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Keywords:
Pieris rapae, Bemictatabaci, Chemical control, side effects and natural enemies.

ABSTRACT
The aim of this study was to investigate the efficiency of four pesticides thiamethoxam, emamectin benzoate, lambdacyalothrin and methomyl (Lannate) against brassica plant pests Bemictatabaci, Pries rapae and their side effects on the associated natural enemies infesting brassica plants under field condition during the two growing seasons, 2021 and 2022 in Sharkia governorate in Egypt.

The obtained results showed that the thiamethoxam compound recorded the highest reduction percentage against Bemictatabaci after 1, 7 and 10 days of spray. Also, emamectin benzoate and lambdacyalothrin compounds recorded the highest reduction percentage against Pierisrapae pests after 1, 7 and 10 days from treatment. The side effect was a significantly effectual reduction in population predators, where's methomyl gave efficacy against Chrysoperlacarnea, also emamectin benzoate gave efficacy on Cocconellaseptumpunctata, while other compounds showed a lower effect in population predators.

INTRODUCTION
Cabbage (Brassica oleracae var. capitata L.) is a very important vegetable field that contents as vitamins and many task minerals as human food in all countries where contents as vitamins and many tasks mineral so infested by different pests, whereas brassica (cabbage), whitefly, Bemictatabaci (Genn.) and whitefly, Pieris rapae (Linn.) one of the important insect pests of brassica and crop which causes remarkable quantitative and qualitative crop losses, these pests caused very losses in crop yields fresh which needed to control, the control of these pests whitefly, B. tabaci and p. rapae beside side effects pesticides on bio enemy green lacewing, Chrysoperlacarnea (Stephens) and Chrysoperlaseptumpunctata by convention pyrothriod pesticides in brassica and cauliflower fields.

Cabbage (Brassica oleracae var. capitata L.) is an herbaceous green leafy vegetable belonging to the Brassica genus, of the Brassicaceae family with several other crop species including broccoli, cauliflower, kale and kohlrabi (Katz and Weaver.,2003). Cabbage plants have been subjected to infestation by severe insect pests, especially the butterflies, Pieris. brassicace, L. and P. rapae L (Razmi et al., 2011; El-Sheikh, 2020).
However, the control of plant pests should be based on observations of the pest population and pest species (Ellis and Singh, 1993) in north Egypt, a weekly survey of pests present in cabbage crops was assayed by Embaby and Lotfy (2015).

The main objective of this study was to study the efficacy thiamoxam, lambadacyhalothrin, emamectin benzoate and methomyl compounds against whitefly, *B. tabaci* and white butterfly, *P. rapae* and their associated natural enemies on brassica fields.

### MATERIALS AND METHODS

To study the occurrence of the most important economic pests attacking cabbage plants, field experiments were executed. An area of about one feddan.

**Tested Compounds:**

- **Lambada-cyhalothrin** (Karate 5% EC) at a rate of 75ml/100/liter water obtained from Kafr El-Zayt Company for pesticides.
- **Thiamoxam** (Actara 25% WG) at a rate of 80g/feddan, obtained from Syngenta Agro company Yanbu StreetDokki Giza-Egypt.
- **Methomyl** (Lannate 90% SP) at a rate of 300g/feddan, obtained from Du Pont USA Starchem Industrial chemicals.
- **Emamectin benzoate** (proclaim 5%SG) at rate of 60g/feddan, obtained from AGRES Syngenta.

To evaluate the reduction percentage of *P. rapae* larvae, 4 cabbage plants were tagged and visually examined in the field, 4 replicates for treatment ) in addition to the control (without treatment). Mean numbers of *P. rapae* larvae were counted before spray by the selected compounds and consequently after 1-, 7- and 10-days post application. The reduction percentage of the targeted insect pest larvae was calculated according to Henderson and Tilton's (1955) equation. Data were statistically analyzed according to Littie and Hills (1975), using F-test and means were compared according to Fisher (1950) and Duncan's multiple range tests as described by Steel and Torrie (1982). Controlling these pests substantially with insecticides treatments; expansiveuse of insecticides has led to controlling these pests substantially with led to several problems, including the reduction of natural enemies caused by insecticides causing rejuvenescence of new pests and the eruption of secondary pests (Ferandes et al., 2010). *C. carnea* is a polyphagous sucker that preys on a wide range of pest species similar as; aphid, scale insects, leafhoppers, whiteflies, psyllids, thrips, psocids Lepidoptera, hence they are truly important biocontrol agents. These natural enemies fail to survive as a result of the extensive use of pesticides and sudden environmental changes (Nayar et al., 1976) *C.septempuntata*, isanaphidphagous enemy species and animportant natural control agent (Hoded&HonA.., 1996, Alexidze). Extensive use of insecticides will lead to the death of many of the vital enemies of the pest, as well as the emergence of many secondary pests that harm the crop, (Cloud, 2012).

**Field Experiments:**

Experiments were done in Abn El-Aase, Kafr Sakr region, Sharkia governorate, Egypt during brassica planting seasons (2021 and 2022) in fields planted with brassica plants in October to evaluate the efficiency of tesed insecticides namely, emmamactn benzoate (Proclaim), thiamethoxam (Actara), lambadacyhalothrin (Karate zeon) and methomyl (Lannet) against *B. tabaci, P. rapae* and their side effects on the associated natural enemies during two consecutive seasons 2021 and 2022 in Sharkia Governorate Egypt on brassica (cabbage) fields. Moreover, the study pests were whitefly, *Bemiciatabaci* (Genn.) and white butterfly, *Pieris rapae* (Linn.) and associated predators the green lacewing, *Chrysoperlacarnea* (Stephens) and *Coccinellae spp.*
The experiment area about 1 feddan divided into 4 treatments and untreated (control), each treatment replicated three times. The plot had an area of 1/100 feddan. brassica plants treated with the tested compounds at the recommended rates with a solodosal sprayer motor (20 liters of water).

Randomly 25 brassica plants of each replicate were inspected in the field, the number of *P. rapae* and two predators (*C. carnea& Coccinellae spp*); all instar larvae and two predators, were counted just before spraying and after one day (initial kill), 7 and 10 days (residual effect) with the tested insecticides. Additionally, the numbers of *B. tabaci* adult insects were counted visually in the early morning 25 leaves from three levels of the plant were picked up and put in paper bags then the sample was transferred to the laboratory and the number of *B. tabaci* nymphs was counted using a binocular stereomicroscope. The reduction percentages of pests were calculated according to Henderson and Tilton's (1955) equation:

\[
\text{Reduction percentage} = 1 - \left( \frac{A}{B} \times \frac{C}{D} \right) \times 100
\]

Where:
- A = No. of alive larvae in the treatment after application.
- B = No. of alive larvae in the treatment before application.
- C = No. of alive larvae in the control before application.
- D = No. of alive larvae in the control after application.

Statistical Analysis:

All obtained results statistically determined the significant difference between means according to Little and Hills' (1975) methods using software Costat program. Data were analyzed using commercial statistical software. One-way analysis of variance (ANOVA) was used to test for significant differences between mean values.

### RESULTS AND DISCUSSION

**A- Impact of Tested Compounds on *Piers rapae* Pests In Brassica Field During 2021-2022 Seasons.**

Data in Table (1), showed that the highest initial effect of pesticides understudies on *Pieris rapae* pests were (87.69 and 85.13%) and (84.53 and 81.69%) recorded with emamectin benzoate and lambada–cyhalothrin compounds, respectively during seasons 2021and 2022, but the lowest initial effect were 60.00 and 57.55% for thiamoxam. Also, the highest residual effects were (94.97 and 94.32%) and (89.13 and 90.72%) recorded with emamectin benzoate and lambada–cyhalothrin compounds, respectively on *Pieris rapa* during both seasons, compared to the lowest effects were 52.00 and 47.34% recorded with thiamoxam on *Pieris rapae* during seasons 2021-2022. The highest annual mean effects were (92.54 and 91.22%) and (87.53 and 87.71%) with emamectin benzoate and lambada–cyhalothrin, but the lowest annual mean effects were 54.67 and 50.74% recorded with thiamoxam treatment. In an agreement study about the other tested compounds in his manuscript, e. g. Evure (tau-fluvilomat) and Karate zeon (Lambda-cyhalothrin Sc 9.4% ), Vukovic *et al.*, (2014) tested the efficacy of Tau-fluvalinate insecticide and Lambda –cyhaothrin based insecticides in the management of *P. rapae* and *P. xylostella* caterpillars. The results are supported by Sing, Rai and Singh (2010) and Youha and Hongemi (2009), who reported that emamectin benzoate compounds were effective in reducing the larval population of cabbage butterfly, *Pieris rapae* pests controlling 80-90%. Also, the results in agreement with the authors Gautam *et al.*, (2022), showed that emamectin benzoate and spinosad were found to give efficient control over cabbage butterfly, *Pieris brassicae*. 
Table 1: Reduction parentage of *Pieris rabae* for some pesticides in brassica fields during seasons 2021-2022.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial kill 7d.</td>
<td>Residual mean 7d.</td>
</tr>
<tr>
<td></td>
<td>56.31±</td>
<td>58.45±</td>
</tr>
<tr>
<td>Methomyl</td>
<td>62.75</td>
<td>59.86</td>
</tr>
<tr>
<td>Emamectin</td>
<td>87.69</td>
<td>94.67</td>
</tr>
<tr>
<td>Thiamoxam</td>
<td>60.00</td>
<td>54.00</td>
</tr>
<tr>
<td>Lambada</td>
<td>84.53</td>
<td>88.86</td>
</tr>
<tr>
<td>F. Test</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>1.58</td>
<td>2.25</td>
</tr>
</tbody>
</table>

Values followed by the same letter (s) in the column are not significantly different according to Little and Hills (1975). % Reduction = 1 - (A/B* C/D) *100

Where:
A= No. of alive larvae in the treatment after application.
B= No. of alive larvae in the treatment before application.
C= No. of alive larvae in the control before application.
D= No. of alive larvae in the control after application during 2021-2022 seasons.

B- Impact of Tested Compounds on *Bimiciatabaci* Pests in Brassica Field During 2021-2022 Seasons:

Results in Table (2), indicated the initial effect of the tested insecticides thiamethoxam expressed as the effectual reduction percentage were 91.78 and 90.17% after 24hr. from treatment during seasons 2021 and 2022, while emamectin benzoate and methomyl compounds gave moderate efficacy in the initial effect where the reduced percentage in population *B. tabaci* were (68.42 and 69.57%) and (65.81 and 65.70%), respectively, in both seasons, while the reduce initial effect were for methomyl during seasons on *B. tabaci* pests. Also, the highest residual effects were 95.38 and 91.79% for thiamoxam, compared with emamectin benzoate showed moderate efficient residual effectswere 81.49 and 79.02% and methomyl 68.83 and 69.58% against pests. The highest annual mean effects were 94.18 and 91.25% in both seasons, but the moderate efficient annual mean effects were (77.13 and 75.87%) and (67.82 and 68.28%) with emamectin benzoate and methomyl during seasons 2021-2022. In agreement, Al-Kherb (2011) showed the highest efficacy against whiteflies in cucumber and tomato with thiamethoxam which partially agreed with the above results. The results are in accordance with Naggar and Zidan (2013), who showed that imidacloprid and thiamethoxam were the high effective against the sucking insect pest such as whitefly, jassids and aphids. Results in agreement with Das and Islam (2014) found that thiamoxam + emamectin benzoate showed moderate efficacy against whitefly *B. tabaci*. As well as the obtained results from (Wafa Al-Kherb, 2011) showed the effect of neonicotinoid insecticides, acetamiprid, imidacloprid and thiamoxam on immature stages and adults of *B. tabaci* was high on cucumber under field conditions, the tested neonectoniod could consider promising candidates, in controlling whitefly with a lower effect on their predators.

Mohanasundaram and Sharma (2011), found that thiamethoxam effectively reduced the sucking pests viz., leathhopper, whitefly and red spider mite populations during 1st, the 2nd, and 3rd sprays over two seasons on Okra, respectively.
Table 2: Reduction percentage of *Bemiciatabaci* for some pesticides in brassica fields during 2021-2022.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>2021</th>
<th></th>
<th></th>
<th></th>
<th>2022</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial kill</td>
<td>Residual effect</td>
<td>Residual mean</td>
<td>Annual mean</td>
<td>Treatments</td>
<td>Initial kill</td>
<td>Residual effect</td>
<td>Residual mean</td>
</tr>
<tr>
<td>Methomyl</td>
<td>65.81</td>
<td>69.19</td>
<td>68.17</td>
<td>68.83^a</td>
<td>67.82^a</td>
<td>Methomyl</td>
<td>65.70</td>
<td>72.02</td>
</tr>
<tr>
<td>Emamectin</td>
<td>68.42</td>
<td>83.26</td>
<td>79.72</td>
<td>81.49^e</td>
<td>77.13^e</td>
<td>Emamectin</td>
<td>69.57</td>
<td>77.24</td>
</tr>
<tr>
<td>Thiamoxan</td>
<td>91.78</td>
<td>95.01</td>
<td>95.74</td>
<td>95.38^b</td>
<td>94.18^b</td>
<td>Thiamoxan</td>
<td>90.17</td>
<td>92.08</td>
</tr>
<tr>
<td>Lambda</td>
<td>83.64</td>
<td>87.34</td>
<td>89.43</td>
<td>88.39^b</td>
<td>86.80^b</td>
<td>Lambda</td>
<td>74.09</td>
<td>87.17</td>
</tr>
<tr>
<td>F. Test</td>
<td></td>
<td>**</td>
<td>**</td>
<td>F. Test</td>
<td></td>
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<td></td>
<td>**</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>1.64</td>
<td>1.43</td>
<td></td>
<td></td>
<td></td>
<td>LSD 0.05</td>
<td>1.89</td>
<td>1.43</td>
</tr>
</tbody>
</table>

Values followed by the same letter(s) in the column are not significantly different according to Little and Hills (1975). \%

Reduction = \(1-\frac{(A/B \times C/D)}{100}\)

Where:

\(A\)= No. of alive larvae in the treatment after application.

\(B\)= No. of alive larvae in the treatment before application.

\(C\)= No. of alive larvae in the control before application.

\(D\)= No. of alive larvae in the control after application.

C- Side Effects of Pesticides for Natural Enemies on Brassica:

1- *Chrysoperlacarnea*:

Results in Table (3): showed the high efficacy reduction percentage of the initial effect were 91.86 and 91.27% after 24 hr. for methomyl compound during seasons 2020-2021, but the lowest initial effect were 50.45 and 53.96% for emamectin benzoate during seasons on *C. canacea* pests, also the highest residual effects were 92.37 and 92.37% with methomyl compound in both seasons, compared the lowest residual effect were 58.79 and 57.72% with emamectin benzoate during seasons 2021-2022. The highest annual mean effects were 92.20 and 92.00% for methomyl, also the lowest annual mean effects were 56.01 and 56.47% for emamectin benzoate in both seasons 2021-2022. In the same trend, Methomyl proved toxic to the larvae of *C. carnea* was in favor with the findings of Guvent et al. They found that Lannat (methomyl) showed high toxicity resulting in mortality rate of 100% (2003). Salama, *et al.* (1990) described that Lannat (methomyl) was proved toxic to *C. carnea* larvae in soya bean field conditions. It means that methomyl remained toxic even in field conditions. Also, Plapp Bull (1978) and Varghese and Beevi (2004) indicated that most organophosphate insecticides and methomyl were highly toxic to *C. canea* also, Badawy and El- Arnaouty (1999) had the same trend and reported that organophosphorous insecticides were more toxic and carbamates. That methomyl showed high toxicity resulting in mortality rate of 100%. Regarding to the reduction percentage of initial effect. The present findings regarding emamectin benzoate are in conformity with those of Sechser and Ayoub (2003) who reported that emamectin benzoate was at all stages of *C. carnea*. Castilhos *et al.* (2010) also classified abamectin as slightly harmless recorded the lowest reduction percentage after 24 hr.
Table 3: Side effects of pesticides on the associated natural enemies *Chrysoperla carnea* on *brassica* during 2021-2022 seasons.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial kill</td>
<td>Residual effect</td>
</tr>
<tr>
<td>Methomyl</td>
<td>91.86</td>
<td>92.82</td>
</tr>
<tr>
<td>Emamectin</td>
<td>50.45</td>
<td>55.07</td>
</tr>
<tr>
<td>Thiamoxam</td>
<td>59.97</td>
<td>49.87</td>
</tr>
<tr>
<td>Lambada</td>
<td>91.95</td>
<td>93.20</td>
</tr>
<tr>
<td>F. Test</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>0.67</td>
<td>1.87</td>
</tr>
</tbody>
</table>

Values followed by the same letter (s) in the column are not significantly different according to Little and Hills (1975).

% Reduction = 1 - (A/B<sup>*</sup> C/D)<sup>*</sup>100

Where:
A= No. of alive larvae in the treatment after application.
B= No. of alive larvae in the treatment before application.
C= No. of alive larvae in the control before application.
D= No. of alive larvae in the control after application.

The obtained results in Table (4), indicated the highest initial effects reduction population *Cocconella spp*. 80.98 and 70.63% recorded with emamectin benzoate during seasons 2021-2022, but the lower initial effect were (60.29 and 41.03 %) and (64.13 and 74.25%) recorded with thiamoxam and methomyl compounds, respectively during both seasons, as well as the high efficacy residual effects were 84.34 and 74.42% with emamectin benzoate compound, also the lowest residual effects were (54.08 and 40.16%) and (49.00 and 56.21%) recorded with thiamoxam and methomyl, respectively. The highest annual mean effects were 83.22 and 73.15% with emamectin benzoate compound compared the lower annual mean effects were recorded (56.15 and 40.46%) and 54.03 and 62.22%) with thiamoxam and methomyl compounds, respectively during both seasons. In the same trend, Wafaa *et al.*, (2019) showed that emamectin benzoate recorded the highest reduction percentage on the predator insect *Coccinella spp*. Results agree with (Wafa Al-Kherb, 2011) showed the effect of neonicotinoid insecticides, acetamiprid, imidacloprid and thiamoxam could be considered promising candidates, in controlling whitefly with a lower effect on their predator,*Coccinella spp*.

Table 4: Side effects of pesticides on the associated natural enemies *Coccinella septempunctata* on *brassica* during 2021-2022.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial kill</td>
<td>Residual effect</td>
</tr>
<tr>
<td>Methomyl</td>
<td>64.13</td>
<td>53.73</td>
</tr>
<tr>
<td>Emamectin</td>
<td>80.98</td>
<td>84.99</td>
</tr>
<tr>
<td>Thiamoxam</td>
<td>60.29</td>
<td>60.47</td>
</tr>
<tr>
<td>Lambada</td>
<td>79.00</td>
<td>71.99</td>
</tr>
<tr>
<td>F. Test</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>1.57</td>
<td>1.92</td>
</tr>
</tbody>
</table>

Values followed by the same letter (s) in the column are not significantly different according to Little and Hills (1975).

% Reduction = 1 - (A/B<sup>*</sup> C/D)<sup>*</sup>100

Where:
A= No. of alive larvae in the treatment after application.
B= No. of alive larvae in the treatment before application.
C= No. of alive larvae in the control before application.
D= No. of alive larvae in the control after application.
REFERENCES


فعالية بعض المبيدات الحشرية على الذباب البيضاء وابي دقيق الكرنب والاعداء الحيوي والمصاحبه كا حقول الكرنب

مشيره أحمد سيد احمد1 – نهى حسن عصام لقمه 2

1 – معهد بحوث وقاية النباتات – الدقي – الجيزة

2 – قسم وقاية النبات كلية الزراعه جامعة القاهرة

ARABIC SUMMARY

تفيد هذه الدراسة إلى دراسة فعالية أربع من مبيدات الأفات وهي ثيوميسكسام ومامداثيروثرين وميثوميل واثيوسوكساس لجانب الافات الكرنب الذباب البيضاء وابي دقيق الكرنب وكذلك دراسة الآثار الجانبية على الأعداد الحيوية المصاحبه تحت ظروف الاعمالية في موسمى الزراعة 2021 و2022 في محافظة الشرقية.

أظهرت النتائج أن مبيد ثيوميسكسام سجل أعلى نسبة خفض في تعداد الذباب البيضاء بعد 10 أيام من المعاملة. كما أظهرت النتائج ان هناك تأثير معنويي خفض اعداد المفترسات. سجل مبيد إيمامكتين بنتازات ومبيد لمبيدات الهالوكريورين أعلى نسبة خفض في تعداد ابي دقيق الكرنب والمفترسات معا. في حين أعطي مبيد ميثوميل أعلى تأثير ضار على المفترسات. أما مبيد صغير خاص الإيمامكتين بنتازات أظهر تأثير ضار على المفترسات.

وأشارت النتائج أيضاً إلى أن المركبات أن تأثيرات أقل على المفترسات.