The trap treated with BFL225 caught the highest number of insect. Hence, this research supports the use of BFL 225 as an efficient tool in integrated pest management approach for stored grains.
Keywords: Beetle lure, Bullet synthetic, Insects, Pheromone, Treated traps.
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1. Introduction

Effective monitoring is an essential tool for a successful integrated pest control program. It is the cornerstone of an integrated pest management program as it promotes good understanding of insect pest, mite, beneficial and destructive insect activities.It gives information on the number and type of pest present as well as detects variation and dynamics in the population of pest over time and determine various points of infestation and also its entry routes. The formulation of artificial insect pheromones and attractants has immensely made it easier for the food industries to develop improved and early detection tools for insect infestation. The application of pheromone-treated traps to observe insect population avail various edges over inspection (Ukeh *et.al* 2008)

Multi-methods have been implored to monitor insects in bulk produce and in storage facilities. Tools which assist crop scouts and growers monitor pests and predict pest pressure, include: Pheromone traps (which attract males of specific pests such as the Heliothis moth), Yellow sticky traps (which attract a broad spectrum of flying insects), Blue sticky traps (which can be used for some thrips and leaf miners), Leaf wetness sensors, Forecasting models, Disease prediction models and Insect development models. These tools will help provide information about the range and activity of pests in crops and stored produce. Data collected from these traps can be recorded to identify flights, or periods of peak activity. This data will assist in determining the required frequency of crop scouting. Note that during peak production periods, it is important to check traps more frequently. Traps treated with artificial pheromones are used in food processing industries mostly and seldom in bulk –stored produce (Philips et.al 2000). Applying a holistic approach in stored produce protection, the use of pheromones can reduce inorganic treatments, with economic advantage and enhancement of food product quality (Trematerra 2002).

According to Philips et.al (2000) new approach as an alternative to inorganic insecticides is required to control pest in the stored produce. The use of pheromones currently as a tool for the monitoring of stored produce insects does not stand for a direct control to inorganic control (Van and Ryckeghem, 2011)

The pioneering work of Wood and Silverstein in the 1960's on the pine weevil colonization of suitable host trees showed the first time that host plant volatiles and pheromones can act attractively to produce a greater attractive effect. Since that time, much work has been carried out on similar chemicals and their possible role in push-all strategies for pest control "whereby attractants, and repellants from non-host plants can equally be put in place for manipulation of pest species away from crops and into traps (Cook et.al, 2007).

Although pheromones have been chemically identified for ± 40 species of pheromones traps for stored-produce insects, however just available for key pest. Pheromones are sex specific with respect to the kind of insect they attract. For instance, the pheromones for cigarette beetle and moth are synthetic, the same as attractant for female- produced, thereby attracting males only. However male-produced aggregation pheromones of *Tribolium spp* attract both sexes (Arthur and Philips, 2002).

There are different designs and patterns of trap for a certain type of pest. Arthur and Philips (2002) stated two major designs of trap, for the crawling insects or flying insects. They stated that flying moths or beetle are commonly captured by sticky traps where on a protected sticky surface. These traps are simple to use and also covered with dust easily. Most times, they are filled with insects and may require change after sometimes of usage. The non-sticky traps for flying insects can be recycled, they are costlier that sticky traps and they have landing surface as a reservoir which serves as a collection point of trapped insects (Arthur and Philip 2000).

Ukeh *et.al* (2008) reported that traps used for the monitoring of insect are pieces of equipment that are used to capture insect over a period of time thereby giving the manager specific data about insect activity. The information obtained from trap catch is more reliable than visual inspection data. Most insects are not commonly seen during inspections, because they are not easily observed. Regular inspections with different types of insect's traps at different places all over the stores can supply information on the presence of particular species of insects, the relative dynamics in populations and variation in species over stipulated time, the location where the insects are found and their relative presence at particular place (Arthur and Philips, 2002). Different trapping methods are available, with some being more useful in certain locations than others.

The Glue boards

The pest monitoring industry has made use of the glue boards for a longtime in trapping and inspecting rodent pest. However, the glue boards also have been effective for examine pets. For pest management purposes, small sticky cards have been useful (Arthur and Philip, 2002).

Importantly it is worthy of note that insects respond to traps differently. For instance, the red flour beetle, avoid crossing a sticky surface (Arthur and Philips, 2002). Glue boards are example of traps with least response among the other traps; however, they are affordable and manageable.

Pheromone traps

Pheromone traps are the species-specific and most sensitive traps available for monitoring insect pests. Its usage for an artificial type of the natural attractant of a particular species to trap insects. Eke *et.al* (2008) reported that artificial attractants are made to dispense slowly. The sponginess is gradually diffused into the micro environment from a lure and it remains effective for weeks or months.

On the basis that pheromones are species-oriented in their signals, they attract insect of their species or related species that use the attractant in the natural essence. They are important for observing a specific pest for which the pheromone is easily found.

Arthur and Philips (2002) pointed out that aggregation sex attractant are used to attract insects looking out for breeding areas.

However, several reports have it that traditional methods of stored produce pest control exists which are known as natural pesticides. Duke *et al*., 2003, Beoke *et. al*., 2004, Liu *et.al*., 2006 and Isman, 2006 reported that plant extracts and essential oils consist of monoterpenoids, diterpenoids sesquiterpenoids and other product that has ovicidal, larvicidal, repellent, deterrent and anti-feedant characteristics in a wide range of insects. There are many reviews on the application of such plant products in deterrents, anti-feedants and fumigants (Regnault Roger *et al*., 2008; Adler *et.al*, 2000; Isman, 2006). A new approach however is the use of plant odours with unattractive characteristics to repel insects from stored produce which is getting more face of recent times (Beoke et. al., 2004; Liu et al., 2006) or to use attractive plant odors in traps.

Conventionally, the paramount objective of protecting grain is to ensure that no live insects are found in the produce stored. To achieve this, it implies application of high levels of pesticides. However, to stop depending on pesticides, a more environmentally compatible and suitable approach had to be invoked in order to reduce demand for insecticides and to ensure that pest population density does not increase above the threshold level thereby causing huge economic damage to the stored grain (Cox, 2004).

2. Material and Method

Experimental location

The experiment was carried out at the Crop Science Insect Behavior Room, University of Calabar, Calabar.

Calabar is located in the Southeastern humid tropical rainforest zone of Nigeria ($4.5^0 – 5.2^0$ N, $8.0^0 – 8.3^0$ E), 39 m above sea level. It has a bimodal annual rainfall distribution ranging from 3000 to 3500 mm, a mean annual temperature range of 27 ^{0}C 35 ^{0}C and relative humidity between 75-85 % (CRADP, 2008).

Experimental treatment and design

Traps and pheromones:

Floor traps having sticky bases and the artificial multi-attractant pheromone (BFL 225) were gotten from Agriscene BCS Ltd, UK. The pheromone dispensers consisted of non-harmful plant extract impregnated with a flat profile cellulose matrix controlled medium. The "bullet" multi-attractant synthetic pheromone capsule was obtained from 'insects' limited Inc., USA. This was also used in pest monitoring.

Efficacy of the synthetic general beetle lure (BFL 225) and bullet synthetic multi – attracted trap on insects.

Four grain stores (two each) in two major markets within Calabar metropolis, were sampled at random and selected for this research. Three groups of four traps each with sticky bases were treated as follows: Trap group "A" was treated with BFL225 pheromone multi-attractant, Trap group "B" was treated with bullet lure multi-attractant pheromone and Trap group "C" was untreated (control) and positioned simultaneously at the four cardinal points of the store. This experiment was replicated on monthly basis for a period of eight months to also ascertain the influence of weather conditions on trapped insect population. Insects caught were identified base on the different trap efficacy and recorded following the method in Ukeh and Mordue, (2009). All traps were re-treated monthly for efficient trapping. Data obtained from the experiment were laid out as factorial in CRD and subjected to analysis of variance using GenStat statistical software (Version 6). Significant means were compared using LSD and DNMRT at 5 percent level of probability.

3. Results

Table 1:

Comparative efficacy of the synthetic general beetle lure (BFL 225) and "Bullet" synthetic multipurpose attractant to stored insect's pests in two market store houses.

	Mean no of insect trapped		
Treatment	Watt	Marian	Mean
BFL225	1514.00	1152.00	1313.00
Bullet	1285.00	1059.00	1172.00
Untreated	1142.00	1031.00	1086.00
X	1313.66	1080.66	

LSD (0.05) Trap (T) =59.60
LSD (0.05) Market (MI) =84.3

Key:
BFL225 = Synthetic general beetle lure
UNT = Untreated trap
BUL = Bullet synthetic multi-attractant lure

Table 1 above shows that the treated trap groups significantly ($p<0.05$) caught more insects than the untreated trap groups. However, between the treated traps, the BFL 225 significantly ($p<0.05$) caught more insects than the bullet trap.

Table 2
Effect of treatment and time [months] on the number of insects at Marian Market.

	Mean number of insect trapped			
Month	BB	BFL	UNT	X (mean of month)
Jan	139.00g	155.00f	116.00i	136.67c
Feb	101.00j	129.33h	139.33g	123.22d
March	86.67L	74.00m	64.67n	75.11f
April	35.33q	54.00p	34.67q	41.44h
May	36.67q	59.00o	51.00p	48.89g
June	262.67c	208.00d	203.33e	224.67b
July	126.00h	91.00k	137.00g	118.00e
August	275.00b	383.00a	274.00b	310.67a
(Trap)Mean=	132.79b	144.21a	127.50c	

* Means for traps, months and interaction of traps and months followed by the same letter are not significantly different at 5% probability level according to DNMRT.
* Significant at 5 percent
** Significant at 1 and 5 per cent
Key:
BB - Bullet
BFL - BFL 225 trap
UNT - Untreated trap

Table 2 above shows the effects of different trap treatments and months on the number of insects caught in Marian market. It further shows that the number of insects caught varied significantly ($p<0.05$) with the time (month). The wet month of August significantly had the highest number of insects followed by June. The dry months of January and February also had high number of insects relative to the other months. The least number of insects caught was obtained in the month of April and May, interaction between trap type and month was significant ($p<0.05$). Generally, higher number of insects were caught in both treated and untreated traps in the wet month (June – August) as compared with other months. BFL 225 traps significantly caught the highest number of insects in August, followed by the bullet trap and the untreated in the same month. The bullet trap caught the least number of insects in April and May and was not significantly ($p<0.05$) different from the number caught by the untreated trap (control) in the month of April.
The trap group treated with BFL225 caught the highest number of insect.

Table 3
Effects of trapping and months (time) on the number of insects at Watt Market

Month	BB	BFL	UNT	(X) Mean of month
Jan	180.00h	185.00g	112.00 op	159.00c*
Feb	96.00r	129.00m	132.67L	119.22e
March	117.67no	126.00m	110.00p	117.89e
April	86.00t	111.330p	82.00u	93.11g
May	114.67n	103.33q	92.33s	103.44f
June	206.06f	334.00b	301.33d	280.44b
July	166.00i	153.00J	140.67k	153.22d
August	319.00c	371.67a	150.75c	308.56a
(Trap) Mean	160.67b**	189.17a	150.75c	

* Means for traps, months and interaction for traps and months followed by the same letter are not significantly different at 5% probability level according to DNMRT.
* Significant at 5 percent
** Significant at 5 percent
Key:
BB - Bullet trap
BFL - BFL 225 trap
UNT - Untreated trap

Table 3 above shows the effects of the different traps and month on the number of insects caught in Watt Market. It shows that the result almost followed the trend of that of Marian market (Table 2). BFL 225 treated traps significantly ($p<0.05$) caught the highest number of insects followed by the bullet treated traps. The month of August had significantly the highest number of insects followed by June. The least number of insects were recorded in the month of April and May. The interaction between the trap treatment type and month was significant ($p<0.05$). Generally, more insects were caught in both the treated and untreated traps in wet months

(June – August), while the least number was caught in the month of April and May. The highest number of insects caught were in August by BFL-225 followed by the same trap in June. In the month of February, the untreated trap (control), significantly ($p<0.05$) caught more insects than the treated traps. This was Also the case in June where the blank trap caught more insect than the bullet trap. The least number of insects was caught by the untreated trap in April and this was closely followed by bullet trap in the same month.

4. Discussion

The result of this study shows that the traps treated with BFL 225 were more efficient in the trapping of insects namely, weevils (*Sitophilus spp),* Rice moth (*Corcyra ciphilonica*)*,* Red flour beetle(*Tribolium castaneum) and* Cowpea beetle *(Callosobrochus maculatus*) than the traps treated with bullet lure and the control (untreated) during the period. Arthur and Philips (2002), Ukeh and Udo (2008), have reported similar findings that constant monitoring with various insect traps of diverse types at many locations throughout a facility can provide data concerning the presence of particular species of insect. *Sitophilus spp* and *Callosbrochus maculatus* which are known notorious storage pest of great damaging effect on stored produce (Ofuya *et.al* 2010) were trapped in large number in August. *Tribolium castanuneum* were trapped all through the months of the experiment and this confirms them to be regular pest of stored produce in the tropics (Ukeh and Umoetuk 2011). Data generated from the experiment also reveals that greater number of insects were caught during the rainy season (June – August) than in the dry season which indicates that the insects may not be able to tolerant extreme dry weather conditions. As rainfall increased, the number of insect caught increases in both treated and untreated traps. However, this disagrees with the work of Donald et.al (2013) though different pest spp were involved. Similar result was also recorded by Arthur and Philip (2002). The insects captured in treated traps strongly suggested that the population was increasing towards the end of the study period- August.

5. Summary, Conclusion and Recommendation

The risks of crop produce infestation within the processing cycle from the field to the consumer remains worrisome due to certain aspects of packaging, negligence in warehouses and stores as well as average shelf-life of products. The application of pheromone-treated traps as a means to checkmate the populations of insect provide different edges over inspections. The applications of insect pheromones in controlling pest involves the careful observation of attractants, early notice and creation of awareness, isolation and observation for infestation, control measures and the right time to control, population dynamics, evaluation of the effects of control methods, etc. The need for insect trap in integrated pest management (IPM) is on the basis that no one method is sufficient in itself to provide adequate protection to crops against pest infestation. Hence, for effective pest control and crop protection an integrated approach that is ecologically balanced and friendly is the only option.

Traps treated with BFL 225 lure significantly caught a higher number of insect/pest than the bullet lure and the untreated (control) during the study. It is therefore recommended that the use of BFL225 pheromone trap should be encouraged given its high efficacy in insect monitoring and forecasting. Regular monitoring with the help of pheromone strap should be done to regulate pest infestation outbreak.

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