

Effectiveness of some Insecticides for Eggplant Sucking-Piercing Insects Management with Reference to Their Side Effects on Natural Enemies

Hamdy K. Abou-Taleb¹ and Ahmed A. Barrania²

ABSTRACT

Two field experiments were conducted during 2012 and 2013 seasons at Nubarya district, to evaluate one synthetic insecticide, four insecticide alternatives and their binary mixtures against some eggplant sucking insects. The side effect of these insecticide treatments against two predatory insects was also investigated. Results showed that, Admire, Admire-Achook mixture, and Admire-Applaud mixture achieved the highest reduction percentages of whitefly, where mean reduction percentages were 93.4, 91.7 and 93.3% at 2012 and 94.3, 95.1 and 94.1% at 2013, respectively. In the case of aphids, in 2012 and 2013 seasons, the highest reduction percentages were achieved by Admire (98.6 and 98.2%), Kemesol (95.2 and 94.9%), Admire-Kemesol mixture (98.9 and 99.4%), Admire-Achook mixture (98.6 and 99.1%) and Admire-Applaud mixture (96.9 and 95.8%). Concerning jassid, it was recorded that Admire and Admire-Achook mixture treatments achieved the highest reduction followed by Admire-Kemesol mixture. In both seasons, Admire has the highest negative effect on the lady beetle, *Coccinella sp.* and aphid lion, *Chrysopa spp.* Admire reduced lady beetle by 59.8 and 57.7% in 2012 and 2013, respectively and reduced aphid lion by 25.5 and 22.6% in 2012 and 2013, respectively. On the other hand, Breef oil has the least side effects on the two predators in both seasons. Finally we can conclude that, Admire-Achook mixture can be used for sucking-piercing insects management on eggplant, where this mixture achieved the highest reduction percentages against the insect pests and relative low ones against natural enemies.

INTRODUCTION

Eggplant (*Solanum melanogena* L.) is an important vegetable crop grown in various tropical and temperate parts of the world (Kashyap *et al.*, 2003). It is a good source of vitamins and minerals (particularly iron) making its total nutritional value comparable with tomato (Kalloo, 1993). Eggplant has been used in traditional medicines (Khan, 1979). For example, tissue extracts have been used for treatment of asthma, bronchitis, cholera and dysuria; fruits and leaves are beneficial in lowering blood cholesterol. Whitefly, *Bemisia tabaci* (Genn.), aphid, *Aphis gossypii* Glover, and jassid, *Emboasca lybica* deBerg, are between the most important insect pests of eggplant (Yadav and Kumawat, 2013). These insect pests are attacking a

wide spectrum of economic plants, causing great losses in their yield. The problems of these insects are not only due to its direct damage to the infested plants but also to its capability to transmit viruses.

The continuous and unwise uses of insecticides by farmers usually lead to adverse effects on naturally occurring biological control agents and the biotic environment as well. Also, eggplant can be infected by insect pests during the harvesting period. Therefore, the search for more safe insecticide alternatives is becoming so urgent. So, the aim of this work was to evaluate some insecticide alternatives in comparison with the synthetic insecticide Admire against the three insect pests as well as two natural enemies. In addition, the mixtures of each of these alternatives with Admire (each at half field rates) were also evaluated.

MATERIALS AND METHODS

Tested insecticides and control agents: The evaluated insecticides and control agents, common names and rates were introduced in the following Table (1):

Field experiments: Two experiments were conducted during 2012 and 2013 seasons, at Nubaryia district. Eggplant seedlings were transplanted at March 20, 2012 and March 18, 2013. Treatments were arranged in a randomized complete block design (RCBD). Each treatment was replicated four times (84 m² per each). The insecticides were sprayed by Knapsack sprayer equipment (CP3) at the rate of 200 liter per feddan on May 1, 2012 and May 2, 2013, respectively. Control was sprayed only by water.

The efficiency of the tested products was estimated by counting of the target alive insects on the lower surface of ten eggplant leaves per each plot. Pre-treatment counts were done just before application while post-treatment counts were made on days 1, 3, 5, 7, 9 and 12 days after treatment. Counts were done in the early morning when flight activity is minimal according to Bulter *et al.* (1988). Reduction percentages were calculated according to Henderson and Tilton equation (1955). The treatments were compared with each other using one way ANOVA with LSD_{0.05} (CoStat Statistical Software, 1990).

¹Plant Protection Research Institute, ARC, Sabahia, Alexandria, Egypt.

²Plant Protection Research Institute, Etay El-baroud Agric. Res. Station. Agric. Res. Center, Egypt.

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Table 1. insecticides and control agents treatments, common names and field rates

| Trade name | Common name | Rate / 100 liter water |
|------------------|--------------|------------------------|
| Admire 20% SC | Imidacloprid | 125 ml |
| Kemesol 95% EC | Mineral oil | 1000 ml |
| Achook 0.15% EC | Azadirachtin | 250 ml |
| Applaud 25% SC | buprofezin | 200 ml |
| Breef | Orange oil | 500 ml |
| Admire + Kemesol | | 65 ml + 500 ml |
| Admire + Achook | | 65 ml + 125 ml |
| Admire + Applaud | | 65 ml + 100 ml |
| Admire + Breef | | 65 ml + 250 ml |

RESULTS AND DISCUSSION

Field efficiency of some insecticide treatments

against whitefly on the eggplant: Gradual reduction percentages of whitefly numbers as a result of insecticide treatments were recorded in both seasons 2012 and 2013 (Tables 2.A and 2.B). The highest reduction percentages of whitefly were recorded by Admire, Admire-Achook mixture, and Admire-Applaud mixture, where mean reduction percentages were 93.4, 91.7 and 93.3% at 2012 and 94.3, 95.1 and 94.1% at 2013, respectively. The least reduction percentages were recorded by Breef and Admire-Breef mixture at the two seasons (2012 and 2013). The same gradual increasing in reduction percentages in whitefly numbers was recorded with the nicotinic acetylcholine receptor agonist Confidor (imidacloprid), which was potent on days 7 and 14 after application as recorded by Motohiro and Casida (2003); Horowitz *et al.* (1998). Our results were comparable with El Bessomy (2003), where he reported that Admire (imidacloprid) gave good reduction percentages against the whitefly after 84 hrs of application.

Field efficiency of some insecticide treatments

against aphids on the eggplant: Field evaluation of some insecticides treatments against aphids on the eggplant at 2012 and 2013 seasons was carried out (Tables 3. A & B). In both seasons 2012 and 2013, the highest reduction percentages were achieved by Admire (98.6 and 98.2%), Kemesol (95.2 and 94.9%), Admire-Kemesol mixture (98.9 and 99.4%), Admire-Achook mixture (98.6 and 99.1%) and Admire-Applaud mixture (96.9 and 95.8%). These results are in agreement with Abdel Rahman and Abou-Taleb, (2008), where they reported that, Confidor (imidacloprid) was the most effective in controlling aphids on cotton plants. Also, Shehata *et al.* (2009) mentioned that Confidor achieved the highest aphid control on the cucumber plants.

Field efficiency of some insecticide treatments against jassid on the eggplant:

Reduction percentages

of jassid as a result of some insecticide treatments on eggplants at 2012 and 2013 seasons are presented in Tables (4. A & B). In 2012, Admire and Admire-Achook mixture treatments achieved the highest effectiveness followed by Admire-Kemesol mixture with mean reduction percentages of 89.7, 87.1 and 81.5%, respectively (Table 4.A). The same trend was observed in 2013 (Table 4.B). Admire and Admire-Achook mixture treatments caused jassid reduction percentages of 89.7 and 86.7%, respectively. These results were comparable with results of many authors. Aslam *et al.* (2004) reported that, between seven insecticides tested against cotton sucking insects in Pakistan, Confidor® was the most effective in controlling jassid and thrips. Also, Wahla *et al.* (1997) and Hameed *et al.* (1997) investigated that Confidor® effectively controlled thrips and jassid in cotton.

Side effects of some insecticide treatments on the

lady beetle and Aphid lion: Probably the most common pest management activity that negatively impacts beneficial organisms in agroecosystems is pesticide application. As a result, modifications of pesticide use practices are the most commonly implemented form of conservation biological control, and have long been considered an important component of integrated pest management programs (Ruberson *et al.*, 1998). Lady beetles are known to be voracious predators of plant pests such as aphids (Gordon 1985). It is often assumed that aphidophagous lady beetles are highly polyphagous, consuming most aphid species that they encounter (Pedigo and Rice 2006). Also, Chrysopidae lacewings family has been amongst useful insects of agricultural ecosystems which are very effective and practical in biological control programs against agricultural pests (Canard *et al.* 1984). This family included more than 90 types and 1800 well-known species which their predating behavior always attracted the entomologists' intention in biological control programs (Brook and Barnard, 1990).

In this study, the side effects of insecticide treatments on the two predators, lady beetle and aphid

lion was investigated and presented in Tables (5. A & B and 6. A & B). In both seasons, Admire has the highest negative effect on the lady beetle and aphid lion. Admire reduced lady beetle by 59.8 and 57.7% compared to control in 2012 and 2013, respectively (Tables 5. A & B) and reduced aphid lion by 25.5 and 22.6% compared to control in 2012 and 2013, respectively (Tables 6. A & B). On the other hand, Breef oil has the least side effects on the two predators in both seasons. Mixtures of Admire with Achook or Applaud or Breef (each at a half field rate) have a moderate side effects against the two predators in both seasons.

Reduced-risk products such as insecticidal soaps, vegetable oils and plant extracts represent alternative pest controls that are considered to have fewer health and environmental impacts than conventional pesticides (Fraser, 2005). Combining acute insecticides in low rates with such reduced-risk products can improve pest control as well as preserving the natural enemies and reducing environmental pollution. This is what has been achieved to a great extent in this work by using the mixtures of Admire and Achook or Kemesol at the half field rates for each.

Table 2. A. Efficacy of certain treatments against whitfly on the eggplant (season 2012)

| Treatments | % Reduction | | | | | | Mean |
|------------------|-------------|--------|--------|--------|--------|---------|---------|
| | 1-day | 3-days | 5-days | 7-days | 9-days | 12-days | |
| Admire | 81.2 | 93.1 | 97.3 | 98.2 | 95.4 | 95.2 | 93.4 a |
| Kemesol | 56.5 | 75.4 | 75.2 | 80.0 | 78.3 | 78.1 | 73.9 c |
| Achook | 50.7 | 70.1 | 82.6 | 83.8 | 79.9 | 80.5 | 74.6 bc |
| Applaud | 40.5 | 62.3 | 83.5 | 88.6 | 91.3 | 88.4 | 75.8 bc |
| Breef | 34.4 | 47.2 | 58.7 | 68.3 | 71.4 | 75.6 | 61.7 d |
| Admire + Kemesol | 75.1 | 77.3 | 80.2 | 80.9 | 83.4 | 79.0 | 79.3 b |
| Admire + Achook | 80.9 | 88.3 | 95.9 | 95.8 | 95.5 | 93.7 | 91.7 a |
| Admire + Applaud | 83.7 | 89.1 | 97.2 | 96.6 | 97.0 | 96.3 | 93.3 a |
| Admire + Breef | 50.5 | 60.4 | 67.3 | 72.9 | 72.6 | 71.8 | 65.9 d |

Means followed by the same letters are not significantly different according to the LSD_{0.05}.

Table 2. B. Efficacy of certain treatments against whitfly on the eggplant (season 2013)

| Treatments | % Reduction | | | | | | Mean |
|------------------|-------------|--------|--------|--------|--------|---------|---------|
| | 1-day | 3-days | 5-days | 7-days | 9-days | 12-days | |
| Admire | 85.5 | 95.7 | 97.9 | 98.3 | 95.2 | 93.2 | 94.3 a |
| Kemesol | 60.6 | 79.1 | 80.3 | 80.5 | 77.4 | 77.3 | 75.9 c |
| Achook | 52.2 | 76.1 | 84.7 | 85.5 | 81.6 | 82.7 | 77.1 c |
| Applaud | 49.3 | 71.5 | 89.2 | 88.9 | 90.3 | 92.6 | 80.3 bc |
| Breef | 40.5 | 55.6 | 63.1 | 69.8 | 70.9 | 72.2 | 63.3 d |
| Admire + Kemesol | 77.8 | 82.1 | 84.5 | 85.6 | 86.7 | 83.8 | 83.4 b |
| Admire + Achook | 84.6 | 97.3 | 97.1 | 97.7 | 96.9 | 97.0 | 95.1 a |
| Admire + Applaud | 84.2 | 93.6 | 97.0 | 98.4 | 96.3 | 95.2 | 94.1 a |
| Admire + Breef | 50.5 | 58.6 | 65.5 | 70.1 | 72.3 | 70.4 | 64.6 d |

Means followed by the same letters are not significantly different according to the LSD_{0.05}.

Table 3. A. Efficacy of certain treatments against aphids on the eggplant (season 2012)

| Treatments | % Reduction | | | | | | Mean |
|------------------|-------------|--------|--------|--------|--------|---------|--------|
| | 1-day | 3-days | 5-days | 7-days | 9-days | 12-days | |
| Admire | 93.6 | 98.2 | 100.0 | 100.0 | 100.0 | 100.0 | 98.6 a |
| Kemesol | 80.6 | 95.8 | 96.3 | 98.5 | 100.0 | 100.0 | 95.2 a |
| Achook | 78.0 | 84.2 | 88.7 | 93.5 | 92.8 | 94.4 | 88.6 b |
| Applaud | 76.3 | 80.1 | 89.7 | 90.8 | 90.0 | 92.9 | 86.6 b |
| Breef | 44.6 | 49.5 | 52.5 | 60.1 | 66.9 | 68.3 | 57.0 c |
| Admire + Kemesol | 95.4 | 98.1 | 100.0 | 100.0 | 100.0 | 100.0 | 98.9 a |
| Admire + Achook | 94.2 | 97.3 | 100.0 | 100.0 | 100.0 | 100.0 | 98.6 a |
| Admire + Applaud | 90.5 | 93.2 | 97.5 | 100.0 | 100.0 | 100.0 | 96.9 a |
| Admire + Breef | 80.6 | 87.4 | 90.0 | 90.1 | 92.5 | 91.3 | 88.7 b |

Means followed by the same letters are not significantly different according to the LSD_{0.05}.

Table 3. B. Efficacy of certain treatments against aphids on the eggplant (season 2013)

| Treatments | % Reduction | | | | | | Mean |
|------------------|-------------|--------|--------|--------|--------|---------|---------|
| | 1-day | 3-days | 5-days | 7-days | 9-days | 12-days | |
| Admire | 92.4 | 96.7 | 100.0 | 100.0 | 100.0 | 100.0 | 98.2 a |
| Kemesol | 82.5 | 92.8 | 96.3 | 97.9 | 100.0 | 100.0 | 94.9 ab |
| Achook | 81.4 | 87.1 | 91.7 | 94.2 | 96.9 | 95.1 | 91.1 bc |
| Applaud | 73.5 | 78.8 | 85.1 | 88.6 | 91.2 | 92.0 | 84.9 d |
| Breef | 42.5 | 47.8 | 50.1 | 57.3 | 67.8 | 68.1 | 55.6 e |
| Admire + Kemesol | 96.5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 99.4 a |
| Admire + Achook | 96.2 | 98.5 | 100.0 | 100.0 | 100.0 | 100.0 | 99.1 a |
| Admire + Applaud | 88.6 | 93.0 | 95.2 | 97.8 | 100.0 | 100.0 | 95.8 a |
| Admire + Breef | 80.3 | 86.1 | 89.9 | 91.2 | 90.6 | 90.7 | 88.1 cd |

Means followed by the same letters are not significantly different according to the LSD_{0.05}.

Table 4.A. Efficacy of certain treatments against jassid on the eggplant (season 2012)

| Treatments | % Reduction | | | | | | Mean |
|------------------|-------------|--------|--------|--------|--------|---------|---------|
| | 1-day | 3-days | 5-days | 7-days | 9-days | 12-days | |
| Admire | 85.3 | 88.2 | 90.6 | 90.3 | 92.8 | 91.1 | 89.7 a |
| Kemesol | 55.0 | 55.6 | 58.8 | 59.1 | 61.7 | 60.9 | 58.5 cd |
| Achook | 42.6 | 45.2 | 50.8 | 50.1 | 51.4 | 48.9 | 48.2 e |
| Applaud | 37.2 | 39.6 | 38.9 | 40.1 | 40.1 | 41.6 | 39.6 f |
| Breef | 35.9 | 41.7 | 44.9 | 46.0 | 45.2 | 46.6 | 43.4 f |
| Admire + Kemesol | 72.4 | 80.6 | 83.8 | 85.1 | 83.0 | 83.9 | 81.5 b |
| Admire + Achook | 79.3 | 86.2 | 87.9 | 89.0 | 91.4 | 88.8 | 87.1 a |
| Admire + Applaud | 52.6 | 59.1 | 64.2 | 62.1 | 64.2 | 66.7 | 61.5 c |
| Admire + Breef | 50.6 | 54.3 | 55.1 | 55.7 | 54.9 | 55.0 | 54.3 d |

Means followed by the same letters are not significantly different according to the LSD_{0.05}.

Table 4.B. Efficacy of certain treatments against jassid on the eggplant (season 2013)

| Treatments | % Reduction | | | | | | Mean |
|------------------|-------------|--------|--------|--------|--------|---------|---------|
| | 1-day | 3-days | 5-days | 7-days | 9-days | 12-days | |
| Admire | 83.8 | 86.5 | 91.0 | 92.7 | 93.4 | 90.6 | 89.7 a |
| Kemesol | 59.5 | 62.3 | 61.3 | 59.8 | 63.1 | 60.5 | 61.1 c |
| Achook | 45.1 | 49.4 | 55.9 | 57.4 | 58.9 | 54.0 | 53.5 d |
| Applaud | 39.6 | 41.6 | 41.4 | 43.7 | 43.8 | 44.3 | 42.4 e |
| Breef | 34.2 | 40.6 | 45.8 | 45.8 | 44.6 | 44.1 | 42.5 e |
| Admire + Kemesol | 73.7 | 82.2 | 84.6 | 87.7 | 86.2 | 84.4 | 83.1 b |
| Admire + Achook | 80.0 | 84.8 | 85.8 | 89.9 | 90.3 | 89.3 | 86.7 ab |
| Admire + Applaud | 54.7 | 61.1 | 62.8 | 64.5 | 66.8 | 64.0 | 62.3 c |
| Admire + Breef | 51.1 | 55.7 | 54.9 | 57.0 | 59.2 | 57.2 | 55.9 d |

Means followed by the same letters are not significantly different according to the LSD_{0.05}.

Table 5.A. Efficacy of certain treatments against lady beetle on the eggplant (season 2012)

| Treatments | % Reduction | | | | | | Mean |
|------------------|-------------|--------|--------|--------|--------|---------|--------|
| | 1-day | 3-days | 5-days | 7-days | 9-days | 12-days | |
| Admire | 56.4 | 61.3 | 62.8 | 61.7 | 58.1 | 58.3 | 59.8 a |
| Kemesol | 33.2 | 35.6 | 37.1 | 36.8 | 38.9 | 40.8 | 37.1 b |
| Achook | 21.9 | 27.8 | 34.1 | 32.7 | 31.9 | 31.6 | 30.0 c |
| Applaud | 26.7 | 30.8 | 35.8 | 39.2 | 40.6 | 39.5 | 35.4 b |
| Breef | 8.2 | 10.3 | 11.7 | 10.1 | 9.6 | 7.2 | 9.5 e |
| Admire + Kemesol | 28.0 | 31.6 | 29.8 | 29.5 | 27.2 | 25.9 | 28.7 c |
| Admire + Achook | 18.4 | 17.7 | 20.1 | 18.2 | 18.2 | 16.0 | 18.1 d |
| Admire + Applaud | 20.3 | 21.5 | 24.7 | 22.1 | 20.3 | 19.9 | 21.5 d |
| Admire + Breef | 15.6 | 20.1 | 21.4 | 19.5 | 18.3 | 17.8 | 18.8 d |

Means followed by the same letters are not significantly different according to the LSD_{0.05}.

Table 5.B. Efficacy of certain treatments against lady beetle on the eggplant (season 2013)

| Treatments | % Reduction | | | | | | Mean |
|------------------|-------------|--------|--------|--------|--------|---------|---------|
| | 1-day | 3-days | 5-days | 7-days | 9-days | 12-days | |
| Admire | 54.0 | 58.7 | 60.2 | 61.3 | 56.9 | 55.1 | 57.7 a |
| Kemesol | 30.8 | 31.3 | 35.8 | 35.7 | 34.2 | 35.9 | 34.0 b |
| Achook | 23.6 | 25.1 | 28.7 | 30.5 | 31.0 | 31.4 | 28.4 c |
| Applaud | 23.1 | 27.3 | 32.0 | 33.7 | 34.5 | 34.3 | 30.8 bc |
| Breef | 10.0 | 11.8 | 9.2 | 8.5 | 8.7 | 5.4 | 8.9 e |
| Admire + Kemesol | 25.2 | 28.8 | 27.1 | 27.8 | 25.9 | 23.6 | 26.4 c |
| Admire + Achook | 16.6 | 16.1 | 18.8 | 18.5 | 16.4 | 15.9 | 17.1 d |
| Admire + Applaud | 18.0 | 19.4 | 21.3 | 22.6 | 18.8 | 17.2 | 19.6 d |
| Admire + Breef | 12.8 | 15.0 | 17.7 | 16.1 | 15.6 | 15.2 | 15.4 d |

Means followed by the same letters are not significantly different according to the LSD_{0.05}.

Table 6.A. Efficacy of certain treatments against Aphid lion on the eggplant (season 2012)

| Treatments | % Reduction | | | | | | Mean |
|------------------|-------------|--------|--------|--------|--------|---------|---------|
| | 1-day | 3-days | 5-days | 7-days | 9-days | 12-days | |
| Admire | 24.1 | 26.6 | 27.7 | 26.3 | 24.2 | 23.9 | 25.5 a |
| Kemesol | 13.5 | 15.0 | 15.4 | 17.1 | 16.6 | 15.3 | 15.5 b |
| Achook | 9.1 | 10.4 | 10.7 | 12.9 | 11.6 | 9.2 | 10.7 c |
| Applaud | 14.1 | 16.5 | 17.3 | 16.0 | 15.2 | 13.9 | 15.5 b |
| Breef | 2.7 | 5.6 | 5.8 | 4.5 | 6.4 | 4.9 | 5.0 d |
| Admire + Kemesol | 10.3 | 12.6 | 13.5 | 11.9 | 11.8 | 9.3 | 11.6 bc |
| Admire + Achook | 11.3 | 13.8 | 12.5 | 11.7 | 10.4 | 9.4 | 11.5 bc |
| Admire + Applaud | 12.0 | 13.4 | 13.5 | 11.7 | 10.6 | 9.1 | 11.7 bc |
| Admire + Breef | 5.2 | 5.6 | 6.9 | 5.1 | 4.5 | 4.0 | 5.2 d |

Means followed by the same letters are not significantly different according to the LSD_{0.05}.

Table 6.B. Efficacy of certain treatments against Aphid lion on the eggplant (season 2013)

| Treatments | % Reduction | | | | | | Mean |
|------------------|-------------|--------|--------|--------|--------|---------|--------|
| | 1-day | 3-days | 5-days | 7-days | 9-days | 12-days | |
| Admire | 20.5 | 22.8 | 22.0 | 24.3 | 23.7 | 22.2 | 22.6 a |
| Kemesol | 10.1 | 12.4 | 11.6 | 13.6 | 13.2 | 12.3 | 12.2 b |
| Achook | 6.8 | 7.6 | 7.9 | 8.2 | 8.3 | 6.5 | 7.6 bc |
| Applaud | 12.5 | 13.2 | 13.8 | 14.7 | 13.6 | 13.2 | 13.5 b |
| Breef | 2.1 | 2.7 | 2.1 | 3.2 | 3.5 | 2.7 | 2.7 d |
| Admire + Kemesol | 7.9 | 8.3 | 8.6 | 8.2 | 7.1 | 7.0 | 7.9 bc |
| Admire + Achook | 8.2 | 8.6 | 9.0 | 8.5 | 7.0 | 7.5 | 8.1 bc |
| Admire + Applaud | 9.6 | 10.4 | 11.7 | 8.3 | 7.7 | 6.8 | 9.1 bc |
| Admire + Breef | 3.5 | 3.8 | 4.6 | 3.6 | 3.8 | 3.5 | 3.8 c |

Means followed by the same letters are not significantly different according to the LSD_{0.05}.

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