ACUTE TOXICITY AND BIOLOGICAL EFFECTS OF SOME SYNTHETIC ORGANIC COMPOUNDS ON SPINY BOLLWORM

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Abstract

The chemical compounds synthetized at the laboratory of faculty of science, Zagazig University. These compounds as follows: 3-amino-5-chloro-4-phenylazo-1H-pyrazole (**A**), 3-amino-5-mercapto-4-phenylazo-1H-pyrazole (**B**), 3-amino-5-hydrazino-4-phenylazo-1H-pyrazole (**C**) were tested on neonate larvae of spiny bollworm, *Earias insulana* (Boisd.) at constant conditions of 26± 1ºC. and 80 ± 5% R.H. Acute toxicity as well as their latent effects on the different stages of the survived larvae were studied. Corresponding to the acute toxicity, at LC50 level the toxicity effect of the three tested chemicals were in descending order as follows: A, C and B compounds. During larval stage, hydrazino phenyl pyrazole C caused significant prolongation in duration of the larval stage of spiny bollworm. All tested compounds revealed highly significant decrease in the weight of treated spiny bollworm larvae, pupation percentage and pupal duration compared to untreated larvae. In contrast, tested compounds A and B showed an increase on larval mortality percentage. On The other hand, adult emergence percentage was significantly affected by C compound, but sex ratio of emerged adults was not significantly affected compared to untreated larvae. A, B and C compounds shortened the male longevity compared with the untreated. The A compound shortened the female longevity compared with untreated. But C compound elongated the female longevity compared with the untreated check. All treatments decreased number of deposited eggs, which proved significant with A and B. Incubation periods were did not affected. Significantly A compound caused reduction in the hatchability of deposited eggs.

INTRODUCTION

Cotton consider an important crop all over the world hence it is strategic crop by sharing in Egyptian national income. Cotton plants likes other field crops are liable to attack by several species of insect pests during it's growing season. In Egypt, bollworms are considered the most destructive pests infesting cotton plants causing severe damage resulting in high loss in both quality and quantity of cotton (khidr *et al.,* 1996).

The pesticides are used to control the spiny bollworm. The level of resistance to some insecticides has increased and new group of chemicals is needed to manage resistant populations in cotton. Insecticidal pyrazoles was a new family of insecticides that act on the gamma – amino butric acid (GABA) receptors of insects by blocking the passage of chloride ions, inducing disruption of the central nervous system (Cole *et al.*,1993).

The fipronil is the first compound of phenyl pyrazole insecticide class to be registered for commercial use which is toxic to both piercing – sucking and chewing insects (Eric *et al.*,2001).

Pyrazoles has shown excellent activity against *Spodoptera litura* , tarnished plant bug and European corn borer larvae (Scott. and Sondgrass (2000)

The first objective of the present study is to evaluate the toxicity of some synthetic pyrazoles against the newly hatched larvae of the spiny bollworm *Earias insulana* (Boisd.), under laboratory at constant conditions of 26± 1ºC. and 80 ± 5% R.H. The second objective of this work is to study the latent effects of these compounds on some biological aspects of spiny bollworm such as larval mortality, larval durations, weights of full grown larvae and pupae resulted from treated newly hatched larvae, percent of pupation, pupal period, moth's emergence percentage and sex ratio. The longevity of female and male adults were recorded. The numbers of deposited eggs and hatchability percentage were also considered.

MATERIALS AND METHODS

Materials:

1- Chemical insecticides:

The chemical compounds synthetized at the laboratory of faculty of science, Zagazig University. These compounds as follows:

A= 3-amino-5-chloro-4-phenylazo-1H-pyrazole

B= 3-amino-5-mercapto-4-phenylazo-1H-pyrazole

C= 3-amino-5- hydrazino-4-phenylazo-1H-pyrazole

2- Susceptible strain of spiny bollworm:

A susceptible strain was supplied by the Bollworm Research Department, Plant Protection Research Institute (Sharkia branch) at Zagazig, where it has been reared for several years under laboratory conditions. The rearing procedure was adopted as that recorded by Abd El-Hafez *et al*. (1982) and Rashad *et al.* (1993).

Methods:

1- Artificial diet:

The artificial diet for maintaining a mass culture of spiny bollworm, larvae were followed according to the method described by Abd El-Hafez *et al*. (1982) and Rashad *et al.* (1993). Diet medium consists of 860g dried kidney beans (boiled in water), 128 g dried active yeast, 10g ascorbic acid, 5g methyl-P-hydroxy benzoate, 5g sorbic acid and 48g agar, to which 600 ml distilled water were added.

2- Rearing technique of spiny bollworms:

Active and healthy full grown larvae of spiny bollworm *Earias insulana* (Boisd.) were collected from infested cotton bolls at the end of cotton growing season. These larvae were reared in incubator at constant conditions of 26± 1ºC. and 80 ± 5% R.H , on artificial diet previously described in bollworms laboratory, Plant Protection Research Institute (Sharkia branch) at Zagazig.

The emerged adults were continual reared for about 30 successive generations under the previously mentioned conditions to obtain individuals of a susceptible strain, which their larvae were used for the present toxicological studies.

3- Acute toxicity effect against spiny bollworm neonate larvae:

To evaluate acute toxic effects of three chemical insecticides; 5-chloropyrazole (A), 5-mercaptopyrazole (B) and 5-hydrazinopyrazole (C) against newly hatched larvae of spiny bollworm; serial aqueous dilutions of the three tested compounds in water were prepared from the stock solution three to four dilutions. The concentrations of each compound gave about 20 – 80 % larval mortality of spiny bollworm. The stock solution of each tested chemicals were achieved by adding 1g to 25ml acetone (solvent) as first concentration then the forward concentrations were 50, 25, 12.5 and 6.25% for 5-chloropyrazole (A), 5-mercaptopyrazole (B) and 5-hydrazinopyrazole (C), respectively for spiny bollworm.

The surface of each petri dishes containing layer of artificial diet (5 gram) were treated with different concentrations of the three tested chemicals by adding 3ml of each concentrations of each compounds. All the Petri dishes were treated with all concentrations of each compounds as well as untreated check and the petri dish treated was left on air to dryness.

Each concentration was replicated three times. using a camel hair brush, 20 newly hatched larvae (0-6 hr old) were transferred over treated diet, and the petri dishes were covered with fine and soft toilet paper below the glass cover to prevent larvae from escape. Three replicates for every tested chemical as well as control (treated with water only) were incubated under mentioned above conditions.

The dead larvae were counted after 48 hours for the all tested compounds and untreated check and the percent of larval mortality was estimated. The LC50, LC90 and slope values of each tested compound were calculated according to the method described by Finney (1971).

Toxicity index (T.I.) was determined by using sun's equation (1950) as follows:

$$\textbf{Toxicity index (T.I.)} = \frac{LC_{50} \text{ or } LC_{90} \text{ of the chemical (A)}}{LC_{50} \text{ or } LC_{90} \text{ of the chemical (B)}} \times 100$$

Where:
A= Is the most effective chemical.
B= Is the other tested chemical.

Relative potency (R.P.) values were measured according to the method described by Zidan and Abdel-Megeed (1988).

$$\textbf{Relative potency (R.P.)} = \frac{LC_{50} \text{ or } LC_{90} \text{ of the lowest toxic insecticide}}{LC_{50} \text{ or } LC_{90} \text{ of the tested insecticide}}$$

4- Chronic effect against spiny bollworm neonate larvae:

To study the latent effects of the tested chemicals on certain biological aspects of spiny bollworm *E. insulana* (Boisd.), The concentrations used were (2838.7309 ppm); (4284.969 ppm) and (5516.1297 ppm) for 5-chloropyrazole (A), 5-mercaptopyrazole (B) and 5-hydrazinopyrazole (C), respectively for spiny bollworm. The alive larvae after 48 hours from treatment with LC20 for each tested chemical and the control was transferred individually into glass tube (2×7.5 cm), containing two grams of untreated diet. Afterwards, glass tubes were covered with a piece of absorbent cotton and held under the same conditions as mentioned before, the weight of the 4**th** instar larvae, time of entering the last instar in the pre-pupal period and date of adult emergence were estimated. From these records, some biological aspects such as durations of larvae, pre-pupae and pupae as well as weight of both 4th instar larvae and pupae, and percent of pupation were considered. The insects were sexed in the fourth larval stage according to Raslan (1994). After the insect pupation, pupae were transferred individually to clean vials covered with cotton stopper and incubated at mentioned above till moth emergence. The adult emergence percentage and sex ratio were calculated. The emerged moths from each treatment and control were caged in one pair (male and female) in glass jar (7.00 cm in diameter and 11.5 cm in height) under the previously mentioned rearing conditions and covered with muslin cloth serving as oviposition site, and secured by rubber bands. The glass cages were provided with cotton soaked in 10% sugar solution for adult nutrition. The hatchability percentages of all deposited eggs per female was also determined. At the beginning of the female oviposition period, 100 eggs from each replicate was taken and incubated under the previously mentioned optimum conditions. The deposited eggs of adult female on muslin cloths were gazerd and counted dialy. The adult longevity was recorded up to mortality.

Statical analysis

The obtained results of mortality each and biological measurements were subjected to analysis of variance to clear the significantly of the toxic and latent effects of the different tested materials against the tested insect. The proper "F" and LSD value & Standard Error values was calculated as described by Fisher (1950) and Snedecor (1970).

RESULTS AND DISCUSSION

1- Acute effect against spiny bollworm neonate larvae is shown in table (1):

1-1- LC50 and LC90 values:

Data showed that at LC_{50} level the toxicity effect of the three tested chemicals can be arranged in descending order as follows: A, B and C, where their values were, 5891.216, 20086.71and 24055.03 ppm., respectively.

Corresponding the LC_{90} values, data in Table (1) showed that chemical A was the most toxicant one, followed by B and C chemicals, which recorded LC_{90} of, 17897.83, 210663.1 and 226502.9 ppm., respectively

Generally, from LC_{50} and LC_{90} values, it could be notice that chemical A was the most toxicant one, and chemical B and C were in par to each other in their toxicant effect and strongly less in their toxicant action than chemical A against the spiny bollworm neonate larvae. It could be concluded that chemical A, is considered one of the promising compound for controlling *E.insulana*.

1-2- Toxicity lines, slope and LC_{50}/LC_{90} ratio:

According to the results obtained in Table (1), it could be revealed that chemical A, has the steepest toxicity line, where it has the highest slope value and lowest LC_{90}/LC_{50} ratio, on the other hand chemical B, has the flattest one, where it has the lowest slope value and highest LC_{90}/LC_{50} ratio and the compound C, was in intermediate between A and B chemicals. The slope values in descending order were, 1.2556 (B), 1.3159 (C) and 2.6556 (A), while LC_{90}/LC_{50} ratio were, 3.038 (A), 9.416 (C) and 10.487 (B).

1-3- Toxicity index:

According to Sun's equation (1950) the relative toxicity of the three tested chemicals against the spiny bollworm neonate larvae, were evaluated. At the LC_{50} and LC_{90} levels, chemical A was taken as the standard (which resulted in the least LC_{50} of all tested chemicals) and given the arbitrary value of 100 unites. The toxicity indices of the other two chemicals at LC_{50} were 29.328 and 24.490 at LC_{90} level were 8.4959 and 7.9018 for B and C , respectively.

1-4- Relative potency:

The potency levels of the tested chemicals are expressed as the number of folds at the required toxicity level, compared with the least effective chemical in the three chemicals tested. Hence the number of folds representing the relative potency level at Table (1) was obtained by dividing the LC_{50} and LC_{90} of chemical C (the standard chemical) by the corresponding figures of A and B. At the relative potency levels were 4.0832 and 1.1975 times as toxic as C, respectively. At the LC_{90} level, the relative potency levels for the same compounds were 12.655 and 1.07521 times as compared with C compound, respectively.

2- Latent effect:

The main objective of these experiments is to study the latent effect of phenyl pyrazoles on some biological aspects of the survived larvae and the subsequent developmental stages of spiny bollworm.

2.1- Larval duration:

Data in Table (2) indicated that phenyl pyrazoles caused prolongation in duration of the larval stage of spiny bollworm, which was significant only with compound C as compared with untreated larvae. The mean larval durations were 15.26, 15.67 and 16.10 days for A, B and C respectively, compared with 15.00 days for control.

2.2- Larval weight:

Statistical analysis of data presented in Table (2) showed that all tested chemicals caused highly significant decrease in larval weight of spiny bollworm. The mean larval weight was 0.0675, 0.0623 and 0.0640 g. for A , B and C, respectively. While, it revealed, 0.0834 g at control.

2.3- Larval mortality percentage:

Data presented in Table (2) indicated that all compounds caused insignificant increases on larval mortality percentage of spiny bollworm compared with control. The highest average percentage of larval mortality (28.86%) was obtained with compound B while, the lowest percentage (13.33%) was recorded for C chemical as compared with control (10.00%).

2.4- Pupation percentage:

The effect of the three tested compounds on the pupation percentage of spiny bollworm was shown in Table (2). Statistical analysis of data indicated that the effect of the tested compounds on pupation percentage was insignificant. The highest average of pupation percentage was 86.67% for C compound. While, the lowest one was 71.14% for B compound compared with 91.00% for untreated. Generally, all tested chemicals resulted in pupation percentages less than control.

2.5- Pupal weight:

The result concerning the effect of the tested compounds on the pupal weight indicated insignificant effect (Table 2). The mean pupal weights were 0.0548, 0.0523 and 0.0524 g for A, B and C. respectively, while it was 0.0630g for control.

2.6- Pupal duration:

Data presented in Table (2) indicated that all tested compounds caused insignificant decreases on pupal durations of spiny bollworm compared with control. The pupal periods were 9.74, 10.38, 8.73 and 10.00 days for A,B,C and control, respectively.

2.7- Pupal mortality percentage:

Data in Table (2) indicated that the phenyl pyrazoles C caused significant increase in pupal mortality (22.23%) of spiny bollworm compared with control (40.00%).

2.8- Adult emergence:

Statistical analysis of data in Table (2) indicated that, percent of adults emergence in case of compound C was significantly affected. The percentages of adult's emergence averaged 90.27, 94.84 and 77.78% for A, B and C compounds, respectively compared with 96.00% at control. Generally, it was noticed that phenyl pyrazole compounds caused lower adult emergence than control.

2.9- Sex ratio:

Date in Table (2) showed the calculated sex ratio. The sex ratio was insignificantly affected by the three tested compounds compared with control. The percent of female was differed slightly from compound to another. The percentages of female were 39.07, 41.67, 47.03 and 45.33 % for A, B, C and control, respectively.

2.10- Adult longevity:

2.10.1- Male longevity:

Data in Table (3) indicated that the three compounds had insignificant effect on the spiny bollworm male longevity. Male longevity averaged 15.4 days at control while it shortened to 11.53, 13.33 and 14.53 days after treatment of neonat larvae with A, B and C compounds, respectively.

2.10.2- Female longevity:

The obtained data in Table (3) revealed that the female longevity resulted from compound A was significantly shorten compared with control and the other treatments. The mean female longevities were 14.50, 16.33 and 18.07 days for A, B and C compounds, while the untreated was 17.77 days. The A compound shortened the female longevity (14.50 days) compared with untreated (17.77 days).

2.11-Pre-ovi position, Oviposition and Post oviposition periods:

No significant differences were found between the tested compounds and untreated check.

2.14- Female Fecundity:

The number of eggs deposited by female was insignificantly affected by treatment with C compound compared with control, but it was significant in case of A and B treatments compared with untreated Table (4). The mean number of eggs averaged 41.70, 37.77 and 68.93 eggs /female for A, B and C treatments, respectively, comparing with 107.87 eggs /female at control. Generally, the fecundity of female produced from newly hatched larvae treated with phenyl pyrazole compounds were greatly reduced than that obtained from control.

2.15- Incubation period:

Data in Table (4) showed insignificant effects between tested compounds and untreated. The mean incubation period of spiny bollworm eggs lasted 4.13, 4.09, 4.08 and 4.16 days for A, B, C and control, respectively.

2.16- Hatchability percentage:

Data presented in Table (4) showed that B, C and A compounds caused significant reduction in the viability of eggs deposited by spiny bollworm female survived from treated newly hatched larvae. Generally, the phenyl pyrazole compounds caused higher reduction than that of control on the hatchability rate.

The present results are in accordance with those obtained by Arthur (2002) working on stored grain insects; adult red flour beetles and maize weevils treated with 10 ppm Ethiprole (pyrazole compound) alone or in combination treatments. The mortalities of maize weevils ranged from 77.9 to 100%, and mortalities of red flour beetles were from 46.2 to 94.2%. Eric *et al.* (2001) found that phenylpyrazole insecticide fipronil was very toxic to neonate European corn borer larvae in feeding bio assays (LC_{50} = 3.34 ng a.i./cm^2 of treated diet) and to fifth instars in topical bio assays (LD_{50} = 18.78 ng /insect. Ester *et al.* (1997) mentioned that seeds of winter leeks (*Allium porrum*) coatings with fipronil and imidacloprid gave a good control against *Thrips tabaci*. Krushelnycky and Reimer (1998) showed that phenyl pyrazoles were active against many species of ants. Recently Chandler *et al.* (2004) found that phenyl pyrazoles was highly toxic to *Esturaine copepod* (*Amphias custenuiremis*) with a 96-h acute LC_{50} of 6.8 Mg /L. These results are agree with Mohamed *et al.* (2007) who stated that phenyl pyrazole has an extended (latent)effect on the reproduction capacity of the adults derived from the phenyl pyrazole treated larvae.

Table 1. Toxicity of three pyrazoles compounds against neonate larvae of *Earias insulana* (Boisd.) laboratory strain spiny bollworm.

Chemicals	LC_{50} (ppm)	LC_{90} (ppm)	Toxicity index at		Relative potency (folds) at		Slope	Ratio LC_{50}/LC_{90}
			LC_{50}	LC_{90}	LC_{50}	LC_{90}		
A	5891.216	17897.83	100.00	100.00	4.0832	12.655	2.6556	3.038
B	20086.71	210663.1	29.328	8.4959	1.1975	1.07521	1.2556	10.487
C	24055.03	226502.9	24.490	7.9018	1.00	1.00	1.3159	9.416

Table 2. Effect of three pyrazoles compounds on biological aspects of larval and pupal stages of spiny bollworm treated as neonate larvae.

Chemical	Larval duration (day)	Larval weight (gram)	larval Mortality %	Pupation%	Pupal weight (gram)	Pupal duration (day)	Pupal Mortality %	Adult emergence%
A	15.26±0.558[b] (14.8-15.9)	0.0675±0.0049[b] (0.0637-0.0729)	26.67±16.08 (15-45)	73.34±16.08 (55-85)	0.0548±0.0036 (0.054-0.0603)	9.74±1.01 (9.06-10.9)	9.73±7.34[ab] (5-18.18)	90.27±7.34[ab] (94-81.82)
B	15.67±0.578[ab] (15-16)	0.0623±0.0011[b] (0.0614-0.0634)	28.86±7.859 (20-35)	71.14±7.859 (65-80)	0.0523±0.0075 (0.0446-0.0597)	10.38±0.579 (9.85-11)	5.16±4.51[b] (0-8.33)	94.84±4.506[a] (91.67-100)
C	16.10±0.101[a] (16-16.2)	0.0640±0.0029[b] (0.0608-0.0667)	13.33±5.774 (10-20)	86.67±5.774 (80-90)	0.0524±0.0024 (0.0496-0.0539)	8.73±0.988 (8.16-9.87)	22.23±11.11[a] (11.12-33.34)	77.78±11.11[b] (66.67-88.89)
Control	15.00±0.00[b] (15)	0.0834±0.0002[a] (0.0831-0.0836)	10.00±1 (8-10)	91.00±1 (90-92)	0.0630±0.0017 (0.061-0.064)	10.00±0.00 (10)	4.00±1[b] (3-5)	96.00±1[a] (95-97)
F.test	*	***	N.S	N.S.	N.S.	N.S	*	*
$LSD_{0.05}$	0.76	0.01	--	--	--	--	13.27	13.27

Data are the means ±SD of the three replicate of immature stages. Within the same column and source data followed by the same letter are not significantly different (P>0.05; LSD mean separately.

Table 3. Effect of three pyrazoles compounds on biological aspects of adults of spiny bollworm adults treated as newly neonate larvae.

Chemicals	Sex ratio %Female/total adults	Pre-oviposition period (day)	Oviposition period (day)	Post oviposition period(day)	Male longevity (day)	Female longevity (day)
A	39.07±4.363 (35.71-44)	5.40±0.917 (4.6-6.4)	5.27±0.306 (5-5.6)	3.87±0.703 (3.2-4.6)	11.53±1.859 (10-13.6)	14.50±0.5[c] (14-15)
B	41.67±2.887 (40-45)	6.60±0.656 (6-7.3)	4.60±0.4 (4.2-5)	5.13±0.417 (4.8-5.6)	13.33±0.578 (13-14)	16.33±0.839[b] (15.8-17.3)
C	47.03±8.342 (38.88-55.55)	5.63±0.06 (5.6-5.7)	5.78±1.35 (4.6-7.25)	6.67±1.89 (4.5-8)	14.53±0.924 (14-15. 6)	18.07±0.612[a] (17.4-18.6)
Control	45.33±0.578 (45-46)	5.20±0.53 (4.8-5.8)	7.00±1.95 (4.8-8.5)	5.57±0.41 (5.1-5.8)	15.40±2.117 (13.8-17.8)	17.77±1.194[ab] (16.4-18.6)
$LSD_{0.05}$	--	--	--	--	--	1.57
F.test	N.S.	N.S.	N.S.	N.S.	N.S.	**

Data are the means ±SE of the three replicate of immature stages. Within the same column and source data followed by the same letter are not significantly different (P>0.05; LSD mean separately.

Table 4. Effect of three pyrazoles compounds on fecundity and fertility of spiny bollworm treated as newly neonate larvae.

Chemicals	No. of eggs/Female	Incubation period (day)	Hatchability %
A	41.70±5.109[b] (36.2-46.3)	4.13±0.036 (4.09-4.16)	68.67±5.508[d] (65-75)
B	37.77±16.83[b] (25.8-57)	4.09±0.05 (4.06-4.14)	85.17±2.844[b] (82-87.5)
C	68.93±37.41[ab]	4.08±0.031 (4.06-4.12)	77.67±2.517[c] (75-80)
Control	107.87±14.14[a] (44.5-112)	4.16±0.04 (4.2-4.15)	95.67±1.155[a] (95-97)
$LSD_{0.05}$	41.13	-	6.391
F.test	*	N.S.	***

Data are the means ±SE of the three replicate of immature stages. Within the same column and source data followed by the same letter are not significantly different (P>0.05; LSD mean separately.

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التأثير السام والبيولوجى لبعض المركبات العضوية المخلقة على دودة اللوز الشوكية

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تم تقييم ثلاث مركبات مخلقة هى: **(ا)**: ٣–امينو٥–كلورو–٤–آزو فينيل– ١ اتش – بيرازول . **(ب)**: ٣– امينو–٥– ميركبتو–٤–آزو فينيل– ١ اتش – بيرازول. **(ج)**: ٣ – أمينو٥–هيدرازينو–٤–آزو فينيل– ١ اتش – بيرازول ضد دودة اللوز الشوكية تحت ظروف معملية ثابتة من ٢٦ ± ١ درجة حرارة مئوية و ٨٠ ± ٥٪ رطوبة نسبية. حيث تم دراسة التأثير المباشر على اليرقات المعاملة وكذلك التأثير البيولوجى على الأطوار المختلفة لليرقات الحية، وكان ملخص النتائج كالتالى:

١– بالنسبة للتأثير المباشر عند التركيز القاتل ل ٥٠٪ من اليرقات كان الترتيب التنازلى لتلك المركبات من حيث السمية هو (ا، ج ثم ب).

٢– تم استكمال الدراسة البيولوجية للتركيزات المختلفة علي اليرقات الحية التى أعطت نسبة موت أقل من ٢٠٪ لكل مركب مختبر.

أ– أثناء مرحلة الطور اليرقي أطال مركب فينايل بيرازول (ج) فقط العمر اليرقى لدودة اللوز الشوكية. كل المركبات لها تأثير معنوى على وزن اليرقات و نسبة الموت التراكمى لليرقات جميع المعاملات اعطت أعلى نسبة موت لليرقات من المقارنة.

ب– أثناء مرحلة العذراء، كل المعاملات لم تعطى نسب تعذير معنويه مقارنة بنسبة تعزير المقارنة. لم تختلف أوزان العذارى الناتجة من كل المعاملات معنويا عن أوزان عذارى المقارنة. كل المعاملات لم تختلف معنويا فى فترة العذراء عن المقارنة. جميع المركبات لم تؤثر معنويا على نسبة موت العذارى ماعدا مركب (ج) اعطى اعلى نسبة موت فى العذارى.

ج– أثناء مرحلة الحشرة الكاملة، كان هناك تأثير معنوى للمركب (ج) فقط على نسبة خروج الحشرات الكاملة ولم توثرعلى النسبة الجنسية. مركب (أ) قصر أعمار كل من الذكور و الاناث وذلك مقارنة بالمقارنه.

٣– كل المركبات قللت عدد البيض لكل أنثى وكان هذا الخفض معنويا مع مركبات(ا، ب و ج) بالمقارنه بغير المعامل . فترة حضانة البيض لم تتأثر معنويا. خفضت مركبات(ا، ب و ج) نسبة فقس البيض معنويا .