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Comparison of Insecticidal Efficiency, IGRs, Certain Oils and their Binary Mixtures against, *Spodoptera littoralis* (Boisd)

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ABSTRACT

Toxicity of certain insecticides Emamectin benzoate (E) IGRs, Diflorate (D) 25%, Grand (G) 5% EC, mineral oil KZ oil (KZ) and plant oil Garlic oil (GO) were tested against strain producer laboratory of 4th larvae instar of *Spodoptera littoralis* (Boisd) The LC_{50}, LC_{25} and LC_{10} were calculated for all treatments. The mixtures results may be arrangement in categories as following; 1. Mixtures showed that highest potential action by the lowest concentration of LC_{25}+ LC_{10} (E+D), LC_{25}+ LC_{10} (E+ G), LC_{10}+ LC_{25} (E+ G), LC_{25}+ LC_{10} (E+ Kz), LC_{10}+ LC_{25} (D+ G), LC_{10}+ LC_{25} (D+ Kz), LC_{10}+ LC_{10} (G+ G) and LC_{10}+ LC_{25} (G+ Kz); 2. Mixtures revealed that antagonism action LC_{10}+ LC_{50} (E+ D), LC_{10}+ LC_{25} (E+ G), LC_{10}+ LC_{50} (E+ Kz), LC_{25}+ LC_{50} (G+ G) and LC_{25}+ LC_{50} (G+ Kz); 3. Mixtures cleared that additive effective LC_{25}+ LC_{50} (E+ D), LC_{50}+ LC_{10} (E+ G), LC_{25}+ LC_{25} (E+ G), LC_{50}+ LC_{50} (E+ Kz), LC_{50}+ LC_{25} (D+ G), LC_{25}+ LC_{25} (G+ G) and LC_{50}+ LC_{25} (G+ Kz) though, use IGRs, plant or mineral oils, compounds in binamy as a mixture with little concentrations, it has been shown to be effective in controlling of *S. littoralis*.

Keywords: *Spodoptera littoralis*, IGRs, oils, mass rearing and insecticidal efficiency.

INTRODUCTION

Leaf worm of cotton *Spodoptera littoralis*, Boisd (Noctuidae:Lepidoptera), one major of most notorious and injurious phytophagous insect pests in Egypt, not only to cotton plant but also to other crops and vegetables (Kandi L *et. al*., 2003). It control program is based mainly on use of insecticides, which created some problems such as insecticides- resistance, environmental pollution and hazard to natural enemies and beneficial insects (Nada, 1990). It breeds continuously throughout the year, attack cotton fields and most other economic crops including vegetables and other ornamentals and develops resistance may stem from the large generation turn- over and its continuous exporsure to pesticides over a wide area (Maher Ali and Ayad, 1975). Recently, plant exrtracts have more attention in controlling many pests that are nontoxic to man and animals, possess distinct. Toxicity and lead to antifeeding activity and inhibition growth of some pests (Sharaby and Ammar, 1997; Badr *et al*., 2000 and D' Andrea *et. al*., 2001). Raslan, 2002, mentioned that, the IGR_S (growth regulators of insect) are very important in protection of plant crops, its cause great selectivity to insect beneficial and suitable properties. Stadler and Buteler, 2009, resulted that, the oils used in the control process have a major effect on insects, and the more importantly, it blocks the insect air holes "Spiracles" throughout which insect breathing and cause death due to phyxiation and may act as toxins, the interact with insect fatty acids and interfere with natural metabolism.

This study aimed to evaluate the comparison of insecticidal efficiency, IGRs, certain oils and their binary mixtures against *S. littoralis.*

MATERIALS AND METHODS

Mass rearing of the cotton leaf worm, *Spodoptera littoralis* (Boids).

The fresh leaves of castor *Ricinus communis* were used as a food and reared several generations of *Spodoptera littoralis* (Boids) as susceptible stock cultures at temperature degree of 27±1°C and relative humidity of 70±5%. The egg masses were putted on the leaves of castor in glass jars, and a piece of cotton moistened with sugar solution (10%) ready as a supply of emerged adults, and the fresh Tafla branches *Nerium oleander*, were used as appropriate host for the tested insect ovipostion. Jars contained treatments were investigated and the newly laid of egg masses collected daily. The procedure reared larvae were conducted and continued for several generations until the 4th instar according to (EL Defrawi *et. al*., 1964).

Tested Insecticides:

The insecticides tested: Emamectin benzoate (E) (Hyperon 5% SG).

Insect growth regulators:

Lufenuron (G) (Grand 5%).
Diflubenzuron (D) (Diflorate 25% WP).

Plant oil:

Garlic oil (GO) A commercial for mulation form was purchased from El- Captin company Egypt.

Mineral oil:

KZ oil (KZ) 95% rate.

Bioassay tests for *S. littoralis*:

Experiments were conducted to determine the effect of the toxicity of the tested some pesticides against laboratory culture against 4th larval instar of *S. littoralis*. The castor bean leaves were soaked in four tested concentrations

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of Emamectin benzoate; IGR_S; Kz and Garlic oils for times of (10 sec.), then it is left to dry in the laboratory wither (air dryness). Each treatment (10 larvae) was replicates four times. Action of joint toxic and mortality regression lines were studied of the different tested mixtures. Tested compounds alone or mixtures of Emamectin; KZ oil and Garlic oils, mortality were estimated for 24 hrs., after treatment, while Tested compound alone or mixture IGR_S mortality were estimated for 72 hrs., after treatment. The treatments were investigated under conditions of temperature degree of 25±2°C and relative humidity of 65±5%. Obtained data were corrected according to equation "Abbott, 1925", and analysis subjected according to of "Busvine 1971, method". The LC_{50}, LC_{25} and LC_{10} with curves and slope values were calculated.

Preparation of experiments:

Values LC_{50}; LC_{25} and LC_{10} were calculated for each concentrations of tested insecticide; IGR_S and oils and corresponding prepared to their values. Treatments were applied on 4th larval instar of *S. littoralis*, proportional to mineral and plant oil toxicity on Emamectin and IGR_S. Studied binary mixtures were (LC_{50}+ LC_{50}), (LC_{50}+ LC_{25}), (LC_{50}+ LC_{10}), (LC_{25}+ LC_{50}), (LC_{25}+ LC_{25}), (LC_{25}+ LC_{10}), (LC_{10}+ LC_{50}), (LC_{10}+ LC_{25}), (LC_{10}+ LC_{10}) respectively.

Estimation of Co-toxicity factors (CF):

The Co-toxicity factor equations (CF) were used in analyzed and estimation action method of combined effect according to the given equation by Mansour *et. al*., (1966), as follow.

Co-toxicity factor (CF) = Observed mortality% - Expected mortality% X 100/Expected mortality%

Co-toxicity factor (CF), divided the obtained results of three divisions as following; a positively factor, 20 or more is potentiation considered; a negatively factor, 20 or more is antagonism considered and between -20 - 20 as an intermediate values only indicate on additive effect.

RESULTS AND DISCUSSION

In this aim, the insecticidal efficiency was studied of several compounds mixtures against 4th larval instar *S. littoralis*. Data presented in (Table 1), showed the calculated LC_{50}, LC_{25}, LC_{10} and slope values for Emamectin benzoate SG5% (Hyperon 5%) compound, Tow formulations of IGR_S Diflubenzuron (Diflorate 25% WP), Grand 5% EC (Lufenuron), two mineral oil formulation (KZ oil 95% EC) and one plant oil (Garlic oil). The obtained data showed Emamectin benzoate pesticide give highly efficacious compound than others (IGR_S) and the compound KZ oil give highly toxic effect than others oils.

In Tables, 2, 3, 4 and 5, illustrated that, the Effectiveness response of combination toxic action of 11 binary tested insecticides contained, IGR_S and the mineral plant oils as mix materials on 4th larval instar *S. littoralis.*

Data in (Table 2), showed that the case of the mixtures of the pesticide Emamectin benzoate and IGR_S Diflubenzuron, Grand 5% Lufenuron, It produced various levels of additives and combined effect, and in case of combinations (LC_{10}+ LC_{10}), data resulted highly synergistic action occurred, followed by (LC_{25}+ LC_{10}) and (LC_{50}+ LC_{10}), where CFS were + 24.5, 102 and 41.6 respectively, while in case combinations (LC_{10}+ LC_{25}), and (LC_{25}+ LC_{25}), give the low synergistic action where CFS recorded + 34.2 and + 28 respectively. On the other hand the compounds (LC_{10}+ LC_{50}) and (LC_{50}+ LC_{50}), the antagonism was found, where CFS recorded (-45) and (-1) respectively. Data obtained only the additive effect was found in case mixtures (LC_{50}+ LC_{25}), where CF recorded (5.3). The Co- toxicity factor obtained with (LC_{50}+ LC_{10}), in case the mixture compound of pesticides Emamectin benzoate and IGR Grand 5% EC, resulted 11.6 value when the mortality% observed reached (60%) and give additive effect, while the variable rates of antagonistic action occurred in most mixtures in case of combinations (LC_{10}+ LC_{50}) CF= -66.6, (LC_{10}+ LC_{25}) CF= -57, (LC_{50}+ LC_{25}), CF= -29.3, (LC_{10}+ LC_{10}), CF= -32.5 and (LC_{50}+ LC_{50}), CF= -23.

Table 1. Toxicity comparative of different materials assayed against 4th larval instar of *S. littoralis*

Treatments	LC^{50} ppm	LC^{25} ppm	LC^{10} ppm
1- Emamectin benzoate Hyperon 5%	4.09	2.23	0.98
2- Diflorate 25% WP	189.43	53.33	16.73
3- Grand 5% EC Lufenuron	63.35	28.53	13.53
4- Garlic oil	1.62	0.76	0.32
5- KZ oil 95% EC	1.52	0.42	0.197

Table 2. Combination action and Co-toxicity factor of compound Emamectin benzoate (Hyperon 5% SG) against 4th larval instar of *S. littoralis*, after 24 hrs.

Mixture	Emamectin benzoate/ Diflorate 25% Hyperon 5% WP. (E+ D)			Emamectin / Grand 5% EC Hyperon 5% WP (E+ G)		
	Expected morality%	Observed mortality%	CF*	Expected mortality%	Observed mortality%	CF*
LC_{50}+ LC_{50}	100	99	-1	100	77	-23
LC_{50}+ LC_{25}	75	79	5.3	75	53	-29.3
LC_{50}+ LC_{10}	60	85	41.6	60	67	11.6
LC_{25}+ LC_{50}	75	68.2	-9.0	75	85	13.3
LC_{25}+ LC_{25}	50	64	28	50	65	30
LC_{25}+ LC_{10}	35	71	102	35	79	125.7
LC_{10}+ LC_{50}	60	33	-45	60	20	-66.6
LC_{10}+ LC_{25}	35	47	34.2	35	15	-57
LC_{10}+ LC_{10}	20	69	24.5	20	13.5	-32.5

Data obtained resulted only highly synergism in case combination (LC_{25}+LC_{10}), where (CF was ± 125.7), on contrary, in case the combination (LC_{50}+ LC_{10}), resulted only additive effect, where (CF was 11.6).

As shown data in (Table 3), the insecticide mixture of Emamectin/Garlic oil give the highly level of potentiation synergism action occurred for all combinations, except (LC_{50}+ LC_{50}), where resulted additive effects (CF was +0), followed by mixtures compounds of Emamectin/KZ oil 95% resulted more effects and potentiation of actions, while data showed only antagonism in case combinations (LC_{50}+ LC_{50}) and (LC_{50}+ LC_{25}) where CF resulted (-10) and (5.3),

respectively. Also the additive effect appeared in case mixture (LC_{25}+ LC_{50}), where CF resulted (-14).

Data showed in (Table 4), the mixtures compound of IGR Diflorate 25% WP with the different formulations of oil, the all of combinations Diflarate with formulations Garlic oil and KZ oil showed antagonism on different levels, expect with combination compounds Diflarate/KZ oil (LC_{10}+ LC_{25}), caused only highest synergism (CF+ 45.7).

Remaining mixtures compounds of Diflorate/Garlic oil give synergism on different levels, where the combination (LC_{10}+ LC_{25}), resulted the highly level of synergism action followed by (LC_{10}+ LC_{50}), (LC_{50}+ LC_{25}) and (LC_{25}+ LC50), (CFS were +40, +29, +16 and +13 respectively), while the combinations (LC_{25}+ LC_{10}) and (LC_{25}+ LC_{50}) showed weak rate of additive effect where (CFS resulted +8 and -8 respectively). While, mixtures compounds showed antagonism on different levels, included (LC_{25}+ LC_{25}), followed by (LC_{50}+ LC_{10}), (LC_{10}+ LC_{10}), (CFS were -13, -7 and -5 respectively).

Table 3. Combination action and Co-toxicity factor of compound Emamectin benzoate (Hyperon 5% SG) one mineral oil and Garlic oil against 4th of *S. littoralis* larvae after 24 hrs.

Mixture	Emamectin / Garlic oil (E+ GO)			Emamectin/ KZ oil 95% EC (E+ KZ)		
	Expected morality%	Observed mortality%	CF*	Expected mortality%	Observed mortality%	CF*
LC_{50}+ LC_{50}	100	100	0	100	90	-10
LC_{50}+ LC_{25}	75	93.2	24.2	75	79	5.3
LC_{50}+ LC_{10}	60	86	43.3	60	73.5	22.5
LC_{25}+ LC_{50}	75	93	24	75	64.4	-14
LC_{25}+ LC_{25}	50	95	9	50	62	24
LC_{25}+ LC_{10}	35	89	154.2	35	53	51.4
LC_{10}+ LC_{50}	60	91	51.6	60	42	-30
LC_{10}+ LC_{25}	35	92.5	164.2	35	33	-5.7
LC_{10}+ LC_{10}	20	65	22.5	20	29.5	47.5

Table 4. Combination action and Co-toxicity factor of compound IGR Diflorate 25% WP and two mineral oils against 4th larval instar of *S. littoralis* after 72 hrs.

Mixture	Diflorate 25% WP/ Garlic oil (D+ GO)			Diflorate 25% WP/ KZ oil 95% EC (D+ KZ)		
	Expected morality%	Observed mortality%	CF*	Expected mortality%	Observed mortality%	CF*
LC_{50}+ LC_{50}	100	92	-8	100	37	-6.3
LC_{50}+ LC_{25}	75	91	16	75	33	-56
LC_{50}+ LC_{10}	60	53	-7	60	29	-51.6
LC_{25}+ LC_{50}	75	88	13	75	25	-66
LC_{25}+ LC_{25}	50	37	-13	50	21	-58
LC_{25}+ LC_{10}	35	43	8	35	15	-57.1
LC_{10}+ LC_{50}	60	89	29	60	20	-66.6
LC_{10}+ LC_{25}	35	75	40	35	51	45.7
LC_{10}+ LC_{10}	20	25	5	20	18	-10

The obtained data showed in (Table 5), illustrated that, the mix compounds of Grand 5% /KZ oil resulted the highly levels of potentiation, which were (LC_{10}+ LC_{25}), (LC_{25}+ LC_{10}) and (LC_{25}+ LC_{25}), being (CFS were +102, +92.2 and 48 respectively). On the other hand, the combination compounds which give additive effect were (LC_{50}+ LC_{50}), (LC_{50}+ LC_{25}) and (LC_{10}+ LC_{50}), where CF were 0,-4 and -13, respectively.

Remaining mixtures compound of Grand 5% Garlic oil showed the synergism on different levels, where the combination (LC_{10}+LC_{10}), showed highly level of synergism followed by ((LC_{10}+LC_{25}), (LC_{25}+LC_{10}), and (LC_{10}+LC_{50}), (CFSwere+132.5, 85, 81.4 and 53 respectively), while the combinations (LC_{50}+LC_{10}), and (LC_{50}+LC_{25}), showed the weak rate of additive effect (CFS were +48.8 and 2 respectively). The remaining mixtures combinations (LC_{25}+ LC_{50}), followed by (LC_{25}+LC_{25}), (LC_{50}+LC_{50}), showed the antagonism on different levels where (CF resulted -66, -6 and -5 respectively.

Table 5. Combination action and Co-toxicity factor of compound IGR Grand 5% EC and two mineral oils against 4th larval instar of *S. littoralis* after 72 hrs.

Mixture	Grand 5%/ Garlic oil (G+ GO)			Grand 5%/ KZ oil (G+ KC)		
	Expected morality%	Observed mortality%	CF*	Expected mortality%	Observed mortality%	CF*
LC_{50}+ LC_{50}	100	95	-5	100	100	0
LC_{50}+ LC_{25}	75	76.5	2	75	72	-4
LC_{50}+ LC_{10}	60	89.3	48.8	60	56	-6.6
LC_{25}+ LC_{50}	75	25.5	-66	75	60	-20
LC_{25}+ LC_{25}	50	47	-6	50	74	48
LC_{25}+ LC_{10}	35	63.5	81.4	35	67	92.2
LC_{10}+ LC_{50}	60	92	53	60	52	-13
LC_{10}+ LC_{25}	35	65	85	35	71	102
LC_{10}+ LC_{10}	20	46.5	132.5	20	75.5	277.5

Throughout the obtained result, it should be report that, high levels of synergy achieved from mixing the lowest concentrations together, while antagonist rates were less appeared when mixing the highly concentrations.

Zidan *et. al*., 1987, mentioned, that the cotton leaf worm. *S. littoralis* was very affected when mixing of insecticides with mineral oils. Khaleq Uzzaman and Chowdhury. 2003, found that the mixing of neem oil, sesame castor oil and soybean oil with pirim phos- methyl increase the adult mortality% of *T. castanium*. Abd- El-Razik *et al*., 2012, reported that the combination for oils of sesame, corn and sun flower with "pyridalyl abamectin" give the high level of synengistic action against adult of *callosobruchus maculates*. The obtained data were agreement with those of Ghoneim *et al*., 2012, mentioned that the mixing of IGR_S with organophosphorus insecticides (OP) give the highly resistant of cotton leaf worm population *S. littoralis* Boisd in the field, and Co-toxicity factor calculated when mixing IGR_S with chlorpyrifos against 4^{th} larval instar showed the high synergism and give additive effects.

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مقارنة الكفاءة الإبادية لبعض المبيدات ومنظمات النمو الحشرية وبعض الزيوت وخلائطهم في مكافحة دودة ورق القطن *Spodoptera littoralis* (Boisd)

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تم إجراء هذه التجربة بغرض دراسة مقارنة سمية بعض المركبات إيمامكتين بنزوات ومنظمات النمو الحشرية دايفوريت ٢٥%، جراند ٥% والزيوت النباتية منها زيت الثوم، الزيوت المعدنية منها كزد أويل منفردة ومختلطة ثنائياً ضد العمر اليرقي الرابع للسلالة المعدنية لدودة ورق القطن كذلك تم حساب كلاً من LC_{50}، LC_{25}، LC_{10} لكل المركبات المستخدمة في تجربة الخلط ويمكن حصر النتائج الخلط في عدد من الدرجات من ناحية التأثير يمكن ترتيبها كالتالي:١- خلائط أظهرت أعلى تأثير تنشيطي بأقل التركيزات (LC_{25}+ LC_{10}) إيمامكتين+ دايفوريت و (LC_{25}+ LC_{10}) إيماكتين + جراند و (LC_{10}+ LC_{25}) إيمامكتين+ زيت الثوم و (LC_{25}+ LC_{10}) إيمامكتين+ كزدأويل و (LC_{10}+ LC_{25}) دايفوريت+ زيت الثوم و (LC_{10}+ LC_{25}) دايفوريت + كزدأويل و (LC_{10}+ LC_{10}) جراند+ زيت الثوم و (LC_{10}+ LC_{25}) جراند + كزد أويل.٢- خلائط أظهرت تأثير تنشيطي مضاد (LC_{10}+ LC_{50}) إيمامكتين+ دايفوريت و (LC_{10}+ LC_{25}) إيمامكتين+ جراند و (LC_{10}+ LC_{50}) إيمامكتين+ كزد أويل و (LC_{25}+ LC_{50}) جراند + زيت الثوم و (LC_{25}+ LC_{50}) جراند+ كزد أويل.٣- خلائط أظهرت تأثير إضافة (تنشيطي) (LC_{25}+ LC_{50}) إيمامكتين+ دايفوريت و (LC_{50}+ LC_{10}) إيمامكتين+ زيت الثوم و (LC_{25}+ LC_{25}) إيمامكتين+ زيت الثوم و (LC_{50}+ LC_{50}) إيمامكتين+ كزد أويل و (LC_{50}+ LC_{25}) دايفوريت+ زيت الثوم و (LC_{25}+ LC_{25}) جراند+ زيت الثوم و (LC_{50}+ LC_{25}) جراند + كزد أويل. لذلك فإن استعمال الزيوت النباتية أو المعدنية وبعض منظمات النمو الحشرية والمركبات الكيماوية- كخلائط ثنائية مع أقل تركيزات أظهرت كفاءة إبادية ضد دودة ورق القطن.