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Efficacy of Chemical and Non-Chemical Compounds against the Egyptian Mealybug, *Icerya Aegyptiaca* (Douglas) (Hemiptera: Coccoidea: Monophlebidae) under Laboratory Condition

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ABSTRACT

Laboratory experiment was carried out to determine the toxicity effect of different chemical and non-chemical compounds against immature stages (nymphs) and mature stages (adult females) of the Egyptian mealy bug, *Icerya aegyptiaca* (Douglas) on citrus leaves in Ismailia Agricultural Research Station, Ismailia Governorate, Egypt on 10th August, 2018. Four insect insecticides : (Acetamiprid, Chlorpyrifos, Diflubenzuron and Malatox), bio-insecticide (Bioranza), mineral oil (Super Royal oil) and plant oil (Jasmine oil) were used. The obtained results revealed that the tested chemical and non-chemical compounds on I. aegyptiaca were varied under laboratory conditions. Moreover, these compounds gave the same efficacy against both the nymphs and adult females. But, the adult females of I. aegyptiaca were lowest susceptible to the tested compounds than the nymphs. Also, Acetamiprid and Chlorpyrifos were the most effective insecticide against the nymphs and adult females of mealybug on citrus leaves, while the mineral and plant oils were the least effective treatment in controlling this insect species.

Keywords: Icerya Aegyptiaca, Acetamiprid, Chlorpyrifos, Diflubenzuron, Malatox, Bioranza, Acetamiprid, Chlorpyrifos

I. INTRODUCTION

The Egyptian mealybug, *Icerya* aegyptiaca (Douglas) (Hemiptera: Monophlebinae) is highly polyphagous insect pests known to feed on about 123 species of plants belonging to 49 plant families **(Ben-Dov *et al*., 2009).** The adult female is covered in about ten long white waxy projections, which are curved at the tip and coverer the body and egg case. Over 100 eggs are laid into an egg sac of waxy plates attached to the end of the female body. The crawlers emerge through the wax plates of the egg sac and move onto the host plant to start feeding. Damage is caused by feeding on host tissues and injecting toxins or plant pathogens into host plants. In addition, mealybugs secrete honeydew, which is a sugary liquid that falls on the leaves, coating them with a shiny and stick film. Honeydew serves as a medium for the growth of sooty mould fungus, which reduces the plant photosynthetic abilities and ruins plants **(Mangoud and Abd El-Gawad 2003).** The high number of insects, attacking leaves, branches and fruits of the tree, resulting in a great loss of sap, thus leading to defoliation, dryness, wilting, early leaves drop, malformations, dwarfing, and deprive the trees from its nutrients, ultimately quality and quantity of the fruit is severely reduced and reduction of the tree vitality **(El-Said, 2006 and Mangoud, 2000).**

Due to their waxy hydrophobic covering, managing mealybugs with pesticide spray can be difficult and contact insecticides are most effective. Recommendation of controlling mealybugs with mineral oils is very important especially during fruiting period. So, efforts should be directed towards testing and using other materials as alternative to mineral oils, insect growth regulators and plant oils are suggested for controlling the mealybug **(Mangoud *et al.*, 2007 and Franco *et al.*, 2009).** This study was undertaken to determine the toxicity effect of different chemical and non-chemical compounds against *I. aegyptiaca* under laboratory conditions.

II. MATERIALS AND METHODS

The tested insecticides and oils:

- **Dimilin® 48% SC (Diflubenzuron)**: produced by Chemtura Europe LTD, Booklands Farm, Cheltenham Road, at rate 125 cm^3/Faddan.
- **Chlorpyrifos® 48% EC:** is an organophosphate insecticide, formulated by DOW chemical company, U.S.A., used by 1.5 cm^3 per L. water.
- **Mospilan® 20% SP (Acetamiprid):** Neonicotinoid at rate 0.25 g per liter water, produced by Nisso Co.
- **Malatox ® 57% EC (Malathion):** Organophosphat, produced by El-Naser chemical company used by 2.5 cm^3 per L. water.
- **Bioranza®10% WP: Containing 10%** *Metarehizum aneasopliea* and 90% inert ingredient, used by 2 gm/L water.
- **Super Royal oil 85.7%:** Amiscible mineral oil (summer oil), produced by petroleum corporation, Society at rate 1.5 L. per 100 L. water.
- **Jasmine oil** (plant oil), produced by Captain CO. (Cap. Farm), (Tween 80: used at rate 0.3% for emulsification in water).

Experimental design:

Laboratory experiment was conducted in Ismailia Agricultural Research Station, Ismailia Governorate, Egypt on 10th August, 2018, to determine the toxicity effect of different chemical and non-chemical compounds against immature stages (nymphs) and mature stages (adult females) of the Egyptian mealy bug, *I. aegyptiaca* (Douglas) on citrus leaves under laboratory conditions. Different concentrations of each tested insecticides and oils were prepared in distilled water (Five concentrations per treatment); three replicates were used for each concentration. The infested citrus leaves were collected randomly from private farm in Ismailia district and kept in paper bags then transferred to laboratory; thirty infested leaves were used for each concentration (10 leaves/ replicate).The leaves were dipped by the tested insecticides and oils, the control leaves dipped in water only and the leaves were left for dryness in air. Died individuals were counted and recorded after 24 h, 48 h and 72 h **(Shah *et al.*, 2016).**

The average percentage of corrected mortality of insects for each concentration and for control was calculated according to **Abbott (1925)**.

$$\text{Corrected mortality percentage} = \left(1 - \frac{\text{No. in T after treatment}}{\text{No. in C after treatment}}\right) \times 100$$

Where: T = Adults mortality percentage in treatment.
C = Adults mortality percentage in control.

The toxicity lines were statistically analyzed according to the method described by, **(Finney, 1971)**. From which the corresponding toxicity lines (Ld-P lines) were estimated of the tested insecticides and oils; LC_{10}, LC_{25} and LC_{50}. Slope values of tested compounds, Resistance Ratio (RR) and Chi-square test values were also estimated. Toxicity index were calculated according to **(Sun, 1950):**

Toxicity index = (LC_{50} of the most effective compound / LC_{50} of other tested compound) x 100.

III. RESULTS AND DISCUSSION

Results in Tables (1and 2) and Figs. (1 and 2), show the toxicity of the tested insecticides and oils against nymphs and adult females of *I. aegyptiaca* after 72h. under laboratory conditions.

A- Nymphs stage:

Data is presented in table (1) and fig. (1), showed the different potencies of certain compounds by different concentrations against the nymphs of *I. aegyptiaca*. This reduction gradually increased by increasing the used concentration. Acetamiprid was the most effective among the tested compounds with LC_{50} value 12.99 ± (7.68-19.09) ppm, the toxicity index at LC_{50} was 100.00 % and the resistance ratio (RR) was 1.00, followed by Chlorpyrifos, Diflubenzuron, Malathion, Bioranza, Super Royal oil and Jasmine oil with LC_{50} values 15.15 ± (9.43-22.08), 17.97 ± (10.35-28.47), 25.39 ± (17.62-37.20), 37.22 ± (26.19-57.94), 46.85 ± (32.44-78.92) and 126.41 ± (86.29-178.92), respectively. Toxicity index values at LC_{50} for these compounds were 85.75%, 72.27%, 51.15%, 34.89%, 27.71% and 10.27%, respectively and the (RR) were 1.17, 1.48, 1.95, 2.87, 3.61 and 9.73, respectively. The slope value is known to be a very important feature of the regression line. It is helpful in determining the exact reaction of population of tested compounds. Compasratively, low slope values indicate the heterogenic in response to the tested treatments and have the possibility of further decrease in sensitive after continuous uses with tested compounds. But, when the population of pest is similar in homogeneity or the degree of resistance meaning the slope is big or increase in regression. The slope value of bio-insecticide, Bioranza had the highest slope was 1.44 ± 0.257. But, Diflubenzuron (IGR) had the lowest slope was 1.08 ± 0.23.

B- Adult females stage:

The obtained results are represented in Table (2) and Fig. (2), revealed the toxicity of the tested insecticides and oils against of *I. aegyptiaca*, Acetamiprid was the most effective with LC_{50} value was 21.58 ± (13.10-34.75), the toxicity index value at LC_{50} was 100.00% and the (RR) value was 1.00. Followed by Chlorpyrifos, Diflubenzuron, Malathion, Bioranza, Super Royal oil and Jasmine oil, $LC_{50's}$ values were 23.41 ± (14.59-37.76), 37.48 ± (23.62-72.45), 39.55 ± (26.47-68.71), 52.37± (35.98-91.64), 59.07 ± (40.79-104.37) and 186.03 ± (128.74-272.36) and their toxicity indexes were 92.18%, 57.59%, 54.56%, 41.21%, 36.54% and 11.60% and the resistance ratio (RR) values were 1.08, 1.74,1.83, 2.43, 2.74 and 8.61 respectively. Also, the obtained results showed that the tested compounds gave the same efficacy against the adult females. The mineral oil (Super Royal oil) had the highest slope value (1.48 ± 0.28), but Diflubenzuron had the lowest slope value (1.05 ± 0.24).

As results in Tables (1 and 2) revealed that nymphs of *I. aegyptiaca* were more susceptible to the tested compounds than the adult females. **Suresh *et al.* (2010)** suggested a need based utilization of insecticides like profenofos 50% EC 2 ml/L, chlorpyriphos 20% EC 2 ml/L, dimethaote 2 ml/L, imidacloprid 0.6 ml/L and thiamthoxam 0.6 g/L. Mangoud and Abd El-Gawad (2004) in Egypt, stated that Malathion used at a rate of 2 ml/liter of water gave good reduction against nymphs and adult females of *Icerya purchasi* on citrus, but Masrona oil (20 ml/liter of water), Biofly (1.5 ml/liter of water), Sulphur (2 g/liter of water) and Neem Azal (1.5 ml/liter of water) gave medium effect against nymphs and adult females.

Other insecticidal arrangements like Buprofezin against nymphal and adult population of cluster infestation **(Muthukrishnan *et al.*, 2005).** Organophosphates have as of now been accounted for to be the best for mealybug control e.g., methomyl, chlorpyrifos, methidathion and profenofos **(Saeed *et al*., 2007 and Aheer *et al*., 2009). Shah *et al*. (2016)** concluded that the insecticide, Acetamiprid provided better results infavour to control the cotton mealybug.

IV. CONCLUSION

Carried study proved that, Acetamiprid and Chlorpyrifos showed high toxic and insecticidal efficiency against *I. aegyptiaca* on citrus trees while the plant oil (Jasmine oil) gave the least effect; it was un suitable to control this pest. Also, the nymphs of *I. aegyptiaca* were more susceptible to the tested chemicals than the adult females. As well as, the tested chemical and non-chemical treatments on *I. aegyptiaca* were varied under laboratory conditions.

V. RECOMMENDATION

It could be recommended, Acetamiprid at concentration 0.25g per L. water and Chlorpyrifos at rate of 1.5 cm^3 per L. water for controlling *I. aegyptiaca* infested citrus trees. The plant oil was suitable to be used as additive to conventional insecticides used in controlling this pest, to increase their effect then decreasing their rate of application in other complete experiments.

Table (1) : Toxicity of tested compounds against nymphs of *Icerya aegyptiaca* under laboratory conditions.

Treatment	Lethal concentrations and their limits (ppm)			Slope ± SE	χ^2 test	%Toxicity index at LC_{50}	Resistance Ratio (RR)
	LC_{10}	LC_{25}	LC_{50}				
Acetamiprid	1.34 ± (0.25 - 3.01)	3.94 ± (1.33 -6.86)	12.99 ± (7.68 -19.09)	1.30 ± 0.248	0.14	100.00	1.00
Chlorpyrifos	1.63± (0.35 -3.47)	4.68 ± (1.76 -7.86)	15.15 ± (9.43 -22.08)	1.32 ± 0.247	0.39	85.75	1.17
Diflubenzuron	1.18± (0.12 -3.07)	4.29 ± (1.11 -7.99)	17.97 ± (10.35 -28.47)	1.08 ± 0.23	1.03	72.27	1.48
Malathion	3.21± (1.03 -5.83)	8.55 ± (4.31 -12.87)	25.39 ± (17.62 -37.20)	1.42 ± 0.250	1.21	51.15	1.95
Bioranza	4.80± (1.73 -8.25)	12.67 ± (7.07-18.43)	37.22 ± (26.19 -57.94)	1.44 ± 0.257	6.15	34.89	2.87
Super Royal oil	5.71± (2.05 -9.74)	15.48 ± (8.84 -22.50)	46.85 ± (32.44 -78.92)	1.40 ± 0.26	4.63	27.71	3.61
Jasmine oil	14.29±(4.9 8 -26.45)	40.14 ± (20.34 -61.87)	126.41 ± (86.29 -178.92)	1.35 ± 0.20	3.41	10.27	9.73

Table (2): Toxicity of tested compounds against adult females of *Icerya aegyptiaca* under laboratory conditions.

Treatment	Lethal concentrations and their limits (ppm)			Slope ± SE	χ^2 test	%Toxicity index at LC_{50}	Resistance Ratio (RR)
	LC_{10}	LC_{25}	LC_{50}				
Acetamiprid	1.46 ± (0.18 -3.59)	5.24 ± (1.54 -9.35)	21.58 ± (13.10 -34.75)	1.09 ± 0.236	0.10	100.00	1.00
Chlorpyrifos	1.68 ± (0.24 -3.95)	5.86 ± (1.90 -10.17)	23.41 ± (14.59 -37.76)	1.12 ± 0.237	0.40	92.18	1.08
Diflubenzuron	2.28 ± (0.30 -5.24)	8.60 ± (3.03 -14.47)	37.48 ± (23.62 -72.45)	1.05 ± 0.238	1.33	57.59	1.74
Malathion	3.63 ± (0.92 -6.98)	11.25 ± (5.37 -17.34)	39.55 ± (26.47 -68.71)	1.23 ± 0.247	1.75	54.56	1.83
Bioranza	6.39 ± (2.33 -10.76)	17.31 ± (10.09-25.10)	52.37 ± (35.98 -91.64)	1.40 ± 0.264	3.64	41.21	2.43
Super Royal oil	8.00 ± (3.24 -12.94)	20.63 ± (12.70 -29.49)	59.07 ± (40.79 -104.37)	1.48 ± 0.276	5.67	36.54	2.74
Jasmine oil	18.95 ± (6.66 -34.65)	55.92 ± (29.37 -84.88)	186.03 ± (128.74 -272.36)	1.29 ± 0.198	2.49	11.60	8.61

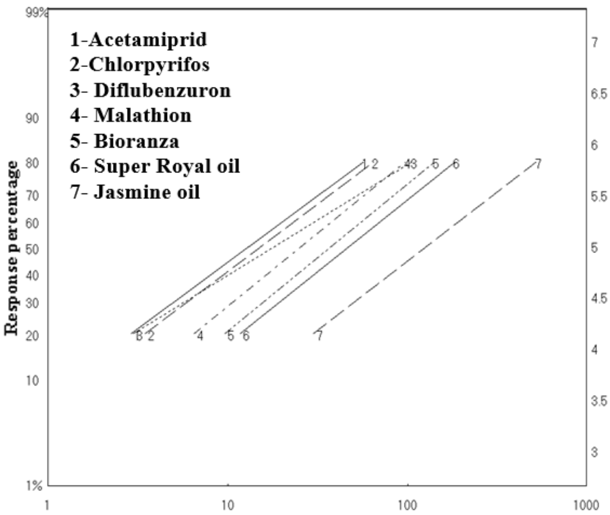

Fig. (1): Toxicity lines of tested compounds against nymphs of *I. aegyptiaca*.

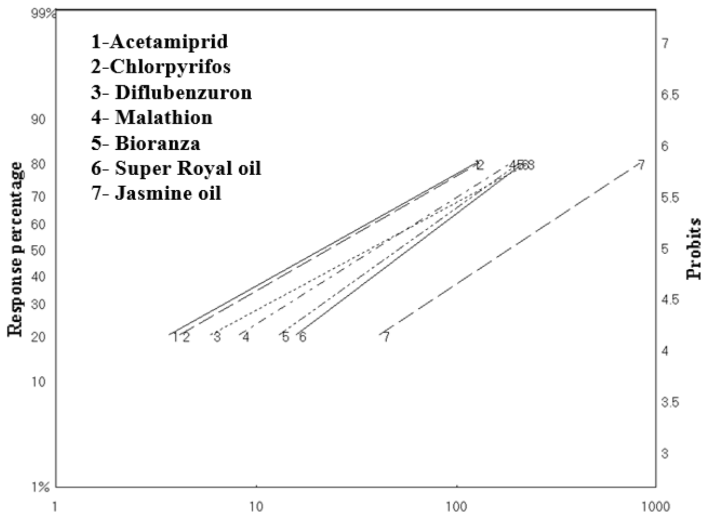

Fig. (2): Toxicity lines of tested compounds against adult females of *I. aegyptiaca*

VI. REFERENCES

[1]. Abbott, W.S. (1925): A method for computing the effectiveness of an insecticide. J. Econ. Entomol., 18: 265-267 pp.

[2]. Aheer, G.M.; R. Ahmad and A. Ali (2009): Efficacy of different insecticides against cotton mealybug, Phenacoccus solenopsis Ferris. J. Agric. Res., 47: 47-52 pp.

[3]. Ben-Dov, Y.; D.R. Miller and G.A.P. Gibson (2009): Scale Net: a database of the scale insects of the world. http://www.sel.barc.usda.gov/scalenet/scalenet.htm.

[4]. El-Said, M.I. (2006): Studies on some Eco-Physiological factors affecting resistance of five mango cultivars to the mealybugs, Icerya seychellarum (Westwood). Ph.D. Thesis, Fac. Agric., Cairo Univ., 121 pp.

[5]. Finney, D.J. (1971): Probit analysis. A statically treatment of the sigmoid response curve. Cambridge Univ. Press, England, 318 pp.

[6]. Franco, J.C.; A. Zada and Z. Mendel (2009): Novel approaches for the management of mealybug pests. Bio. Cont. of Arthro. Pests. Springer, 233-278 pp.

[7]. Mangoud, A.A.H. (2000): Integrated pest management of apple trees. PH.D. Thesis, Fac. Agric., Cairo Univ., 196 pp.

[8]. Mangoud, A.A. and H.A.S. Abd El-Gawad (2003): Evaluation of different integrated pest management concepts for controlling the Egyptian mealybug, Icerya aegyptiaca on ornamental plants. Bull. Ent. Soc. Egypt, Econ. Ser., 29: 137-149 pp.

[9]. Mangoud, A.A. and H.A.S. Abd El-Gawad (2004): Evaluation of different integrated pest management tactics for controlling the Australian mealybug, Icerya purchasi Maskell infesting citrus trees. Bull. Ent. Soc. Egypt, Econ. Ser., 30: 81-90 pp.

[10]. Mangoud, A.A.; M.S. Abd El-Wahid and M.A. Abd El-Aziz (2007): Effect of different Bio-control against on the Bamboo pit scale, Bambusaspis bambusae and the seychellarum mealybug, Icerya seychellarum under laboratory conditions. Egypt. J. Agric. Res., 85(5): 1629-1641 pp.

[11]. Muthukrishnan, N.; T. manoharan, P.S.T. Thevan and S. Anbu (2005): Evaluation of buprofezin for the management of grape mealybug, Maconellicoccus hirsutus (Green). J. Entomol. Res., 29: 339–344 pp.

[12]. Saeed, S.; M Ahmad, M. Ahmad and Y.J. Kown (2007): Insecticidal control of the mealybug Phenacoccus gossypiphilous (Hemiptera: Pseudococcidae), a new pest of cotton in Pakistan. Entomol. Res., 37: 76–80 pp.

[13]. Shah, Z. H.; H.A. Sahito, G.A. Shar, T. Kousar, W.M. Mangrio and K.A. Kanhar (2016): Toxicity of different insecticides against mealybug, Phenacoccus solenopsis (Tinsley) under cotton field conditions. Pak. J. Entomol. 31 (1): 39-50 pp.

[14]. Suresh, S.; R. Jothimani, P. Sivasubrmanian, P. Karuppuchamy, R.Samiyappan and E.I. Jonatha (2010): Invasive mealybugs of Tamil Nadu and their management Karnataka. J. Agric. Sci., 23: 6–9 pp.

[15]. Sun, Y.P. (1950): Toxicity index an improved method of comparing the relative toxicity of insecticide. J. Econ. Entomol., 43: 45-53 pp.

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