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# RESPONSE OF PEACH FRUIT FLY, *Bactrocera zonata* (Saunders) (DIPTERA : TEPHRITIDAE) TO SOME AMMONIUM COMPOUNDS AS OLFACTORY STIMULANTS

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## ABSTRACT

Nine ammonium compounds (ammonium acetate, ammonium carbonate, ammonium hydroxide, di-ammonium phosphate, ammonium tartrate, ammonium chloride, ammonium oxalate, ammonium citrate and ammonium benzoate) were evaluated as lures for the peach fruit fly, *Bactrocera zonata* (Saunders) (PFF) in guava orchard at Mansoura district, Dakahlia governorate, Egypt. Four concentrations (1, 2, 3 and 4%) of each compound were evaluated during the period from 11th till 26th of October 2006. Statistical analysis indicated that ammonium acetate traps lures significantly higher numbers of PFF adults than the other tested compounds. The lowest efficiency was recorded in traps baited with ammonium chloride followed by ammonium oxalate, ammonium citrate and ammonium benzoate. All tested compounds except ammonium tartrate attracted the higher numbers of the PFF females than males with no significant difference.

Trap catches (at all tested concentrations) indicated that, as the time passes the efficiency of ammonium carbonate and ammonium citrate (at 4% concentration) significantly increased, while the efficiency of ammonium chloride and ammonium benzoate significantly decreases. With respect to the other tested compounds or concentrations, the attractiveness of PFF adults not affected by the time. Each increasing in the dose of ammonium compounds (ammonium carbonate, ammonium hydroxide and ammonium citrate) attracted a considerable higher number of PFF adults, while increasing the concentration of the other tested compounds, the attracted number was reduced.

## INTRODUCTION

Fruit trees are mostly infested with many pests which affect their productivity. Fruit flies are the most destructive pests since they infest the fruits directly causing a great damage to them. Peach fruit fly (PFF), *Bactrocera zonata* (Saunders) and (Diptera : Tephritidae) is one of the most serious pests of fruits (White and Elson-Harris, 1994).

It has proved to be a destructive pest in every country where it had been established (Narayana & Batra, 1960 and Kapoor & Agarwal, 1982). Available and succession of host fruit coupled with enormous fecundity of the insect have caused its rapid increase and dissemination over the country resulting considerable damage to horticultural crops.

In Egypt, *B. zonata* became a serious pest in the last decade attacking a wide range of fruits that differ in their ripening time stage all over

the year. It is a polyphagous insect attacking 40 species of fruit and vegetable crops as well as wild host plants of Families: Euphorbiaceae, Lecytidaceae and Rhomnaceae (Syed *et al.*, 1970).

The efficiency of many attractants (olfactory, food and sex attractant compounds) was evaluated against PFF by several authors (Gopaul and Price, 1999; Hanafy *et al.*, 2001; Amin, 2003 & 2008; Saafan, 2005a&b and Afia, 2007).

Two objectives of using the attractants, the first one, using the attractants for detecting and monitoring the peach fruit fly (PFF) populations, the second one, for fruit flies control.

So, the present investigation aims to evaluate the efficacy of some ammonium attractants as lures for detecting and monitoring the adult populations of peach fruit fly, *B. zonata* in guava orchards.

## MATERIALS AND METHODS

Nine ammonium compounds (ammonium acetate, ammonium carbonate, ammonium hydroxide, di-ammonium phosphate, ammonium tartrate, ammonium chloride, ammonium oxalate, ammonium citrate and ammonium benzoate) were evaluated under field conditions. Each ammonium compound was investigated by using four concentrations (*i.e.* 1, 2, 3 and 4%).

To evaluate the efficacy of ammonium compounds as olfactory attractants for PFF adults, an experiment was carried out in an area of about two feddans cultivated with guava (*Psidium guajava*) in the experimental farm of the Faculty of Agriculture, Mansoura University at Mansoura district, Egypt during the period from 11$^{th}$ till 26$^{th}$ of October 2006.

The modified Nadel traps (described by Hanafy *et al.*, 2001) were used in this experiment; by putting about 200 ml of each concentration of each ammonium compound in the trap. Each treatment was replicated five times. All prepared traps were distributed in a completely randomized design. The traps were hanged at about 1.5 meters on the trees.

The traps were tested every 3 days (as intervals) along a period of 15 days. Captured females and males of *B. zonata* were counted and recorded as CTD (capture/trap/day).

Statistical analysis was done as one way ANOVA and means separated was conducted by using L.S.D. at the probability of 5% (CoStat, 1990), in addition to the regression analysis was done.

## RESULTS

As shown in Figures (1 and 2), trap tests indicated that the peach fruit fly, *Bactrocera zonata* (Saunders) adults showed different degrees of preference for the different tested ammonium compounds. Ammonium acetate attracted the highest numbers of *B. zonata* at all tested concentrations. Ammonium carbonate, ammonium hydroxide, di-ammonium phosphate and ammonium tartrate ranked the second group and recorded

the moderate level of attractiveness with significantly different from ammonium acetate, while ammonium chloride and ammonium oxalate lured relatively low numbers of PFF adults. Ammonium citrate and ammonium benzoate represented another group that was significantly less preferable.

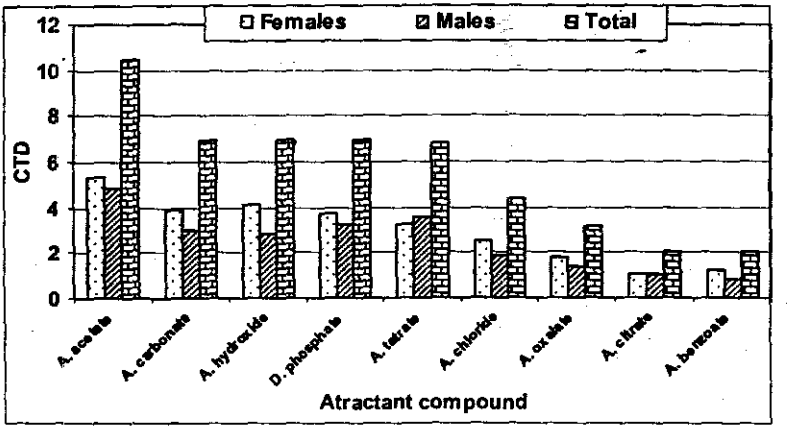


**Figure (1): Mean CTD of the total captured females and males of *B. zonata* over 15 days by all concentration of the tested ammonium compounds in guava orchards at Mansoura district (for total, L.S.D$_{P=5\%}$ = 1.35).**

With respect to the tested concentrations of each ammonium compound, data illustrated in Figures (2) indicated that at 1% concentration, di-ammonium phosphate, ammonium tartrate, ammonium oxalate and ammonium benzoate exerted the highest efficiency. While, ammonium acetate exhibited the highest attractant at 2 and 1% concentration; CTDs reached 13.16 and 11.16 adults followed by di-ammonium phosphate (9.69) and ammonium tartrate (8.73). On contrary, the highest efficiency of ammonium carbonate and ammonium hydroxide against PFF adults was recorded at 4% concentration (CTDs = 8.07 adults). Statistical analysis indicated that there were no significant differences between the attractiveness of ammonium acetate at 1, 2 and 4% concentrations as well as between all tested concentrations of ammonium carbonate and ammonium hydroxide.

On the other hand, the obtained data indicated that, *B. zonata* females showed different degrees of preference for the different tested ammonium compounds. However, all of the tested ammonium compounds (except ammonium tartrate) attracted females more than males with no significant difference (Figures, 1 and 2). PFF males showed relative preference for ammonium tartrate (at 1, 2 and 3% concentrations) in comparison with females.

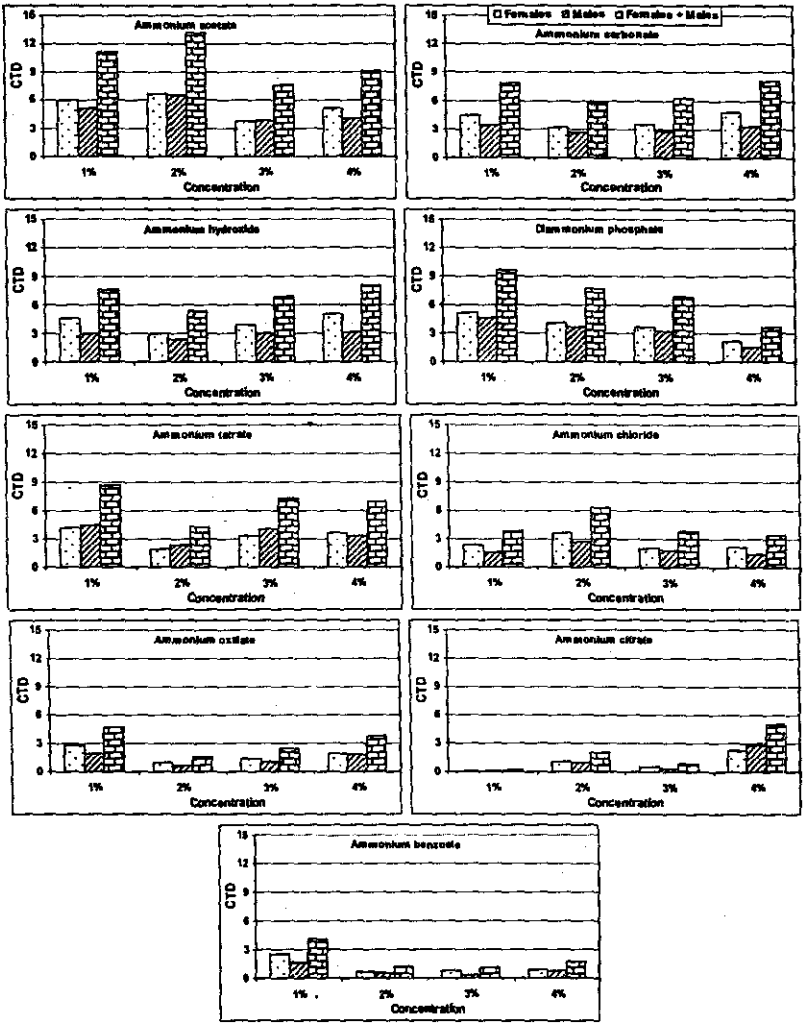


**Figure (2): General CTD (capture/trap/day) of *B. zonata* for the four concentrations (1, 2, 3 and 4%) of the tested ammonium compounds over 15 days in guava orchard (L.S.D = 2.59 for ♀ & = 2.26 for ♂ & = 4.69 for total).**

Regression analysis between the CTD and the concentrations of the tested compounds obviously indicated that di-ammonium phosphate had an adverse relationship between trap catches and concentrations. However, the CTDs decreased significantly as the concentration increased (Table, 1), while the captured flies by the rest of tested compounds did not affected by the concentration.

**Table (1): Regression analysis (b-regression coefficient) for the captured adults (CTD) of *B. zonata* on ammonium concentrations.**

| Ammonium compound | Females | | Males | | Total | |
|---|---|---|---|---|---|---|
| | b | P | b | P | b | P |
| Ammonium acetate | -0.55 | 0.414 | -0.62 | 0.369 | -1.17 | 0.375 |
| Ammonium carbonate | 0.12 | 0.795 | 0.00 | 0.990 | 0.12 | 0.861 |
| Ammonium hydroxide | 0.21 | 0.692 | 0.10 | 0.647 | 0.31 | 0.667 |
| Di-ammonium phosphate | -0.95 | 0.020 | -0.97 | 0.032 | -1.91 | 0.026 |
| Ammonium tartrate | -0.03 | 0.958 | -0.19 | 0.740 | -0.22 | 0.848 |
| Ammonium chloride | -0.22 | 0.612 | -0.15 | 0.666 | -0.37 | 0.628 |
| Ammonium oxalate | -0.21 | 0.641 | 0.01 | 0.986 | -0.20 | 0.811 |
| Ammonium citrate | 0.60 | 0.170 | 0.75 | 0.212 | 1.35 | 0.191 |
| Ammonium benzoate | -0.45 | 0.298 | -0.28 | 0.369 | -0.73 | 0.321 |

To evaluate the potentiality of the tested compounds (as lures for PFF) against time, regression analysis has been done between the CTD and time (days).

Data illustrated in Figure (3) showed the regression of the attractiveness of each tested ammonium compounds to PFF adults over 15 days in guava orchards.

Regression analysis illustrated that the potentiality of the tested ammonium compounds varied according to the compound and concentration. However, the efficiency of all concentrations of ammonium carbonate and ammonium citrate (at 4% concentration) significantly increased by the time. On the contrary, the efficiency of ammonium chloride (at 4% concentration) and ammonium benzoate (at 4% concentration) significantly decreased by the time (Figure, 3).

With respect to the other tested compounds or concentrations, the attractiveness for PFF adults not affected by the time.

From above mentioned results it could be concluded that, the lowest concentration (1%) of di-ammonium phosphate, ammonium carbonate, ammonium tartrate, ammonium hydroxide, ammonium oxalate and ammonium benzoate is the best concentration for catching PFF adults, while the best concentration of ammonium acetate and ammonium chloride was 2%. On contrary, the highest efficiency of ammonium citrate was recorded at 4% concentration.

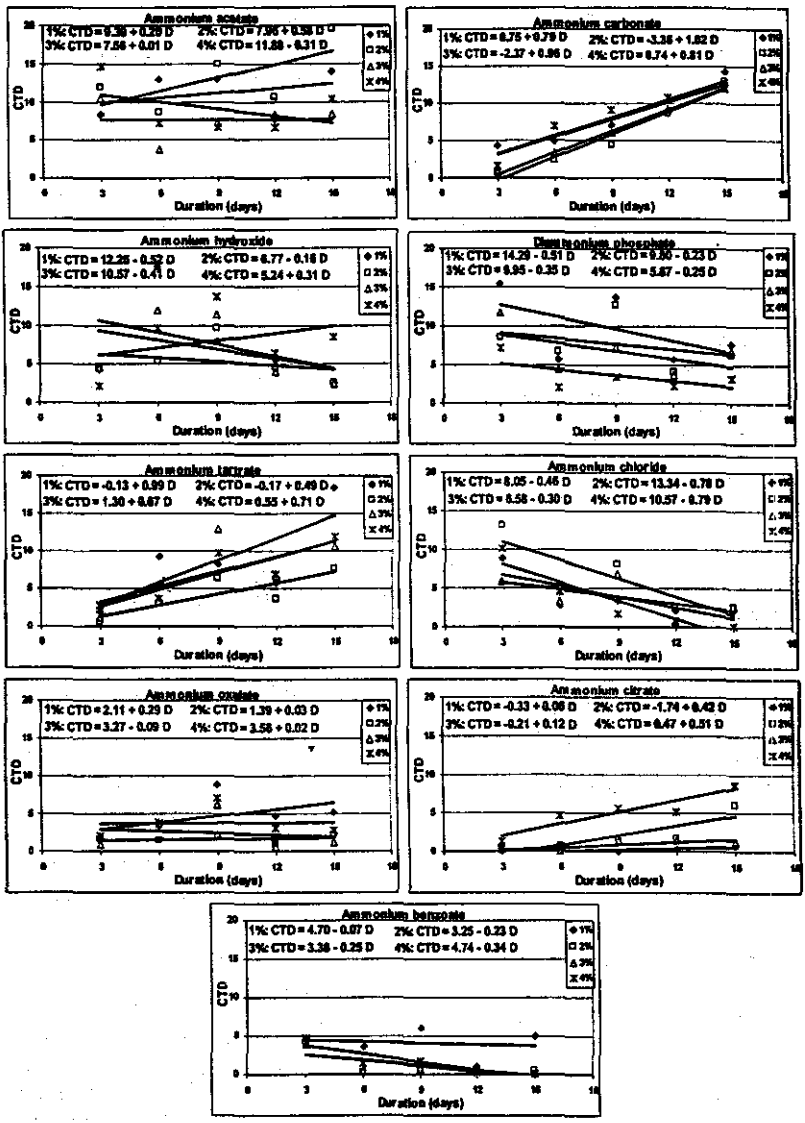


**Figure (3): Stability of 1, 2, 3 and 4% concentrations of the tested ammonium compounds in their attraction of *B. zonata* adults (females + males) over 15 days in guava orchards during October 2006.**

The relationships between the time (in days) and the CTDs of these ammonium compound traps are described statistically as follow :

Ammonium carbonate concentrations :

At 1% : CTD = 0.75 + 0.79 D & At 2% : CTD = -3.35 + 1.02 D
At 3% : CTD = -2.37 + 0.96 D & At 4% : CTD = 0.74 + 0.81 D

Ammonium tartrate concentrations :

At 1% : CTD = -0.13 + 0.99 D & At 2% : CTD = -0.17 + 0.49 D
At 3% : CTD = 1.30 + 0.67 D & At 4% : CTD = 0.55 + 0.71 D

Ammonium acetate concentrations :

At 1% : CTD = 9.39 + 0.20 D & At 2% : CTD = 7.96 + 0.58 D
At 3% : CTD = 7.56 + 0.01 D & At 4% : CTD = 11.88 - 0.31 D

## DISCUSSION

The present study indicated that PFF adults (male and female) exhibited positive response to all tested ammonium compounds. So, ammonium compounds successfully attracted fruit flies; these compounds can be used in monitoring populations of fruit flies (Hafez and Ezzat, 1967; Jones, 1987 and Mohamed, 2002) and can be used in mass trapping as a part of integrated control of fruit flies (Saafan, 2001).

The tested ammonium compounds showed differences in their attractiveness toward peach fruit fly, *B. zonata* with time. However, the highest efficiency of di-ammonium phosphate, ammonium chloride and ammonium chloride was recorded earlier (after 3 days), while, the highest efficiency of ammonium acetate, carbonate, tartrate and citrate was recorded after 15 days. This difference in time may be due to the complete ionization of inorganic salts. However, the ammonia emission rate of inorganic ammonium salts is more than that of organic salts.

In Egypt, Hanafy *et al.* (2001), Saafan (2005 a & b) and Afia (2007) mentioned that females were more attracted to ammonium compounds than males for MFF and PFF. In addition to Delrio and Orto (1989) (in Sardinia) stated that ammonium acetate attracted a high proportion of females. In the present study, the females were more attracted to all tested ammonium compounds than males with no significant differences between the two sexes.

According to Hanafy *et al.* (2001), di-ammonium phosphate was the best compound for attracting PFF in comparison with the other tested compounds. The obtained results illustrated that ammonium acetate and ammonium carbonate proved to be the best compounds for attracting PFF adults. However, these compounds exhibited the highest attractions and their potentiality had increased with time.

It could be suggested that the present results may be used in integrated pest management control programs to obtain ammonium compounds (ammonium acetate and ammonium carbonate) attracted the highest numbers of PFF by using the lowest concentrations (1 or 2%) and their potentiality along lasted time (15 days). In Fayoum governorate, Amin (2003) found that the concentration 3% of di-ammonium phosphate was the

superior followed by 2 and 1% according to the total catch number of PFF adults. The variation between these results and those of the present may be attributed to the variation of climatic factors in the two areas.

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## استجابة ذبابة ثمار الخوخ لبعض مركبات الأمونيوم كمنبهات شمية

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أجريت هذه الدراسة ببستان الجوافة بالمزرعة البحثية لكلية الزراعة – جامعة المنصورة – محافظة الدقهلية . حيث تم تقييم تسعة مركبات أمونيوم (وهى أمونيوم أسيتات ، أمونيوم كربونات ، أمونيوم هيدروكسيد ، داى أمونيوم فوسفات ، أمونيوم ترارترات ، أمونيوم كلوريد ، أمونيوم أوكسالات ، أمونيوم سترات ، أمونيوم بنزوات) وذلك باستخدام أربعة تركيزات من كل مركب (وهى ١ ، ٢ ، ٣ ، ٤%) خلال الفترة من ١١ الى ٢٦ أكتوبرلعام ٢٠٠٦ .

وقد أوضح التحليل الاحصائى أن المركب أمونيوم أسيتات كان الأعلى كفاءة بدرجة معنوية فى جذب الحشرات الكاملة لذبابة ثمار الخوخ مقارنة ببالقى المركبات . بينما وجد أن المركبات (أمونيوم كربونات ، أمونيوم هيدروكسيد ، داى أمونيوم فوسفات وأمونيوم ترارترات) جذبت تعداداً عالى نسبياً من هذه الآفة (ولا يوجد بين هذه المركبات اختلافات معنوية فى الجذب) . كما وجد أن أقل كفاءة فى جذب هذه الحشرات كانت فى حالات أمونيوم كلوريد ، أمونيوم أوكسالات ، أمونيوم سترات وأمونيوم بنزوات . من ناحية أخرى وجد أن كل هذه المركبات (ماعدا أمونيوم ترارترات) جذبت الاناث أكثر من الذكور ولكن بدون اختلافات معنوية بين تعداد كل من الاناث والذكور المنجذبة .

أوضحت النتائج أن كل تركيزات المركب أمونيوم كربونات والتركيز ٤% من المركب أمونيوم سترات زادت كفاءتها فى الجذب بمرور الوقت . بينما بمرور الوقت انخفضت كفاءة التركيز ٤% من المركبين أمونيوم كلوريد وأمونيوم بنزوات . أما باقى المعاملات المختبرة فلم تتأثر كفاءتها فى جذب الحشرات الكاملة لذبابة ثمار الخوخ معنويا بمرور الوقت .

ومن ناحية أخرى وجد أنه توجد علاقة عكسية بين الكفاءة وزيادة التركيز فى المركبات أمونيوم أسيتات ، داى أمونيوم فوسفات ، أمونيوم ترارترات ، أمونيوم كلوريد ، أمونيوم أوكسالات وأمونيوم بنزوات حيث ينخفض معدل الجذب اليومى للمصيدة بزيادة تركيز المادة . بينما كل من المركبات أمونيوم كربونات ، أمونيوم هيدروكسيد وأمونيوم سترات ازدادت كفاءتها بزيادة التركيز .