academicresearchJournals

Vol. 7(1), pp. 1-5, January 2019
DOI: 10.14662/ARJB2018.050

ISSN: 2384-616X
https://www.academicresearchjournals.org/ARJB/Index.htm

Academic Research
Journal of Biotechnology

Full Length Research

Effectiveness of insecticides, insect growth regulators, mineral and plant oils against the cotton mealybug, *Phenacoccus solenopsis* (Hemiptera: Pseudococcidae) infesting cotton plants

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Accepted 10 January 2019

Different chemical and non-chemical treatments were evaluated for their influence against nymphs and adult females of *Phenacoccus solenopsis* on cotton leaves under laboratory conditions in El-Mattana Agricultural Research Station, Luxor Governorate in 20th August, 2018. Three insect insecticides: Mospilan, Malatox and Admiral, bio-insecticide (Biover), mineral oil (KZ- oil) and plant oil (sesame oil) were used. The method of dipping was used throughout the present investigation. The obtained results revealed that the tested chemical and non-chemical treatments on *P. solenopsis* were varied under laboratory conditions. Also, these compounds gave the same efficacy against both the nymphs and adult females. But, the nymphs of *P. solenopsis* were more susceptible to the tested chemicals than the adult females. As well as, the insecticidal efficiency of Mospilan and Malatox showed the highest toxic against nymphs and adult females of mealybug on cotton leaves, while the plant oil (sesame) showed the lowest effect.

Key words: *Phenacoccus solenopsis*, effectiveness, insecticides, insect growth regulators, plant oils and cotton.

Cite This Article As: Bakry, M.M.S., Mohamed, L.H.Y. (2019). Effectiveness of insecticides, insect growth regulators, mineral and plant oils against the cotton mealybug, *Phenacoccus solenopsis* (Hemiptera: Pseudococcidae) infesting cotton plants. Acad. Res. J. Biotech. 7(1): 1-5

INTRODUCTION

Cotton plants are subjected to infestation by different pests. Among these pests, the cotton mealybug, *Phenacoccus solenopsis* (Hemiptera: Pseudococcidae) is considered one of the most main destructive pests of cotton plants and a polyphagous insect pest (Hodgson *et al*., 2008 and Arif *et al*., 2009) and was observed on different host plants including field crops, vegetables, ornamentals, weeds and fruits in Egypt (Abdel-Razzik *et al*., 2015). This pest attacks tender shoots, stem, bloom, veins of leaves and boll of cotton. Usually, this insect weakens the infested plant itself by sucking the sap with the mouth parts causing thereafter deformations by the action of the toxic saliva and poor shoot growth. The female lays a large number of eggs (600-800 eggs/female) in an ovisac made of wax secreted from wax gland lays on the lower side of *P. solenopsis*. The mealybug feeding on the sap sucked from the host plant tissues. As this sap contains only a very low concentration of protein, the insect sucks a great amount of sap from which it obtains the amount of protein sufficient for its growth and egg development (Saeed *et al*., 2007). Large populations of mealybugs cause general weakening, defoliation, and death of susceptible plants. Indirectly, it may also damage plants by serving as vectors of plant diseases. Moreover, the honeydew excreted by the mealybugs causes growth of sooty moulds and other secondary infections that decreases photosynthesis and reduces the marketability of plant products (El-Zahi *et al*., 2016). Generally, late season infestations of cotton plants, during the reproductive crop stage, cause severe economic damage to the yield about 34.9% (Vennila *et al*., 2010). Recommendation of controlling mealybugs with mineral oils is very important especially during fruiting period. Since mineral oils used in high amount in one side and increasing of using mineral oils in petrochemical industries in other side, therefore 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 *P. solenopsis* (Dreistadt, 2001 and Franco *et al*., 2009). The aim of investigation is to evaluate the efficacy of new and conventional insecticides, bio-insecticide, mineral and plant oils against *P. solenopsis* attacking cotton plants under laboratory conditions was carried out in El-Mattana Agricultural Research Station, Luxor Governorate.

MATERIALS AND METHODS

Insect insecticides:

-Mospilan® 20% SP (Acetamiprid): Neonicotinoid at rate 0.25g per liter water, produced by Nisso Co.
-Malatox® 57% EC (Malathion): Organophosphat, used by 2.5 cm^3 per liter water.
-Admiral® 10% EC (Pyriproxyfen): insect growth regulators (IGRs) at rate 0.5 cm^3 per liter water, produced by Sumitomo Chemical Co. Ltd.

Bio-insecticide:

Biover® 10% WP: an entomopathogenic fungi, containing 10% *Beauvaria bassiana* and 90% inert ingredient, used by 2 g / L water.

Mineral oil:

KZ- oil 95% EC, it is a mineral oil, recommended for controlling mealybugs at concentration 1.5% (V./V.), produced by Kufr el-Zayaat Co. for Pesticides and Chemicals, Kufr el- Zayaat, Egypt.

Plant oils:

Sesame oil (plant oil), produced by Captain CO. (Cap. Farm).

Control: without use of insecticides.

Laboratory treatment

Laboratory experiment was carried out to determine the toxicity of different chemical and non-chemical compounds for their influence against *P. solenopsis* on cotton leaves (Giza 90 cultivar) under laboratory conditions in El-Mattana Agricultural Research Station, Luxor Governorate in 20th August, 2018. Three insect insecticides: Mospilan, Malatox and Admiral, bio-insecticide (Biover), mineral oil (KZ- oil) and plant oil (sesame oil). Five concentrations of each tested insecticides and oils were prepared in distilled water; three replicates were used for each concentration. Thirty infested leaves were used for each concentration (10 leaves/ replicate). Samples of infested cotton leaves with nymphs and adult females of *P. solenopsis* were collected randomly from infested cotton plants and kept in paper bags then transferred to laboratory. The leaves were dipped by the tested insecticides and oils into each solution for 30 seconds and the control leaves dipped in water only and the leaves were left for dryness in air. Died and alive individuals were counted and recorded after 24, 48 and 72 hours of exposure (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 = Mortality percentage in treatment.
C = 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 treatments, LC_{10}, LC_{25} and LC_{50}, slope values, Resistance Ratio (RR) of tested compounds 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.

Table (1): Toxicity of different compounds against the nymphs of cotton mealybug, *P. solenopsis* under laboratory conditions.

Treatment	Lethal concentrations and their limits (ppm)			% Toxicity index at LC_{50}	Resistance Ratio (RR)	Slope ± SE	Line equation regression of probit (y) on log concentration (x)
	LC_{10}	LC_{25}	LC_{50}				
Mospilan	**0.04 ± (0.003-0.10)**	**0.16 ± (0.05-0.25)**	**0.68 ± (0.45-1.69)**	**100.00**	**1.00**	**1.06 ± 0.29**	**Y= 56.03 + 1.06x**
Malatox	**0.14 ± (0.03-0.29)**	**0.37 ± (0.13-0.58)**	**1.03 ± (0.70-1.37)**	**65.60**	**1.52**	**1.50 ± 0.33**	**Y= 57.79 + 1.50x**
Admiral	**0.05 ± (0.003-0.12)**	**0.23 ± (0.08-0.36)**	**1.11 ± (0.64-6.27)**	**61.34**	**1.63**	**0.98 ± 0.30**	**Y= 47.3 + 0.98x**
Biover	**0.05 ± (0.002-0.13)**	**0.24 ± (0.08-0.38)**	**1.20 ± (0.67-8.79)**	**56.40**	**1.77**	**0.95 ± 0.30**	**Y= 45.98 + 0.95x**
KZ oil	**0.18 ± (0.02-0.39)**	**0.63 ± (0.24-0.99)**	**2.50 ± (1.69-4.57)**	**27.14**	**3.68**	**1.12 ± 0.26**	**Y= 31.65 + 1.12x**
Sesame oil	**0.39 ± (0.001- 1.68)**	**2.19 ± (0.08-5.20)**	**15.10 ± (7.48-28.92)**	**4.50**	**22.23**	**0.80 ± 0.25**	**Y= 43.48 + 0.80x**

RESULTS AND DISCUSSION

A- Nymphs stages:

The obtained results are presented in Table (1) and in Figure (1), showed the different potencies of certain control treatments by different concentrations against the nymphs of *P. solenopsis*. This reduction gradually increased by increasing the used concentration. Mospilan found to be the highly potent compound. The LC_{50} value was 0.68 ± (0.45-1.69) %. The other tested treatments could be arranged according to their $LC_{50's}$ in the following descending order: Mospilan, Malatox, Admiral, Biover, KZ oil and Sesame oil. $LC_{50's}$ of these tested treatments were 0.68 ± (0.45-1.69), 1.03 ± (0.70-1.37), 1.11 ± (0.64-6.27), 1.20 ± (0.67-8.79), 2.50 ± (1.69-4.57) and 15.10 ± (7.48-28.92) %, respectively and their toxicity indexes were 100, 65.60, 61.34, 56.40, 27.14 and 4.50 %, 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. Comparatively, 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 treatments. The slope value for organophosphat insecticide, Malatox had the highest slope was 1.50 ± 0.33. But, the plant oil for Sesame had the lowest slope was 0.80 ± 0.25.

B- Adult females stages:

As shown in Table (2) and in Figure (2), showed the potency of the same tested chemical and non-chemical control treatments on the adult females of *P. solenopsis* using the same technique. Mospilan most efficient compound against adult females population followed by Malatox, Admiral, Biover, KZ oil and Sesame oil. The $LC_{50's}$ of these tested compounds were 1.03 ± (0.65-3.29), 1.36 ± (0.94-2.26), 1.47 ± (0.77-16.41), 2.15 ± (1.15-13.94), 3.99 ± (2.26-20.86) and 24.36 ± (15.57-50.67) %, respectively and their toxicity indexes were 100, 75.44, 69.76, 47.82, 25.80 and 4.22 %, respectively. The obtained results revealed that the tested chemical compounds gave the same efficacy against the adult females. The slope value of bio-insecticide, Biover had the highest slope was 1.36 ± 0.37. But, the mineral oil (KZ) had the lowest slope was 0.81 ± 0.26. From results in Tables (1 and 2) noticed that nymphs of *P. solenopsis* were more susceptible to the tested chemicals 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,

Table (2): Toxicity of different compounds against the adult females of cotton mealybug, *P. solenopsis* under laboratory conditions.

Treatment	Lethal concentrations and their limits (ppm)			%Toxicity index at LC_{50}	Resistance Ratio (RR)	Slope ± SE	Line equation regression of probit (y) on log concentration (x)
	LC_{10}	LC_{25}	LC_{50}				
Mospilan	**0.08 ± (0.01-0.15)**	**0.27 ± (0.14-0.40)**	**1.03 ± (0.65-3.29)**	**100.00**	**1.00**	**1.16 ± 0.31**	**Y= 48.26 + 1.16x**
Malatox	**0.12 ± (0.009-0.27)**	**0.38 ± (0.10-0.61)**	**1.36 ± (0.94-2.26)**	**75.44**	**1.33**	**1.21 ± 0.33**	**Y= 50.56 +1.21x**
Admiral	**0.07± (0.003-0.14)**	**0.29 ± (0.11-0.47)**	**1.47 ± (0.77-16.41)**	**69.76**	**1.43**	**0.95 ± 0.31**	**Y= 42.69 + 0.95x**
Biover	**0.25 ± (0.10-0.37)**	**0.69 ± (0.47-1.39)**	**2.15 ± (1.15-13.94)**	**47.82**	**2.09**	**1.36 ± 0.37**	**Y= 31.19 + 1.36x**
KZ oil	**0.10 ± (0.001-0.33)**	**0.59 ± (0.08-1.08)**	**3.99 ± (2.26-20.86)**	**25.80**	**3.88**	**0.81 ± 0.26**	**Y= 30.49 + 0.81x**
Sesame oil	**1.17 ± (0.06-3.10)**	**4.94 ± (1.17-8.63)**	**24.36 ± (15.57-50.67)**	**4.22**	**23.68**	**0.97 ± 0.26**	**Y= 34.36 + 0.97x**

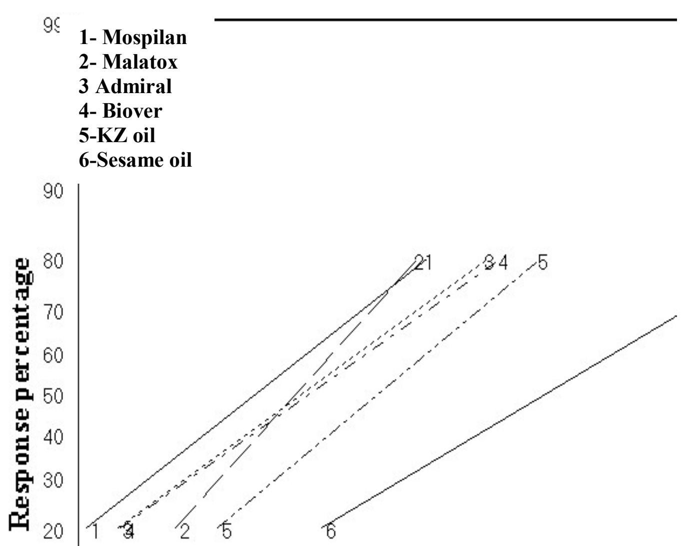

Figure 1: Toxicity lines of tested compounds against nymphs of *P. solenopsis*.

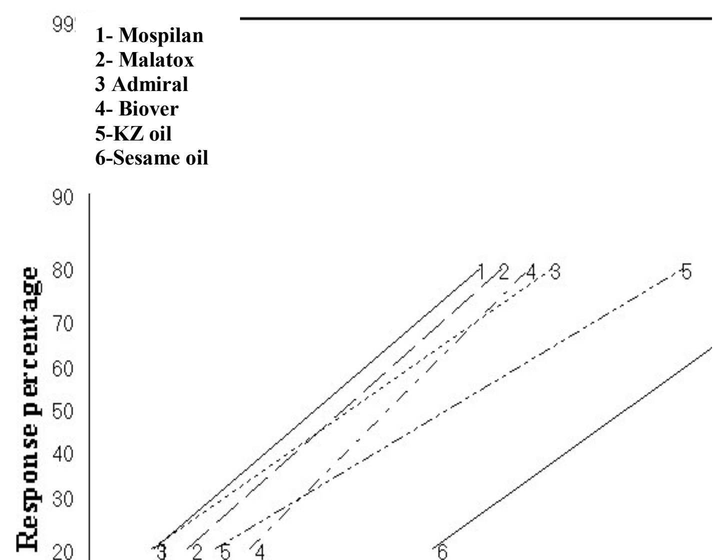

Figure 2: Toxicity lines of tested compounds against adult females of *P. solenopsis*.

imidacloprid 0.6 ml/L and thiamthoxam 0.6 g/L. 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 in favour to control the cotton mealybug.

CONCLUSION

Carried study proved that Mospilan and Malatox showed high toxic and insecticidal efficiency against *P. solenopsis* on cotton plants while the plant oil showed lowest effect; they were unsuitable to control this pest. Also, the nymphs of *P. solenopsis* were more susceptible to the tested chemicals than the adult females. As well as, the tested chemical and non-chemical treatments on *P. solenopsis* were varied under laboratory conditions.

RECOMMENDATION

It could be recommended Mospilan at concentration 0.25g per L water and Malatox at rate of 2.5 cm^3 per L. water for controlling *P. solenopsis* infested cotton plants. 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.

REFRENCES

Abbott WS (1925). A method for computing the effectiveness of an insecticide. J. Econ. Entomol. 18:265-267.

Abdel-Razzik MI, Attia AR, Abdel Aziz M (2015). Newly host plants of cotton mealybug *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) in Egypt. Egypt. Acad. J. Biolog. Sci., 8(3): 31-33.

Aheer GM, Ahmad R, Ali A (2009). Efficacy of different insecticides against cotton mealybug, *Phenacoccus solenopsis* Ferris. J. Agric. Res., 47: 47-52.

Arif MI, Rafiq M, Ghaffar A (2009). Host plants of cotton mealybug (*Phenacoccus solenopsis*): a new menace to cotton agroecosystem of Punjab, Pakistan. Int. J. Agric. Biol., 11:163–167.

Dreistadt SH (2001). Integrated pest management for floriculture and nurseries. UCANR Publications.

El-Zahi SE, Aref SA, Korish SKM (2016). The cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) as a new menace to cotton in Egypt and its chemical control. J. Plant Prot. Res., 56 (2): 211-215.

Finney DJ (1971). Probit analysis. A statically treatment of the sigmoid response curve. Cambridge Univ. Press, England, pp 318.

Franco JC, Zada A, Mendel Z (2009). Novel approaches for the management of mealybug pests. Biorational Control of Arthropod Pests. Springer, 233-278.

Hodgson CJ, Abbas G, Arif MJ, Saeed S, Karar H (2008). *Phenacoccus solenopsis* Tinsley (Sternorrhyncha: Coccoidea: Pseudococcidae), an invasive mealybug damaging cotton in Pakistan and India, with a discussion on seasonal morphological variation. Zootaxa, 1913: 1–35.

Muthukrishnan N, manoharan T, Thevan PST, Anbu S (2005). Evaluation of buprofezin for the management of grape mealybug, *Maconellicoccus hirsutus* (Green). J. Entomol. Res., 29: 339–344.

Saeed S, Ahmad M, Ahmad M, Kown YJ (2007). Insecticidal control of the mealybug *Phenacoccus gossypiphilous* (Hemiptera: Pseudococcidae), a new pest of cotton in Pakistan. Entomol. Res., 37: 76–80.

Shah ZH, Sahito HA, Shar GA, Kousar T, Mangrio WM, Kanhar KA (2016). Toxicity of different insecticides against mealybug, *Phenacoccus solenopsis* (tinsley) under cotton field conditions. Pak. J. Entomol. 31 (1): 39-50.

Sun YP (1950). Toxicity index an improved method of comparing the relative toxicity of insecticide. J. Econ. Entomol., 43: 45-53.

Suresh S, Jothimani R, Sivasubrmanian P, Karuppuchamy P, Samiyappan R, Jonatha EI (2010). Invasive mealybugs of Tamil Nadu and their management Karnataka. J. Agric. Sci., 23: 6–9.

Vennila S, Deshmukh AJ, Pinjarkar D, Agarwal M, Ramamurthy VV, Joshi S, Kranthi KR, Bambawale OM (2010). Biology of the mealybug, *Phenacoccus solenopsis* on cotton in the laboratory. J. Insec. Sci., 10 (115): 1-9.