

Efficacy of some IGRs/insecticides, Kz oil and binary mixtures on mortality and enzyme activity of Egyptian mealybug *Icerya aegyptiaca* (Douglas) attacked Guava trees in Alexandria Governorate

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ABSTRACT

Nine chemicals [four IGR insecticides [Lufenuron (match®), Chromafenozide (Acro®), Pyriproxyfen (Admiral®) and RH- 2485 (Runner®)], Kz mineral oil and four binary combinations] were evaluated on Guava trees against the soft scale insect *Icerya aegyptiaca* (Douglas) (Homoptera: Margarodidae) at El-Sabahia Research Station, Alexandria Governorate during September, 2004. Mortalities were recorded at zero, one, two, three, four and eight weeks. Also, mealybug from treated Guava trees had been collected to investigate the effect of the tested chemicals on alkaline phosphatase (AKP), Alanine transferase (ALT) and Aspartate transferase (AST) enzymes activity. There were no significant differences among the chemical combinations, which caused more reduction effect than single treatments, and so they affected enzyme activity by the same trend. It could be concluded that Kz oil enhanced the toxicity effect of IGRs.

Keywords: IGRs, Insecticides, Kz oil, *Icerya aegyptica*, Guava trees, Enzyme activity.

INTRODUCTION

Extensive uses of chemical toxicants for pest control caused many problems, such as acute and chronic human and animal toxicity, development of insect resistance to chemicals and environmental pollution. So we need alternative effective and environmentally safe insecticides such as IGRs and mineral oils (Abdel Salam, 1993 and MALR, 1997).

IGRs show good effect against scale insects and white flies on cotton, citrus, fruit trees and vegetables. Their effects have been observed in

embryonic, larval and nymphal development on metamorphosis, reproduction in both males and females, on behavior and on several forms of diapauses (Ware, 2000). It also affects development, maturation and survival of the immatures (Pawar *et al.*, 1995). Insect growth regulators (IGRs) disrupt insect growth and development in three ways: as juvenile hormone (JH), as prococenes and as chitin synthesis inhibitors. Pyriproxyfen, for example, is environmentally safe and non-toxic to animals and human where the mode of action of pyriproxyfen revealed that it mimics the action of natural insect juvenile hormone, (Palma and Meola, 1993 and Dhadialla, *et al.*, 1998). Insect treated with pyriproxyfen cannot reproduce normally (Shiotsuki *et al.*, 1999).

Local sprays of mineral oils are used for years against scale insects, mealybugs, thrips, aphids and mites on different crops and fruit trees, (Moursi, 1996 and El-Deeb *et al.*, 2002). Oil sprays are used most commonly in horticulture to control scale insects and mites (Chapman *et al.*, 1952). Micks and Berlin (1970) and El Sebae *et al.*, (1976) stated that resistance was not recorded for mineral oils which still have the advantage of being effective to resistant strains.

Guava trees are attacked by many scale insects, (such as Egyptian mealybug *Icerya aegyptiaca* (Douglas)) which cause serious damage and yield reduction. These pests are usually controlled by chemical insecticides or biological means (Moursi, *et al.*, 1991; El-Deeb, 1999 and Abo-Shanab *et al.*, 2002).

The importance of phosphatase enzymes in the different developing insect stages had led to several studies. Alkaline phosphates is located in cells which are the most active in the synthesis of fibrous proteins and may be correlated to the gradual growth and development of the imaginal tissues that overlap with histolysis of the larval tissues. Maintenance of the balanced "amino acid pool" in insects resulting from various biochemical reactions is usually carried out by a group of enzymes called amino transferases (Meister, 1955). Such reactions are mainly responsible for the degradation and biosynthesis of amino acids, linking the glucose and protein metabolism and synthesis of certain specific compounds

The amino transferases, especially Alanine transferases (ALT) and Aspartate transferases (AST) are two components of oxidative metabolism of proline, which is utilized in certain insects during the initial periods of

heights (Bursell, 1965). It also acts as a catalytic agent in the metabolism of carbohydrate (Katunuma *et al.*, 1968).

The aim of the present work is to evaluate the field toxicity of some IGRs, Kz oil and their combinations on the soft scale insect *Iceiya seychellurum* (Westwood) (Homoptera: Margarodidae). Also the study was directed to throw the light on the effect of these chemicals on the activity of Alkaline phosphatase, (AIKP) Alanine transferase (AST) and Aspartate transferase (ALT).

MATERIALS AND METHODS

Table (1): Chemicals used, sources, and applications rates

Trade name	Application rate %	Common name	Chemical name	Manufacture
I- IGRs				
Match 5% (wlv)	0.2	Lufenuron	(RS)- 1- (2,5- dichloro - 4 - (1,1 2,3,3-hexafluoro-prpxyl) -phenyl)-3-(2,6-difluoro benzoyl) - Urea	Novartis Co. (Syngenta)
Admiral 10% EC	0.05	Pyriproxyfen	4-phenoxyphenyl (RS)- 2- (2- pyridyloxy) propyl ether	Sumitomo Chemical Co
Runner 24% SC	0.05	RH- 2485	N- t- butyl-N'-(3,5-dimethyl benzoyl) -3-methoxy -2- methyl benzohydrazide	Rohm & Haas European Region
Acro EC	0.2	Chromaf Enozide	2'-t- butyl- 5- methyl- 2'-(3,5-xyloyl) chroman - 6-carbohydrazide	Nippon Kayaku Co
II-Mineral Oil				
Kz oil 95% E.C	1.5			Kafr El-Ziat Pesticides and Chemicals Co.
III - The binary Mixtures				
Kz + (Lufenuron or Pyriproxyfen or RH- 2485 or Chromafenozone) at 1 : 1				

Insect and chemicals used :

Soft scale insect *Icerya aegyptiaca* (Douglas) (Homoptera: Margarodidae) was selected as target organism and the chemicals used in the present study and their applications rates are listed in Table (1).

Field Experiment :

The field experiment was conducted during September 2004 in an orchard of Guava trees (15 years old) at EI-Sabahia, Alexandria Governorate. Treatments as well as control treatment were replicated five times and randomly distributed over 50 trees (same age, height and size). Knapsack sprayer used for the application. Forty leaves from each treatment were selected, pre-treatment and five periods post treatment (one, two, three, four and eight weeks). Numbers of living individuals (adults and nymphs) were counted immediately, before and after spraying. To evaluate the efficiency of the tested chemicals, percentage of reduction was calculated according to Henderson and Tilton (1955). Statistical analysis of variance and L.S.D value for comparing the mean effects of each treatment were adopted according to Snedecor (1961).

Biochemical studies :

Samples of treated and untreated leaves were collected after 24, 48, 72 and 96 hours of application. Alive insect stages were collected and kept in a deep freezer (-20 °C) until the biochemical assay.

Sample Preparation and assays :

One gram of collected stages was placed in clean vials and homogenized in one ml distilled water using a Teflon homogenizer surrounded with a jacket of crushed ice for 3 minutes. Homogenates were centrifuged at 5000 r.p.m for 30 minutes at 4 °C and the supernatants were used directly as an enzyme source.

- Alkaline-phosphatase activity was spectrophotometrically determined according to the method of Powell and Simth (1954).
- Alanine transferases (ALT) and aspartate transferases (AST) activities were determined according to the method of Reitman and Frankle (1957).

RESULTS AND DISCUSSION

1- Field Experiment :

Figure (1) illustrates the reduction effect of tested treatments against *Icerya aegyptiaca* (Douglas) after one, two, three, four and eight weeks. The data indicate that there were no significant differences among tested binary mixtures of IGRs (lufenuron, chromafenozide, pyriproxyfen and RH- 2485) with Kz oil and they could be arranged in the descending order as follows : Kz + lufenuron > Kz + RH- 2485 > Kz + chromafenozide > Kz + admiral where they caused reduction effect as 90.96, 87.44, 87.19 and 84.46 % respectively. Also there were no significant differences among chromafenozide, pyriproxyfen and RH-2485 when applied as a single treatment where they caused reduction effect as 77.28, 74.6 and 73.94 % respectively. However IGR lufenuron which caused reduction effect of 69.48 % differ significantly from the other treatments. Kz oil alone did not differ significantly with it's binary mixtures with chromafenozide, admiral and RH- 2485.

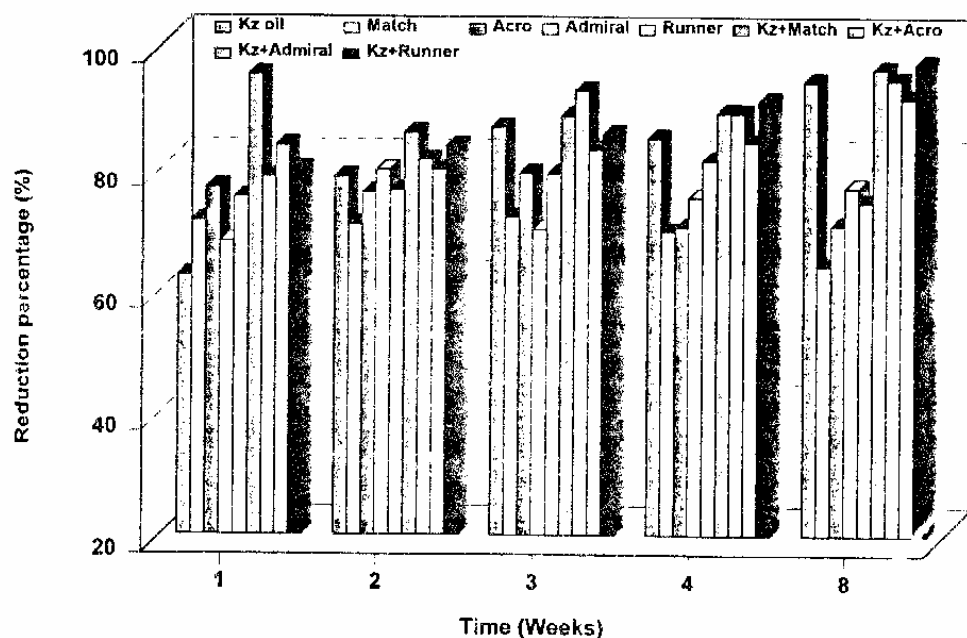


Fig. (1) : Reduction effect of IGRs, Kz oil and binary mixtures against mealybug *Icerya aegyptiaca* (Douglas) attacked Guava trees in Alexandria Governorate 2004.

Lufenuron had the lowest effect when applied alone but it was the best one when mixed with Kz oil. These findings may be resulted as an increasing of spreading and/or insect cuticle easily penetration which caused by Kz oil in the mixture.

IGRs alone caused a reduction effect that is increased with time up to 3 weeks while Kz oil and it's binary mixtures were increased up to 8 weeks of application. These results are in agreement with finding of El-Kordy *et al.*, (1995) and Abdel Hafez *et al.*, (1993). They stated that pyriproxyfen could be considered as inhibiting agents for protein synthesis.

II- Biochemical studies (Enzyme activities assay) :

Data presented in Figures (2, 3 and 4) illustrate the effects of the tested chemicals against enzyme activity of Aspartate transferase (AST), Alanine transferase (ALT) and alkaline phosphatase (AIKP) of Egyptian mealy bugs *Icerya aegyptiaca* (Douglas) infested Guava trees in Alexandria Governorate after 24, 48, 72 and 96 hours of the application.

Generally, treatments increased the tested enzymes inhibition (*in vivo*) as a function of time (24, 48, 72 and 96 hours). The mixture of Kz oil and pyriproxyfen was the most effective one in *in vivo* inhibition of Aspartate transferase (AST) without significant differences with the other tested mixtures and so Kz oil alone where they caused 100, 95.2, 91.52, 89.6 and 87.65 % for Kz + pyriproxyfen, Kz + RH- 2485, Kz + chromafenozide, Kz oil and Kz + lufenuron respectively (Fig, 2). There were no significant differences among the tested IGRs when used lonely except lufenuron, which showed the least inhibition effect (37.8 %) after showing little enzyme activation after 24h. of treatment (-6.79 %).

RH- 2485 and mixtures of Kz oil with tested IGRs inhibited AST enzyme activity without significant differences where they caused inhibition percentages of 100, 100, 99.71, 97.26 and 96.7 by Kz + RH- 2485, Kz + Lufenuron, RH- 2485, Kz + Pyriproxyfen and Kz + Chromafenozide respectively.

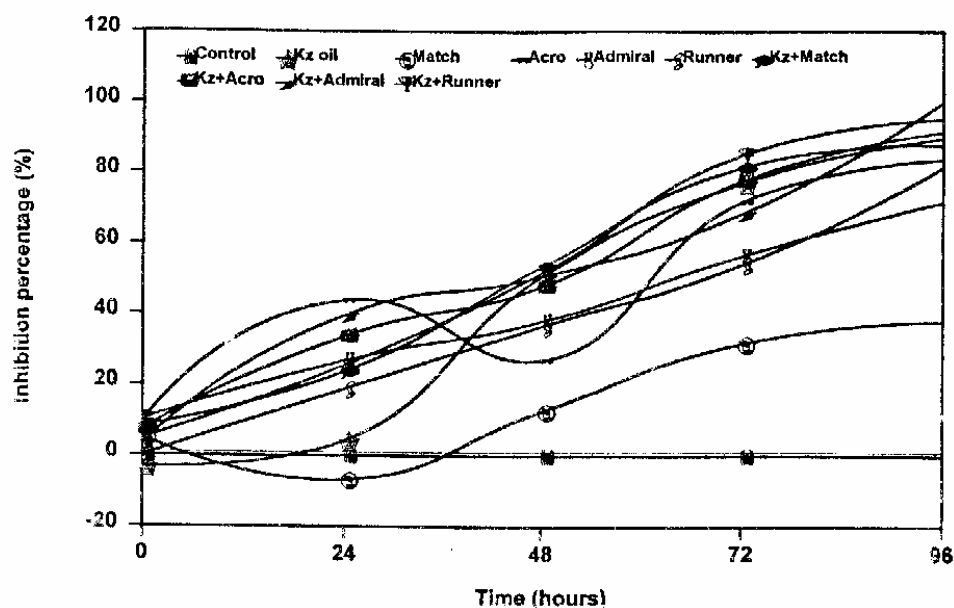


Fig. (2) : Effect of IGRs, Kz oil and binary mixtures on Aspartate transferase (AST) enzyme activity of mealybug *Icerya aegyptiaca* (Douglas) attacked Guava trees in Alexandria Governorate 2004.

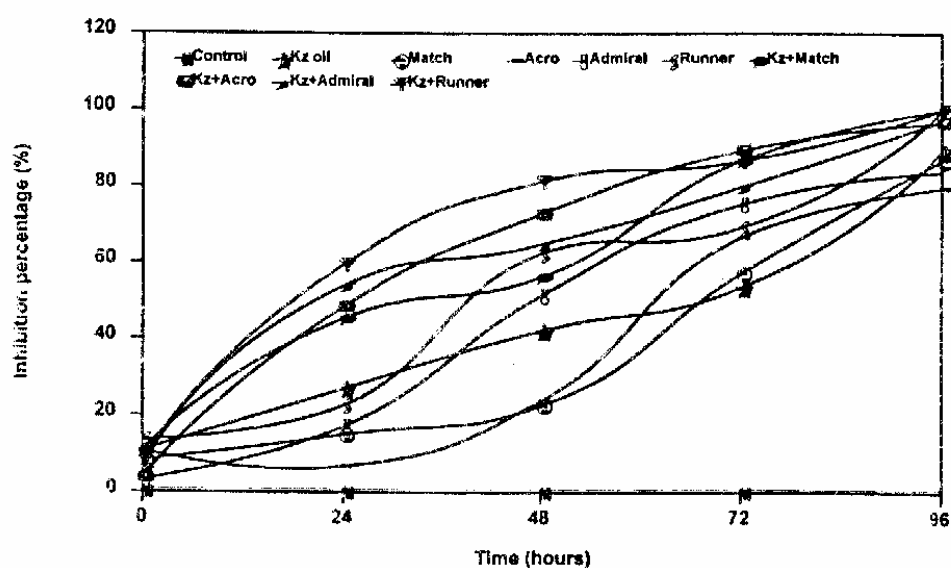


Fig. (3) : Effect of IGRs, Kz oil and binary mixtures on Alanine transferase (AST) enzyme activity of mealybug *Icerya aegyptiaca* (Douglas) attacked Guava trees in Alexandria Governorate 2004.

Chromafenozide caused least inhibition effect (79.6 %) without significant differences with Kz oil (89.4 %), Lufenuron (86.86 %) and Pyriproxyfen (83.8 %)

These results are not in agreement with finding of Said (1998) who stated that IGRs increased the ALT and AST activity in larvae of *A.ipsilon*. Abdel Hafez *et al.*, (1993) found that the changes in ALT and AST activities were in harmony with the changes in protein and free amino acids. Also Zidan *et al.*, (1996) and El-Deeb (2004) mentioned that the inhibition of AST by IGRs was the greatest within 24 h.

Data showed in Figure (4) illustrate that there were no significant differences among RH- 2485 (100 %), Kz + Chromafenozide (98.02 %), Kz + RH- 2485 (95.64 %), Kz oil (93.61 %) and Kz + Pyriproxyfen (89.1 %) in inhibiting (*in vivo*) alkaline phosphatase of *Iceria aegyptica*.

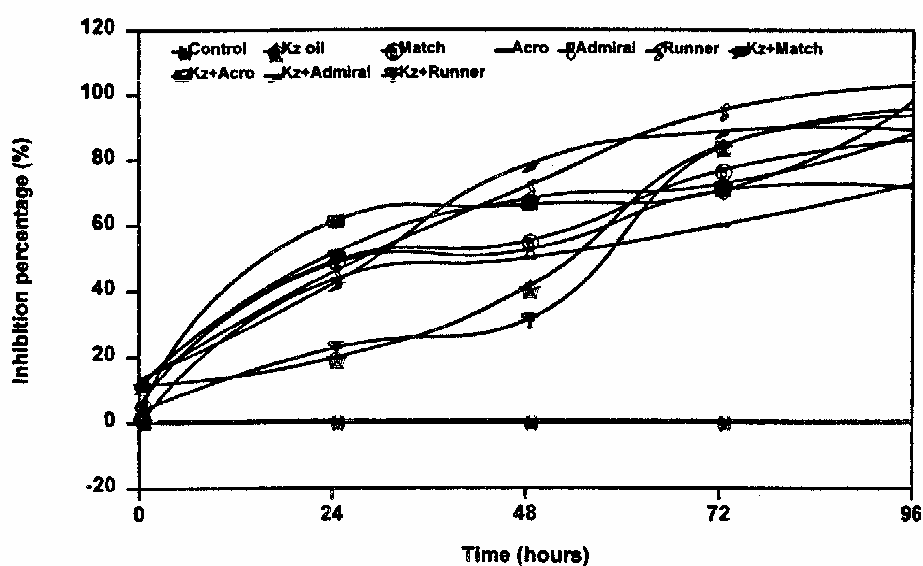


Fig. (4) : Effect of IGRs, Kz oil and binary mixtures on alkalinephosphatase (ALP) enzyme activity of mealybug *Iceria aegyptiaca* (Douglas) attacked Guava trees in Alexandria Governorate 2004.

Pyriproxyfen caused least inhibition effect (71.48 %) without significant differences with Chromafenozide (72.67 %) and so there were no significant differences between Kz + Lufenuron (88.02 %) and Lufenuron (86.12 %).

Generally, it could be concluded that the use of insect growth regulator (IGRs) and their mixtures with mineral oils instead of conventional hazardous insecticides; were efficient as inhibitors for insect enzymes such as ALKP, ALT and AST and this may reduce the environmental pollution and hazard effects on human health.

Our data supported that IGRs are effective when applied in very minute quantities and apparently have no undesirable effects on human and wildlife. Consequently, when used with precision, IGRs may play an important role in future insect pest management programs especially when mixed with mineral oils.

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كفاءة بعض منظمات النمو الحشرية والزيت المعدني كزرد ومخاليطهم على تعداد ونشاط بعض انزيمات حشرة البق الدقيقى المصرى التى تصيب اشجار الجوافة فى محافظة الاسكندرية

احمد صالح ابو شنب

المعمل المركزى للمبيدات - المسبحة - اسكندرية - مركز البحوث الزراعية

تم تقييم تأثير خمسة منظمات نمو حشرية (ماتش - أكرو - أدميرال - أريتش ٢٤٨٥ - رونر) والزيت المعدني (كزد) ومخاليط منظمات النمو مع الزيت المعدني على تعداد حشرة البق الدقيقى المصرى التى اصابت اشجار الجوافة فى مزرعة محطة البحوث الزراعية بالاسكندرية موسم ٢٠٠٤ حيث سجلت النتائج قبل المعاملة وبعد ١، ٢، ٣، ٤، ٨ أسابيع.

تم جمع عينات حشرات كاملة من على الأشجار المعاملة بعد ٢٤، ٤٨، ٧٢، ٩٦ ساعة لدراسة تأثير المعاملات المطبقة على نشاط انزيمات الألكالاين فوسفاتيز (AKP)، إيسبريت ترانسفيريز (AST)، ألانين ترانسفيريز (ALT).

أظهرت النتائج ان الخلط اعطت نسبة خفض فى تعداد الحشرة ونسبة تثبيط لمجموعة الانزيمات المختبرة اكبر من معاملات منظمات النمو الحشرية او الزيت المعدني عند تطبيقهم بصورة فردية مما يوضح ان الزيت المعدني (كزد) ينشط عمل منظمات النمو الحشرية. ولم تظهر اى فروق معنوية بين تأثيرات مجموعة الخلط المختبرة وكذلك المعاملات الفردية.