*Zagazig J. Agric. Res., Vol. 38 No. (5) 2011* 1283-1294

# EFFECT OF SOME COMPOUNDS AGAINST THE CABBAGE APHID, *BREVICORYNE BRASSICAE* L. (HOMOPTERA: APHIDIDAE)

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## ABSTRACT

**Four chemical compounds; malathion, aphox, neem oil and Agrimax 3H were tested against the cabbage aphid, *Brevicoryne brassicae* in the laboratory. The leaf dipping technique was used for evaluating the toxicity. $LC_{25}$, $LC_{50}$, $LC_{75}$ and $LC_{90}$ values were as follows: (54.35, 105.48, 204.70 and 372.05), (3.29, 7.13, 15.43 and 30.96), (57.17, 112.94, 223.11 and 412.05) and (99, 458, 2122 and 8444) µg/ ml , respectively. The insecticide aphox was the highest toxic compound and was taken as the standard insecticide which represents a toxicity index of 100%, while the toxicity index for the other compounds; neem oil, malathion and Agrimax 3H at levels $LC_{25}$ , $LC_{50}$, $LC_{75}$, and $LC_{90}$ were (5.75, 6.31, 7.39 and 7.51), (6.05, 6.76, 8.09 and 8.32) and (3.32, 1.56, 0.85 and 0.37%), respectively. Aphox was the most efficient compound followed by malathion, neem oil and Agrimax 3H was the least toxic one among the tested compounds against the cabbage aphid, *B. brassicae* L.**

**Keywords: Cabbage crop, *Brevicoryne brassicae*, malathion, aphox, neem oil, Agrimax 3H, toxicity.**

## INTRODUCTION

The cabbage aphid, *B. brassicae* L. is one of the most serious pests of cabbage in the world (Moharramipour and Fathipour, 2003). It causes direct damage, resulting from feeding which may induce plant deformation and indirect damage, caused either by honeydew or transmission of viruses (Lashkari *et al.*, 2007) .The cabbage aphid is a vector of 20 virus diseases in large range of plants (Ellis *et al.*, 1998).

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The objective of this study was to evaluate the toxicity of some insecticides against the cabbage aphid, *B. brassicae*.

## MATERIALS AND METHODS

### Tested Compounds

Organophosphorus compound: Malathion (57% EC)

Chemical name: O, O dimethyl- (1.2- dicarbethoxy ethyl) phosphorodithioate.

Rate of application: 1.250 L/ feddan

Carbmate compound : Primicarb (Aphox 50% DG)

Chemical name:- 2- (dimethyl amino)–5,6- dimethyl-4- pyrimidinyl dimethyl carbamate.

Rate of application : 50 g/100 L.

Plant extract: (Neem oil 0.15%) .

Molecular formula: $C_{35}$ $H_{44}$ $O_{16}$.

Rate of application: 200 ml/ feddan

Adjuvants: Surfactant: Agrimax 3H

Chemical name: oil based micro emulsion forming system, which contain mixed alkyl pyrrolidones, surfactant, and water insoluble polymers.

Salts : Ammonium sulphate.

Molecular formula: $(NH_4)_2$ $SO_4$.

Rate of application : 1 kg/100L

### Laboratory Experiments

Preparation of serial cultivation of cabbage saplings infested with the aphid, *B. brassicae* L. Saplings were cultivated in plastic pots (30cm diameter, 20cm height) in the laboratory. When sapling reached to 3 leaves, infested by the field colony using fine brush. Saplings of cabbage cultivated on different times (intervals) to increase food source to make colonies and infested of *B. brassicae*. Aphid colonies were protected from out side contamination by placing infested saplings in cages covered with a muslin cloth. These cages were proved to be free from parasites and predators. Aphid colonies were maintained according to Ramadan, 1982.

Serial concentrations of aqueous solutions were prepared (20, 80 160, 180, 220 and 250 µg/ml) for malathion, (1.5, 3, 7.5, 20, 80 and 120 µg/ml) for aphox, (20, 80,160, 180, 220 and 250 µg / ml) for neem oil and (100, 500, 700, 1200, 1500 and 2000 µg/ml) for Agrimax 3H.

Mixtures of Agrimax 3H $LC_{25}$: (99 µg/ml) with concentrations ($LC_{25}$, $LC_{50}$ and $LC_{75}$ of malathion, aphox and neem oil, respectively, were used for application. 10 individuals of *B. brassicae* were used for each replicate using three replicates for each concentration of each compound.

Mortality percentages were calculated to Sun, 1950 equation as follows:

$$\text{Toxicity index} = \left(\frac{\text{LC}_{50} \text{ or } \text{LC}_{90} \text{ of the highest efficient compound}}{\text{LC}_{50} \text{ or } \text{LC}_{90} \text{ of the other compound}}\right) \times 100$$

Relative pontency (R.P) of the tested insecticides was also calculated according to Zidan and Abdel- Megeed (1988) as follows:

$$\text{Relative potency (No. of folds)} = \frac{\text{LC}_{50} \text{ or } \text{LC}_{90} \text{ of the other compound.}}{\text{LC}_{50} \text{ or } \text{LC}_{90} \text{ of the highest efficient compound}}$$

## Joint Action Technique

### Determination of co–toxicity factor

Joint action technique was carried out as follows: spray solution of Agrimax 3H at the concentration that kill 25% of *B. braccicae*. adults was prepared $LC_{25}$, $LC_{50}$ and $LC_{75}$ of malathion were also prepared, separately. Fifty ml of the investigated surfactant, Agrimax 3H was mixed with an equal quantilty of each of the three mixtures were evaluated according to the previous mentioned technique (leaf dipping technique). The joint action data of the tested mixtures in terms of co-toxicity factor (C.F.) were estimated according to Mansour *et al.* (1966).

$$\text{C.F.} = \left(\frac{\text{Observed mortality \} - \text{Expected mortality \}}{\text{Expected mortality \}}\right) \times 100$$

- A positive factor of + 20 or more is considered potentiation,
- A negative factor of -20 or more is considered antagonism
- Values between -20 and +20 indicate additive effect.

## RESULTS AND DISCUSSION

The leaf dipping technique was used to evalute the toxicity of some compounds, malathion, aphox, neem oil, and surfactant Agrimax 3H and their mixtures against individuals of the cabbage aphid, *B. brassicae* under laboratory conditions (30°C and 60% R.H.).

## Acute Toxicity

Toxicity was studied for compounds malathion, aphox, neem oil and Agrimax 3H. The tested compounds could be arranged according to their potency against the aphid, *B. brassicae* at $LC_{25}$ $LC_{50}$, $LC_{75}$ and

$LC_{90}$ levels as follows : (54.35 , 105.48 , 204.70 and 372.05), (3.29, 7.13, 15.43 and 30.96), (57.17, 112.94, 223.11 and 412.05) and (99, 458 , 2122 and 8444 µg/ml), respectively. Whereas, slop values of these tested compounds were 2.34, 2.01, 2.28 and 1.01, respectively. Comparing the toxicity action of the four tested toxicants on bases of aphox toxicity which was the most potent one and taken as the standard insecticide that gave 100%, while the toxicity index values of neem oil, malathion and Agrimax 3H at $LC_{25}$, $LC_{50}$, $LC_{75}$ and $LC_{90}$ were (5.75, 6.31, 7.39 and 7.51), (6.05, 6.76, 8.09 and 8.32) and (3.32, 1.56, 0.85 and 0.37%), respectively (Table1 and Figures1, 2 and 3).

Aphox was the most efficient compound followed by malathion, neem oil and Agrimax was the least toxic one among the tested compounds against the aphid, *B. brassicae* (Table 1).

Relative potency level can be used as aconvenient method in comparing the degree of toxicity of different compounds to any pest.

The relative potency levels at $LC_{25}$, $LC_{50}$, $LC_{75}$ and $LC_{90}$ of the tested compounds are expressed as the number of folds at the least effective compound included in the evaluation against the same test insect. The number of folds representing the relative potency level (Table1) where potency level was obtained by dividing the $LC_{25}$, $LC_{50}$, $LC_{75}$ and $LC_{90}$ of Agrimax 3H which was considered the standard compound at the $LC_{25}$, $LC_{50}$, $LC_{75}$ and $LC_{90}$ levels.

The relative potency levels expressed as number of folds indicate that aphox was highly effective against the cabbage aphid, *B. brassicae* which recorded (30.09, 64.23, 137.52 and 272.74 at levels, ($LC_{25}$, $LC_{50}$, $LC_{75}$ and $LC_{90}$) levels, respectively. While, malathion, neem oil and Agrimax 3H were moderate effect on the same pest, *B. brassicae*. The relative potency folds were recorded 1.82, 4.34, 10.37 and 22.70) and (1.73, 4.06, 9.51 and 20.49) for aphox, malathion and neem oil at ($LC_{25}$, $LC_{50}$, $LC_{75}$ and $LC_{90}$), respectively.

Duhra and Hameed (1985) found that the insecticides, phosalone, fenitrothion, endosulfan and malathion were moderately toxic against the $4^{th}$ instar nymphs of *Brevicoryne brassicae* L. in the laboratory. In Bangladesh, Debaraj *et al.* (1996) reported that morocrotophos, qinalphos and malathion were more effective against *B. brassicae* than endosulfan, dichlorvos, carbaryl or the neem. Karim *et al.* (2001) stated that the insecticide malathion

**Table 1. Acute toxicity of some insecticides against the cabbage aphid, *B. brassicae* under laboratory conditions**

| Concentrations (µg/ml) | compounds | | | | Toxicity index | | | | Relative potency fold (s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Agrimax 3H | Neem oil | Malathion | Aphox | Agrimax 3H | Neem oil | Malathion | Aphox | Agrimax 3H | Neem oi | Malathion | Aphox |
| $LC_{25}$ | 99 | 57.17 | 54.35 | 3.29 | 3.32 | 5.75 | 6.05 | 100 | 1 | 1.73 | 1.82 | 30.09 |
| $LC_{50}$ | 458 | 112.94 | 105.48 | 7.13 | 1.56 | 6.31 | 6.76 | 100 | 1 | 4.06 | 4.34 | 64.23 |
| $LC_{75}$ | 2122 | 223.11 | 204.70 | 15.43 | 0.85 | 7.39 | 8.09 | 100 | 1 | 9.51 | 10.37 | 137.52 |
| $LC_{90}$ | 8444 | 412.05 | 372.05 | 30.96 | 0.37 | 7.51 | 8.32 | 100 | 1 | 20.49 | 22.70 | 272.74 |
| Slope | 1.01 | 2.28 | 2.34 | 2.01 | | | | | | | | |

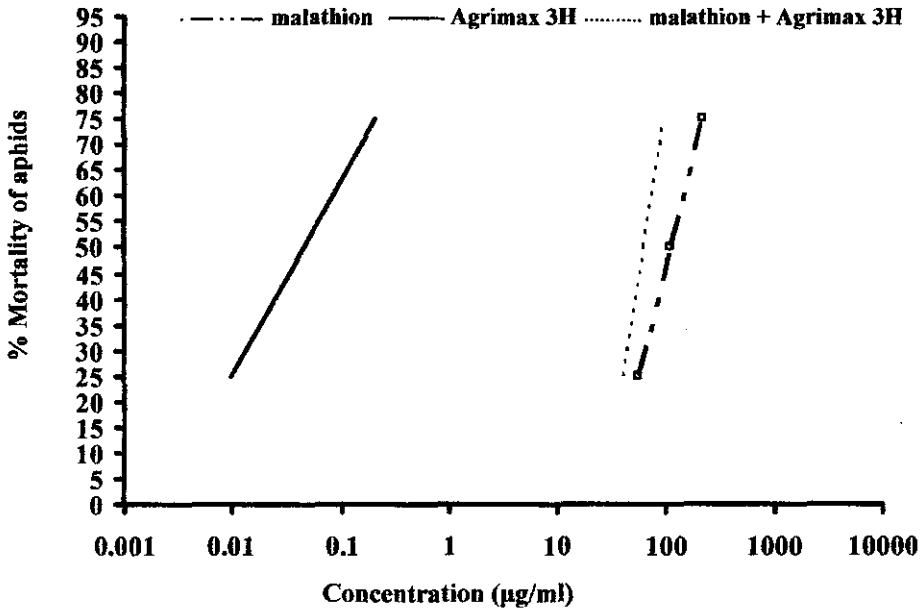


**Fig. 1. Concentration- mortality regression lines of malathion, the surfactant (Agrimax 3H) and their binary mixture tested**

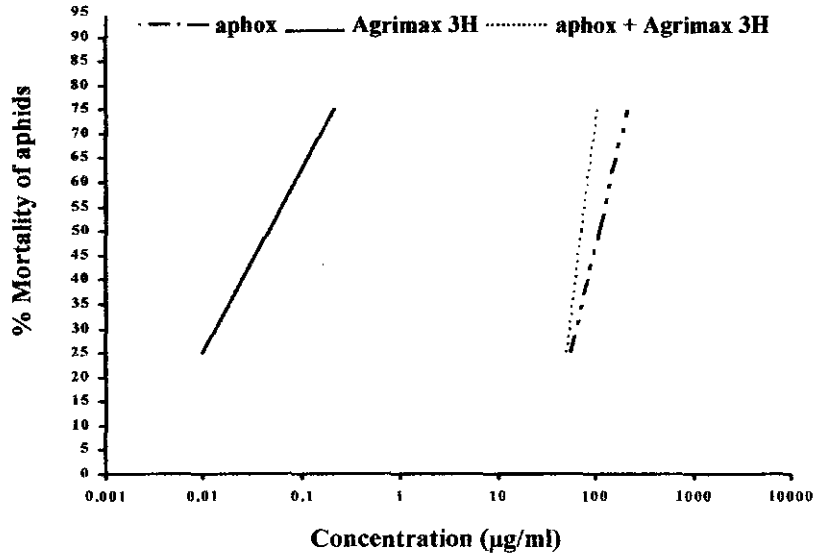


**Fig. 2. Concentration- mortality regression lines of aphox, the surfactant (Agrimax 3H) and their binary mixture tested**

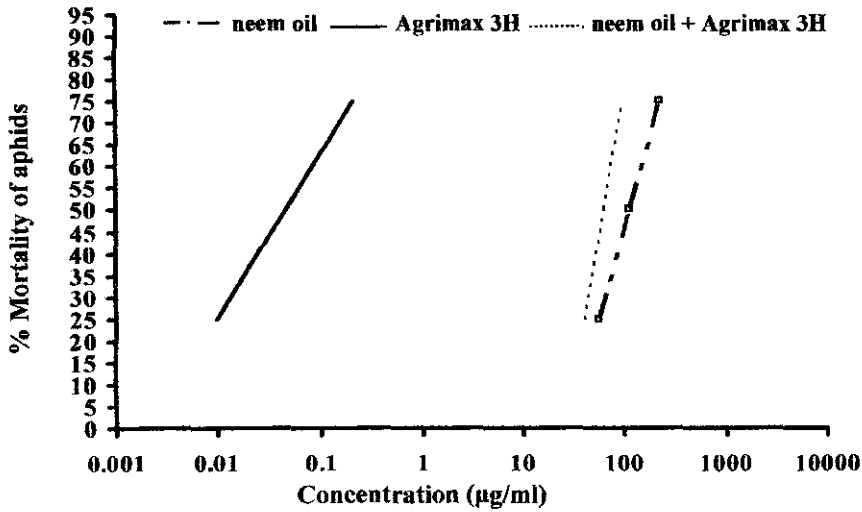


**Fig. 3. Concentration- mortality regression lines of neem oil, the surfactant (Agrimax 3H) and their binary mixture tested**

was least toxic against aphid, *A. gossypii* (Glov.) after 12 and 24 h of treatment. El- Aranaouty *et al.* (2003) showed that the neem affected the nymphs and adults of a susceptible strain of *A. craccivora* after the exposure period of 24h. at toxicity levels ($LC_{25}$, 0.60 ml/L) and ( $LC_{50}$ 1.2 ml/L). Farag and Gesraha (2007) found that the insecticide, aphox gave 100% mortality after 48h from application of aphid, *B. brassicae*. Panwar and Singh (2007) showed that the 3$^{rd}$ and 1$^{st}$ instar aphids, *Lipahis erysimi* were the most susceptible to chlorpyrifos followed by dichlorvos, malathion and endosulfan, respectively. A similar of order of susceptibilily was recorded in 2$^{nd}$ instar nymphs. Carvalho *et al.* (2008) showed that neem (*Azadirachta indica*) at all the tested concentrations (1.0% and 2.0%) is efficient in the control of *B. brassicae*. Khalequzzaman and Jesmun (2008) found that Malathion was the least toxic at $LC_{50}$ against *Aphis craccivora* Koch, *A.gossypii* Glov., *Myzus persicae* (Sulzer) and *Lipaphis erysimi* (Kalt.) respectively, infesting important crop, bean, brinjal, potato and cauliflower. Also, they stated that azadirachtin as a natural plant origin insecticide proved to be the most toxic at level $LC_{50}$. Araujo *et al.* (2009) stated that the neem spraying treatment at 2.0% provided 90% mortality of the aphids, *B.brassicae* and *L .erysim* (Kalt.) in laboratory.

## Joint Action

### Joint action of Agrimax 3H with malathion

Data in Table 2 show that mixtures of these compounds at $LC_{25}$ with malathion at $LC_{25}$ recorded an antagonism effect where co- toxicity factor (C.F.) was -33.34. Also, malathion at $LC_{50}$ with Agrimax 3H at $LC_{25}$ recorded an additive effect of 6.66 and malathion ($LC_{75}$) mixture with Agrimax 3H $LC_{25}$ recorded an additive (0) as Co- factor.

In this aspect: Duhra and Hameed (1985) found that in the laboratory the insecticides, phosalone, fenitrothion, endosulfan and malathion were moderately toxic against the 4$^{th}$ instar nymphs of *B. brassicae*. Wood and Tedders (1997). Reported that the non-ionic super- wetting organosilicone, Silwet l-77 was highly effective against blackmargined aphid, *Monellia caryella* (Fitch). However, higher Silwet L-77 concentrations were highly effective in killing aphids.

### Joint action of Agrimax 3H with aphox

According to Table 3 the mixture of Agrimax 3H at $LC_{25}$,

$LC_{50}$, $LC_{75}$ with aphox at $LC_{25}$ recorded an additive effect where co- toxicity Factors (C.F) were - 13.34, 12.22 and zero, respectively.

Concerning the joint action mixing of two compounds (aphox and Agrimax 3H), data in Table 3 show that mixtures of theses compounds at $LC_{25}$ with aphox at $LC_{25}$ recorded an additive effect where co-toxicity factor (C.F) was -13.34. Also, aphox at $LC_{50}$ with Agrimax 3H at $Lc_{25}$ recorded an additive effect was 2.22 and aphox $LC_{75}$ with Agrimax 3H at $LC_{25}$ recorded (0) an additive as co-factor. Farag and Gesraha (2007) found that the insecticide, aphox gave 100% mortality after 48h. from the application of the aphid *B. brassicae* L

**Joint action of Agrimax 3H with neem oil**

Data given in Table 4 showed that mixtures of these compounds at $LC_{25}$ with neem oil at $LC_{25}$, $LC_{50}$ and $LC_{75}$ levels recorded an additive effect where co- toxicity factors (C.F) were - 6.68, -2.22 and 0 respectively.

Taha and Mahgoup (1999) found that the compounds neemix 4-5% (azadirachtin), carbosulfan and malathion differed significantly in reducing the density of apterous aphid. While, carbosulfan or malathion combined with mineral oil provided the best reduction in aphid numbers. A combination of an effective aphicide plus a mineral oil can be effective in reducing aphid population. Walter (1999) stated that adjuvants such as joint venture and kinetic will increase the effectiveness of an azadirachtin formulation to control pests, white files, *Bemidia tabaci* and aphid, *Aphis* spp. El-Aranaouty *et al.* (2003) showed that the neem affected the nymphes and adults of a susceptible strain of *A. craccivora* after exposure period of 24h at the

toxicity levels of ($LC_{25}$, 0.60 ml / L) and ($LC_{50}$ 1.2 ml/L). Carvalho *et al.* (2008) showed that neem (*Azadirachta indica*) at all the tested concentrations is efficient in the control of *B. brassicae*. khalequzzaman and Jesmun (2008) stated that azadirachtin as a natural plant origin insecticide proved to be the most toxic at level $LC_{50}$ against *Aphis cracivora*, *A. gossypii* and *Myzus persicae* and *Lipaphis erysimi*. Araujo *et al.* (2009) mentioned that the neem spraying treatment at 2.0% provided 90% mortality of the aphids, *B. brassicae* and *L. erysim* (Kalt.) in laboratory.

**Table 2. Joint action at $LC_{25}$ level (99µg/ml) of Agrimax 3H with different concentrations of the insecticide, malathion against the cabbage aphid, *B. brassicae***

| Compound | Concentration of malathion (µg/ml) | % mortality | | C.F.* | Joint action |
|---|---|---|---|---|---|
| | | Expected | observed | | |
| Malathion | $LC_{25}$ (54.35 ) | 50 | 33.33 | -33.34 | antagonism |
| | $LC_{50}$ (105.48) | 75 | 70 | 6.66 | additive |
| | $LC_{75}$ (204.70) | 100 | 100 | 0 | additive |

C.F. * = Co- toxicity factor

**Table 3. Joint action at $LC_{25}$ level (99 µg/ml) of Agrimax 3H with different concentrations of insecticide, aphox against the cabbage aphid, *B. brassicae***

| Compound | Concentration of aphox (µg/ml) | % mortality | | C.F.* | Joint action |
|---|---|---|---|---|---|
| | | Expected | Observed | | |
| Aphox | $LC_{25}$ (2.2 ) | 50 | 43.33 | -13.34 | antagonism |
| | $LC_{50}$ (6.965 ) | 75 | 73.33 | 2.22 | additive |
| | $LC_{75}$ (17 ) | 100 | 100 | 0 | additive |

C.F.* = Co- toxicity factor

**Table 4. Joint action at $LC_{25}$ (99 µg/ml) of Agrimax 3H with different concentrations of the insecticide, neem oil against the cabbage aphid, *B. brassicae***

| Compounds | Concentration of Neem oil ( µg/ml) | % mortality | | C.F.* | Joint action |
|---|---|---|---|---|---|
| | | Expected | observed | | |
| Neem oil | $LC_{25}$ (57.17) | 50 | 46.66 | - 6.68 | additive |
| | $LC_{50}$ (112.94) | 75 | 73.33 | - 2.22 | additive |
| | $LC_{75}$ (223.11) | 100 | 100 | 0 | additive |

C.F. * = Co- toxicity factor

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# تأثير بعض المركبات ضد من الكرنب بريفيكورين برسيكا التابعة لرتبة متشابهة الأجنحة وعائلة أفيديدى

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تم تقييم تأثير بعض المركبات (الملاثيون ، الأفوكس ، زيت النيم ، الأجـريمكس ٣ إتش). حيث أظهرت النتائج أن مبيد الأفوكس أكثر المبيدات المختبرة تأثيرا ضـد مـن الكرنب يليه مستخلص النيم ثم مبيد الملاثيون بينما مركب الأجريمكس ٣ إتش ( مادة نشطة سطحياً) على المستويات المختلفة لسمية ٢٥ ، ٥٠ ، ٧٥ ،٩٠ % كانت أقل تـأثير ضـد حشرة من الكرنب. كما أوضحت النتائج أن إضافة مادة الأجريمكس عند التركيز الذى يصل ٢٥% إلى كل المركبات التي تحت الدراسة (الملاثيون، الأفوكس، النيم) عنـد مـستويات السمية ٢٥ ، ٥٠ ، ٧٥ % أنها تعمل كعامل إضافة للمركبات المختبرة .