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Using some ammonia derivatives for improving the attractant of protein-based bait (Buminal®) to the adults of the Mediterranean fruit fly, *Ceratitis capitata* (Diptera: Tephritidae) under field conditions

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Abstract

The Mediterranean fruit fly (Medfly) *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), is a polyphagous insect pest that infests a wide range of fruits and vegetables in Egypt, as well as worldwide. The present study aimed to evaluate the attractiveness of certain ammonium compounds to medfly adults, in addition to using effective treatments to enhance the attractiveness of Buminal (The recommended protein-based bait) to this pest in mandarin orchards. The obtained results showed that ammonium hydroxide and ammonium chloride were superior in attracting Medfly adults, followed by ammonium acetate, with no obvious differences between these compounds, Ammonium sulfate ranked next. Thiourea and hydroxyl ammonium chloride showed no effects in attracting medfly adults. The high attractant of ammonium hydroxide, ammonium acetate, and ammonium sulfate to Medfly adults was recorded at 2.5% concentration, while the highest attractant of ammonium chloride was recorded at 2.0%. Adding ammonium hydroxide, ammonium chloride, or ammonium acetate (With concentrations of 1.0% or 2.0%) to Buminal 5% significantly increased its attractiveness to medfly adults.

Introduction

In Egypt, one of the most vital crops is fruit, which is considered a major component of Egypt's agricultural exports (Which increase national income), in addition to its great importance in local consumption (Which helps to meet local needs). Fruit trees are infested by several insect pests that affect their productivity. Fruit flies are among the most important insect pests infesting fruit crops (Syed *et al*., 1974; Hafez *et al*., 1973; Ghanim, 2009; Darwish, 2016; Ghanim, 2017; Metwaa, 2019; and El-Kelany, 2025).

One of the most destructive fruit pests in the world, the Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), is native to the Afrotropical region and is known by some as the worst pest of fruit trees (Enkerlin and Mamford, 1997, and Teresa *et al*., 2002). According to White and Elson-Harris (1992) and Borge and Basedow (1997), medflies have a major effect on fruit production. Their females lay their eggs inside

fruits, and the hatching maggots eat the pulp. Secondary infestations of bacterial and fungal diseases are then common, and the infected fruits fall to the ground, making them unsuitable for marketing or exportation.

It was found by Pinero *et al*. (2015) and Epsky *et al*. (2014) that tephritid fly females require protein ingestion to lay their eggs. Hull and Cribb (2001) explained that ammonia odors released from protein-based bait have significant effects on their attraction. So, Medfly (As one of the tephritid flies) strongly responds to nitrogen-containing food sources (Kaspi *et al*., 2000; Yuval *et al*., 2007; Abd El-Kareim *et al*., 2008; Ghanim *et al.*, 2021; Abd El-Salam and Youssef, 2023 and Hendawy *et al*., 2024). Hence, protein-based bait mixed with insecticides have been used to control medfly (El-Metwally, 2018; Hendawy *et al*., 2024 and El-Kelany, 2025). So, Mangan (2009 and 2014) proved that protein-based baits should have high levels of attraction and stimulate adults of fruit flies (*i.e.,* Medfly) to ingest the lethal doses of the used insecticides for good suppression of the insect population.

From the previously mentioned information, the development of effective ammonia-containing baits for Medfly attraction is aimed at by El-Metwally (2018), Abd El-Salam and Youssef (2023), and Hendawy et al. (2024). However, fruit flies are attracted to ammonia-based compounds in a dose-dependent manner, indicating that the range of repellences is greater than the range of attractiveness (Bateman and Morton, 1981, and Mazor *et al*., 2002). Therefore, to increase the efficiency of protein-based baits against fruit flies, it is crucial to add specific quantities of ammonium compounds to them (Pinero *et al*., 2015).

The present study aims to evaluate some ammonium compounds as olfactory attractants for medfly adults by using five concentrations and to determine the effective ammonium compounds for improving the attractant of Buminal (The recommended protein-based bait) to Medfly adults in a mandarin orchard under field conditions.

Materials and methods

The present study was done in an area of 15 feddans (1 feddan = 0.42 ha) cultivated with mandarin (*Citrus reticulata* Blanco). This orchard is located in the Mansoura district, Dakahlia Governorate, Egypt. Ammonium hydroxide (NH_4OH), ammonium chloride (NH_4Cl), ammonium acetate (CH_3COONH_4), ammonium sulfate ($(NH_4)_2SO_4$), thiourea (H_2NCSNH_2), and hydroxyl ammonium chloride ($HONH_2{\cdot}HCl$) were obtained from Edwic Company, Egypt. Buminal (Protein 39.78%), was obtained from the Plant Protection Research Institute, Agricultural Research Center, Egypt.

Five concentrations (0.5, 1, 2, 3, and 5%) of each ammonium compound were prepared by diluting with water (One liter for each). Then the prepared liter of each treatment was divided into four amounts (250 ml of each) and put inside four modified Nadel traps (Hanafy *et al*., 2001) as replicates. After that (On the 7th of October 2024), the traps were dispersed randomly and hung on trees at a height of roughly two meters in windy and shady areas. To avoid interference among traps inside the orchard, the distance between every two successive traps was about 20 meters. Over fifteen days (Till 22nd of October 2024), every three days, traps were inspected by filtration to separate adults of fruit flies from the solutions, and then solutions were returned to the traps again, while fruit flies were transferred to the laboratory for inspection. Adult medflies were counted and recorded for each trap in

the lab as captured flies/trap/day (FTD values).

To improve the attractiveness of Buminal to medfly adults, it was diluted in water to obtain a concentration of 5% (v/v). Also, 1 and 2% concentrations of each effective ammonium compound (As an attractant for Medfly) were prepared as previously mentioned. Then, each concentration of ammonium compound was mixed with Buminal 5% (As 1:1), and 250 ml of each prepared mixture was placed inside a modified Nadel trap. As a control, 250 ml of Buminal 5% without mixing any of the ammonium compounds was used for comparison inside a trap. Each treatment was replicated four times. On the 27th of October 2024, as previously stated, the constructed traps were strung and dispersed over the chosen mandarin orchard. Over fifteen days (Till the 11th of November 2024), every three days, the traps were inspected, and as previously stated, the number of adult medflies that were collected was counted.

The least significant difference (LSD) (At a probability level of 5%) between means was calculated by using the statistical analysis program of CoHort Software (2004), which used one-way ANOVA to analyze the obtained data. Also, regression analysis was performed by the same program.

Results and discussion

During the present study, six ammonium compounds (Ammonium hydroxide, ammonium chloride, ammonium acetate, ammonium sulfate, thiourea, and hydroxyl ammonium chloride) were evaluated as olfactory attractants for medfly adults to use for improving the attractant of Buminal (The recommended protein-based bait) to medfly adults in a mandarin orchard.

The results obtained revealed that thiourea and hydroxyl ammonium chloride (At all of the tested concentrations) showed no effects in attracting Medfly adults throughout the test. The results of the other tested ammonium compounds could be represented as follows:

1. Ammonium hydroxide:

Data represented in Table (1) showed that there were no significant differences between the attractants of the two concentrations of 1.0 and 2.0% of ammonium hydroxide to medfly adults at all inspections and ranking first. On the contrary, the concentration of 0.5% was significantly the lowest attractant concentration at all inspections except after 15 days (Where there were no significant differences among all of the tested concentrations). The concentrations of 3.0% showed no significant differences with the attractant concentrations (1.0 and 2.0%) after 6 and 12 days of hanging the traps, while the concentrations of 5.0% showed no significant differences with the attractant concentrations after 6 days only.

The mean FTDs of attracted Medfly adults by 1.0% and 2.0% of ammonium hydroxide reached 0.73±0.12 and 0.59±0.08, respectively (With no significant difference between them). The attractant of 3.0% ranked second (Mean FTD=0.53±0.11); while 0.5% and 5.0% concentrations ranked third (Mean FTD = 0.28±0.07 and 0.23±0.05), with no significant difference between them (Table 1).

Table (1): Adult medflies' attraction to ammonium hydroxide concentrations (Con.) in a mandarin orchard during a period of 15 days.

Con.	Flies/trap/day (FTD) after (In days)					
	3	6	9	12	15	Mean
0.5%	0.00±0.00^{c}	0.00±0.00^{b}	0.49±0.22^{bc}	0.58±0.08^{bc}	0.33±0.19^{a}	0.28±0.07^{c}
1.0%	0.42±0.08^{a}	0.33±0.13^{ab}	1.33±0.14^{a}	1.26±0.29^{a}	0.49±0.09^{a}	0.73±0.12^{a}
2.0%	0.34±0.14^{ab}	0.42±0.15^{a}	0.99±0.13^{ab}	0.83±0.10^{ab}	0.41±0.15^{a}	0.59±0.08^{ab}
3.0%	0.17±0.09^{bc}	0.25±0.16^{ab}	1.08±0.21^{a}	0.99±0.14^{ab}	0.17±0.09^{a}	0.53±0.11^{b}
5.0%	0.08±0.08^{bc}	0.17±0.09^{ab}	0.33±0.19^{c}	0.25±0.15^{c}	0.33±0.13^{a}	0.23±0.05^{c}

Note: In each column, means had the same letter did not differ significantly at a probability of 95%.

Figure (1) illustrates the mathematical relationship between the concentration of ammonium hydroxide and attraction to medfly adults. As shown in this figure, the concentration of ammonium hydroxide showed an obvious effect on its attractiveness to Medfly adults, where R2 reached 60%. On the other hand, the highest attractively of ammonium hydroxide is mathematically close to 2.5%.

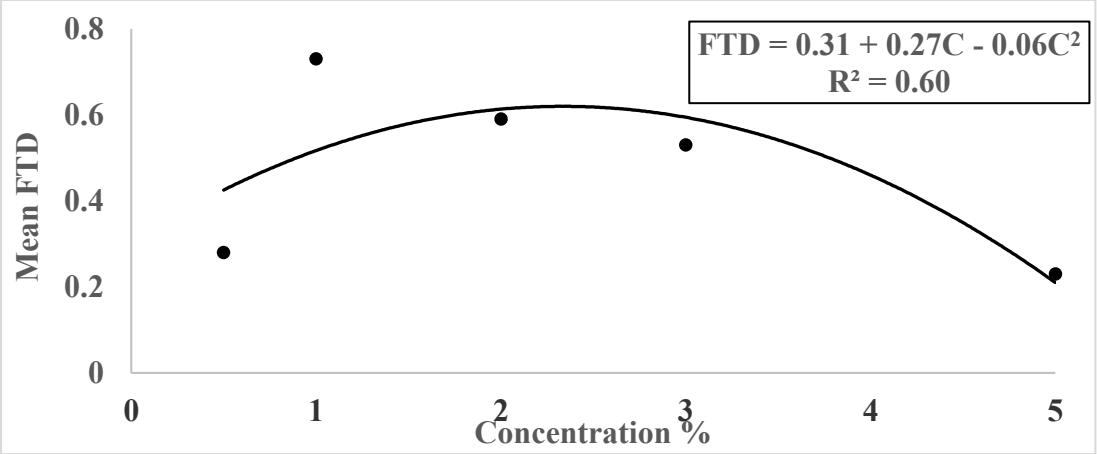

Figure (1): The mathematical correlation between ammonium hydroxide concentrations and their effectiveness in luring adult Medflies to a mandarin orchard.

When using ammonium hydroxide for improving Buminal (the protein-based bait) with its highest attractant concentrations (1.0 and 2.0%), it increased the attractant of Buminal to Medfly adults with significant values in comparison with the control treatment, which was non-improved Buminal 5.0% (Figure 2). On the other hand, the improved Buminal by 1.0% ammonium hydroxide was statistically equal to that improved by 2.0% after 3 and 9 days of hanging tarps, while after 6, 12, and 15 days, as well as the general mean over the tested period (15 days), the improved Buminal by 2% was significantly higher in attracting Medfly adults.

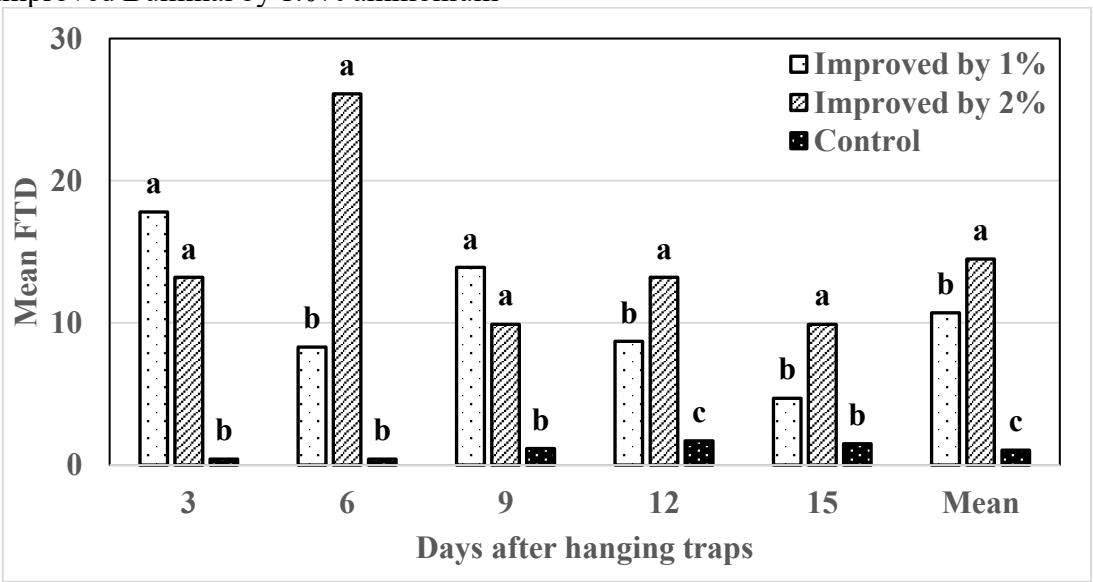

Figure (2): Attractant of improved Buminal 5.0% by 1.0 and 2.0% of ammonium hydroxide to medfly adults in comparison with non-improved (Buminal 5.0% only as control) over 15 days in a mandarin orchard (Note: At a 95% probability, means with the same letter in each inspection did not differ significantly).

2. Ammonium chloride:

After 3 and 6 days of hanging the traps, which were baited with ammonium chloride, the concentrations of 2.0 and 3.0% were the highest attractants for Medfly adults, with no significant differences between them (Table 2). After 9, 12, and 15 days, 1.0% of ammonium chloride increased significantly and ranked first, with significant differences between its attractant and the attractant of the other concentrations. The lowest attractant concentration varied from one inspection to another; there were no attracted medfly adults at the concentration of 1.0% after 6 days, and there were also no attracted flies at the concentrations of 0.50% and 2.0% after 15 days of hanging traps.

Also, data illustrated in Table (2) showed that the mean FTDs of attracted medfly adults by 1.0 and 3.0% of ammonium chloride reached 0.87±0.21 and 0.49±0.11, respectively (With no significant difference between them). The attractants of 0.5, 2.0, and 5.0% ranked second (Mean FTDs were 0.25±0.06, 0.41±0.08, and 0.27±0.06, respectively), with no significant difference between them and the concentration of 3.0%.

Table (2): In a mandarin orchard, the attraction of ammonium chloride concentrations (Con.) to adult medflies over a period of 15 days.

Con.	Flies/trap/day (FTD) after (In days)					
	3	6	9	12	15	Mean
0.5%	0.25±0.08^{b}	0.17±0.09^{bc}	0.41±0.16^{b}	0.41±0.21^{b}	0.00±0.00^{b}	0.25±0.06^{b}
1.0%	0.08±0.08^{b}	0.00±0.00^{c}	1.16±0.22^{a}	1.74±0.21^{a}	1.38±0.55^{a}	0.87±0.21^{a}
2.0%	0.58±0.21^{ab}	0.57±0.28^{ab}	0.50±0.21^{b}	0.42±0.08^{b}	0.00±0.00^{b}	0.41±0.08^{b}
3.0%	0.91±0.28^{a}	0.91±0.16^{a}	0.25±0.15^{b}	0.16±0.16^{b}	0.25±0.08^{b}	0.49±0.11^{ab}
5.0%	0.16±0.09^{b}	0.25±0.15^{bc}	0.50±0.21^{b}	0.25±0.08^{b}	0.17±0.16^{b}	0.27±0.06^{b}

Note: In each column, means with the same letter did not differ significantly at a probability of 95%.

The mathematical relationship between the concentration of ammonium chloride and attractant to Medfly adults (Figure 3) showed that concentration had a relatively low effect on its attractant to medfly adults, where R^2 reached 22%. On the other hand, the highest attraction of ammonium chloride is mathematically close to 2.0%.

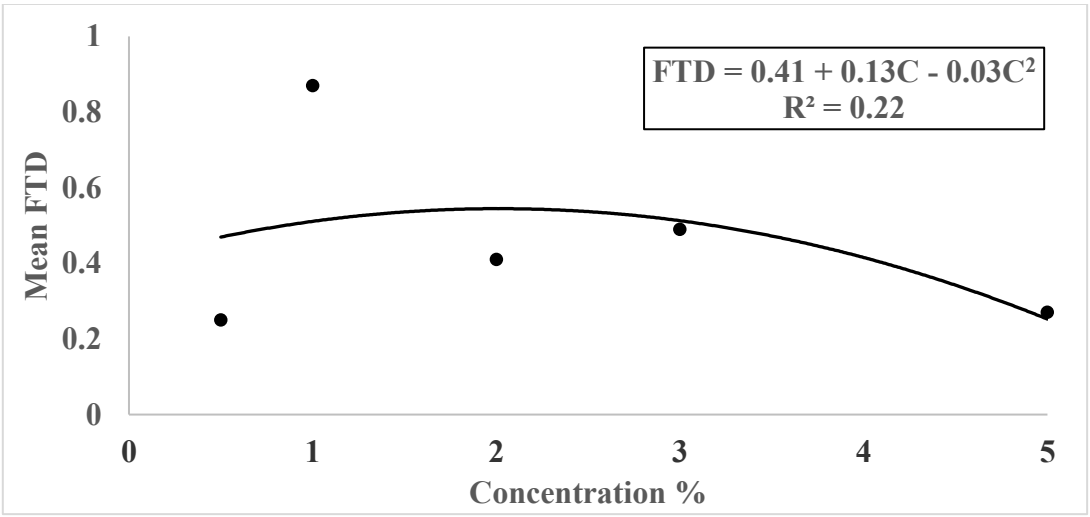

Figure (3): The mathematical correlation between ammonium chloride concentrations and how well they attract adult medflies in a mandarin orchard.

Improving Buminal by 1.0 and 2.0% concentrations of ammonium chloride increased the attractant of Buminal to medfly adults, with significant values in comparison with the control treatment (Buminal 5.0% without adding

ammonium chloride). On the other hand, the improved Buminal with 2.0% ammonium chloride as an attractant for Medfly adults was statistically higher than the improved Buminal by 1.0% at all inspections, as well as the general mean over the tested period, except after 3 days, which recorded that the improved Buminal with 1% ammonium chloride was the highest (Figure 4).

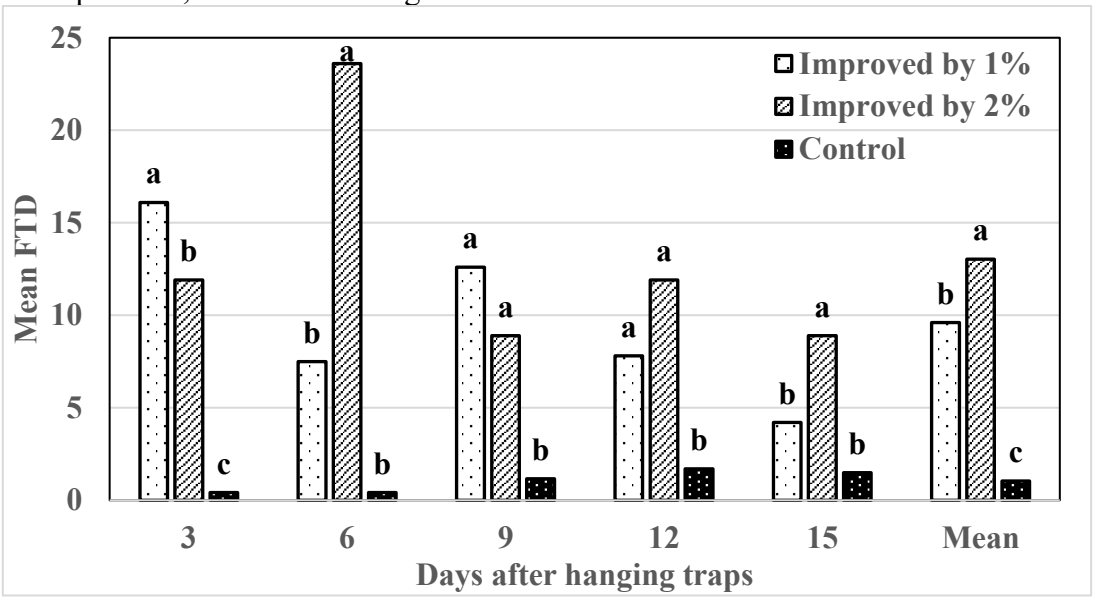

Figure (4): Attractant of improved Buminal 5.0% by 1.0 and 2.0% of ammonium hydroxide to Medfly adults in comparison with non-improved (Buminal 5.0% only as control) over 15 days in the mandarin orchard (Note: In each inspection, means with the same letter did not differ significantly at a probability of 95%).

3. Ammonium acetate:

After three and six days of hanging traps, the data in Table (3) demonstrated that there were no significant differences in the attractant of the three concentrations of ammonium acetate to medfly adults: 1.0, 2.0, and 3.0%, ranking the first with no significant differences between them. After 9 days, the concentrations of 1.0% and 3.0% ranked first in attracting Medfly adults, with no significant difference between them. All the measured ammonium acetate concentrations showed no significant differences in attractant during the 12-day examination. After 15 days of hanging traps, ammonium acetate 2% was significantly superior in attracting medfly adults. On the contrary, the lowest attraction of insect adults was recorded with 0.5 and 5.0% concentrations (Together or alternately).

The mean FTDs of attracted medfly adults by 2.0% of ammonium acetate reached 0.68±0.17, followed by the concentrations of 1.0 (0.55±0.13) and 3.0% (0.36±0.08) (With significant differences between them). The attractants of 0.5 and 5.0% ranked the least (Mean FTDs were 0.12±0.04 and 0.10±0.04), with no significant difference between them (Table 3).

Table (3): Attractant of ammonium acetate concentrations (Con.) to medfly adults over 15 days in a mandarin orchard.

Con.	Flies/trap/day (FTD) after (In days)					
	3	6	9	12	15	Mean
0.5%	0.00±0.00 ^{b}	0.00±0.00^{b}	0.25±0.15^{b}	0.33±0.13^{a}	0.00±0.00^{c}	0.12±0.04^{d}
1.0%	0.08±0.08^{ab}	0.17±0.09^{ab}	0.49±0.09^{ab}	0.50±0.21^{a}	1.49±0.21^{b}	0.55±0.13^{b}
2.0%	0.33±0.19^{a}	0.41±0.15^{a}	0.33±0.13^{b}	0.25±0.15^{a}	2.08±0.28^{a}	0.68±0.17^{a}
3.0%	0.08±0.08^{ab}	0.17±0.09^{ab}	0.83±0.16^{a}	0.66±0.00^{a}	0.08±0.08^{c}	0.36±0.08^{c}
5.0%	0.00±0.00^{b}	0.00±0.00^{b}	0.17±0.09^{b}	0.25±0.15^{a}	0.08±0.08^{c}	0.10±0.04^{d}

Note: In each column, means with the same letter did not differ significantly at a probability of 95%.

Figure (5) illustrates the mathematical relationship between the concentration of ammonium acetate and its attractiveness to Medfly adults. As shown in this figure, the concentration of ammonium acetate showed an obvious effect on its attractiveness to medfly adults, where R^2 reached 64%. On the other hand, the highest attractant of ammonium acetate is mathematically close to 2.5%.

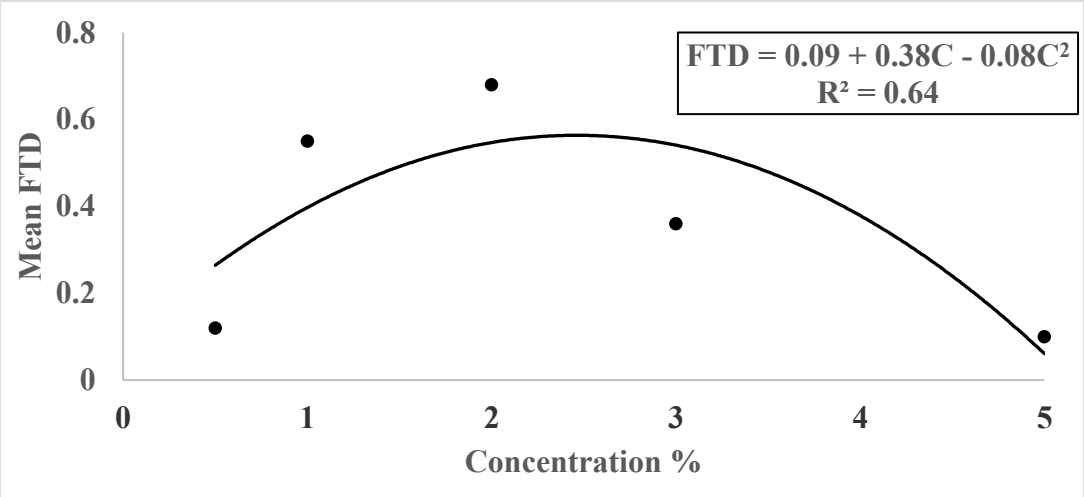

Figure (5): The mathematical correlation between ammonium acetate concentrations and how well they attract adult Medflies in a mandarin orchard.

When using the highest attractant concentrations of ammonium acetate (1.0 and 2.0%) for improving Buminal, it increased the attracted Medfly adults to Buminal with significant values in comparison with the control treatment, which was non-improved Buminal 5.0% (Figure 6). On the other hand, the improved Buminal by 1.0% ammonium hydroxide was statistically equal to that improved by 2.0% after 9 and 12 days of hanging tarps, while after 3 days, the improved Buminal by 1.0% ammonium hydroxide was statistically higher than that improved by 2.0%. After 6 and 15 days, as well as the general mean over the tested period (15 days), the improved Buminal by 2% was significantly higher in attracting medfly adults.

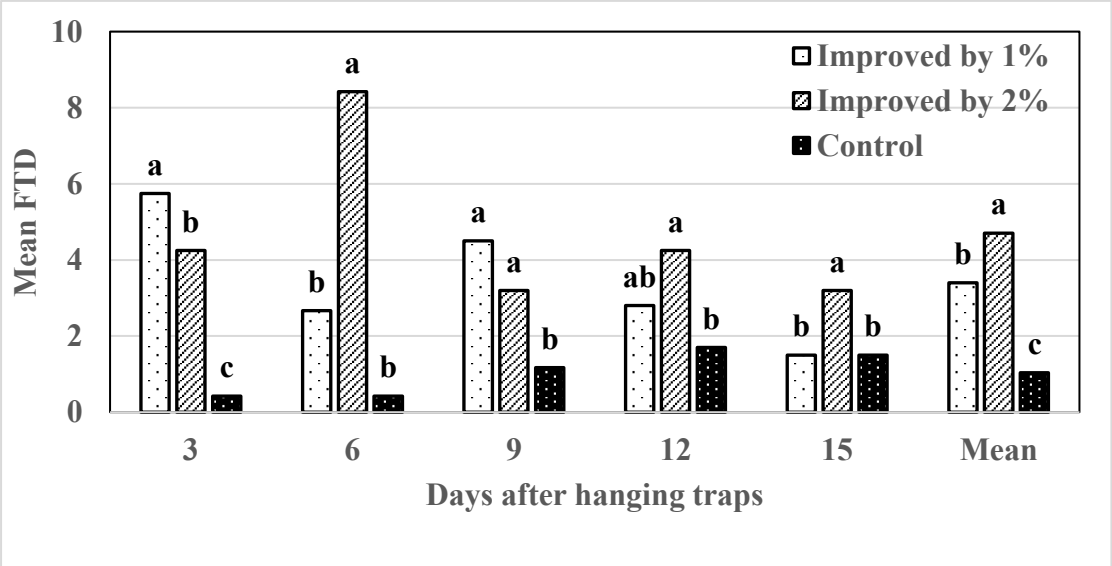

Figure (6): Attractant of improved Buminal 5.0% by 1.0 and 2.0% of ammonium acetate to Medfly adults in comparison with non-improved (Buminal 5.0% only as control) over 15 days in a mandarin orchard (Note: In each inspection, means with the same letter did not differ significantly at a probability of 95%).

4. Ammonium sulfate:

After 3 and 6 days of hanging the traps, which were baited with ammonium sulfate, the concentration of 2.0% was the highest attractant for medfly adults, while after 15 days, the concentration of 3.0% was the highest, with significant differences between their attractions and the attractions of the other concentrations (Table 4). After 9 and 12 days, there were no significant differences between the attraction of all of the tested concentrations. The lowest attractant concentration generally occurred when a 5.0% concentration of ammonium sulfate was used, followed by 1.0% of the same compound.

Data represented in Table (4) showed that the mean FTDs of attracted medfly adults by 2.0, 1.0, and 3.0% of ammonium sulfate reached 0.30±0.05, 0.18±0.05, and 0.15±0.05, respectively (With no significant difference between them). The attractants of 0.5 and 5.0% ranked second (Mean FTDs were 0.08±0.03 and 0.02±0.01, respectively), with no significant difference between them and the concentrations of 1.0 and 3.0%.

Table (4): Ammonium sulfate concentrations' (Con.) ability to attract adult medflies in a mandarin orchard over 15 days.

Con.	FTD after (in days)					
	3	6	9	12	15	Mean
0.5%	0.00±0.00^{b}	0.00±0.00^{b}	0.25±0.08^{a}	0.17±0.09^{a}	0.00±0.00^{b}	0.08±0.03^{b}
1.0%	0.16±0.16^{b}	0.16±0.09^{b}	0.25±0.15^{a}	0.33±0.13^{a}	0.00±0.00^{b}	0.18±0.05^{ab}
2.0%	0.42±0.08^{a}	0.50±0.16^{a}	0.25±0.15^{a}	0.16±0.09^{a}	0.17±0.09^{b}	0.30±0.05^{a}
3.0%	0.00±0.00^{b}	0.08±0.08^{b}	0.08±0.08^{a}	0.08±0.08^{a}	0.49±0.09^{a}	0.15±0.05^{ab}
5.0%	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{a}	0.08±0.0^{a}	0.00±0.00^{b}	0.02±0.01^{b}

Note: In each column, means with the same letter did not differ significantly at a probability of 95%.

The mathematical relationship between the concentration of ammonium sulfate and attractant to Medfly adults (Figure 7) showed that concentration had a relatively high effect on its attractant to Medfly adults, where R^2 reached 74%. On the other hand, the highest attractivity of ammonium sulfate is mathematically close to 2.5%.

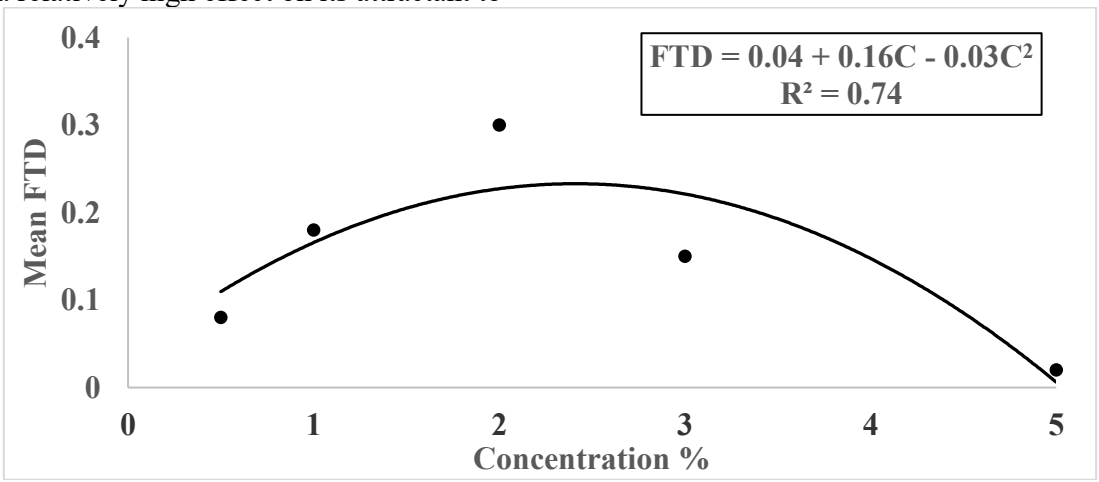

Figure (7): The mathematical correlation between ammonium sulfate concentrations and how well they attract adult Medflies in a mandarin orchard.

Improving Buminal by 2.0% concentration of ammonium sulfate increased the attractiveness of Buminal to medfly adults (Compared with the control) in most of the inspections. These increases are significant after 6 days of hanging traps, as well as the general means of attracting flies all over the tested period (15 days) and non-significant at the rest of the inspections. Concerning adding 1.0% of ammonium sulfate to Buminal 5%, it resulted in no significant effects on the attractant of Buminal to Medfly adults all over the tested period (Figure 8).

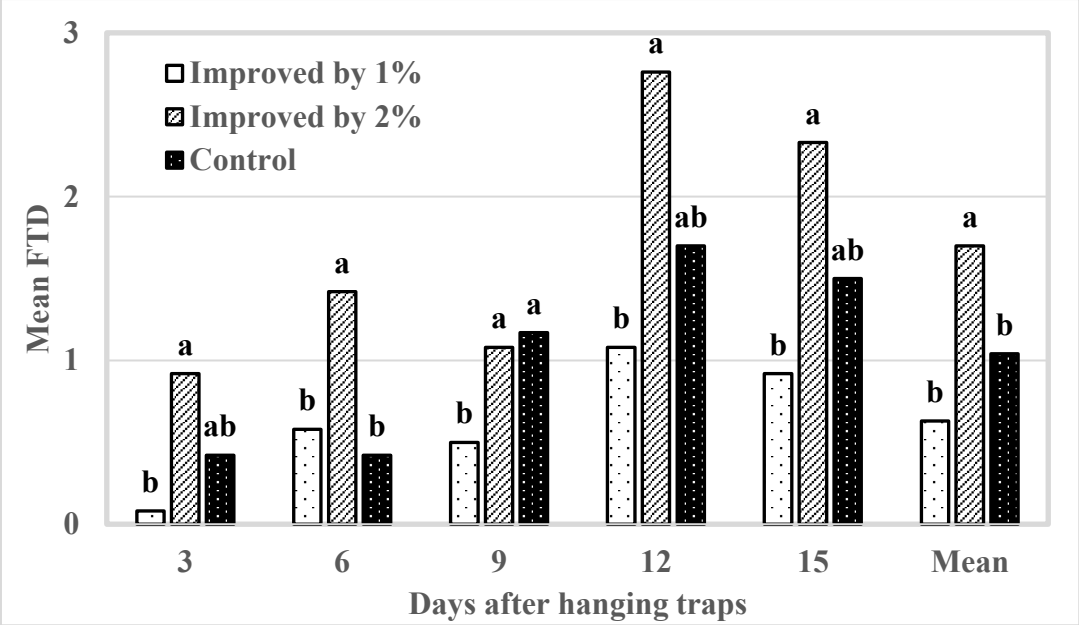

Figure (8): Attractant of improved Buminal 5.0% by 1.0 and 2.0% of ammonium sulfate to Medfly adults in comparison with non-improved (Buminal 5.0% only as control) over 15 days in the mandarin orchard (Note: In each inspection, means with the same letter did not differ significantly at a probability of 95%).

Female fruit flies use ammonia and its derivatives as volatile stimuli for finding protein-rich food sources that are necessary for the development of eggs (Pinero *et al*., 2015). In the current study, ammonium hydroxide and ammonium chloride were superior in attracting medfly adults, followed by ammonium acetate, with no obvious differences between these compounds. Ammonium sulfate ranked next as an attractant for the fly adults. In contrast, thiourea and hydroxyl ammonium chloride showed no effects in attracting Medfly adults. These findings are in agreement with those obtained by Moustafa and Ghanim (2008), El-Abbassi *et al*. (2017), Makkar *et al*. (2017), and Ragab and Youssef (2021), reported that ammonium acetate and ammonium hydroxide are the effective attractants for medfly adults. According to Ghanim *et al.* (2014), in Christ's thorn orchards (In Saudi Arabia), ammonium acetate and ammonium chloride are the obvious attractants for the zizyphus fruit fly, *Carpomya incompleta* (Beeker) (Diptera: Tephritidae). On the other hand, Moustafa and Ghanim (2008) reported that chloride was one of the least effective treatments in attracting medfly adults. The variation between the present study and the other may be attributed to the variation of ecological factors, especially weather factors and/or the source of the tested ammonium compounds.

Bateman and Morton (1981) and Mazor (2009) reported that increases in ammonia produced from protein-based baits, which included bacterial degradation, increased the attractiveness of these baits to adults of fruit flies. For Abd El-Kareim *et al*. (2008), Moustafa and Ghanim (2008), Ghanim *et al*. (2014), Ghanim *et al.* (2021), Ragab and Youssef (2021), Abd El-Salam and Youssef (2023), and Ghanim *et al*. (2023), the highest attractive concentration of ammonium compounds to fruit flies varied according to the tested compound, fruit fly species, and the environmental factors (Especially weather factors). These assumptions can support the current study, where the high efficiency of ammonium hydroxide, ammonium acetate, and ammonium sulfate as attractants to Medfly adults was

recorded at 2.5% concentration, whereas ammonium chloride's maximum attractant was noted at 2.0%. The lower attractant of the concentrations that are less than these concentrations may be attributed to their low odor emissions, which resulted in low attractiveness to the medfly adults, while the lower attractant of the concentrations more than the highest attracted concentrations may be attributed to their high odor emission, which resulted in an appearance of Medfly adult repellency to ammonia emissions. This explanation is also reported by Ghanim *et al*. (2023) (On medfly), Abd El-Salam and Youssef (2023) (On the peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae). The range of ammonium compounds' attractiveness to fruit flies is very narrow, whereas their range of repellence is much wider, according to Bateman and Morton (1981) and Mazor *et al*. (2002). This phenomenon may be caused by the fact that fruit flies' attraction level to ammonium compounds is dependent.

According to Epsky *et al.* (2014) and Pinero *et al.* (2015), fruit fly females may be strongly attracted to protein-based baits since they need to consume protein sources to mature their eggs. So, dietary sources reach in nitrogen showed strong attraction to fruit flies (Kaspi *et al*., 2000, and Yuval *et al*., 2007). This theory explained the studies of Leblanc *et al*. (2010), El-Metwally (2018), Ghanim (2018), Ghanim and El-Metwally (2019), Abd El-Salam and Youssef (2023), Ghanim *et al*. (2023), and Hendawy *et al.* (2024). They reported that protein-based baits, which include ammonia in their formulations or are added to their formulations, have relatively high attractant for adults of fruit flies because of the advantage of ammonia, which attracts fruit flies, especially females.

The previously mentioned studies supported the present one, where the present study demonstrated that adding ammonium hydroxide, ammonium chloride, or ammonium acetate (with 1.0 or 2.0% concentrations) in addition to ammonium sulfate (With 2.0% concentration only) to Buminal 5% significantly increased its efficiency as an attractant to Medfly adults many times. In contrast, adding ammonium sulfate 1.0% to Buminal 5% did not differ significantly from the control treatment (Buminal 5 without additives) in attracting Medfly adults. These results are in agreement with those of El-Metwally (2018), Ghanim and El-Metwally (2019), Bayoumy *et al.* (2021), Ghanim *et al*. (2023), and Hendawy *et al.* (2024). They found that adding ammonium compounds (such as ammonium chloride, ammonium acetate, and ammonium hydroxide) to protein-based baits increased their attractiveness to Medfly adults.

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