Egypt. Acad. J. Biolog. Sci., 5(2): 175 -181 (2012) (Review Article) A. Entomology
Email: egyptianacademic@yahoo.com ISSN: 1687–8809
Received: 15/5 /2012 www.eajbs.eg.net

Chemicals control of scale insects (Hemiptera: Coccoidea) under local conditions

Mangoud, A. A. H. and Abou-Setta, M. M.
Plant Protection Research Institute, Agriculture Research Center, Dokki, Giza, Egypt

ABSTRACT

Scale insects are small insects of Superfamily Coccoidea, Order Hemiptera. They are found in different parts of the world. They attack different economic crops in Egypt. This article includes a historical review of chemical control of scale insects in Egypt as well as literature review concerning chemical control of the important families (i.e. armored scale insects (Diaspididae), mealybugs (Monophlebidae and Pseudococcidae) and soft scales (Coccidae).

Keywords: Chemicals control, scale insects

INTRODUCTION

There are many different species of scale insects that attack cultivated plants. These sap-sucking insect pests can weaken the growth of a wide range of plants. Many species excrete a sticky, sugary substance, called honeydew, on the leaves and stems on which they are feeding on. They also produce white, waxy mounds on stems and the undersides of leaves. These are the egg masses of the brown sap-sucking insect that attack fruit and ornamental trees.

Chemical control play an important role in controlling scale insects (Hemiptera: Coccoidae). It may be warranted when natural enemies and other control measurements are not sufficient to prevent plant injury and reduce produce value. Egyptian stat policy is to evaluate the compounds of pest control upon request of suppliers (i.e. pesticide companies).

Optimal chemical control program for scale insects requires:

1- Scouting and prediction of scale insects.
2- Suitable time for controlling.
3- Appropriate active ingredient which is most effective with least side effects such pesticide residues in fruits, hazards to applicators and on non-target organisms.
4. Use suitable sprayers or method of application.

Chemical control of scale insects started initially by fumigation with hydrogen cyanide [HCN]. Other available metallic pesticides (as arsenates) or natural botanical pesticides as nicotine, rotenone or pyrethrum were not effective against scale insects because this group of insects' structure. Fumigation was used for treating trees under tents against scale insects. The effect of high-dose cyanide is quick, and death occurs within minutes. It has some advantages such as highly volatility with no residual effects. In the meantime it is very tedious, labor intensive and kills all natural enemies with health hazards to conductors. As adequate required machinery became available (after World War I) control of scale insects started using relatively heavy mineral oils (machine lubricating oils emulsified as mayonnaise type). These oils usually contain no more than 85% mineral oil and the rest is water and emulsifiers. It has some disadvantages such as negative effects on tree physiology. Using mineral oil began around 1935 up till now. It requires the use of specific sprayers with high-pressure.

A highly effective chlorinated hydrocarbon (insecticide) developed during World War II, as DDT (dichloro-diphenyl-trichloroethane) began in 1943 and became the most widely used pesticides but was not effective against scale insects (due to it is stomach poisons). During 1960's organophosphorous (Op) compounds were introduced to Egypt after the failure of the pesticide Toxaphene in cotton pests' control. The early organophosphorous pesticides were very effective and high toxicity to mammals also. As a result Parathion was used as tank mix with mineral oils. Later ready mixed Parathion with mayonnaise mineral petroleum oils became available as Packol and Aleoparaphine. These materials replaced gradually fumigation. It used to be applied during winter spray only. Storage of these compounds for long time affected its stability. During 1970's new Ops compounds which is less toxic such as Malathion and Diemethoate became available. Also the first light EC oil (SunOil), (which can be applied at lower rates and during summer season) became available. This opened the way for summer application to control scale insects. During 1970 to 1980 a very wide spectrum of Ops compounds were recommended for scale insects control. Later on mixtures of these Ops and mineral oil were recommended also.

Agricultural petroleum oils are derived from crude petroleum oil, which is separated into fractions by heat in a distillation tower. Different fractions represent different hydrocarbons of various weights, structures and boiling points and each fraction may have different pesticidal properties. The range of boiling points for their constituents is relatively narrow. It is measured as the 10 to 90 percent distillation range (the measurements at which 10 percent and 90 percent of the oil has distilled).

During 1981 Scale Insects Department eliminated recommending insecticides which are more toxic than 150 ml/kg body weight of rabbits (i.e. equivalent to dimethoate toxicity) to reduce human health hazards to be applied for scale insects control on fruit trees. Later on this policy was adapted by Ministry of Agriculture for other crops. Pesticide application in most cases is applied manually to orchard trees. This resulted in elimination of many recommended Ops such as parathion which is highly toxic by contact and inhalation. In the meantime the Department cooperated with the pesticide and oil companies in a national project to evaluate new formulations of local oils to correspond to the international standard specifications as EC or miscible formulation. These new group of oils contain at least 95% oil and the rest is emulsifier additives. As a result several summer oils were register for using as summer and winter seasons during 1984. Newly developed compounds (Pyrethroids and Carbamates) did not show high efficiency against scale insects. The introduced insect growth regulators as juvenile hormone mimics (Pyriproxyfen) gave satisfactory results. Other groups of pesticides (as natural extracts or botanical oils) have not been mentioned in literature to be effective. The most recent recommendations include only use light mineral oils against scale insects in Egypt.

RESULTS

Literature review of most important scale insects families' chemical control in Egypt:

1. Armored scale insects (Diaspididae):

El-Kifl *et al.* (1980) indicated that organophosphorus insecticides when added to mineral oil (Volck oil) gave better results in controlling the Latania scale, *Hemiberlesia latania* (Signort) when spraying oil alone on fig trees. One percent Sun oil was the most effective while 2% Triona oil was the least one on different scale insects (Helmy *et al.*, 1982). Helmy *et al.* (1984) reported that miscible oils were preferred

for controlling scale insects on citrus. KZ oil was the most effective oil at concentration of 2.0%. Nymphs were the most sensitive stage during a period of 1-3 months after application (Ibrahim, 1990). Helmy *et al.* (1991) tested the sensitivity of some scale insects to insecticides; Basudin, Reldan, Sumithion, Oleoekaluk, Sumi oil and KZ oil. They found that the purple scale, *Lepidosaphes beckii* (Newman) was the most sensitive to test scalicides, followed by the red scale, *Aonidiella aurantii* (Maskell), while the olive scale, *Parlatoria oleae* (Colvee) was the least responsive. The nymphal stage was more susceptible, followed by adult females, while ovipositing females were less responsive. Abdel-Megeed *et al.* (1992) assayed the relative response of the nymphs, adult females and ovipositing females of *L. beckii, A. aurantii* and *P. oleae* to different concentrations of Sumithion (50), Sumi oil (6) and KZ oil (95). Sumithion and Sumi oil at the recommended rate, proved to be most effective followed by KZ oil. Based on LC_{50}s of KZ oil (the least effective compound), the relative efficacy of Sumithion and Sumi oil ranged from 20.2 to 36.69 times, respectively. *L. beckii* and *A. aurantii* showed high susceptibility compared with *P. oleae* to the insecticides being used. Hemly *et al.* (1992) tested five Egyptian miscible oils on orange trees. Miscible oils were successful as scalicides and scale ovicides for summer and autumn spraying on citrus trees infested by the nabk scale, *Parlatoria ziziphi* (Lucas). Also Tukuthion was the more effective insecticides against scale insects on Valencia orange followed by Selecron, KZ oil, Hilithion and finally Shokrona oil (Selim, 1993). Khalil (1996) tested KZ oil and Misrona-super oil at 1.5% against *L. beckii* and *A. aurantii.* He reported all tested treatments gave satisfactory results against different stages of the two insects at 2, 4 and 6 weeks after summer spray on balady orange trees. Asfoor (1997) tested Cidial, Sumi oil, Diazinon, Fenitrothion, KZ oil, Misrona oil and Fenvalerate against *P. oleae* on pear, plum and apple trees. He reported that the nymphs were the most susceptible stage to the tested insecticides, followed by the ovipositing females, whereas the non-ovipositing females were the most tolerant individuals. Malathion, Sumi oil, Admiral, Super Massrona and KZ oil were the effective compounds on *I. pallidula*, respectively. While *A. aurantii* affected by Super Masrona, Admiral, Malathion, Sumi oil and KZ oil, respectively (Mohamed, 2002). Mohamed (2002) tested Simithion 50% (fenitrothion) (organophosphorus compounds), Admiral 10% EC (pyriproxyfen) (IGR), Super Masrona (mineral oil 94% EC), Admiral + oil and Jojoba extract on *P. oleae* in Ismailia. Obtained results revealed that oil alone or mixed with other compounds held superior category all over the time specially after three months of application. Admiral seemed to be more efficient during summer time than spring. Mangoud (2008) found the black parlatoria, *Parlatoria ziziphi* (Lucas) (Homoptera : Diaspididae) is a dangerous pest of citrus trees. Misrona oil and Buprofezin gave good percent reduction against nymphs, adults and adults with eggs after one, two and three-month. Oil and Buprofezin have a major long-term effect. The natural control agents (M-pede, NeemAzal and Biofly) gave medium or low reduction against *P. ziziphi*.

2. Soft scale insects (Coccidae):

Nada *et al.* (1990) mentioned that spring spray with insecticides or summer oils gave good results for *Klifia acuminata* (Signoret) and *P. psidii* in mango in Sharqiya. Kwaiz (1999) indicated that the pre adult stages of *K. acuminata* were highly susceptible to profenofos fololowed by diazinon, chlorpyrifos-methyl, malathion, KZ and Shekrona oils compared with the adult stage. Mangoud *et al.* (2008b) evaluated the insecticidal efficacy of seven chemical and natural controlling agents against the Mediterranean black scale, *Saissetia oleae* (Oliver) on olive trees during 2006 and

2007 seasons. In both seasons, the two IGR's (Buprofezin and Pyriproxyfen) gave good reduction rates against nymphs, medium reduction on adults and adults with eggs after one, two and three months of spraying. Moreover, both compounds have major long-term effect. On the other hand, the natural control agents (Naturalis-L, and NeemAzal) gave medium reduction against *S. oleae* nymphs and low reduction against adults and adults with eggs,; in addition have not long-term effect. Also, results obtained that mineral oil, Super-Misrona gave the highest reduction effect of all tested alternatives against all stages of *S. oleae* either after 1, 2 or 3 months of treatments. Whereas, Malathion alone or mixture with oil have major long-term effect. Gave highly reduction rates against nymphs, adults and adults with eggs after one, two and three months of spraying.

3. Mealybugs (Pseudococcidae):

Barakat *et al.* (1994) studied the perpetration of organophosphorous insecticides in the margarodid, *Icerya seychellarum* (Westwood) under laboratory conditions. They found that the total initial deposites on ovipositing females (wax, ovisacs and females bodies) were 54.99, 74.03 and 88.49 ppm for profenophos, fenitrothion and primiphos-methyl, respectively. After 24 hours post-treatment (dipping method), primiphos-methyl rapidly diasapperaed followed by fenitrothion and then profenophos. The differences in rate of disappearance may be due to the speed of solubility of the insecticide in the waxy layer or to the relative stability of the compound. The insecticides diasppeared gradually from the waxy and ovisacs and translocated to the female bodies. Mangoud and Abd El-Gawad (2003) tested two spraying methods (oriented and whole tree spraying) were carried out to control Egyptian fluted mealybug, *Icerya aegyptiaca* (Douglas) (Homoptera : Margarodidae) in August 2002. Biofly and oil gave poor average reduction in infestation against adult females (41.6% and 49.1%, respectively), while NeemAzal and Sulphur gave moderate effect (64.1% and 60.7%, respectively). Malathion and Malathion + Oil gave good reduction (85.1% and 91.4%, respectively). Biofly, NeemAzal, oil and Sulphur gave moderate average reduction against nymphs (67.5%, 69.3%, 71.5% and 71.0%, respectively), while Malathion and Malathion + oil gave good average reduction (93.9% and 91.9%, respectively). Mohammad *et al.* (2010) found the pink hibiscus mealybug *Maconellicoccus hirsutus* is a serious pest on the ornamental plant *Hibiscus rosa sinensis* at Ismailia governorate. So, the comparative effects of six commonly used insecticides [four nonconventional pesticides ; Biofly, Biovar, Bioranza and Orange oil & two conventional pesticides Admiral (pyriproxyfen) and Cidial (phenthoate)]. They applied under field conditions on the population(s) of the pink hibiscus mealybug, *Maconellicoccs hirsutus* (Green).Results showed that the least reduction value was recorded by Biovar, Bioranza, Admiral and Orange oil on the mealybug population(s). The highest effect was occurred by cidial treatment. Mangoud *et al.* (2012) studied the relative toxicity of different compounds against the seychellarum mealybug, *Icerya seychellarum* (Westwood) (Homoptera : Margarodidae) and the vedalia beetle, *Rodalia cardinalis* (Mulsant) (Coleoptera : Coccinellidae) were studied on mango leaves under laboratory conditions. The obtained data indicated that different compounds (Biofly, NeemAzal and Super Mesrona oil) gave medium effects on nymphs, and adult females of *I. seychellarum* and immature and mature stages of their predator *R.cardinalis*, compared with Malathion which gave highly effects on the mealybug and its predator using direct exposure technique.

4. Pit scale (Asteroleacaniidae):

Mangoud *et al.* (2008a) tested four control agents (Biovar, Bio-Ranza, Micronized sulphur and Super Misrona oil) against the bamboo pit scale, *Bambusaspis bambusae* (Boisduval) and the results gave moderate effect on nymphs and gave low reduction on non-gravid and gravid females of *B. bambusae* . On the other hand, Sumithion gave high average reduction in all stages, on branches, trunks and on leaves. The whole tree spraying trail gave similar results to those obtained from the oriented trail (spraying of trunk and main branches). About 7 litres of spraying volume per palm was sufficient to cover these parts. About 2 litres of spraying volume per tree were sufficient to complete cover the whole tree. Whole tree spraying method was also carried out in 15th December 2004. In addition, four control agents (Biovar, Bio-Ranza, Micronized sulphur, and Super Misrona oil) were applied and compared with Sumithion compound. In general, the four control agents (Biovar, Bio-Ranza, Micronized sulphur and Super Misrona oil) gave moderate reduction on nymphs and gave low reduction on non-gravid and gravid females. On the other hand, Sumithion gave high average reduction in all stages, on branches, trunks and on leaves. Mangoud *et al.* (2010) tested the efficacy of four natural control agents (Biovar, Bio-Ranza, NeemAzal and Super Misrona oil) as well as with Sumithion were tested against the fig scale insect, *Russellaspis pustulans* (Hemiptera: Asteroleacaniidae) on apple trees in Gharbia Governorate on 15th April during two successive seasons (2008 and 2009). In these trails, the whole tree spraying was compared with the oriented spraying (spraying of trunk and main branches). Biovar, Bio-Ranza, NeemAzal and Super Misrona oil agents gave moderate reduction on nymphs, non-gravid and gravid females also gave moderate toxicity on parasitoid. On the other hand, Sumithion gave highly average reduction to all stages of scale insect and its parasitoid. The whole tree spraying trail gave similar results to those obtained from the directed spray trail. About 7.5 litres of spraying volume per apple tree was sufficient to cover these parts, while about 20 litres of spraying volume per tree were sufficient to complete cover the whole tree.

REFERENCES

Abdel-Mageed, M. I.; Zidan, Z. H.; Helmy E. I.; Zidan, A. H. and El-Imery (1992): Response of some armored scale insects infesting orange trees to some tested scalicides in laboratory. Fourth Arab Cong. Plant Protection, Cairo: 43-48.

Agnello, A. (2002): Petroleum-derived spray oils: chemistry, history, refining and formulation. pp 2-18 In Spray Oils Beyond 2000 (edited by G. Beattie et al.). Univ. of Western Sydney Press.

Asfoor, M. A. (1997): Seasonal abundance and control of the plum scale insect, *Parlatoria oleae* (Clovee') on some deciduous trees. Ph. D. Thesis, Fc. Of Agric. Zagazig University, pp. 398.

Barakat, A. A.; Badawy, H. M. A.; El-Metwaly, H. E. and Mangoud, A. A. H. (1994): Penetration of profenofos, fenitrothion and pirimiphos-methyl in the mealybug, *Icerya seychellarum* (Westwood). Bull. Ent. Soc. Egypt, Econ. 21: 161-169.

El-Kifl, A. H.; Salama, H. S. and Hamdy, M. K. (1980): Chemical control of scale insects infesting fig trees in Egypt. J. Fac. of Agric., Al-Azhar Univ., Egypt, 609-615.

Helmy, E. I.; Rawhy, S. H.; Zidan, Z. H. and Afifi, F. A. (1982): Bioresidual efficacy of certain organophosphorous insecticides, mineral oils and their mixtures, on different scale insects and parasites, in winter and summer seasons. Proc. Egypt's Nat. Conf. Entomol., 11: 673-685.

Helmy, E. I.; Zidan, Z. H.; El-Hamaky, M. A.; El-Emery, S. M. and El-Deep, W. (1991): Efficacy of certain scalicides against *Parlatoria oleae* (Colvee), other scale insects and their parasites on navel orange trees in summer. 4th Arab Cong of Plant Protection, Cairo, 1-5 Dec., pp. 49-57.

Ibrahim, F. A. (1990): Morphological effects of mineral oils used to control scale insects on citrus trees. M. Sc. Thesis, Fac. of Agric., Cairo Univ., Egypt, 127 pp.

Khalil, E. A. O. (1996): Survey and population studies of some scale insects attacking citrus trees and its control in Qualyobia and Beni-Suef governorates. M. Sc. Thesis, Fac. of Agric. Cairo Univ. Egypt, 189 pp.

Kwaiz, F. A. M. (1999): Ecological and toxicological studies on the mango soft scale, *Kilifa acuminata* (Signoret) with special reference to insecticide residues in mango fruits. Ph. D., Thesis, Fac. of Agric. Cairo, Univ. Egypt 171 pp.

Mangoud, A. A. H. (2008): Insecticidal effect of some chemical and natural control agents against the black parlatoria scale, *Parlatoria ziziphi* (Lucas) and associated parasitoids on citrus trees. Egypt., J. Agric. Res., 86 (6): 2157-2167.

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

Mangoud, A. A. H. ; Selim, A. A. and Asfoor, M. A. (2008b): Use of different pesticide alternatives in management of the Mediterranean black scale, *Saissetia oleae* and its associated natural enemies on olive trees in North Sinai, Egypt. The 4th International Conference, Plant Protection Research Institute, Giza, Egypt, 21-24 December, 2008.

Mangoud, A. A. H.; Abd-Rabou, S. M. and Ali, N. A. (2010): Comparison between oriented and whole tree spraying by different natural control agents in reducing the fig scale insect, *Russellaspis pustulans* on apple trees. Conf. of From Academia to Pesticide Industry, Fac. Agric., Alexandria Univ., 24-25 March, 2010.

Mangoud, A. A. H.; Abd El-Wahid, M. S. and Abd El-Aziz, M. A. (2008a): Comparison between oriented and whole tree spraying methods for controlling *Bambusaspis bambusae* (Boisduval) on bamboo plants. Egypt, J. Agric. Res., 86 (5): 1861-1875.

Mangoud, A. A. H.; Abd El-Wahid, M. S. and Abd El-Aziz, M. A. (2012): Screening test of different compounds against *Icerya seychellarum* and harmful effect on the beneficial predator *Rodalia cardinalis* under laboratory conditions. (in press).

Mohamed, A. A. (2002): Integrated control of scale insects on certain fruit trees. Ph. D. Thesis, Fac. of Agric., Al-Azhar University, pp. 173.

Mohamed, S. E. (2002): Environmental safe approaches for controlling some scale insects infesting olive trees in new reclaimed areas. M.Sc., Thesis, Institute of Environmental Studies and Research, Ain-Shams University, pp. 84.

Mohammad A.; H.; Moussa, S. F.; Abo-Ghalia, A. H. and Ahmed, S. A. (2010): Efficiency of certain insecticides on the population of the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) and their natural enemies under the field condition in Ismailia governorate. Egypt. Acad. J. Biolog. Sci., 2 (2): 11- 17.

Nada, M. A.; Abd-Rabou, S. and Hussien, G. E. (1990): Scale insects infesting mango trees in Egypt (Homoptera: Coccoidea). Proc. ISSIS, VI, Part II: 133-134.

ARABIC SUMMARY

المكافحة الكيميائية للحشرات القشرية تحت الظروف المحلية

أشرف هندى و محمد محمد أبوستة
معهد بحوث وقاية النباتات -مركز البحوث الزراعية -الدقي-جيزة-مصر

الحشرات القشرية هي حشرات صغيرة تنتمي لفوق عائلة Coccoidea - رتبة نصفية الأجنحة. فالحشرات القشرية تتواجد في كل جزء من العالم وتصيب العديد من المحاصيل الإقتصادية في مصر. وهذا العمل يتضمن المكافحة الكيماوية لأهم عائلات الحشرات القشرية المسلحة والبق الدقيقي (الحقيقي والكاذب) والحشرات القشرية الرخوة.