



Botanical Pesticides and Luring Efficacy of Natural Substances in the Management of Sorghum Chafer under Field and Laboratory Conditions

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Received 2 July 2014; revised 11 August 2014; accepted 21 September 2014

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Abstract

Sorghum chafer, *Pachnoda interrupta* (Olivier) (Coleoptera: Scarabaeidae: Cetoniinae) is one of the major problems on sorghum. The purpose of this study was to investigate alternative management methods. The studies were conducted under laboratory and field conditions. We tested efficacy of *Jatropha curcas*, *Lantana camara*, *Croton mychrostaches*, *Agave* sp. (*sisal*) and *Melia azadrech*. The lure effects of banana, guava, local beer residue (Atela), malt and molasses were evaluated. The result from laboratory showed that *C. mychrostaches*, *L. camara*, *M. azadrech*, *Agave* sp. and *J. curcas* caused beetle mortality of 44% - 60%, 24% - 64%, 43% - 63%, 45% - 64%, and 65% - 78%, respectively. Also with the result from field it was confirmed that *C. mychrostaches*, *L. camara*, *M. azadrech*, *Agave* sp. and *J. curcas* caused beetle mortality of 23% - 56%, 27% - 55%, 36% - 58%, 40% - 55% and 76% - 82%, respectively. In the bait experiment, a higher number of beetles were attracted using banana (>3000 beetles) and guava fruit (>3500 beetles) than the other attractants. Male beetles were more attracted than the female beetles. Thus, we recommended that all botanical pesticides with banana and guava fruits as baits could be used in sorghum chafer management.

Keywords

Pachnoda interrupta, Ethiopia, Banana, Chafer

Subject Areas: Agricultural Science, Entomology, Plant Science

1. Introduction

Pachnoda interrupta (Olivier) (Coleoptera: Scarabaeidae: Cetoniinae) is a polyphagous pest distributed particu-

How to cite this paper: Dejen, A. (2014) Botanical Pesticides and Luring Efficacy of Natural Substances in the Management of Sorghum Chafer under Field and Laboratory Conditions. *Open Access Library Journal*, 1: e821.

<http://dx.doi.org/10.4236/oalib.1100821>

larly in Africa [1]. In Ethiopia, surveys conducted about 20 years ago revealed the presence of nine species of *Pachnoda*, one represented by two subspecies [2]. Except, the two species, *P. stehelini* Sch. and *P. abyssinica* Blan. were recorded in greater than 2000 m.a.s.l. Other species were found in the acacia woodlands distributed between 800 and 1800 m.a.s.l. [3]. Among the nine species, the sorghum chafer, *Pachnoda interrupta*, has become a well-established regular pest in the last eight years. It attacks a wide range of crops (over 35 types), of which sorghum is the major one [4] [5].

[6] [7] had reported that sorghum chafer was as a major insect pest of sorghum since 1977 in Ethiopia. The beetles feed on flowers, milky grains or early dough grains of sorghum and millet causing sterilization of florets or damage to kernels. The genus *Pachnoda* is originated in Africa and Arabia where it occurs as a large number of species; the adult beetles are recorded damaging flowers and fruits of quite a large cultivated plants, including peach, cotton, citrus, rose, mango, acacia, maize, sunflower, and the milky grain of sorghum and pear millet [8]. In Mali under cage experiment sorghum chafer could cause sorghum yield losses from 10% to 49% with beetle densities of 1 - 10 beetles per head. [1] [3] reported that sorghum chafer together with grasshopper destroyed 50% of potential millet harvest in Mali. In Ethiopia sorghum chafer caused more than 80% yield loss on sorghum and 20% on maize. [4] [9] suggested that, for the effective management of sorghum chafer one should first identify the larval breeding areas, monitoring larval densities and apply appropriate control measures before pupation. Management of sorghum chafer through synthetic chemicals in the form of spraying is impossible because of long height of sorghum (2 - 3 m) and it causes health and environment hazard. Behavioural and antennal responses of the sorghum chafer *Pachnoda interrupta* (Olivier) were tested to the synthetic compounds, such as eugenol, methyl salicylate, methyl anthranilate, isoamyl acetate and butyl butyrate. In the field, all odour-baited traps, except isoamyl acetate applied on cotton dispensers, were significantly more attractive than blank (unbaited) traps and all compounds, except isoamyl acetate elicited dose-dependent responses in both male and female antennae [5].

Therefore, the objectives of the studies were to evaluate alternate bio-pesticides, to select best attractant and to investigate the response of adult male and female beetles towards different odours of attractants.

2. Materials and Methods

2.1. Study Site Description

Bati district, is situated in 39°59'E and 11°11'N and with an altitude between 1300 - 1657 meter above sea level. It received rainfall twice a year. The short rain period (April and May) and the main rainfall season (June to September). The study was carried out during the main rainfall season. Bati district receives a mean annual rainfall of 1183 mm and there was enough rain during the main season. The mean minimum and maximum temperature are 13.6°C and 28.3°C, respectively. During the experimental season, the mean relative humidity of Bati is 67.2%. The major soil types of the district are alluvial, clay and loam. Bati is one of the areas districts that where sorghum chafer caused sorghum grain yield losses.

2.2. Botanical Pesticides

The tested botanical pesticides are available in all locations. The studies were carried out under laboratory and field conditions in 2006 and 2007. The field experiments were conducted in Oromia administration zones (Bati district) of Amhara Regional State, Ethiopia. Laboratory experiment was carried out at Sirinka Agricultural Research Centre.

Randomised complete design (RCD) and randomised complete block design (RCBD) with three replications were used for under laboratory and field conditions, respectively and three times replicated. The treatments were *Jatropha curcas* (physics nut), *Lantana camara*, *Croton mychrostaches* (Bisana), *Schinus molle* and *sisal*. Fresh leaves of each botanical were collected and chopped with mortal. The 1 - 2 kg of chopped leaves of each botanical pesticides were squeezed manually to obtain enough juice (2 lt). Little water (0.25 lt) was used to enhance enough juice. The extracted juice (2 lt) of each botanical (1.5 lt) was allowed to stand for seven days before application under room temperature. The food bait (three banana fruits (200 - 300 g) was mixed uniformly with each fermented botanical juice (1.5 ml) and kept in plat plastic jar until used. During laboratory experimentation, hundred adult beetles were added to plastic jar (35 cm × 25 cm × 30 cm) three banana and extracts of each botanical pesticide. The numbers of dead and live beetles were recorded after an hour of beetles exposing on each treatment.

Similar preparation and procedures were followed as that of laboratory experiments for field experiment. The mixed treatments (banana and botanical juices) were put in flat clay pots (25 cm × 20 cm × 10 cm). The mixtures were suspended or hanged on acacia species, *Zizyphus spinacristy* and *Carissa edulis* flowers that adult beetles fed on [9]. Each treatment was kept away one kilometer apart from each other to avoid confusion of the beetles towards the odour of each bait. The number of dead beetles fallen under trees was counted.

2.3. Food Baits/Luring Substances

Luring efficacy of molasses (sugar factory by-product), malt (beer factory), fruits (banana, guava, mango) and local beer residue (Atela) were evaluated for their adult beetles attraction. The treatments were a mixture of each fruit species and attractants. Randomised complete block design with three replications was used. A single fruit (200 - 300 g) of each type and small amount molasses (0.5 lt), malt (400 g) and local beer (1 lt) residue (300 g) were mixed. The mixtures were put in flat bottom containers (3 lt) and hanged on trees or bushes. Similarly, each attractant was mixed with a teaspoon of carbaryl 85 WP for comparison purpose. The dead and weakened beetles fallen down on the ground after feeding were counted. Percent mortality was calculated based on dead and total attracted beetles after an hour exposure.

The number of attracted male and females beetle to each attractant were counted and percent male and female was calculated based on the total attracted beetles.

3. Result and Discussion

3.1. Botanical Pesticides

Beetle mortalities of 45% - 64%, 24% - 64%, 44% - 60%, 43% - 63% and 65% - 78% were recorded obtained using Sisal, *L. camara*, *C. mychrostaches*, *P. lilac* and *J. curcas*, respectively at laboratory condition (**Figure 1**) in both years. All botanicals also showed good potential in beetle mortality under field condition; *J. curcas* caused higher mortality (75.9% - 81.6%) than the other botanicals tested in both years. Beetle mortalities of 39.6% - 55.4%, 75.9% - 81.6%, 26.5% - 55.3%, 22.7% - 55.6% and 35.8% - 57.9% were recorded using sisal, *J. curcas*, *L. camara*, *C. mychrostaches* and *S. mollie*, respectively at field condition (**Table 1**). Similarly beetles mortality trends were recorded at laboratory condition. Thus, beetle mortalities of 45% - 64%, 24% - 64%, 44% - 60%, 43% - 63% and 65% - 78% were recorded obtained using sisal, *L. camara*, *C. mychrostaches*, *P. lilac* and *J. curcas*, respectively at laboratory condition (**Figure 1**) in both years. [10] [11] reported that water extract of Birbira seed (filtered with cheese cloth) caused 45% - 60% mortality sorghum chaffer within 24 - 48 hrs and this was significantly higher than mortality caused by the standard insecticide, carbaryl.

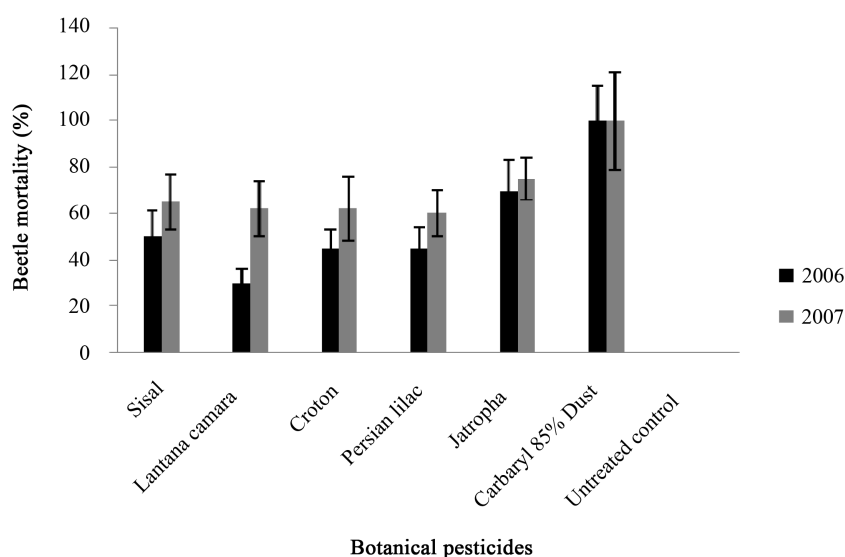


Figure 1. The efficacy of botanical pesticides on sorghum chafer mortality under laboratory conditions.

Bio-pesticides tested at field condition were as effective as laboratory condition in beetle mortality (**Table 1** and **Figure 1**). During the data collection, it was observed that all beetles fed on the mixture of botanical pesticides were weakened (49% - 42%) and fell down. Moreover, it was observed that the weakened and fallen beetles to ground were easily exposed to natural enemies like birds and ants. Besides exposed to natural enemies, it was easy to spray chemicals and to kill mechanically. These types of point applications were accepted by farmers because the spray of chemicals in the fields and grazing lands was harmful to their animals and bees as well as polluted the drinking water.

3.2. Luring the Adult Beetles

Significantly a higher number of beetles were attracted to banana (>3000 beetles) and guava fruit (>3500 beetles) while the other baits were less efficient (**Figure 2**). The local beer residue (atela) and the factory by products (malt and molases) were not effective attractants as compared to the fruits. Adult male beetles were more attracted by baits than females' beetles in both years (**Table 2**). [10] reported that volatile compounds originating from sorghum and other host plants are highly attractive to the beetles. When these compounds alone or in mixtures are deployed as lures in traps, a high number of beetles are caught. Field experiments also indicate that

Table 1. The effect of botanical pesticides on sorghum beetles mortality (%) under field condition.

Botanical pesticides	Adult beetle mortality (%)	
	2006	2007
Sisal	55.4 ± 6.1b	39.6 ± 8.1c
Jatropha curcas	81.6 ± 10.1a	75.9 ± 11.1ab
Lantana camara	55.3 ± 5.3b	26.5 ± 2.5d
Croton mychrostaches	55.6 ± 4.6b	22.7 ± 2.1d
Shines mollie	57.9 ± 7.0b	35.8 ± 7.6c
Carbaryl 85%	100.0 ± 9.6a	100.0 ± 11.1a
Control	0	0
CV (%)	22.9	36.1

Mean (±SE) within columns, along each district, followed by the same letters do not differ significantly at the 5% (multiple range test).

Table 2. Attracted male to female ratio using different baits at Bati district in 2006 and 2007.

Year	Attractants	Mean number of attracted beetles		Attracted (%)	
		Males	Females	Males	Females
2006	Banana	1977 ± 21.4b	1063 ± 11.1a	65 ± 6.3a	35 ± 5.0a
	Guava	2278 ± 22.2a	1257 ± 8.9a	64 ± 4.1a	36 ± 3.1a
	Atela	23 ± 2.1c	21 ± 4.1b	52 ± 2.3b	48 ± 7.3a
	CV (%)	23	28	11	13
2007	Banana	1605 ± 12.1a	869 ± 20.2a	65 ± 5.7a	35 ± 2.3a
	Atela	118 ± 11.4c	108 ± 8.2b	52 ± 2.9b	48 ± 5.1a
	Guava	250 ± 9.0b	146 ± 13.1b	63 ± 6.6a	37 ± 6.0a
	CV (%)	21.4	31.4	12.5	10.2

Mean (±SE) within columns, along each district, followed by the same letters do not differ significantly at the 5% (multiple range test).

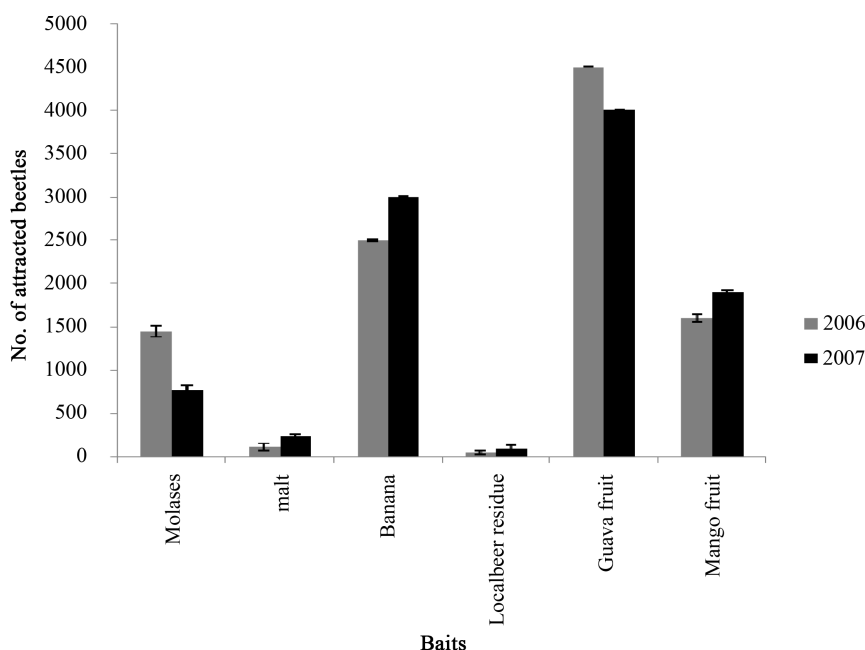


Figure 2. The effect of different baits in luring sorghum chafer beetle at Bati district.

a combination of pheromones and plant compounds constitutes an even more powerful attractant to the sorghum chafer.

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