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Beef Extract as Protein Bait for Monitoring and Control of the Peach Fruit fly *Bactrocera zonata* (Saunders) (Diptera: Tephritidae)

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ABSTRACT

Monitoring and control of the peach fruit fly *Bactrocera zonata* (Saunders) is based on two strategies; one is the Bait Application Technique (BAT) relies on protein baits. Beef extract was used as a source of hydrolysed protein. Beef extract was used at rate of 0.25 and 0.5% in tested bait solutions. The second is the male annihilation technique. The commercial bait, Buminal was used as standard protein bait at recommended rate (5.0%). Field trial was conducted at Alexandria house backyards during August and September 2005. Laboratory and field studies revealed that no significant differences were observed between the standard hydrolysed protein, Buminal, and the solution contained 0.5% beef extract in numbers of trapped *B. zonata*. The present investigation indicated that the mixture of beef extract, molases, borax and malathion can be recommended to be used in the formulation for monitoring and control of the peach fruit fly, *B. zonata*.

Key Words: Beef extract, Bait Application Technique, *Bactrocera zonata.*

INTRODUCTION

Bactrocera zonata (Sound.) is a serious polyphagous pest species attacks over 50 host plant species of fruit trees including, guava, mango, peach, apricot, figs, date and citrus (White and Elson-Harris, 1992). In 1998, *B. zonata* was first found from infested guava fruits collected from Agamy and Sabahia, near Alexandria (El-Minshawy *et al.*, 1999). Presently, it is well established in most Egypt provinces even in the dry desert regions.

Control of fruit fly populations is based on two mass trapping strategies. The first strategy uses the Male Annihilation Technique (MAT) in which wooden blocks impregnated with Para pheromone and malathion insecticide are distributed on trees. Control occurs as males are attracted to these blocks and ingest both the Para pheromone and the insecticide. (Soonoo *et al.*, 1996 and Permalloo *et al.* 1998). While, the second strategy is the Bait Application Technique (BAT) which relies on protein baits (Roessler 1989). In which, a mixture of protein bait and malathion insecticide is sprayed in "spots" on foliage or tree branches. Fruit flies are attracted to these spots, and are killed as a result of ingesting insecticide during feeding on the bait. Although trimedlure is highly effective for monitoring males of *Ceratitis capitata* (Berroza, *et al.* 1961) and methyl eugenol for *B. zonata* (White and Elson-Harris, 1992), no equivalent lure is available for females of the two species. Improved lures, especially for fruit fly females, are needed to monitor and suppress populations of fruit flies and to prevent establishment of their populations in areas that currently do not have these pests.

The present investigation aimed to evaluate the role of beef extract as a protein bait attractant for the peach fruit fly, *B. zonata* under laboratory and field conditions.

MATERIALS AND METHODS

Beef extract was used as a source of hydrolyzed protein (supplied by El-Gomhouria Chemical Company, Egypt). Pure Malathion (96%) was supplied by Plant Protection Institute; Egyptian Ministry of Agriculture. Tested solutions were BM50, BM100, and Buminal. The solution BM50 was prepared by adding 2.5g beef extract to a mixture of 4g molasses, 10g sodium borate (borax), 5.0ml malathion 96% and 1000ml water. The solution of BM100 was prepared by adding 5g beef extract to a mixture of 4g molasses, 10 g borax, 5.0 ml malathion 96% and 1000 ml water. Buminal solution was prepared by adding 50 ml commercial buminal to 5.0ml malathion 96% and 1000 ml water. Tap water was used as control treatment.

Laboratory bioassay was conducted in a wooden cubical olfactometer (1x1x1m). Olfactometer sides were provided with 16 plastic traps held on 16 openings (each side include 4 traps). The trap consisted of plastic funnel held on a plastic container supplied with protein bait for receipting tested adult flies. Traps were hung up in horizontal position around the olfactometer sides. One hundred and thirty laboratory-reared, mature

adults (mixed sexes) were released inside the olfactometer. Investigated solutions were exposed to adult flies for a period, of 5 hours. Laboratory bioassays followed complete randomized design. Four replicates were maintained for each solution bait. Trapped flies were counted.

A field validation trial was conducted at house backyards at Agamy region, Alexandria during August and September 2005. Agamy house backyards are cultivated by hundreds of fruit trees such as; guava, apricot, pomegranate, peach, citrus...etc. Natural occurrence level of *B. zonata* was extremely high (from 250–500 adult male/trap/day) during August and September (Al-Eryan *et al.*, 2005). Three Nadel traps, each with 250 ml of hydrolyzed protein bait, were hung at eye level on branches of guava trees. Trapping was counted three times per month, with 7 days trapping duration for each trapping time. Trapped flies were counted in the laboratory. Random sample of 1000 flies were taken from both beef extract traps and buminal traps and was sexed to females and males. Field trials followed a complete randomized design. Number of replications was three for each solution bait.

Laboratory and field data were analyzed following randomized analysis of variance (ANOVA). Means were compared by LSD values at 0.05.

RESULTS AND DISCUSSION

Attraction rate of *B. zonata* adult to various protein bait solutions under laboratory conditions is shown in Table (1). Mean numbers of flies per trap were, 8.58, 10.25 and 12.5 for BM50, BM100 and Buminal solutions, respectively. Few flies were trapped in the water control treatment (*i.e.*, < 0.5 per replicate). Analysis of variance revealed that differences between numbers of trapped flies to BM100 and Bumial were statistically insignificant. Also, no significant differences were observed between BM50 and BM100. At the same, time there was significant difference between BM50 and buminal.

The field validation trial conducted at house backyards during August revealed that number of flies per trap per day was 75.78, 82.33, and 87.33 for BM50, BM10 and Buminal baits, respectively (Table 2). During September, numbers increased to 160.67, 193.56 and 199.89 flies/trap/day, respectively. Analysis of variance revealed that the differences between BM100 and Buminal bait in the number of trapped flies during August and September were insignificant. At the same time, significant differences were observed between BM50 and Buminal baits during August and September (Table 2). The ratio of female: male of *B. zonata* in traps baited with buminal was 375♂: 625♀ while it was 415♂: 585♀ in traps baited with beef extract solutions. The trapped numbers of *B. zonata* flies in the present investigation were extremely high because house backyards are often, cultivated with different successive fruit trees harbouring fruit flies all the year round. In Alexandria house backyards, Al-Eyan *et al.* (2005) recorded 250–500 adult flies\trap\day using Jackson trap baited with methyl eugenol.

In the old bait mixtures of carbohydrates and other fermented substances (such as molases, sugars.... etc.) in combination with inorganic insecticides such as lead arsenate were used to control fruit flies (Roessler 1989). In the 1950's, protein hydrolysate baits mixed with parathion were first used in Hawaii (Steiner 1952). Malathion was used later with hydrolysed protein baits in very successful campaigns against the Med fly, *C. capitata* in Florida (Steiner *et al.*, 1961). The chemicals in these food-based lures provided nutrients critical for female reproductive capability (Steiner 1955). Addition of sodium borate (borax) to aqueous bait reduced decomposition of trapped flies and increased bait pH and attraction of the fruit flies (Heath *et al.* 1994).

Table (1): Mean attraction rate of *B. zonata* adults to various protein bait solutions under laboratory conditions.

Bait solutions	Mean no. flies per trap ± SD
Control	00.50 ± 0.57 a
BM50	08.75 ± 2.73 b
BM100	10.25 ± 2.75 bc
Buminal	2.25 ± 1.71 c

Table (2): Mean attraction rate of *B. zonata* adults to various protein bait solutions under field conditions.

Bait solutions	Mean no. flies per trap± SD,	
	August	September
	75.78± 03.89 a	160.67± 12.91 a
	82.33± 04.10 ab	193.56± 08.88 b
	87.33± 00.96 bc	199.89± 05.30 bc

Means followed by the same letter are not significantly different (P> 0.05).

Results presented in Tables (1) and (2) indicated that beef extract baits were significantly attractive to adult flies of *B. zonata* compared with the imported protein hydrolysate (Buminal). No significant difference was observed in numbers of *B. zonata* trapped between the imported protein hydrolysate and the local protein formulation (BM 100). The prepared solution of imported bait, buminal, used in these trials had protein concentration of approximately 5.0 % compared with the concentrations of only 0.25 - 0.5% for the beef extract bait solutions.

In Egypt, investigations on production of hydrolysed protein from primary organic substances on large scale should be undertaken to help in fruit fly control activities. In this concern, hydrolysed protein is the highest cost component of BAT comprising approximately 15 % of total costs of fruit flies control programs in Mauritius (Rasamimanana, 1997). In Mauritius, Gopaul and Price (1999) produced locally protein bait by acid hydrolysis of yeast from brewery waste instead of the imported protein bait (Buminal).Generally; the present investigation indicated that beef extract can be considered as available hydrolysed protein for monitoring and control of the peach fruit fly, *B. zonata* in Egypt.

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الملخص العربى

مستخلص اللحم كجاذب غذائى بروتينى لرصد ومكافحة ذبابة ثمار الخوخ
Bactrocera zonata (Saunders) (Diptera: Tephritidae)

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يعتمد رصد ومكافحة ذباب الفاكهة على عدة خطط. أحد هذه الخطط هى تقنية تطبيق الجاذبات الغذائية BAT والتى تعتمد على إستخدام البروتينات المتحللة كجاذب لذبابة الخوخ *Bactrocera zonata* (Saunders) . فى هذه الدراسة إستخدم مستخلص اللحم كبروتين متحلل فى محاليل الجاذبات المختبرة بمعدل ٠,٢٥ و٠,٥ %. كما إستخدم الجاذب الغذائى التجارى (بومينال) بالمعدل الموصى به (5.0 %) للمقارنة مع التجهزات المختبرة. كما أستخدم المولاس كمصدر للسكر بنسبة ٠,٤% . وتم إضافة البوراكس بنسبة ١,٠ %. استخدم المبيد الحشرى الملاثيون ٩٦ % كمادة سامة بنسبة ٠,٥% فى المحاليل المختبرة وتم اجراء الإختبار الحقلى فى الحدائق المنزلية بالأسكندرية خلال شهرى سبتمبر وأكتوبر ٢٠٠٥. وقد أظهرت النتائج المعملية والحقلية أن مستخلص اللحم بنسبة ٠,٥ % لايختلف جوهريا مع البروتين التجارى بومينال فى جذبه لذبابة الخوخ. كما تشير الدراسة الحالية الى إمكانية إستخدام مخلوط مستخلص اللحم و المولاس والبوراكس والملاثيون كجاذب لرصد ومكافحة ذبابة الخوخ.